Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants

ICMAI

THE INSTITUTE OF
COST ACCOUNTANTS OF INDIA
(Statutory body under an Act of Parliament)

Guidance Note on
Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants

ICMAI
THE INSTITUTE OF
COST ACCOUNTANTS OF INDIA
(Statutory body under an Act of Parliament)

HQ: CMA Bhawan, 12, Sudder Street, Kolkata-700 016
Delhi Office: CMA Bhawan, 3, Institutional Area, Lodhi Road, New Delhi-110 003

Edition: January, 2024

Published by:

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA
CMA Bhawan
12 Sudder Street, Kolkata-700016

Delhi Office

CMA Bhawan
3, Institutional Area, Lodhi Road, New Delhi 110003

Limited Edition

Any mistake, error or discrepancy noted may be brought to the notice of the Professional Development Directorate which shall be taken care of in the next edition.

This material has been compiled on the existing legal and regulatory requirements. Since these keep changing frequently, the users are advised to refer to the latest changes if any.

FOREWORD
PRESIDENT, ICMAI

I am delighted to announce the release of a groundbreaking publication that promises to significantly impact our professional landscape. Entitled "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants," this resource has the potential to shape the trajectory of our field in the coming years.

In an era marked by profound technological advancements, it is imperative for Management Accountants to remain at the forefront of innovation. Artificial Intelligence (AI), with its far-reaching influence across sectors and societal management, presents both a promising opportunity and a formidable challenge that demands our attention.

A team of experts and professionals has meticulously crafted the Guidance Note, providing a comprehensive examination of AI's involvement in the realm of management accounting. I take great pleasure in highlighting the expansive scope and profound significance of this publication.

The Guidance Note delves into contemporary AI methodologies, ensuring that our members possess a deep understanding of the cutting-edge technology driving AI progress. Key areas covered include:

- ***The Influence of Artificial Intelligence on Industries that Utilize Cost Audits:*** This analysis explores the significant impact of AI on industries susceptible to cost audits, providing vital insights and services to clients by understanding how AI transforms various sectors.
- ***AI's Potential in the Office of the Chief Adviser-Cost, Government of India:*** This study investigates how AI can enhance governance effectiveness in domains such as subsidy determination, project management, valuation, and pricing negotiations. The insights provided aim to guide professionals in leveraging AI-powered technologies.
- ***Philosophical Position on Ethical AI Use:*** In an era marked by concerns about data privacy and ethics, we take a philosophical stance on the conscientious use of AI. The Guideline Note aligns with the Digital Personal and Data Protection Act, ensuring adherence to ethical and legal principles in AI implementation.

This publication exemplifies our commitment to knowledge acquisition, adherence to professional standards, and ethical behaviour. It underscores our dedication to equipping members with the skills and knowledge necessary to navigate the complexities and possibilities brought about by AI in the era of digitalization.

I extend my sincere gratitude to the diligent group of specialists, academics, and practitioners who contributed their knowledge and enthusiasm to formulate this Guideline Note. Special recognition goes to CMA Soumen Dutta, my Council colleague CMA M.K. Anand, and CMA Nisha Dewan, Additional Director, PD Directorate for their valuable technical and administrative support and steadfast dedication in development of this Guidance Note.

I encourage all members and stakeholders of The Institute of Cost Accountants of India (ICMAI) to actively engage with this Guidance Note. The insights provided will not only enhance professional expertise but also guide our collective pursuit of a future where AI augments human capabilities, reinforcing our commitment to ethical and responsible conduct.

We express our gratitude for the consistent support and unwavering commitment shown towards our esteemed profession. Together, we will navigate the ever-changing landscape of artificial intelligence with the utmost levels of proficiency, honesty, and ethical behaviour.

Sincere regards,

CMA Ashwin G. Dalwadi
President, ICMAI

PREFACE
CHAIRMAN, PROFESSIONAL DEVELOPMENT & CEP COMMITTEE

I am honoured to introduce this guidance note, a remarkable resource that marks a significant milestone in our professional journey. Titled "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants," this publication is a testament to the dynamic nature of our field and our unwavering commitment to staying at the forefront of change.

In today's rapidly evolving business landscape, the influence of Artificial Intelligence (AI) cannot be overstated. Its transformative impact touches every aspect of our professional lives, from financial decision-making to governance and beyond. As management accountants, it is our responsibility to not only understand this paradigm shift but also harness its potential to drive innovation and excellence.

This Guidance Note represents a collaborative effort, drawing upon the expertise and insights of professionals, scholars, and experts who have dedicated their time and knowledge to illuminate the path forward. Within its pages, you will find a wealth of information, guidance, and practical recommendations to navigate the intricate intersection of AI and Management Accounting.

Key highlights of this Guidance Note include:

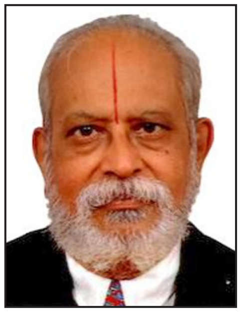
1. **AI Landscape:** A comprehensive overview of the AI landscape, covering the latest advancements, techniques, and technologies that are reshaping our profession.
2. **Impact on Industries:** In-depth insights into how AI is revolutionising industries are subject to cost audits, enabling us to provide valuable insights and services to our clients.
3. **Government and Governance:** Exploration of how AI can enhance governance, particularly in the context of the Office of the Chief Adviser-Cost, Government of India We delve into areas such as subsidy determination, project management, valuation, and price negotiations, showcasing how AI-driven analytics can lead to more effective governance.
4. **Ethics and Responsibility:** We emphasise the responsible and ethical use of AI in a time when data privacy concerns and ethical considerations are prevalent. This Guidance Note aligns with the latest Digital Personal and Data Protection Act to ensure that AI practices are ethical and lawful.

As you embark on this enlightening journey through the world of AI and its implications for Management Accounting, I encourage you to absorb the knowledge within these pages with an open mind and a commitment to excellence. The insights you gain will empower you to not only embrace the potential of AI but also to shape its ethical and responsible application in our profession.

I extend my heartfelt gratitude to CMA Soumen Dutta and our senior member of the Cost and Management Accountancy profession, CMA V R Kedia, for searching, nurturing, and motivating the author, and to all those who have contributed to this Guidance Note, a collective effort driven by a shared passion for excellence and innovation. It is their dedication that has made this publication a reality.

Thank you for your dedication to our noble profession. Together, let us embrace the Warm regards,

CMA M K Anand
Chairman,
Professional Development & CEP Committee
The Institute of Cost Accountants of India



MESSAGE
CHAIRMAN, INFORMATION TECHNOLOGY COMMITTEE

It gives me immense pleasure to share with you a ground-breaking publication that heralds a new era in the realm of management accounting: the "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants."

As the Chairman of the Information Technology Committee at The Institute of Cost Accountants of India, I am particularly thrilled to introduce this Guidance Note, which represents a landmark achievement in our profession's ongoing journey of adaptation and growth.

This guidance note transcends traditional boundaries to embrace the cutting-edge field of artificial intelligence (AI). It is designed to serve as a compass, guiding us through the intricate landscape of AI's impact on our profession. I wish to underscore several key facets of this publication:

1. **Comprehensive AI Coverage:** The Guidance Note comprehensively covers the current AI techniques and technologies that are reshaping industries and governance. It ensures that our members stay well-informed about the latest advancements in this transformative field.
2. **AI's Influence on Cost Audit-Enabled Industries:** We delve deep into the profound implications of AI for industries subject to cost audits. By understanding how AI is revolutionising these sectors, we empower our members to provide invaluable insights and services to their clients.
3. **AI's Contribution to Government:** The Guidance Note explores how AI can support the Office of the Chief Adviser-Cost, Government of India, in various domains, including subsidy determination, project management, valuation, and price negotiations. It showcases how AI-powered analytics can drive more effective governance.
4. **AI Ethics and Data Protection:** In an era of heightened concern for data privacy and ethical AI, the guidance note takes a principled stance on the responsible use of AI. It addresses AI ethics and aligns with the Digital Personal and Data Protection Act to ensure ethical and legal AI practices.

I extend my deepest gratitude to the dedicated team of experts, CMA Soumen Dutta and our Professional Development & CEP Committee Chairman, CMA M K Anand, who have worked tirelessly to bring this Guidance Note to fruition. Their unwavering commitment to excellence is reflected in the depth and relevance of the content.

I urge each member and stakeholder of the Institute of Cost Accountants of India to engage with this Guidance Note. It is a roadmap that not only enriches our professional expertise but also empowers us to navigate the dynamic AI-driven landscape with confidence and integrity.

Thank you for your continued support and commitment to our noble profession. Together, we shall embrace AI as a catalyst for progress, innovation, and ethical practice.

Sincere greetings,

CMA T.C.A Srinivasa Prasad
Chairman,
Information Technology Committee
The Institute of Cost Accountants of India

ADVANCE PRAISE FOR THE BOOK

I trust that this correspondence reaches you in a state of optimal physical well-being. I am delighted to address you today regarding the upcoming publication entitled "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants," with much enthusiasm and expectation. As someone with extensive involvement in the fields of AI and Quantum science, holding the esteemed position of Gartner Ambassador, being recognised as a leading authority in Generative AI, and fulfilling the role of Chief Technology Officer at Intell AI Neotech, I possess a comprehensive comprehension of the significant influence that AI is exerting on our global landscape. Furthermore, my professional background as a former Head of AI at YES BANK, together with my accolades as a Top 50 AI Influencer, Top 20 Chief Data Officer (CDO), Top 20 AI Key Opinion Leader (KOL), Top 15 Generative AI Experts, TEDx speaker, and author of 7 books, has provided me with direct exposure to the profound impact of artificial intelligence (AI) in several sectors.

I am particularly enthusiastic about the forthcoming publication produced by a prominent scholar, as it holds the potential to establish a connection between the realms of Artificial Intelligence and Management Accounting. This guidance paper provides a thorough examination of artificial intelligence (AI) techniques, their ramifications for sectors that are subject to Cost Audits, and their capacity to improve government activities such as subsidy determination and project management. Moreover, the profession of Cost and Management accountant focuses considerable importance on the ethical aspects of Artificial Intelligence(AI) and data protection, thereby aligning itself with the most stringent ethical norms. After carefully examining this advice paper, I am convinced that it will serve as a highly helpful resource for professionals aiming to efficiently navigate the era of Artificial Intelligence. This initiative signifies a pivotal advancement in the preparation of Management Accountants, as it aims to provide them with the necessary knowledge and abilities required to thrive in a progressively digital and data-centric environment. I posit that this book will not only enhance the capabilities of members of CMAs but also make a substantial contribution to the wider discussion on the involvement of Artificial Intelligence in the realms of Finance, Governance, and Management Accounting. This statement demonstrates the dedication of the Institute of Cost Accountants of India to promoting knowledge, innovation, and excellence in the field of Cost and Management Accountancy. I am eagerly anticipating the publication of the "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants" and am confident that it will serve as a significant milestone in the ongoing journey of the Institute of Cost Accountants of India (ICMAI) towards embracing technological advancements and fostering innovation, all while maintaining a steadfast commitment to ethical conduct and responsibility.

I would like to express my sincere gratitude to you and the entire staff at The Institute of Cost Accountants of India for your unwavering commitment to the progress of the cost and management accounting profession. The remarkable efforts made in supporting the release of this guidance note are highly appreciated, and there is a positive outlook that it will serve as a catalyst for promoting excellence within our community. I express my gratitude for your steadfast dedication to the pursuit of professional growth and advancement through innovation.

Sincere greetings,

Utpal Chakraborty
Chief Technology Officer (CTO),
IntellAI Neotech

ADVANCE PRAISE FOR THE BOOK

I trust that this correspondence finds you well. I'm writing to express my sincere gratitude and admiration for the outstanding guidance paper, "Guidance Note on Techniques of Artificial Intelligence (AI) and the Role of Cost and Management Accountants," to be published by The Institute of Cost Accountants of India.

As an academic as well as a practitioner of FinTech, Artificial Intelligence and Automation, I have been fortunate enough to observe the significant influence of AI across diverse industries. The author's work serves as a commendable contribution that effectively addresses the convergence of AI and Management Accounting, two interconnected domains that are becoming increasingly interwoven within the contemporary business environment. This Guidance Note exhibits a profound comprehension of the complexities surrounding artificial intelligence (AI) and its ramifications for professionals in the field of management accounting. The author offers a thorough examination of artificial intelligence (AI) approaches while also emphasising the ethical concerns that hold utmost importance in the proper implementation of AI in the field of Cost and Management accounting.

The insights presented in this Guidance Note have significant value for professionals aiming to traverse the intricate aspects of artificial intelligence (AI) and its incorporation into the realm of Cost and Management accounting practices. The author's proficiency, diligence, and determination in furthering their knowledge in the realm of Cost and Management Accounting within the domain of artificial intelligence are evident. It is anticipated that the work of the author will make a substantial contribution to the knowledge and advancement of the community of Cost and Management Accountants. Publications of this nature serve to enhance the standing of the profession and provide comprehensive resources for Cost and Management accountants (CMAs) to effectively address the complexities posed by a progressively digitised and data-centric global landscape.

I would like to convey my sincere congratulations to the author on his exceptional accomplishment, and I praise The Institute of Cost Accountants of India for cultivating a conducive atmosphere for the dissemination of knowledge and the advancement of professional growth. I express my gratitude for your unwavering commitment to the progression of the unique Cost and Management Accountant (CMA) profession. I eagerly anticipate observing the favourable influence that this Guidance Note will have on all members of the profession as well as the wider financial community.

Yours faithfully,

Prof. Sumit Jha
Guest faculty, SPJIMR Mumbai
Chief Technology Officer (CTO) Elint Data

ACKNOWLEDGEMENTS

Professional Development and CEP Committee of the Institute of Cost Accountants of India (2023-24)

CMA Manoj Kumar Anand	Chairman
CMA Neeraj Dhananjay Joshi	Member
CMA Rajendra Singh Bhati	Member
CMA Dr. V. Murali	Member
CMA Vinayaranjan P	Member
CMA Suresh Rachappa Gunjalli	Member
CMA Navneet Kumar Jain	Member
CMA Avijit Goswami	Member
CMA D.S. Bhatia, Co-opted	Member
CMA S.K. Varma Gadhiraju, Co-opted	Member
CMA K. Biswal, Co-opted	Member
CMA Nisha Dewan, Addl. Director	Secretary

CONTENTS

CHAPTER - 1
Introduction

The transformative potential of artificial intelligence (AI) across industries has created a need for in-depth understanding and strategic adaptation. This guidance notebook explores the impact of AI on various sectors and the pivotal role cost accountants play in harnessing its benefits, accompanied by real-world case studies.

1.1 The reason for the study

- The transformation brought about by Artificial Intelligence (AI) is becoming comprehended as it significantly impacts many businesses. Through the examination of its effects on various industries, one can acquire valuable knowledge on the transformative nature of artificial intelligence (AI) on corporate operations. This includes the optimisation of efficiency and the creation of novel opportunities for innovation.
- The relevance of AI implementation varies across different industries. Gaining a comprehensive understanding of the distinct ramifications of artificial intelligence (AI) in sectors such as manufacturing, healthcare, finance, and others enables individuals to grasp the industry-specific obstacles, prospects, and transformative capacities.
- Strategic decision-making is a crucial aspect of organisational management that involves the process of selecting and implementing courses of action that align with a having a comprehensive understanding of the effects of artificial intelligence (AI) on different sectors enables individuals to make well-informed and educated choices. As a cost accountant, it is possible to propose the use of artificial intelligence (AI) based solutions in order to improve cost effectiveness, regulatory adherence, and financial oversight, customised to meet the unique demands of a particular industry.
- The optimisation of business processes is a critical task in achieving efficient cost management and effective resource allocation. Within this context, cost accountants assume a vital position in driving these optimisation efforts. Gaining a comprehensive comprehension of the impact of artificial intelligence (AI) on various sectors enables one to discern the specific domains in which AI has the potential to optimise operational efficiency, streamline procedures, and mitigate resource inefficiencies.
- **Maintaining Competitiveness:** In an ever-changing corporate environment, it is imperative to remain informed about the influence of artificial intelligence (AI). This programme provides individuals with the necessary expertise to effectively respond to shifts within the sector, so ensuring both personal and

organisational competitiveness and relevance.

- The enhancement of cost analysis is closely linked to the role of cost accountants in the domain of financial analysis. The examination of the impact of artificial intelligence (AI) on various industries facilitates the enhancement of cost analysis methodologies, the adjustment to evolving cost frameworks, and the provision of precise financial information to organisations.
- The identification of AI-driven opportunities by cost accountants who possess a comprehensive understanding of the role of artificial intelligence can facilitate the unlocking of value within organisations. This may encompass proposing cost optimisation plans driven by artificial intelligence, assessing the return on investment
- of artificial intelligence deployment, and guaranteeing the cost-efficient integration of artificial intelligence technologies.
- The application of artificial intelligence (AI) frequently necessitates collaborative efforts between financial and technical teams. A comprehensive comprehension of the role of artificial intelligence (AI) enables cost accountants to proficiently engage in communication and collaboration with information technology (IT) and data science teams, hence facilitating the harmonisation of financial objectives with technical initiatives.
- The use of artificial intelligence (AI) has the potential to give rise to many considerations pertaining to compliance and regulation. Examining the influence of artificial intelligence (AI) on different sectors enables cost accountants to verify that the integration of AI is in accordance with the specific norms and standards of each industry.

The increasing prevalence of artificial intelligence (AI) necessitates the presence of professionals capable of effectively integrating AI technology with industry-specific requirements, hence ensuring the longevity and relevance of their careers. Engaging in the study of this particular subject provides individuals with the necessary skills and knowledge to effectively contribute as a strategic asset towards the advancement and progress of their respective organisations.

Essentially, conducting a study on the industry-specific implications of artificial intelligence (AI) and the involvement of cost accountants offers a thorough comprehension of the transformative effects of AI on business environments. This knowledge empowers individuals to make informed strategic choices and positions them as valuable contributors to both industry innovation and financial management.

1.2 Understanding Artificial Intelligence :

1.2.1 What AI is and how it works:

- AI is the simulation of human intelligence in machines, which gives them the ability to do tasks that usually take human cognitive skills. AI systems are made to look at data, learn from patterns, make decisions, and solve complex problems, often with the goal of improving efficiency, accuracy, and total performance in different areas.

1.2.2 Different kinds of AI:

- **Narrow AI (Weak AI):** AI systems that are designed and trained for a single job or a small number of tasks are said to be narrow. These AI systems are great at doing well-defined jobs in a small area, but they don't have much intelligence or understanding in general. They follow rules and patterns that have already been set, and they can only do the one thing they were meant to do. Narrow AI includes things like Siri and other virtual helpers and chatbots used for customer service.

Narrow AI has the following traits:

- **Specialised**: These AI systems are made to solve a certain problem or do a certain job.
- **Limited Scope:** They can't do things that aren't in their area of responsibility.
- **Task-Oriented:** Narrow AI systems are best at doing certain jobs and don't have a wide range of cognitive skills.
- **Depends on Data:** Their success is based on the data and patterns they learned in training.
- **No Consciousness:** Narrow AI is not aware of itself or has no consciousness.
- **Strong AI (General AI):** General AI, also called Strong AI or Human-Level AI, is the name for AI systems that are as smart as humans and can understand, learn, and do any intellectual job a human can. General AI would be able to think, understand what's going on, learn from its mistakes, and be very flexible across a wide range of jobs.

Things that make general AI different:

- **Intelligence like that of humans:** General AI systems would have the same cognitive skills as humans.
- **Versatility:** They would be able to do different jobs without being programmed or trained to do so.

- **Autonomous Learning**: AI systems in general would be able to teach themselves new skills and adapt to new settings on their own.
- **Contextual understanding:** They could understand complicated situations and details and act in the right way in those situations.
- **Self-Awareness Potential:** Strong AI might be able to be self-aware and have awareness.

In short:

In short, Artificial Intelligence covers a wide range of abilities, from Narrow AI, which is focused on a specific job, to General AI, which is based on theory and has cognitive abilities like humans. Narrow AI systems have been very good at solving certain problems, but the development of General AI is still a complicated and ongoing process that has big effects for technology, society, and the future of how humans and machines work together.

1.3 Technologies related to artificial intelligence include machine learning, natural language processing, and robotics.

- **Machine Learning:** Machine Learning is a subfield of artificial intelligence that focuses on giving computers the ability to learn from data and improve their performance over time without being explicitly programmed. Machine Learning, or ML, is an abbreviation for the field. Machine learning algorithms may recognise patterns, formulate hypotheses, and modify their models based on the information they are given.

Importance in Relation to the Evolution of the Industry:

- **Analytics Predictive:** Machine learning algorithms can analyse past data to forecast future trends, which enables businesses to make more educated decisions and more efficiently distribute their resources.
- **Personalization:** Machine learning is the engine that drives recommendation systems, which in turn personalise user experiences and revolutionise industries such as e-commerce and entertainment.
- **Optimisation of Manufacturing:** Machine learning helps with predictive maintenance by analysing equipment data, which in turn reduces downtime and increases production efficiency.

In the field of healthcare diagnostics, machine learning algorithms examine patient data and medical pictures to provide assistance in making accurate diagnoses and treatment recommendations.

- **Detection of Financial Fraud:** Machine learning is used to identify unusual trends in financial transactions, which assists in the prevention of fraudulent operations.

- **Energy Efficiency:** ML allows for the optimisation of energy consumption patterns and the prediction of peak demand periods, which leads to improved energy management.
- **Natural Language Processing:** Natural Language Processing, also known as NLP, is a subfield of artificial intelligence (AI) that focuses on teaching computers how to comprehend, analyse, and create human language. Processing and analysis of vast quantities of text or speech data are required for this task.

Importance in Relation to the Evolution of the Industry:

- **Automation of client Service:** Chatbots driven by NLP manage client queries and complaints, leading to increased levels of customer satisfaction.
- **Sentiment analysis:** Sentiment analysis is a subset of natural language processing (NLP) that analyses consumer and social media input to get insights into public opinion and improve marketing strategy.

Real-time translation is made possible by natural language processing, which in turn makes international communication and company expansion easier.

- **Data Extraction**: Natural Language Processing (NLP) is able to extract useful information from unstructured text, which helps industries such as the legal and financial sectors with document analysis.
- **Medical Documentation:** Natural language processing helps transcribe medical records, which optimises the processes involved in healthcare documentation.
- **Robotics:** The field of robotics focuses on the design and construction of devices that are capable of performing tasks independently or partially independently. Robots that are powered by artificial intelligence have the ability to observe their surroundings, develop decisions, and carry out physical actions.

Importance in Relation to the Evolution of the Industry:

Manufacturing automation refers to the process in which difficult assembly operations are carried out by AI-driven robots. This helps to improve both the manufacturing efficiency and the product quality.

Assistance in Healthcare: Surgical robots help in performing precise surgeries, and exoskeletons driven by artificial intelligence help patients who have difficulty moving about.

AI robots are being used in logistics and warehousing to undertake duties such as sorting, packing, and delivering items, hence improving the efficiency of supply chains.

Agricultural automation refers to the use of robotic systems that are equipped with artificial intelligence to execute jobs in agriculture such as planting, harvesting, and monitoring crops. This leads to an increase in agricultural productivity.

Retail and Customer Interaction: ***AI-powered robots can help customers navigate stores, making for a more enjoyable shopping experience overall.***

In a nutshell:

Important areas of artificial intelligence research include machine learning, natural language processing, and robotics. These areas are driving transformative developments in a variety of business sectors. They make it possible to make decisions based on data, improve customer experiences, optimise procedures, and lead to new solutions that improve business operations in general, including efficiency, accuracy, and overall productivity. The potential for additional innovation and disruption is enormous as industries continue to adopt and integrate these technologies.

*****

CHAPTER - 2
Industry-wise Impact of AI:

2.1 The Industrial Manufacturing Sector: A Case Study on the Implementation of Predictive Maintenance in the Manufacturing Industry

The manufacturing industry is a sector of the economy that involves the production of goods through various processes, such as assembly, fabrication, and processing.

This Guidance Note presents a case study that explores the application of predictive maintenance techniques in the manufacturing sector. The study examines the benefits, challenges, and outcomes of implementing predictive maintenance strategies at a manufacturing facility.

Within the manufacturing sector, the occurrence of machine downtime resulting from unforeseen equipment malfunctions can give rise to disruptions in production, amplified expenses associated with maintenance, and diminished levels of operational effectiveness. Predictive Maintenance, driven by artificial intelligence, has emerged as a transformative approach to tackle these aforementioned difficulties. ***This case study examines the impact of artificial intelligence (AI) on the industrial sector, specifically focusing on the implementation of predictive maintenance strategies.***

- **Challenges in Traditional Maintenance:** Traditional maintenance systems, including preventative maintenance, which follows predetermined schedules, and reactive maintenance, which involves restoring equipment after failure, are associated with inefficiency and high costs. Unforeseen periods of operational inactivity have the potential to disturb the established production timetables, while an excessive amount of maintenance activities can result in avoidable financial expenditures.
- *The application of artificial intelligence (AI) in predictive maintenance entails the utilisation of AI algorithms to examine real-time data obtained from sensors, equipment logs, and historical performance records. This analysis enables the prediction of potential equipment failures. This functionality allows manufacturers to strategically schedule maintenance activities at the most opportune times, thereby minimising periods of inactivity and maximising the efficiency of maintenance expenditures.*
- **The case study presents a scenario wherein Company X, a prominent automotive manufacturer,** encountered persistent challenges with a crucial welding machine situated within its manufacturing line. The occurrence of frequent equipment malfunctions led to unplanned periods of inactivity, which had a detrimental effect on the adherence to production timelines and led to an escalation in expenses.

The following are the steps for implementing the project:

- **Data Collection:** *In order to gather real-time data, Company X implemented the installation of sensors on the welding equipment. These sensors were designed to capture various parameters such as temperature, vibration, and energy usage.*
- *The AI algorithms underwent training utilising past data obtained from the performance of the welding equipment, with the objective of finding patterns that are indicative of failure.*

Predictive modelling was employed in this case study, wherein an artificial intelligence model utilised real-time sensor data to forecast the probable occurrence of a breakdown in the welding equipment. The model considered other parameters, including temperature spikes, atypical vibrations, and changes in power.

The AI model produced alerts for the maintenance crew when it identified initial indications of probable failure, signalling the need for specific component attention.

- **Scheduled Maintenance:** In accordance with the alerts provided by the artificial intelligence system, the maintenance team has arranged for maintenance activities to take place during pre-planned periods of system inactivity. These activities involve the replacement or repair of the specific components that have been recognised as requiring attention.

The findings of the study are as follows:

The implementation of proactive measures to resolve issues before they reached critical levels resulted in a substantial reduction in unscheduled downtime, hence enhancing production schedules.

- **Cost savings** were achieved by optimising maintenance expenses through the performance of just necessary repairs, hence minimising the need for needless part replacements.
- **Improved Efficiency:** The improvement in equipment uptime has resulted in a boost to overall production efficiency and a reduction in the wasting of resources.
- **Enhanced Planning:** The optimisation of resources and manpower allocation by the maintenance team can be achieved through better alignment with predictive maintenance schedules.

In conclusion, the integration of artificial intelligence (AI)-enabled predictive maintenance has brought about a transformative impact on the industrial operations of Company X. Through the use of real-time data and machine learning algorithms, the organisation successfully mitigated periods of inactivity, enhanced maintenance endeavours, and bolstered overall production efficacy. This case study highlights the significant influence of AI-driven predictive maintenance on the manufacturing industry, establishing a precedent for other industries to leverage the capabilities of AI technologies.

2.1.2 Healthcare Industry: A Case Study on Medical Image Analysis for Diagnostic Purposes

The healthcare industry is a sector that encompasses many organisations and professionals involved in the provision of medical services and products. It plays a crucial role in promoting and maintaining the health care sector.

This case study explores the application of medical image analysis techniques in the field of diagnostics. The analysis of medical images plays a crucial role in aiding healthcare professionals in accurate disease detection and treatment planning.

Introduction:

- Medical imaging is an essential component in the diagnosis and treatment of a wide range of disorders. Nevertheless, the analysis of medical images can be a laborious process that heavily relies on the proficiency of radiologists. This case study examines the impact of AI-driven analysis on medical picture interpretation, highlighting its transformative effects on disease identification and diagnostic precision within the healthcare industry.
- **Challenges in Conventional Image Analysis:** The conventional analysis of medical images, including X-rays, MRIs, and CT scans, frequently necessitates the manual interpretation performed by radiologists. The aforementioned approach is susceptible to human fallibility, temporal limitations, and may provide discrepancies in the determination of diagnoses.
- **AI technologies**, like as machine learning and computer vision, have the capability to undergo training using extensive collections of medical images. This training enables them to identify patterns, anomalies, and traits that may not be discernible to human observers. This facilitates expedited and precise diagnostics.
- ***The case study scenario involves Hospital Y, which had difficulties in promptly diagnosing lung cancer through the use of chest X-rays. The interpretations of radiologists frequently exhibited discrepancies, resulting in the postponement of treatment decisions and the possibility of erroneous diagnoses.***

The following are the steps required for implementation:

- **The collection of data**: Hospital Y has amassed a comprehensive dataset consisting of chest X-ray scans, encompassing both normal cases and those exhibiting indicators of lung cancer.

- The AI model underwent training using machine learning techniques on a dataset in order to discern patterns linked to lung cancer, including characteristics such as tumour forms, sizes, and densities.
- The AI model underwent a validation process using novel X-ray pictures in order to ascertain its level of accuracy. The refinement process was subsequently enhanced with the use of feedback received from radiologists.
- **Real-time Analysis**: Upon the acquisition of a fresh chest X-ray, the artificial intelligence model promptly conducted an analysis, promptly identifying probable indications of malignancy.
- The integration of artificial intelligence (AI) technology has facilitated collaboration between radiologists, enabling them to benefit from AI-assisted outcomes that enhance the quality and precision of their diagnostic assessments.

The findings of the study are as follows:

- The AI model demonstrated a high level of accuracy in detecting subtle symptoms of lung cancer at an early stage, hence facilitating prompt intervention and treatment.
- The implementation of artificial intelligence in collaboration with human practitioners has resulted in improved accuracy by mitigating human error and reducing the potential for misdiagnosis.
- The implementation of artificial intelligence (AI) in radiology has the potential to enhance efficiency within the field. By utilising AI technology, radiologists can allocate their attention towards challenging situations, as routine scans can be rapidly analysed by the AI. Consequently, this division of labour can result in a reduction of the radiologists' workload.
- **Enhanced Patient Outcomes**: The implementation of faster and more reliable diagnostic methods has resulted in enhanced treatment planning and improved patient outcomes.

In conclusion, the integration of artificial intelligence (AI)-based medical picture analysis into the diagnostic workflow at Hospital Y demonstrated the capacity of technology to enhance medical proficiency. The implementation of artificial intelligence (AI) has greatly accelerated the process of diagnosing diseases such as lung cancer by swiftly identifying minor indicators. This has resulted in a notable enhancement in the accuracy of diagnostic procedures. This case study elucidates the profound influence of artificial intelligence (AI) inside the healthcare sector, showcasing its capacity to augment patient care, optimise operational processes, and ultimately contribute to the preservation of human lives.

2.1.3 Financial Services Industry: A Case Study on the Application of Artificial Intelligence in Algorithmic Trading

The financial services industry encompasses a wide range of activities related to the management, investment, and distribution of money and financial assets

This Guidance Note presents a case study that explores the utilisation of artificial intelligence (AI) in the field of algorithmic trading. Algorithmic trading refers to the use of automated systems to execute trades in financial markets.

- **Introduction:** The financial services sector is characterised by the swift execution of transactions, intricate market dynamics, and the imperative for well-informed and prompt decision-making. This case study examines the impact of incorporating AI algorithms into algorithmic trading on decision-making processes, the enhancement of trading strategies, and the subsequent rise in profitability.
- **Challenges in Traditional Trading:** Traditional trading methodologies are predicated upon human analysis, which can be susceptible to emotional influences, cognitive biases, and constrained capacity for processing extensive market information.
- **AI-Powered Algorithmic Trading**: Artificial intelligence (AI) algorithms, specifically those utilising machine learning techniques, possess the capability to analyse substantial amounts of up-to-date market data, detect recurring trends, and autonomously conduct trading operations without the need for human involvement. As a consequence, the aforementioned outcome leads to expedited, data-centric, and heightened levels of accuracy in the realm of trading determinations.
- ***The case study scenario involves Investment Firm Z, which had difficulties in effectively optimising trading methods for their diverse portfolio of equities and commodities. Frequently, the utilisation of manual strategies resulted in decisions that were less than ideal and failed to capitalise on potential chances.***

The following are the steps required for implementation:

- The investment firm, referred to as Firm Z, conducted data collection activities to gather historical market data. This data encompassed many elements such as stock prices, trading volumes, and external events that exerted an influence on market movements.
- The process of training machine learning models involved the use of past data to identify and comprehend patterns that are indicative of effective trading strategies.

- Pattern recognition is a capability possessed by AI models that enables them to discern complex patterns and connections within market data that may go unnoticed by human traders.
- The implementation of the trading strategy involved the utilisation of an AI-powered trading system, which executed transactions by conducting real-time analysis of the prevailing market conditions and adhering to the predetermined trading strategy.
- The feedback loop of the system involved a process wherein it assimilated knowledge from its trading decisions, leading to iterative adjustments in its algorithms and tactics with the purpose of achieving ongoing enhancements.

The findings of the study are as follows:

- The utilisation of AI-driven algorithmic trading facilitated expeditious decision-making, allowing for rapid responses to market fluctuations within extremely short time intervals.
- The AI system's capacity to effectively analyse extensive quantities of data resulted in heightened precision in predictions and trading methods.
- **The Mitigation of Emotionally**-Driven Decision Making: The elimination of emotional bias has been found to enhance decision-making processes, hence mitigating impulsive and irrational trading behaviours.
- **Enhanced Profitability:** The implementation of revised tactics resulted in a notable rise in profitability, mostly attributed to the prompt execution of transactions guided by data-driven insights.

In conclusion, the utilisation of artificial intelligence (AI) algorithms in the context of algorithmic trading at Investment Firm Z serves as a notable illustration of the significant influence of technology within the financial services sector. Through the utilisation of artificial intelligence (AI) for the analysis of market data, identification of trends, and precise execution of trades, the firm successfully attained enhanced trading methods and a notable rise in profitability. This case study highlights the impact of AI-driven algorithmic trading on the financial decision-making process, leading to significant changes in transactional practises within the dynamic realm of finance.

2.1.4 Retail Industry: A case study of Personalised Marketing Strategies Utilising Artificial Intelligence

The retail industry is a sector of the economy that encompasses businesses involved in the sale of goods and services to consumers.

This case study aims to examine the efficacy and implications of personalised marketing strategies facilitated by artificial intelligence (AI). By analysing a specific

case, this study seeks to shed light on the potential benefits.

- **Introduction**: Establishing a personal connection with customers is a crucial aspect within the retail business, as it serves as a catalyst for enhancing customer engagement, boosting sales, and fostering loyalty. This case study exemplifies the impact of incorporating AI-driven personalised marketing on client interactions, resulting in enhanced engagement, elevated sales, and heightened customer loyalty.
- The utilisation of traditional marketing methods has several challenges. One such challenge is the tendency for mass marketing strategies to produce generic commercials that may fail to effectively connect with the specific tastes and wants of individual clients.
- **AI-Powered Personalised Marketing**: Utilizing artificial intelligence (AI) algorithms, extensive customer data, encompassing previous transactions, browsing patterns, and demographic details, is analysed to customise marketing endeavours according to individual tastes and behaviours.
- ***The case study scenario involves Retailer A, which faced challenges related to low consumer engagement and difficulty in differentiating itself in a highly competitive industry. The marketing strategies that were designed to cater to a wide range of audiences produced limited outcomes.***

The following are the steps for implementing the project:

- **The process of gathering and categorising data:** Retailer The client data was gathered and subsequently organised into categories based on demographics, purchasing history, and internet behaviour.
- **The data was subjected to analysis** using AI algorithms in order to detect patterns and correlations that could provide insights into client preferences, shopping behaviours, and product affinities.
- **Tailored Content Creation:** Utilising insights gathered by artificial intelligence, Retailer a developed customised marketing content encompassing product recommendations, exclusive promotions, and focused adverts.
- **Dynamic campaigns** refer to personalised marketing initiatives that are implemented through many channels, including email, social media, and the retailer's website. These campaigns aim to maintain a consistent and pertinent message to the target audience.
- **Real-time optimisation** refers to the process in which an artificial intelligence (AI) system constantly monitors client responses and makes necessary adjustments to marketing tactics in real time, taking into account engagement metrics and conversions.

The findings of the study are as follows:

- **Enhanced Customer Engagement:** The implementation of personalised marketing material was shown to effectively resonate with customers, leading to notable improvements in click-through rates and overall engagement levels.
- The implementation of pertinent product recommendations and offers resulted in elevated conversion rates and a subsequent rise in sales revenue.
- The implementation of personalised experiences resulted in customers perceiving a sense of value, so cultivating a lasting sense of loyalty and encouraging repeat purchases.
- The implementation of targeted campaigns resulted in improved outcomes, thereby optimizing marketing budgets by eliminating unnecessary expenditures on populations that are not relevant.

In conclusion, it can be inferred that Retailer A's implementation of AI-powered personalised marketing exemplifies the profound influence of customised client engagements. The retailer achieved enhanced consumer engagement, increased sales, and fostered heightened customer loyalty through the application of artificial intelligence (AI) for the analysis of customer data and the development of tailored marketing strategies. This case study examines the utilisation of AI-driven personalised marketing as a means for merchants to differentiate themselves in a highly competitive industry and cultivate enduring customer relationships, ultimately resulting in long-term business expansion.

2.1.5 Energy Industry: A Case Study on the Integration of Artificial Intelligence in Smart Grid Management

This case study examines the application of artificial intelligence (AI) in the management of smart grids. The study explores the benefits and challenges associated with the integration of AI technologies in the context of smart grid operations.

- **Introduction:** The energy sector encounters difficulties in effectively managing the equilibrium between energy provision and consumption, all the while prioritising efficiency and sustainability. This case study investigates the impact of integrating AI-driven smart grid management on energy distribution, waste reduction, and overall energy efficiency enhancement.
- The energy distribution systems often employed have various challenges, primarily stemming from the absence of real-time data and automation. These limitations result in inefficiencies, power outages, and escalated energy wastage.

- The management of smart grids utilising AI technology involves the utilisation of AI algorithms to analyse real-time data from a variety of sources, such as smart metres, sensors, and weather forecasts. The primary objectives of this approach are to optimise the distribution of energy, reduce inefficiencies, and improve the overall stability of the grid.
- ***The case study scenario is around Utility Company B, which had challenges in managing variable energy demand, leading to inefficiencies in the distribution of electricity. The organisation encountered difficulties in ensuring a steady supply during moments of high demand.***

The following are the steps for implementing the project:

- The integration of data from many sources, including smart metres, sensors, and weather forecasts, was undertaken by Utility Company B. This integration aimed to generate a comprehensive and up-to-date representation of energy consumption patterns and system conditions.
- The analysis conducted in this study involved the utilisation of machine learning algorithms to examine historical data as well as real-time inputs. The primary objective was to forecast energy consumption patterns, identify instances of demand spikes, and assess potential vulnerabilities within the grid system.
- **The AI system developed predictive models** that provided recommendations for energy distribution techniques based on many aspects like demand, supply, weather conditions, and grid capacity, with the aim of optimising energy distribution.
- **Automated Control:** Smart grid devices, governed by artificial intelligence algorithms, dynamically regulate energy distribution in real-time, thereby guaranteeing energy accessibility while simultaneously minimising inefficiencies.
- **The AI-powered system** exhibited dynamic responsiveness by promptly adjusting energy distribution strategies in response to unforeseen circumstances such as abrupt increases in demand or equipment malfunctions.
- **The findings of the study are as follows:**
- The implementation of AI-driven optimisation techniques resulted in improved energy efficiency by minimising energy wastage and effectively allocating energy resources based on specific requirements.
- **Enhanced Grid Stability:** The use of automated mechanisms to address grid vulnerabilities effectively mitigated the occurrence of overloads and ensured a continuous supply of electricity, hence diminishing the likelihood of power outages.

- **Cost savings** were achieved through the implementation of optimised energy distribution, resulting in reduced operational expenses and a less need on emergency measures during periods of peak demand.
- **The use of energy conservation** measures has resulted in a more sustainable energy distribution system, thereby aligning with the objectives of environmental preservation.

In conclusion, it can be inferred that

The disruptive influence of artificial intelligence (AI) in the energy sector is exemplified by the effective integration of AI-driven smart grid management by Utility Company B. Through the utilisation of real-time data and predictive analysis, the organisation effectively optimised the allocation of energy, resulting in a reduction in wastage and an enhancement of overall efficiency. This case study examines the role of AI-driven smart grid management in designing a more dependable, efficient, and sustainable energy distribution landscape.

*****

CHAPTER - 3

The Influence of Artificial Intelligence on the Cost Audit-Enabled Industry in Accordance with Section 148(3) of the Indian Companies Act

The utilisation of Artificial Intelligence (AI) is revolutionising multiple sectors, resulting in improved effectiveness, decision-making processes, and operational procedures. This discourse examines the influence of artificial intelligence (AI) on particular sectors and emphasises the essential contribution of Cost Accountants in enabling efficient cost audit reporting to the Board of Directors.

3.1 Type of AI Impact on Cost Audit enabled Industries:

Telecommunication Services:

- **Network Optimisation:** The field of network optimisation involves the utilisation of artificial intelligence (AI) techniques to analyse data with the objective of optimising network performance, minimising instances of downtime, and improving the overall user experience.
- **Client Support:** Client support is enhanced through the utilisation of AI-powered chatbots, which effectively enhance client interactions by promptly delivering precise responses.

Petroleum and Petroleum Products:

- **Exploration and Drilling:** The utilisation of artificial intelligence (AI) in the field of exploration and drilling has proven to be crucial in enhancing the efficiency of resource extraction by aiding in the prediction of optimal drilling locations.
- **Predictive Maintenance:** The implementation of Artificial Intelligence (AI) in the field of Predictive Maintenance has proven to be highly effective in anticipating equipment breakdowns, hence minimising downtime and enhancing production optimisation.

Steel Industry:

- **Quality Control:** The process of quality control involves the utilisation of artificial intelligence (AI) to examine and categorise steel products, thereby guaranteeing compliance with established quality benchmarks.
- **Supply Chain Management:** The implementation of artificial intelligence (AI) in supply chain management has proven to be crucial in enhancing the efficiency of logistics and inventory management processes, leading to cost optimisation in operations.

Fertilizers Industry:

- **Optimised Production:** The utilisation of artificial intelligence (AI) in the analysis of many aspects that impact crop output has proven to be advantageous in the optimisation of fertiliser production processes.
- **Resource distribution:** Artificial Intelligence (AI) proposes accurate nutrient distribution strategies for crops, resulting in a reduction in unnecessary resource wastage.

Pharmaceuticals:

- **Drug Discovery:** The utilisation of artificial intelligence (AI) has significantly expedited the process of drug discovery through the analysis of extensive datasets and the prediction of drug interactions.
- **Clinical Trials:** The utilisation of artificial intelligence (AI) has proven to be advantageous in various aspects of clinical trials, including patient recruitment, monitoring, and data analysis.

Cement Industry:

- **Process Optimisation**: The utilisation of artificial intelligence (AI) in the optimisation of kiln operations has been shown to effectively reduce both energy usage and emissions.
- **Maintenance Planning**: Maintenance planning is the utilisation of artificial intelligence (AI) to forecast and anticipate maintenance requirements, hence reducing the occurrence of unforeseen downtime.

Sugar Industry:

- **Production Efficiency:** The application of artificial intelligence (AI) technology in the sugar cane industry has been essential in enhancing production efficiency. By leveraging AI algorithms, sugar cane harvesting and refining operations have been optimised to achieve higher yields.
- **Energy Management**: The field of energy management involves the utilisation of artificial intelligence (AI) to analyse energy consumption patterns and afterwards propose methods aimed at enhancing overall efficiency.

Textiles :

- **Design and Manufacturing:** The integration of artificial intelligence (AI) technology in the field of design and manufacturing has proven to be highly beneficial. AI systems have been developed to aid in the design of fabrics, enhancing the efficiency and effectiveness of this process. Additionally, AI has been utilised to optimise and streamline various manufacturing processes, resulting in improved productivity and cost-effectiveness.

- **Inventory Management:** Inventory management involves the utilisation of artificial intelligence (AI) to enhance the optimisation of inventory levels by considering factors such as demand patterns and market trends.

Tyres and Tubes Industry:

- **Quality Assurance:** The implementation of artificial intelligence (AI) in the quality assurance process has proven to be effective in detecting and mitigating faults in tyre and tube production. By utilising AI technology, manufacturers are able to conduct thorough **inspections and** assessments, so ensuring a higher level of quality control throughout the production process.
- **Supply chain optimisation:** The optimisation of supply chains is enhanced by the utilisation of artificial intelligence (AI), which effectively optimises the sourcing and distribution of raw materials.

Vanaspati Industry:

- **Production Efficiency:** The implementation of artificial intelligence (AI) technology in production processes has been shown to significantly improve production efficiency. By leveraging AI algorithms and machine learning techniques, companies are able to optimise their production processes, resulting in reduced costs and enhanced product quality.
- **Demand Forecasting:** Demand forecasting is the utilisation of artificial intelligence (AI) to accurately predict patterns of demand. This enables organisations to engage in effective production planning strategies.
- **The Significance of Cost Accountants in Facilitating Effective Cost Audit Reporting:**
- **Data Analytics and Insights:** The field of data analytics and insights encompasses the systematic analysis and interpretation of data to extract meaningful information and gain valuable insights. Cost Accountants utilise artificial intelligence (AI)-based data analytics techniques to identify and analyse cost patterns, inefficiencies, and potential for optimisation.
- **Risk Management:** Risk management is a crucial aspect of organisational operations that involves identifying, assessing, and mitigating potential risks. It is a proactive approach. Cost Accountants are responsible for examining the insights offered by artificial intelligence in order to detect potential financial hazards and propose appropriate measures for their reduction.
- **Compliance Assurance:** The concept of compliance assurance refers to the measures and processes implemented by organisations to ensure adherence to relevant laws, regulations, and standards. Cost Accountants are responsible for the validation of AI-generated data to ensure its adherence to cost Accounting standards and industry norms.

- **Strategic Decision Support:** The provision of strategic decision support is a critical component in facilitating effective decision-making processes within organisations. Artificial intelligence (AI)-generated predictions and analyses assist Cost Accountants in developing strategies to optimise cost-efficient processes.
- **Report Generation:** AI tools are employed by Cost Accountants to produce precise and thorough cost audit reports for the Board of Directors.
- **Ethical Considerations**: Cost Accountants play a crucial role in ensuring that procedures driven by artificial intelligence (AI) adhere to ethical standards and are aligned with the values of the firm.
- **Continuous learning:** Continuous learning refers to the ongoing process of acquiring knowledge, skills, and competencies throughout one's lifetime. Cost Accountants actively seek to remain informed about the latest breakthroughs in artificial intelligence (AI) in order to proficiently evaluate and properly utilise insights offered by AI systems.

In conclusion, the incorporation of artificial intelligence (AI) in various sectors yields significant advantages, and Cost Accountants assume a crucial position in using AI-generated insights to produce efficient cost audit reports. Through the utilisation of artificial intelligence (AI), cost accountants play a significant role in facilitating well-informed decision-making, ensuring compliance, managing risks, and ultimately enhancing the financial well-being of the organisation.

3.1.2 Telecommunication Services: AI Impact on Network Optimization, Customer Support, and Effective Cost Audit Reporting

The Optimisation of Networks Using Artificial Intelligence

- The utilisation of artificial intelligence (AI) in network optimisation plays a crucial role in guaranteeing reliable connectivity, minimising periods of inactivity, and improving user contentment within the communications sector.
- Predictive maintenance involves the utilisation of artificial intelligence (AI) to examine real-time data obtained from network components with the aim of forecasting probable faults or performance difficulties. The ability to forecast future events allows for preventive maintenance, thereby reducing the occurrence of disruptions and minimising periods of downtime.
- ***Load balancing*** involves the utilisation of artificial intelligence algorithms to effectively disperse network traffic, thereby mitigating congestion and facilitating efficient data flow.
- ***Resource allocation*** is a process in which artificial intelligence (AI) is utilised to optimise the distribution of resources by analysing usage patterns. This approach aims to achieve optimal network performance and enhance the

efficiency of resource utilisation.

- The application of artificial intelligence in anomaly detection enables the identification of atypical network behaviour, facilitating the detection of security breaches or technical irregularities that necessitate prompt intervention.
- The use of artificial intelligence (AI) in spectrum management facilitates the dynamic distribution of frequencies, thereby optimising the usage of the spectrum to improve the quality of services and reduce instances of interference.

The advantages of AI network optimisation are manifold :

- **Enhanced User Experience**: Networks that have been optimised exhibit enhanced performance in terms of increased speed, reduced latency, and reliable connectivity, resulting in heightened levels of user contentment.
- The implementation **of predictive maintenance** strategies effectively mitigates unplanned outages, thereby guaranteeing uninterrupted network availability.
- The implementation of artificial intelligence (AI) enables the achievement of cost efficiency through the utilisation of AI-driven optimisations. These optimisations facilitate the optimal allocation of resources, resulting in a reduction in operational costs.
- **Scalability** refers to the ability of artificial intelligence (AI) systems to adjust and accommodate fluctuating network needs, thereby ensuring optimal performance even during periods of high usage.
- **The implementation of proactive issue resolution** strategies, such as anomaly detection and predictive maintenance, serves to mitigate the impact of issues on users by preventing their occurrence.
- **Customer service** in the communications industry has been significantly transformed by the implementation of AI-powered chatbots, which provide immediate assistance and effective resolution of issues.

The Implementation and Impact of AI-Enhanced Customer Support:

- **24/7 Availability:** Artificial intelligence chatbots are accessible at all times, offering prompt service irrespective of the hour.
- **Chatbots provide** rapid responses to frequently asked questions, thereby reducing waiting times and enhancing customer satisfaction.
- **Personalisation:** Artificial intelligence (AI) uses data analysis techniques to customise client interactions, providing individualised solutions and recommendations.

- **Advanced chatbots** that are equipped with natural language processing have the ability to comprehend and effectively respond to intricate consumer inquiries, thereby providing precise responses.
- **Data Access:** Chatbots include the capability to retrieve pertinent customer account information, service history, and preferences, facilitating interactions that are imbued with contextual relevance.
- **The advantages of customer support that is powered by artificial intelligence (AI) are manifold.**
- AI chatbots offer rapid and consistent responses, thereby diminishing client waiting periods. The use of artificial intelligence effectively streamlines the handling of routine queries, allowing human agents to allocate their attention towards more intricate matters.
- **Consistency** is a key benefit of AI, as it ensures that clients are provided with consistent and correct information throughout different engagements.
- Scalability: Chatbots possess the capability to effectively manage numerous customer inquiries concurrently, ensuring uninterrupted help even during moments of high demand.
- **Increased contentment**: The utilisation of artificial intelligence in customer service results in improved experiences, consequently augmenting the overall level of customer contentment.
- **Cost accountants play a crucial role in simplifying the process of generating comprehensive and accurate Cost Audit reports that are presented to the Board of Directors.**
- In the field of data analysis, cost accountants employ insights gained by artificial intelligence (AI) to examine patterns in costs, identify anomalies, and identify potential areas for optimisation.
- The utilisation of artificial intelligence (AI) insights in the field of risk management is employed by Cost Accountants to effectively identify potential financial hazards and provide recommendations for the implementation of methods aimed at mitigating these risks.
- The utilisation of AI-derived projections and insights plays a crucial role in assisting Cost Accountants in developing strategies aimed at achieving cost-effective operations.
- Ethical considerations are of paramount importance in the role of Cost Accountants, since they are responsible for ensuring that AI-driven procedures conform to ethical standards and are in alignment with the values of the firm.

- **Compliance Assurance**: Cost Accountants are responsible for verifying AI-generated data to ensure compliance with Cost Accounting standards and industry laws.
- The utilisation of artificial intelligence (AI) techniques by Cost Accountants enables the production of comprehensive and tailored Cost Audit reports specifically designed for the Board of Directors.

The task of interpreting and communicating AI-generated insights falls upon cost accountants, who are responsible for converting these insights into useful information that can be effectively conveyed to the board.

- Continuous learning is a crucial aspect for Cost Accountants, as it enables them to remain well-informed about the latest breakthroughs in artificial intelligence (AI). This knowledge is essential for Cost Accountants to accurately comprehend and effectively utilise the insights offered by AI systems.

In the domain of telecommunication services, the revolutionary influence of artificial intelligence (AI) on network optimisation and customer assistance is evident. The influence of Cost Accountants is further enhanced by the utilisation of AI-driven insights in order to generate effective cost audit reports. The incorporation of artificial intelligence (AI) enhances services, enhances user experiences, and optimises operations. Meanwhile, cost accountants play a crucial role in ensuring the transparent, ethical, and strategic utilisation of AI-generated data for precise cost audit reporting to the Board of Directors.

3.1.3 The Impact of Artificial Intelligence on Petroleum Exploration, Drilling, Predictive Maintenance, and Cost Audit Reporting for Petroleum and Petroleum Products

The utilisation of AI algorithms enables the processing and analysis of extensive geological and geophysical data, hence facilitating the enhanced identification of probable oil and gas reserves by geologists and exploration teams.

The utilisation of machine learning models has the potential to improve the efficacy of seismic imaging, hence facilitating the identification and characterization of subterranean reserves.

Exploration, Drilling, Predictive Maintenance

- The optimisation of drilling operations can be achieved through the utilisation of artificial intelligence (AI). By continuously analysing drilling parameters, AI has the capability to detect equipment failures and make real-time adjustments to drilling methods. This enables the maximisation of efficiency and the reduction of downtime in drilling operations.
- The utilisation of machine learning techniques can enhance the identification of the most favourable well location by analysing geological data, hence augmenting the probability of encountering reservoirs with high productivity.

- The concept of predictive maintenance refers to the practise of utilising data analysis and machine learning techniques to anticipate and prevent potential equipment failures or breakdown.
- The utilisation of AI-driven predictive maintenance systems enables the monitoring of the operational state of drilling equipment and other machinery, hence facilitating the anticipation of maintenance requirements to avert expensive equipment failures and minimise periods of inactivity.
- The utilisation of machine learning models facilitates the identification of anomalies in the behaviour of equipment, such as pumps and compressors. This capability enables timely intervention to prevent significant failures from transpiring.

Reporting of Cost Audits.

- The utilisation of artificial intelligence (AI) systems can facilitate the automation of expense tracking and analysis in the context of petroleum exploration and production. This automation ensures the provision of precise and punctual cost reporting.
- The utilisation of artificial intelligence (AI) can assist corporations in effectively monitoring compliance with regulatory and financial reporting obligations, hence mitigating the potential for penalties.

In general, the influence of artificial intelligence (AI) on the petroleum business is significant.

The utilisation of artificial intelligence (AI) has the potential to effectively mitigate costs associated with exploration and drilling activities through the optimisation of operations and the prevention of equipment breakdowns. This, in turn, can lead to enhanced profitability within the industry.

- **Enhanced Precision:** Artificial intelligence algorithms have the capability to offer predictions and recommendations with heightened accuracy, hence mitigating the potential for drilling unproductive wells or incurring financially burdensome mistakes.
- **The implementation of AI-driven predictive maintenance** systems contributes to the enhancement of safety measures by reducing the likelihood of equipment failures and accidents occurring at drilling sites.
- The utilisation of artificial intelligence (AI) has the potential to significantly mitigate the environmental impact of petroleum operations by enhancing drilling and exploration processes.
- **The utilisation of data:** Artificial intelligence has the capability to extract significant insights from both historical and real-time data, hence facilitating improved decision-making processes for long-term planning and strategic purposes.

Nevertheless, it is crucial to acknowledge that the effective integration of artificial intelligence (AI) into the petroleum business necessitates substantial efforts in data acquisition, model refinement, and infrastructure capitalization. Furthermore, it is imperative for the sector to confront ethical and environmental issues that are linked to the rise in automation and extraction operations. However, artificial intelligence (AI) remains a crucial factor in the ongoing transformation of the petroleum industry, as it contributes to enhanced efficiency, cost reduction, and overall operational improvements.

3.1.4 Steel Industry: AI Impacts on Quality standards, logistics and inventory management for cost effective operations in supply chain management with Cost Audit report

The steel sector is significantly influenced by the implementation of artificial intelligence (AI), which has notable effects on several aspects such as enhancing quality standards, optimising logistics and inventory management, and facilitating cost-effective operations within supply chain management. These technological improvements facilitate enhanced operational efficiency and foster increased competitiveness within the business. Artificial intelligence (AI) is exerting a significant impact in various domains.

Enhancement of Quality Standards:

- Predictive maintenance involves the use of artificial intelligence (AI) to develop models that analyse data obtained from a range of sensors and equipment. The purpose of these models is to foresee and predict instances of machinery breakdowns. Within the steel business, it is imperative to guarantee that equipment operates at its highest level of efficiency, thereby minimising any periods of inactivity and upholding the established benchmarks for quality.
- Computer vision and machine learning algorithms have the potential to be employed for the purpose of real-time quality control in the steel manufacturing process. The primary function of these systems is to identify and analyse flaws and inconsistencies inside manufactured goods, guaranteeing the production of only superior-grade steel.

Process Optimization:

- The utilisation of artificial intelligence (AI) models facilitates the optimisation of diverse steel manufacturing processes, encompassing refining, casting, rolling, and heat treatment. Through the process of fine-tuning, artificial intelligence (AI) has the capability to improve the quality and uniformity of steel products.

The optimisation of logistics:

- Demand forecasting is the utilisation of artificial intelligence (AI) to meticulously examine historical data, market trends, and external factors in order to make precise predictions regarding the demand for steel. This practice aids in the enhancement of production and logistics planning.

- The utilisation of AI-powered route optimisation algorithms guarantees the transportation of steel goods through the most efficient and cost-effective routes, thereby minimising both transportation costs and lead times.
- The use of AI-driven demand forecasting and inventory optimisation tools aids steel firms in effectively managing their inventory levels. This strategy effectively minimises the expenses associated with inventory holding while simultaneously guaranteeing a sufficient supply of goods to satisfy customer demand.

Effective Cost Management through Inventory Control:

- Inventory optimisation involves the utilisation of artificial intelligence (AI) algorithms to enhance the efficiency of inventory management. These algorithms take several aspects into account, such as changes in demand, lead times for manufacturing, and expenses associated with storage. By including these considerations, AI algorithms aim to optimise inventory levels and improve overall operational performance. This practice reduces surplus inventory and associated carrying expenses.
- The implementation of AI-driven inventory management systems can ***effectively support just-in-Time (JIT)*** manufacturing practices, wherein the production and delivery of steel are synchronised to occur precisely when they are required. This leads to a decrease in storage expenses and enhances cost efficiency.
- The integration of artificial intelligence (AI) into supply chain management systems facilitates greater collaboration between organisations and their steel suppliers. Predictive analytics possesses the capability to forecast potential supplier delays or interruptions, enabling the implementation of preventive steps to effectively minimise associated risks.

Cost Audit Reporting:

- **Data Analytics**: The utilisation of artificial intelligence (AI) in data analytics can be advantageous for the purpose of cost audit reporting. These AI-driven solutions possess the capability to analyse financial data, detect instances of cost outliers, and monitor the patterns of cost fluctuations over a given period.
- **Fraud Detection:** The use of artificial intelligence algorithms enables the identification of irregularities and the detection of probable fraudulent activities within financial transactions and cost reporting. ***The implementation of this measure guarantees the precision and reliability of cost audit reports.***

- **Real-time Cost Monitoring**: AI-driven dashboards offer instantaneous analysis of cost-related indicators, enabling prompt modifications and effective cost management.
- **Energy Efficiency:** The concept of energy efficiency refers to the ability to achieve a certain level of energy output while minimising the amount of energy input. The application of artificial intelligence (AI) in energy management has the potential to enhance energy consumption optimisation in the steel manufacturing industry. ***By utilising predictive models, AI can accurately forecast energy demand, enabling proactive measures to be taken.*** Additionally, AI may identify specific areas within the manufacturing process where energy-saving opportunities exist, leading to more efficient resource allocation.
- **Environmental Compliance:** The use of artificial intelligence (AI) has the potential to assist steel businesses in effectively monitoring and reporting their environmental impact, thereby ensuring adherence to regulatory requirements and sustainability benchmarks.

In summary, ***artificial intelligence (AI) is having a transformative impact on the steel sector through enhancements in quality standards, optimisation of logistics and inventory management, and facilitation of cost-effective supply chain operations.*** Organisations that leverage artificial intelligence (AI) in these domains can attain enhanced operational effectiveness, decreased expenditures, and a competitive advantage within the worldwide steel industry. ***The utilisation of AI-driven data analysis in cost audit reporting yields advantages in terms of precise and punctual financial reporting.***

3.1.5 Fertiliser Industry: AI improves fertiliser output by assessing yield factors. AI precisely distributes crop nutrients, reducing waste and aiding cost audits. Cost auditor reporting

Artificial Intelligence (AI) has shown notable advancements within the fertiliser sector, specifically in the areas of improving fertiliser production, optimising nutrient allocation, minimising wastage, and streamlining cost audit reporting. The following elucidates the transformative impact of artificial intelligence (AI) on the fertiliser industry.

Improving Fertiliser Production Efficiency:

- **Crop Yield Prediction:** Artificial intelligence (AI) models employ a comprehensive analysis of many parameters, including meteorological data, soil composition, past crop productivity, and satellite imagery, in order to achieve precise forecasts of crop yields. This capability allows fertiliser makers to efficiently generate appropriate quantities and varieties of fertiliser tailored to the individual requirements of different geographical areas and crops.

- **Customized Formulations:** The use of AI-driven algorithms enables the generation of personalised fertiliser formulations by taking into account the nutrient composition of the soil and the specific requirements of the crop. This method guarantees that farmers are provided with fertilisers that are customised to meet their individual requirements, leading to enhanced agricultural productivity.
- **Accurate Nutrient Allocation:** Variable Rate Application (VRA) refers to the utilisation of artificial intelligence (AI) in systems that dynamically modify the rate of fertiliser application. These systems make real-time adjustments by analysing data obtained from sensors and remote sensing technologies. The exact allocation of nutrients in this context serves to optimise the growth of crops while simultaneously minimising the wastage of fertilisers.
- **Nutrient Monitoring:** The use of AI sensors enables the continuous monitoring of soil nutrient levels, facilitating the provision of real-time feedback to automated fertiliser application systems. This practice guarantees that agricultural crops are provided with the appropriate nutrients at the optimal time.
- **Waste Reduction**: The use of artificial intelligence (AI) contributes to the mitigation of environmental consequences by addressing the issue of excessive fertiliser usage. This is particularly significant due to the potential bad effects associated with the overuse of fertilisers, such as the contamination of water bodies through nutrient runoff. The optimisation of nutrient application facilitated by artificial intelligence (AI) plays a significant role in fostering farming practices that are more sustainable and environmentally friendly.
- **Cost Savings:** Through the reduction of excessive fertiliser usage, artificial intelligence (AI) aids in the optimisation of fertiliser expenses, enhancing the cost-effectiveness of agricultural practices.

Cost Audit reporting:

- **Data Analytics**: The use of artificial intelligence (AI) in data analytics enables the examination of production, distribution, and cost data with the purpose of detecting inefficiencies, cost anomalies, and potential avenues for reducing expenses.
- **Predictive Maintenance**: The application of artificial intelligence (AI) in the realm of predictive maintenance has the potential to forecast maintenance requirements for manufacturing equipment, thereby mitigating instances of downtime and minimising associated maintenance expenses. This practice guarantees the optimal manufacturing of fertilisers.
- **Inventory Management**: The use of artificial intelligence (AI) in inventory management can effectively optimise the levels of fertiliser inventory,

thereby minimising the expenses associated with carrying inventory while simultaneously ensuring that sufficient stock is maintained to meet the prevailing demand.

- **Compliance and Reporting**: It involves adhering to rules, regulations, and standards set by governing bodies or organisations. The use of artificial intelligence (AI) holds the potential to assist fertiliser companies in maintaining regulatory compliance with environmental and safety laws. This can be achieved through the implementation of AI systems that monitor and report on the extent to which these companies adhere to the prescribed criteria.
- **Quality Control**: The implementation of AI-driven quality control systems enables the detection of variations in fertiliser composition, thereby ensuring compliance with industry requirements.

The integration of artificial intelligence (AI) into the fertiliser business not only enhances operational efficiency but also fosters the adoption of sustainable and environmentally conscientious agricultural methodologies. Through the use of artificial intelligence (AI), fertiliser makers and farmers have the ability to enhance crop yields, reduce expenses, and mitigate environmental consequences by implementing accurate nutrient management and cost optimisation strategies. Furthermore, the utilisation of artificial intelligence (AI) in data analysis and reporting contributes to the improvement of transparency and precision in cost audit reporting within the fertiliser business.

3.1.6 Cement Industry: AI optimises kiln operations to reduce energy and emissions. AI anticipates maintenance needs, reducing downtime. AI aids in pricing setting and cost audits.

Artificial Intelligence (AI) is significantly impacting the cement business, leading to substantial transformations in operational processes, sustainability practices, pricing strategies, and cost auditing methodologies. Artificial intelligence (AI) has emerged as a transformative technology with substantial implications for the cement manufacturing business.

Optimisation of Kiln Operations:

- **Energy Efficiency**: The use of artificial intelligence (AI) enables the constant monitoring and real-time optimisation of kiln operations, thereby enhancing energy efficiency. In order to optimise energy efficiency and mitigate energy costs and carbon emissions, several parameters such as temperature, fuel consumption, and airflow are carefully calibrated and adjusted.
- **Emissions Reduction**: AI algorithms play a crucial role in mitigating emissions by effectively optimising combustion processes and regulating the presence of particulate matter. This not only improves the level of environmental sustainability but also guarantees adherence to emissions standards.

Predictive Maintenance:

- **Equipment Health Monitoring:** The concept of predictive maintenance refers to the proactive approach of utilising data analysis and machine learning techniques to anticipate and prevent any equipment failures or the utilisation of AI-driven predictive maintenance systems enables the analysis of data collected from sensors affixed to machinery, facilitating the anticipation of equipment failure. This facilitates the implementation of preventive maintenance strategies, thereby mitigating unforeseen periods of operational inactivity and enhancing the overall dependability of the plant.
- **Reduced Maintenance Costs:** One advantage of anticipating maintenance needs in cement plants is the ability to strategically schedule maintenance activities during planned downtime. This proactive approach helps to minimise the occurrence of emergency repairs, reducing associated costs. Additionally, by effectively managing maintenance, the lifespan of equipment can be extended, further contributing to cost savings.

Pricing strategies and cost audits

- **Pricing Optimization**: Pricing optimisation is a process in which artificial intelligence (AI) is employed to assist cement firms in formulating pricing strategies. These strategies are determined by considering several elements, such as market demand, production costs, and rival pricing. This strategy ensures the establishment of competitive price structures while simultaneously upholding profitability.
- **Cost Audit Reporting**: The use of AI-driven data analysis and reporting tools in cost audit reporting enables the examination of production, distribution, and cost data to detect inefficiencies, identify cost anomalies, and uncover potential avenues for cost reduction. The implementation of this measure contributes to the improvement of transparency and precision in the reporting of cost audits.

The optimisation of supply chains:

- **Inventory Management**: The optimisation of cement inventory levels in inventory management is achieved by the utilisation of artificial intelligence (AI). This advanced technology takes into account many elements, such as fluctuations in demand, lead times for production, and expenses associated with storage. This practice effectively reduces surplus inventory and associated carrying expenses.
- **Demand Forecasting**: Demand forecasting is the utilisation of artificial intelligence (AI) to analyse historical data and market patterns in order to accurately estimate the demand for cement. This practise aids in the optimisation of production and logistical planning.

Sustainability and environmental compliance

- **Emissions Monitoring:** The monitoring of emissions is facilitated by artificial intelligence (AI) in order to maintain adherence to environmental rules in a continuous manner. Additionally, it has the capability to forecast emissions levels by utilising production data, thereby assisting cement plants in achieving their sustainability objectives.
- **Raw Material Optimization:** The utilisation of artificial intelligence (AI) holds the potential to optimise the allocation and utilisation of raw resources, hence mitigating wastage and minimising the adverse environmental consequences associated with mining and processing activities.

Process Automation:

- **Quality Control:** Process automation refers to the use of technology and software to streamline and automate repetitive tasks and processes inside an organisation. This approach aims to the implementation of AI-driven solutions has been found to significantly boost the process of quality control by effectively identifying and detecting differences in the composition of cement. This practice ensures that products adhere to Robotic Process Automation (RPA): industry standards and fulfil the expectations of customers.
- **Robotic Process Automation** (RPA) involves the use of artificially intelligent robots to execute repetitive operations, including material handling and packing. This implementation aims to minimise reliance on human labour and enhance overall operational efficiency.

In the cement business, artificial intelligence (AI) is playing a pivotal role in creating notable advancements. It achieves this by bolstering energy efficiency, promoting sustainability, optimising maintenance practices, refining pricing tactics, and boosting cost audit reporting. The adoption of artificial intelligence (AI) technology by cement makers enables them to maintain competitiveness, lower operating expenses, and make significant contributions to fostering a more sustainable and ecologically conscientious business.

3.1.7 Sugar Industry: AI boosts sugar cane harvesting and refining yields. AI analyses energy usage, recommending efficiency techniques and helping the government set sugar prices.

The sugar business is seeing significant transformations as a result of the implementation of artificial intelligence (AI). These changes are notably evident in various aspects of the sector, including sugar cane harvesting, refining processes, energy management, and pricing strategies. Artificial intelligence (AI) is exerting a substantial influence inside this particular industry, as evidenced by the following observations:

The Process of Sugar Cane Harvesting and Refining

- **Harvesting Optimization:** The optimisation of sugar cane harvesting involves the use of AI-powered systems to analyse several aspects, including weather conditions, soil moisture levels, and crop maturity. These elements are taken into account to identify the most favourable timing for the harvesting process. This practice guarantees optimal crop productivity and sugar concentration in the harvested sugarcane.
- **Quality Control:** AI-driven quality control systems are used to monitor and analyse the sugar content of harvested cane in order to ensure its quality. This practice facilitates the preservation of uniform sugar quality and purity throughout the entirety of the refining procedure.
- **Process Optimization**: Process optimisation involves the utilisation of artificial intelligence (AI) models to enhance the efficiency and effectiveness of different phases within the sugar refining process. These stages encompass the crushing of sugar cane, the extraction of juice, and the subsequent purifying procedures. This intervention enhances operational effectiveness and mitigates energy usage, ultimately resulting in heightened sugar production.

An Analysis of Energy Usage and Efficiency Techniques

- **Energy Monitoring:** The use of artificial intelligence enables the ongoing surveillance of energy usage within sugar processing facilities. The data analysis process involves the examination of sensor data in order to detect trends and anomalies in energy consumption.
- **Energy Efficiency Recommendations:** Energy efficiency recommendations involve the utilisation of AI systems to suggest strategies for enhancing energy consumption, which may include modifying equipment configurations, adopting energy-saving technology, and organising maintenance schedules to ensure optimal performance of the equipment.
- **Renewable Energy Integration:** The integration of renewable energy sources, such as solar and biomass, into the energy mix of sugar firms can be facilitated through the use of artificial intelligence (AI). This application of AI technology can effectively reduce the dependence on fossil fuels and thus lead to a decrease in energy costs.

The practice of government intervention in sugar price determination

- **Market Analysis:** This study offers valuable insights that can assist government officials in making well-informed judgements pertaining to sugar price limits and subsidies.
- **Policy Recommendations:** The utilisation of AI-driven analytics presents an opportunity to propose policies that effectively address the concerns of

sugar producers, consumers, and government revenue, thereby establishing a just and consistent sugar price framework.

Supply chain optimisation

- **Inventory Management:** The optimisation of sugar inventory levels in inventory management is facilitated by the implementation of artificial intelligence (AI) techniques. This approach takes into account many aspects, such as changes in demand, lead times in manufacturing, and expenses associated with storage. This practice reduces surplus inventory and associated carrying expenses.

- **Demand Forecasting:** Demand forecasting is the utilisation of artificial intelligence (AI) to analyse historical data and market patterns in order to accurately estimate the demand for sugar. This practice aids in the optimisation of production and logistics planning, resulting in decreased transportation expenses and waste reduction.

Sustainability and environmental compliance

- **Emissions Reduction:** AI-driven systems have the potential to optimise various processes in order to effectively minimise emissions that are linked to sugar production. This aligns with the objectives of sustainability and adhering to environmental standards.

- **Resource Optimization**: The utilisation of artificial intelligence (AI) holds the potential to enhance resource optimisation in the sugar industry. By leveraging AI technology, sugar firms may effectively manage water and other resources, resulting in reduced waste and mitigated environmental consequences associated with the process of sugar refining.

The function of artificial intelligence (AI) in the sugar business extends beyond mere enhancements in production and efficiency. It further encompasses contributions towards sustainability, energy conservation, and the development of improved pricing methods. The adoption of artificial intelligence (AI) technologies by sugar producers can effectively contribute to their long-term competitiveness and facilitate the implementation of acceptable environmental practices within this crucial industry.

The sugar business is seeing significant revolutionary effects as a result of the implementation of Artificial Intelligence (AI). These effects are notably evident in various aspects of the sector, including sugar cane harvesting, refining processes, energy management, and pricing strategies. Artificial intelligence (AI) has emerged as a transformative force inside this sector, exerting a substantial influence on various aspects of its operations.

The Process of Sugar Cane Harvesting and Refining:

- **Harvesting Optimization**: The optimisation of sugar cane harvesting involves the utilisation of AI-powered systems to analyse a multitude of elements, including weather conditions, soil moisture levels, and crop maturity. These aspects are taken into consideration in order to establish the most advantageous time for conducting the harvesting process. This practise guarantees the attainment of optimal crop productivity and sugar concentration in the harvested sugarcane.
- **Quality Control:** AI-driven quality control systems are utilised to monitor and analyse the sugar content of harvested cane in order to ensure its quality. This practise facilitates the maintenance of constant levels of sugar quality and purity throughout the entirety of the refining process.
- **Process Optimization:** Process optimisation involves the utilisation of artificial intelligence (AI) models to enhance the efficiency and effectiveness of different stages within the sugar refining process. These phases encompass crushing, juice extraction, and purification. This intervention enhances operational effectiveness and mitigates energy usage, ultimately resulting in heightened sugar production.

An Examination of Energy Consumption Analysis and Strategies for Enhancing Efficiency.

- **Energy Monitoring:** The application of artificial intelligence enables the ongoing monitoring of energy consumption within sugar processing plants. The data analysis process involves the examination of sensor data in order to detect trends and anomalies in energy consumption.
- **Energy efficiency recommendations** involve the utilisation of AI systems to suggest strategies for enhancing energy consumption. These strategies encompass modifying equipment settings, adopting energy-saving technology, and scheduling maintenance activities to ensure optimal efficiency of the equipment.
- **Renewable Energy Integration:** The integration of renewable energy sources, such as solar and biomass, into the energy mix of sugar firms can be facilitated by the utilisation of artificial intelligence (AI). This application of AI technology aims to decrease dependence on fossil fuels and achieve cost reduction in energy consumption.

The government's role in setting sugar prices.

- **Market Analysis:** The market analysis conducted by artificial intelligence (AI) encompasses a comprehensive examination of various market data, such as the prevailing supply and demand patterns, import and export statistics, as well as the global pricing trends of sugar. This study offers valuable insights to governmental officials, enabling them to make well-informed decisions pertaining to the implementation of sugar price controls and subsidies.

- **Policy Recommendations:** The utilisation of AI-driven analytics can provide policy recommendations that effectively address the interests of sugar producers, consumers, and government income, hence establishing a just and consistent sugar price framework.

The optimisation of supply chains.

- **Inventory Management:** The optimisation of sugar inventory levels in inventory management is achieved by the utilisation of artificial intelligence (AI). This approach takes into account several aspects such as fluctuations in demand, lead times for production, and expenses associated with storage. This practise reduces surplus inventory and associated carrying expenses.
- **Demand Forecasting:** Demand forecasting is the utilisation of artificial intelligence (AI) to analyse historical data and market patterns in order to make accurate predictions on the demand for sugar. This practise contributes to the enhancement of production and logistics planning, resulting in the reduction of transportation expenses and waste.

Sustainability and environmental compliance.

- **Emissions Reduction:** AI-driven systems have the potential to optimise operations in order to mitigate emissions related to sugar production, thereby aligning with sustainability objectives and adhering to environmental standards.
- **Resource Optimization:** The utilisation of artificial intelligence (AI) holds potential in the domain of resource optimisation for sugar firms. By using AI technology, these companies may effectively optimise the consumption of water and other resources, leading to a reduction in waste generation and a mitigation of the environmental consequences associated with sugar refining processes.

The importance of artificial intelligence (AI) in the sugar business extends beyond mere enhancements in productivity and efficiency. It encompasses significant contributions to sustainability, energy conservation, and the development of improved pricing methods. The implementation of artificial intelligence (AI) technologies within the sugar production sector can effectively guarantee sustained competitiveness and the adoption of environmentally acceptable practises in this critical industry.

3.1.8 Textile Industry: AI aids fabric design and manufacture.AI optimises inventories based on demand and trends and helps government with textile policy.

The textile industry is undergoing a significant transformation due to the advent of artificial intelligence (AI), which is introducing novel approaches and enhancing effectiveness in fabric design, manufacturing processes, inventory management, and policy formulation. Artificial Intelligence (AI) is exerting a substantial influence inside the textile industry, and this impact is worthy of examination.

The study and production of fabric design and manufacturing

- **Design Assistance:** The utilisation of artificial intelligence (AI) in design tools provides support to textile designers by facilitating the creation of novel and complex fabric patterns and designs.
- **Quality Control:** The implementation of AI-driven quality control systems has facilitated the identification of flaws and anomalies in fabrics throughout the manufacturing process. By implementing this measure, the production of textiles is limited to high-quality standards, resulting in a reduction of waste and an enhancement of the overall quality of the products.
- **Process Optimization:** The utilisation of artificial intelligence (AI) models facilitates the optimisation of several industrial processes, including but not limited to dyeing, printing, and finishing. Through the process of fine-tuning, artificial intelligence (AI) has the potential to mitigate energy use, ***minimise water usage, and decrease production costs.***

Inventory Management and Demand Forecasting:

- **Demand Forecasting:** Demand forecasting is the utilisation of artificial intelligence (AI) to analyse several aspects such as historical sales data, market trends, and external influences (such as fashion trends and weather conditions) in order to accurately estimate the demand for textiles. This solution aids textile enterprises in the optimisation of production and inventory management, thereby mitigating the occurrence of overstock and understock scenarios.
- **Just-In-Time Manufacturing:** The implementation of AI-driven inventory management systems can effectively support the practice of just-in-time manufacturing, a production approach that involves the timely production and delivery of textiles based on real-time demand. This practice results in a decrease in storage expenses and a reduction in waste generation.

The Government's Textile Policy:

- **Market Analysis:** The market analysis conducted by artificial intelligence (AI) encompasses a comprehensive examination of market data, which encompasses imports, exports, price dynamics, and consumption patterns.

This analytical process yields valuable insights that may be utilised by government authorities for informed decision-making purposes. These insights have the potential to shape textile policies, trade agreements, and industry regulations.

- **Policy Recommendations:** The utilisation of AI-driven analytics has the potential to provide policy recommendations that effectively foster sustainability, innovation, and competitiveness within the textile industry. This encompasses policies pertaining to environmental regulations, trade facilitation measures, and incentives for research and development.

Sustainability and environmental compliance:

- **Resource Optimization**: The utilisation of artificial intelligence (AI) holds potential for aiding textile enterprises in optimising the allocation of resources, including water, chemicals, and energy. This optimisation process can effectively curtail waste generation and mitigate the adverse environmental consequences associated with textile production.
- **Eco-Friendly Materials:** Artificial intelligence (AI) has the potential to contribute to the advancement of environmentally friendly textiles through its ability to identify sustainable materials and production procedures.

Personalized Textiles:

- **Customization:** The subject of personalised textiles pertains to the customization of textile products to suit individual preferences and needs. This practice involves the application of the implementation of AI-driven personalisation enables textile producers to provide consumers with tailored products. This encompasses the provision of customised textiles, designs, and garments tailored to suit particular inclinations, thereby enhancing client involvement.

Supply Chain Optimization:

- **Supplier Collaboration:** The integration of artificial intelligence in supply chain management facilitates improved collaboration with textile suppliers. Predictive analytics possesses the capability to forecast potential supplier delays or interruptions, enabling the implementation of preventive steps to effectively minimise associated risks.

The role of artificial intelligence (AI) in the textile industry encompasses a wide range of functions, including the improvement of design and production processes, the promotion of sustainable practices, and the exertion of influence on government regulations. Through the utilisation of artificial intelligence (AI) technology, textile enterprises have the potential to enhance the calibre of their products, diminish expenses, accommodate evolving consumer inclinations, and make valuable contributions **towards the advancement and sustainability of the sector as a whole.**

3.1.9 Tyres and Tubes Industry: AI checks tire and tube quality during production, reducing defects. AI optimizes raw material sourcing and distribution.

The tyre and tube business is experiencing notable advancements driven by artificial intelligence (AI), namely in the areas of quality control, raw material optimisation, and supply chain management. Artificial intelligence (AI) is significantly influencing this particular industry by exerting a big impact.

Quality Control during Production:

The implementation of quality control measures during the production process is essential for ensuring the overall quality of the final product.

- **Defect Detection:** The process of defect detection involves the use of computer vision systems driven by artificial intelligence to examine tyres and tubes during the manufacturing process. These systems are capable of identifying and promptly alerting operators to any faults or irregularities that may be present. This practice guarantees that only products of superior quality are sent to consumers, thereby diminishing the probability of recalls and warranty claims.
- **Process Optimization:** Process optimisation involves the utilisation of artificial intelligence (AI) models to analyse production data with the aim of enhancing manufacturing processes, namely those related to curing and vulcanization. As a result, there is an enhancement in the uniformity of the product and a decrease in the amount of waste produced.
- **Predictive Maintenance:** The use of artificial intelligence in predictive maintenance aids in the early detection of machinery malfunctions, thereby preventing any potential disruptions in production and maintaining a seamless and optimal manufacturing process.

The Optimisation of Raw Materials

- **Sourcing Optimization:** Sourcing optimisation involves the use of artificial intelligence (AI) to analyse several parameters, including market prices, supplier performance, and demand projections. The primary objective is to optimise the sourcing process for raw materials such as rubber, fabric, and steel. This measure guarantees a supply chain that is both cost-effective and dependable.
- **Quality Assurance:** Quality assurance involves the use of artificial intelligence (AI) to evaluate the quality of incoming raw materials, ensuring that only items that adhere to predetermined standards are utilised in the production process. By employing this approach, the potential for utilising inferior materials that may have a detrimental impact on the quality of tyres and tubes is mitigated.

- **Inventory Management:** The use of artificial intelligence (AI) in inventory management facilitates the optimisation of levels of raw material inventory, minimising the expenses associated with carrying inventory while simultaneously maintaining a steady supply to satisfy the demands of production.

Supply Chain Management:

Supply chain management (SCM) refers to the strategic coordination and integration of all activities involved in the production, procurement, conversion, and distribution of goods and services.

- **Demand Forecasting:** Demand forecasting is the utilisation of artificial intelligence (AI) to analyse past sales data, market trends, and external variables in order to make precise predictions on the demand for tyres and tubes. This facilitates the process of production planning and mitigates the accumulation of surplus inventory.
- **Distribution Optimization:** The utilisation of AI-driven route optimisation algorithms enhances the efficiency of tyre and tube distribution to dealers and retailers, resulting in decreased transportation expenses and improved delivery timelines.
- **Supplier Collaboration**: The integration of artificial intelligence (AI) into supply chain management facilitates improved collaboration with suppliers of raw materials, promoting punctual deliveries and reducing the likelihood of supply chain disruptions.

Energy Efficiency:

The concept of energy efficiency refers to the ability of a system or device to effectively utilise energy resources in order to minimise energy waste.

- **Energy Management:** The implementation of artificial intelligence (AI) in energy management has proven to be highly beneficial in the tyre and tube manufacturing industry. By utilising AI technology, energy consumption may be optimised by several means, such as anticipating energy demand, identifying opportunities for energy conservation, and strategically altering production schedules to capitalise on lower energy prices during off-peak hours.
- **Environmental Impact:** The implementation of artificial intelligence (AI) technology in tyre manufacturing processes has the potential to significantly mitigate the environmental impact of this industry. By leveraging AI, tyre manufacturers may optimise their energy consumption and enhance their waste management practices, thereby reducing their overall environmental footprint.

Customization and Personalization:

- **Product Customization:** The concepts of customization and personalisation are frequently discussed in various fields, including marketing, technology, and consumer behaviour. These terms refer to the ability to tailor products and services.The use of artificial intelligence (AI) facilitates the customization of tyres and tubes, enabling the fulfilment of precise customer specifications. This encompasses a range of options, such as unique tread patterns, various sizes, and other features. Predictive analytics refers to the practice of utilising statistical models and algorithms to forecast future events or outcomes based on historical data and patterns.

Predictive Analytics:

- **Market Trends:** Market trends are analysed by artificial intelligence (AI) to examine consumer preferences. This enables producers to modify their product offerings and marketing tactics in order to effectively respond to dynamic market conditions.

The use of artificial intelligence (AI) in the tyre and tube business encompasses various aspects, including the assurance of product quality, the optimisation of manufacturing processes, the streamlining of the supply chain, the reduction of costs, and the enhancement of sustainability. By adopting artificial intelligence (AI) technologies, organisations operating in this industry can augment their competitive advantage and effectively address the changing needs of customers and the market.

3.2.1 Vanaspati Industry: AI improves quality and low-cost production. Demand prediction via AI aids production planning. And price determination

Artificial Intelligence (AI) is significantly impacting the Vanaspati business by facilitating revolutionary changes in various aspects such as enhancing product quality, optimising manufacturing costs, predicting demand, planning production activities, and determining prices in a cost-effective manner. Artificial intelligence (AI) is exerting a substantial influence inside this particular industry, as evidenced by the following observations:

Quality Improvement and Cost Effective Production:

- **Quality Control:** Quality control in Vanaspati manufacturing is achieved by the implementation of AI-driven systems that provide constant monitoring and control of the production process. These systems play a crucial role in maintaining consistency and ensuring the overall quality of the Vanaspati product. This practice effectively mitigates product failures and minimises waste.

- **Process Optimisation:** Process optimisation involves the utilisation of artificial intelligence (AI) models to enhance the efficiency and effectiveness of different stages within the production process, including hydrogenation and refining. Through the process of fine-tuning, artificial intelligence (AI) has the capability to decrease energy consumption, minimise raw material utilisation, and lower production costs.
- **Predictive Maintenance:** The implementation of artificial intelligence (AI) in the field of predictive maintenance has proven to be highly effective in anticipating machinery maintenance requirements. This proactive approach significantly reduces the occurrence of unplanned downtime, enhancing the overall reliability of industrial plants.

Demand Prediction and production planning:

- **Demand Forecasting:** Demand forecasting involves the use of artificial intelligence (AI) to examine past sales data, market trends, and external variables such as seasonality and economic indicators. By doing so, it aims to provide precise predictions on the demand for Vanaspati. This practice aids in the optimisation of production volumes and scheduling.
- **Inventory Management**: The implementation of AI-driven inventory management systems facilitates the production of Vanaspati in accordance with real-time demand, thereby mitigating the accumulation of surplus inventory and minimising associated storage expenses.
- **Supply Chain optimisation:** The optimisation of supply chains is facilitated by the utilisation of artificial intelligence (AI), which effectively coordinates production schedules, raw material acquisition, and distribution processes in order to efficiently satisfy the demands of the market.

Price Determination:

- **Market Analysis:** The market analysis involves the use of artificial intelligence (AI) to examine many aspects of the market, such as rival pricing, consumer preferences, and production costs. This study offers valuable insights into the establishment of competitive pricing strategies that effectively optimise profit margins.
- **Dynamic Pricing:** The implementation of artificial intelligence (AI) has the potential to facilitate dynamic pricing methods, enabling Vanaspati manufacturers to promptly modify prices in response to market conditions, fluctuations in demand, and costs associated with the supply chain.

Resource and Energy Efficiency:

- **Resource Optimisation:** Artificial intelligence (AI) has the potential to enhance the efficient use of raw materials and resources, such as palm oil and hydrogen, thereby mitigating wastage and minimising costs.

- **Energy Management**-The application of artificial intelligence (AI) in energy management enhances the efficiency of energy consumption in the manufacturing of Vanaspati. This is achieved through the utilisation of predictive models to estimate energy demand, the identification of potential energy-saving measures, and the strategic scheduling of activities during periods of low-cost energy availability.

Sustainability and compliance:

- **Environmental Impact Reduction:** The implementation of artificial intelligence (AI) technology has the potential to significantly contribute to the reduction of environmental impact in the Vanaspati manufacturing industry. By leveraging AI, manufacturers may optimise several aspects of their operations, including energy consumption, waste management, and resource utilisation. This optimisation process, facilitated by AI, has the capacity to effectively minimise the environmental footprint associated with Vanaspati production.
- **Regulatory Compliance: The** use of artificial intelligence (AI) can be advantageous in the realm of regulatory compliance by facilitating the monitoring and enforcement of food safety and quality requirements, as well as environmental rules.
- **The concepts of customization and personalisation are frequently discussed in several fields and industries.**
- ***The utilisation of artificial intelligence (AI) procedures enables the modification of Vanaspati goods in order to cater to individual customer demands, encompassing differences in flavour, packaging, and nutritional aspects. The involvement of artificial intelligence (AI) in the Vanaspati business encompasses various aspects, including the improvement of production processes and quality control, the optimisation of supply chain management, pricing strategies, and the implementation of sustainable practices. By harnessing artificial intelligence (AI) technologies, makers of Vanaspati can enhance the quality of their products, minimise expenses, respond effectively to dynamic market situations, and sustain a competitive advantage within the sector.***

*****

CHAPTER - 4

What is Generative AI? An Overview of the Role of Generative AI for Cost Accountants and Cost Auditors in Understanding the Impact of Product Costing

Generative AI, alternatively referred to as Generative Adversarial Networks (GANs), constitutes a branch of artificial intelligence (AI) that centres on the production of novel data, images, text, or other forms of material that bear resemblance to pre-existing data. The process entails the utilisation of two neural networks, namely a generator and a discriminator, which collaborate to generate and assess data. This paper provides a comprehensive analysis of the significance of generative artificial intelligence (AI) in the context of Cost Accountants and auditors, specifically focusing on its function in enhancing their grasp of the implications of product costing.

Data Generation and Simulation:

- Generative artificial intelligence (AI) has the capability to simulate and generate extensive datasets containing cost-related information. For professionals in the field of cost accounting, this tool can be used to generate artificial datasets that can be used for the purpose of cost analysis, modelling, and simulations.
- Generative AI can be employed by cost auditors to simulate diverse financial scenarios and evaluate the potential ramifications of different cost factors on financial statements and audit processes.

What-If- Analysis :

- The utilisation of generative artificial intelligence (AI) enables cost professionals to engage in "what-if" analysis through the generation of alternative cost structures and scenarios. Cost Accountants can utilise this tool to evaluate the potential impact of alterations in manufacturing processes, materials expenses, or labour expenses on the comprehensive assessment of product costing.
- Cost auditors have the ability to replicate diverse audit scenarios in order to comprehend the effects of fluctuations in financial data on auditing techniques and results.

Cost Prediction and Forecasting :

- Generative artificial intelligence (AI) models have the capacity to undergo training in order to make predictions regarding forthcoming expenses by leveraging past data. Cost accountants have the ability to utilise these projections in order to proactively anticipate cost trends and then develop appropriate plans.
- The utilisation of generative artificial intelligence (AI) by cost auditors enables them to make predictions regarding prospective audit difficulties or abnormalities in financial

data, enhancing the efficiency and effectiveness of the audit planning process. The topic of interest is anomaly detection.

Anomaly Detection :

- Generative artificial intelligence (AI) has the potential to assist in the detection and identification of abnormalities or irregularities within cost data.
- This technology can be utilised by cost auditors to autonomously identify atypical cost patterns or inconsistencies within financial records, potentially signalling the presence of fraudulent activities or inaccuracies.

The Optimisation of Costs:

- The utilisation of generative AI has the potential to enhance cost structures through the generation of alternatives that are more cost-effective. Cost accountants have the ability to examine various cost-saving solutions and strategies by utilising scenarios generated by artificial intelligence (AI).
- Cost Auditors have the ability to evaluate the efficiency of cost optimisation initiatives through the use of generative artificial intelligence (AI) in order to simulate and analyse the effects of cost-reduction methods on financial statements.

Enhanced Reporting:

- Generative artificial intelligence (AI) has the potential to aid in the production of thorough reports that offer valuable insights into cost structures and their influence on financial performance. These reports provide significant value for both cost accountants and cost auditors by effectively conveying their findings and suggestions.

Risk Assessment

- The utilisation of generative AI holds potential for evaluating financial risk through the simulation of scenarios encompassing diverse levels of risk exposure. This aids cost specialists, such as cost auditors, in the assessment and reduction of financial risks linked to product costing.

In brief, the utilisation of generative artificial intelligence (AI) has considerable promise in providing substantial support to Cost accountants and cost auditors across multiple dimensions of their professional responsibilities. ***This technology has the potential to be utilised for several purposes, such as data creation, cost analysis, prediction, anomaly detection, and decision assistance.*** Professionals in the aforementioned domains can enhance their capacity to make well-informed judgements and recommendations by leveraging generative AI tools and techniques. These tools and techniques enable them to delve into product costing, financial performance, and audit processes, thereby facilitating a more comprehensive understanding of these areas.

4.1 Generative AI in Banking and Insurance: Case Studies

Significant progress has been observed in the implementation of generative artificial intelligence (AI) within the banking and insurance industries. This advancement has resulted in the introduction of novel approaches that aim to improve several aspects of these sectors, including operational efficiency, customer satisfaction, and risk mitigation. Presented below are several case studies that exemplify the practical implementations of generative artificial intelligence (AI) within various industries:

Customer Support Chabot's:

- **Bank:** The banking industry has witnessed the widespread use of generative AI-powered Chabot's, which are used to manage routine customer questions, furnish account information, and even facilitate basic transactions. These Chabot's employ natural language processing techniques and generative models to efficiently interact with clients.
- **Impact:** The use of several strategies has resulted in a notable impact on customer service, characterised by the provision of round-the-clock support, expedited response times, and the delivery of consistent and precise information. The automation of regular tasks resulted in a decrease in operational costs.

Credit Risk Assessment:

Credit risk assessment is a crucial aspect in the field of finance that involves evaluating the potential risk associated with extending credit to individuals or entities.

- **Bank:** Banks employ generative AI models for the purpose of credit risk analysis. These models have the capability to produce artificial data in order to replicate diverse credit situations and evaluate the influence of various factors on creditworthiness.
- **Impact:** The impact of this development includes the enhancement of risk assessment, the improvement of credit scoring accuracy, and the reduction of default rates. Enhanced decision-making in lending practices and lowered vulnerability to nonperforming loans.

Fraud Detection

- **Bank:** In the banking industry, generative artificial intelligence (AI) is employed to analyse transactional data and provide patterns that pertain to both typical and atypical behaviours. Real-time analysis enables the identification of atypical patterns or abnormalities, highlighting probable instances of fraudulent actions.

- **Impact:** The impact of implementing advanced fraud detection and prevention measures is multifaceted. Firstly, it leads to improved fraud detection capabilities, enabling banks to identify and mitigate fraudulent activities more effectively. This, in turn, contributes to a reduction in financial losses incurred by both banks and customers. Additionally, the implementation of such measures enhances the overall security of banking systems, safeguarding the interests of both financial institutions and their clientele.

Claims Processing in Insurance:

- **Insurance Company:** Claims processing in the insurance industry is a crucial aspect that involves the evaluation and settlement of insurance claims. This process plays a significant role in ensuring the smooth functioning of insurance companies and maintaining customer satisfaction. The insurance company applies generative artificial intelligence models to evaluate and analyse insurance claims. The aforementioned models possess the capability to analyse previous claims data and produce estimations for claim settlements, thereby expediting the procedure and diminishing the need for personal intervention.

- **Impact:** The implementation of faster and more efficient claims processing has had several notable impacts. *Firstly, it has led to a reduction in administrative expenses. Additionally, the expedited processing has facilitated quicker claim settlements, enhancing client satisfaction.*

Chatbots for Insurance Queries:

- **Insurance Company:** Similar to banks, insurance companies use generative AI-powered Chabot's to handle customer inquiries related to policy information, claims, and coverage details. The use of this technology has resulted in several notable effects. Firstly, there has been a significant enhancement in customer service quality, as evidenced by improved responsiveness to client inquiries.

- **Impact:** Additionally, the adoption of this technology has led to a reduction in the burden on human agents, enabling them to allocate their time and efforts towards more intricate jobs.

Investment Recommendations:

- **Financial Advisory Firm:** The financial advisory firm uses generative artificial intelligence models to analyse financial market data and then create investment recommendations. These models have the capability to replicate diverse investing methods and the potential results they may yield.

- **Impact:** The impact of utilising this approach includes enhanced investment decision-making through increased information, improved portfolio management, and heightened levels of client satisfaction.

Regulatory Compliance:

- **Financial Institution:** Generative artificial intelligence (AI) has the potential to facilitate the generation of regulatory compliance reports and paperwork within financial institutions. The implementation of regulatory standards assists in ensuring that banks and insurance businesses comply with intricate and continuously changing regulations.
- **Impact:** The impact of implementing this measure includes a reduction in compliance risks, an improvement in reporting accuracy, and the avoidance of regulatory penalties.

The aforementioned case studies exemplify the utilisation of generative AI within the banking and insurance industries, with the aim of optimising operational efficiency, elevating client satisfaction, mitigating potential risks, and enhancing decision-making procedures. With the ongoing evolution of technology, it is anticipated that there will be a proliferation of new applications within these industries.

4.1.2 Best sector where generative AI can give accurate result

The capacity of generative AI to deliver precise outcomes in diverse sectors and businesses is contingent upon the particular application and use case at hand. The efficacy of generative artificial intelligence (AI) is contingent upon various elements, including the calibre of the data, the training of the model, and the intricacy of the assigned task. There are several fields in which generative artificial intelligence (AI) has the potential to produce precise outcomes.

Healthcare and Medical Imaging:

Generative artificial intelligence (AI) is employed in the field of medical image analysis, encompassing tasks such as the production of high-resolution images, the identification of tumours, and the diagnosis of diseases. The importance of precision in the healthcare field cannot be overstated, and generative artificial intelligence (AI) has demonstrated potential for enhancing diagnostic precision.

Manufacturing and Quality Control:

The utilisation of generative artificial intelligence (AI) holds potential for its application in the realm of quality control inside manufacturing processes. The utilisation of this technology enables the precise detection and identification of flaws, irregularities, and deviations within manufacturing processes, thereby facilitating the preservation of product excellence.

Financial Services:

It involves within the field of finance, generative artificial intelligence (AI) has the capability to offer precise evaluations of risk, detect instances of fraud, and provide predictive analytics for the purposes of asset management and investment strategies. Additionally, it has the capability to produce precise financial projections.

Natural Language Processing (NLP):

NLP is a field of study that focuses on the interaction between computers and human language. It involves the development of algorithms and models that enable computers to understand, interpret, and generate human Natural Language Processing (NLP) applications, such as text generation and sentiment analysis, get advantages from the use of generative artificial intelligence (AI). The precision of language generation and comprehension holds significant importance in various domains, including customer support, content creation, and the analysis of legal documents.

Autonomous Vehicles:

Generative artificial intelligence (AI) plays a crucial and indispensable role within the realm of autonomous driving systems, as it effectively interprets sensor data with precision and expeditiously formulates real-time decisions. In order to maintain road safety, it is imperative that this technology exhibit a high level of accuracy.

Drug Discovery and Pharmaceuticals:

The field of drug discovery and pharmaceuticals includes the process of identifying and developing new medications for the treatment of various diseases and medical conditions. Generative artificial intelligence (AI) models play a crucial role in the field of drug development by effectively forecasting the molecular structures and properties of possible therapeutic candidates with a high degree of accuracy. The implementation of this approach has the potential to greatly enhance the efficiency of the drug development process.

Agriculture:

Generative artificial intelligence (AI) has the capability to offer precise and reliable observations pertaining to crop management, yield forecasting, and disease identification by means of analysing data derived from sensors, drones, and satellites.

Energy and Utilities:

The sector of energy and utilities encompasses several industries involved in the production, distribution, and consumption of energy resources. Generative artificial intelligence (AI) holds significant potential within the energy sector as it offers the capability to optimise energy production, forecast equipment malfunctions, and enhance grid management. These advancements can result in more precise energy distribution and reduced periods of system downtime.

Environmental Monitoring:

Generative artificial intelligence (AI) has demonstrated a high level of accuracy in the analysis of environmental data, encompassing areas such as climate modelling, weather prediction, and pollution monitoring. This capability holds significant potential for providing valuable insights to inform policy decisions and the development of climate-related policies.

Space Exploration:

Generative artificial intelligence (AI) is employed in the domain of space exploration to facilitate precise data analysis, picture processing, and the simulation of space settings. The attainment of precision is of utmost importance in ensuring the accomplishment of the task. India's recent lunar exploration mission, Chandrayaan-3, and solar exploration mission, Aditya spacecraft, have achieved significant achievements in the realm of scientific inquiry and study. The Indian Space Research Organisation (ISRO) employed artificial intelligence (AI) for this particular objective. The implementation of artificial intelligence has resulted in a reduction in costs.

Creative Arts:

Generative artificial intelligence (AI) has the capability to produce remarkably authentic visual representations, musical compositions, and various forms of creative content within the realm of the creative industries. The importance lies in the precision of reproducing artistic styles and the ability to generate original innovations.

The best sector for high accuracy in generative AI depends on the needs of the application and how easy it is to get access to high-quality training data. With the ongoing advancements in AI technology, it is anticipated that there will be an enhancement in accuracy across diverse sectors. Consequently, generative AI is poised to become a significant asset for numerous businesses.

4.1.3 The most promising application of generative AI to date

Among the many promising sectors where generative AI has been put to use are those dealing with natural language processing (NLP), and more specifically with language models like GPT-3 and their descendants. Reasons why generative AI holds so much promise in natural language processing

Chatbots and other conversational AI

Advanced chatbots and virtual helpers are now possible thanks to generative artificial intelligence. These systems are able to have conversations with users in a way that is both natural and contextually relevant, allowing them to provide support, answer queries, and provide unique responses. They can be used in the fields of customer service, healthcare, and others.

Creation of Content:

Useful for coming up with content, generative AI may produce language that reads like it was written by a person. It can be used to produce journalistic writing, blog entries, product descriptions, and even fiction. This has ramifications for the future of marketing, journalism, and the automation of content creation.

Translated from the language:

As a result of generative AI models, machine translation systems have become more precise and natural-sounding. As a result of their ability to translate text between languages while maintaining context and meaning, they have become invaluable for facilitating cross-cultural dialogue.

Synopsis of the Text:

Using generative AI, you may get short and well-organised summaries of even the longest texts, articles, or reports. This is helpful for rapidly gleaning relevant data from massive text collections.

Analysing Opinions:

The sentiments, emotions, and attitudes expressed in language can be analysed using generative AI. This is helpful for companies in monitoring their brand's reputation online and through social media.

Customised content:

With the help of generative AI, material can be personalised for each user depending on their tastes and habits. This is a frequent component of various recommendation systems, including those that suggest items to purchase or watch on streaming services.

Comprehending Language:

The generative AI models can interpret natural language at a high level. They may produce code or mathematical answers, as well as answer complex inquiries and provide explanations. This can be used in a variety of settings, including classrooms, help desks, and laboratories.

Input from humans into machines :

With the help of generative AI, people and machines may have conversations that feel more natural and fluid. This is becoming increasingly apparent with the widespread use of virtual aides such as voice assistants, chatbots, and virtual companions.

Accessibility:

It is possible that generative AI will help make digital information more accessible for people with physical impairments. It can make it easier for people who use screen readers by generating audio descriptions and converting text to voice.

Reviving and Protecting Dying Languages :

By creating text, translations, and educational materials, generative AI can help with language preservation and revival efforts.

The use of generative AI in natural language processing (NLP) has revolutionised how we use and comprehend language. Applications that benefit communication, content automation, and information accessibility have flourished as a result of its text production capabilities. We may anticipate many more intriguing uses in the future as research in this sector continues to develop.

4.1.4 What role may generative AI play in assisting governments with the allocation of scarce resources like spectrum and subsidies for agriculture?

Generative artificial intelligence (AI) has the potential to serve as a beneficial tool in aiding governments in the allocation of limited resources, such as spectrum and subsidies for agricultural purposes. The use of the aforementioned concept can be observed in various domains, as outlined below:

Spectrum Allocation:

- **Demand Prediction:** The utilisation of generative artificial intelligence (AI) entails the examination of past data, mobile usage trends, and pertinent data to anticipate forthcoming spectrum demand across various geographical areas. This information aids regulatory agencies in the more effective allocation of spectrum resources to address the increasing demands of the telecoms industry.
- **Spectrum Auction Optimization:** The optimisation of spectrum auctions involves the utilisation of generative artificial intelligence (AI) techniques to simulate diverse auction situations with the aim of enhancing the allocation of spectrum licences to telecom enterprises. The utilisation of artificial intelligence (AI) holds potential for optimising revenue generation for governmental entities through the careful consideration of many elements such as bidding tactics, coverage needs, and interference limits.
- **Dynamic Spectrum Sharing**: The utilisation of generative AI can be employed to facilitate the implementation of dynamic spectrum sharing policies. The system has the capability to continuously monitor the utilisation of the spectrum in real-time and assign the available spectrum resources in a dynamic manner to various users, including commercial providers, emergency services, and Internet of Things (IoT) devices. This ensures the optimal and effective utilisation of the spectrum.
- **Spectrum Policy Simulation:** The use of generative AI enables the simulation of the effects of various spectrum laws and regulations on both the telecoms

industry and consumers. The use of spectrum management and policy modifications aids governments in making well-informed judgements.

The Allocation of Agricultural Subsidies:

- **Crop Yield Prediction:** Crop yield prediction involves the utilisation of generative artificial intelligence (AI) to analyse past records encompassing weather patterns, soil conditions, and crop yields. This analytical process enables the generation of predictions for forthcoming agricultural output. This data assists governmental entities in identifying geographical areas that require financial assistance in response to projected crop failures or diminished agricultural yields.
- **Optimizing Subsidy Distribution:** The use of generative AI can facilitate the development of optimisation models that enhance the efficiency of subsidy distribution among farmers. This is achieved by considering several parameters, such as land size, crop type, and historical performance. This measure guarantees that subsidies are allocated to individuals with the greatest need.
- **Fraud Detection:** The utilisation of generative AI holds potential in the realm of fraud detection, namely in the identification of false subsidy claims. This is achieved through the analysis of data patterns and anomalies. This measure aids governments in mitigating subsidy leakage and ensuring the appropriate utilisation of funds as per their intended purpose.
- **Market Price Analysis:** The use of generative AI in the analysis of market prices for agricultural products holds the potential to offer valuable insights to government authorities. This information facilitates the establishment of subsidy levels that effectively address the interests of both agricultural producers and consumers.
- **Policy Impact Assessment:** The use of generative AI in policy impact assessment enables the simulation of various subsidy schemes and their effects on agricultural production, income distribution, and broader economic results. This facilitates the ability of governments to make informed judgements regarding subsidy programmes based on empirical evidence.

Generative artificial intelligence (AI) has the potential to offer governments valuable insights and decision support tools for the efficient allocation of limited resources, utilising predictive analytics, optimisation techniques, and simulation methodologies. By harnessing the potential of these AI-powered skills, governments can enhance their decision-making processes related to spectrum allocation and agricultural subsidies, leading to better informed and fair outcomes. This, in turn, can have positive impacts on both their economies and the well-being of their populations.

4.1.5 Basic Mathematics and Statistics are Fundamental to Grab the Generative AI

Basic Mathematics and statistics play a pivotal role in comprehending and proficiently using generative artificial intelligence (AI), particularly in the domains of data analysis, model assessment, and result interpretation. Basic statistics play a vital role in the field of generative artificial intelligence (AI).

- **Data Pre- Processing:** Data pre-processing is a crucial step that must be undertaken prior to training generative artificial intelligence (AI) models. This process involves the necessary steps of cleaning and preparing the data. ***Fundamental statistical measures, such as the mean, median, standard deviation, and skewness, play a crucial role in detecting outliers, comprehending the distribution of data, and informing decisions on data transformation and normalisation.***
- **Data Understanding:** The data understanding phase involves the examination of *descriptive statistics,* which offer valuable insights into many features of the data, including measures of central tendency, dispersion, and distribution. This comprehension aids in the selection of suitable generative artificial intelligence algorithms and the adjustment of their parameters.
- **Probability Distributions:** A fundamental understanding of probability distributions, ***such as the Gaussian (normal), Poisson, and Bernoulli distributions, is crucial for the purpose of data modelling and the generation of authentic synthetic*** data through the utilisation of generative AI models, such as GANs (Generative Adversarial Networks).
- **Hypothesis Testing:** Hypothesis testing can be employed in some scenarios to evaluate the statistical significance of disparities between actual and generated data. This holds particular significance in instances where generative artificial intelligence (AI) is employed for the purpose of anomaly identification or quality control.
- **Model Evaluation:** The evaluation of generative AI models involves the use of basic statistical measures to assess their performance. ***Metrics like mean squared error (MSE), mean absolute error (MAE), and correlation coefficients a***re used to evaluate the degree of similarity between the generated data and the actual data.
- **Cross-Validation:** ***Cross-validation is a commonly employed method in the field of generative artificial intelligence (AI)*** models to assess their robustness and generalisation ability. Techniques such as k-fold cross-validation and bootstrapping, which are rooted in statistical principles, are utilised for this purpose.
- **Probability and Sampling:** A fundamental understanding of basic statistical principles is crucial for comprehending probability distributions, which serve as

the foundation for generative artificial intelligence models. A comprehensive understanding of probability principles is necessary for the effective use of sampling approaches in generative models.

- **Model Interpretation:** The interpretation of generative AI model outcomes is facilitated by a comprehension of statistical concepts. When creating text or images, it is imperative to evaluate the diversity and quality of the created samples by employing statistical techniques.
- **Data Ethics:** The incorporation of fundamental statistical reasoning is imperative in the examination of the ethical ramifications associated with the use of generative artificial intelligence. The process aids in the identification of biases within the training data and facilitates the evaluation of the fairness and representativeness of the generated content.
- **Iterative Improvement:** The process of training and enhancing generative AI models involves the use of basic statistical analysis to monitor and evaluate model performance across successive iterations. This analysis aids in identifying specific areas that require further refinement.

In essence, a fundamental understanding of statistics is essential for proficiently engaging with generative artificial intelligence. Generative AI solutions benefit from their assistance in various stages, including data pre-processing, model selection, evaluation, and interpretation. This support ensures that the solutions are characterised by accuracy and reliability. Furthermore, a comprehensive comprehension of statistics is crucial for making well-informed decisions throughout the process of developing and implementing generative artificial intelligence.

A fundamental foundation of mathematics, including calculus, is necessary to acquire a comprehensive understanding of artificial intelligence.

The conversational AI model, ChatGPT, is a language model developed by OpenAI. Indeed***, it is important to possess a fundamental comprehension of elementary mathematics, encompassing calculus, in order to get a more profound comprehension of artificial intelligence (AI) and its diverse array of applications. The significance of mathematics, specifically calculus, in the context of artificial intelligence (AI) is as follows:***

- **Fundamental Concepts:** The fundamental principles of differentiation and integration, as provided by calculus, play a crucial role in comprehending the functioning of AI systems, particularly within the realm of optimisation problems.
- **Optimization Algorithms:** *Optimisation algorithms are frequently employed in various artificial intelligence (AI) methods, such as machine learning and deep learning models, to effectively determine optimal parameters or solutions. Calculus plays a pivotal role in the process of optimising objective functions.*

- **Gradient Descent:** Gradient descent is a widely employed optimisation approach in the field of artificial intelligence (AI) that mainly depends on notions from calculus. The process entails the computation of derivatives in order to determine the direction of the greatest increase or decrease in the space of the loss or cost function.
- **Loss Functions:** *Loss functions are frequently employed in the field of machine learning to quantify the discrepancy between anticipated and observed values.* The discipline of calculus is employed to calculate the derivatives of these functions, which play a crucial role in guiding the training process of models.
- **Neural Networks:** *Neural networks, specifically deep learning, pertain to the field of artificial intelligence (AI) and encompass the process of training neural networks that consist of numerous layers*. The utilisation of calculus is observed in the process of backpropagation, which facilitates the computation of gradients for the purpose of altering the weights and biases of neural network layers during the training phase.
- **Probability and Statistics:** Probability theory and statistics play a crucial role as fundamental mathematical frameworks in the field of artificial intelligence, namely in the development and implementation of machine learning algorithms. The concepts of probability distributions, conditional probability, and statistical inference play a vital role in the field of statistics.
- **Linear Algebra:** Linear algebra is a mathematical field that exhibits a tight relationship with artificial intelligence (AI). The purpose of this tool is to serve as a means of describing data, facilitating transformations, and elucidating the mathematical principles underlying neural networks and matrix operations.
- **Data Analysis:** The utilisation of calculus principles is applicable in the realm of data analysis, encompassing tasks such as feature engineering, data pre-processing, and other essential components inside artificial intelligence initiatives.
- **Reinforcement Learning:** The use of calculus is integral to the optimisation of policy functions and value functions in reinforcement learning, facilitating the training of intelligent agents.
- **Research and Innovation:** Individuals engaged in AI research and innovation must possess a profound comprehension of mathematics, encompassing calculus, in order to facilitate the development of novel algorithms, enhance current ones, and advance the frontiers of AI capabilities.

In essence, the field of mathematics, encompassing calculus, serves as the fundamental framework for comprehending and engaging with artificial intelligence. Although an extensive comprehension of calculus is not universally necessary for all artificial intelligence (AI) applications, possessing a strong foundation

in fundamental mathematical principles will enhance your understanding of AI concepts, algorithms, and models. This will ultimately increase your proficiency in utilising and advancing the area of AI.

4.1.6 The acquisition of key competencies necessary to effectively utilise generative artificial intelligence is of paramount importance.

Indeed, the acquisition of essential competencies is crucial in order to properly harness the potential of generative artificial intelligence (AI). ***The following are crucial competencies and skills necessary for properly engaging with generative artificial intelligence:***

- **Acquiring Profound AI Proficiency:** Comprehend the rudimentary principles *and fundamental concepts of artificial intelligence, encompassing machine learning, deep learning, and generative models*. ***A solid understanding of the fundamental mathematical concepts, including linear algebra, calculus, and probability, is also crucial.***
- **Data Handling and Pre-processing:** Proficiency in the collection, cleansing, and pre-processing of data is crucial in the field of data handling. The training of generative AI models necessitates the utilisation of high-quality data, hence emphasising the significance of data preparation abilities.
- **Programming Skills:** *Proficiency in at least one programming language commonly used in the field of artificial intelligence, such as Python, is required for the development of programming skills.* One should possess the capability to implement, train, and assess generative artificial intelligence models by utilising programming libraries such as TensorFlow, PyTorch, or Keras.
- **Machine Learning and Deep Learning:** *This AI Guideline of The Institute of Cost Accountants of India aims to provide an understanding of the fundamental principles of machine learning, encompassing both supervised and unsupervised learning approaches, along with an exploration of deep learning techniques.* The utilisation of generative artificial intelligence (AI) frequently depends on deep learning frameworks such as generative adversarial networks (GANs), thus emphasising the significance of possessing a strong knowledge base in this domain.
- **Model Building and Training:** The acquisition of knowledge and skills in model building and training is essential for individuals to effectively design and construct generative artificial intelligence models. This includes the ability to configure model hyper parameters and subsequently train these models using relevant data. This encompasses the comprehension of loss functions, optimizers, and methodologies for achieving model convergence.
- **Data Visualization:** The ability to effectively visualise data and model outputs is a crucial skill in the field of data visualisation. Proficiency in data visualisation is

crucial for comprehending the efficacy of models and effectively conveying outcomes to relevant stakeholders.

- **Model Evaluation:** This course aims to enhance participants' abilities in appraising generative artificial intelligence (AI) models. It will focus on the use of metrics to evaluate the excellence of generated material, encompassing aspects such as image fidelity, text coherence, and data similarity.
- **Ethical AI:** The topic of ethical artificial intelligence (AI) pertains to comprehending the ethical implications and inherent biases that are linked with generative AI. It is imperative to remain cognizant of ethical AI protocols and their potential implications for privacy.
- **Domain Knowledge:** The acquisition of domain-specific knowledge is advantageous in various application domains. In the context of developing generative artificial intelligence (AI) systems for healthcare applications, a comprehensive understanding of medical ideas and data is deemed crucial.
- **Problem Solving:** Issue-solving is a crucial skill set that plays a vital role in the identification of suitable applications for generative AI, the formulation of issue statements, and the development of efficient solutions.
- **Mathematical Foundations:** It is imperative to possess a comprehensive comprehension of mathematics, encompassing linear algebra, calculus, and probability, as these fundamental principles serve as the basis for numerous generative artificial intelligence models and algorithms.
- **Continuous Learning:** Continuous learning entails the imperative of remaining well-informed regarding the most recent advancements within the realm of generative artificial intelligence. The field of artificial intelligence is characterised by its rapid evolution, necessitating a continuous process of learning in order to maintain a competitive edge.
- **Collaboration:** Collaboration is of utmost importance, particularly in the context of interdisciplinary teams comprising data scientists, engineers, domain experts, and business professionals.
- **Communication:** Communication plays a crucial role in effectively conveying AI concepts, presenting findings, and engaging in collaborative efforts with others who lack technical expertise.
- **Experimentation and Innovation:** The pursuit of experimentation and innovation is crucial in the realm of generative AI, since it necessitates a willingness to explore various ways and devise novel solutions to address complex challenges in a creative manner.
- **Project Management:** Project management skills play a crucial role in the successful execution of generative artificial intelligence (AI) efforts within the field of AI projects. By employing project management techniques, such

initiatives can be carried out with efficiency and effectiveness, ultimately leading to the achievement of project objectives.

The acquisition of these competences may encompass formal education, online courses, practical projects, and ongoing practice. The domain of generative artificial intelligence (AI) is characterised by its dynamic nature and presents intriguing prospects. However, it necessitates a dedication to acquiring knowledge and keeping abreast of breakthroughs in AI technology and optimal methodologies.

4.1.7 Cost accountants need re-skilling for generative AI :

Cost accountants, similar to experts in various other fields, can derive advantages by engaging in reskilling activities in order to effectively adapt to the era of generative artificial intelligence (AI). In the context of generative AI, *there are several critical areas where reskilling can hold significant value for cost accountants.*

- **AI Fundamentals:** It is imperative for cost accountants to develop a foundational comprehension of AI principles, encompassing machine learning, deep learning, neural networks, and generative models. This body of knowledge serves as the fundamental basis for comprehending the functioning principles of generative artificial intelligence.
- **Data Handling:** The process of reskilling should encompass the acquisition of knowledge and skills pertaining to the proper handling and pre-processing of data. Cost accountants must possess the capability to effectively analyse both structured and unstructured data in order to derive valuable insights.
- **Programming:** Although ***it is not necessary for all cost accountants to possess programming abilities, acquiring some coding skills can prove advantageous. Acquiring proficiency in programming languages such as Python, which is widely employed in the field of artificial intelligence (AI),*** can facilitate the manipulation of data and the creation of rudimentary AI models.
- **Machine Learning:** The acquisition of a fundamental comprehension of machine learning techniques is recommended for cost accountants, given that generative artificial intelligence frequently relies on these principles. Having a solid understanding of fundamental concepts like supervised learning, unsupervised learning, and model evaluation is highly advantageous.
- **Generative AI:** The need to place a more explicit emphasis on generative artificial intelligence (AI) cannot be overstated. ***It is recommended that cost accountants acquire knowledge regarding generative models such as generative adversarial networks (GANs) and variational auto encoders (VAEs), as well as their many applications.***
- **Data Ethics and Security:** The comprehension of ethical implications pertaining to artificial intelligence, encompassing data privacy and prejudice, is vital for cost accountants. It is imperative for individuals to have the necessary

skills and knowledge to effectively and ethically manage sensitive financial information.

- **AI Tools and Frameworks:** ***Having knowledge and experience in utilising AI libraries and frameworks, such as Tensor Flow and PyTorch, can provide significant benefits for cost accountants seeking to collaborate effectively with AI experts.***
- **Statistical Analysis:** Enhancing one's proficiency in statistical analysis is crucial, given that statistics serve as the foundation for numerous artificial intelligence systems. This acquired information facilitates comprehension of model results and evaluation of their dependability.
- **Domain Knowledge:** In the realm of cost accounting and financial analysis, ***it is imperative for cost accountants to integrate their proficiency in finance with a comprehensive understanding of artificial intelligence (AI). This amalgamation of knowledge enables the development of AI-based solutions that effectively tackle the unique issues encountered in cost accounting and financial analysis.***
- **Continuous Learning:** Given the rapid evolution of the area of artificial intelligence (AI), it is imperative for cost accountants to engage in ongoing learning endeavours in order to remain abreast of the newest breakthroughs and best practices in AI. ***The Advanced studies department of the Institute of Cost Accountants of India has greater responsibility to equip the members on latest AI tools. AI is new technology. Advanced studies department of ICMAI need to be very active and need to start AI related course as soon as possible.***
- **Collaboration:** Collaboration is crucial for Cost Accountants to enhance their proficiency in efficiently using artificial intelligence (AI) in the domains of cost accounting and financial analysis. It is imperative for them to cultivate the necessary abilities to collaborate harmoniously with data scientists and AI professionals. ***ICMAI needs to act immediately. Collaboration with AI-related education institutes, management institutes like IIM or SPJIMR, etc., or online certificate programme companies like Eruditus, Upgrade, Lake University, Austin University Data Science, IIM Calcutta Fintech and Blockchain Programme, SPJIMR Fintech and Blockchain Programme, etc. is the need of the hour to equip members and students. The Cost Accounting community needs to invest time and money in learning AI. It will aid them in long-term market survival.***
- **Problem-Solving:** The utilisation of artificial intelligence (AI) has the potential to enhance the efficiency of resolving intricate financial challenges. It is imperative for Cost Accountants to acquire the skills necessary to effectively recognise and address these issues while also demonstrating proficiency

in the use of artificial intelligence (AI) methodologies. For this regular CEP programme should be organised at various chapters of ICMAI and Specialist speaker like well-known HR specialist, motivational speaker etc should be arranged to train the members effectively.

The process of acquiring the necessary skills for generative artificial intelligence (AI) typically entails engaging in educational courses, participating in workshops, obtaining certifications, and engaging in practical projects. Recognising the significance of artificial intelligence (AI) in the field of Cost Accounting, it becomes evident that its integration may augment the capabilities of professionals in this domain. By leveraging AI, Cost Accountants can expand their proficiency in analysing financial data, optimising cost management, and delivering valuable insights to organisations.

4.1.8 The Prospects for Accountants in the Age of Generative AI

The advent of generative artificial intelligence (AI) presents both obstacles and opportunities for professionals in the field of accounting. In this dynamic and growing business environment, several potential opportunities arise for professionals in the field of accounting.

- **Automation of Repetitive Task:** The implementation of generative AI has the potential to automate mundane and repetitive accounting operations, including but not limited to data entry, reconciliation, and fundamental financial reporting. This enables accountants to direct their attention towards strategic and value-enhancing endeavours.
- **Improved Data Analysis:** Generative AI possesses the capability to rapidly analyse extensive quantities of financial data and detect patterns, anomalies, and trends that may not be readily discernible to human accountants. This facilitates accountants in gaining more profound insights to inform their decision-making processes.
- Fraud Detection: The application of generative AI in fraud detection involves the analysis of trends and departures from established norms to identify potential anomalies and instances of fraudulent activity inside financial transactions. Accounting professionals have the capability to utilise artificial intelligence (AI)-generated alerts in order to conduct thorough investigations into potentially illicit or questionable activity.
- **Cost Reduction:** The implementation of generative AI in specific jobs can contribute to the reduction of operating expenses associated with accounting, thereby facilitating the development of a more streamlined finance department.
- **Predictive Analytics**: Predictive analytics is a field where generative artificial intelligence (AI) may be utilised to aid accountants in forecasting forthcoming

financial outcomes. This application of AI enables organisations to make proactive financial decisions and enhances their ability to efficiently manage risk.

- **Financial Reporting**: The utilisation of AI-driven reporting solutions facilitates the expeditious and precise generation of financial reports, thereby ensuring adherence to accounting standards and regulatory mandates. The use of AI-powered catboats or virtual assistants enables the provision of personalised financial advice to clients, enhancing the level of service offered by accountants.
- **Skill Development:** Accountants who acquire proficiency in artificial intelligence (AI) and data analytics can establish themselves as important resources in organisations seeking to utilise generative AI for financial analysis.
- **Compliance and Audit Support:** The use of generative AI can provide support for compliance and audit procedures through the automation of data sampling, the execution of risk assessments, and the detection of potential audit concerns.
- **Ethical Considerations:** Accountants are tasked with the responsibility of monitoring the ethicality and adherence to industry standards and regulations of AI-driven financial choices.
- **Continuous Learning:** The necessity for accountants to engage in continual learning arises from the rapid expansion of AI, as it demands their awareness and familiarity with the most recent technology and optimal methodologies.
- **Enhanced Collaboration:** Accountants may benefit from establishing closer collaborative relationships with data scientists and experts in artificial intelligence (AI) in order to optimise the utilisation of generative AI tools and models.
- **Regulatory Changes:** The Impact of Regulatory Changes on Accountants in the Context of AI's Expanding Role in Financial Reporting and Analysis
- **Data Security and Privacy:** The issue of data security and privacy must be duly considered by accountants while handling sensitive financial data and utilising artificial intelligence (AI) technology.

In brief, the use of generative AI has promise for automating and improving several facets of the accounting field. However, it also offers avenues for accountants to adapt their responsibilities, enhance their analytical proficiencies, and offer more strategic perspectives to organisations. ***Accounting professionals who actively adopt and integrate artificial intelligence (AI) technologies into their practices while also adjusting to the evolving business environment can effectively maintain their significance in the realm of financial management and decision-making.***

4.1.9 The Role of Different Accounting Institutes and Their Parent Bodies in the Era of Generative Artificial Intelligence

The developing environment of the accounting profession necessitates the adaptation of various accounting institutes and their parent bodies in response to the era of generative artificial intelligence (AI). In the current period, accounting institutes and their parent bodies have the potential to make significant contributions.

The American Institute of Certified Public Accountants (AICPA) and the Application of Artificial Intelligence in the Field of Auditing

The American Institute of Certified Public Accountants (AICPA) has the capability to produce comprehensive rules and optimal methodologies for the seamless integration of artificial intelligence (AI) within auditing procedures. One potential approach is to establish AI training and certification initiatives specifically designed for Certified Public Accountants (CPAs), aiming to enhance their competence in utilising AI tools for auditing purposes

The integration of AI technology in the field of Management Accounting has garnered significant attention, particularly in relation to the Chartered Institute of Management Accountants (CIMA).

The Chartered Institute of Management Accountants (CIMA) might direct its attention towards exploring the potential of artificial intelligence (AI) in augmenting management accounting practices, namely in the areas of budgeting, forecasting, and performance analysis. The provision of training and resources to management accountants about the adoption of artificial intelligence (AI) can be facilitated.

The integration of Artificial Intelligence (AI) in Financial reporting, specifically in relation to the Institute of Chartered Accountants in England and Wales (ICAEW).

The Institute of Chartered Accountants in England and Wales (ICAEW) has the potential to take a leading role in the standardisation of financial reporting practices that are driven by artificial intelligence (AI). Organisations have the opportunity to engage in collaborative efforts with regulatory agencies in order to guarantee that financial reports created by artificial intelligence (AI) systems adhere to established accounting standards.

The International Federation of Accountants (IFAC) and the establishment of global AI standards

The International Federation of Accountants (IFAC) has the potential to contribute to the development of universally accepted guidelines pertaining to the utilisation of artificial intelligence (AI) in the fields of accounting and auditing. One potential strategy to foster uniformity in the implementation of artificial intelligence (AI) is through the facilitation of cross-border collaboration across accounting organisations.

Research and development:

Accounting institutions have the opportunity to allocate resources towards research and development endeavours aimed at investigating the potential implications of artificial intelligence (AI) on the accounting profession. Funding can be allocated towards conducting research studies that investigate the impact of artificial intelligence on ethical considerations, regulatory frameworks, and the development of optimal approaches.

Ethics and professional standards:

Institutions have the ability to revise their codes of ethics and professional standards in order to effectively tackle ethical concerns associated with artificial intelligence (AI), including but not limited to issues of transparency, bias, and data protection.

The field of education and training encompasses various aspects related to the acquisition of knowledge and skills.

Accounting organisations have the capacity to provide educational programmes and training with a specific focus on artificial intelligence (AI) in order to educate their members with the necessary skills in this field. The curriculum encompasses a range of subjects, such as AI ethics, data analytics, and AI-driven decision-making.

The Intersection of Advocacy and Regulation: An Analysis

Institutions have the capacity to advocate for regulatory frameworks that effectively achieve a harmonious equilibrium between promoting innovation in artificial intelligence (AI) and guaranteeing accountability and transparency in the realm of AI-driven accounting practices. Collaboration with technology providers is a crucial aspect of modern business operations.

Collaboration between accounting bodies and technology businesses can facilitate the development of artificial intelligence (AI) tools and solutions that are customised to address the distinct requirements of accountants and auditors. The act of sharing knowledge

Institutions have the capacity to establish platforms that facilitate the dissemination of knowledge and the exchange of best practices among their constituents with respect to the adoption of artificial intelligence (AI) and its ramifications in the field of accounting.

Public awareness is of significant importance in contemporary society

Accounting institutions possess the capacity to disseminate knowledge to the general public on the advantages and potential drawbacks associated with artificial intelligence (AI) in the field of accounting. This educational endeavour aims to foster a sense of trust and assurance in the utilisation of AI-powered financial procedures.

The concept of continuous learning refers to the ongoing process of acquiring knowledge, skills, and competencies throughout one's lifetime.

- Encourage the establishment of a culture that fosters ongoing learning and professional growth among individuals in order to effectively adapt to the swift advancements in artificial intelligence technology.
- During the current era characterised by the prevalence of generative artificial intelligence (AI), it is imperative for accounting institutes and their respective parent organisations to assume a crucial responsibility in facilitating and directing the profession's adjustment to AI technologies. The endeavours made by individuals can contribute to the effective use of AI in the field of accounting while also upholding ethical standards and adhering to legal obligations. Ultimately, these efforts aim to improve the overall quality and value of accounting services.

4.1.9.1 Anticipating Potential Challenges Faced by Accounting Institutes and IFAC in the Era of Generative Artificial Intelligence:

Accounting institutions like the International Federation of Accountants (IFAC) are likely to encounter numerous obstacles in the era of generative artificial intelligence (AI). It is imperative to proactively anticipate these difficulties in order to adequately and efficiently solve them. There are several potential issues that may arise.

- **Ethical Considerations:** The utilisation of generative artificial intelligence (AI) in the field of accounting gives rise to ethical apprehensions, encompassing matters pertaining to transparency, impartiality, and potential biases. *The development of rules and standards by accounting institutes and the International Federation of Accountants (IFAC) is important in order to effectively address the ethical concerns at hand.*
- **Data Privacy and Security:** The use of generative AI necessitates the use of extensive datasets, which may include sensitive financial data, hence raising concerns regarding data privacy and security. The preservation of data privacy and security holds paramount importance, and adherence to data protection standards, such as *the General Data Protection Regulation (GDPR), is imperative.*
- **Regulatory Compliance:** The increasing prevalence of artificial intelligence (AI) in accounting practices may prompt regulators to create more laws and regulations pertaining to regulatory compliance. Accounting institutions and the International Federation of Accountants (IFAC) will be required to remain updated on these changes and assist their members in adhering to the growing standards.

- **Professional Competence:** The acquisition of new skills and competencies connected to artificial intelligence (AI) is necessary for accountants in order to maintain their professional competence and effectiveness in their respective roles. *It is imperative for accounting institutes to offer comprehensive training and educational programmes in order to adequately equip their members for the integration of artificial intelligence (AI) technologies.*
- **Trust and Reliability:** The implementation of artificial intelligence (AI) in the field of accounting may give rise to concerns over the dependability and credibility of financial reports and analyses provided by AI systems. *It is imperative for institutes and the International Federation of Accountants (IFAC) to collaborate in order to cultivate a sense of confidence in accounting practices that are driven by artificial intelligence (AI).*
- **Bias and Fairness:** The issue of bias and fairness arises in the context of generative AI models, as these models have the ability to acquire biases from the training data they are exposed to. This, in turn, can result in biased financial decision-making. The task of mitigating bias in artificial intelligence (AI) algorithms and promoting fairness is a substantial obstacle.
- **Liability Issues:** The determination of accountability in instances where errors or mistakes are made by AI systems might present a complex set of issues related to liability. *It is recommended that accounting institutes and the International Federation of Accountants (IFAC) undertake a comprehensive examination of liability frameworks and recommendations.*
- **Education and training:** *The provision of sufficient education and training on artificial intelligence (AI) may require a substantial allocation of resources.* In order to effectively manage their operations, institutes will be required to devote resources and provide suitable training programmes.
- **Cost of Adoption:** The adoption of AI technology may pose financial issues for small and medium-sized accounting businesses in terms of cost. Accounting institutions have the capacity to offer assistance and direction on the implementation of cost-efficient artificial intelligence (AI) technologies.
- **Global Standardization:** The attainment of global standardisation in the realm of artificial intelligence (AI) practices and regulations is a formidable challenge, mostly stemming from the diverse regulatory landscapes prevailing across different countries and regions. The International Federation of Accountants (IFAC) may be required to assume substantial responsibility for enabling the establishment of international alignment.
- **Resistance to Change:** Accountants and auditors may exhibit reluctance towards embracing the integration of artificial intelligence (AI) as a result of

apprehension around potential job displacement or uncertainty surrounding novel technological advancements. *Institutions have the potential to mitigate this resistance through educational initiatives and supportive measures.*

- **AI Governance:** The establishment of governance mechanisms for artificial intelligence (AI) in the field of accounting can be a complicated undertaking. This encompasses the establishment of clear delineations of roles and responsibilities, the implementation of measures to ensure individuals are held accountable for their actions, and the development of systems to provide effective supervision and monitoring.
- **Evolution of Roles:** The evolution of roles is anticipated as artificial intelligence (AI) progressively automates mundane work, perhaps leading to transformations in the responsibilities and functions of accountants. It is imperative for accounting institutes and the International Federation of Accountants (IFAC) to provide assistance to their members in effectively adjusting to new tasks and responsibilities.
- **Market Competition:** The early adoption of artificial intelligence (AI) by firms has the potential to confer a competitive edge in the market, hence presenting hurdles for those entities that have not yet embraced this technology. In order to adapt to the dynamic nature of the market, institutes may find it necessary to provide help to their members in order to maintain their competitiveness.
- **Long-term Impact on the Profession: *The potential long-term ramifications of the broad integration of artificial intelligence (AI) have the capacity to significantly alter the landscape of the accounting profession.*** Accounting institutions and the International Federation of Accountants (IFAC) ought to proactively anticipate and strategically prepare for the enduring consequences that may arise in the future.

To effectively tackle these difficulties, it is imperative to foster collaboration among accounting institutes, regulatory organisations, and industry stakeholders. Maintaining equilibrium between harnessing the potential advantages of artificial intelligence (AI) and addressing the accompanying hazards is imperative in order to sustain the enduring integrity and pertinence of the accounting field.

4.1.9.2 Languages of critical importance for the development of generative AI must be mastered.

Mastering specific programming languages and tools is crucial for effectively advancing generative artificial intelligence (AI) and engaging in this domain. ***The following are several languages and technologies that hold significant importance in the advancement of generative artificial intelligence (AI) development:***

- **Python:** Python is widely recognised as the predominant programming language employed in the fields of artificial intelligence (AI) and machine learning (ML), encompassing generative AI as well. The field of machine learning benefits from a diverse range of libraries and frameworks, including TensorFlow, PyTorch, and Keras. These tools play a crucial role in the development and training of generative models.
- **TensorFlow:** TensorFlow, an open-source machine learning framework, was developed by Google. It is very suitable for deep learning and is extensively employed in the development of generative models such as GANs (Generative Adversarial Networks).
- **PyTorch:** PyTorch is a widely used deep learning framework renowned for its adaptability and dynamic computation architecture. Developing generative models is widely preferred by numerous researchers and practitioners.
- **Keras:** Keras is a user-friendly, high-level application programming interface (API) for neural networks, designed to operate atop TensorFlow and other deep learning frameworks. The use of this tool is highly advantageous for expeditious prototyping of generative models.
- **CUDA:** CUDA is a parallel computing platform and application programming interface (API) that has been specifically created by NVIDIA to facilitate GPU acceleration in computational tasks. Accelerating the training process of deep neural networks, especially generative models, is of utmost importance.
- **Jupyter Notebooks:** Jupyter Notebooks are widely used for the creation and dissemination of documents that encompass executable code, mathematical calculations, graphic representations, and explanatory prose. The use of this tool is prevalent in the context of conducting experiments and documenting generative artificial intelligence (AI) initiatives.
- **R:** Python is widely recognised as the dominant programming language in the field of artificial intelligence (AI). However, it is worth noting that R is also used as a language of choice in the domains of AI and data science. The software ecosystem includes many libraries, such as the Caret package, which is used for machine learning, and the MXNet framework, which is employed for deep learning.
- **Julia:** Julia is a contemporary programming language that has garnered attention for its exceptional computational efficiency, leading to its increasing adoption in the realm of scientific computing, particularly within the field of artificial intelligence research.

- **MATLAB:** The use of MATLAB persists in certain academic and research environments for the purposes of artificial intelligence (AI) and machine learning (ML). Notably, MATLAB offers a comprehensive deep learning toolbox that facilitates the building of neural networks.
- **GitHub:** GitHub, although not classified as a programming language, holds significant importance as a platform for version control and collaborative efforts within the realm of artificial intelligence projects. This platform serves the purpose of facilitating code exchange, fostering collaboration among individuals, and enabling the monitoring of modifications.
- **SQL:** SQL, also known as Structured Query Language, is a vital tool for the manipulation and management of databases, particularly when dealing with extensive datasets. The efficient management of large datasets is typically a crucial requirement in the field of artificial intelligence.
- **Docker:** Docker containers are a valuable tool in the realm of artificial intelligence (AI) applications, as they facilitate the packaging of these applications and ensure their consistent execution across diverse environments.
- **OpenAI:** OpenAI Gym offers a comprehensive toolbox and library for anyone who possesses an interest in the field of reinforcement learning and aspires to train agents within simulated environments.
- **Apache Spark:** Apache Spark is a crucial tool in the realm of large data processing and distributed computing, particularly in the context of handling extensive datasets for the purpose of training generative models.

Acquiring proficiency in these languages and technologies will furnish individuals with a robust groundwork for the development of generative artificial intelligence and engagement in diverse artificial intelligence endeavours. It is important to note that the selection of tools and programming languages required for a project may differ based on the specific requirements and objectives of the project.

4.1.9.3 In the age of generative artificial intelligence, Cost Accountants who can code and analyse large amounts of data will go far.

In the era of generative artificial intelligence (AI), Cost Accountants who possess coding proficiency and the capacity to analyse substantial volumes of data will enjoy a competitive advantage and can achieve exceptional performance in their professional capacities. In the contemporary era, the acquisition of coding and data analysis abilities has significant importance for Cost Accountants.

- **Data-Driven Decision Making:** The practice of data-driven decision-making involves the utilisation of extensive financial and operational data by Cost

Accountants. The use of coding and data analysis tools enables individuals to make judgements that are more informed and based on empirical evidence.

- **Automation of Routine Tasks:** The acquisition of coding skills empowers Cost Accountants to automate mundane and labour-intensive activities, such as the input of data and the creation of reports. This enables individuals to allocate their time towards pursuits that are more strategic and add value.
- **Advanced Analytics:** The utilisation of modern analytics techniques, such as machine learning, enables cost accountants who possess coding abilities to acquire more profound insights into cost structures, pricing strategies, and financial performance.
- **Predictive Analysis:** The utilisation of coding and data analysis techniques enables the construction of predictive models, which facilitate the anticipation of forthcoming cost trends. This capability empowers organisations to engage in efficient planning and strategic decision-making.
- **Identification of Cost Savings:** The process of data analysis can facilitate the identification of cost-saving options, enabling organisations to enhance their cost management strategies.
- **Auditing and Compliance:** The use of coding can facilitate the automation of audit procedures, thereby enhancing adherence to financial regulations and improving the efficacy of anomaly detection and fraud identification.
- **Efficiency and Accuracy:** The automation of tasks through coding has been found to decrease the likelihood of errors and improve efficiency, particularly in the field of Cost Accounting, where accuracy is of utmost importance.
- **Custom Reporting:** Cost Accountants have the ability to generate personalised reports and dashboards that are specifically designed to cater to the unique requirements of their respective organisations, utilising coding and data visualisation tools.
- **Integration with AI Tools:** The integration of coding skills with AI tools is of great importance in the context of working with AI and generative AI tools. This integration enables Cost Accountants to effectively utilise the capabilities of AI for predictive modelling and decision assistance.
- **Adaptation to Technology Trends:** The ability to adapt to technology trends is crucial for Cost Accountants in the evolving Accounting profession. Those who possess coding skills and data analysis capabilities are more likely to effectively adjust to emerging technologies and tools in the future.
- **Competitive Advantage:** Possessing proficiency in coding and data analysis helps distinguish cost accountants within the labour market, rendering them

more sought-after candidates for positions that necessitate data-centric decision-making.

- **Cross-Disciplinary Collaboration:** The ability of Cost Accountants to code can improve the facilitation of cross-disciplinary collaboration, enabling more effective collaboration with data scientists, IT professionals, and AI experts. This proficiency promotes the development of interdisciplinary teamwork within organisations.
- **Continuous Learning:** In light of the ever-changing technology landscape, individuals in the field of Cost Accounting who possess coding abilities are more adept at engaging in ongoing education and becoming informed about developing technologies.

In conclusion, ***proficiency in coding and data analysis is becoming increasingly indispensable for Cost Accountants in the era of generative artificial intelligence. The acquisition of these skills empowers Cost Accountants to enhance organisational value, optimise operational efficiency, and render better-informed financial judgements through the utilisation of data-driven insights***.

*****

CHAPTER - 5

The Impact of AI on Audits and Their Digitization

5.1 Robotic Process Automation in Audit and Accounting:

Robotic Process Automation (RPA) is a software technology that enhances human capabilities through the automation of various business processes. In contemporary practice, accountants rely heavily on computer-based tools and processes that involve a combination of automated functions and manual interventions, necessitating multiple steps and keystrokes. Robotic Process Automation (RPA) has the potential to revolutionise accounting operations by integrating many disjointed tasks into a seamless automated procedure. The following is a simplified explanation of robotic process automation (RPA).

Initially, the Robotic Process Automation (RPA) bot records the users' on-screen actions, such as mouse clicks and data entries, while executing accounting operations.

Furthermore, the application produces a script by analysing the users' on-screen gestures.

Furthermore, the RPA bot employs scripts in order to automate monotonous and rule-based accounting operations.

Robotic workflow automation (RPA) bots replicate human actions when executing a task within a given workflow. These software applications possess the capability to efficiently and precisely perform repetitive activities with a high level of consistency. RPA presents a distinct opportunity for accountants to enhance the efficiency and effectiveness of their accounting procedures.

What is the rationale for the use of Accounting automation using robotic process automation (RPA) in enterprises?

- **Labour Shortages:** The phenomenon of labour shortages refers to a situation in which there is an insufficient supply of available workers to meet the demand for employment within manpower-intensive sectors such as transport and retail, which are currently facing a significant challenge in the post-pandemic era due to the emergence of manpower shortages. As a Chief Executive Officer (CEO) or manager, it is imperative to implement effective methods aimed at conserving limited human resources within your organisation. The implementation of automation systems can effectively mitigate an organisation's excessive reliance on human labour. The implementation of robotic process automation (RPA) can effectively streamline accounting procedures, thereby alleviating the burden on the team. Subsequently, the surplus work hours can be reallocated to alternative tasks or departments as a strategic measure to mitigate the impact of workforce shortages.

- **The provision of services:** Contemporary consumers are presented with a wide array of choices that are readily accessible. In order to distinguish oneself from others, it is imperative to continually provide exceptional customer service and provide the highest quality experience. One must avoid the risk of losing a supplier or client as a result of delays in the processing of invoices. The adoption of robotic process automation (RPA) in the field of accounting enables the automation of labour-intensive processes, resulting in enhanced service delivery and an improved customer experience.
- **Regulatory Compliance:** Regulatory compliance refers to the adherence of individuals, organisations, or systems to laws, regulations, and guidelines set forth by governing bodies. The proliferation of cloud-based technologies has led to the expansion of the business environment outside of physical locations. Enforcing global and industry standards for regulatory compliance has become progressively more arduous for companies. The utilisation of robotic process automation (RPA) can effectively facilitate the achievement of precise and uniform execution of accounting best practices and regulations across the entire organisation. One potential use involves the use of robotic process automation (RPA) robots to generate comprehensive audit trails for accounting procedures that include handling sensitive data. These trails provide a comprehensive visualisation of the entire process and facilitate historical auditability, hence mitigating the potential for non-compliance.
- **Data Governance:** Data governance refers to the overall management and control of an organisation's data assets. It involves the establishment of policies, procedures, and Tasks in the field of accounting, such as the processing of invoices, necessitate the handling of confidential customer data. In order to provide effective data governance, it is imperative to implement direct oversight measures to limit the potential risks associated with data leaks and breaches. Are you capable of overseeing accounting teams operating in a remote work environment? No, it is not possible to do so. The implementation of robotic process automation has the potential to assist your organisation in surmounting the aforementioned challenge. As an illustration, emails encompass confidential information and the personally identifiable data (PID) of clients. Robotic Process Automation (RPA) can be employed as a means to extract pertinent data from electronic mail messages for the purpose of invoice processing. The implementation of robotic process automation (RPA) in this particular stage diminishes the vulnerability and potential hazards associated with data breaches caused by covert inside individuals.
- **Digital Transformation:** The concept of digital transformation refers to the process by which organisations adopt and integrate digital technologies into their operations, strategies, and business models. The advent of disruptive technologies such as artificial intelligence (AI) and robotic process automation

(RPA) has resulted in a more equitable business landscape, granting newfound capabilities to start-up enterprises while potentially diminishing the dominance of established multinational corporations. Enterprise-scale organisations have the ability to effectively counter intense competition from start-ups through strategic investments in digital transformation initiatives. Process automation plays a vital role in facilitating digital transformation and ensuring sustained success in the contemporary technology-driven industry. ***By employing robotic process automation (RPA), it becomes possible to digitise invoices, automate accounting procedures, and harness the power of artificial intelligence (AI) to optimise workflow efficiency. Accounting process automation can be measured and optimised to provide ongoing enhancements. The use of robotic process automation (RPA) is an imperative measure in the pursuit of digital transformation.***

Source: GGS IT Consulting

- **The Process of Invoice processing in the Context of Accounts Payable:** The successful execution of invoice processing necessitates the adherence to strict timelines, a high degree of precision, and the maintenance of consistent practices. However, attaining such a high degree of perfection proves to be challenging without the implementation of automated processes. To begin with, the manual processing of invoices can result in operational delays within the accounts payable department. RPA can be employed to automate the many stages of invoice processing, encompassing the receipt, verification, and payment of bills. Robotic Process Automation (RPA) coupled with optical character recognition (OCR) technology enables the extraction of data from diverse sources. This integration facilitates the automated matching of purchase orders with corresponding invoices, while also identifying and flagging any discrepancies found within the documents. Subsequently, the cleared invoices will be transmitted to designated team members for their approval, while reminders will also be established. In order to enhance the metric of Days Payable Outstanding (DPO), it is recommended to implement robotic process automation (RPA) for automating accounts payable procedures. The bot has the capability to optimise the processes of vendor verification, purchase order entry, payment reconciliation, and expense compliance audit.

- **The concept of accounts Receivable:** The accounting process exhibits a susceptibility to errors and heavily relies on internal documentation, making it a perfect candidate for automation. To enhance Days Sales Outstanding (DSO), it is imperative to ensure precision and promptness in execution. However, the attainment of this objective presents difficulties as a result of the involvement of human factors from both the payee and recipient perspectives. RPA can be employed to automate several aspects of accounts receivable operations, encompassing tasks such as customer data configuration and administration, data extraction, sales quote creation, and invoice dissemination. Robotic Process Automation (RPA) solutions that possess powerful functionalities have the potential to enhance cash flow and mitigate cash shortfalls. Robotic Process Automation (RPA) is a technology that facilitates the collection of data from many sources and automates the process of data entry. Accountants will not require multiple information systems.

- **The Process of Expense Reporting:** Companies accrue expenses through various business activities. The process of expense reporting plays a vital role in facilitating effective bookkeeping and financial management. Nevertheless, the manual execution of this procedure is both laborious and expensive. Based on statistical data, the cost of generating a single expense report is approximately Rs 27. The implementation of automation has the potential to significantly decrease the cost of producing each report to Rs 5. Expense reporting can be automated through the use of robotic process automation (RPA). Robust robotic process automation (RPA) bots possess the capability to consolidate data into comprehensive expenditure reports, associate receipts with matching entries, authenticate pre-existing expense logs, and identify instances of policy non-compliance or data inconsistencies. ***The implementation of robotic process automation (RPA) has the potential to mitigate errors, enhance employee satisfaction, and promote compliance with organisational norms and legal regulations.***

- **Payroll Management:** Payroll management refers to the systematic administration and oversight of an organisation's financial processes related to employee compensation. This includes activities such as calculating wages, deducting taxes, and other The management of employee payroll encompasses a variety of labour-intensive activities, including the extraction and input of data, the verification of timesheets, the coordination of payment schedules, and the computation of both earnings and deductions. The accounting team will also authenticate personnel data from several platforms, encompassing sick leave and expenditures. In order to mitigate the occurrence of payment delays and inaccuracies, it is recommended to employ robotic process automation (RPA) as a means of automating payroll management. RPA bots with strong resilience possess the capability to efficiently get data from diverse sources and accurately perform calculations for deductions and bonuses while ensuring full adherence to tax regulations.

- **Financial Reporting, Planning, and Forecasting:** Financial reporting, planning, and forecasting is a crucial aspect of financial management that involves the systematic collection, analysis, and presentation of financial information. This process enables organisations to effectively communicate their financial performance, make informed decisions, and develop strategic plans for the future. By utilising various financial tools and In order to ensure effective oversight of their financial performance, prosperous enterprises engage in the systematic monitoring and reporting of earnings and losses with precision and consistency. As an individual with expertise in the field of accounting, one is well aware of the difficulties associated with the manual process of updating profit and loss reports. RPA can be employed to automate the aforementioned labour-intensive procedure, thereby facilitating prompt and precise financial reporting. Robotic Process Automation (RPA) bots possess the capability to generate balance sheets and income statements, hence enhancing the efficiency of variance analysis and financial-close procedures. Financial planning and forecasting can be enhanced by the utilisation of previous data and pertinent information included within papers. The use of robotic process automation (RPA) in automating this particular business process has the potential to significantly improve both transparency and accuracy.

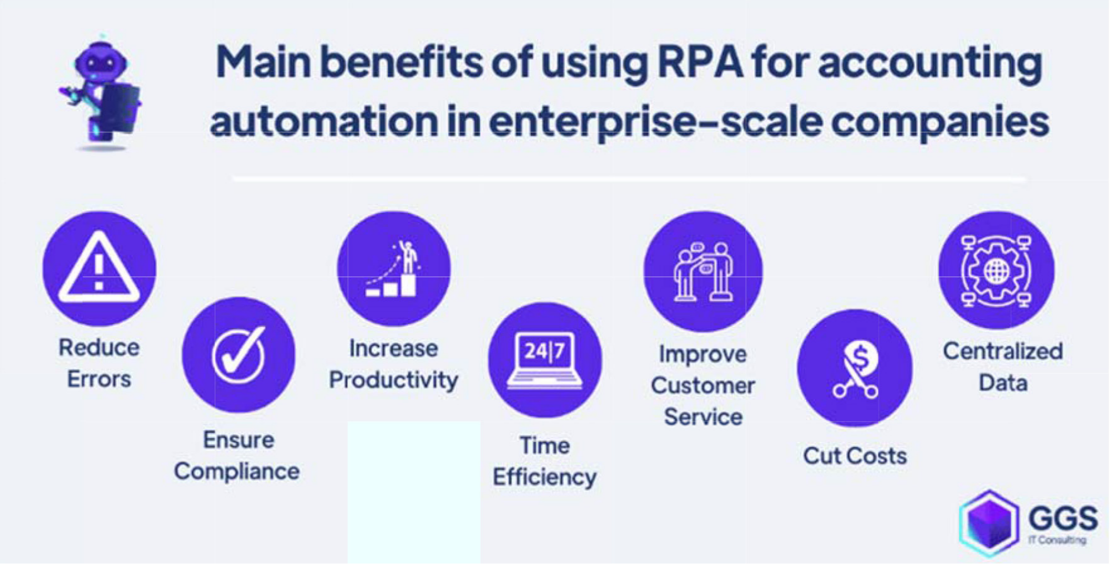
- **Intercompany Reconciliations (ICR):** Robotic Process Automation (RPA) can be employed to automate Intelligent Character Recognition (ICR), thereby facilitating the generation of precise financial statements through the reconciliation of accounts. The aforementioned procedure encompasses the laborious tasks of inputting data, extracting information, and verifying its accuracy through cross-referencing. Robotic Process Automation (RPA) bots possess the capability to collect transactional data, authorise documents that fit predetermined criteria, and identify and highlight any inconsistencies or conflicts that may arise. The aforementioned tasks encompass the ability to optimise data retrieval processes, verify the accuracy of statements by cross-referencing, correspond with clients via email, and generate journal entries.

- **Tax Compliance:** Large-scale corporations that have a worldwide or national presence adhere to various state and federal tax statutes. In order to mitigate the potential for non-compliance, it is advisable to incorporate RPA (Robotic

Process Automation) robots into one's tax compliance software. Robotic Process Automation (RPA) bots possess the capability to collect data pertaining to tax responsibility, generate a tax basis, revise tax return workbooks, and compile and submit tax reports to relevant authorities. The automation of these procedures has the potential to yield time-saving benefits and mitigate potential legal complications in the future.

- **Inventory Management and Accounting:** In the current challenging circumstances, retail enterprises worldwide face significant threats posed by supply chain concerns. The importance of effective inventory management has become increasingly significant in the present context. Inventory accounting involves the systematic recording of stock levels in financial documentation, including profit and loss statements and balance sheets. The implementation of automation is highly suitable for this particular business process due to its criticality. ***Robotic Process Automation (RPA) bots have the capability to enhance the efficiency of inventory management through continuous monitoring, accurate forecasting, and timely alerting of inventory levels, thereby facilitating the prompt placement of stock orders.*** RPA systems can be employed to automate inventory accounting procedures, encompassing tasks such as data extraction and inputting information into financial records. The implementation of robotic process automation (RPA) in e-commerce and retail establishments has the potential to enhance lead times, mitigate stock-outs, and optimise storage expenses.

- **The utilisation of robotic process automation (RPA) in accounting automation within enterprise-scale companies offers numerous advantages:**



Source: GGS IT Consulting

- **Cut Costs:** Based on the findings of the Institute for Robotic Process Automation (RPA), it has been determined that the implementation of ***RPA solutions has the potential to yield significant cost savings for enterprises, ranging from 25% to 40% in terms of labour expenses. The concept of time holds significant economic value.*** Robotic Process Automation (RPA) robots exhibit superior efficiency in executing repetitive activities when compared to their human counterparts, resulting in the conservation of limited resources. The implementation of robotic process automation (RPA) in accounting can effectively streamline and optimise various operations, leading to a reduction in personnel costs.

- **Enhancing Productivity:** Consider the significant amount of time that is expended in the process of gathering data and completing invoices. These labour-intensive activities result in operational inefficiencies and diminish the productivity of your accounting professionals. One potential strategy for streamlining accounting processes and reducing reliance on human labour is the use of robotic process automation (RPA). By implementing RPA technology, organisations can automate various accounting tasks, thereby minimising the need for manual intervention in their workflows. Robotic Process Automation (RPA) bots have the capability to do activities at a rate that is 20 times faster than human counterparts, hence significantly enhancing productivity across the entire organisation.

- **Minimise Mistakes:** Accounting operations in major corporations encompass a multitude of sequential procedures and involve the collaboration of multiple departments. The accumulation of minor human errors within several stages or departments might result in substantial financial losses. By leveraging robotic process automation (RPA), large-scale enterprises have the capability to automate accounting activities that are often performed manually and prone to errors, effectively mitigating the occurrence of human errors.

- **Time Efficiency:** The concept of time efficiency refers to the ability to complete tasks or achieve goals in the most optimal and effective manner within a given timeframe. ***Based on Gartner's analysis, it has been determined that robotic process automation (RPA) has the potential to significantly mitigate the need for finance departments and accounting teams to engage in about 25,000 hours of repetitive tasks that arise due to human errors.*** Implementing robotic process automation (RPA) in accounting practices has proven to be a highly efficient strategy for minimising time inefficiencies and enhancing overall operational effectiveness. By implementing robotic process automation (RPA), accountants can significantly reduce the amount of time dedicated to routine and repetitive operations. By reallocating the time that has been saved, organisations can allocate resources towards activities that generate money, thereby enhancing their competitive edge. To guarantee adherence to regulations and standards.

- **Ensure Compliance:** The task of maintaining regulatory compliance has become ever more difficult in light of the evolving corporate landscape. The implementation of innovative robotic process automation (RPA) systems has been shown to effectively mitigate errors and establish comprehensive task trails, thereby enhancing the quality of historical documentation and facilitating auditability. The implementation of robotic process automation (RPA) in accounting practices can effectively enhance compliance with both internal and external financial regulations for large-scale enterprises.
- **Enhancing the Quality of Customer Service:** A solitary mistake in the process of reconciliation has the potential to impede the timely processing of invoices and compromise the overall satisfaction of customers. In order to enhance customer service, ***it is recommended to implement robotic process automation (RPA) to automate manual and repetitive processes inside the accounting workflow. Robust robotic process automation (RPA) systems possess the capability to effectively expand their operations to accommodate increasing demand, hence improving precision and minimising time lags.*** Robotic Process Automation (RPA) bots are capable of providing customer support of exceptional quality, hence ensuring an optimal client experience.
- **Centralized Data:** The concept of centralised data refers to the practice of consolidating and storing data in a single location or system. RPA robots might be conceptualised as ERP-agnostic connectors that facilitate integration across disparate systems. The individuals engage in interactions with various data sources and effectively combine precise information into a unified location. By utilising robotic process automation (RPA), the need to physically access many systems or departments in order to locate essential financial data is eliminated.

The advantages of robotic process automation (RPA) extend beyond the realm of process automation and encompass psychological benefits as well. Engaging in extended periods of repetitive work can have a demoralising effect. By employing robotic process automation (RPA), organisations have the ability to automate routine accounting processes, resulting in increased efficiency and productivity. Additionally, the implementation of RPA can have a positive impact on employee morale within accounting teams. Furthermore, this technology facilitates ongoing enhancements. ***As a managerial figure and leader of a department, it is advisable to utilise the expertise and competencies possessed by accountants in order to augment the capabilities of your robotic process automation (RPA) bots.*** One potential strategy to enhance the effectiveness of your ***robotic process automation (RPA) solution is to establish a Centre of Excellence (CoE) dedicated to the acquisition and dissemination of accounting best practices from proficient accountants***. This particular method has the potential to assist organisations in optimising their accounting procedures with the aim of achieving continual improvement.

Guidance to Management Accountants:

The use of robotic process automation (RPA) is having a profound impact on various departments inside large-scale enterprises. Management accountants and CFOs have the option to implement robotic process automation (RPA) in order to streamline various financial tasks like invoice processing, expense reporting, payroll management, and financial forecasting. The implementation of robotic process automation (RPA) in accounting has a range of advantages, such as cost reduction, loss mitigation, enhanced productivity, and increased adherence to regulatory requirements. In order to optimise the effectiveness of your solution, it is advisable to adhere to the established best practices for implementing robotic process automation (RPA).

5.2 Automation of Robotic Processes for Internal Audit:

Both large and small Internal Audit (IA) departments have initiated their foray into automation by broadening their utilisation of conventional analytics to encompass predictive models, robotic process automation (RPA), and cognitive intelligence (CI). Given the rapid advancement of automation technologies and the demonstrated efficiency of early adopters, it is imperative to comprehend and prioritise prospects for automation at present. Consequently, it is crucial to take significant measures to prepare for a deliberate and progressive deployment of automation.

Approach to RPA Implementation in Internal Audit:

Typically, RPA evaluation entails the inventorying, prioritisation, and vetting of processes to ensure their suitability. As soon as possible, all processes that are technically or economically unfeasible should be eliminated by collecting baseline data and pragmatically identifying obstacles to automation. The establishment of a criterion matrix that incorporates process automation and value creation is essential in order to evaluate qualified processes qualitatively and quantitatively.

To justify pursuing RPA implementation, a business case detailing complexity and implementation cost should be developed utilising fully qualified processes. RPA implementation generally adheres to the Agile methodology, comprising the subsequent phases:

Design and define

Construct and refine.

Examine and deploy

It is crucial to establish distinct definitions for the project's scope, requirements, budget, timeline, and approach during the define and design phases. The implementation team enhances efficiency during the build and refine phase by iteratively developing the entire product in potentially deployable increments and by conducting frequent feedback and improvement cycles. Constantly designing, developing, testing, and integrating new features results in builds that are progressively more stable and comprehensive. By identifying and implementing effective practices, the team can potentially enhance efficiency and rectify any errors that may have occurred during this phase. During the final phase of testing and deployment, the product or solution reaches a sufficient level of maturity to be implemented in the end-user domain. This typically necessitates the availability of user documentation to support the transition and the completion of a functional subset of the product or solution to an acceptable standard of quality.

Documenting the project and all of its deliverables is an essential component of any RPA endeavour. Should an organisation opt to engage a third party to provide RPA assurance, these deliverables will be indispensable for comprehending and obtaining confirmation that RPA is operating in accordance with its intended goals.

RPA Implementation during the Internal Audit Risk Assessment Phase:

Risk assessments are performed by organisations in order to delineate various categories of organisational risk. As an illustration, they might perform risk assessments in order to identify the organisation's exposure to strategic, operational, financial, and compliance risks.

The results of the risk assessment of auditable processes, functions, and entities within the organisation can be transferred from the spreadsheet to the planning worksheet using RPA. Auditors may potentially conserve significant hours of labour, and the risk assessment plan will consistently be revised throughout the year.

Implementation of RPA throughout the Fieldwork Phase of an Internal Audit:

The audit team is in charge of conducting the audit during this phase. Several routine procedures are typically executed while conducting fieldwork:

Examine the accompanying documentation.

Conduct analyses.

Determine the exceptions.

In order to automate the IA department, the following instances have been extracted from the fieldwork phase of various audits and mapped to RPA:

- By configuring RPA to detect and address potential fraudulent activities, such as money laundering, through automated rules-based monitoring of transactions (e.g., flagging activities for auditors' review), auditors are able to allocate their attention to other areas of risk.
- Using RPA, suspicious records associated with IT systems can be identified. The collection of audit evidence and documentation is a time-consuming, semi-manual process that requires meticulous attention to detail. Documentation of business processes, IT systems, transactions, and controls is gathered

automatically to facilitate continuous assurance, which expedites corrective action.

- ***User access to systems is the subject of one set of controls tested under the Sarbanes-Oxley Act (SOX) in the United States or Other respective relevant customised programme based software (Oracle have such facilities). Throughout history, the prescribed test plan has been predominantly executed manually on a quarterly basis.*** The implementation of RPA automation enhances current manual labour by alleviating the burden on human resources.
- Management teams conduct labour-intensive manual testing of system configurations (specifically, security settings) on an annual basis. By reducing the effort required to populate work papers, which has traditionally been a non-value-added task, RPA configuration allows auditors to concentrate exclusively on issue confirmation and evaluation.
- The verification of the validity and accuracy of each expense report and supporting receipt can require a substantial quantity of manual labour and time. Using RPA, audit compliance can be enhanced while yearly hours of manual review are reduced by a significant amount.
- ***RPA can be used to audit entire populations as opposed to individual samples.*** Consistently and autonomously executing tests can yield results that can be examined for anomalies or exceptions. By configuring RPA to perform data reconciliation from a distinct system, hundreds of hours could be saved during each audit.

The preceding examples serve as introductory points to commence a discourse on RPA. The ultimate determination of processes and steps ought to be predicated upon the organisation's inclination and congruence with the IA department's objective.

Utilisation of RPA During Audit Closure and Subsequent Actions:

Official communication of a summary of audit findings, conclusions, and specific recommendations occurs during the audit closing phase.

The utilisation of RPA enables the automation of the subsequent two facets:

1) Audit teams allocate a substantial amount of time to transmitting, monitoring, and receiving confirmations from stakeholders. This is an extremely manual procedure prone to error and delay.
2) The process of collecting audit documentation and evidence is laborious, time-consuming, and extremely meticulous. During audit closure, audit document archiving can be most effectively automated with the assistance of RPA.

IA ensures that all audit findings are followed up on within one year of the report's issuance. Follow-up audits can be completed in thousands of hours annually with

the help of RPA. It will reduce human error and enhance audit quality by managing documents automatically.

Critical Factors to Consider Throughout RPA Implementation :

Implementing RPA is a crucial step towards the digitization of processes, but it exposes the organisation to additional risk. ***Important factors for the IA department to consider include:***

- It is critical to secure accounts provisioned for bots, segregate duties, implement password management governance, and obtain access attestations during the implementation of RPA.
- The necessity for automation continuity planning arises with the growing reliance of humans on automated work steps.
- Testing strategies must take into account factors such as data quality, system and human actions, and upstream and downstream dependencies.
- ***When non-technicians are able to develop automations, governance of development activities, release management, and coding standards become necessary.***
- The governance framework must take into account both the scalability strategy and the management of automation-related risks.
- Generic bot identification frequently exposes software licences to the risk of noncompliance as a result of indirect usage.

In conclusion, it can be inferred that the aforementioned points collectively support the notion that.......

As organisations incorporate novel technologies and embrace innovative business models, it becomes imperative for them to simultaneously transform their culture, working methodologies, and organisational frameworks. The planned and controlled transformation of the organisation, as well as the risk and control management functions, are of utmost importance in attaining strategic objectives. Robotic Process Automation (RPA) has the potential to support Internal Audit (IA) by facilitating the generation and standardisation of data for the purpose of executing customised analytics. Additionally, RPA may automate the early stages of data collection and classification during the annual risk assessment process. Furthermore, RPA can be used to conduct tests of details, which involve verifying the consistency of data fields across different sources. Lastly, RPA can automate the testing of controls through the use of bots.

Moreover, robotic process automation (RPA) plays a crucial role in the monitoring of pending evidence, follow-up inquiries, and the administration of corresponding responses. The Internal Audit (IA) department has the potential to enhance efficiency by implementing robotic systems to carry out many repetitive duties, as elaborated upon in the following discussion. This approach can assist in directing the attention of the internal auditors towards distinctive and significant tasks, thereby facilitating a more comprehensive and advanced evaluation of risk within the audit procedure.

Guidance Note for Management Accountants:

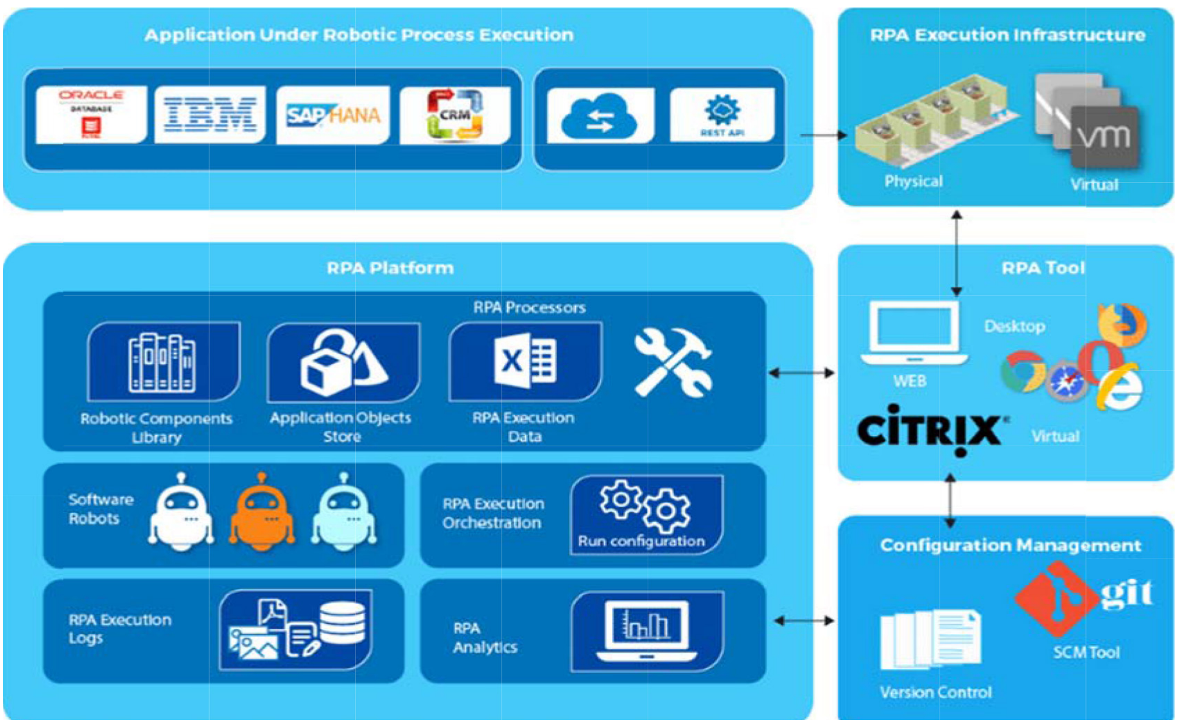
Please proceed with the following reading:

Adopting Robotic Process Automation in Internal Audit: Fortifying the Third Line of Defence with Robotic Process Automation, Deloitte. Internal audit robotic process automation adoption:

https://www2.deloitte.com/us/en/pages/risk/articles/internal-audit-robotic-process-adoption.html

5.3 The structure of RPA:

The architectural framework of robotic process automation (RPA) encompasses several tools, platforms, and infrastructure components. Collectively, they constitute a comprehensive Robotic Process Automation (RPA) toolkit. ***To gain a comprehensive understanding of the subject matter, please refer to the accompanying visual representation that provides a concise illustration of a typical robotic process automation (RPA) solution and its architectural framework.***



The RPA Solution Structure
Source: gologica

The RPA structure offers several squares that can be accessed.

The application under Robotic Process Execution

Robotic Process Automation (RPA) is often regarded as a highly suitable technology for both corporations and their corresponding applications. The process of application development may involve the utilisation of several record handling programmes, such as SAP, Siebel, or Mainframes. These kinds of applications are typically focused on information, driven by data, and filled with repetitive tasks.

RPA Methods:

The capabilities that are commonly present in any RPA device are delineated as follows:

- RPA tools enable the automation of a variety of processes across multiple environments (e.g., desktop, web, Citrix, etc.).
- RPA instruments enable the development of programming programmes that can be constructed through the documentation, design, and enhancement of the programming logic, including conditions and cycles, among others.
- Robotic Process Automation (RPA) devices enable the construction of reusable components that can be implemented on various robotics.
- This ensures consistent time-based quality, expedited workflows, and streamlined support.
- RPA tools enable the execution of software robots while simultaneously receiving and writing to multiple data sources.
- The use of RPA tools enables the development of shared applications, UI object storage, and item repository systems that incorporate object finders.

The RPA Framework :

Cloud-based RPA software bots behave as if they were stored in a shared repository, allowing them to be distributed across software robot libraries. The RPA phase facilitates the coordination, distribution, and verification of programming robot execution. Additionally, it provides the capability to generate substantial amounts of knowledge regarding programming programmes and their execution metrics.

Execution Infrastructure for RPA:

The RPA execution foundation is defined as a repository housing physical or virtual laboratory devices that are subject to management in accordance with use designs. The process of concurrently increasing or decreasing the quantity of devices utilised to automate the task can also be executed. This cycle does not require any additional human involvement, so it can potentially remain unattended for an extended period of time.

Managing Configurations:

The purpose of configuration management is to specify the version of RPA assets that serve as the foundational application. It facilitates the construction of product robots and updates them to more contemporary forms. Additionally, it facilitates the branching and merging of RPA machines by allowing for their reuse across libraries. Therefore, RPA is a comprehensive system and architecture comprised of a number of distinct application and tool layers that are integrated. RPA is an architecture comprised of a variety of application and utility layers in concert.

Layer	Purpose	Benefit
Process	Business rules Hand-off point prioritization if not in management control	Focus on business rule without needing to create links simplify changes
Subprocess	Reusable business logic Identity Verification Reconciliation	Reusability Avoid multiple changes in the process when logic changes
Object	Procedures for performing specific tasks Eg. Log on, enter the address	Reusability within systems keep away from various changes in the process when rationale changes
Component	Individual screen interaction Eg. Enter address inline 1	Lower risk, faster changes target application incorporation can be changed without the danger of changing business rules.

Robotic Process Automation incorporates some fundamental segments that structure the RPA stage. These segments together help to robotize monotonous and rule-based cycles.

The centre segments of robotic process automation are recorded beneath:

- Recorder
- Improvement Studio
- Module/Extension
- Bot Runner
- Control Centre

Suppose we were to illustrate each of these segments in isolation:

- **Reorder:** One of the fundamental components of robotic process automation is the recorder. It provides the capability to automate work areas, centralised servers, and web applications on a massive scale, similar to a path, without the need for programming, coding, or scripting. A fundamental mode of operation for a recorder in mechanical mechanisation is an article recording approach. Undoubtedly, RPA programmes acquire object properties, which encompass their approximations of dynamic components across the entire account. Following the completion of the chronicle, RPA programmes identify analogous components and replay the recorded interaction. During content execution, RPA machines execute operations such as snap, float, drag, and look on components that are similar in nature. RPA Recorder also includes the capability to physically add framework activities and modify the workflow. These activities may include operations such as launching applications, navigating to a specific window, manipulating Excel data, and so forth.

- **Improvement Studio:** Almost every RPA device still associates Development Studio with its core components. The Development Studio facilitates the creation or planning of intelligent interaction mechanisation processes. It enables one to effectively manage mechanisation. In addition, the implementation of action bundles, wizards, recorders, and custom modules is permitted.

A few typical features of RPA Developer Studio are described as follows:

- The GUI (Graphical User Interface) of the dashboard.
- There are diverse varieties of recorders.
- Management of logging and exceptions.
- Implementing OCR (Optical Character Reader) for assistance.
- A variety of simplified, pre-assembled configurations.
- The comprehensive exploration alternative to examining every robotization asset, including libraries, exercises, projects, and so forth,

A module or extension:

The majority of RPA stages are comprised of a small number of modules and expansions that execute and conduct simple turns of events. RPA modules comprise a collection of applications that can be installed in conjunction with the RPA device. These modules are utilised for a variety of purposes, including deciphering discourse, regulating the dates of diverse data sets, and extracting information from requests, among others. RPA modules are advantageous because they reduce development efforts, error rates, and execution time. They are immediately usable following their integration with the RPA instrument.

Bot Runner:

The bot runners are utilised for executing the created programming bots. They are the machines on which robots are run or executed. Various bots can be amassed parallelly for quicker execution. The lone necessity to run the bots is 'Run License'. The bots likewise report the execution status (i.e., execution logs, pass, or come up short, and so on) back to the control place. When a designer makes a product bot or task and further updates the status in the control room, the control room plans and executes the bots on the bot sprinter. The sequence of bot execution generally relies on the necessities or needs.

- **Centre of Control:** The control community is central to every RPA device. It is a digital platform that the Bot Creator employs to regulate the product bots. It enables customers to strategize, supervise, regulate, and scale the operations of a substantial portion of the advanced workforce. In addition, it provides functionalities such as dedicated client representatives, automation integration, source management, and a dashboard.

5.4 The Function of Management Accountants in RPA implementations:

Management accountants play a crucial role in the successful implementation of robotic process automation (RPA) within an organization. RPA implementation involves automating routine and rule-based tasks, which can significantly impact financial processes and reporting. Here's how management accountants contribute to and guide RPA implementation:

Process Identification and Assessment:

- **Identifying Suitable Processes:** Management accountants collaborate with cross-functional teams to identify financial and accounting processes that are suitable for automation. They assess these processes to determine which tasks can be automated to improve efficiency and accuracy.

Cost-Benefit Analysis:

- **Financial Impact Analysis:** Management accountants conduct a cost-benefit analysis to evaluate the financial impact of RPA implementation. They consider the costs of acquiring and implementing RPA solutions and weigh them against the expected benefits, including cost savings, improved accuracy, and reduced operational risks.

Vendor Selection:

- **Evaluating RPA Providers:** Management accountants may participate in the selection of RPA software and service providers. They assess potential vendors based on factors such as functionality, scalability, security, and cost.

Process Redesign:

- **Optimising Processes:** Management accountants work with RPA developers to optimise existing financial processes before automation. This may involve simplifying and standardising workflows to ensure that RPA integration is seamless.

Data Management:

- **Ensuring Data Quality:** Accurate and structured data is crucial for RPA success. Management accountants are responsible for ensuring data quality, cleanliness, and consistency. They work to clean and prepare data for automation.

Integration with Financial Systems:

- **Integrating RPA with Financial Software:** Management accountants facilitate the integration of RPA solutions with existing financial and accounting software systems, such as enterprise resource planning (ERP) systems and financial reporting tools.

Compliance and Control:

- **Ensuring Regulatory Compliance:** Management accountants ensure that RPA implementations adhere to regulatory and compliance requirements, such as Sarbanes-Oxley Act (SOX) controls, data privacy laws, Digital Personal Data Protection Act, 2023 and industry-specific regulations.

Change Management:

- **User Training and Adoption:** Management accountants help with change management efforts by ensuring that employees understand the purpose of RPA, providing training, and supporting its adoption across the organisation.

Performance Monitoring:

- **Tracking Key Performance Indicators (KPIs):** Management accountants establish KPIs to measure the performance and impact of RPA. They monitor and report on these metrics, providing insights into the effectiveness of RPA implementations.

Continuous Improvement:

- **Iterative Enhancements:** Management accountants oversee the continuous improvement of RPA processes. They identify opportunities to refine and enhance automated processes, making them more efficient and effective.

Risk Management:

- **Identifying Risks:** Management accountants assess potential risks associated with RPA, such as data security, operational disruptions, and compliance issues. They develop risk mitigation strategies to address these concerns.

Reporting and Analysis:

- **Leveraging RPA Data:** Management accountants use the data generated by RPA systems to perform financial analysis, reporting, and forecasting. RPA can provide real-time data, which allows for more accurate decision-making.

In summary, management accountants play a pivotal role in the implementation of RPA within financial and accounting processes. They bridge the gap between finance, technology, and operations, ensuring that RPA is seamlessly integrated, provides tangible benefits, and complies with regulations and standards. Their involvement in RPA initiatives is essential for achieving the full potential of automation in finance and accounting.

5.5 The contrast between Traditional Finance and Modern Finance in AI age:

Do you concur? A transition to "new "finance" is occurring. In what regard do you envision yourself positioned in relation to the ten subsequent significant subjects?

CFO Duties:

- **Traditional Finance:** Traditional finance was primarily concerned with cost management, financial reporting, and compliance.
- **Modern Finance in AI age:** A strategic business collaborator with an emphasis on growth, innovation, and value creation.

Accounting :

- **Traditional Finance:** Antiquated Finance involved the use of paper and manual ledgers and physical documents for Accounting.
- **Modern Finance in AI age:** Cloud-based, Automated Accounting systems that provide access to financial data in real time.

Partnerships in business:

- **Traditional Finance:** The Traditional finance system exhibited restricted collaboration and interaction with other business entities.
- **Modern Finance in AI age:** Active collaboration and strategic alignment with business divisions to drive performance and value are characteristics of New Finance.

FP&A: Financial Planning and Analysis

- **Traditional Finance:** Heavy reliance on spreadsheets and historical data; forecasting was conducted less frequently.
- **Modern Finance in AI age:** Utilisation of advanced modelling and predictive analytics; continuous forecasting in New Finance

Tax Administration:

- **Traditional Finance:** Compliance and manual tax calculations, with limited emphasis on strategic tax planning.
- **Modern Finance in AI age:** Strategic tax planning that is proactive in nature and employs advanced tax software and analytics

Budgeting

- **Traditional Finance:** Biannual budgeting cycles characterised by rigid budgets and restricted scenario analysis
- **Modern Finance in AI age:** Budgets that are adaptable to shifting business conditions and feature rolling projections.

Technology:

- **Traditional Finance:** The previous financial system relied on specialised desktop software and Excel, which had restricted capabilities for automation and data analytics.
- **Modern Finance in AI age:** Advanced data analytics integrated with AI and machine learning to enable real-time decision-making and insights.

Soft Skills:

- **Traditional Finance:** a greater emphasis on technical expertise and a lesser amount on collaboration and communication.
- **Modern Finance in AI age:** In addition to technical expertise, communication, leadership, and strategic thinking are emphasised.

Management of Risk

- **Traditional Finance:** A reactive risk management approach that primarily targeted insurable risks.
- **Modern Finance in AI age:** the proactive and comprehensive approach to risk adopted by modern Finance takes into account financial, operational, and strategic risks.

Value Creation:

- **Traditional Finance:** The traditional approach to finance prioritises cost reduction and efficiency over strategies that foster innovation and value creation.
- **Modern Finance in AI age:** Emphasise strategies for long-term value creation, innovation, and sustainability.

5.6 Ten Artificial Intelligence (AI) Tools for Finance:

CASH RECOVERY	zapliance	AI assists in identifying and prioritising duplicate-entered liabilities. Digital Audit Preparation, Finance Benchmarking, Continuous Monitoring

FORECASTING	spindle AI	Modelling and Forecasting performed using Generative AI (e.g., cash, sales, and scenarios).
TAX ASSISTANTS	Z ZeroTax.ai	Rapid and Precise Tax Responses via an AI-powered helpdesk team and chatbot.
INVESTMENTS	FinChat.io ChatGPT for Finance	Instrument generative for investment research encompassing 50,000 companies In general,
EXCEL FORMULAS	formula bot	For analytics, AI-Generated Formulas, SQL, Data Preparation, and Explanation
GST/VAT ASSISTANCE	blue dot	Utilising AI, computes and identifies all eligible and qualified GST/VAT expenditures.
FINANCIAL RISK	MindBridge	Identifies Financial Risks by Integrating Data Science and AI with Audit and Finance Knowledge
BOOKKEEPING	Booke.ai	Bookkeeping powered by AI that performs tasks such as categorization and error checks automatically.
REPORTING	CLARITY AI	Technology Powered by AI for Benchmarking and Reporting (ESG, Regulatory Topics)
ACCOUNTS PAYABLE	VIC.AI	AI-assisted accounts payable automation that incorporates intelligent analytics

Guidance Note to Management Accountant:

The instruments specified above are provided for informational purposes only and are not mandatory. The effectiveness of an AI instrument is contingent upon the organisation. Before any AI tools are implemented, a cost-benefit analysis must be performed.

5.7 What is CHATGPT and what are its benefits and drawbacks?

CHATGPT is an OpenAI-developed language model that is built upon the GPT-3.5/4 framework. Its design facilitates natural language generation and comprehension, enabling it to participate in text-based dialogues with users.

There are a myriad of potential applications for CHATGPT, accompanied by certain drawbacks:

Implementations of CHATGPT:

- **Content Generation:** CHATGPT is capable of producing text for a multitude of objectives, such as composing reports, articles, and creative content, among others.
- **Answering Questions:** In response to inquiries pertaining to general knowledge, it offers solutions that render it a highly advantageous instrument for retrieving information.
- **Language Translation:** CHATGPT has the capability to provide translation services across various languages.
- **Coding Assistance:** CHATGPT provides developers with code snippets and programming assistance.
- **Educational Tool:** CHATGPT has the capability to function as an educational instrument by providing students with information and explanations pertaining to a wide range of subjects.
- **Customer Support:** CHATGPT is utilised by numerous businesses to respond to customer inquiries and offer preliminary assistance.
- **Drafting Emails and Messages:** It can be utilised to assist in the composition of messages, emails, and other forms of written correspondence.

Disadvantages of CHATGPT:

- **Inadequacy of Critical Thinking and Genuine Comprehension:** CHATGPT is deficient in both. As it generates responses predicated on patterns identified in the training data, there is a possibility that such responses may be inaccurate or illogical.
- **Biases:** As the model can acquire biases from the training data, it is possible that it will generate content that is unintentionally biased or inappropriate.

- **Contextual Errors:** Occasionally, during lengthy conversations, CHATGPT may fail to maintain context and deliver responses that are contradictory or irrelevant.
- **Controversial Material:** It has the potential to produce content that is detrimental, offensive, or inappropriate.
- **No Verification of Information:** The information presented by CHATGPT should be subjected to fact-checking, as the platform does not provide any assurance regarding the veracity of its replies.
- **Security Considerations:** CHATGPT may be employed to generate deceptive or fraudulent content in certain circumstances.
- **Resource Intensive:** CHATGPT can be resource-intensive to deploy and utilise, which may restrict its availability to smaller organisations or individuals.
- **High Cost:** Depending on the level of utilisation, certain users may find the cost of utilising CHATGPT APIs or services to be an impediment.

It is essential to appreciate CHATGPT's capabilities and constraints and to employ it responsibly. Individuals and organisations ought to review and implement safeguards on the content they produce to ensure that it adheres to their standards and values. Adhering to the ethical and responsible usage guidelines established by OpenAI is of utmost importance in order to alleviate certain drawbacks commonly associated with language models such as CHATGPT.

5.8 Financial experts' utilisation of CHATGPT:

- **For Writing: Use CHATGPT to prepare your Writing Communications**

E- Mails	Action Plan
Memos	Cover Letter
Instruction	Agenda
Presentation	Proposal
Speech	Template
Dunning Letter	Executive Summary
Minutes	Press Release
Report	User Manual
Checklist	Project Plan
Policy Document	Notes to Financial Statements

- **For Financial Analysis: Use CHATGPT to help you Financial Analysis**

Cost Analysis	Debt and Equity Analysis
Pricing Analysis	Budget Variance Analysis
Liquidity Analysis	Capital Structure Analysis
Revenue Analysis	Capital Budgeting Analysis
Cash Flow Analysis	Financial Statement Analysis
Sensitivity Analysis	Investment Appraisal Analysis
Profitability Analysis	Risk Management & Analysis
Break-Even Analysis	Cost Volume-Profit Analysis
Financial-Ratio Analysis	Financial Performance Benchmarking
Working Capital Analysis	Return on Investment(ROI) Analysis

- **For Draft Procedures: Use CHATGPT to Draft Procedures for You**

Invoice Approval Procedure	Credit Management Procedure
Debt Collection Protocol	Expense Reimbursement Protocol
Monthly Closing Checklist	Capital Expenditure Approval Process
Budget Management Guide	Fixed Assets Management Policy
Payroll Processing Workflow	Investment Evaluation Procedure
Cash Handling Manual	Financial forecasting Guide
Financial Reporting Framework	Fraud Prevention and detection Protocol
Tax Compliance Procedure	Purchasing and procurement Procedure
Vendor Management Policy	Financial Risk Assessment Framework
Internal Audit Guidelines	External Audit Coordination Procedure

- **For Tool Teacher: use CHATGPT to be your dedicated tool teacher**

MS Office Tools	Word, Excel, PowerPoint, and Outlook
Business Intelligence(BI) Tools	Power BI, Tableau, and Anaplan

- **For Problem Solving: use CHATGPT for Second brain:**

Risk Mitigation Ideas	Capital Structure Optimisation
Tax Liability Reduction	Working Capital Management
Vendor Management	Sustainable Finance Initiative

- **Use CHATGPT for these other Use Cases:**

Simplify Complex Financial Topics
Structure your Financial Storytelling
Explain Legal Terms
Summarize Long Documents

- **Guidance Note to Management Accountant and Declaration from Institute about use of CHATGPT:**
- **Use of CHATGPT:** The declaration acknowledges that management accountants can use CHATGPT in a variety of ways, including writing communications, conducting financial analysis, drafting work procedures, and using it as a tool in a manner similar to how they use Microsoft Office and Business Intelligence Tools. This implies that CHATGPT can serve as a valuable resource for management accountants in their professional work.
- **Use as a Second Brain**: The declaration suggests that CHATGPT can be used as a "second brain" to aid management accountants in their tasks, indicating its potential as a knowledge and information resource.
- **ICMAI's Non-Liability**: **The declaration makes it clear that ICMAI is not liable for any correct or incorrect information or workings produced by CHATGPT. This disclaimer emphasises that the responsibility for the accuracy and appropriateness of the information generated using CHATGPT lies with the user, not the institute.**
- **Information for Members**: The information provided in the declaration is intended for the benefit of members of ICMAI. It serves to inform them about the capabilities and potential uses of CHATGPT in their professional context.
- **No Recommendation by ICMAI**: **The declaration explicitly states that ICMAI is not recommending the use of CHATGPT to its members. While it provides information about its potential uses, the institute does not endorse or advocate for its use.**

In summary, the declaration acknowledges the utility of CHATGPT for management accountants but places the responsibility for its use squarely on the individual members, emphasising that ICMAI does not recommend or endorse its use and is not responsible for the outcomes.

*****

CHAPTER - 6

Some More Promising AI Technology in the coming year

Within the dynamic realm of artificial intelligence, the years 2022–23 hold great potential as a number of nascent technologies stand ready to exert a substantial influence.

The following AI technologies are anticipated to be fruitful in the future:

- **Generative Adversarial Networks (GANs):** GANs have garnered significant interest due to their capacity to produce lifelike content, including text, images, and videos.
- **Reinforcement Learning:** Reinforcement learning has been an indispensable component in the development of autonomous systems, such as robotics and self-driving vehicles. We can anticipate an increase in the use of reinforcement learning to optimise complex duties and decision-making in 2022–23/2023-24/2024-25.
- **AI in Healthcare:** With applications in medical imaging, drug discovery, and predictive analytics, AI is positioned to revolutionise healthcare. It is anticipated that the prevalence of personalised medicine and diagnostic instruments powered by AI will increase, leading to enhanced patient care and outcomes.
- **Quantum Computing and AI:** The convergence of artificial intelligence and quantum computing has the potential to resolve computationally infeasible and complex problems. Quantum AI is anticipated to have an effect on materials science, cryptography, and optimisation.
- **Natural Language Processing (NLP):** The continuous development of NLP technologies, such as OpenAI's GPT models, enhances the capabilities and naturalness of chatbots and conversational AI. Sentiment analysis, language translation, and text summarization are additional domains in which NLP is indispensable.
- **AI in cybersecurity:** In response to the increasing sophistication of cyber threats, real-time detection and response to security vulnerabilities are becoming possible. In order to detect intrusions, machine learning models are trained to recognise anomalies and patterns.
- **Explainable AI (XAI):** Increasing concern surrounds the transparency of AI models; this is explainable AI (XAI). With the intention of enhancing the interpretability of AI models, XAI offers insights into the decision-making process. In industries such as finance, law, and healthcare, where accountability is of the utmost importance, this is vital.
- **AI in Finance:** Applications of AI in algorithmic trading, risk assessment, fraud detection, and customer service are transforming the financial sector. The prevalence of robo-advisors, which provide automated investment advice to individuals, is increasing.
- **AI in Education:** Intelligent tutoring systems and personalised learning experiences are utilising the potential of AI to tailor education to the needs of individual students.

Platforms powered by AI assist educators in modifying their instructional strategies and materials.

- **AI Ethics and Bias Mitigation:** The integration of AI systems into everyday life raises significant concerns regarding ethical considerations and the mitigation of bias in AI algorithms. Efforts are being made by organisations and researchers to develop AI systems that are more impartial and ethical.

  In 2022–23, a multitude of prospective AI technologies are anticipated to significantly influence the environment. The continuous advancement of AI will have a profound effect on numerous industries and sectors, presenting fresh prospects for progress and advancement while concurrently presenting novel obstacles that demand resolution.

6.1 Quantum Computing and AI:

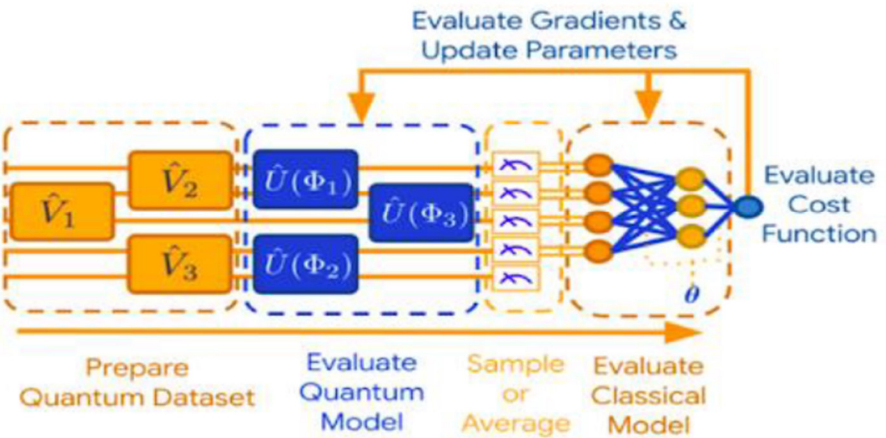
Honeywell has initiated investments in this technology alongside other companies. Quantum computing is comparable to classical computing in many respects, including the storage of data as bits (0 or 1). In contrast, quantum computing operates by encoding information within the quantum bit, also known as a qubit, thereby enabling the concurrent storage of multiple phases of data. Concepts from quantum mechanics, including entanglement and superposition, come into play here. Quantum computing differs from conventional computing in that it manipulates information in accordance with the same physical principles that an atom employs. Quantum computing is purported to offer numerous benefits to artificial intelligence, including the processing of enormous, complex datasets and the development of algorithms that facilitate improved learning, reasoning, and comprehension. Quantum computing offers numerous prospects for machine learning algorithms and natural language processing. As an illustration, a natural language processing algorithm that generates a "meaning-aware" algorithm was recently executed on quantum computing. Meaningful awareness signifies that the computer is now capable of deciphering both individual words and the entire sentence. Presently, this level of awareness can be extended to encompass entire phrases, resulting in real-time speech that does not necessitate any conjecture. It is also feasible to execute machine learning and deep learning algorithms at a faster rate than their classical counterparts using quantum computation. Quantum computers that make use of quantum physics are capable of producing more precise computing results than their alternatives. Detailed discussions of the effects and potentialities of integrating quantum computing and artificial intelligence are contained in this guidebook.

6.2 The evolution of AI via Quantum computing:

The combination of AI and quantum computation will produce an optimised solution capable of producing world-class results. With quantum AI, numerous possibilities exist. There is a proliferation of research articles that demonstrate the importance of this combination.

The following are some of the potential applications of quantum AI. Diverse libraries are in the works to provide developers with support for this innovation.

1) Enhancement of the AI learning process through the implementation of quantum algorithms.
2) 2. Advancements in AI neural search through the utilisation of quantum algorithms
3) 3. Artificial intelligence and game theory intersect in the context of stochastic scenarios.



Picture 1. Quantum Computing and AI [10]

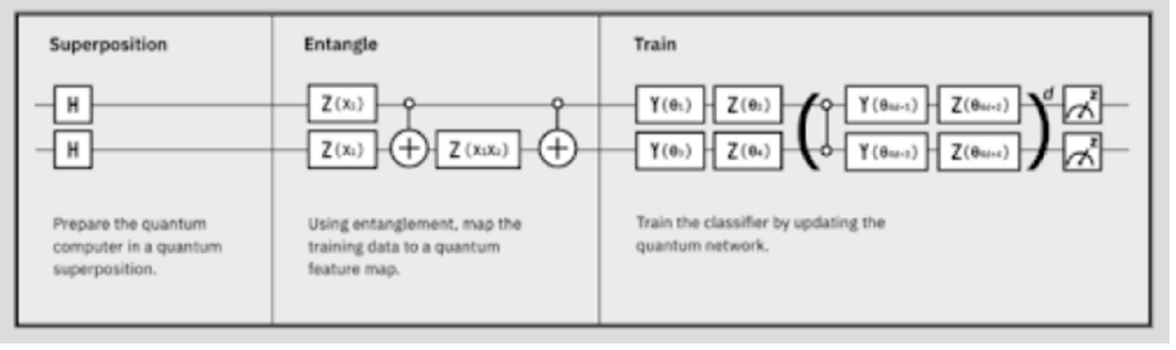
Source: J. I. Cirac, "Quantum computing and simulation," Nanophotonics, vol. 10, no. 1, pp. 453–456, 2021.

```
# A hybrid quantum-classical model.
model = tf.keras.Sequential([
    # Quantum circuit data comes in inside of tensors.
    tf.keras.Input(shape=(), dtype=tf.dtypes.string),

    # Parametrized Quantum Circuit (PQC) provides output
    # data from the input circuits run on a quantum computer.
    tfq.layers.PQC(my_circuit, [cirq.Z(q1), cirq.X(q0)]),

    # Output data from quantum computer passed through model.
    tf.keras.layers.Dense(50)
])
```

Picture 2. Tens of Flow Quantum Library [11]

Source: J. B. Rahmad, S. Suwandi, C. K. T. Soedaryono, L. F. D. Aryanti, and D. Aprialiasari, "Analysis of the Effect of the Community's Role in CSR Activities on the Image of the Company of Minarak Brantas Gas, Inc.," ADI Journal on Recent Innovation, vol. 3, no. 2, pp. 153–171, 2022.

Moving forward, the development of AI learning algorithms based on quantum technology will accelerate the resolution of commonplace issues and contribute to the acceleration of domains such as AI training, pattern recognition, and deception analysis. The IBM Quantum community created Qiskit, an open-source framework for quantum computation. The objective is to pit quantum computing against artificial intelligence. It is possible for scientists to convert machine learning scenarios into inputs for QiskAqua algorithms, which can then be executed on physical quantum machines.



Picture 3. Quantum Classifier [15]

Source: A. Dudhat and M. A. Abbasi, "Discussion of Agile Software Development Methodology and its Relevance to Software Engineering," ADI Journal on Recent Innovation, vol. 3, no. 1, pp. 105–114, 2021.

6.3 Optimization:

It is widely acknowledged that conventional or classical computing approaches are inadequate for efficiently resolving intricate machine learning problems. In order to tackle this concern, the field of quantum computing has emerged. Classical computers are reported to impede the performance of machine learning algorithms when confronted with a high-dimensional vector space dataset. Quantum computing provides two crucial methodologies—quantum parallelization and quantum associative memories—that are purported to accelerate computation times or decrease execution speed and can be applied to optimise and learn intricate machine learning tasks. It is noteworthy to mention that quantum computers exhibit proficiency in handling higher-dimensional tensors and dot matrices. This functionality demonstrates significant utility in decreasing the execution time of machine learning algorithms. One of the reports reveals that quantum computers have the capability to factor integers in polynomial time, a capability that classical computers typically lack. Several problems in machine learning are intractable and cannot be resolved within the allotted time frame. Heuristics are employed to address seemingly insurmountable challenges within the constraints of the resources at hand. Quantum computing can be utilised in this situation to accelerate computation times.

Picture 4. Quantum Computing.

6.4 Simulation:

Quantum simulators, which operate on classical computers, facilitate the execution and evaluation of quantum programmes within a simulated environment that forecasts the responses of qubits to various erations. A multitude of challenges exist, spanning from optimisation to the simulation of chemical processes or materials, for which exceptionally effective quantum algorithms have been devised to enable quantum computers to resolve them considerably more rapidly than any classical computer. In addition to pharmaceuticals, material design, industrial processes, and data processing, they have a vast array of other applications. Particularly when it comes to qubits, quantum computing can deliver substantial speeds for a limited number of problems. However, when applied to other problems, its capabilities are comparatively modest.

6.5 Quantum Computing's Potential:

Quantum computers harness the principles of quantum mechanics to perform computations that are practically impossible for classical computers. These machines use quantum bits, or qubits, which can represent multiple states simultaneously. This parallelism allows quantum computers to tackle complex problems with exceptional speed and efficiency.

AI and Quantum Computing Synergy:

- **Optimisation:** Quantum computers excel at optimisation problems, which are prevalent in various fields. AI algorithms can benefit from quantum computing when it comes to optimising large-scale systems, such as supply chain logistics, financial portfolios, or energy grids. Quantum annealers, a type of quantum computer, are particularly well-suited for these tasks.

- **Cryptography:** Quantum computing poses a unique challenge to traditional cryptographic systems. Shor's algorithm, for example, can factor large numbers exponentially faster than classical algorithms, potentially breaking widely-used encryption methods. AI can play a role in quantum-safe cryptography by identifying and developing new encryption techniques that are resilient to quantum attacks.
- **Machine Learning:** Quantum computing can accelerate machine learning tasks, particularly in training deep neural networks. Quantum machine learning algorithms can process and analyse data in quantum states, potentially leading to more efficient training processes and better model performance.
- **Materials Science:** Quantum computing can simulate the behaviour of molecules and materials at the quantum level. This is incredibly valuable for materials science, as it allows researchers to discover new materials with unique properties for applications in energy, electronics, and more. AI can assist in the analysis of quantum simulation results and the design of experiments.

Challenges and Opportunities:

- **Hardware Limitations:** Building and maintaining stable quantum hardware remains a significant challenge. Quantum computers are highly sensitive to external factors, and their qubits are prone to errors. AI can help develop error-correcting codes and algorithms to mitigate these issues.
- **Algorithms:** Developing quantum algorithms that genuinely outperform classical counterparts is an ongoing research area. AI and machine learning can play a role in optimising quantum algorithms and finding innovative applications.
- **Interdisciplinary Collaboration:** Successful quantum AI requires collaboration between experts in quantum physics, computer science, and AI. Interdisciplinary teams will drive innovation in this field.
- **Quantum-Safe AI:** As quantum computing matures, AI developers will need to consider the impact of quantum attacks on their systems and implement quantum-safe security measures.

In summary, the convergence of quantum computing and AI holds immense promise. It has the potential to revolutionise fields like cryptography, optimisation, and materials science while also posing new challenges that will require innovative solutions. As both quantum computing and AI continue to advance, we can expect to see more ground-breaking applications and discoveries at the intersection of these two technologies.

6.6 AI in Finance:

AI's role in the finance sector is indeed transformative, and its applications continue to evolve rapidly. Let's delve deeper into how AI is revolutionising finance:

- **Algorithmic Trading:** AI-driven algorithmic trading systems are capable of processing vast amounts of financial data in real time. These systems can identify patterns, execute trades, and manage portfolios with minimal human intervention. AI enhances trading strategies by making split-second decisions based on historical data, market sentiment, and news events.
- **Risk Assessment:** AI is instrumental in assessing and managing financial risks. Machine learning models can analyse creditworthiness, detect anomalies in transactions, and predict market fluctuations. Risk assessment models, powered by AI, enable financial institutions to make more informed lending and investment decisions.
- **Fraud Detection:** AI-driven fraud detection systems are essential for safeguarding financial transactions. These systems continuously monitor for suspicious activities, such as unusual spending patterns or identity theft. AI can quickly identify and flag potential fraudulent behaviour, reducing financial losses and protecting customers.
- **Customer Service:** Chatbots and virtual assistants powered by AI enhance customer service in the finance industry. They can provide 24/7 support, answer queries, and assist with basic financial tasks. Natural language processing (NLP) allows these AI-driven interfaces to engage in meaningful conversations with customers.
- **Personalised Banking:** AI enables banks and financial institutions to offer personalised financial services. This includes tailoring investment strategies, recommending suitable financial products, and providing budgeting advice based on an individual's financial goals and history.
- **Robo-Advisors:** Robo-advisors are automated investment platforms that use AI to create and manage investment portfolios for individuals. These platforms assess an investor's risk tolerance and financial goals to make data-driven investment decisions. Robo-advisors offer lower fees compared to traditional financial advisors and democratise access to investment services.
- **Credit Scoring:** AI-driven credit scoring models evaluate a person's creditworthiness more accurately by considering a wider range of factors, including non-traditional data sources. This is particularly valuable for individuals with limited credit histories.
- **Regulatory Compliance:** AI aids financial institutions in adhering to complex and ever-evolving regulations. Machine learning models can monitor transactions to ensure compliance, helping prevent money laundering and fraud.

- **Quantitative Analysis:** In quantitative finance, AI assists in developing sophisticated mathematical models for pricing complex financial instruments, optimising portfolios, and managing risk.
- **High-Frequency Trading:** AI is instrumental in high-frequency trading strategies, where split-second decisions can make a significant difference. These systems can analyse market data and execute trades with unparalleled speed and accuracy.

While AI has revolutionised the finance industry, it also brings challenges related to data privacy, security, and the need for transparency in AI-driven decision-making. As AI continues to advance, we can expect further integration of AI technologies in finance, enabling more efficient and customer-centric financial services while addressing these challenges.

Instances of Financial Institutions Employing AI:

54% of financial service organisations with 5,000 or more employees are utilising artificial intelligence, per Forbes.

The following are examples:

- **Capital One:** "Eno" was the inaugural natural language SMS text-based assistant introduced by a bank in the United States, according to Capital One.
- **Bank of America:** Since its introduction in 2018, the chatbot "Erica" at Bank of America has assisted over ten million consumers. As of mid-2019, Erica had achieved comprehension of nearly 500,000 distinct query formats.
- **JPMorgan Chase:** According to Business Insider, JPMorgan Chase employs key fraud detection applications, including the implementation of an algorithm to identify fraud patterns. Credit card transaction information is transmitted to data centres, which determine whether or not the transactions are fraudulent.
- **Kensho:** As stated on the organisation's website, Kensho is engaged in the development of analytical products that are put to use by Bank of America, Merrill Lynch, Goldman Sachs, JPMorgan Chase, and other prominent global financial institutions.
- **Alphasense:** Built In describes Alphasense as "an AI-powered search engine for the finance industry... [Serving] clients such as investment firms, Fortune 500 companies, and banks." Natural language processing is utilised by the platform to analyse keyword searches and identify market trends and shifts.

Ethics in Financial Sector AI:

There are ethical challenges associated with artificial intelligence, particularly in regards to the security of your personal and financial data. ***The Fintech Times***

identifies three areas of apprehension regarding artificial intelligence in the financial industry:

- **Bias:** AI failures are possible, and in many instances, the cause is an algorithmic flaw. An instance from The Fintech Times is as follows: "Optimising profits could quickly lead to predatory behaviour on the part of an AI system tasked with determining a customer's creditworthiness; for instance, it might seek out individuals with low credit scores in order to sell subprime loans." ***This practice may be deemed unethical and socially disapproved of, but artificial intelligence is incapable of comprehending such subtleties.***
- **Accountability:** In the event that artificial intelligence errs in its judgement, who bears the fallacy? To illustrate, in the event of a catastrophe involving a self-driving car, who bears responsibility?
- **Transparency:** the manner in which algorithms arrive at specific conclusions and the rationale behind their derivation determining this is not always straightforward.

Furthermore, an additional notion frequently linked to artificial intelligence is the imminent displacement of human labourers by robotics. According to Forbes, although research indicates that AI will supplant specific employment categories, organisations and businesses will have the capacity to allocate resources towards other, more valuable obligations. ***"Weaponized machinery"—in which artificial intelligence and machine learning tools are used for unethical purposes, such as prying into individuals' private information—is an additional ethical concern, per Investopedia.***

The Prospects for AI in Finance:

Given the increased prevalence of artificial intelligence across industries, its meteoric rise in the financial sector is unsurprising, particularly in light of the COVID-19 pandemics impact on human interaction. By analysing data and information and streamlining and consolidating processes significantly quicker than humans, ***AI has had a profound effect, and experts estimate that it will save the banking industry approximately $1 trillion by 2030.***

McKinsey & Company states, ***"Artificial intelligence technologies are becoming increasingly integrated into the world in which we live; therefore, banks must deploy these technologies at scale to remain relevant."*** "Achieving success necessitates a comprehensive overhaul that influences various tiers of the organisation." Additionally, "Gen Zers" and millennials are becoming the "largest addressable consumer group" for banks in the United States. ***This means that financial institutions are increasing their budgets for IT and AI "to meet higher digital standards," as younger consumers frequently prefer digital banking. Indeed, 78% of millennials indicate that if an alternative exists, they will not visit a bank.***

6.7 Explainable AI (XAI):

Explainable AI (XAI) is an essential development in the field of artificial intelligence, particularly in contexts where transparency and accountability are crucial. Here's a more detailed look at XAI:

Why XAI Matters:

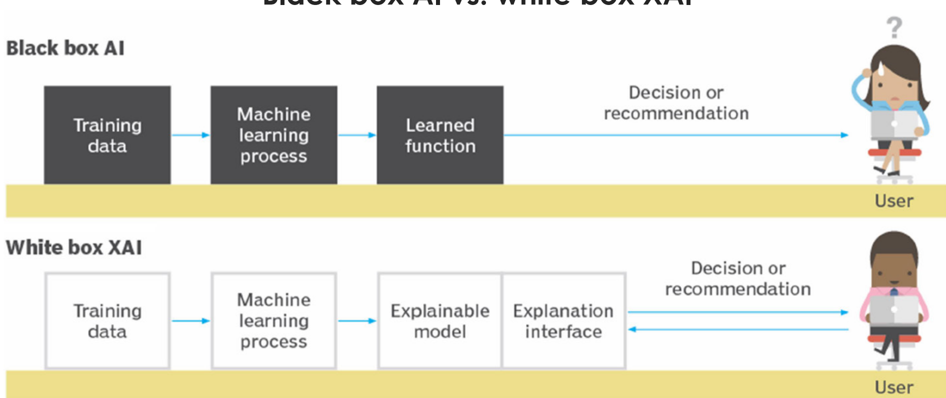
In many AI applications, particularly those in finance, law, and healthcare, decisions made by AI systems have a direct impact on individuals, organisations, and even society as a whole. These decisions can range from loan approvals and medical diagnoses to legal judgements and investment recommendations. In such critical domains, understanding why an AI system made a specific decision is vital for several reasons:

- **Accountability:** Users and stakeholders need to know why a particular decision was reached. This is essential for holding AI systems accountable, ensuring that they make fair and justifiable decisions.
- **Bias and Fairness:** Transparency allows for the detection and mitigation of bias in AI systems. XAI can help reveal when AI models make decisions based on biased data, helping organisations take corrective actions.
- **Regulatory Compliance:** In heavily regulated sectors like finance and healthcare, XAI can aid organisations in complying with legal requirements. For instance, the ***General Data Protection Regulation (GDPR) in Europe*** mandates that individuals have the right to an explanation for automated decisions.

Explainable AI is the use of methods and techniques in artificial intelligence (AI) applications so that human experts can understand the results of the solution.

It contrasts with the concept of the "black box" in machine learning, where even their designers cannot explain why the AI arrived at a specific decision. XAI is an implementation of the social right to explanation.

Black box AI vs. white box XAI



Source: TechTarget

- **How XAI works:**

  XAI is not a single technique but a collection of methods and approaches to make AI models more interpretable. These methods include:

- **Feature Importance:** XAI techniques can highlight which features (variables) had the most significant influence on a model's decision. This is helpful in understanding which factors the model considered when making a prediction.

- **Local Interpretability:** Instead of explaining the entire model, local interpretability focuses on explaining a specific prediction. It provides insights into why the model made a particular decision for a specific data point.

- **Saliency Maps:** In computer vision, saliency maps indicate which parts of an image are most relevant for a model's classification. This helps in understanding why an image was classified in a certain way.

- **Decision Trees:** Decision trees are inherently interpretable models that can be used for XAI. They provide a clear, step-by-step path to a decision based on the features of the data.

- **Rule-Based Models:** Rule-based AI systems use a set of human-readable rules to make decisions, making them highly interpretable.

- **LIME and SHAP Values:** Local Interpretable Model-Agnostic Explanations (LIME) and Shapley Values (SHAP) are techniques that provide insights into specific model predictions.

Formally, explanations can differ considerably according to context and intent. Figure 1 illustrates heat-map and human-language explanations of model actions. Designed for use by physicians, the ML model utilised below can detect hip fractures using frontal pelvic x-rays. A physician provides a "ground-truth" report in the original document, which is supported by the x-ray located on the far left. The generated report includes a heat map illustrating the specific regions of the x-ray that influenced the decision, along with an explanation of the model's diagnosis. The generated report furnishes physicians with a comprehensible and verifiable explanation of the model's diagnosis.

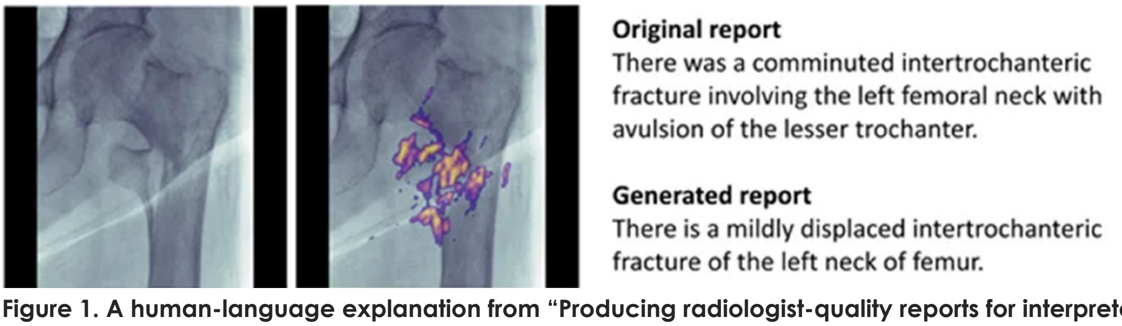


Figure 1. A human-language explanation from "Producing radiologist-quality reports for interpretable artificial intelligence." https://arxiv.org/pdf/1806.00340.pdf

An interactive, extremely technical representation of the layers of a neural network is illustrated in Figure 2. By utilising this open-source application, users are capable of manipulating the neural network's architecture and observing the evolution of individual neurons during training. Heat-map explanations of the structures underlying machine learning models can offer valuable insights to machine learning practitioners regarding the underlying mechanisms of opaque models.

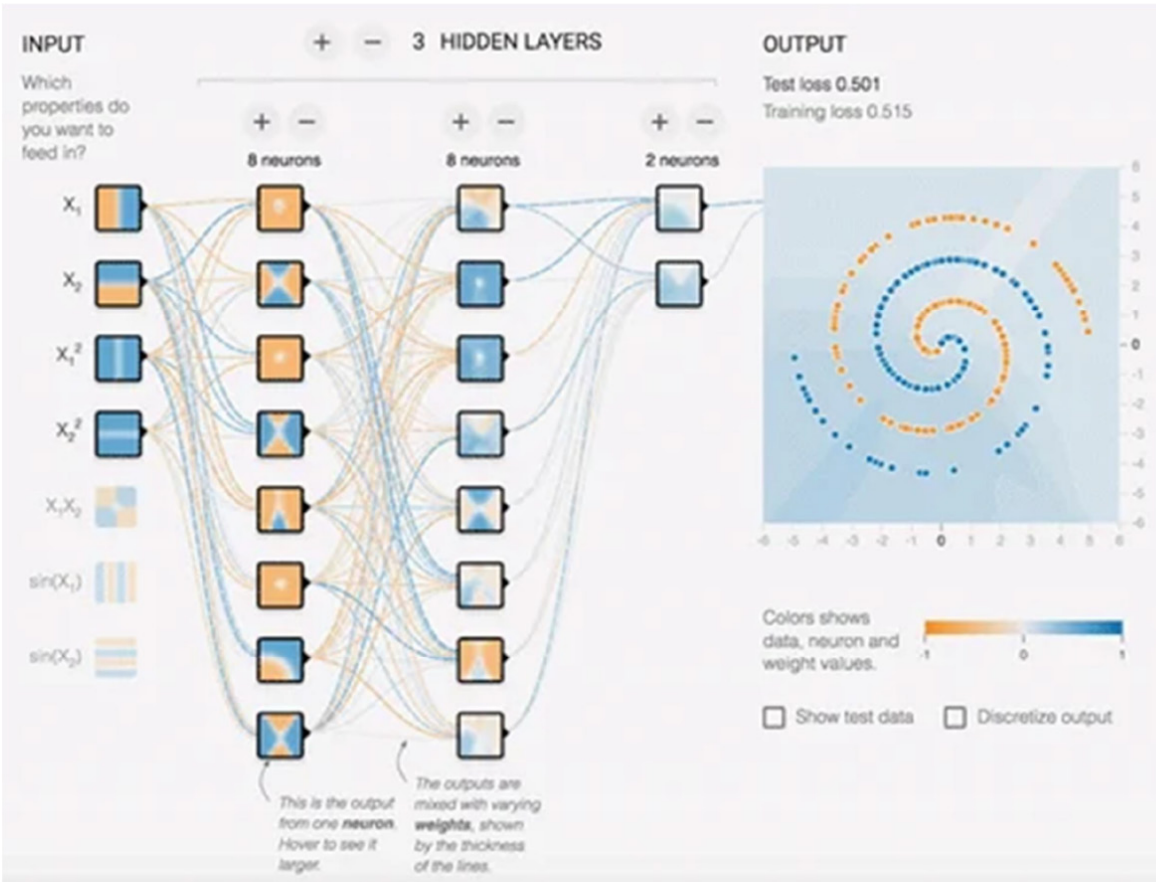
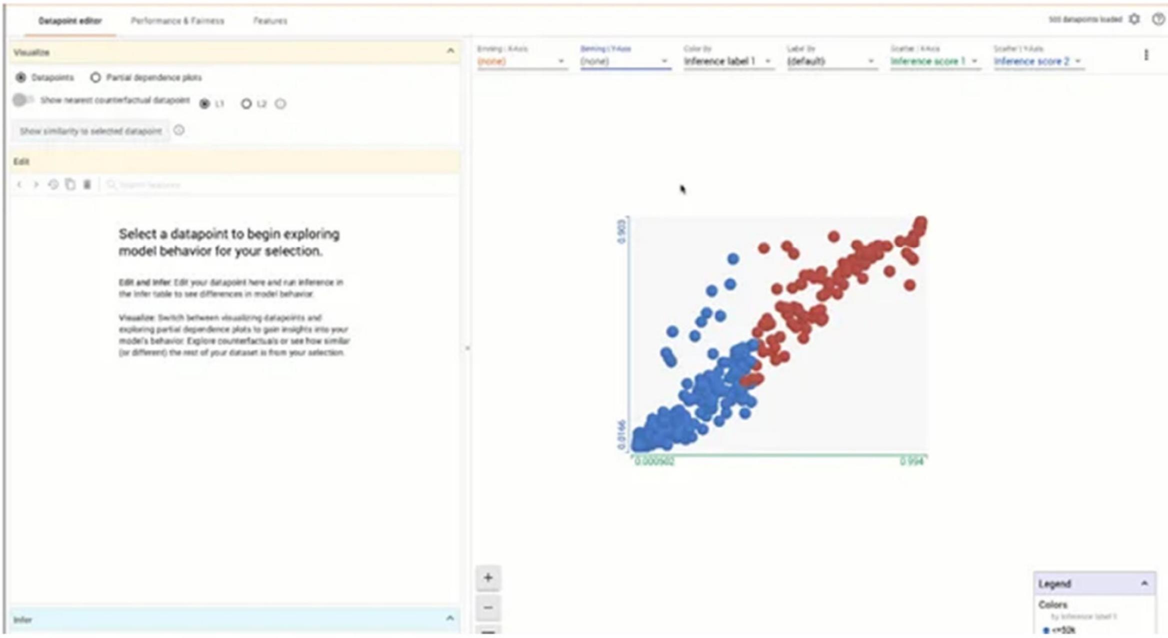


Figure 2. Heat maps of neural network layers from Tensor Flow Playground.

The What-If Tool generated the graph presented in Figure 3, which illustrates the correlation between two distinct categories of inference scores. By utilising this interactive visualisation, users are able to assess the performance of models across various "slices" of the data, identify the input attributes that significantly influence model decisions, and scrutinise their data for outliers or biases by means of graphical explanations. Although these graphs are predominantly comprehensible to machine learning specialists, they may provide essential performance and fairness insights that can subsequently be conveyed to non-technical stakeholders.



Applications of XAI:

XAI is relevant in various domains:

- **Finance:** In the finance sector, understanding why a loan application was denied or approved is essential for transparency and fairness.
- **Healthcare:** In medical diagnosis, it's crucial to explain why a certain treatment was recommended or a specific diagnosis was given.
- **Legal:** In the legal field, XAI can help explain the factors that contributed to a legal prediction or decision.
- **Regulatory Compliance:** Organisations must comply with regulations that require transparency and accountability, such as GDPR in Europe.

In summary, XAI is a critical development in AI that addresses the need for transparency and interpretability in complex decision-making systems. It enables users, organisations, and regulators to understand and hold AI systems accountable, ensuring ethical and fair use of AI in various domains.

6.8 AI in Education:

AI is making significant inroads into the field of education, revolutionising how students learn and teachers instruct. The use of AI in education spans various applications, with personalised learning and intelligent tutoring systems at the forefront. Here's a more comprehensive overview:

Personalised Learning:

- **Adaptive Learning Platforms:** AI-driven platforms analyse a student's performance, learning style, and pace. They then adjust the content and difficulty level of lessons to meet individual needs.
- **Recommendation Systems:** Similar to how streaming services recommend movies, AI recommends supplementary learning materials and resources tailored to each student's progress and interests.
- **Individualised Learning Paths:** AI can create customised learning paths for students, ensuring they cover the necessary topics while allowing them to explore areas of interest.

Intelligent Tutoring Systems (ITS):

- **Real-Time Feedback:** ITS provides students with instant feedback on assignments and assessments, helping them understand mistakes and learn from them.
- **Adaptive Assessments:** AI can generate adaptive assessments that become more challenging as students demonstrate proficiency, ensuring they are continually challenged.
- **Scaffolding Learning:** ITS systems provide support when students struggle and gradually reduce assistance as students become more proficient.
- **Data-Driven Insights:** Educators can access data on student performance, which helps identify areas for improvement, strengths, and weaknesses.

Administrative Tasks:

- **Student Enrolment and Administration:** AI streamlines administrative processes, including enrolling students, managing class schedules, and tracking attendance.
- **Grading and Assessment:** AI can automate the grading of multiple-choice questions and even provide insights into subjective assessments like essays.

Language Learning:

- **Language Translation:** AI assists language learners by providing real-time translation services, helping them understand and communicate in foreign languages.
- **Pronunciation and Speech Recognition:** AI-powered tools evaluate pronunciation and fluency, offering feedback to language learners.

Special Education:

- **Assistive Technologies:** AI aids students with disabilities by providing text-to-speech, speech-to-text, and image recognition tools.

- **Personalised Plans:** AI helps create individualised education plans for students with special needs.

Content Creation:

- **Content Generation:** AI can generate educational content, such as quizzes, flashcards, and even lecture materials.
- **Adaptive Textbooks:** AI-driven textbooks adapt their content based on student responses and progress.

Data Analysis:

- **Predictive Analytics:** AI helps institutions forecast student performance and dropout rates, allowing them to intervene when necessary to support struggling students.
- **Challenges and Considerations:** AI in education offers immense potential, but there are challenges related to data privacy, security, and the ethical use of AI. Additionally, the effectiveness of AI systems depends on high-quality data and appropriate implementation. Ensuring that students and educators are comfortable with AI's role in the learning process is crucial.

In summary, AI is enhancing education by personalising learning experiences and offering intelligent support to both students and educators. It is creating a more adaptable and engaging educational environment that caters to individual needs and fosters continuous improvement.

How can AI be best exploited for the common good in education? (Source: Unesco UNESDOC Digital Library)

As has been explored, AI is already being used in educational contexts in multiple ways. However, despite using cutting-edge technologies, these applications often do little more than automate some outmoded classroom practices, rather than using the unique affordances of AI to reimagine teaching and learning. In other words, the attention of AI researchers and developers working in education has so far been focused on the relatively easy-to-address, although still complex, low-hanging fruit of memorising and recalling knowledge. Few possibilities that address more complex educational issues, such as collaborative learning or new ways to assess and accredit, have yet to be fully researched, let alone made available as commercial products at scale. Accordingly, in order to stimulate a dialogue, some innovative ways in which AI might be exploited for the common good in education are suggested.

- **AI-driven lifelong learning companions :** The desire for every student to have their own personalised lifelong tutor is what first inspired the use of AI in learning. Technically speaking, it would not necessarily be difficult to leverage the capabilities of smartphones and related technologies to create an AI-driven learning companion that could accompany individual learners throughout their lives. Rather than setting out to teach the student in the manner of an instructionist, a learning companion would provide continuous support, building on the individual student's interests and goals, to help them decide what to learn, as well as where and how. It could also guide the student along individualised learning pathways designed to help them address their emerging goals and connect their learning interests and achievements, while encouraging them to reflect on and revise their long-term learning aims. However, despite the profound potential, there are currently no commercial AI-enabled lifelong learning products and little research.

- **AI-enabled continuous assessment :** Although there is little evidence for their validity, reliability, or accuracy, high-stakes examinations are central to educational systems around the world. With such examinations in place, schools and universities often teach to the test, prioritising routine cognitive skills and knowledge acquisition (the types of knowledge being supplanted by AI) over in-depth understanding and authentic application. In fact, AI is already being developed to extend existing examination practices. For example, AI-driven face recognition, voice recognition, keyboard dynamics, and text forensics are increasingly being used to verify candidates in examinations for distance learners. 64 Although this might have benefits for some students (e.g., those with disabilities who find it challenging to attend face-to-face examinations), these tools have not proved effective at scale, and they perpetuate rather than ameliorate the problems of exam-based assessment practices. An alternative approach to assessment might be possible with AI tools designed to constantly monitor student progress provide targeted feedback and assess the student's mastery. All of this information might be collected throughout a student's time in formal educational settings. While the use of AI-driven continuous assessment to replace high-stakes stop-and-test examinations may be attractive, but it also illustrates the two sides of applying AI in education: the benefits and the challenges. Allowing students to demonstrate their competencies while they learn, which is advantageous in some respects, but how this might be achieved without continuous Monitoring, i.e., surveillance, is less clear. Such monitoring involves many ethical concerns.

- **AI-enabled record of lifelong learning achievements**

  An 'AI-driven e-portfolio' might be used to collate all of the continuous assessment information, recorded throughout a student's time in formal education, together with data on the student's engagement with non-formal learning (such as learning a musical instrument or a craft) and informal learning (such as acquiring a language). This record would function as an intelligent and dynamic resume that could be underwritten and authenticated by blockchain technologies. 65 In this way, students would have a robust, accredited record of their learning experiences and achievements, potentially far more detailed than a collection of exam certificates. They would be able to share secure access to relevant parts. Of their e-portfolio with higher education providers and prospective employers.

6.9 AI Ethics and Bias Mitigation:

AI ethics and bias mitigation are critical components of the responsible development and deployment of artificial intelligence. As AI systems become more pervasive, addressing these concerns is essential to ensuring fairness, transparency, and trust. Here's a detailed exploration of AI ethics and bias mitigation:

AI Ethics:

AI ethics refers to the moral principles and guidelines that govern the development and use of AI systems. It involves considering the societal, ethical, and legal implications of AI technologies. Key aspects of AI ethics include:

- **Fairness:** ensuring that AI systems do not discriminate against individuals based on attributes like race, gender, age, or socioeconomic status. Fairness can be achieved through balanced data representation, careful model design, and algorithmic fairness measures.
- **Transparency:** making AI systems more transparent and understandable to users. This includes providing explanations for AI-driven decisions and ensuring that users are aware when they are interacting with AI.
- **Privacy:** safeguarding the privacy of individuals by protecting their personal data and ensuring that AI systems do not infringe upon individuals' rights to privacy. Compliance with data protection regulations like GDPR is crucial.
- **Accountability:** Establishing mechanisms for holding AI developers and users accountable for the consequences of AI-driven decisions Accountability includes addressing errors, biases, and harm caused by AI systems.
- **Safety:** ensuring that AI systems are safe for users and do not pose risks to their well-being. This is especially important in applications like autonomous vehicles and healthcare.

Bias Mitigation:

Bias in AI systems arises when training data contains prejudices or reflects historical inequalities. AI can inadvertently learn and perpetuate these biases, resulting in unfair and discriminatory outcomes. Bias mitigation techniques aim to address and rectify these issues:

- **Data Pre-processing:** Cleaning and pre-processing training data to remove bias, outliers, and inaccuracies this may involve data augmentation, data balancing, and data de-biasing techniques.

- **Bias Detection:** Employing bias detection tools and methods to identify biased patterns within AI models This helps developers recognise where bias exists and where improvements are needed.
- **Model Fairness:** Incorporating fairness metrics during model training to ensure that the model's decisions do not discriminate against any particular group. This includes measures like demographic parity and equal opportunity.
- **Explainability:** Developing AI models with interpretability and explain ability in mind Explainable AI (XAI) allows users to understand how decisions are made, detect bias, and correct it.
- **Diverse and Inclusive Data:** Ensuring that training data represents a diverse and inclusive range of individuals and groups. this helps in reducing bias by providing the model with a more balanced perspective.
- **Bias Audits:** Conducting regular audits of AI systems to identify and rectify bias Continuous monitoring and auditing are essential to address bias over time.

Challenges:

Addressing AI ethics and bias mitigation is complex and ongoing. Challenges include the need for diverse and representative datasets, the interpretability of complex AI models, and the integration of ethics into the development process. Additionally, addressing bias and fairness often requires a combination of technical solutions, policy changes, and societal awareness.

In summary, AI ethics and bias mitigation are integral to responsible AI development. Researchers, organisations, and policymakers must collaborate to create AI systems that are not only technologically advanced but also ethically sound and unbiased. This ensures that AI technologies contribute positively to society while minimising harm and discrimination.

*****

CHAPTER - 7
2023 Deployment

7.1 Data Observability –

Data observability pertains to an organisation's holistic comprehension of the well-being and efficiency of the data residing within their systems.

Data observability systems utilise automated monitoring, root cause analysis, data lineage, and data health insights to actively identify, address, and mitigate data anomalies in a proactive manner. This methodology yields more robust data pipelines, heightened team efficiency, improved data management strategies, and, finally, elevated levels of client satisfaction.

The five fundamental principles of data observability encompass:

The concepts of freshness, quality, volume, schema, and lineage are important factors for any Data. These terms hold significance in several fields of study and research. Collectively, these constituents offer significant insight into the calibre and dependability of your data**. Let us engage in a more comprehensive analysis.**

- ***Freshness:*** The concept of freshness pertains to the timeliness of data tables and the frequency of updates made to these tables. The attribute of freshness holds significant importance in the context of decision-making since outdated data can be considered to be associated with unproductive utilisation of time and financial resources.
- **Quality:** While your data pipelines may be functioning properly, it is possible that the data being processed within them is of poor quality. The quality pillar of data analysis examines the inherent characteristics of the data, including metrics such as *the percentage of missing values (NULLS), the percentage of unique values, and if the data falls within an acceptable range. The concept of quality provides valuable information regarding the reliability and credibility of tables as it pertains to the expectations associated with the underlying data.*
- **Volume:** The concept of volume pertains to the comprehensiveness of data tables and provides valuable insights about the reliability and robustness of data sources. It is imperative to be aware of any significant reduction in the number of rows, such as a rapid decrease from 200 million to 5 million.
- **Schema:** The alteration in the structural arrangement of data inside an organisation, commonly referred to as schema, frequently signifies the presence of corrupted or flawed data. The fundamental aspect of comprehending the state of your data ecosystem lies in the monitoring of the individuals responsible for modifying these tables and the corresponding

timestamps of these modifications.

- **Lineage:** In the context of data disruption, the initial inquiry that arises is invariably centred around the location of the occurrence. Data lineage offers insights by identifying the upstream sources and downstream injectors that were affected, as well as the teams responsible for data generation and the individuals that use it. The concept of lineage encompasses the gathering of metadata, which pertains to the governance, business, and technological principles linked to particular data tables. This compilation serves as a reliable and authoritative reference for all data consumers.

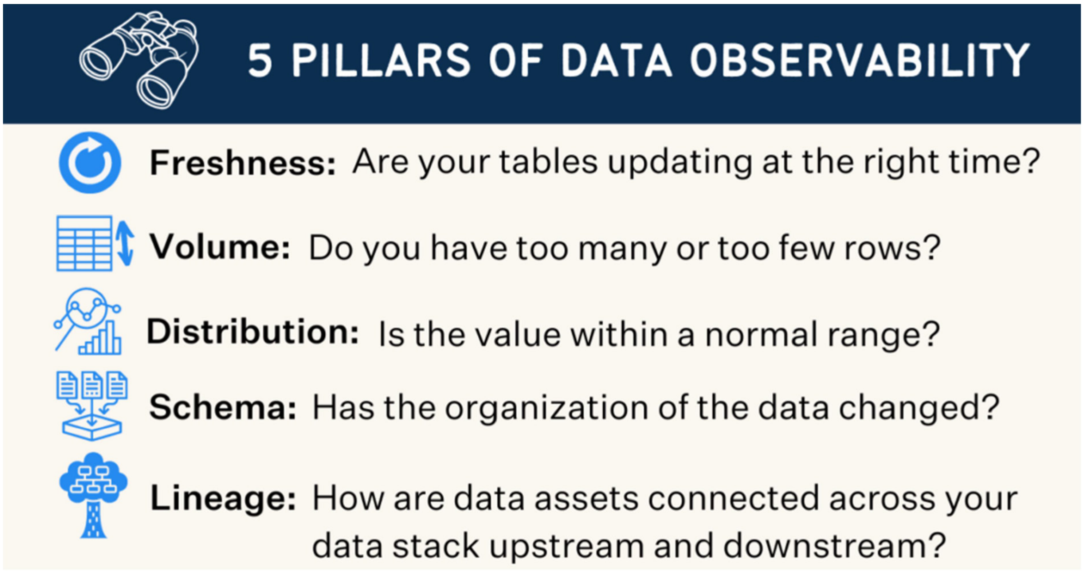
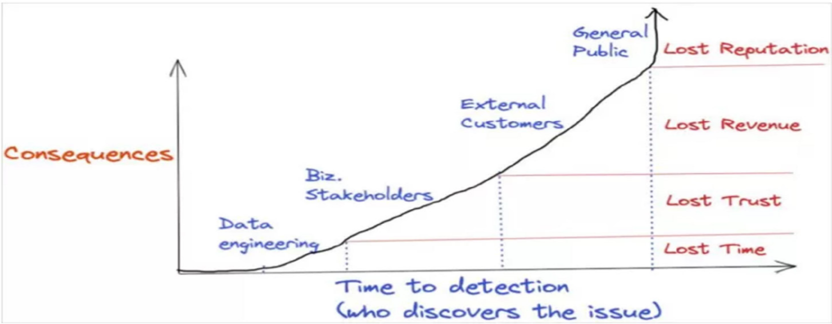


Fig 1: The 5 pillars of data observability.
Source: https://www.montecarlodata.com/

- **The fundamental components of observability data can be categorised into three pillars.**
- **Metrics**: Metrics are numerical representations of data that are measured and recorded over a specific period of time.
- **Logs**: Logs serve as documentation of an event that transpired at a particular point in time, hence offering significant contextual information pertaining to the temporal occurrence of said event.
- **Traces**: Traces serve as indicators of causally linked occurrences within a distributed setting.

Why is data observability important?



Data observability is important because the consequences of data downtime can be severe. Image courtesy of Shane Murray.

Source: https://www.montecarlodata.com/

Data observability is of significant importance to data engineers and developers due to the potential consequences associated with data downtime, which can result in the squandering of valuable time and resources. Moreover, data consumers are also affected by this issue, as it undermines their trust and confidence in the decision-making process.

The significance of monitoring data pipelines and ensuring data observability is immense. *However, it is improbable that the chief financial officer will approve the use of the term "priceless" while constructing your business justification.*

Let us now examine the Methodologies Employed by data teams in assessing data quality.

Data observability is a crucial aspect for both data engineers and developers, as it serves to mitigate the negative consequences associated with data downtime, which can result in the squandering of valuable time and resources. Moreover, data observability also plays a significant role in instilling trust in the decision-making process for data consumers.

From this perspective, the significance of monitoring data pipelines and ensuring data observability is of immense value. *However, it is improbable that the chief financial officer will deem "priceless" an acceptable factor when constructing your business justification.*

Let us now examine the methodologies employed by data teams in assessing data quality.

The formula for data downtime.

How to Measure Data cost?

- A preliminary calculation of the yearly incidence rate, irrespective of the present detection of occurrences, can be derived by dividing the total count of tables inside the specified environment by 15.
- You can multiply the aforementioned value by the average time to detection and resolution. If the metrics in question are not currently being captured, it is important to note that this is a common occurrence and should not be a cause for concern.
- The industry average for the first category is approximately four hours, while for the second category it is approximately nine hours. Please feel at liberty to utilise or modify these estimates in accordance with the level of data quality maturity within your organisation.
- Now, let us proceed with the computation of its cost, consequently determining the worth of a data observability solution.
- The initial component of the computation, namely labour cost, is relatively uncomplicated. Given the empirical evidence that data quality professionals allocate approximately 40% of their time to suboptimal data quality practices, *we may employ the following mathematical expression:* The total compensation for data engineers can be calculated by multiplying the number of data engineers by the average number of working hours in a year (1804), the average income ($62), and a factor of 0.4.
- Quantifying the operational cost associated with inadequate data quality poses a certain level of difficulty. A data event can range from a benign occurrence, such as a malfunctioning dashboard that is not utilised, to a more severe situation involving the dissemination of inaccurate figures to the stock exchange.
- ***One possible approach for estimating this is to assess the aggregate level of risk. I***f an organisation allocates resources towards enhancing its data team with the objective of augmenting overall efficiency by a certain percentage (such as 10% or any other specified value), it may be inferred that for every hour of data outage, the organisation's productivity is expected to decrease by 10%. ***The formula can be expressed as follows: the product of the overall data downtime and the percentage drop in hourly income earned.***

The essential characteristics of Data Observability Tools :

A comprehensive data observability platform encompasses the following key features:

- The integration process with your current stack is efficient and smooth, as it does not necessitate any alterations to your data pipelines, the creation of new code, or the use of a specific programming language. This approach enables rapid attainment of value and comprehensive testing coverage without necessitating significant financial commitments.

- The system actively monitors the data in its current state without necessitating the extraction of the data from its existing storage location. The aforementioned feature enables the data observability solution to exhibit high performance, scalability, and cost-effectiveness. Additionally, it guarantees adherence to the most stringent standards of security and compliance.
- A minimal configuration is necessary, and there is virtually no need to define any thresholds. The incorporation of machine learning models into data observability technologies enables the automatic acquisition of knowledge pertaining to the user's environment and data. Anomaly detection techniques are employed to provide notifications regarding the occurrence of system malfunctions. The reduction of false positives is achieved by considering not just individual measurements but also adopting a comprehensive perspective of the data and the potential consequences arising from specific issues.
- There is no requirement to allocate resources towards the configuration and maintenance of noisy rules inside your data observability platform.
- No preliminary mapping of the elements to be monitored and the manner in which they should be monitored is necessary.
- This tool facilitates the identification of crucial resources, dependencies, and invariants, enabling comprehensive data observability with minimal exertion.
- The system offers comprehensive context that facilitates prompt assessment and resolution of problems, as well as efficient contact with individuals affected by concerns over data dependability.

Data observability tools should not be limited to providing alerts such as "the values in field X of table Y are currently below Z."

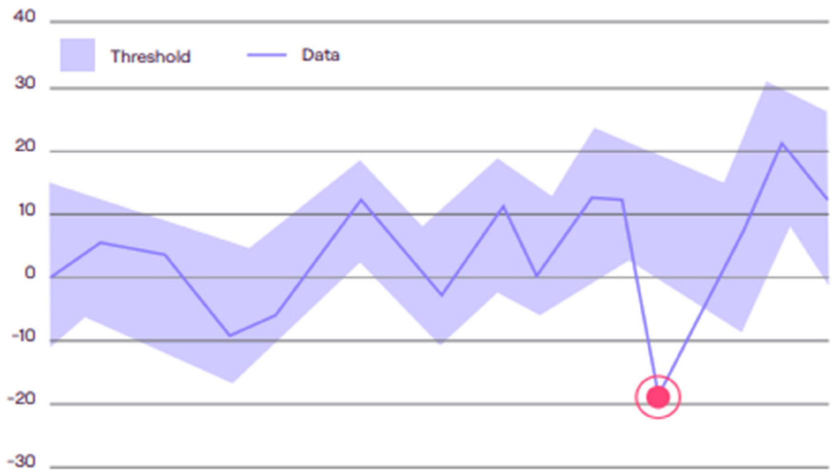
The proactive exposure of comprehensive information regarding data assets serves as a preventive measure against potential issues, enabling responsible and proactive changes and modifications.

The basics of how data Observability Solutions work

- **Integrations:** Data observability solutions typically collect data from the data warehouse, but will also collect data from many other places in the data stack (e.g., BI tools, traditional databases), depending on the solution. They also integrate with multiple other tools in the stack, such as Slack in order to send alerts to data teams when issues are detected.
- **Defining bad data:** There are many forms of bad data. Some of the most common are: data not updating on time, too few or too many table rows, and issues related to schema changes.

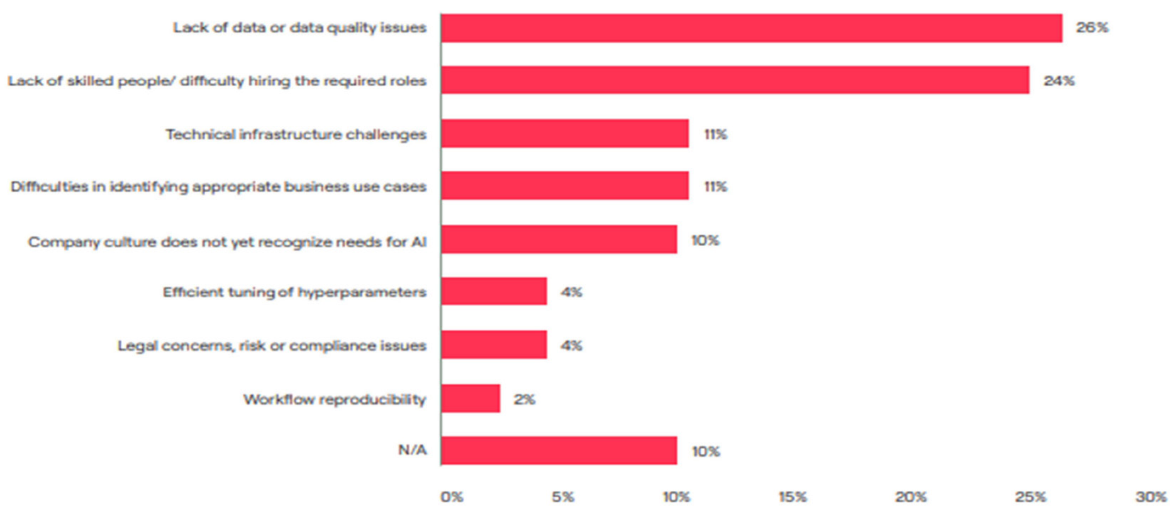
- **Catching bad data:** solutions will typically use anomaly detection to catch bad data. Machine learnings Models will forecast how they expect the data to look. based on historical data, taking into account factors such as seasonality. If the actual data goes outside of the forecasted thresholds, an anomaly alert is sent to the data team. For instance, if a table normally has 10 million rows, and this suddenly drops to 1 million, there is a good chance Something has gone wrong, and an alert will be sent.

Anomaly detection - red dot represents an anomaly as data went outside of forecasted threshold



Source: *Datafold*

AI adoption survey – Lack of data or data quality issues is the main bottleneck
Question: What is the main bottleneck holding back further AI adoption? (select one)



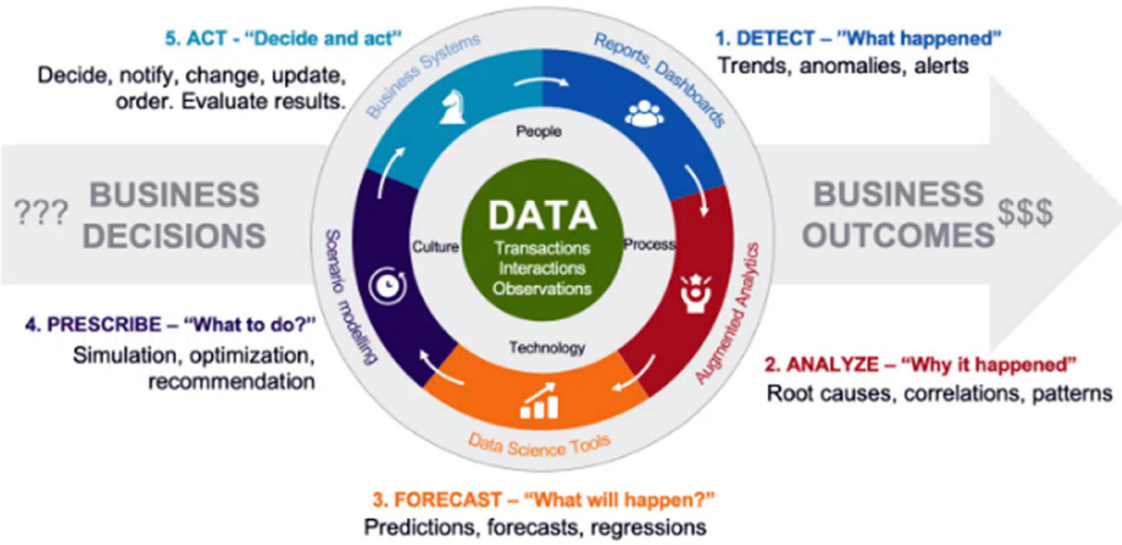
Note: *Respondents were those considered AI mature – those who already used AI in analysis or production*
Source: *The quest for high-quality data – O'Reilly (oreilly.com)*

7.2 Decision Intelligence

Decision intelligence refers to a computational framework that analyses and interprets existing data in order to generate informed suggestions for potential courses of action.

Powerful decision intelligence tools encompass software applications that collect and structure data for the purpose of facilitating informed decision-making. The subsequent advancement in this field of technology pertains to artificial intelligence, which possesses the capability to autonomously generate forecasts and offer recommendations.

The tools utilised by developers are being enhanced in order to automate the processes of data collection, analysis, and decision-making. Depending on the level of complexity or significance of a decision, human intervention may be deemed unnecessary.



Source: Apptivo

What are some Instances of Decision Intelligence Tools?

- **Answer-** ***One prevalent illustration of decision intelligence technologies is the process of loan approval.*** During earlier times, individuals would engage in conversations with their community's financial institution representative, sometimes referred to as a banker, who has the authority to grant or reject loan requests. Currently, lenders enter an applicant's information into a computer system and then obtain a decision. These technological instruments enable educational institutions to electronically manage the loan procedure and expedite the disbursement of cash while minimising potential risks.

- ***An additional illustration pertains to the utilisation of inventory management software.*** A small-scale entrepreneur is not required to perform numerous computations in order to determine the appropriate timing for placing an order. The decision-making process of a programme involves analysing several factors such as sales volume, seasonality, budget constraints, and other relevant facts in order to determine the optimal product reordering strategy.

Example of 6 Decision Intelligence Tools help for Marketing

1. **CRM-**Customer relationship management (CRM) is a strategic approach that organisations employ to manage and analyse interactions with their customers. It involves the use of Strong relationships are a crucial component for the success of firms, and the utilisation of customer relationship management solutions is imperative. Utilise a customer relationship management (CRM) system equipped with integrated predictive analytics in order to acquire a more profound understanding of your clientele and their behavioural tendencies. The acquisition of relevant information is crucial for the development of buyer personas that are of high quality.

   The utilisation of predictive characteristics inside a customer relationship management (CRM) system enables the identification of customers who should be targeted with a more assertive approach. The most notable customer relationship management (CRM) products encompass HubSpot, Salesforce, and Zoho.

2. **Buyer Intent Data**

   The subject of buyer intent data is rapidly expanding, as it provides insights into the online behaviours of one's target audience. The process involves identifying the stage of the buyer journey that prospects are currently in and making predictions regarding the individuals or groups that should be prioritised for targeting.

   The domain of buyer intent is characterised by intense competition, hence providing an opportunity for potential buyers to negotiate and personalise a favourable agreement through the process of haggling with their designated sales representative

3. **Competitive Analysis:**

   Competitive analysis is a crucial aspect of decision intelligence, where several vital instruments are employed. These programmes provide a comparative analysis of your brand's performance in relation to your competitors.

   Utilise these tools to ascertain your market position and monitor prevailing trends. Subsequently, analyse the data in order to identify novel prospects

and strategies for distinguishing oneself in terms of product offerings and communication.

To gain insights into the performance of your competitors, it is recommended to utilise tools such as Semrush, Open SEO Stats, SpyFu, or BuzzSumo. ***These platforms can provide valuable information regarding the strategies and outcomes of your competitors. These technologies have the capability to provide guidance on the selection of keywords and subjects, as well as the appropriate timing for their emphasis.***

4. **Marketing Automation Software:** Marketing automation software refers to a type of technology that enables businesses to automate various marketing tasks and processes. This software is designed to streamline and optimise marketing efforts by automating repetitive tasks, such as email marketing and social marketing.

   One can achieve several advantages by implementing marketing automation techniques***. One advantage of employing efficient campaign creation and execution is the ability to disseminate messaging promptly, resulting in time savings.***

   In addition, the efficacy of decision intelligence programmes and models is contingent upon the quality and quantity of data that is provided to them. The use of automated campaigns and the prompt collection of feedback significantly enhance the accuracy of decision intelligence tools and models.

   It is probable that your customer relationship management (CRM) system already possesses automation capabilities; however, additional software programmes or plug-ins may be necessary. Mailchimp and HubSpot are often regarded as suitable options for email marketing, while Sprout Social and Brand24 are highly recommended for automating social media management.

5. **Content Management System:** A content management system (CMS) is a software application that allows users to create, manage, and modify digital content. Marketing automation also implies that competitors are consistently generating and disseminating content. In order to effectively manage material, it is imperative to implement a content management process that facilitates the systematic scheduling, uploading, editing, and examination of content.

   When evaluating content management systems (CMS), it is advisable to consider WordPress or Drupal as potential options. The data plays a crucial role in the data intelligence process.

6. **Website Analytics:** Website analytics refers to the practice of collecting, measuring, analysing, and interpreting data related to website usage and

performance. It involves the use of many tools and techniques to gather the marketing efforts should aim to direct individuals to the company's website, with the intention of fostering active participation and ultimately leading to customer inquiries and potential purchases. ***In the scenario where marketing efforts successfully drive traffic to the website, a potential issue arises if the buyer's journey abruptly terminates. Utilise website analytics as a means to comprehend your intended audience and proficiently segment them.***

Typically, web data serves as the initial component of decision intelligence tools and is readily accessible. Google Analytics remains the widely accepted and commonly utilised initial resource for obtaining this information.

What is the significance of Decision Intelligence software?

- The decision intelligence software is designed to consolidate data from several programmes into a unified system, facilitating the generation of decisions. The software utilises computational models to simulate several hypothetical scenarios and forecast the outcomes associated with each decision.
- In principle, it is possible to collaborate with any organisation that provides decision-intelligence tools. Nevertheless, the use of RevOptics for marketing purposes is particularly advantageous, especially considering the availability of a free trial.
- The software provides guidance on prioritising prospects and determining the most efficient activities for advancing buyers through the sales funnel. The provision of guidance about the allocation of marketing resources and the dissemination of relevant findings are facilitated.

What is the rationale for Utilising Decision Intelligence tools at present?

Decision intelligence tools can provide several benefits to organisations, including:

- **Maintain a competitive edge:** Rely on the use of cutting-edge technology by your competitors to gain an advantage. Prepare yourself to effectively respond using advanced technologies and strategic approaches.
- **Developing self-assurance:** Reduce reliance on speculation and communicate ideas with greater conviction. Eliminate the phenomenon known as "paralysis of analysis" to a significant extent.
- **Execute more rapidly:** The ability to execute tasks at a faster pace is highly valuable, as time is a valuable resource. Decision intelligence technologies have the capability to enhance agility, enabling individuals to be more efficient and effective. Research indicates that organisations that reduce decision-making processes from a duration of nine months to one month have achieved substantial cost savings in the millions.

- **Increase stakeholder engagement:** The executive team is more likely to provide support when data-driven decisions lead to enhanced levels of success. One can provide rationale for budgets and mitigate resistance.
- **Ensure accountability:** In instances of failure, having empirical evidence will provide a solid basis for justifying one's decisions. Additionally, it is possible to identify specific areas for improvement in future endeavours.

Key Takeaways:

- Decision intelligence tools process data to give you predictive analysis and solid recommendations.
- CRM software, buyer intent data, competitive analysis, automation, CMS, and web analytics are vital decision intelligence tools.
- Predictive tools keep you competitive, help you make better decisions, and give you credibility with your team.

7.3 Augmented Data and Analytics:

Augmented analytics refers to a kind of analytics that uses artificial intelligence (AI) and machine learning (ML) to enhance a person's capacity to engage with data within a contextual framework. Augmented analytics include a range of tools and software designed to extend analytical skills to a broader user base. These capabilities may include providing recommendations, insights, or guidance in response to user queries.

According to Gartner, a renowned global research and advisory group, *augmented analytics refers to the use of advanced technologies like machine learning and artificial intelligence (AI) to support various data-related tasks such as data preparation, insight production, and insight explanation*. This approach aims to enhance the process of data exploration and analysis within analytics and business intelligence (BI) platforms.

The significance of machine learning in the domain of Augmented Analytics:

- *Machine learning is a prominent field within computer science that employs data to derive algorithms and learning models. It serves as a fundamental technology for numerous augmented analytics functionalities. Machine learning plays a crucial role in facilitating data analysis by alleviating the burden of laborious tasks, enabling individuals to derive valuable insights and expedite decision-making processes.* This process encompasses various stages, including data cleansing, data shaping, data examination, and data filtering, in order to achieve enhanced accuracy and provide more comprehensive analysis.
- The inclusion of machine learning functionalities in business intelligence (BI) platforms frequently presents the outcomes of sophisticated algorithms in the

form of suggestions. Furthermore, several implementations of augmented analytics utilise machine learning (ML) techniques to acquire knowledge about industry and organisational semantics, as well as user preferences, over a period of time. This enables the generation of personalised and impactful questions and findings within the business context during the analysis process.

Augmented analytics vs. Automation

- Automation is a common feature in augmented analytics solutions, but it's important to understand the difference between automating tasks, as many technologies do, and automating the decision-making that analytics informs. Automating data-driven decision-making takes away the need for human capability, whereas augmentation provides a methodology for underlying technology to guide users to uncover insights they might not see or discover otherwise.
- Domain knowledge has always been important for analysis, but augmented analytics, fuelled by AI and machine learning, make this skill set even more critical. There are often gaps where humans need to fill in the necessary context and use the insight gained from analysis to help them make the best decision for the problem at hand.

What are the Advantages Associated with the use of Augmented Analytics?

The implementation of augmented analytics has the potential to enhance the speed, efficiency, and accuracy of analysts' tasks. Machine learning and natural language technologies facilitate the integration of domain experts, individuals deeply immersed in the business context, with their data by eliminating technological obstacles to analysis. This includes granting access to more sophisticated techniques to those with limited proficiency in data skills and expertise.

- **Agility**: Increasing the utilisation of AI-powered augmentation has the potential to expedite the process of discovering valuable insights by reducing the scope of the search, presenting pertinent material to individuals in a timely manner, and proposing productive avenues for research. By comprehensively monitoring user behaviours, systems have the capability to offer more intelligent default settings and suggest activities, as well as refine and personalise them gradually by analysing people's responses. When individuals are able to respond to their data inquiries more expeditiously, they can allocate their attention towards more strategic endeavours and reduce the amount of time dedicated to scrutinising data in search of valuable insights.
- **Enhancing Precision:** Offering a Comprehensive Perspective Due to their constant operation, machines exhibit exceptional proficiency in executing repeated tasks and conducting calculations. The utilisation of artificial

intelligence (AI) and machine learning (ML) technology in augmented analytics enables a comprehensive examination of various data sources, facilitating the user's ability to make well-informed judgements through a meticulous study. This comprehensive perspective assists individuals in mitigating confirmation bias while formulating their judgements.

- **Efficiency:** Significant advancements have been achieved in the realm of machine learning and artificial intelligence, particularly in domains where algorithms are empowered by the execution of highly specialised and repetitive tasks. Consider the scenario where websites provide users with ideas for relevant information or products through the use of "you may also be interested in..." recommendations. Another example is the implementation of fraud detection programmes. Augmented analytics provides a means of automating tasks, resulting in time and energy savings for individuals engaged in data-related activities such as data preparation, data discovery, and statistical analysis.
- **Confidence:** The concept of confidence holds significant importance when considering the process of conducting powerful analysis within a certain environment.

  Augmented technologies exhibit a high level of user friendliness, enhancing the accessibility of data manipulation and facilitating the acquisition of insights for a wider range of individuals. Augmented technologies possess the capability to be customised in order to effectively represent and present data within a specific context. This enables users to validate their intuition and establish a high level of confidence in the accuracy and reliability of their judgements. Although business users may possess limited knowledge of analytical procedures, they possess a strong understanding of their own sector or industry. Consequently, they can effectively utilise their experience to assess the applicability of the insights provided by augmented analytics. Certain augmented technologies are seamlessly incorporated into the operational processes of businesses and are harmoniously integrated with various tools and software. This integration empowers individuals to expeditiously investigate their particular inquiries without causing any disruption to their research. Furthermore, in certain instances, there is no need for supplementary actions to be taken in order to prepare the data.

Use Cases of Augmented Analytics

Across the many use cases for augmented analytics, AI and machine learning strive to make more advanced analysis faster and easier, empowering more people – regardless of their data skills and technical abilities – to get value from their data by asking the best questions and making the most informed decisions.

Examples by role

- **Sales teams** may use augmented analytics to investigate trends in their quotas and deals.
- **Executives** can use augmented analytics to easily explore data live during board meetings instead of relying on static reports.
- **IT departments** may use augmented analytics to uncover the drivers behind spikes in server and system usage.
- **Analysts and data stewards** can use augmented analytics to clean, shape, and prepare data faster for analysis.

Examples by industry

- **Supply chain management** can use augmented analytics to understand why certain locations aren't delivering products at the expected rate.
- **Travel and hospitality** organisations may use augmented analytics to find optimal, personalised offers to upsell or cross-sell customers.
- **Marketing and communications agencies** can use augmented analytics to explore the effectiveness of ad campaigns and uncover variables that might be hidden in the data.
- **Applications:**

  Table 1 provides an overview of the uses of artificial intelligence (AI) throughout the various stages of the analytics cycle, serving as a means to assess the present condition of augmented analytics. These applications exhibit varying levels of development. For instance, the proposal of including visualisations for pre-determined data has been observed in the context of self-service business intelligence, although the utilisation of natural language processing (NLP) is considerably less developed. We provide instances of tools available on the market that offer the aforementioned applications. The list is not intended to be comprehensive. The primary objective of this study is to demonstrate the implementation of applications through the use of software tools.

Tabic 1 Applications of AI through the analytics cycle		
Phase of the analytics cycle		Applications ol AI
1.	Business problem and opportunity identification	(Possibly teeds on input from prcxious cycles)
2.	Data preparation Data profiling	Automatic assessment of data quality
	Data transformation	Suggestions for data cleansing, restructuring, blending and enrichment
3.	Data analysis Data discovery	Suggestions of visualizations for prc-sclcctcd data, enhance-ment of visualizations with advanced analytics, guidance in data discovery, natural language data exploration, natural language generation
	Modeling	Feature engineering, model tournaments

4.	Model deployment	Direct model deployment and embedding into production systems
5.	Decision	(Possibly automated)
6.	Action	(Possibly automated)
7.	Monitoring	Dynamic adjustment of models

7.4 Cloud Data Ecosystems:

The cloud ecosystem encompasses a network of interconnected components that collaborate to provide cloud services. Cloud computing hardware and software, as well as the various stakeholders involved, such as cloud developers, consultants, integrators, collaborators, and clients, collectively contribute to the functioning and effectiveness of this comprehensive system, each playing a distinct role. Individually, every player inside the system possesses limited capacity to contribute. However, when considered collectively, these components form a comprehensive framework that provides immense capabilities and advantages.

The utilisation of cloud computing has the potential to optimise service delivery, enable organisations to maintain competitive pricing strategies, enhance provisioning efficiency, and provide numerous additional benefits. Collaboration within an expanded network facilitates enhanced cooperation and data analysis, stimulates innovation, and propels enterprises towards exponential growth.

Fig. 1 shows a generic representation of the data governance problem in a cloud ecosystem

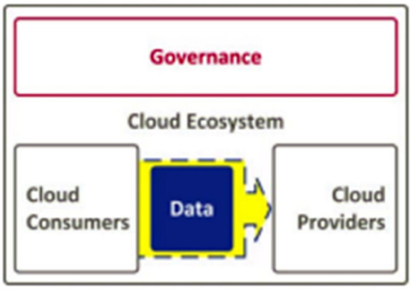


Figure 1. Data governance problem in a cloud ecosystem

Source: Accountability for Data Governance in Cloud Ecosystems, 2013 IEEE International Conference on Cloud Computing Technology and Science

How Does the Cloud Ecosystem Work?

- The cloud ecosystem can be conceptualised as a wheel or a "hub and spoke" model. Typically, a cloud provider assumes a central role and plays a crucial role in the functioning of cloud ecosystems. In general, the prevailing model is a public cloud infrastructure rather than a controlled private cloud.
- One illustrative instance of a cloud system that can be readily comprehended is Amazon Web Services (AWS). Within the framework of our cloud ecosystem

model, they would assume the role of the "hub" or "nucleus. A myriad of interrelated interactions might emanate from a widely used cloud service such as AWS. Tech firms have the potential to utilise AWS services for their applications, while consultants and third-party organisations may establish a strategic alliance with AWS.

- This is the point at which the situation becomes intricate. As a key partner, AWS actively participates in the ecosystem of numerous apps it supports. As an illustration, it is possible for Amazon Web Services (AWS) to provide support for Salesforce within its ecosystem. Salesforce, being a substantial corporation, maintains its own ecosystem, which is housed in the pre-existing AWS cloud ecosystem.
- Salesforce leverages the AWS infrastructure to host and support a subset of its services. Consequently, Salesforce customers are granted access to specific components within the AWS architecture, such as storage resources. The increasing complexity of the total ecosystem network is advantageous for all participants as it enhances the dynamism of the ecosystem and mitigates the risk of vendor lock-in, which compels users to remain with a single vendor due to apprehension of transferring.

The Players in a cloud Ecosystem

Cloud ecosystems are interconnected through a central element, namely the public cloud provider, which serves as the foundation for all other services and applications inside the ecosystem. Consequently, these networks have the potential to expand significantly in size, exhibit intricate structures, and pose challenges in terms of monitoring and management.

Typically, the participants within the majority of cloud ecosystems can be classified into one of four distinct categories:

- **Providers and brokers** refer to organisations such as AWS, Microsoft Azure, Liquid Web, and others.
- **Consumers** refer to the entities or organisations that utilise various cloud services offered by providers.
- **Developers** refer to information technology experts who are employed by a specific organisation within the broader ecosystem.
- **End-users** refer to those who use items that are developed based on cloud services.
- Let us revisit the case previously mentioned in this Guidance Book. AWS is the chosen cloud provider, assuming a central role within the ecosystem. Salesforce is a consumer that develops its customer relationship management (CRM) software with the infrastructure provided by AWS' cloud services.

- **Salesforce employs internal developers** that strive to achieve a smooth interface between the services offered by Amazon Web Services (AWS) and the functionality provided by Salesforce.
- The developers are additionally assigned the responsibility of investigating potential avenues for Salesforce to utilise the cloud services provided by AWS, with the aim of expanding the range of products or services available to its customer base.
- The end-users would consist of the customers, specifically the millions of business owners who pay for Salesforce subscriptions.

Service Model in a cloud Ecosystem

Cloud ecosystems typically support one of three fundamental service models. Services and applications developed on public cloud platforms can be classified as either:

- **Software-as-a-Service (SaaS)** refers to the provision of software programmes to customers through internet-based delivery methods. Software-as-a-Service (SaaS) programmes eliminate the need for installation or maintenance, providing end-users with a convenient "software-on-demand" experience.
- **Infrastructure-as-a-Service (IaaS)** primarily emphasises the allocation and management of computer resources necessary for enabling computational processes. The utilisation of cloud technology enables the provision of storage, computing, and networking resources on an as-needed basis, catering to the requirements of small and medium-sized enterprises (SMEs) at cost-effective rates.
- **Platform-as-a-Service (PaaS)** is a cloud computing service that offers software firms a comprehensive development environment. Organisations provide hardware and software resources using diverse virtualization techniques, enabling developers to construct a wide range of applications, spanning from rudimentary to enterprise-level.

Cloud Ecosystem Deployment Models :

The hosting framework exhibits a certain degree of flexibility owing to the inherent characteristics of cloud infrastructure. In order to achieve the functionalities offered by cloud computing, it is important for the system to possess a more advanced architecture compared to that of a conventional dedicated server.

Cloud ecosystems can typically be categorised into three distinct models:

- **The public cloud concept** involves a hosting company that offers shared resources, such as servers, applications, and storage, to the wider public. The pool of resources is shared among multiple tenants, and these tenants are charged based on a subscription model for the resources they require.

- **A private cloud** is a type of cloud computing infrastructure that is exclusively dedicated to a particular organisation, ensuring that its resources are not shared with any other entities. The primary advantage of private clouds is their enhanced security measures, as they provide a single-tenancy environment.
- **A hybrid cloud** is a computing environment that integrates both public and private cloud infrastructures. This architectural framework provides enterprises with a combination of advantages, as both cloud environments are integrated, facilitating the seamless sharing of applications and data.

If one is considering the migration of their business operations to the cloud, it is advisable to consider utilising a private cloud as the most suitable approach. In addition to providing enhanced security measures, this option offers the most convenient rehosting process. The procedure is further simplified with the assistance of our experts at Liquid Web.

Cloud Architecture :

Cloud architecture refers to the conceptualization and arrangement of software applications that leverage Internet-based, readily available services. Cloud designs serve as the foundational framework for an infrastructure that is utilised exclusively when there is a requirement to access essential resources in a timely manner and execute a particular task, then releasing surplus resources and terminating them upon completion of the task. The services provided can be accessed globally, as the cloud serves as a centralised point of entry for consumers' computing requirements***. Cloud designs are designed to tackle the primary challenges associated with processing vast amounts of data at scale.***

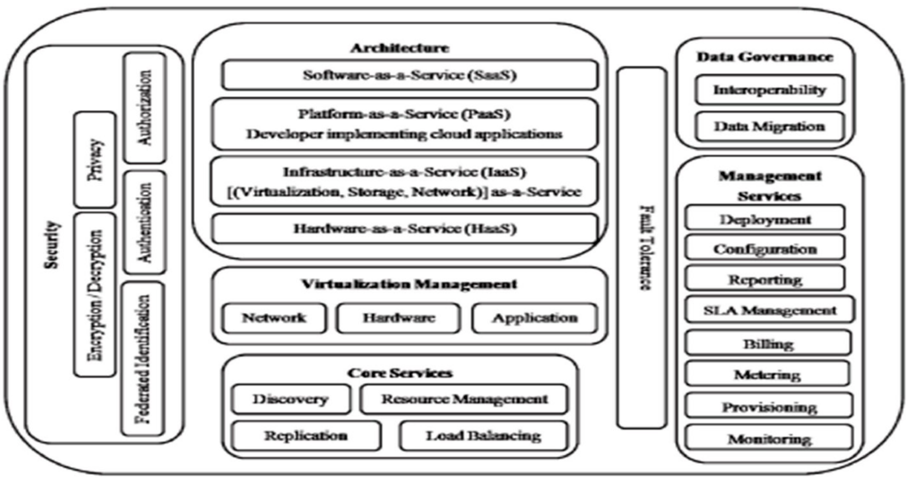


Figure 2.1 A taxonomy of cloud computing

Source: A Taxonomy, Survey, and Issues of Cloud Computing Ecosystems-
Bhaskar Prasad Rimal, Eunmi Choi, and Ian Lumb

CHAPTER - 8
2022 Deployment

8.1 Natural Language processing:

Natural Language Processing (NLP) constitutes a subfield within the realm of artificial intelligence (AI), which centres its attention on the intricate dynamics that transpire between computers and human language. Natural language processing (NLP) facilitates the comprehension, interpretation, and generation of human language by computer systems in a meaningful and advantageous manner. The following are several fundamental components and practical implementations of natural language processing (NLP).

- **Text Analysis:** Text analysis involves the utilisation of Natural Language Processing (NLP) techniques to examine extensive quantities of textual information with the objective of extracting valuable insights, attitudes, and patterns. This technology finds application in diverse domains, encompassing social media monitoring, analysis of client feedback, and market research.
- **Speech Recognition:** Speech recognition is facilitated by natural language processing (NLP), which enables the conversion of spoken words into written text. The aforementioned technology finds application in voice assistants such as Siri and Google Assistant, as well as in transcription services.
- **Machine Translation:** Natural Language Processing (NLP) plays a vital role in the functionality and effectiveness of machine translation programmes such as Google Translate. This technology facilitates the automated conversion of written content from one language to another.
- **Sentiment Analysis:** Sentiment analysis, a branch of natural language processing (NLP), is capable of discerning the sentiment or emotional disposition conveyed within a given textual composition. This practice holds significant value for firms as it enables them to assess client opinions, reviews, and social media discussions.
- **Named Entity Recognition:** Named Entity Recognition (NER) is a task in Natural Language Processing (NLP) that involves the identification and classification of named entities present in textual data. These entities can include the names of individuals, organisations, geographical locations, and specific dates. NLP models are capable of performing this task by using various techniques and algorithms. This technique seems to be beneficial for the process of extracting and indexing information.
- **Question Answering Systems:** Question-answering systems, which are driven by natural language processing (NLP), have the ability to comprehend user inquiries and deliver pertinent responses sourced from extensive datasets,

such as databases or documents.

- **Chatbots and Virtual Assistants:** Natural Language Processing (NLP) plays a crucial role in the functionality of chatbots and virtual assistants, enabling them to comprehend and provide appropriate responses to user inquiries expressed in a natural manner.
- **Text Generation:** Natural Language Processing (NLP) models, encompassing generative artificial intelligence (AI), possess the capability to produce text that closely resembles human-generated content, such as articles, narratives, or computer programming code. This phenomenon demonstrates practical uses in the fields of content generation and automation.
- **Language Understanding:** NLP models possess the capability to analyse the semantic and contextual aspects of language, facilitating the generation of more precise and contextually sensitive answers inside AI systems.
- **Text Summarization:** Text summarization is a process in natural language processing (NLP) that enables the automatic generation of concise summaries for lengthy texts or documents. This capability of NLP facilitates the extraction of crucial information, enhancing the user's ability to comprehend and utilise the content effectively.
- **Text Classification:** Text classification is a common application of natural language processing (NLP) techniques. It involves the categorization of textual data into predefined classes or categories. Some examples of text classification jobs include spam detection, sentiment classification, and content categorization.
- **Language Translation Services:** Language translation services rely heavily on natural language processing (NLP), which serves as a fundamental element. NLP facilitates instantaneous translation between different languages, thereby facilitating effective communication and content localization.
- **Healthcare Applications:** Natural Language Processing (NLP) has extensive applications in the healthcare sector, particularly in medical record analysis, diagnosis assistance, and patient data extraction.
- **Financial Services:** NLP is used within the financial services industry to do sentiment analysis of financial news, evaluate risks, and discover instances of fraudulent activities.
- **Legal Services:** NLP has the potential to provide valuable support in various legal domains, including the study of legal documents, the assessment of contracts, and doing legal research.
- **Academic Research:** Academic research on the topic of natural language processing (NLP) facilitates investigations across diverse disciplines such as

linguistics, social sciences, and information retrieval.

Natural Language Processing (NLP) is a swiftly progressing discipline that finds utility in various sectors. The process entails the advancement of intricate algorithms and models, encompassing deep learning methodologies, in order to comprehensively comprehend and produce human language. The ongoing advancements in NLP technology are anticipated to assume heightened significance in our engagements with computers and AI systems.

- **NLU:** Natural language understanding (NLU) refers to the process of receiving an input text string and conducting an analysis to ascertain its intended meaning. The occurrence can manifest to a limited extent. *For instance, when an individual peruses a user's inquiry on the social media platform Twitter and subsequently responds with a suitable answer, or on a more extensive scale, such as when the technology giant Google analyses an extensive corpus of papers to ascertain their subject matter, Natural Language Understanding (NLU) refers to the computational capacity of a computer system to comprehend and interpret human language.*

- The technology can be utilised for a variety of applications, including but not limited to chatbots, voice assistants, and automatic translation services.

- Parsing is considered the fundamental form of natural language understanding (NLU). It involves the conversion of natural language material into a structured format that can be comprehended by computers.

  As an illustration, the given text "hello world" would be transformed into its constituent components of speech, specifically nouns and verbs. Similarly, the line "I am hungry" would be segmented into two distinct sentences: "I am" and "hungry."

- **NLG:** Natural language generation (NLG) refers to the computational process of converting data that is in a format usable by computers into writing that is easily understandable by humans. To illustrate, in the case of desiring to construct a conversational bot that emulates human-like responses, the use of Natural Language Generation (NLG) software might be employed to ensure the output resembles the textual output of a distinct individual rather than generating arbitrary words or phrases.

The operational mechanisms of Natural Language Understanding :

Natural language understanding (NLU) refers to the act of analysing and comprehending natural language inputs, such as sentences or paragraphs, in order to generate meaningful outputs. Consumer-facing apps, such as web search engines and chatbots, frequently employ plain English as a means for consumers to communicate with the programme.

The process can be divided into three distinct parts:

- **Tokenization:** Tokenization is the initial step in natural language understanding (NLU), which entails dividing a provided input into discrete words or tokens. The set of characters encompasses punctuation marks, various symbols, and vocabulary originating from diverse linguistic systems.
- **Lexical analysis:** The process of lexical analysis involves the placement of tokens into a dictionary, which includes information about their respective parts of speech, such as whether they belong to the category of nouns or verbs. Additionally, the process involves the identification of specific phrases that are to be segregated into a distinct database for future use.
- **Syntactic analysis:** Syntactic analysis involves the examination of tokens in order to determine their grammatical structure. The process involves the identification of the functions of each word and the determination of any potential ambiguity that may arise from multiple interpretations of these roles.

The significance of natural language understanding :

The process of natural language comprehension involves the identification and interpretation of the semantic content of textual information. This capability is increasingly seen as a crucial factor in the realm of commercial operations. The use of natural language understanding software can potentially provide a competitive edge by furnishing novel insights into data that were previously inaccessible.

When conducting data analysis using natural language understanding software, novel approaches for making informed business decisions can be derived from the available information.

For example, consider the scenario where you operate as an e-commerce entity possessing comprehensive data pertaining to the purchasing behaviour and temporal patterns exhibited by your clientele.

The use of a natural language understanding programme enables the identification of patterns in client behaviour, facilitating informed decision-making regarding future product offerings.

Organisations can leverage natural language understanding technologies for marketing initiatives by tailoring distinct communications to specific demographic segments, aligning with their existing interests. It has the capability to anticipate the future preferences of individuals.

Software for Understanding Natural Language

- **Interactive voice response (IVR):** Interactive voice response (IVR) systems and message routing. The use of natural language understanding (NLU) systems in the task of handling customer calls and effectively routing them to the appropriate department or individual is a common and routine scenario.

The implementation of an interactive voice response (IVR) system enables organisations to effectively manage client inquiries around the clock without the need to recruit additional personnel or incur expenses related to overtime work.

- **Data Capture:** The process of acquiring and recording information from various sources is commonly referred to as data capture. The implementation of a data capture application will facilitate users in inputting information into designated fields on a web form by employing natural language pattern matching, thereby eliminating the need for manual typing of each field using a keyboard. The implementation of pre-filled fields significantly enhances user efficiency by eliminating the need for users to recall the specific meaning of each field or adhere to correct input methods, such as keyboard-based date formatting.
- **Customer Support:** Customer support agents have the ability to utilise Natural Language Understanding (NLU) technology in order to get information from clients during phone conversations, eliminating the need to manually type out each individual query.Agents can provide assistance to customers with intricate problems by utilising natural language understanding (NLU) technology in conjunction with natural language generation tools. This enables the agents to provide personalised solutions tailored to the exact details of each customer's scenario.
- **Chatbots:** Chatbots, also known as conversational agents, are computer programmes designed to simulate human conversation. A chatbot is a software application that employs artificial intelligence techniques to replicate human-like discussions with users. A chatbot has the capability to generate a response to each input provided by the user, or it may possess a predetermined set of responses designed to address frequently asked questions or commonly used phrases. The primary objective of a chatbot is to minimise the duration of human-computer interactions, thereby optimising the allocation of individuals' time towards alternative activities.
- **Virtual Assistants:** Virtual assistants, also known as intelligent virtual agents or chatbots, are computer programmes designed to simulate human conversation and provide assistance to users. Virtual assistants are software applications specifically developed to aid in the execution of fundamental duties, including but not limited to appointment scheduling, reminder creation, and email transmission.

These applications have the capability to seamlessly interact with other applications on both mobile devices and computers, eliminating the need for users to constantly switch between different software programmes. This integration facilitates efficient completion of tasks, such as sending emails or managing online errands, without interrupting workflow, particularly when time is of the essence, such as prior to embarking on a vacation in the upcoming week.

Examples of Natural Language Understanding :

- *The field of natural language understanding encompasses the utilisation of artificial intelligence methodologies for the purpose of comprehending human languages.* The objective of natural language understanding is to attain a level of computer-human communication that closely resembles human-to-human interaction. This is accomplished by the development of a digital framework capable of accurately perceiving and effectively reacting to human speech.
- *Voice recognition technology is widely regarded as the most prevalent illustration of natural language understanding.* Voice recognition software possesses the capability to analyse oral utterances and transform them into textual form or alternative data formats that may be effectively processed by a computer system.
- **Example 1:** An illustrative instance is the Alexa software developed by Amazon, which enables users to issue commands through vocalisation rather than manual input via typing.
- **Example 2:** An additional illustration is the Messenger application developed by Facebook, wherein natural language processing (NLP) techniques are employed to enhance interpersonal communication with individuals who are geographically distant yet maintain emotional and psychological proximity.

8.2 Machine learning:

Machine learning is a subset of artificial intelligence (AI) that focuses on the development of algorithms and models that allow computer systems to learn and make predictions or decisions without being explicitly programmed. It's a field that uses statistical techniques to enable machines to improve their performance on a task through experience, typically by analysing and learning from data. ***Let's dive into a broader understanding of Machine Learning with some statistical examples:***

1. **Supervised Learning:**

   Example: **Handwritten Digit Recognition**

   ➢ **Task**: Classify handwritten digits (0–9) into their respective categories.

   ➢ **Data**: A dataset of images of handwritten digits along with their labelled categories

   ➢ **Algorithm**: supervised learning algorithms like Support Vector Machines (SVM) or Convolutional Neural Networks (CNN).

   ➢ **Statistical Aspect**: The model learns statistical patterns and features from the labelled data to make predictions. It generalises from the examples it has seen to classify new, unseen digits accurately.

2. Unsupervised Learning:

Example: **Customer Segmentation**

- **Task**: Group customers into clusters based on their purchasing behaviour.
- **Data**: Purchase history data for a set of customers without predefined categories.
- **Algorithm**: Unsupervised learning algorithms like K-Means clustering or principal component analysis (PCA)
- **Statistical Aspect**: The algorithms find hidden patterns or structures in the data, helping businesses identify customer segments that might not be evident through manual analysis.

3. Reinforcement Learning:

Example: **Game Playing**

- **Task**: Train an AI agent to play a video game optimally.
- **Data**: The agent interacts with the game environment, receiving rewards or penalties for its actions.
- **Algorithm**: reinforcement learning algorithms like Q-Learning or Deep Q-Networks (DQN).
- **Statistical Aspect**: The agent uses statistical probabilities to make decisions and learns the optimal strategy by trial and error.

4. Regression Analysis:

Example: **Predicting House Prices**

- **Task**: Predict the selling price of houses based on various features (e.g., size, location, number of bedrooms).
- **Data**: historical data on house sales, including both the features and the actual sale prices.
- **Algorithm**: Regression algorithms like linear regression or random forest regression
- **Statistical Aspect**: The model uses statistical relationships between the features and the target variable (price) to make predictions.

5. Natural Language Processing (NLP):

Example: **Sentiment Analysis**

- **Task**: Determine the sentiment (positive, negative, or neutral) of a text or social media post.

- **Data**: A dataset of text samples labelled with sentiment categories
- **Algorithm**: NLP techniques like text classification using naive Bayes or recurrent neural networks (RNNs).
- **Statistical Aspect**: The model analyses the statistical distribution of words or phrases in the text to classify sentiment.

6. **Dimensionality Reduction:**

   Example: **Image Compression**

   - **Task**: Reduce the size of images while preserving important information.
   - **Data**: high-resolution images
   - **Algorithm**: Techniques like Principal Component Analysis (PCA) or t-Distributed Stochastic Neighbour Embedding (t-SNE)
   - **Statistical Aspect**: The algorithms identify statistical patterns and correlations in the pixel data to reduce the dimensionality without significant loss of information.

In all these examples, statistical methods and techniques play a central role in building machine learning models. These models leverage statistical patterns and relationships in data to perform tasks such as classification, clustering, prediction, and decision-making, making machine learning a powerful tool for a wide range of applications across various domains.

Examples of statistical computations in the context of Machine Learning:

- **Confusion Matrix:**

  Example: **Binary Classification**

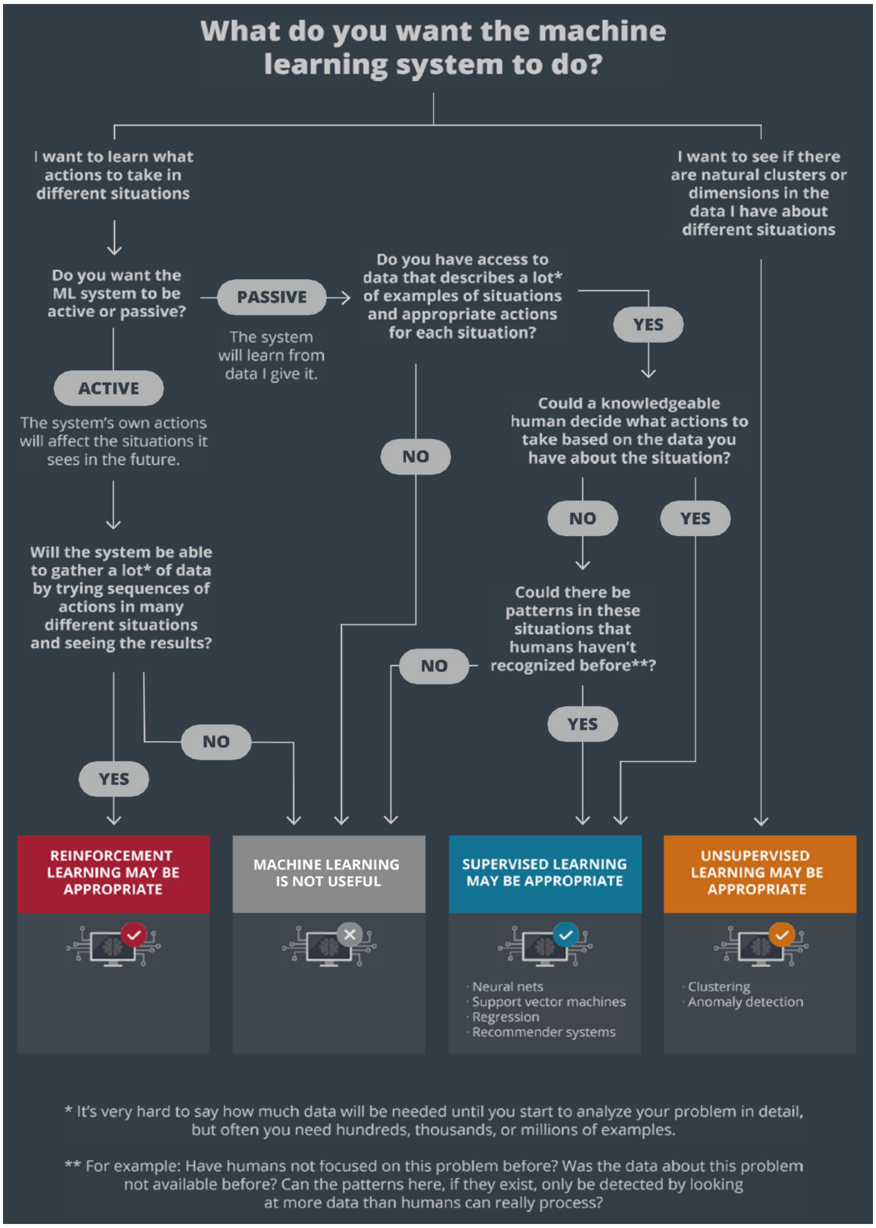
  - **Calculation**: A confusion matrix is used to evaluate the performance of a binary classification model. It includes metrics like true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN).
  - **Statistical Aspect**: It quantifies how well the model distinguishes between positive and negative cases and provides insights into accuracy, precision, recall, and F1-score calculations.

- **Mean Squared Error (MSE):**

  Example: **Regression**

  - **Calculation**: MSE measures the average squared difference between the predicted values and the actual values in a regression model.
  - **Statistical Aspect**: It quantifies the goodness of fit of the model, where lower MSE values indicate a better fit to the data.

- **Cross-Entropy Loss (Log Loss):**



Example: **Logistic Regression and Neural Networks for Classification**

- **Calculation**: Cross-entropy loss measures the dissimilarity between the predicted probabilities and the actual class labels.
- **Statistical Aspect**: It quantifies the model's performance in terms of classification accuracy and is widely used as a loss function in classification problems.

- **Pearson Correlation Coefficient:**

  Example: **Correlation Analysis**

  - **Calculation**: The Pearson correlation coefficient measures the linear relationship between two variables and ranges from -1 (perfect negative correlation) to 1 (perfect positive correlation).
  - **Statistical Aspect**: It assesses how strongly two variables are related and provides insights into the direction and strength of the relationship.

- **Area Under the Receiver Operating Characteristic Curve (AUC-ROC):**

  Example: **Binary Classification**

  - **Calculation**: AUC-ROC measures the model's ability to distinguish between positive and negative classes. It is calculated by plotting the ROC curve and calculating the area under it.
  - **Statistical Aspect**: It quantifies the model's discriminatory power, with values closer to 1 indicating better performance.

- **Chi-Square Test:**

  Example: **Feature Independence Testing**

  - **Calculation**: The Chi-Square test assesses the independence of two categorical variables in a contingency table. It calculates the chi-square statistic and associated p-value.
  - **Statistical Aspect**: It helps determine whether there is a significant association between variables, aiding feature selection and hypothesis testing.

- **Kullback-Leibler Divergence (KL Divergence):**

  Example: **Information Theory**

  - **Calculation**: KL divergence measures the difference between two probability distributions. In machine learning, it is often used to compare the similarity between two probability distributions.
  - **Statistical Aspect**: It quantifies the information lost when one distribution is used to approximate another, providing insights into the dissimilarity between distributions.

- **ANOVA (Analysis of Variance):**

  Example: **Comparing Multiple Groups**

  - **Calculation**: ANOVA assesses whether there are statistically significant differences among the means of three or more groups.

- **Statistical Aspect**: It helps determine whether variations among groups are due to real differences or random chance and is often used in feature selection and group comparisons.

These statistical calculations and metrics are essential tools for evaluating and interpreting machine learning models' performance, assessing data relationships, and making informed decisions in various machine learning applications.

- **Framework for Predicting Where Machine Learning Will Be Useful**

  A simple framework, this one designed to predict where machine learning can be useful. Since most recent advances in AI are based on various forms of Machine Learning, ***This framework applies to many kinds of current AI.***

Fig 1, Source Thomas Malone in MIT Sloan and CSAIL 2019, Module 2

As depicted in this illustration, contemporary machine learning algorithms typically require the presence of two crucial criteria in order to be deemed valuable. Initially, it is important to acknowledge that these algorithms typically necessitate substantial quantities of data, frequently ranging from hundreds to thousands or even millions of instances.

Machine learning can prove to be highly advantageous when there is access to relevant data, such as recordings of past customer interactions or sensor logs of previous machine activities. The success of Google Translate can be attributed to the accessibility of extensive textual data in multiple languages found on the internet.

Furthermore, the efficacy of machine learning is contingent upon the presence of a discernible pattern that can be identified. For instance, machines possess the capability to perform credit-risk evaluations that are comparable to those conducted by individuals, utilising pertinent data such as the borrower's existing assets, income, and debt. Moreover, it is noteworthy that machine learning algorithms have the capability to be trained to identify patterns inside extensive datasets that surpass the analytical capacity of people.

As exemplified, e-commerce platforms like Amazon employ artificial intelligence methodologies to discern intricate patterns inside extensive datasets pertaining to customer preferences and product purchases (Hardesty, 2019). ***However, it is improbable that any quantity of machine learning will have the capability to accurately forecast the precise trajectory that a particular buyer will traverse within a retail mall.***

8.3 Text summarization:

Text summarization refers to the automated process of producing a brief and cohesive summary of a longer textual document, such as a research paper, news article, or other written content. This application is a significant use of natural language processing (NLP) and machine learning techniques, specifically developed to extract the most crucial information from a given text while maintaining its inherent meaning and contextual relevance. ***There are two main methodologies for text summarization:***

- **Extractive Summarization:** Extractive summarising is a technique wherein a system is employed to identify and choose the most pertinent lines or phrases from the source text, then arrange them in a coherent manner to create a summary. The sentences that have been chosen are often those that encompass crucial information or serve as exemplars of the principal concepts.
- **Abstractive Summarization:** Abstractive summarising is a technique that goes beyond the mere extraction of sentences and instead focuses on generating a summary that emulates human-like language. The process entails the act of restating and restructuring the information in order to generate a succinct and logically organised synopsis, sometimes using terminology and expressions that were not originally used in the initial text. ***Text summarization is a process that involves condensing a given text into a shorter version while retaining its main ideas and key points. It is a useful tool in several applications, such as information retrieval and document summarization.***

Example of Text Summarization:

- **Original Text:** "The new smartphone from XYZ Company boasts a high-resolution OLED screen, a powerful octa-core processor, and a state-of-the-art camera with advanced image stabilisation technology. It also features a long-lasting battery that can easily last all day, making it perfect for users who are always on the go."
- **Extractive Summary:** "The new smartphone from XYZ Company features a high-resolution OLED screen, a powerful octa-core processor, and a long-lasting battery."
- **Abstractive Summary:** "XYZ Company's latest smartphone impresses with its high-resolution OLED screen, powerful octa-core processor, and long-lasting battery, catering to users with active lifestyles."

Advantages of Text Summarization:

- **Information Retrieval:** Summaries help users quickly grasp the key points of lengthy documents, making it easier to find relevant information.

- **Time-saving:** Summarization automates the process of condensing large texts, saving time for readers and researchers.
- **Content skimming:** It allows users to skim through multiple documents to identify the most relevant ones for in-depth reading.
- **Multi-Language Support:** Summarization models can be trained in multiple languages, aiding cross-lingual information access.
- **Consistency:** Summaries maintain a consistent tone and style, which can be important for presenting information uniformly.

Disadvantages of Text Summarization:

- **Loss of Nuance:** Summarization may lead to the loss of nuanced information or context present in the original text.
- **Challenges with Abstraction:** Abstractive summarization is challenging, and the generated summaries may not always capture the intended meaning accurately.
- **Domain Dependency:** Summarization models trained in one domain may not perform as well in another, requiring domain-specific fine-tuning.
- **Reference Bias:** Summaries generated by models may have a bias towards information that is more frequently mentioned in the training data.
- **Evaluation Difficulty:** Measuring the quality of summaries can be subjective, as it depends on human judgement and the specific use case.

In the realm of artificial intelligence, text summarising presents notable benefits in the domains of information retrieval and efficiency. However, it also presents some obstacles pertaining to the preservation of context and the assurance of precision, particularly in the context of an abstractive summary. Ongoing efforts are being made by researchers and developers to enhance the functionalities of summarization models in order to overcome these constraints.

*****

CHAPTER - 9

In Planning- Evolve Technology & Process Capabilities to Support Data and Analytics

9.1 Adaptive ML:

Machine learning today tends to be open-loop: it collects tonnes of data offline, processes it in batches, and generates insights for eventual action. ***There is an emerging category of ML business use cases called "In-Stream Analytics (ISA)"***. Here, the data is processed as soon as it arrives, and insights are generated quickly. However, actions may be taken offline, and the effects of the actions are not immediately incorporated back into the learning process. If we did, it is an example of a "closed-loop" system; we will call this approach "adaptive machine learning, or AML. ISA is a precursor to AML.

Adaptive machine learning (adaptive ML) refers to the capability of a machine learning system to continuously learn and adapt to changing conditions, data distributions, or user preferences over time. Unlike traditional static machine learning models that are trained once and remain fixed, adaptive ML systems have the ability to update and refine their models as new data becomes available or as the environment evolves.

Here is a small list of business use cases summarised from a recent blog, Stream Processing, where "time" is important—real-time applications, if you will.

1. **Fraud Detection:**

   Rules and scoring based on historic customer transaction information, profiles, and even technical information to detect and stop a fraudulent payment transaction.

2. **Financial Markets Trading:**

   Automated high-frequency trading systems.

3. **IoT and capital equipment-intensive industries:**

   Optimisation of heavy manufacturing equipment maintenance, power grids, and traffic control systems.

4. **Health and Life Sciences:**

   Predictive models monitor vital signs to send an alert to the right set of doctors and nurses to take action.

5. **Marketing Effectiveness:**

   Detect mobile phone usage patterns to trigger individualised offers.

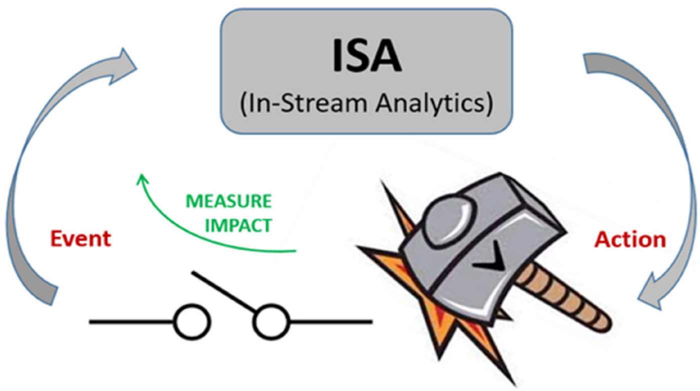
6. **Retail optimisation:**

In-store shopping patterns and cross-selling; in-store price checking; creating new sales from product returns.

The closed-loop nature of these use cases is a component that needs real-time engagement. In each instance, the analytics module assesses an external event and generates a recommended course of action, subsequently producing a response that will promptly influence the external event.

The definition of "real-time" varies depending on the specific scenario. The temporal scale at which data collection, analysis, and subsequent action occur can vary, ranging from milliseconds to hours, days, and beyond.

The term used in the industry to refer to this concept is event stream processing, often known as in-stream analytics (ISA). ISA systems have rigorous criteria that necessitate the availability of certain implementations of computer systems, databases, and data flow.



Source- data science central

It appears to us that when the "Analytics module determines a recommended action and creates a response that will impact the external event", one should also measure the impact of the action so that:

(1) We know if our action was good,

(2) We can use any shortcomings to improve ISA so that the next ISA event will have a better outcome, and

(3) We can attribute the right portion of the result to ISA's action.

If learning is the process of "generalisation from experience", we can be more explicit and say learning is generalisation from past experience and the results of new action—this is the true definition of learning! This is how humans learn from their environment.

With this broader view of learning,, it appears that all analytics applications conform to the definition of learning above, other than purely descriptive analytics. The learning system may be kept "behind the curtain," but any ML application that has business impact will have to close the loop since an offline ML system (behind the curtain) will still require a "trickle" of continuous learning or "tracking" lest the learned system become "aged" and not responsive to new changes. Even a language translation ML system belongs in the closed-loop category for proper continuous operation (new words and expressions enter the lexicon all the time!).

Machine learning has not paid much attention to such "tracking" solutions. Why is that? Business use cases that demand closed-loop solutions may be assumed to be non-varying—in time, space, or other dimensions—as a simplification. But in reality, every model evolves slowly or quickly. Practically, we have not seen a business problem that is fully solved with a "one and done" solution! Any serious solution is like flu shots: adjust the mix and apply on a regular basis. This is because the entities involved vary (over time, in this case), and "tracking" will improve the results and may even be necessary on an ongoing basis if changes are significant.

From the steady state, the ML algorithm learns what represents "normal" (think of an IoT example where a piece of machinery is operating fine); when deviations occur, adaptive ML (AML) will quickly learn the new model. There are two ways to flag this change:

a) Monitor AML model parameters for change.

b) Monitor the output (such as prediction error) of a non-tracking algorithm; the change in the underlying system will cause a larger than normal deviation in the monitored output.

As we can see, BOTH methods will flag an event, but AML is more informative; it characterises the change in terms of new model parameters, which is valuable to know; not only that a change happened, but what was the nature of the change (is it a "new normal," perhaps?). This knowledge will improve future actions.

Accumulated information about the new "normals" adds to the knowledge base, which will allow for more advanced versions of the ML solution in the future. This learning at a higher level (accumulation of knowledge) enhances the power of ML solutions as time goes on—continuous learning leads to smarter ML solutions automatically!

A basic example is recursive least squares (RLS). RLS is exact in the sense that the "batch" Least Squares solution using all the data at one time and the solution obtained by RLS once the same amount of data is accumulated are identical. Solving at every step is the same as learning "as much as can be learned" from each new piece of information as it arrives; this is what RLS does.

RLS is one of a plethora of exact recursive algorithms (ERAs). ERAs solve the estimation problem as each new set of data arrives. ERAs have the ability to track the changes since an exact solution is calculated at each step. In practice, the nature of variation (speed of change, complexity, etc.) will limit the ability of ERAs to be fully change-adaptive.

Cost Accountants can read the book "Systems Analytics", Part II, written by Dr. PG Madhavan, for a better understanding of AML. The book deals with ERAs culminating in state-space formulation and Bayesian estimation using a nonlinear Kalman filter.

Clearly, there are offline applications of ML where insights are generated and the resulting report is submitted to the business executive. Here, the loop is not closed online, but you can be sure that as ML use by the business matures, the executive will want the insights to be applied to the business problem and know if the action produced good results, and if so, what portion of the good result can be attributed to AML. The need to close the loop will become unavoidable in many sustaining ML business applications.

In summary, adaptive ML methods are necessary for closed-loop solutions. Off-line or batch methods are suitable for investigations and explorations, but the solution to any business problem will require it to be closed-loop, with the time available between event and action varying from milliseconds to hours, days, and months. The adaptive nature of AML, where the solution tracks the changing environment, renders the solution fully automatic, removing the need for human intervention in the best case.

9.2 AI Engineering:

AI engineering is a multidisciplinary field that focuses on the practical implementation and deployment of artificial intelligence (AI) and machine learning (ML) solutions in real-world applications. It bridges the gap between AI research and practical, scalable AI systems. AI engineering encompasses a wide range of activities and practices aimed at developing, deploying, and maintaining AI models and systems. Here are key aspects and practices associated with AI engineering:

Key Aspects of AI Engineering:

- **Data Collection and Preparation:** AI engineering begins with collecting and preparing high-quality data for training and testing AI models. Data pre-processing, cleaning, and transformation are crucial steps to ensuring data quality.
- **Feature Engineering:** Feature engineering involves selecting, creating, or transforming input features that are relevant to the problem and will enhance model performance.
- **Model Selection and Architecture:** AI engineers choose appropriate ML algorithms and model architectures based on the nature of the problem and the available data.

- **Model Training:** This involves feeding the model with training data to learn patterns and relationships. Training may require significant computational resources and often involves hyperparameter tuning.
- **Validation and Testing:** AI engineers use validation and testing datasets to evaluate model performance and ensure it generalises well to unseen data.
- **Scalability:** Developing AI systems that can scale to handle large volumes of data and high-demand applications is a critical aspect of AI engineering.
- **Deployment and Integration:** Deploying AI models into production systems and integrating them with existing software and hardware infrastructure is a complex process that requires careful planning and testing.
- **Monitoring and Maintenance:** Once deployed, AI systems need ongoing monitoring to detect issues, adapt to changing data distributions, and ensure continued performance.
- **Ethical Considerations:** AI engineers must consider ethical and responsible AI practices, including fairness, bias mitigation, and privacy protection.
- **Security:** Ensuring the security of AI systems is vital to protect against attacks, data breaches, and adversarial threats.
- **Interoperability:** AI systems often need to interact with other software and systems, so ensuring compatibility and interoperability is crucial.
- **Documentation:** Proper documentation of AI models and systems, including code, data, and model descriptions, is essential for transparency and reproducibility.

Practices in AI Engineering:

- **DevOps for AI:** Applying DevOps principles to AI engineering, including version control, continuous integration, and automated deployment
- **MLOps:** Implementing MLOps practices to streamline the end-to-end machine learning lifecycle, from development to deployment and monitoring
- **Containerization:** Using containerization technologies like Docker to package AI models and their dependencies for easy deployment and portability
- **Model Versioning:** Managing and versioning AI models to keep track of changes and ensure reproducibility
- **Explainability and interpretability:** employing techniques to make AI model predictions more interpretable and understandable
- **AI Governance:** Establishing policies and procedures to govern AI model development, deployment, and usage
- **Collaboration:** Facilitating collaboration between data scientists, engineers, and domain experts to ensure AI models address real-world problems effectively

AI engineering is an evolving field, and best practices continue to emerge as organisations adopt AI technologies more widely. Effective AI engineering practices are essential to harnessing the full potential of AI in various industries, from healthcare and finance to manufacturing and autonomous systems.

9.3 Causal AI:

Causal AI, short for Causal Artificial Intelligence, refers to the application of artificial intelligence techniques and technologies to better understand and analyse causal relationships in data and make predictions or decisions based on causal inference. While traditional machine learning focuses on correlation and pattern recognition, ***causal AI aims to uncover cause-and-effect relationships in complex systems. Here are key aspects and applications of causal AI:***

Key Aspects of Causal AI

- **Causal Inference:** Causal AI seeks to identify causal relationships within datasets. It aims to answer questions like "What causes what?" by distinguishing between variables that have a causal influence and those that are merely correlated.
- **Counterfactual Analysis:** Causal AI often involves counterfactual analysis, which explores what would have happened under different circumstances or interventions. It allows for "what-if" scenarios to evaluate the impact of changes.
- **Causal Graphs:** Causal AI frequently employs causal graphs or Bayesian networks to visually represent causal relationships among variables in a system. These graphical models help in making causal inferences.
- **Causal Discovery:** Causal AI includes techniques for discovering causal relationships in observational data or experiments. It can uncover hidden causal factors that may not be immediately apparent.
- **Interventions:** The ability to predict the outcomes of interventions (actions or changes) is a central aspect of causal AI. It helps in decision-making and policy planning.

Applications of Causal AI:

- **Healthcare:** Causal AI can be used to understand the causal factors behind diseases and treatments, predict patient outcomes, and optimise healthcare interventions.
- **Finance:** In finance, causal AI can help analyse the impact of economic events or policy changes on financial markets and portfolios.
- **Marketing:** Marketers can use causal AI to determine the effectiveness of marketing campaigns, understand customer behaviours, and optimise advertising strategies.
- **A/B Testing:** Causal AI is essential in A/B testing to assess the impact of changes or variations and determine causality rather than just correlation.

- **Economics:** Economists can use causal AI to study the effects of policies, market dynamics, and external factors on economic outcomes.
- **Environmental Science:** Causal AI can analyse the causal relationships between environmental factors and climate change, pollution, and ecological systems.

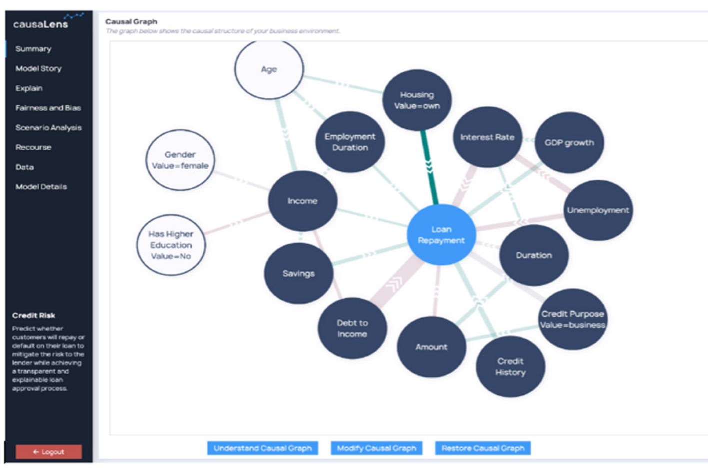
Advantages of Causal AI:

- **Robust Decision-Making:** Causal AI helps make more informed and robust decisions by considering causal relationships and interventions.
- **Understanding Complex Systems:** It provides deeper insights into complex systems by revealing the cause-and-effect relationships among variables.
- **Policy Planning:** Governments and organisations can use causal AI to plan and implement effective policies and interventions.
- **Improved Generalisation:** Causal models can improve the generalisation of AI systems, making them more reliable in real-world scenarios.

Challenges of Causal AI:

- **Data Requirements:** Causal AI often requires high-quality data and domain expertise to build accurate causal models.
- **Causation vs. Correlation:** Distinguishing between causation and correlation is a challenging task, and misinterpretations can lead to incorrect conclusions.
- **Complexity:** Modelling complex causal relationships in large-scale systems can be computationally intensive and require advanced algorithms.

Causal AI holds great promise for addressing causal questions and improving decision-making in various domains. It combines the power of AI and causal inference to provide a more comprehensive understanding of how the world works and how actions and interventions can lead to specific outcomes.



Fairness and bias assessment of a Causal AI model

Source: World Economic Forum

9.4 Composite AI

Composite AI is an approach to solving diverse business problems by combining multiple analytical techniques, such as:

- Machine learning and deep learning
- Natural language processing (NLP)
- Computer vision (CV)
- Descriptive statistics
- Knowledge graphs

AI adoption in business is increasing, but standalone approaches can fall short of solving complex business problems. Moreover, successful AI applications require large datasets, which are not always available.

A unified approach to different analytical techniques can help businesses solve complex problems and reduce costs by:

- enabling human-like decision-making
- reducing the necessity of large data science teams
- allowing users to gain insights from small datasets

Such benefits are why Gartner identified [1] Composite AI as one of the top emerging technologies with a high impact on business over the next several years.

Composite AI refers to the integration and coordination of multiple artificial intelligence (AI) technologies, approaches, or models to solve complex problems and achieve more robust and versatile AI systems. It involves combining different AI components or techniques to leverage their individual strengths and address a wider range of tasks or challenges. Here are key aspects and characteristics of composite AI:

Key Aspects of Composite AI

- **Integration of Multiple AI Technologies:** Composite AI involves combining various AI technologies, such as machine learning, natural language processing, computer vision, and robotics, into a single AI system.
- **Hybrid Models:** It often includes the use of hybrid AI models that blend different AI techniques. For example, combining deep learning with symbolic reasoning or rule-based systems
- **Collaborative AI:** Composite AI can involve multiple AI agents or models working collaboratively to achieve a common goal, such as multi-agent systems in robotics.
- **Enhanced Capabilities:** By integrating multiple AI components, Composite AI aims to enhance the capabilities of AI systems, making them more adaptable, robust, and versatile.

- **Problem-Specific Solutions:** It allows organisations to tailor AI solutions to specific problems or domains by selecting and integrating the most suitable AI components.
- **Interdisciplinary Approach:** Composite AI often involves an interdisciplinary approach, where experts from different AI subfields collaborate to build more comprehensive AI systems.

Examples of composite AI:

- **Self-Driving Cars:** Autonomous vehicles use composite AI by combining computer vision, sensor fusion, machine learning, and decision-making algorithms to navigate and make driving decisions.
- **Virtual Assistants:** Virtual assistants like Siri or Google Assistant use a combination of speech recognition, natural language processing, and machine learning to understand and respond to user queries.
- **Healthcare Diagnostics:** In healthcare, composite AI can integrate medical imaging analysis with natural language processing for comprehensive patient diagnosis and treatment recommendations.
- **Manufacturing Automation:** In manufacturing, robots and automation systems use composite AI to combine computer vision for object recognition with robotic control for precise assembly.

Advantages of Composite AI:

- **Increased Versatility:** Composite AI systems can handle a broader range of tasks and domains due to the integration of diverse AI technologies.
- **Improved Robustness:** By combining multiple AI components, composite AI systems are often more robust and capable of handling real-world variations and challenges.
- **Customization:** Organisations can tailor composite AI solutions to their specific needs, selecting the AI components that best fit their requirements.
- **Interdisciplinary Insights:** Composite AI encourages collaboration among experts from different AI domains, leading to innovative solutions and insights.

Challenges of Composite AI:

- **Complexity:** Integrating multiple AI technologies can result in complex systems that are challenging to develop, maintain, and troubleshoot.
- **Resource-Intensive:** Some composite AI systems may require significant computational resources and data to function effectively.
- **Integration Issues:** Ensuring seamless integration and communication between different AI components can be a technical challenge.

Composite AI represents an advanced approach to building AI systems that can tackle complex and multifaceted tasks. As AI technologies continue to advance, composite AI is expected to play a significant role in developing AI solutions that are more adaptable and capable of addressing a wide range of real-world problems.

The Benefits of Composite AI for Business

Enterprises can use composite AI in countless ways—combining AI techniques is much more effective than relying on just one. A few key benefits include:

- **Fewer data prerequisites:** Composite AI can work even if your organisation has limited data availability or smaller datasets—users have seen success coupling what data they do have with synthetic data from GANs or knowledge graphs.
- **Determine the best action:** By combining ML- and analytics-based AI, you can conduct prescriptive analytics and ensure the insights you garner will guide you to the best decision possible.
- **Leverage emerging tech:** computer vision, NLP, deep learning, and agent-based modelling all have increased capabilities with composite AI. Determine the speed of objects within images, model complex decision-making processes, and manage your entire supply chain.

Besides the general advantages that can be reaped across industries, there are specific advantages for each sector as well. To illustrate this, This Guideline Book laid out examples of composite AI's impact in financial institutions and manufacturing.

Financial Services

By leveraging composite AI, financial services institutions will find they can work with sensitive data faster and more accurately. **A few more benefits include:**

- **Detecting fraud.** Analysing massive amounts of data to detect fraud can overwhelm both personnel and legacy systems. Composite AI solutions like NLP and data mining automate behavioural analysis and send customers a note when they suspect fraudulent activity. This is helpful for Cost Accountants who are doing Forensic Audit.
- **Automating anti-money laundering (AML) investigations** AML investigations are labour-intensive and time-consuming. Banks are now using knowledge graphs and machine learning models to examine transactions at scale, identify suspicious activity, and increase the rate of true positives.
- **Providing better customer service.** By providing customers with personalised service via ML algorithms and knowledge graphs, financial institutions are increasing customer satisfaction and optimising conflict resolution.
- **Speeding up compliance checks.** A financial institution might leverage NLP to gather critical data from documents, along with AI-powered automation to speed up related internal processes.

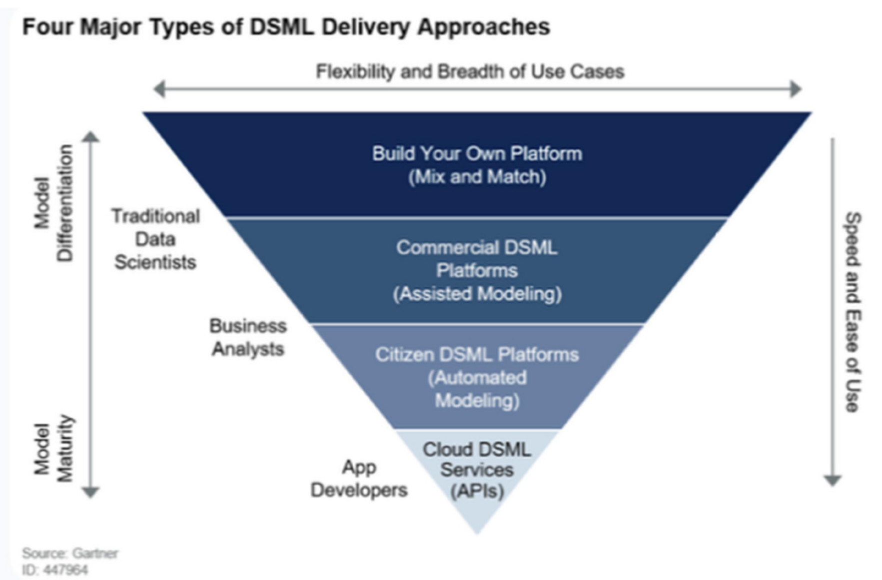
Manufacturing

Manufacturing is another key area where composite AI is making strides**. Here are a few key examples of its potential use cases:**

- **Informing predictive maintenance** Heuristics (strategies derived from previous experience) about certain sensor readings, combined with deep learning, can predict an asset's health and whether it's fit to operate.
- **Reducing waste.** AI-powered systems can be infinitely more efficient than legacy systems, reducing material waste. Automated maintenance results in less downtime and longer lifecycles for plant machinery.
- **Managing the supply chain** By using demand forecasting models to estimate future demand and digital twin technology to simulate how changes would have an impact on your business, you can start optimising your supply chain operations.

Composite AI opens up a tonne of possibilities for your organisation to leverage advanced AI techniques. With the power to combine ML, image recognition, deep learning, NLP, and more with (essentially) no dataset size limits, the world is your oyster.

9.5 Augmented DSML:



According to Gartner, augmented data science and machine learning (DSML) can be considered one of the most influential and empowering technologies within the realm of artificial intelligence (AI). Automated machine learning facilitates the productivity of proficient data scientists operating within the initial two strategies by automating the laborious and monotonous components of the data science process. The utilisation of automation enables individuals to direct their attention towards the human facets of artificial intelligence (AI), concurrently affording them the opportunity to familiarise themselves with novel algorithms that would typically be challenging to acquire due to their current workload. The second option involves the facilitation and empowerment of citizen data scientists, who possess the necessary skills and knowledge to utilise automated machine learning techniques in conjunction with their domain expertise. By leveraging these capabilities, these individuals may construct machine learning models, augmenting their organisation's AI capabilities. The incorporation of guardrails into platforms like DataRobot serves to assure consistent adherence to data science best practices, especially among those lacking comprehensive training and expertise in the field of data science.

In the latest publication titled "The Democratisation of Data Science: Exploring the Implications of Augmented Machine Learning", analysts from Gartner recognise the significant influence that augmented machine learning is poised to exert on various organisations.

Augmented DSML (Data Science and Machine Learning) refers to the incorporation of augmented intelligence techniques into the practice of data science and machine learning. Augmented intelligence, a concept closely related to artificial intelligence, focuses on enhancing human intelligence and decision-making rather than replacing it. In the context of DSML, augmented intelligence leverages AI technologies to assist data scientists and machine learning practitioners in various aspects of their work. ***Here are key aspects and benefits of augmented DSML:***

Key Aspects of Augmented DSML

- **Automated Data Pre-processing:** Augmented DSML systems can automate data cleaning, transformation, and feature engineering tasks, saving data scientist's time and ensuring data quality.
- **Hyper parameter Optimisation:** They assist in optimising model hyper parameters using techniques like grid search or Bayesian optimisation to improve model performance.
- **AutoML:** Augmented DSML platforms can automate the end-to-end machine learning pipeline, including data preprocessing, feature selection, model selection, and evaluation.
- **Explainable AI (XAI):** They provide explanations for model predictions, helping data scientists and stakeholders understand why a model made a particular decision.
- **Anomaly Detection:** Augmented DSML systems can automatically detect anomalies or outliers in datasets, which is useful in fraud detection, quality control, and other applications.

- **Model Selection:** They assist in selecting the most appropriate machine learning algorithms or models based on the characteristics of the data and the problem at hand.
- **Data Visualisation:** Augmented DSML platforms often include data visualisation tools that help data scientists explore and understand their data more effectively.

Benefits of Augmented DSML:

- **Efficiency:** Augmented DSML accelerates the data science and machine learning workflow by automating time-consuming tasks, allowing data scientists to focus on higher-level tasks.
- **Consistency:** Automated processes in augmented DSML systems lead to consistent and reproducible results.
- **Reduced Bias:** Augmented DSML can help identify and mitigate bias in data and models, promoting fairness and ethical AI.
- **Scalability:** These systems make it easier to scale machine learning efforts to handle larger datasets and more complex problems.
- **Improved Model Performance:** By automating hyperparameter tuning and model selection, augmented DSML often leads to better-performing models.
- **Accessibility:** Augmented DSML platforms can make machine learning more accessible to individuals with varying levels of expertise.
- **Interpretability:** They provide tools for understanding and interpreting machine learning models, making it easier to gain insights from data.

Challenges of Augmented DSML:

- **Data Quality:** Augmented DSML systems depend on high-quality data, and issues with data quality can propagate through the automated processes.
- **Complexity:** Setting up and configuring augmented DSML platforms can be complex and require expertise.
- **Interpretability vs. Automation:** There can be a trade-off between full automation and model interpretability, as highly automated systems may produce models that are difficult to explain.

Augmented DSML represents a valuable approach to enhancing the capabilities of data scientists and machine learning practitioners by leveraging AI technologies to streamline and optimise the DSML process. It aims to make machine learning more accessible, efficient, and effective in solving real-world problems.

9.6 Composable D&A:

Composable D&A (data and analytics) refers to a data management and analytics approach that emphasises the ability to flexibly and dynamically assemble, integrate, and use data and analytics components to meet specific business needs and objectives. It involves breaking down data and analytics processes into modular, reusable building blocks that can be combined and orchestrated as needed to support various analytical tasks, decision-making processes, and applications. Here are key aspects and benefits of composable D&A:

Key Aspects of Composable D&A

- **Modularity:** Composable D&A decomposes data and analytics tasks into smaller, modular components or services that can be independently developed, maintained, and scaled.
- **Reusability:** Components in composable D&A are designed to be reusable across different projects and applications, reducing redundancy and improving efficiency.
- **Flexibility:** Composable D&A allows organisations to adapt quickly to changing business requirements by assembling and reassembling components as needed.
- **Integration:** It emphasises the seamless integration of various data sources, data processing techniques, analytics algorithms, and visualisation tools into a cohesive data and analytics ecosystem.
- **Orchestration:** Composable D&A provides orchestration capabilities to manage the flow of data and analytics components, enabling complex workflows and automation.
- **Scalability:** Organisations can scale individual components independently to handle increased data volumes or user demands.

Benefits of Composable D&A:

- **Agility:** Composable D&A enables organisations to rapidly respond to changing business needs, making it easier to experiment with new analytics approaches and technologies.
- **Cost Efficiency:** By reusing components and avoiding redundant development efforts, organisations can achieve cost savings in data and analytics projects.
- **Customization:** Organisations can tailor their analytics solutions to specific use cases and industries by selecting and configuring the most suitable components.
- **Interoperability:** Composable D&A promotes interoperability among different data and analytics tools, ensuring that they work together seamlessly.
- **Scalability:** Components can be scaled independently, allowing organisations to allocate resources efficiently and avoid overprovisioning.

Challenges of Composable D&A:

- **Complexity:** Managing a composable D&A environment can be complex as it involves coordinating and orchestrating a diverse set of components.
- **Governance:** Ensuring data quality, security, and compliance in a composable environment requires robust governance practices.
- **Skill Requirements:** Composable D&A may require a skilled workforce that can design, implement, and manage modular components effectively.
- **Integration Efforts:** Integrating and maintaining various components and ensuring they work together seamlessly can be challenging.

Use Cases for Composable D&A:

- **Advanced Analytics:** Organisations can assemble and customise analytics pipelines for tasks like predictive modelling, machine learning, and AI.
- **Data Integration:** Composable D&A can be used to integrate data from diverse sources, including databases, APIs, IoT devices, and external data providers.
- **Real-Time Analytics:** For applications requiring real-time data processing, composable D&A can be used to build streaming data pipelines.
- **Self-Service Analytics:** It enables self-service analytics platforms where business users can create their analytics workflows using pre-built components.

Composable D&A is a versatile approach that empowers organisations to adapt and innovate in the rapidly evolving field of data and analytics. It provides the flexibility and agility needed to harness the full potential of data for informed decision-making and business value creation.

9.7 Data Fabric:

The concept of data fabric encompasses an architectural framework that enables the seamless integration of diverse data pipelines and cloud environments by leveraging intelligent and automated technologies. In the past ten years, advancements in hybrid cloud, artificial intelligence, the internet of things (IoT), and edge computing have resulted in a significant increase in the volume of big data. This has therefore introduced additional intricacies for organisations to effectively handle and oversee. The expansion of data environments has led to an increased emphasis on the unification and governance of these environments. This is due to the emergence of several difficulties, including the presence of data silos, security vulnerabilities, and impediments to effective decision-making processes. Data management teams are actively tackling these difficulties by implementing data fabric solutions. The organisation is utilising these strategies to integrate their diverse data platforms, incorporate governance practices, enhance security and privacy protocols, and facilitate more data accessibility for employees, specifically those in business-related roles. The utilisation of data fabrics facilitates a comprehensive approach to decision-making that is centred around data. In the past, it was common for enterprises to utilise various data platforms that were specifically tailored to particular areas of business. As an illustration, one may possess distinct HR, supply chain, and consumer data platforms, each hosting data in separate environments, notwithstanding the possibility of overlapping information. Nevertheless, the implementation of a data fabric enables decision-makers to gain a more comprehensive perspective on the data, enhancing their comprehension of the customer lifecycle. This is achieved by establishing links between previously disparate data points that were not previously discernible. Data fabrics are playing a crucial role in expediting digital transformation and automation endeavours within firms by addressing gaps in comprehension pertaining to customers, products, and procedures.

The comparison between data fabric and data virtualization:

Data virtualization is a technological solution that facilitates the implementation of a data fabric strategy. Instead of employing conventional ETL (extract, transform, and load) procedures to physically transfer data from diverse on-premises and cloud sources, a data virtualization solution establishes connections with these sources, selectively integrates the necessary metadata, and generates a virtual data layer. Users are able to utilise the source data in real-time.

Data fabric architecture :

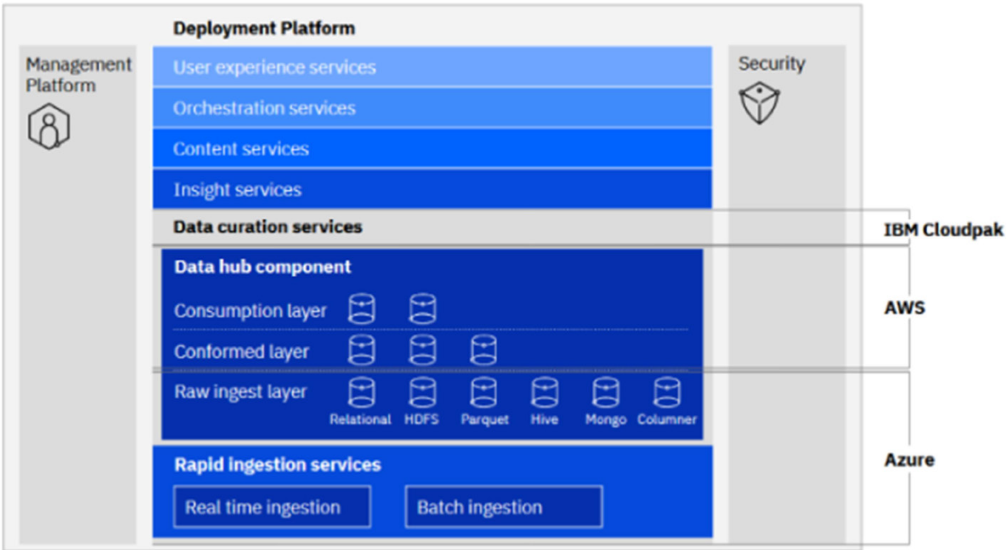
- Data fabrics utilise data services and application programming interfaces (APIs) to aggregate data from many sources such as legacy systems, data lakes, data warehouses, SQL databases, and applications. This integration enables a comprehensive perspective on business performance. In contrast to the aforementioned individual data storage systems, the objective of this approach is to foster greater flexibility within data settings, with the intention of mitigating the issue of data gravity. Data gravity refers to the notion that as data increases in magnitude, its mobility becomes increasingly challenging.
- A data fabric serves as a means of abstraction for the intricate technological processes involved in data transit, transformation, and integration, hence facilitating universal access to all data within an organisation.
- Data fabric architectures revolve around the concept of establishing loose connections between data residing in platforms and the applications that require access to it.

An illustration of data fabric architecture in a multi-cloud context may be observed in the following scenario, wherein a specific cloud provider like AWS has responsibility for data import, while another platform like Azure is tasked with overseeing data transformation and consumption. Additionally, it is possible to incorporate a third vendor, such as IBM Cloud Pak® for Data, which offers analytical services. The data fabric architecture integrates these settings in order to establish a cohesive perspective of data. However, it is important to note that this is merely an isolated instance. The data fabric does not have a standardised data architecture as it is tailored to the specific requirements of individual organisations. The diverse array of cloud providers and data infrastructure implementations results in a wide range of options available to enterprises, leading to variability in their choices. Nevertheless, enterprises who employ this particular data framework demonstrate shared characteristics inside their architectures, which are distinct to a data fabric.

In particular, the aforementioned components consist of six key elements, as outlined by Forrester in the research titled "Enterprise Data Fabric Enables DataOps" (Forrester, n.d.).

The six levels encompass the subsequent components:

- The data management layer is a crucial component in information systems architecture. It is responsible for the organisation, storage, and retrieval of data within the system. The individual or entity in question assumes the responsibility for overseeing data governance and ensuring the security of data.
- The data ingestion layer serves as the initial step in integrating cloud data by identifying relationships between structured and unstructured data.
- The data processing layer is responsible for the refinement of data, with the objective of extracting just the pertinent information for further analysis.
- The data orchestration layer plays a crucial role in the data fabric by performing essential tasks such as data transformation, integration, and cleansing. These processes enable the data to be effectively utilised by various departments within the organisation.
- The data discovery layer facilitates the identification of novel prospects for integrating diverse data sources. For instance, it could facilitate the integration of data from a supply chain data mart and a customer relationship management data system, thereby creating novel avenues for client product offerings or enhancing customer happiness.
- The Data Access layer facilitates the retrieval and use of data, thereby guaranteeing that specific teams possess the appropriate authorizations to adhere to governmental laws. Furthermore, this layer facilitates the presentation of pertinent data by employing dashboards and other tools for data visualisation.



Source: IBM

The use scenarios of data fabrics

The adoption of data fabrics is now in its early stages, nevertheless, these frameworks offer valuable data integration capabilities that support businesses in the process of data discovery, enabling them to address a wide range of use cases. Although the use cases that a data fabric might address may not exhibit significant divergence from other data products, its distinguishing factor lies in its capacity to handle extensive breadth and scale by eliminating data silos. By leveraging the integration of many data sources, organisations and their data scientists can develop a comprehensive understanding of their customer base, a practise that has proven particularly advantageous in the context of banking clientele.

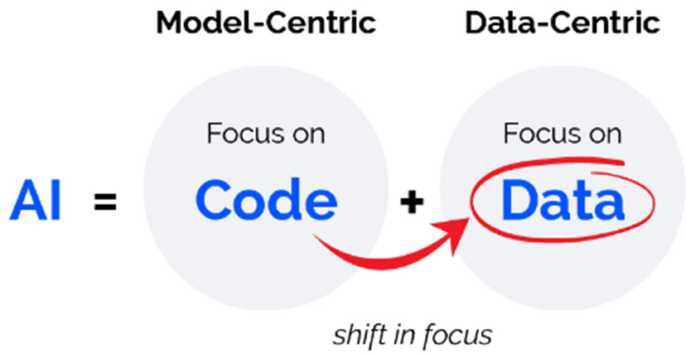
The various applications encompassed within this domain include

- Customer profiles,
- Fraud detection,
- Preventative maintenance analyses,
- Return-to-work risk models,
- And other related areas.

9.8 Data Centric AI:

"Instead of focusing on the code, companies should focus on developing systematic engineering practices for improving data in ways that are reliable, efficient, and systematic. In other words, ***companies need to move from a model-centric approach to a data-centric approach****."*

Andrew Ng, CEO and Founder of Landing AI



Source: Landing AI

Data-centric AI, also known as data-centric artificial intelligence, is an approach to artificial intelligence that places a strong emphasis on the quality, management, and utilisation of data as a fundamental driver of AI system performance and success. In data-centric AI, the focus is on understanding, collecting, organising, and optimising data to improve the outcomes of AI applications.

Here are key aspects and benefits of data-centric AI

Key Aspects of Data-Centric AI:

- **Data Quality:** Data-centric AI prioritises the quality of data, including accuracy, completeness, consistency, and timeliness. High-quality data is considered essential for training and deploying effective AI models.
- **Data collection** involves the strategic collection of relevant and diverse datasets, often requiring data from various sources, including sensors, databases, the internet, and user-generated content.
- **Data Preparation:** Data-centric AI includes data pre-processing tasks such as data cleaning, transformation, feature engineering, and normalisation to ensure data is in a suitable format for AI model training.
- **Data Governance:** It emphasises data governance practices, including data security, compliance, privacy, and data lineage tracking, to ensure responsible and ethical use of data.
- **Data Management:** Efficient data storage, indexing, retrieval, and version control are critical components of data-centric AI systems.
- **Data Integration:** Integrating data from disparate sources and formats is essential for building comprehensive AI models.
- **Data Labelling:** In supervised learning tasks, data-centric AI requires accurate data labelling to create training datasets.

- **Data Augmentation:** Techniques like data augmentation are used to increase the diversity and size of training datasets.
- **Data Bias Mitigation:** Identifying and addressing bias in data is a key concern, as biased data can lead to biased AI models.
- **Data Lifecycle:** Managing data throughout its lifecycle, from collection and storage to archiving and deletion, is part of the data-centric AI approach.

Benefits of data-centric AI:

- **Improved Model Performance:** High-quality, well-prepared data often leads to more accurate and reliable AI models.
- **Generalisation:** Models trained on diverse and representative data are more likely to generalise well to new, unseen data.
- **Ethical AI:** Data-centric AI promotes ethical AI practices by addressing data bias, privacy concerns, and regulatory compliance.
- **Cost Savings:** By focusing on data quality and data management, organisations can avoid costly mistakes caused by poor data.
- **Competitive Advantage:** Effective data-centric AI can provide a competitive edge by enabling better decision-making and customer insights.
- **Innovation:** Quality data is a foundation for AI-driven innovation, enabling new applications and services.

Challenges of data-centric AI:

- **Data Availability:** Ensuring access to the right data, especially in large organisations, can be challenging.
- **Data Privacy:** Striking a balance between data utilisation and user privacy is a complex issue.
- **Data Integration:** Integrating data from disparate sources can be technically challenging and require significant effort.
- **Data Bias:** Identifying and mitigating bias in data is an ongoing challenge.

Data-centric AI is considered a best practice in AI development because it recognises that AI models are only as good as the data they are trained on. By prioritising data quality, governance, and management, organisations can harness the full potential of AI for various applications, from predictive analytics and recommendation systems to computer vision and natural language processing.

Why does data-centric AI matter?

By adopting a data-centric AI approach, companies from diverse industries such as *automotive, electronics, and medical device production have seen improvements* *in deploying* AI and deep learning-based solutions in computer vision scenarios compared to traditional, rules-based implementations. Some improvements we've seen from the adoption of a data-centric approach can make AI benefits accessible to most companies.

- Build computer vision applications 10 times faster.
- Reduced time to deploy the application
- Improved yield and accuracy

9.9 Edge AI:

Edge AI refers to the implementation of artificial intelligence (AI) applications in various devices that are distributed over the physical environment. The term "edge AI" is used to describe the practice of doing AI computations in proximity to the user, at the network edge. This approach involves performing the computations in close proximity to the data, as opposed to centrally in a cloud computing facility or a private data centre.

Due to its worldwide accessibility, the internet possesses a pervasive reach, hence rendering the term "edge of the network" applicable to any given area. Various examples of entities that fall under the scope of this discussion include retail stores, factories, and hospitals, as well as ubiquitous technologies such as traffic lights, autonomous machines, and mobile phones.

The Significance of Edge AI in the Present Context:

Organisations across several industries are actively seeking to enhance automation in order to optimise operations, enhance efficiency, and bolster safety measures. In order to facilitate their functionality, computer programmes necessitate the ability to identify patterns and perform operations in a repetitive and secure manner. However, it is important to acknowledge that the world is characterised by a lack of structure, and the diverse array of jobs undertaken by humans encompasses an endless number of circumstances that cannot be comprehensively captured through programming and rule-based systems.

The progress made in the field of edge AI has created prospects for computers and gadgets, regardless of their location, to function with a level of cognitive "intelligence" comparable to that of humans. AI-powered intelligent apps have the ability to acquire knowledge and execute comparable tasks in diverse situations, akin to the way humans adapt and learn in real-world scenarios.

- ***The effectiveness of implementing artificial intelligence (AI) models at the edge is derived from three recent advancements.***
- **Maturation of Neural Networks:** The maturation of neural networks has reached a stage where they, together with the associated artificial intelligence

infrastructure, have achieved the capability of facilitating generalised machine learning. Organisations are currently acquiring knowledge on effectively training artificial intelligence (AI) models and implementing them in operational environments at the edge.

- **Advances in compute Infrastructure:** The progress in computational infrastructure is crucial for the effective implementation of artificial intelligence (AI) at the edge since it necessitates robust distributed computing capabilities. The utilisation of contemporary highly parallel graphics processing units (GPUs) has been employed to effectively carry out the execution of neural networks.
- **Adoption of IoT Devices:** The adoption of Internet of Things (IoT) devices the proliferation of the Internet of Things has significantly contributed to the rapid growth of big data. The advent of data collection capabilities across several domains of business, encompassing industrial sensors, smart cameras, robotics, and similar technologies, has provided us with the requisite data and devices to effectively implement artificial intelligence (AI) models at the edge. Furthermore, the use of 5G technology is significantly enhancing the capabilities of the Internet of Things (IoT) by offering improved connectivity that is characterised by enhanced speed, heightened stability, and increased security measures.

Lifecycle of an edge AI application.

Source: nvidia

In order for machines to possess the ability to visually see, engage in object detection, operate vehicles, comprehend speech, articulate language, ambulate, or otherwise imitate human capabilities, it is imperative for them to achieve a functional replication of human intelligence.

Artificial intelligence (AI) uses a computational framework known as a deep neural network to simulate human cognitive processes. Deep neural networks (DNNs) are trained to effectively respond to particular question types through exposure to numerous samples of such queries and their corresponding accurate replies.

The training procedure, commonly referred to as "deep learning," is frequently conducted in a data centre or cloud environment due to the substantial volume of data necessary for training a precise model as well as the requirement for collaborative efforts among data scientists in constructing the model. Upon completion of the training process, the model transitions into an "inference engine" capable of providing responses to queries encountered in real-world scenarios.

In edge artificial intelligence (AI) deployments, the inference engine is executed on a variety of computing devices situated in geographically dispersed areas, including but not limited to factories, hospitals, automobiles, satellites, and residential dwellings. In instances where the AI encounters difficulties, the problematic data is frequently transferred to the cloud for additional training of the initial AI model. Eventually, this updated model will supersede the inference engine located at the edge. The feedback loop is a crucial factor in enhancing the performance of models, as it facilitates continuous improvement of edge AI models after deployment, leading to increased intelligence over time.

What are some instances when Edge AI is employed?

- Artificial intelligence (AI) is the most influential technological force in contemporary society. Currently, we find ourselves in an era where artificial intelligence (AI) is significantly transforming the world's most prominent sectors.
- ***Artificial intelligence (AI) is significantly influencing various industries such as manufacturing, healthcare, financial services, transportation, energy, and others.***
- ***This technology is vital in generating novel business outcomes across all sectors, encompassing:***
- **Intelligent Forecasting in Energy:** Intelligent forecasting plays a crucial role in important industries like energy, where the potential disruption of supply poses significant risks to the overall well-being and safety of the general population. Edge AI models play a crucial role in integrating historical data, weather patterns, grid health, and other relevant information to develop intricate simulations. These simulations serve as valuable tools for enhancing the efficiency of energy resource generation, distribution, and management, ultimately benefiting customers.
- **Predictive Maintenance in Manufacturing:** The application of predictive maintenance in the manufacturing industry involves the utilisation of sensor data to identify anomalies at an early stage and anticipate the occurrence of machine failures. The equipment is equipped with sensors that are capable of scanning for defects. In the event that a flaw is detected, the sensors promptly notify management, enabling them to promptly rectify the issue. This proactive approach helps mitigate the risk of costly downtime.

- **AI- Powered Instruments in Healthcare:** The integration of artificial intelligence (AI) into healthcare instruments is a notable development in modern medicine. These advanced medical instruments are now equipped with AI capabilities, enabling them to do tasks such as ultra-low-latency streaming of surgical footage. This technological feature facilitates minimally invasive procedures and provides immediate access to valuable insights as needed.
- **Smart virtual Assistants in Retail:** Retailers are actively seeking to enhance the digital consumer experience through the implementation of intelligent virtual assistants, with a particular focus on voice ordering as a means to supplant traditional text-based searches with voice commands. Voice ordering enables shoppers to conveniently search for things, request product information, and make online purchases through the use of smart speakers or other intelligent mobile devices.

What is the significance of cloud computing in the context of Edge computing?

Artificial intelligence (AI) applications have the capability to operate either within a data centre, such as those found in public clouds, or in the field at the network's edge, in close proximity to the end user. Both cloud computing and edge computing have advantages that can be leveraged in tandem during the implementation of edge artificial intelligence (AI) systems.

The utilisation of cloud computing presents advantages in terms of infrastructure cost reduction, scalability, enhanced utilisation rates, increased resilience against server failures, and improved communication capabilities. Edge computing provides several advantages, including enhanced reaction times, reduced bandwidth expenses, and increased resilience against network failures.

There are multiple methods via which cloud computing can provide support for the deployment of edge artificial intelligence (AI).

- The cloud has the capability to execute the model while it undergoes the training phase.
- The model is continuously executed in the cloud while undergoing retraining using data received from the edge.
- In instances where computational capacity takes precedence over response speed, the cloud has the capability to execute artificial intelligence (AI) inference engines that provide additional support to the existing models deployed in the field. As an illustration, a voice assistant has the capability to acknowledge its designated name, although it delegates intricate queries to the cloud for parsing.
- The cloud facilitates the provision of the most recent iterations of the artificial intelligence model and application.

- Edge artificial intelligence (AI) is frequently deployed across a multitude of devices in various locations, while the associated software is hosted on cloud-based platforms.

The prospective trajectory of Edge AI:

The availability of mature neural networks in the commercial sector, the widespread use of Internet of Things (IoT) devices, advancements in parallel computing, and the deployment of 5G technology have collectively contributed to the establishment of a strong foundation for generalised machine learning. This enables organisations to use the immense potential of integrating artificial intelligence (AI) into their operational environments, enabling them to effectively utilise real-time information, reduce expenses, and enhance data privacy.

The current stage of edge AI is still in its nascent phase, and the potential applications appear to be boundless.

9.1.1 Transformers:

A transformer model is a neural network that discovers context and, consequently, meaning by monitoring relationships in sequential data, such as the words in this sentence.

Transformer models use an evolving set of mathematical techniques known as attention or self-attention to detect the subtle ways even distant data elements in a series influence and rely on one another.

Transformers, which were first described in a 2017 Google paper, are among the newest and most potent classes of models created to date. They are generating a wave of machine learning advancements that some have dubbed transformative AI.

In an August 2021 paper, Stanford researchers referred to transformers as "foundation models" because they see them as spurring a paradigm shift in AI. The "sheer scale and scope of foundation models over the last few years have stretched our imagination of what is possible," they wrote.

What can model transformers do?

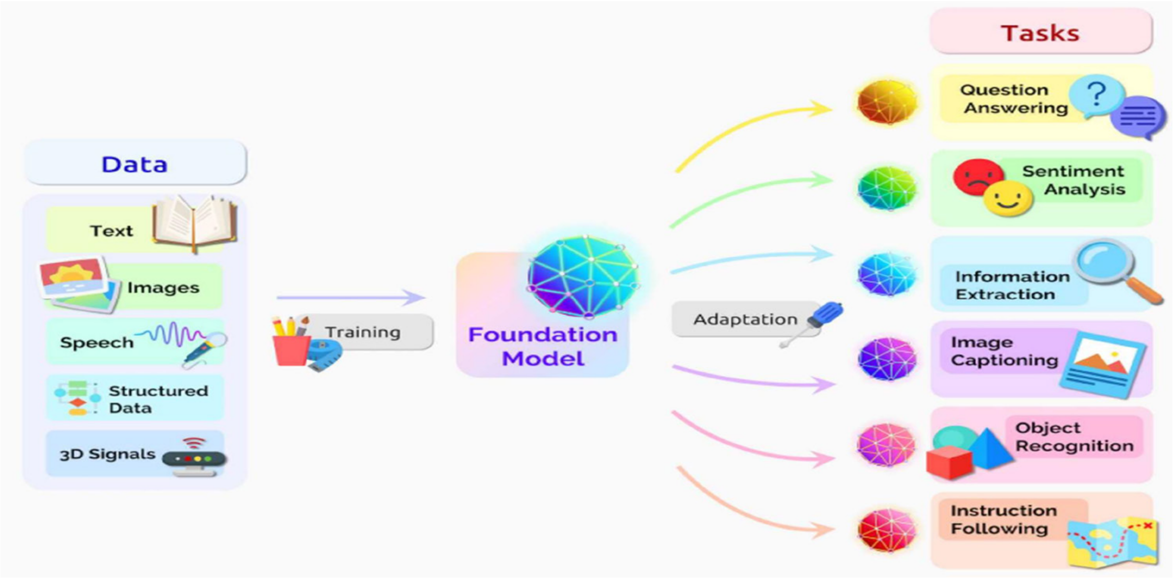
Transformers translate text and speech in almost real-time, making meetings and classrooms accessible to diverse and hearing-impaired participants.

They are assisting researchers in comprehending the chains of genes in DNA and amino acids in proteins so as to expedite the drug design process.

What can model Transformers do?

Transformers translate text and speech in almost real-time, making meetings and classrooms accessible to diverse and hearing-impaired participants.

They are assisting researchers in comprehending the chains of genes in DNA and amino acids in proteins so as to expedite the drug design process.



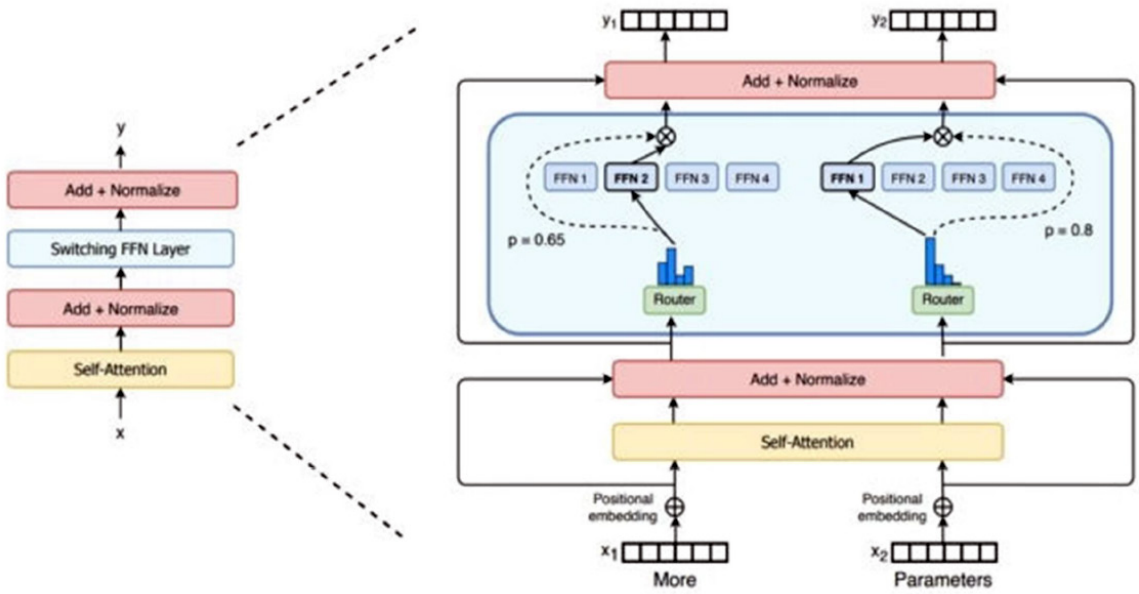
Source : nvidia

The use of transformers as a replacement for convolutional neural networks (CNNs) and recurrent neural networks (RNNs) is being explored. In numerous instances, transformers are being employed as substitutes for convolutional and recurrent neural networks (CNNs and RNNs), which were the prevailing sorts of deep learning models merely half a decade ago.

It is worth noting that a significant proportion, specifically 70 percent, of the research papers on artificial intelligence (AI) that have been published on arXiv within the past two years make reference to transformers. This represents a significant departure from the findings of a 2017 study by the Institute of Electrical and Electronics Engineers (IEEE), which showed that recurrent neural networks (RNNs) and convolutional neural networks (CNNs) were the dominant models for the task of pattern recognition.

The acronym "MoE" stands for "More for Transformers."

In a previous publication, researchers from Google provided a description of the Switch Transformer, which is considered to be among the pioneering models with a trillion parameters. The utilisation of AI sparsity, a sophisticated mixture-of-experts (MoE) framework, and several other advancements are employed to enhance performance in language processing and achieve notable improvements of up to sevenfold in pre-training speed.



Source: nVidia

9.1.2 Federated Machine Learning:

Federated learning refers to a decentralised machine learning approach that enables multiple devices or entities to collaboratively train a shared model while keeping the training data locally on each device, preserving data privacy and security. The given scenario involves a group of N data owners, denoted as {F1, FN}, who collectively aim to train a machine learning model by aggregating their individual datasets {D1, DN}. One often employed approach involves aggregating all available data and utilising the union of datasets D1 through DN to train a model denoted as MSU M. A federated learning system refers to a method of learning.

The proposed approach involves the collaborative training of a model, referred to as MF ED, in which data owners collectively participate. During this process, each data owner, denoted as Fi, ensures the privacy of its data, Di, by not disclosing it to others. Furthermore, it is expected that the precision of MF ED, represented as VF ED, will closely align with the efficacy of MSU M, indicated as VSU M. Let δ represent a non-negative real number.

If the absolute difference between VF ED and VSU M is less than δ, we can conclude that the federated learning algorithm exhibits a -accuracy loss.

Federated learning is a novel approach to training artificial intelligence (AI) models that ensures data privacy by preventing any direct access to or manipulation of the underlying data. This technique enables the extraction of valuable insights from distributed data sources, facilitating the development of innovative AI applications.

Artificial intelligence has become an integral part of contemporary society through the use of data, specifically vast quantities of training examples obtained through site scraping or customer contributions in exchange for various benefits such as free email services, music streaming, and other incentives.

A significant number of these artificial intelligence (AI) applications were trained using data that was collected and processed in a single location. However, the current state of artificial intelligence is undergoing a transition towards a decentralised methodology. Collaborative training of novel artificial intelligence (AI) models is currently being conducted on localised computing devices such as mobile phones, laptops, and private servers. This approach ensures that the data utilised for training purposes remains confined within these devices and does not traverse external networks.

The emerging technique in artificial intelligence training, known as federated learning, is increasingly being adopted as the prevailing method to comply with a multitude of recently implemented requirements pertaining to the management and storage of sensitive personal information. Federated learning presents an opportunity to leverage the unprocessed data originating from many sources, such as satellites, bridges, machines, and an increasing array of smart devices located both in domestic settings and on individuals. This is achieved by doing data processing directly at the source.

Applications :

Federated learning has a promising application in sales, finance, and many other industries where data cannot be directly aggregated for training machine learning models due to factors such as intellectual property rights, privacy protection, and data security. Federated learning is an innovative modelling mechanism that could train a unified model on data from multiple parties without compromising the privacy and security of those data.

Consider clever retail as an illustration. Its purpose is to use machine learning techniques to deliver personalised services to consumers, primarily product recommendations and sales services. Purchasing power, personal preferences, and product characteristics comprise the majority of the data features involved in the smart retail business. In practical applications, these three data characteristics are likely to be dispersed across three departments or businesses. For instance, a user's purchasing power can be inferred from her bank savings, and her personal preferences can be analysed from her social networks, while an e-commerce site records the characteristics of products. In this scenario, we are confronted with two issues. For the preservation of data privacy and security, it is difficult to breach data barriers between banks, social networking sites, and online shopping sites. Consequently, data cannot be aggregated directly to train a model. Second, the data stored by the three parties is typically heterogeneous, and conventional machine learning models cannot operate directly on heterogeneous data. Traditional machine learning methods have not been able to effectively address these problems, which hinders the spread and application of artificial intelligence in additional fields. The solution to these problems lies in federated learning and transfer learning. First, by leveraging the characteristics of federated learning, we can construct a machine learning model for the three parties without exporting enterprise data, which not only fully protects data privacy and security but also provides personalised and targeted services to customers, thereby achieving mutual benefits. In the meantime, we can use transfer learning to solve the data heterogeneity issue and overcome the limitations of conventional artificial intelligence techniques. Federated learning therefore provides a strong technical foundation for us to construct an enterprise-, data-, and domain-spanning ecosphere for big data and artificial intelligence. Using a federated learning framework, one can query multiple-party databases without exposing the data. Suppose, for instance, that in a finance application we are interested in detecting multiparty borrowing, a significant risk factor in the banking industry. This occurs when a user maliciously borrows from one bank to repay another bank's loan. Multiparty borrowing is a threat to financial stability, as a significant number of illegal transactions of this nature could bring about the collapse of the entire financial system. A federated learning framework can be utilised to discover such individuals without exposing the user list between banks A and B. Specifically, we can use the encryption mechanism of federated learning to encrypt the user list at each party and then calculate the intersection of the encrypted lists in the federation. The decryption of the final result reveals the list of multi-party borrowers without revealing the identities of "good" users to the other party.

We also anticipate that the rise of federated learning techniques will have a substantial impact on intelligent healthcare. Medical data, such as disease symptoms, gene sequences, and medical reports, are highly sensitive and confidential; however, medical data are difficult to acquire and are located in isolated medical centres and hospitals. Inadequate data sources and a lack of labels have resulted in the unsatisfactory performance of machine learning models, which has impeded the development of digital healthcare. We anticipate that the performance of machine learning models trained on a large medical dataset would be substantially enhanced if all medical institutions were to unite and share their data to create a large medical dataset. Federated learning combined with transfer learning is the most effective method for achieving this objective. Transfer learning could be used to fill in the missing labels, thereby increasing the amount of available data and enhancing the performance of a trained model. Consequently, federated transfer learning would play a crucial role in the development of digital healthcare, and it could potentially revolutionise human health care.

Fig. 5. Data Alliance Allocates the Benefits on Blockchain

Source: Federated Machine Learning: Concept and Applications

The Challenges and Concerns Surrounding Data :

Google coined the term federated learning in 2016, at a time when the use and abuse of personal data were garnering worldwide attention. The Cambridge Analytica scandal alerted Facebook users and users of similar platforms to the risks of sharing confidential information online. It also prompted a broader debate on the pervasive, often unconsented-to, tracking of Internet users.

At the same time, a series of high-profile data breaches have further undermined public confidence in the ability of companies to safeguard personal information. In 2018, Europe enacted its expansive data privacy law, GDPR, and California, the hub of digital platforms supported by advertising revenues, followed suit. Since then, Brazil, Argentina, and Canada have proposed or enacted their own digital privacy laws. People had been distributing data and computation burdens across multiple servers to accelerate AI training for years.

How learning is spread out works :

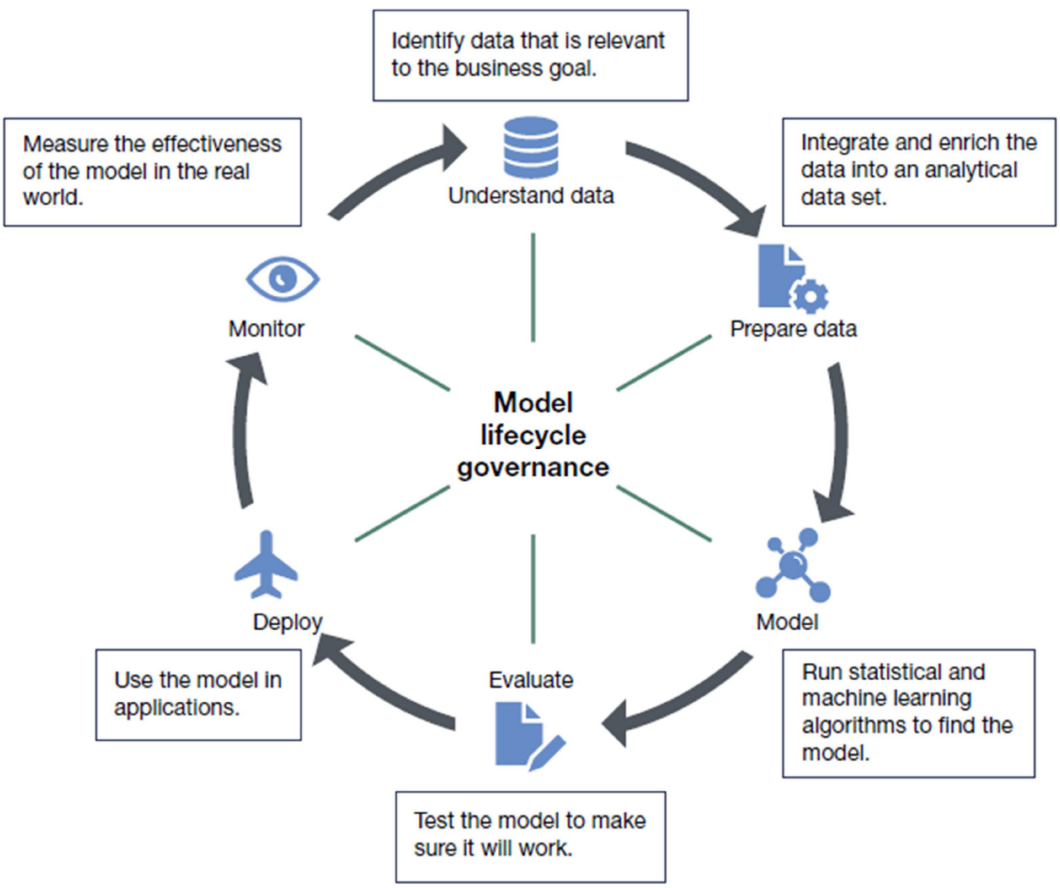
Under federated learning, multiple people share their data remotely to train a single deep learning model together, making small improvements each time. This is similar to a team show or report. Each party gets the model from a cloud-based data center. Usually, this is a pre-trained basic model. They give it their secret data to learn from, and then they summarise and encrypt the new configuration of the model. The changes to the model are sent back to the cloud, where they are decrypted, averaged, and added to the central model. The joint training keeps going, iteration after iteration, until the model is fully trained.

There are three kinds of this distributed, decentralised teaching process. In horizontal federated learning, similar datasets are used to teach the central model. In vertical federated learning, the data are compatible.

For example, a person's music tastes can be predicted by combining their movie and book reviews. Lastly, in federated transfer learning, a foundation model that has already been trained to do something, like find cars, is trained on a different set of data to do something else, like find cats. Baracaldo and her partners are working on making federated learning use foundational models. In one possible use, banks could teach an AI model to spot theft and then use it for other things.

9.1.3 ModelOps:

"Artificial intelligence (AI) model operationalization (ModelOps) is a set of capabilities that primarily focuses on the governance and full life cycle management of all AI and decision models. This includes models based on machine learning (ML), knowledge graphs, rules, optimisation, natural language techniques, and agents. In contrast to MLOps (which focuses only on the operationalization of ML models) and AIOps (which is AI for IT operations), ModelOps focuses on operationalizing all AI and decision models." **– Gartner**



Features of ModelOps :

ModelOps demonstrates exceptional performance in a constantly changing and evolving environment. The model possesses the capability to be readily modified in response to alterations in the specified condition. Organisations employ diverse approaches to address various business challenges. ModelOps allows for the seamless switching or scaling of systems as needed.

ModelOps serves as a connecting link between individuals involved in the fields of data science, data engineering, application ownership, and infrastructure ownership. It facilitates active cooperation and enhances productivity.

Enterprises employ the practice of ModelOps to address various difficulties, such as:

- **Regulatory Compliance:** In order to adhere to regulatory mandates, it is imperative to establish a systematic approach for replicating training, evaluating, and scoring each model. Model monitoring plays a crucial role in upholding compliance gates and controls, thereby ensuring the fulfilment of both business and regulatory prerequisites.

- **Silos Environment:** In the context of model deployment and monitoring, it is common for multiple teams to be involved, resulting in a siloed environment. The lack of good collaboration among teams might pose challenges in the process of growing artificial intelligence. The consolidation of teams is vital, and ModelOps facilitates the establishment of a conducive setting for the seamless transition of models from the data science team to the IT production team.

- **Different models have different Solutions:** Various models exhibit distinct solutions. Enterprises may own a multitude of models tailored to address diverse business difficulties. Each model takes into consideration distinct differences in company processes as well as distinctive segmentations of customers, among other factors. ***ModelOps offers a unified perspective that enables the observation of workflows, auditing processes, performance optimisation, and governance mechanisms, thereby facilitating cost control and value generation.***

- **Complex Technology:** A diverse array of solutions, techniques, and technologies are currently accessible for addressing data and analytics challenges. Managing multiple breakthroughs simultaneously might be challenging. Even the most proficient teams may struggle to maintain pace. ModelOps simplifies the process of incorporating and embracing novel technologies.

- **The Utilisation of ModelOps in Various Scenarios:** Numerous managers have encountered difficulties in showcasing the efficacy of analytics due to the frequent failure of analytics solutions to be implemented in operational settings. The implementation of ModelOps has the potential to address this issue.

ModelOps is being widely utilised in several domains to address the issues associated with model deployment.

- **Finance:** ***In the realm of finance, it is worth noting that banks have adopted the practice of employing statistical models for the purpose of credit approval.*** Furthermore, it is evident that a significant portion of operational decision-making within the field is currently influenced by the utilisation of real-time analytics. The use of a model-based approach has proven beneficial in terms of reducing labour hours within the banking sector. However, the management of these intricate models on a large scale presents its own set of challenges. It is imperative that these models exhibit fairness and robustness, thereby facilitating impartial decision-making. Model Operations (ModelOps) facilitates the monitoring of models for potential bias or anomalies, as well as the subsequent updating of those models as necessary.

- **Healthcare:** The implementation of artificial intelligence (AI) in healthcare has the potential to enhance operational efficiency and the quality of patient care while simultaneously mitigating the occurrence of expensive administrative errors. However, it is necessary to update machine learning models periodically by incorporating up-to-date data, new key performance indicators (KPIs), and other relevant information. Additionally, the data was monitored in order to assess and analyse any deviations from the expected patterns or norms. The revised models must be easily accessible across many platforms, such as a mobile application or a laboratory system, in order to maintain synchronisation of the outcomes.

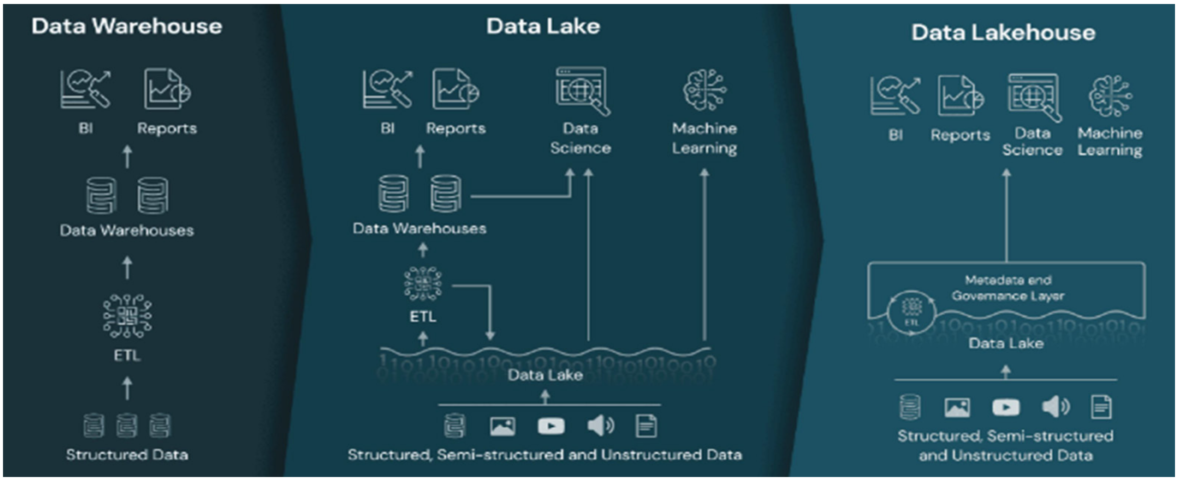
- **Retail:** The retail industry experienced a significant shift towards online operations in response to the onset of the COVID-19 pandemic. However, the successful implementation and monitoring of artificial intelligence (AI) technologies posed challenges during this transition period. The ModelOps framework offers the capability to effectively monitor models and generate a comprehensive overview of essential indicators, enabling the assessment of model performance in a production environment***. In order to comprehend the domains of expansion and alleviate the workload for data scientists and IT professionals, retail enterprises have chosen to implement automation and standardisation of machine learning operators. Companies such as Domino's Pizza have successfully enhanced the effectiveness of managing numerous models on a large scale.***

9.1.4 What is Lakehouse?:

Introduction: In recent years, a novel data management architecture known as the "lakehouse" has been observed to have independently emerged across numerous clients and use cases at Databricks. This guideline publication for cost accountants provides a comprehensive overview of a novel architectural framework and elucidates its inherent benefits in comparison to preceding methodologies. Data warehouses have a significant historical presence within the realm of decision support and business intelligence applications. The technology of data warehousing has seen continuous development since its emergence in the late 1980s, with the introduction of massively parallel processing (MPP) architectures enabling the handling of increasingly bigger volumes of data. However, whereas warehouses have proven to be effective for managing structured data, many contemporary businesses face the challenge of handling unstructured data, semi-structured data, and data that exhibits significant diversity, velocity, and volume. Data warehouses are not well-suited for a significant number of these use cases, and they are definitely not the most economically efficient option.

With the proliferation of data collection by firms from many sources, architects have started conceptualising a unified system capable of accommodating data for various analytical products and workloads. Approximately ten years ago, corporations initiated the construction of data lakes, which serve as storage facilities for unprocessed data in several formats. Although data lakes are effective for data storage purposes, they possess several limitations. Notably, they do not provide support for transactions, fail to enforce data quality, and their lack of consistency and isolation pose challenges in combining appends and reads, as well as batch and streaming tasks. Due to various factors, a significant number of the anticipated advantages associated with data lakes have not been realised, often resulting in the forfeiture of several benefits typically offered by data warehouses.

The demand for a versatile and efficient system remains unchanged. Organisations necessitate the implementation of various systems to cater to a wide range of data applications, encompassing SQL analytics, real-time monitoring, data science, and machine learning. The majority of recent advancements in artificial intelligence (AI) have been focused on the development of enhanced models for effectively analysing unstructured data, such as text, photos, video, and audio. However, it is worth noting that data warehouses, which are designed to optimise structured data storage and retrieval, are not specifically tailored to handle this sort of unstructured data. A frequently employed strategy involves the utilisation of several systems, including a data lake, various data warehouses, and other specialised systems such as streaming, time-series, graph, and picture databases. The presence of numerous systems brings intricacy and, significantly, leads to delays as data professionals inevitably encounter the requirement to transfer or duplicate data across various platforms.



Source: Databricks

What is a lakehouse ?

Beginning to emerge are new systems that resolve the limitations of data lakes. A lakehouse is a novel, open architecture that incorporates the most advantageous characteristics of data lakes and data warehouses. Implementing similar data structures and data management features to those in a data warehouse directly on top of low-cost cloud storage in open formats enables lakehouses. Object stores are what you would get if you had to redesign data warehouses in the modern world, given the availability of inexpensive and extremely reliable storage.

A lakehouse possesses the following characteristics:

- **Transaction Support:** In an enterprise lakehouse, many data pipelines will simultaneously receive and write data. Transaction support is required. Support for ACID transactions ensures data integrity when multiple parties concurrently read or write SQL data.
- **Schema enforcement and governance:** The Lakehouse should support schema enforcement and evolution, supporting DW schema architectures like star and snowflake schemas. *The system should be able to reason about data integrity and have rigorous mechanisms for governance and auditing.*
- **BI Support:** Lakehouses permit the use of BI tools directly on the source data. This reduces staleness and increases recency, decreases latency, and reduces the cost of operationalizing two copies of the data in a data lake and a warehouse.
- **Storage is decoupled from compute:** Storage and computation are decoupled. In practice, this entails the use of distinct clusters for storage and computation, allowing these systems to scale to accommodate significantly more concurrent users and larger data sizes. Several contemporary data repositories also possess this property.

- **Openness:** The storage formats they use, such as Parquet, are open and standardised, and they provide an API so that a variety of tools and engines, such as machine learning and Python/R libraries, can access the data directly and efficiently.
- **Support for various data types spanning from unstructured to structured data:** The lakehouse can be used to store, refine, analyse, and access data types required for numerous new data applications, such as images, video, audio, semi-structured data, and text.
- **Support for diverse workloads:** Support for diverse workloads, including data science, machine learning, SQL, and analytics. There may be a need for multiple tools to support these duties, but they all use the same data repository.
- **Complete streaming:** Real-time reporting is the norm for many businesses. Streaming eliminates the requirement for dedicated systems to serve real-time data applications.

These are the primary characteristics of lakehouses. Enterprise-level systems necessitate additional capabilities. Tools for security and access management are prerequisites. In light of recent privacy regulations, data governance capabilities, such as auditing, retention, and lineage, are essential. *Data discovery tools, such as data catalogues and data usage metrics, are also required. Such enterprise features need only be implemented, verified, and administered for a single system using a lakehouse.*

9.1.5 Personification in AI:

In the realm of artificial intelligence (AI) and technology, personification pertains to the act of attributing human-like qualities, characteristics, or attributes to AI systems or digital entities. This practise is frequently employed to enhance user connection and engagement, hence rendering AI systems more relevant and user-friendly. The following examples illustrate instances of personification within the field of artificial intelligence:

- Virtual assistants such as Siri, Google Assistant, and Alexa are frequently endowed with anthropomorphic characteristics, including names, genders, and distinct vocalisations. Individuals engage with these artificial intelligence entities in a manner that simulates human interaction with personal assistants.
- Chatbots employed in customer care and messaging apps are occasionally endowed with names and avatars, thereby enhancing their semblance to real beings and fostering approachability.
- **Emotional Artificial Intelligence (AI):** Certain AI systems have been developed with the capability to identify and react to human emotions, often ascribed with anthropomorphic qualities by assigning emotional consciousness to them.

For instance, an artificial intelligence (AI) system could be characterised as possessing qualities such as "empathy" or "compassion."

Humanoid robots in the field of robotics are frequently developed with the intention of emulating human actions and expressions, hence giving rise to a phenomenon known as personification. This characteristic enhances their ability to establish a connection and be easily accessible in various contexts, such as healthcare and customer service applications.

The utilisation of artificial intelligence (AI) in the realm of entertainment encompasses the incorporation of AI characters and entities inside various mediums such as video games, movies, and virtual reality experiences. These AI entities are frequently endowed with distinct personalities, emotions, and even backstories, all of which serve to augment user engagement.

Social media bots are automated programmes that operate on social media platforms, designed to emulate human users by creating profiles and identities. These bots engage in conversations and interactions with the intention of appearing more accessible and human-like.

The attribution of AI-generated art and music to AI "artists" or "composers" creates the perception of creative agency inside the realm of AI art and creativity.

Although the utilisation of personification in artificial intelligence (AI) has the potential to enhance user experiences and interactions, it is crucial to acknowledge that AI systems lack consciousness, emotions, and self-awareness. The utilisation of personification as a design strategy is intended to enhance user engagement and usability, rather than serving as a precise depiction of the capabilities of artificial intelligence. It is imperative for users to possess an understanding of the constraints inherent in AI systems and acknowledge their status as human-developed and human-controlled technologies.

9.1.6 Physics-Informed Machine Learning:

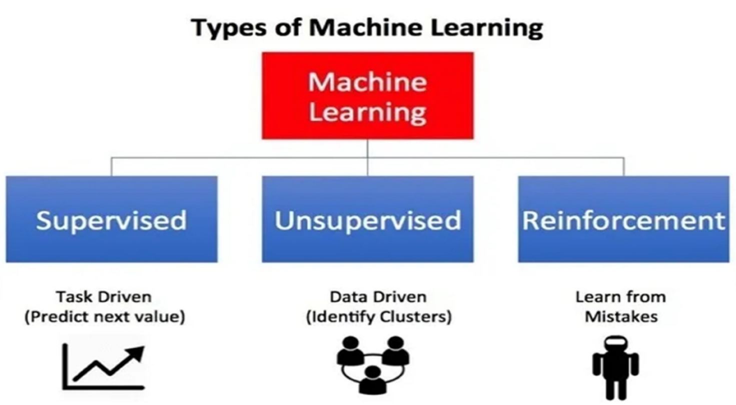
Even though numerical discretization of partial differential equations (PDEs) for simulating multiphysics problems has come a long way, there are still problems with integrating noisy data into current algorithms, dealing with complex mesh generation, and solving high-dimensional problems governed by parameterized PDEs. Furthermore, the resolution of inverse problems involving concealed physical phenomena is frequently financially burdensome and necessitates distinct formulations and intricate computer algorithms. The field of machine learning has shown itself as a viable option; nevertheless, the training of deep neural networks necessitates a substantial amount of data, which may not always be readily accessible for scientific endeavours. Alternatively, these networks have the potential to be trained using supplementary data acquired by the application of physical principles, such as the incorporation of random data points inside the continuous space-time domain. *Physics-informed learning is a methodology that combines both noisy data and mathematical models and applies them using neural networks or other regression networks based on kernels*. Furthermore, there is potential to develop customised network designs that inherently adhere to certain physical invariants, resulting in enhanced accuracy, expedited training, and increased generalisation. In this analysis, Data Scientists examine the predominant patterns observed in the integration of physics principles into machine learning methodologies. We proceed by outlining the existing capacities and constraints in this field and subsequently explore the various applications of physics-informed learning. These applications encompass both forward and inverse problems, encompassing the identification of concealed physical phenomena and the resolution of high-dimensional challenges.

Key factors:

- Even in partially understood, uncertain, and high-dimensional contexts, physics-informed machine learning incorporates data and mathematical physics models seamlessly.
- Kernel-based or neural network-based regression methods offer effective, uncomplicated, and meshless implementations.
- Combined with domain decomposition, physics-informed neural networks are effective and efficient for ill-posed and inverse problems and are scalable for large problems.
- Future research should focus on operator regression, the search for novel intrinsic variables and representations, and equivariant neural network architectures with built-in physical constraints.

There is a need for the development of new frameworks, standardised benchmarks, and mathematics for scalable, robust, and rigorous physics-informed learning machines of the next generation.

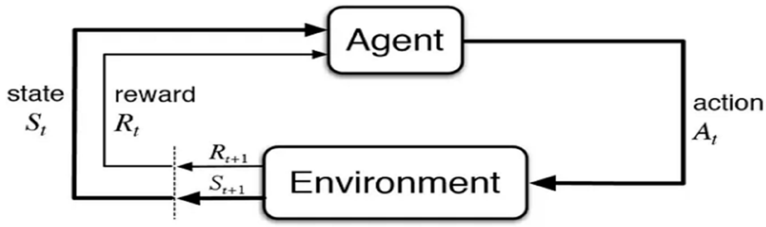
9.1.7 Reinforcement Learning:



Source: towards data science

Reinforcement learning (RL) is a machine learning methodology that facilitates an agent's acquisition of knowledge within an interactive environment through iterative experimentation, relying on feedback derived from its own actions and experiences. While both supervised learning and reinforcement learning involve the mapping of input to output, they differ in terms of the feedback provided to the agent. In supervised learning, the feedback consists of the correct set of actions for performing a task. On the other hand, reinforcement learning uses rewards and punishments as signals to reinforce positive behaviour and discourage negative behaviour.

Reinforcement learning exhibits distinct goal-oriented characteristics in comparison to unsupervised learning. The objective of unsupervised learning is to identify commonalities and disparities among data sets. Conversely, in the context of reinforcement learning, the objective is to determine an appropriate action model that maximises the agent's cumulative reward. The diagram presented below depicts the iterative process of a general reinforcement learning (RL) model, showcasing the interaction between actions taken by an agent and the corresponding rewards received.



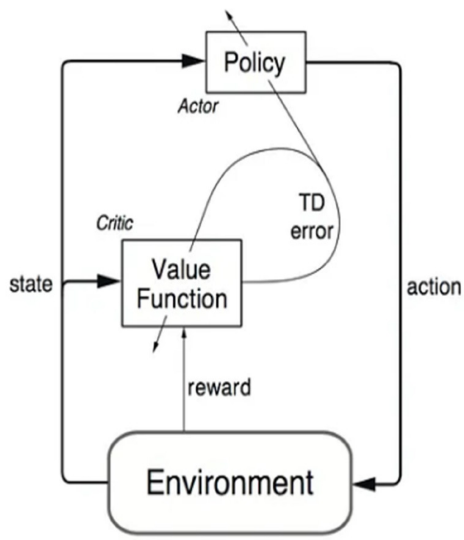
Source: towards data science

- **How can a fundamental reinforcement learning problem be formulated?**
- **Some essential terms describing the fundamental components of an RL problem are:**
- Environment: The physical surroundings in which an agent operates
- Condition: The current standing of the agent
- Reward: Environment-based feed-back
- Policy: mapping between agent state and actions
- Value: The future recompense an agent would receive for performing an action in a given state.

What are some of the most popular algorithms for reinforcement learning?

- ***Q-learning and SARSA (State-Action-Reward-State-Action) are two model-free RL algorithms that are frequently employed.*** Their exploration strategies differ, whereas their exploitation strategies are comparable. SARSA is an on-policy method, whereas Q-learning is an off-policy method in which the agent learns the value based on action a* derived from another policy. These two methods are straightforward to implement, but they lack generalizability because they cannot estimate values for unobserved states.

- ***This can be circumvented by more sophisticated algorithms such as Deep Q-Networks (DQNs),*** which estimate Q-values using neural networks. However, DQNs can only manage discrete action spaces with low dimensions.
- ***Deep Deterministic Policy Gradient (DDPG) is a model-free, off-policy,*** actor-critic algorithm that solves this problem by learning policies in high-dimensional, continuous action spaces. The figure below is a representation of actor-critic architecture.



Source: towards data science

What are the practical applications of reinforcement learning?

Since RL requires a lot of data, it is most applicable in domains where simulated data is readily available, like gaming and robotics.

- RL is quite widely used in building AI for playing computer games. **AlphaGo Zero** is the first computer programme to defeat a world champion in the ancient Chinese game of Go. Others include ATARI games, backgammon, etc.
- In robotics and industrial automation, RL is used to enable the robot to create an efficient adaptive control system for itself that learns from its own experience and behaviour. DeepMind's work on **deep reinforcement learning for robotic manipulation with asynchronous policy updates** is a good example of the same.

*****

CHAPTER - 10
Drive Quantifiable Value with D & A Solutions for the Business

10.1 Conversational User Interfaces (CUI):

A conversational user interface (CUI) refers to an interface that facilitates computer-human interaction through speech or text, replicating the dynamics of human communication in real-life scenarios. Utilising natural language understanding (NLU), this technology has the capability to identify and examine conversational patterns in order to decipher human speech**. *The most generally recognised instances are voice assistants such as Siri and Alexa.***

Voice interactions can occur across many platforms, such as online, mobile, and desktop applications, contingent upon the specific device being utilised. One common characteristic shared by many mediums employed to enable voice interactions is their emphasis on user friendliness and comprehensibility, with minimal requirements for user training or acclimation. The process can be simplified by initiating contact with the customer care department or enlisting the assistance of a colleague to complete the assigned work. CUIs can be understood as an integrated personal assistant that is embedded within pre-existing digital products and services. Historically, users were not afforded the opportunity to issue direct commands to bots. Conversely, individuals were required to retrieve information via the graphical user interface (GUI) by means of executing precise commands or selecting icons. Previous iterations of conversational user interfaces (CUI) were characterised by chat-like interactions, wherein automated bots would promptly reply to clients using predetermined and inflexible scripts.

However, it has undergone a transformation and has now become a very adaptable and dynamic entity, making it increasingly challenging to differentiate it from genuine human connection.

The conversational interface technology possesses the ability to acquire knowledge and engage in self-education, rendering it a perpetually advancing and intelligent mechanism.

What is the operational Mechanism of conversational user interfaces (CUIs)?

The conversational AI model, known as CUI, exhibits the ability to generate intricate and perceptive responses. The current platform transcends the binary nature of its predecessors, enabling it to effectively convey messages, inquire, and exhibit a sense of inquiry. In the past, command-line interfaces necessitated users to submit specific commands with accurate syntax, a limitation that was subsequently addressed with the development of graphical interfaces. Rather than requiring individuals to acquire proficiency in interacting with user interfaces (UI), the focus has shifted towards training conversational UI systems to comprehend human communication.

The fundamental technology is predicated upon:

- **Natural Language Processing (NLP):** Natural Language Processing (NLP) is an interdisciplinary field that integrates principles from linguistics, computer science, information engineering, and artificial intelligence in order to derive semantic understanding from user input. The system possesses the capability to analyse the organisation of human language and effectively manage intricate inquiries.
- **Natural Language Understanding:** Natural Language Understanding (NLU) is commonly regarded as a subfield within the domain of natural language processing with a more specific focus and restricted scope. However, the demarcation between these entities is not clearly defined, and they exhibit a symbiotic relationship. Through collaborative efforts, individuals in the academic community engage in the process of reinterpreting user intent, thereby extending their line of inquiry to acquire additional contextual information.

To illustrate, consider a straightforward inquiry, such as:

"I am in need of reserving accommodations for a hotel room in Mumbai City for the duration of January 10th to January 15th".

To effectively respond to this request, the machine must analyse the phrase by breaking it down into smaller groups of information. I would like to make a reservation for a hotel room (Intent) in Mumbai (City) from January 10th(date) to January 15th(Date)-overall neutral Sentiment.

The conversational user interface (UI) must possess the ability to retain and utilise previously provided context when responding to later inquiries.

As an illustration, an individual might inquire about the demographic size of France. The Common User Interface (CUI) offers a solution to the aforementioned inquiry. Subsequently, in the event that the subsequent statement is "Who currently holds the position of president?" the conversational AI system should not necessitate more clarification as it possesses prior knowledge of the contextual framework pertaining to the subsequent inquiry.

In contemporary software and online development, interactive conversational user interface applications generally comprise the following components:

- **Voice Recognition:** Voice recognition, often known as speech-to-text technology, A computer or mobile device uses a microphone to record and convert spoken language into written text. The method integrates an understanding of grammar, linguistic structure, and the composition of audio signals in order to extract information for subsequent processing. In order to attain the highest degree of precision, it is imperative to consistently update and refine the given information.

- **Natural Language Understanding (NLU):** The intricate nature of human speech poses challenges for computational systems in accurately interpreting user requests. Natural Language Understanding (NLU) is responsible for processing unstructured data and transforming it into a structured format, enabling comprehension and subsequent action based on the input. The system establishes connections between different user requests and corresponding intents, subsequently converting them into a coherent sequence of actions.
- **Dictionary/Sample:** The purpose of this study is to examine the role of dictionaries in language learning and provide examples of their usage. Individuals exhibit a level of complexity in their communication that surpasses the basic nature of computer systems, often employing several strategies to convey a singular message. Therefore, it is imperative that CUI possess an extensive collection of illustrative instances for every purpose. As an illustration, in the case of the user's request "Book Flight", the dictionary ought to encompass phrases such as "I am in need of a flight", "I desire to make arrangements for my travel", and all other comparable variations.
- **Context:** In the aforementioned instance featuring the French president, it was demonstrated that in a sequence of inquiries and responses, it is important for CUI to establish a correlation between them. In contemporary times, user interfaces commonly use an event-driven contextual methodology, allowing for the incorporation of an unstructured conversational flow.
- **Business Logic:** The CUI business logic establishes the rules and constraints of a certain tool by connecting it to particular use cases.
- **Type of Conversational User Interfaces:**

These classifications are based on the different characteristics and functionalities of CUIs.

Some of the commonly recognised types include:

Text-based CUI: There are two discernible categories of conversational user interface (UI) designs that may be identified.

Text-based bots and voice assistants are two distinct types of conversational agents.

Text-based bots are designed to communicate with users through written messages, **while voice assistants** are designed to engage in conversation using spoken language.

It is important to note that there are chatbots that employ the name "chatbot" as a mere marketing buzzword. The aforementioned chatbots are designed to mimic a command-line user interface (CUI) through a point-and-click graphical user interface (GUI), presenting themselves as deceptive representations. This analysis will focus on two distinct classifications of conversational interfaces that do not depend on instructions with syntax specificity.

- Chatbots, also known as conversational agents, are computer programmes designed to simulate human conversation. Chatbots have been present in the technological landscape for a considerable period of time. An instance of a computer programme known as ELIZA, which originated in the 1960s, can serve as an illustrative example. However, it is only through recent breakthroughs in machine learning, artificial intelligence, and natural language processing (NLP) that chatbots have begun to significantly contribute to the resolution of user issues.

- Given the widespread familiarity with messaging platforms, the act of sending a message to a bot requires minimal exertion on the part of most individuals. A chatbot typically assumes the configuration of a messaging interface within a mobile application or a dedicated window within a web browser. The individual articulates their current predicament or poses inquiries in textual format. ***The chatbots are capable of generating follow-up questions or providing relevant responses even in the absence of specific orders.***

- ***Voice recognition systems, also known as speech recognition systems, are technological tools designed to convert spoken language into written text.*** These systems utilise various algorithms and models to analyse and interpret **Voice User Interfaces (VUI) function in a manner akin to chatbots; however, they engage with users primarily through auditory means. Virtual assistants are rapidly gaining popularity and are being integrated into many technologies, such as smartphones, televisions, smart homes, and other consumer devices, much like chatbots.**

- Individuals have the ability to request information from a voice-based virtual assistant, which can retrieve data from many sources, such as their personal mobile devices, the internet, or applications that are compatible with the assistant. The activation of voice systems may vary depending on their nature and level of advancement, necessitating specific actions, prompts, or keywords. As the number of products and services integrated into the system increases, the assistant's capabilities and adaptability also grow in complexity.

Business Use Cases

Chatbots and voice UIs are gaining a foothold in many important industries. These industries are finding new ways to include conversational UI solutions. Its abilities extend far beyond what now-dated, in-dialogue systems could do.

Here are several areas where these solutions can make an impressive impact.

Retail and e-commerce:

A CUI can provide updates on purchases, billing, shipping, address customer questions, navigate through websites or apps, offer product or service information, and many other use cases. This is an automated way of personalising communication with your customers without involving your employees.

Construction sector:

CUI can be helpful for architects, engineers, and construction workers who frequently need to review manuals and other text chunks. Applications are diverse: contractor, warehouse, and material details; team performance; machinery management, among others.

First Responders:

Increasing response speed is essential for first responders. CUI can never replace live operators, but it can help improve outcomes in crises by assessing incidents by location, urgency level, and other parameters.

Healthcare

Medical professionals have a limited amount of time and a lot of patients. Chatbots and voice assistants can facilitate the health monitoring of patients, the management of medical institutes and outpatient centres, self-service scheduling, and public awareness announcements.

Banking, financial services, and insurance:

Conversational interfaces can assist users in account management, reporting lost cards, and other simple tasks and financial operations. It can also help with customer support queries in real-time, plus it facilitates back-office operations.

Smart homes and IoT:

People are starting to increasingly use smart-home-connected devices. The easiest way to operate them is through vocal commands. Additionally, you can simplify user access to smart vehicles (open the car, plan routes, adjust the temperature).

Benefits of Conversational UI :

One of the main benefits of a conversational user interface (UI) is its ability to effectively utilise the inherent efficiency of spoken language. In essence, it enables communication with reduced user effort.

The following are certain advantages that entice several firms to adopt CUI systems:

- **Convenience:** The concept of convenience refers to the state or quality of being easy, efficient, and practical. Utilising human language as a means of communication with technology is comparatively more convenient than acquiring and retaining alternative modes of engagement. Individuals have the ability to complete a task using the most convenient communication channel available to them, which frequently involves using voice-based methods. The use of a CUI (conversational user interface) is an optimal choice in situations when individuals are engaged in driving or running machinery.

- **Productivity:** The concept of productivity refers to the measure of output or efficiency in relation to the resources utilised. The use of voice as a means of communication is very efficient since it generally proves to be a more expedient and effortless method compared to tactile or typewritten modes. The purpose of voice technology is to optimise specific processes and reduce their time requirements. For instance, ***the use of conversational user interfaces (CUIs) has the potential to enhance productivity by assuming control of various tasks, such as:***
    - The process of generating, allocating, and revising assignments.
    - Enhance the exchange of information between enterprises and their customers, enterprises and their staff, as well as consumers and gadgets.
    - Facilitate the arrangement of appointments, coordinate the scheduling of events, and oversee the management of bookings.
    - Provide search results.
    - Please retrieve the reports.
- **Intuitiveness:** The concept of intuitiveness is fundamental aspects that is often discussed and explored in various academic numerous current applications have been specifically developed to possess an intuitive user interface. Conversational interfaces, in contrast, necessitate less effort for users to become acquainted with due to the innate nature of speech. Voice-operated technologies have seamlessly integrated into the daily lives and professional endeavours of users. Given the diverse range of voice request options available in these tools, individuals are able to interact with their gadgets in a manner akin to human communication. Evidently, it is a phenomenon with which everyone is familiar. Consequently, it enhances the level of interactivity between humans and computers.
- **Personalisation:** The concept of personalisation refers to the customization or tailoring of products, services, or when incorporating a conversational user interface (CUI) into an already established product, service, or application, one has the ability to make informed decisions regarding the manner in which information is presented to users. One has the ability to generate distinctive experiences through the use of questions or remarks, employing input and context in various manners to align with one's objectives. Moreover,

individuals possess an innate tendency to associate the auditory qualities of human speech with individual traits and characteristics. Business enterprises are afforded the chance to showcase the human aspect of their brand. The brand's perception by consumers can be influenced by adjusting several voice features, such as tempo, tone, and others.

- **Optimal utilisation of resources:** One effective strategy for optimising employee abilities is to delegate certain tasks to computer user interfaces (CUIs). Due to the obsolescence of certain regular duties, such as customer service or lead qualification, staff are now able to allocate their efforts towards more valuable client engagements. Regarding end-users, this technology enables them to optimise their time use. When employed accurately, conversational user interface (CUI) enables users to trigger a shortcut by means of their vocal commands, thereby obviating the need for manual typing or engaging in protracted interactions with a human operator.
- **Available 24/7:** The service is accessible around the clock, every day of the week. There are limitations on the occasions when the utilisation of CUI is permissible. Whether it is first responders seeking the most urgent occurrences or customers encountering typical problems, their inquiries can be promptly answered. In various industries where bots or voice assistants are used, it is highly probable that organisations would prefer to minimise instances of delayed responses from sales or customer support. Additionally, it obviates the necessity of employing operators on a 24/7 basis for specific activities.

Conversational UI Challenges :

The Future of Conversational UI:

The chatbot and voice assistant market is expected to grow, both in frequency of use and complexity of the technology. Some predictions for the coming years show that more and more users and enterprises are going to adopt them, which will unravel opportunities for even more advanced voice technology.

- Going into more specific forecasts, the chatbot market is estimated to display high growth, continuing its trajectory since 2016. This expected growth is attributed to the increased use of mobile devices and the adoption of cloud infrastructure and related technologies.
- As for the future of voice assistants, global interest is also expected to rise. The rise of voice control in the internet of things, adoption of smart home technologies, voice search mobile queries, and demand for self-service applications might become key drivers for this development. Plus, awareness of voice technologies is growing, as is the number of people who would choose a voice over the old ways of communicating.
- Naturally, increased consumption goes hand-in-hand with the need for more

advanced technologies. Currently, users should be relatively precise when interacting with CUI and keep their requests unambiguous. However, future UIs might follow the principle of teaching the technology to **conform to user requirements rather than the other way around. It would mean that users would be able to operate applications in ways that suit them best, with no learning curve.**

- If the CUI platform finds the user's request vague and can't convert it into an actionable parameter, it will ask follow-up questions. It will drastically widen the scope of conversational technologies, making them more adaptable to different channels and enterprises. Less effort required for CUI will result in better convenience for users, which is perhaps the ultimate goal.
- The reuse of conversational data will also help get inside the minds of customers and users. That information can be used to further improve the conversational system as part of the closed-loop machine learning environment.

10.2 Knowledge Graphs:

A knowledge graph refers to a meticulously organised and structured depiction of knowledge that effectively captures the intricate connections and associations between various things and concepts within a certain field or subject. Information organisation and connectivity are essential components in achieving a full understanding of a certain topic area. Knowledge graphs find applications in several domains, such as artificial intelligence, natural language processing, and data management.

The following are fundamental components of knowledge graphs:

- **Entities:** Entities refer to the objects or concepts inside a specific domain that are of interest in a knowledge network. These entities have the capacity to represent individuals, locations, objects, occurrences, or intangible ideas. In the context of a knowledge graph pertaining to films, the elements encompassed inside it may comprise actors, directors, films, and genres.
- **Relationships:** Relationships denote the interconnections or affiliations among things within the knowledge graph. The aforementioned relationships are frequently categorised in order to delineate the characteristics of the association. In the context of a social network knowledge graph, the links that can be established between entities encompass connections such as "friendship," "employment," or "marital status."
- **Attributes:** Attributes refer to the inherent features or characteristics that are linked to things within the knowledge graph. These properties serve to provide more information pertaining to the entities. In the context of a knowledge graph pertaining to books, the properties associated with a book entity encompass its title, authorship, publishing date, and genre classification.

- **Graph Structure:** Knowledge graphs are commonly depicted as graphs, wherein nodes represent entities, edges represent relationships, and characteristics are associated with either nodes or edges. The utilisation of this graph structure facilitates the execution of versatile and effective data queries.
- **Ontologies:** Ontologies are frequently employed in knowledge graphs to establish and normalise the terminology, relationships, and attributes utilised within the graph. The use of ontologies facilitates the maintenance of consistency and interoperability.
- **Semantic Web Technologies:** Semantic web technologies, such as RDF (Resource Description Framework) and OWL (Web Ontology Language), can be utilised to establish knowledge graphs. These technologies enable the representation and retrieval of data in a standardised and machine-readable format.
- **Applications:** Knowledge graphs possess a diverse array of applications, encompassing semantic search, recommendation systems, natural language understanding, and data integration. Intelligent systems are constructed utilising these tools to facilitate reasoning, inference, and structured relationships.
- **Examples:** Examples of knowledge graphs can be observed in the form of Google's Knowledge Graph and Wikidata. Google's Knowledge Graph is responsible for enhancing search results by including structured information regarding individuals, locations, and objects. On the other hand, Wikidata serves as a collaborative knowledge base that offers structured data on a diverse array of subjects.

The Advantages of using knowledge graphs are Manifold.

- **Semantic Understanding:** Semantic understanding refers to the ability of machines to comprehend the meaning and context of data. This is made possible through the use of knowledge graphs, which enhance information retrieval and reasoning capabilities.
- **Data Integration:** Data integration is a process that facilitates the consolidation of data from several sources, resulting in enhanced data quality and improved accessibility.
- **Recommendation Systems:** The utilisation of knowledge graphs enables the development of advanced recommendation systems, as they facilitate the comprehension of user preferences and item interconnections.
- **Search:** The ability to respond to complex questions and the provision of context-aware results are two ways that search engines can improve.
- **AI and NLP:** Knowledge graphs play a crucial role in facilitating natural

language processing (NLP) operations by offering structured data that enables machines to comprehend and interpret human language.

Knowledge graphs are an influential instrument for the arrangement and utilisation of structured knowledge, rendering them highly advantageous in several disciplines where the comprehension of interactions and connections between entities holds significant importance.

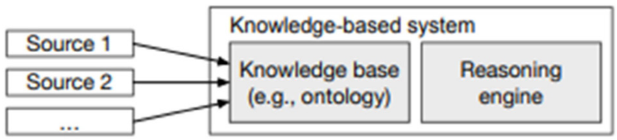


Figure 1: Architecture of a knowledge graph

Figure 1 illustrates the combination of these assumptions, which yields an abstract knowledge graph architecture. Based on this architecture and derived from the terminological analysis, we define a knowledge graph as follows:

> *A knowledge graph acquires and integrates information into an ontology and applies a reasoner to derive new knowledge.*

Source: Towards a Definition of Knowledge Graphs, Lisa Ehrlinger and Wolfram Wöß Institute for Application Oriented Knowledge Processing Johannes Kepler University Linz, Austria {lisa.ehrlinger | wolfram.woess}@jku.at

10.3 Foundation Models:

Foundation models, commonly known as "base models" or "pre-trained models," are expansive and generalised neural network models that act as the initial stage for various natural language processing (NLP) and machine learning endeavours. The models utilised in this study have been trained on extensive datasets and possess the capacity to comprehend and produce text that closely resembles human language. These models serve as the fundamental basis upon which more specialised and goal-oriented models can be constructed.

Foundation models refer to a type of generative artificial intelligence (AI) systems. The outputs of these systems are derived from one or many inputs, sometimes referred to as prompts, and are presented as instructions in human language. The models utilised in this study are founded upon intricate neural networks, which encompass generative adversarial networks (GANs), transformers, and variational encoders.

While there are variations in the functioning of different types of networks, the underlying principles governing their operations exhibit similarities. Typically, a frequency modulator (FM) employs acquired patterns and correlations to anticipate the subsequent element in a sequential arrangement. As an illustration, the model undertakes an analysis of the image and afterwards generates an enhanced rendition that exhibits heightened sharpness and improved clarity. In a similar vein, the model utilises contextual information from preceding words to make predictions about the subsequent word in a given text sequence. Subsequently, the subsequent word is chosen by the utilisation of probability distribution techniques.

Foundation models employ a self-supervised learning approach to generate labels based on the input data. This implies that the model has not been provided with labelled training data sets through instruction or training. This characteristic distinguishes LLMs from prior ML designs that employ either supervised or unsupervised learning methods.

Foundation models have the capability to perform a wide range of tasks.

Despite being pre-trained, foundation models have the ability to further acquire knowledge from data inputs or prompts during the inference process. This implies that one can generate comprehensive outcomes by utilising meticulously selected stimuli. Functions that facility managers (FMs) are capable of executing encompass many cognitive processes such as language processing, visual comprehension, code production, and engagement that is centred around human interaction.

- **Language processing:** The field of language processing encompasses the study and development of computational models and algorithms that enable computers to understand and generate human language. These models possess noteworthy capabilities in addressing questions posed in natural language, and they can even generate short scripts or articles in response to given prompts. In addition, NLP technologies enable the translation of languages.
- **The ability to understand and interpret visual information:** Facility managers (FMs) demonstrate expertise in the field of computer vision, particularly in the domain of image and object recognition. The aforementioned characteristics have potential uses in fields such as autonomous driving and robotics. Another characteristic that may be observed is the ability to generate images based on input words, in addition to engaging in photo and video editing tasks.
- **The process of generating code:** Foundation models have the ability to produce computer code in different programming languages by utilising natural language inputs. Furthermore, it is possible to utilise formal methods (FMs) for the purpose of assessing and troubleshooting code.
- **Human-centred engagement:** The concept of human-centred engagement refers to a strategic approach that places individuals at the core of an interaction or experience. This approach emphasises Generative artificial intelligence (AI) models leverage human inputs to acquire knowledge and enhance their predictive capabilities. One crucial and occasionally

disregarded use pertains to the capacity of these models to facilitate human decision-making. Possible applications encompass clinical diagnosis, decision support systems, and analytics.

An additional capability involves the refinement of pre-existing foundational models to create novel artificial intelligence applications.

Speech to text: The process of converting spoken language into written text is commonly referred to as speech-to-text technology. This technology utilises many algorithms and techniques to accurately transcribe spoken words into written language. Due to their proficiency in language comprehension, FMs possess the capability to fulfil speech-to-text responsibilities, including transcription and video captioning, across diverse linguistic contexts.

The following are essential components of foundation models:

- **Pre-training on Extensive Corpora:** Foundation models undergo pre-training using extensive textual corpora sourced from the internet, which include a diverse range of subjects and languages. The process of pre-training enables individuals to acquire linguistic patterns, grammatical structures, and general information.
- **Transfer Learning:** The fundamental objective of foundational models is to function as a framework for the practice of transfer learning. Rather than starting the training process for each specific NLP task from the beginning, practitioners have the option to fine-tune a pre-trained foundation model to suit the required task.
- **Generalisation:** Foundation models demonstrate robust generalisation skills. Individuals possess the ability to comprehend and produce cohesive written content across many subject matters and fields, rendering them adaptable for a wide range of practical uses.
- **Architecture:** In the field of architecture, these models commonly rely on transformer structures, which are particularly adept at processing sequential data such as text. Transformer-based models have emerged as the prevailing architectural choice for natural language processing (NLP) tasks.
- **Dimension and Elaboration:** Foundation models typically exhibit substantial dimensions in terms of parameter count, encompassing a range from several hundred million to billions of parameters. The considerable magnitude and intricate nature of these models are contributing factors to their exceptional performance.
- **Fine- Tuning:** Fine-tuning refers to the process of training a pre-existing foundational model using a smaller dataset that is specific to the job at hand. Throughout this procedure, the parameters of the model are modified in order

to align with the particular requirements of the intended activity, which may include sentiment analysis, translation, or question-answering.

- **Examples:** BERT (Bidirectional Encoder Representations from Transformers), GPT (Generative Pre-trained Transformer), T5 (Text-to-Text Transfer Transformer), and RoBERTa (A Robustly Optimised BERT Pretraining Approach) are all well-known foundation models. Each of these models functions as an initial framework for a range of natural language processing tasks.

The advantages of foundation models are manifold.

- **Efficiency:** The utilisation of pre-trained foundation models offers a substantial reduction in the computational resources and time needed for training models from the ground up for individual tasks.
- **Performance:** The performance of foundational models is notable for achieving exceptional outcomes on a diverse array of natural language processing benchmarks and tasks. This success can be attributed to the comprehensive pre-training that these models undergo.
- **Transferability:** The adaptability of these models allows for fine-tuning in many downstream activities, enabling their use across other domains.
- **Few-Shot and Zero-Shot Learning:** Few-shot and zero-shot learning have been prominent areas of research in the field of machine learning. Notably, certain foundational models, such as GPT-3, have exhibited the capability to do tasks with limited task-specific training data. These models have demonstrated impressive few-shot learning capabilities as well as the ability to execute tasks without any prior training, known as zero-shot learning.
- **Versatility:** The foundation models exhibit versatility as they may be effectively fine-tuned for a wide range of natural language processing tasks, such as text categorization, named entity recognition, text generation, machine translation, and various others.

The utilisation of foundation models has had a profound impact on the domain of natural language processing since it offers a standardised and remarkably efficient methodology for the creation of NLP applications. Ongoing endeavours to enhance their performance, efficiency, and accessibility across various applications have rendered them a persistently active domain of research and development.

10.4 Deep Learning:

Deep learning refers to a subfield of machine learning that focuses on the development and utilisation of artificial neural networks with multiple layers. These neural networks are designed to simulate the human brain's ability to process and analyse complex Deep learning is a subfield within the broader domain of machine learning, characterised by the utilisation of neural networks with three or more layers. Neural networks aim to replicate the functioning of the human brain, but with limited success, enabling them to acquire knowledge from extensive datasets. Although a neural network with a single layer is capable of making approximate predictions, the inclusion of additional hidden layers can enhance the optimisation process and improve accuracy.

Deep learning plays a pivotal role in advancing various artificial intelligence (AI) applications and services, facilitating enhanced automation and enabling the execution of analytical and physical tasks without the need for human participation. *Deep learning technology underlies a wide range of commonplace products and services, including digital assistants, voice-activated TV remotes, and credit card fraud detection.* ***It also plays a crucial role in the development of new technologies, like autonomous vehicles.***

The Comparison between Deep Learning and Machine Learning:

- In the context of machine learning, deep learning can be seen as a distinct subset. However, it is important to understand the differences between deep learning and other forms of machine learning. *Deep learning is differentiated from standard machine learning by the nature of the data it operates on and the methodologies it uses for learning.*
- Machine learning algorithms use structured and labelled data in order to create predictions. This entails defining certain features from the input data for the model and organising them into tables. *This does not imply that unstructured data is not utilised; rather, it suggests that if it is, it typically undergoes pre-processing to arrange it in a structured manner.*
- *Deep learning obviates certain aspects of data pre-processing that are conventionally associated with machine learning. The algorithms have the capability to receive and analyse unstructured data, such as text and images. Moreover, they facilitate the extraction of features, reducing the reliance on human specialists.*

To illustrate, consider a collection of photographs of various domesticated animals. ***Our objective is to classify these animals into distinct categories such as "cat," "dog," "hamster," and so forth***.

Deep learning algorithms possess the capability to ascertain the relative significance of various traits, such as ears, in discerning one animal from another. In the field of machine learning, the establishment of this hierarchy of features is performed by manual intervention by a human expert. Subsequently, by employing the techniques of gradient descent and backpropagation, the deep learning algorithm undergoes necessary modifications and adaptations to enhance its accuracy, thereby enabling it to generate predictions with greater precision when *presented with a novel photograph of an animal.*

Machine learning and deep learning models possess the ability to engage in several forms of learning, commonly classified as supervised learning, unsupervised learning, and reinforcement learning.

Supervised learning is a machine learning approach that leverages datasets with labelled instances to perform categorization or prediction tasks. This methodology necessitates human involvement in accurately labelling the input data. On the other hand, unsupervised learning does not necessitate the use of labelled datasets. Instead, it focuses on identifying patterns within the data and grouping them based on discernible qualities. Reinforcement learning is an iterative process wherein a computational model acquires the ability to enhance its performance in executing actions inside a given environment by leveraging feedback signals, with the ultimate objective of maximising the rewards obtained.

The Operational Principles of Deep Learning:

Deep learning neural networks, also known as artificial neural networks, endeavour to replicate the functionality of the human brain by employing a combination of data inputs, weights, and iases. The aforementioned parts collaborate in a cohesive manner to effectively identify, categorise, and articulate the characteristics of entities contained inside the dataset.

Deep neural networks are composed of numerous layers of interconnected nodes, with each layer progressively enhancing and optimising the prediction or categorization process.

The process of performing computations in a sequential manner over the network is commonly referred to as forward propagation. The visible layers of a deep neural network are referred to as the input and output layers. The input layer of a deep learning model is responsible for receiving and processing the input data, whereas the output layer is responsible for generating the final prediction or classification.

Another computational technique known as backpropagation uses techniques such as gradient descent to compute prediction errors and subsequently modifies the weights and biases of the function by traversing backwards through the layers, aiming to facilitate model training. The combined processes of forward propagation and backpropagation enable a neural network to perform prediction tasks and afterwards adjust its parameters to rectify any encountered faults. Over the course of time, the algorithm exhibits a progressive improvement in accuracy.

The aforementioned passage provides a concise explanation of the most basic form of deep neural network using straightforward language. Nevertheless, deep learning algorithms exhibit a remarkable level of intricacy, and many categories of neural networks have been developed to tackle distinct challenges or datasets.

To illustrate, Convolutional neural networks (CNNs) are predominantly employed in the fields of computer vision and image classification, where they possess the ability to identify and analyse distinctive features and patterns inside an image. This capability allows for the accomplishment of various tasks, such as object detection and recognition. In the year 2015, a CNN (convolutional neural network) achieved superiority over a human participant in an object identification task, marking a significant milestone in the field. Recurrent neural networks (RNNs) are commonly employed in the fields of natural language processing and speech recognition due to their ability to effectively handle sequential or time-series data.

The utilisation of deep learning in several domains :

Deep learning applications have become ubiquitous in our everyday lives, seamlessly incorporated into many businesses and services. However, users often remain oblivious to the intricate data processing occurring behind the scenes.

Several instances can be cited as examples, which are as follows:

- **Law Enforcement:** Deep learning algorithms possess the capability to analyse and acquire knowledge from transactional data in order to detect and discern perilous trends that may signify potential instances of fraudulent or criminal conduct. The utilisation of speech recognition, computer vision, and other deep learning applications has the potential to enhance the efficiency and efficacy of investigative analysis. By extracting patterns and evidence from various sources, such as sound and video recordings, images, and documents, these technologies facilitate the expeditious and accurate analysis of substantial volumes of data by law enforcement agencies.
- **Financial Services:** The term "financial services" refers to a broad range of economic activities that involve the management, distribution, and investment of money. Predictive analytics is a commonly employed tool by financial institutions to facilitate algorithmic trading of stocks, evaluate business risks associated with loan approvals, identify instances of fraud, and aid in the management of credit and investment portfolios for clients.
- **Customer Service:** Numerous organisations integrate deep learning technology into their customer service procedures. *Chatbots, which are employed in many domains such as apps, services, and customer support portals, represent a simplified manifestation of artificial intelligence. Conventional chatbot systems employ natural language processing and may incorporate visual recognition capabilities, like call centre menus.* Nevertheless, advanced chatbot systems strive to ascertain, via the process of machine learning, whether there are many potential responses to queries that are inherently ambiguous. The chatbot endeavours to provide direct answers to the queries it receives or, alternatively, redirect the conversation to a human user based on the feedback it receives.

Virtual assistants such as Apple's Siri, Amazon Alexa, and Google Assistant expand upon the concept of chatbots by incorporating speech recognition capabilities. This novel approach introduces a mechanism for effectively involving people in a customised manner.

- **Healthcare:** The healthcare sector has experienced significant advantages due to the integration of deep learning capabilities following the *digitization of hospital records and photographs. Image recognition programmes* have the potential to provide assistance to medical imaging professionals and radiologists, facilitating the analysis and evaluation of a larger volume of images within a shorter timeframe.

10.5 Graph Analysis in Finance:

When anti-money laundering (AML) professionals or members of the fraud community discuss their problems, they frequently cite the number of false positives generated by existing monitoring and alerting systems as one of the greatest obstacles.

As regulators increase pressure on banks to capture any indications that could lead to an escalation, alert rules are tuned to identify anything suspicious, resulting in numerous unnecessary alerts and higher costs.

Whether reviewing alerts or acting as an intelligence analyst, anyone analysing financial offences seeks to accelerate the examination process and increase the number of effective escalations.

Graph technologies are revolutionary in the battle against money laundering. *Gartner Group identifies "graph" as one of the industry's key trends and has stated that graph analytics are essential for gaining a comprehension of inappropriate behaviour.*

Graphs profoundly alter our interaction with data by allowing us to comprehend the context extracted from the relationships between entities, locations, accounts, etc.

A graph is employed to:

- AML examinations
- Significant decrease in AML false-positives
- 360° KYC analysis for fraud detection
- Client Due Diligence
- Machine Learning/AI
- Other types of non-investigational applications

Graph enhances data discovery capabilities, going far beyond what is possible with conventional technologies. This can significantly reduce false positives and enhance the detection of actual suspicious financial patterns.

Conventional analytic technologies employed by conventional monitoring systems store and display data in tabular or graphical formats. Graph technologies complement these systems by identifying and analysing the ***relationships and interconnections between data elements.***

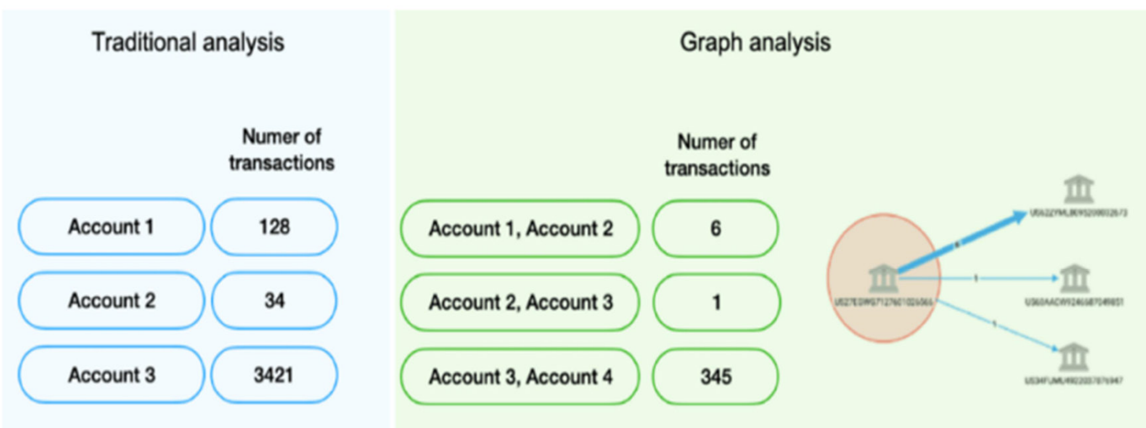
According to Gartner's research, only 10% of innovative initiatives use graph technologies today, but by 2025, that number will skyrocket to 80%. In the coming years, the majority of banks and other enterprise organisations, regardless of their primary focus, will adopt graph technology, according to this forecast. Organisations that adopt graph technology more aggressively can reduce costs, improve compliance, enhance company security, and obtain a competitive advantage.

An Overview of Graph Theory Introduction:

This AI Guidance Note for Cost Accountants provides a concise introduction to the field of graph theory, which is a branch of mathematics that studies the properties and applications of graphs. Graphs are mathematical.

Traditional systems primarily emphasise the storage and analysis of values, whereas graph technology specifically discovers and analyses the connections and interactions among data objects, thereby offering supplementary insights for subsequent analysis.

In conventional analysis, it is customary to include fundamental aggregated data pertaining to the quantity of transactions associated with a particular bank account. By utilising a graph, it becomes straightforward to extract relevant information regarding the interactions between an account and other accounts of significance. This includes determining whether an account is directly or indirectly linked to a suspicious individual, IP address, phone number, or any other pertinent entity.



Source: datawalk

To many, "graph" may simply imply visualizations like bar charts or line charts. However, the *network graphs* referred to in this document are very different. Figure 1 below shows a simple graph, visualizing data elements and their relationships.

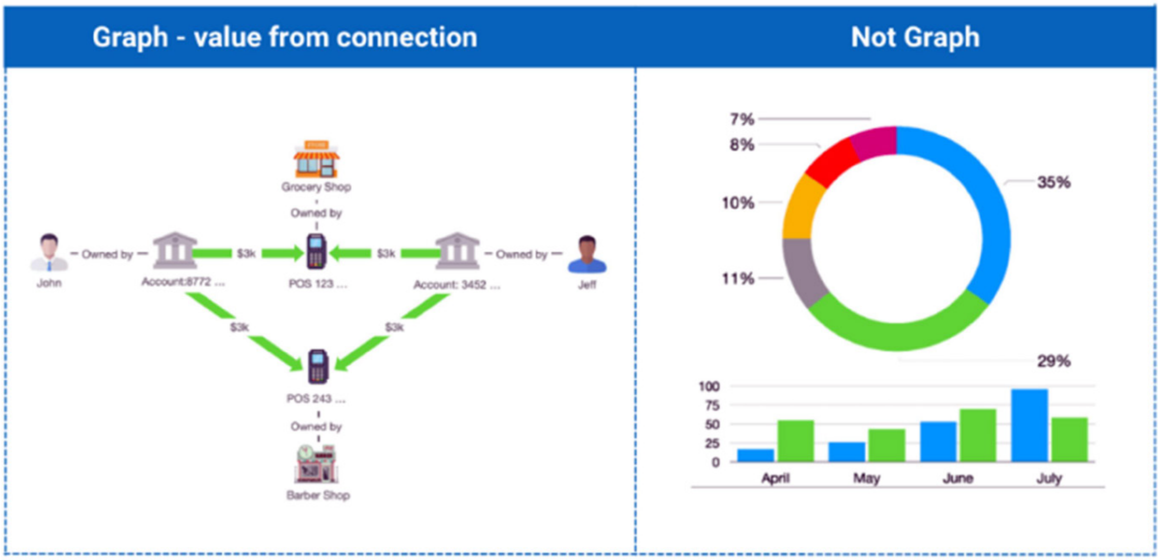


Figure 2. Network graph is very different than traditional charts.

Source: data walk

The concept of graphs naturally gives rise to the phrase graph analytics, which refers to a collection of approaches and skills aimed at facilitating the identification of novel patterns and trends.

The following table provides a description of many types of graph analytics.

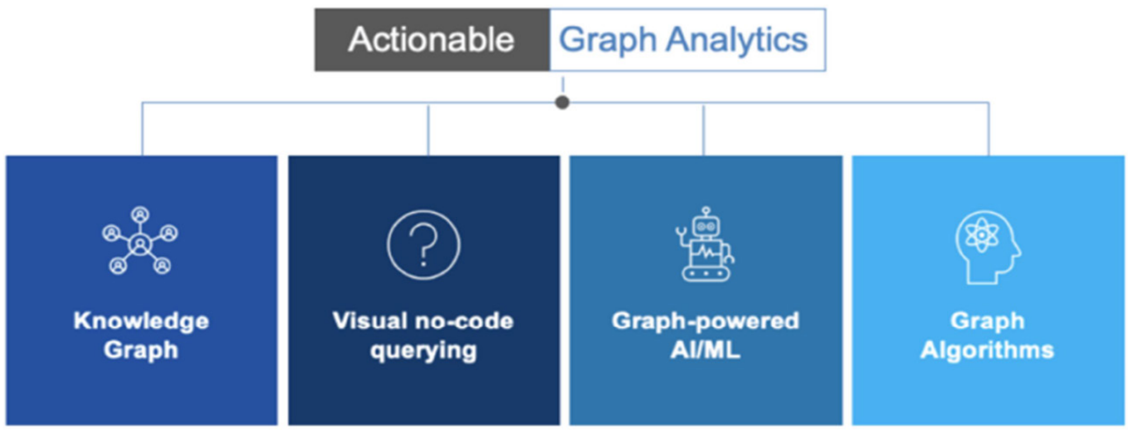


Figure 3. Types of graph analytics

Source: data walk

Excessively Many False Positives :

What are the reasons behind the prevalence of false positives in financial institutions?

This topic can be classified into several distinct groups.

- **"Data lens" Problem:** Issues related to the interpretation and analysis of data through a specific perspective or framework In the past, the construction of a digital depiction of a bank's clientele involved the utilisation of approximately 50 characteristics, which were held across 3 to 5 data repositories. These qualities encompassed personally identifiable information (PII), a risk assessment, certain know-your-customer (KYC) data, as well as details pertaining to the products or services availed by the customer. In contemporary times, the process of replicating the aforementioned task would necessitate the management of more than 500 distinct characteristics, which are dispersed over numerous isolated repositories. These repositories encompass a wide range of sources, such as logs generated by mobile applications, newly established regional and international payment systems, compromised databases (e.g., Pandora Papers, Panama Papers), various social media platforms, consumer segmentation data, and other comparable resources. The process of identifying false-positives or false-negatives within a complex network of data sources can be laborious and frequently unfeasible.
- **Data Quality Problem:** The utilisation of traditional technologies frequently involves the application of generic filters and static reports to analyse data. However, this approach imposes limitations on the capacity to comprehend the complex interconnections between individuals, Accounts, Phones, and other entities. In the absence of comprehensive contextual information, monitoring systems possess the potential to erroneously identify innocent consumers as suspicious or fail to detect genuinely worrisome activities. The failure to employ a wider perspective, namely by incorporating data from other systems inside the organisation, might lead to the oversight of significant insights pertaining to customers or counterparties.

As an illustration, the monitoring system is not designed to raise an alarm when there are multiple transactions of Rs 4,000000 occurring within the same hour from business bank accounts that are not related. Nevertheless, upon conducting a thorough investigation, it is possible for investigators to discover that these businesses share common stakeholders. It is possible that all transactions were conducted using the same IP address, with the additional observation that the browser fingerprints are identical. The absence of appropriate contextual information leads to the occurrence of inaccurate positive results and restricts the capacity to detect instances of misconduct.

The issue of data quality is a significant concern. The presence of disparate siloed data sources, data discrepancies, varied formats, missing values, and data duplication have adverse effects on the detection procedures, leading to a significant number of false positives. In accordance with an often employed term in the field of computer science, the concept of “garbage in, garbage out” suggests that input data of poor quality or insignificance will inevitably result in output that is devoid of value, irrespective of the analytical techniques employed.

One difficult element arises from the deliberate actions of criminals who may attempt to modify their personally identifying information, such as names, addresses, or social security numbers, by altering a single letter or digit. This tactic is employed with the aim of evading detection and frustrating investigative efforts. The utilisation of comprehensive customer data, dispersed across numerous data silos, for the purpose of identifying duplicate records presents notable challenges for legacy systems and pre-existing analytical infrastructures.

The challenges associated with data analytics Despite the significant rise in the number of data sources and the volume of data in recent years, the cognitive ability of humans to comprehend and analyse the outcomes has remained unchanged. From a technological standpoint, the conventional method of detecting suspicious transactions typically involves a collection of rules or vectors that are quite uniform and have been widely employed over an extended period of time. As the complexity and interdependence of data increase, conventional methods that rely on SQL queries for data analysis encounter limitations in terms of scalability and complexity. *In practical application, this leads to the configuration of traditional alerting systems to do rudimentary checks, such as identifying instances where an account engages in transactions with any counterparty that has previously triggered alerts, without thoroughly examining the entirety of the current context.*

In the given scenario, a transaction conducted by a client categorised as high-risk first triggered an alert due to their engagement with a party listed under sanctions. However, subsequent evaluation determined that the aforementioned alert did not pose any concerns. Subsequently, the warning system will once again identify a second transaction of comparable nature as being of elevated risk, given that the customer in question has received repeated alerts and the counterparty involved is listed under sanctions. The current analysis fails to take into account the fact that a prior alert had been created for the same counterparty and subsequently closed. This suggests that the present transaction should either not be flagged for alert or, if reported, should be categorised as low risk. The depicted network graph provides a visual representation of the given scenario.

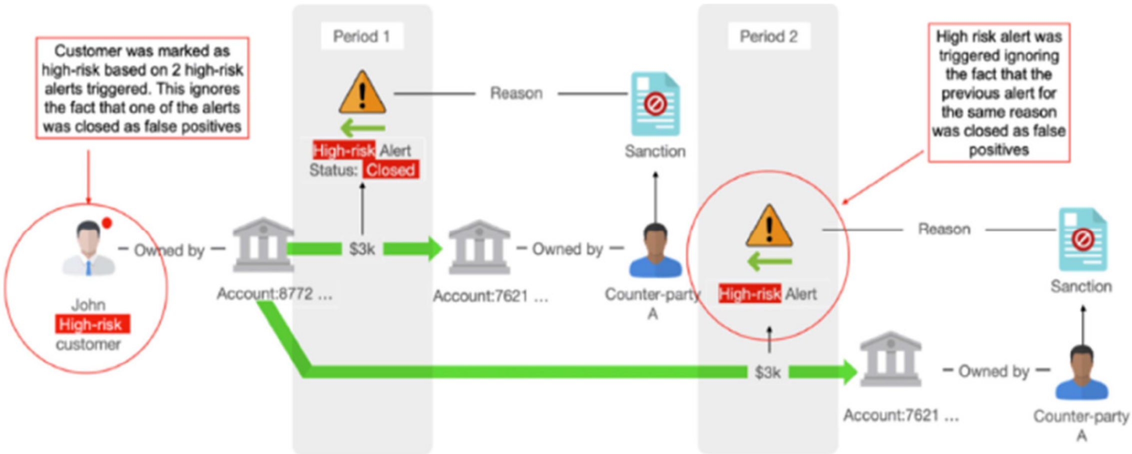


Figure 4. High-risk customer and alert - false positives generated by conventional systems without using the connections context.

Source: data walk

Example 2: The standard alert system lacks the capability to detect indirect and multi-hop connections that may serve as indicators of potentially suspicious transactions. The depicted scenario is visually represented in the network graph provided below.

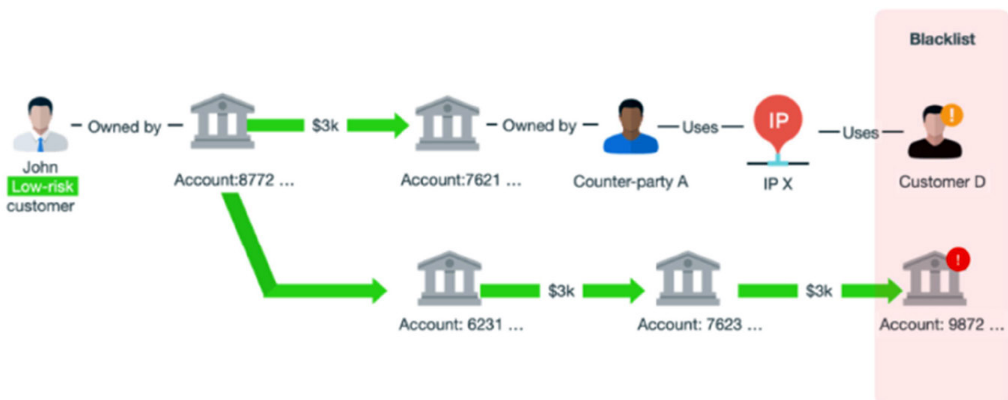


Figure 5. With conventional AML tools a customer was marked as low-risk regardless of the fact that he is connected with blacklisted accounts and customer.

Source: datawalk

- **The utilisation of graphs has the potential to substantially alter the course of contemporary efforts to combat money laundering, which are now characterised by inefficiency.**
- **The use of graphs effectively mitigates the issue of data siloing.**

- Graph technology possesses a distinctive capability to efficiently integrate and establish links between internal and external data, irrespective of its intricacy and magnitude. This is achieved through the establishment of relationships among business entities, processes, and events. A knowledge graph has the ability to enhance data organisation by shifting the focus from data sources to pertinent business entities, such as customers, transactions, phone numbers, or other relevant entities. This capability allows individuals to extract novel perspectives and discern recurring trends from extensive and intricate datasets***. Graph analytics enables companies to effectively integrate many types of data, including anti-money laundering (AML) data, fraud data, and external data sources such as public registers or offshore leak databases (e.g., Pandora Papers).*** By leveraging this approach, clients may effortlessly uncover implicit information by analysing the links and linkages within the data. *Systems such as DataWalk possess the capability to construct and store a comprehensive network of links, ensuring that all client data is pre-established and readily accessible for utilisation.* The use of graphs allows for the consolidation of pertinent information onto a singular interface, mitigating issues related to data fragmentation and significantly expediting the process of prioritising and addressing tasks.

The Use of Graphs enhances the Quality of Data:

- Graph technology is very suitable for entity resolution in relation to important attributes such as names, addresses, phone numbers, bank accounts, and identification numbers. ***Graph technologies provide efficient identification and consolidation of potential matches or duplicates on a large scale through the utilisation of methods such as graph-based expert rules or advanced fuzzy matching algorithms.*** Graph algorithms, such as page rank, have the ability to identify the most influential entity by analysing the quantity of interactions it has relative to other entities. Furthermore, graphs are highly suitable for tracing the genealogy of all things, and they enable non-technical users to easily comprehend and clarify data transformations.

Example 3: Visualisation of Entity Resolution Graph The utilisation of graphs enables the consolidation of warnings, allowing for more efficient management by a single analyst in a contextual manner rather than in isolation. This will expedite the triage procedure.

The network graph depicted below showcases four things that have been matched using a range of fuzzy approaches, including Eudex, Soundex, Double Metaphone, and others. Graph technology has the capability to offer comprehensive transparency and elucidation of the procedures employed to match records.

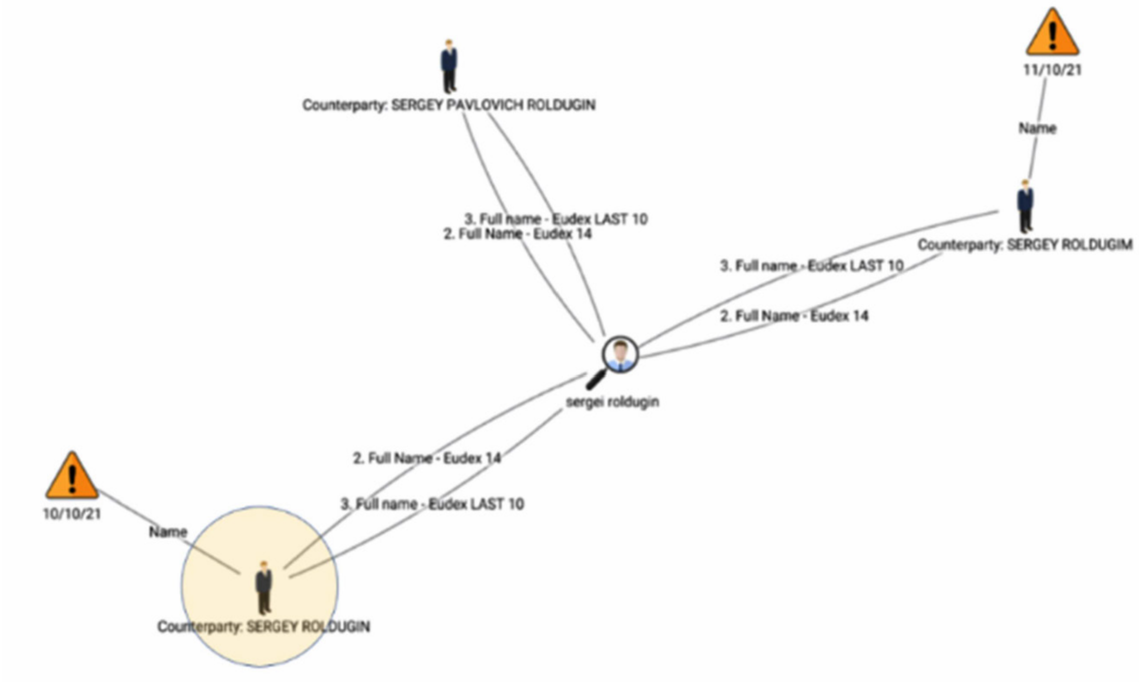


Figure 6. Matching entities on a network graph

Source: data walk

The utilisation of graph powers in Data Analytics :

Graph analytics provide a distinct capability to reveal irregularities inside datasets that are extensive and/or intricate. Moreover, graphs have the capability to facilitate many forms of analysis, including AI/machine learning, hence offering advanced contextual understanding that is obtained through interconnected interactions.

Certain graphs offer a means of engaging with data in a visual format. Knowledge graphs exhibit variability in terms of their characteristics and the range of functionalities they offer. However, their primary purpose is to present extensive and intricate data in a coherent manner through a user-friendly visual interface. ***This interface is designed to revolve around comprehensible business entities, including individuals, accounts, and suspicious activity reports (SARs), transactions, and other relevant elements.*** This approach ensures that the analysis is congruent with individuals' cognitive processes, rather than delving into data using intricate technical frameworks.

Figure 7. Example of a knowledge graph for a financial institution – AML 360°

Source: data walk

Graphs possess a distinctive capacity to expeditiously furnish responses pertaining to the connectivity and nature of relationships among things. Graph algorithms, as their name implies, are algorithms designed expressly for the analysis of graph data. ***These algorithms exploit the inherent connection of graphs to reveal concealed situations, such as:***

- The phenomenon of several individuals utilising a single Social Security Number (SSN) or Aadhar Number.
- The utilisation of numerous Social Security Numbers (SSNs) or Aadhar by an individual.
- The phenomenon of numerous Social Security Numbers (SSNs) or Aadhar being utilised by distinct individuals is observed.
- A location commonly utilised by numerous individuals, commonly referred to as a safe-house.
- Multiple unrelated individuals have utilised the same IP address to access various Accounts.

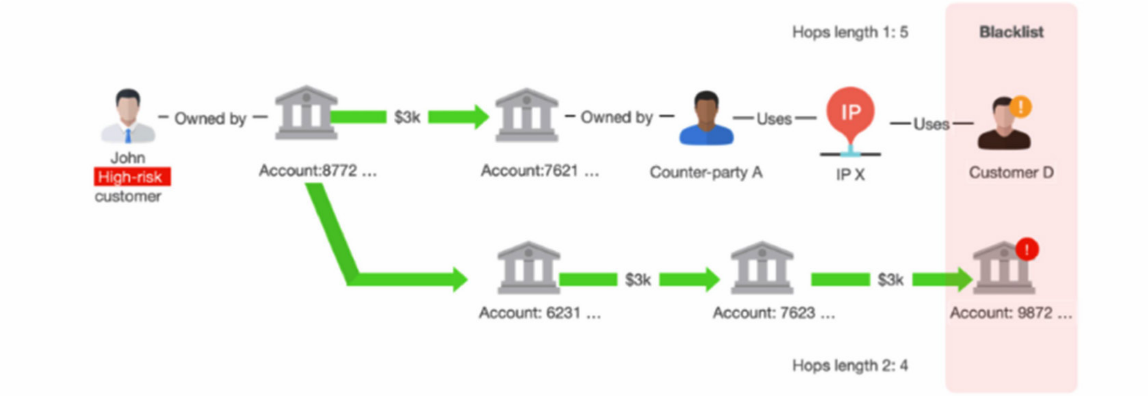


Figure 8. With graph-based solutions a customer was marked as a high-risk respecting of the fact that he is connected with blacklisted accounts and customer

Source: data walk

Example 5- It is important to consider the circumstances in which a conventional alert system had previously issued a notification for the same counterparty but later resolved it. This implies that the occurrence of the counterparty's name on the sanction list is likely coincidental and that the verification process has already been conducted by an individual. As a consequence, the risk level for an alert or customer is reduced from high to low.

Figure 9. When analyzing the graph, John (client) was marked as low risk, taking into account the fact that the previous alert was marked as a false positive

Source: data walk

Example 6: The utilisation of a graph method known as community analysis facilitates the establishment of connections between items and pre-existing networks, sometimes referred to as clusters, such as an organised criminal network. This capacity possesses significant promise, since it has the ability to expedite the identification of a crime ring within minutes, a task that would often require manual identification over a span of days or even weeks. In the above scenario, it is observed that the client and counterparties 1 and 2 exhibit suspicious behaviour due to their sharing of personally identifiable information (PII) with counterparty 3. It is noteworthy that counterparty 3 has been associated with the filing of repeated suspicious activity reports (SARs).

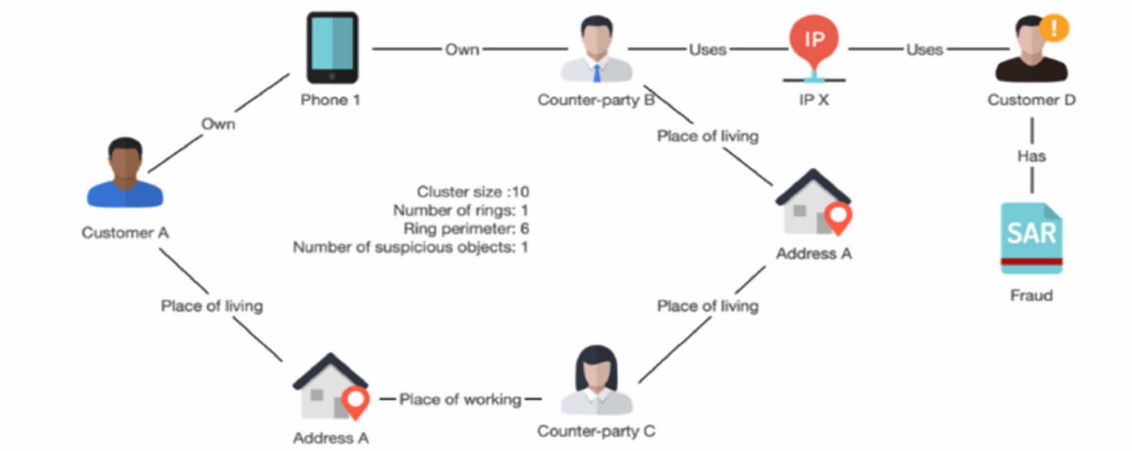


Figure 10. Graph algorithm (community detection) enables you to capture suspicious graph constructs (e.g., organized crimes) as rings describing them with variables such as cluster size, number of rings, perimeter, etc.

Source: data walk

The use of graph algorithms offers a distinctive perspective that may be transformed into rules or machine learning features. This transformation aims to augment prediction capabilities, namely by mitigating or removing instances of false positives and detecting novel suspicious patterns.

The subsequent illustrations encompass characteristics that can be employed for the purpose of machine learning, or for the generation of graph-based rules.

	Distance between blacklisted accounts – based on transactions	Distance between blacklisted accounts – based on PII data	Is part of the cluster?	Number of suspicious rings
Object #1	6	2	1	1
Object #2	4	3	1	2

Source: data walk

In accordance with the above criterion, an object, denoted as A, shall be classified as high risk if two conditions are met. Firstly, the number of intermediary nodes between object A and any blacklisted objects must not exceed six. Secondly, object A must be a constituent of a suspicious cluster that possesses at least one ring.

In contemporary financial institutions, the processes of distribution and promotion, customer interactions, and adherence to regulatory requirements have become increasingly intricate. ***This gives rise to a pressing need for posing intricate inquiries on intricately organised and unstructured data, a task that is frequently unfeasible using conventional technologies like SQL.***

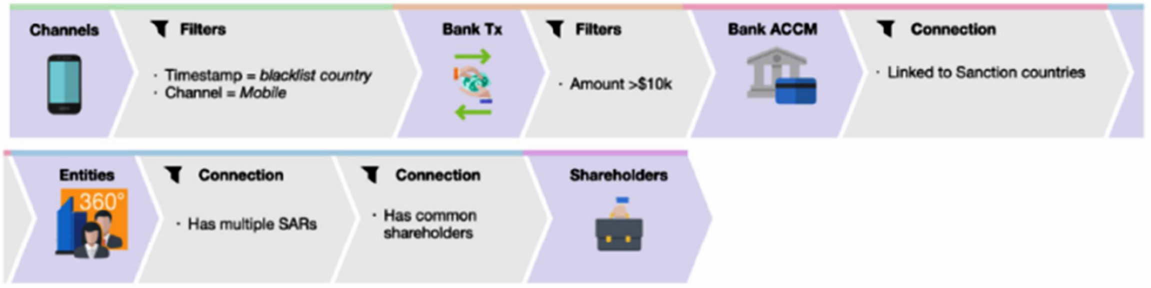


Figure 11. Visualization of a complex question

Source: data walk

Graphs are often used as a facilitating technology to address intricate and impromptu inquiries in various scenarios. The capacity to formulate intricate queries across all available data facilitates prompt validation of hypotheses and a thorough assessment of established rules to determine which ones may require adjustment in order to minimise instances of false positives.

On platforms like Data Walk, graph-based queries, commonly referred to as analyses or rules, have the capability to be assigned weights and merged together in order to generate features that can be used for scoring purposes or as coefficients in machine learning algorithms. Enhancing the data and leveraging insights from connections significantly enhances the efficacy of machine learning, enabling more precise analysis. This, in turn, assists organisations in discerning between false alerts and real positives.

In conclusion, it can be inferred that the ultimate outcome or conclusion of a given situation or argument is of utmost importance.

Graph technology has the potential to offer novel functionalities and advantageous outcomes in assisting financial institutions in accomplishing tasks a, b, and c. Organisations that embrace this nascent technology will experience a distinct competitive edge in comparison to their counterparts.

The "Data Walk".

Data Walk is a software platform for graph analytics that is scalable and does not require coding. The Data Walk graph analysis foundation makes it easier to combine various data sources, allowing for the exploration of intricate structures and the discovery of patterns within sizable and connected datasets. This is achieved through the use of an intuitive knowledge graph. The aforementioned processes encompass data importation, data preparation and integration, data exploration, data analysis (including machine learning), and data lineage. DataWalk serves as a valuable complement to case management and monitoring systems by effectively identifying and eliminating false positives, thereby enhancing the rate of successful escalations.

10.6 Small and wide data:

The transition from big data to tiny and wide data is facilitating the emergence of novel prospects for innovation and data-centric decision-making.

The advent of artificial intelligence (AI), data fabric, and composable analytics solutions has enabled enterprises to analyse many types of data, including both small and large datasets, as well as structured and unstructured data. When utilised in conjunction with an appropriate data strategy, these data sources have the potential to enable enterprises to extract valuable insights from small-scale and even minute data tables.

To provide an illustration, whereas conventional data sources may have a single column indicating the colour of an object, an AI-compatible (wide) data source could encompass numerous columns, or features, inquiring: "Does it possess the attribute of being red? Does it possess a yellow hue? Is the colour of the object in question blue? The database engine must give specific consideration to each of the additional columns in order to fully leverage the advantages of large data sources.

Organisations are expected to persist in utilising their access to diverse data sources, including big, small, and wide data, as a significant competitive advantage. According to Gartner researchers, it is projected that by the year 2025, a significant majority of organisations, approximately 70%, will transition their focus from big data to small and wide data. This shift entails incorporating data from diverse sources, thereby facilitating a more comprehensive context for the purpose of analytics and facilitating intelligent decision-making.

However, it is imperative to understand the distinctions between these various kinds of data and the reasons why enterprises should prioritise their significance.

The comparison between big data, tiny data, and wide data :

The prevalence of big data has been observed since the advent of computer software and hardware with the capacity to efficiently analyse large-scale datasets. Initially utilised by academics and researchers to facilitate significant statistical studies, big data had evolved into an essential requirement for all major corporations by the mid-2000s. ***Data has been referred to as 'the new oil' by The Economist,*** prompting firms to diligently create extensive data repositories and extract valuable insights from them.

The use of big data facilitates comprehensive studies and provides enhanced insights into overarching patterns and trends. In summary, this technique serves as a valuable means of discerning between the visual representation of a human and that of an equine creature.

The utilisation of small and wide data sets enables a more targeted approach to extracting certain pieces of information, facilitating the acquisition of distinct insights. In the context of the man or horse analogy, the concept of small and wide data pertains to comprehending the specific characteristics of the horse under consideration, discerning the coloration of the man's eyes, and elucidating the underlying rationale for the inclusion of both entities inside the shown image.

The concept of wide data involves the integration of diverse data from various sources in order to get insights into phenomena such as human behaviour. For instance, comprehensive data analysis can assist retailers in gaining insights into the probability of a shopper's purchase of a particular item as determined by the contents of their shopping cart.

The concept of small data is characterised by its emphasis on individual-level information. The scope of small data analysis is centred around the acquisition and comprehension of relatively modest data sets derived from a singular entity. Small data is essentially the antithesis of big data and necessitates a distinct data strategy due to its unavailability within large data sets.

In the context of data analysis, there is a growing interest in exploring the potential of small, wide data use cases.

The significant financial implications associated with big data initiatives provide a strong rationale for increased utilisation of wide and small data capabilities. In addition to the considerable intricacy arising from the extensive accumulation of big data and the challenges associated with extracting meaningful insights from large datasets, any approach reliant on big data also necessitates the acquisition of frequently limited and costly expertise. Regrettably, the financial resources required for this level of investment exceed the capabilities of the majority of businesses.

On the contrary, the utilisation of small data sets allows for the acquisition of company-specific insights that can be effectively employed to enhance the process of decision-making. Conversely, the integration of insights derived from large data sets should be prioritised in organisational decision-making endeavours, as it contributes to the enhancement of the overall quality of outcomes resulting from these decisions.

Organisations that are investigating the potential of artificial intelligence (AI) to enhance decision-making capacities might derive significant advantages from the utilisation of extensive datasets. Smaller data sets are comparatively more manageable than large data lakes, thereby increasing the likelihood of their being regularly updated and maintaining instant relevance. The use of algorithms in enhancing decision-making through the utilisation of extensive data generally yields more precise and prompt insights compared to the dependence on comprehensive analyses utilising big data.

In relation to the **aforementioned illustration involving a man and a horse,** comprehensive data can assist corporations in gaining a more profound comprehension of various attributes pertaining to the man, such as hair colour, eye colour, and age, as well as significant characteristics of the horse, including breed, colour, age, and size. Additionally, by leveraging additional data sources, companies can ascertain the lineage of the horse, explore the man's familial connections and hobbies, and deduce

The utilisation of hyper-contextual data insights has the potential to enhance organisational processes and facilitate a deeper comprehension of consumers, staff, and the operational landscape for enterprises.

As the magnitude of data expands to an overwhelming extent, organisations will progressively need to rely on both tiny and large amounts of data in order to bolster their commercial operations.

Organisations aspiring to attain comprehensive data-driven decision-making capabilities should initiate an exploration into the potential of both small and large data sets within specific use cases. This endeavour should be accompanied by a systematic process of discovery aimed at harnessing the inherent power of data to enhance business outcomes.

10.7 Large Scale Pretrained Language Model:

A large-scale pretrained language model (LS-PLM) refers to a Deep learning model employed in the field of natural language processing (NLP) that undergoes pre-training using an extensive corpus of textual data sourced from the internet. These models possess an extensive number of parameters, reaching into the billions, and demonstrate the ability to comprehend and produce text that closely resembles human language. These models belong to the wider classification of foundation models and function as the fundamental basis for several natural language processing (NLP) activities.

The following are essential attributes and pertinent information pertaining to large-scale pretrained language models:

- **Massive Scale Pre-training:** The concept of "massive scale" refers to a situation or phenomenon that occurs on a significantly large or extensive level. During the pre-training phase, language-style Pre-trained language models (LS-PLMs) undergo training using extensive and varied text corpora, which typically encompass hundreds of gigabytes or even terabytes of textual data. The comprehensive pre-training enables students to effectively capture subtle linguistic patterns and acquire a broad range of general information.
- **Transformer Architecture:** The utilisation of transformer designs is common in LS-PLMs, as these structures are particularly adept at processing sequential input, such as text. The efficacy of transformers has led to their widespread adoption as the prevailing architecture for numerous natural language processing (NLP) applications.
- **Considerable Magnitude of Parameters:** These models are renowned for their substantial scale, characterised by the inclusion of billions of parameters. The substantial number of parameters plays a significant role in enhancing their cognitive ability to comprehend and produce textual content.
- **Transfer Learning:** The main objective of LS-PLMs is to function as a foundation for the practice of transfer learning. Instead of training individual models for each natural language processing (NLP) task, researchers and professionals have the option to fine-tune a language model with limited supervision on a smaller dataset that is specific to the task at hand.
- **Generalisation:** Language-specific pre-trained language models (LS-PLMs) demonstrate robust generalisation capabilities. These models have demonstrated strong performance across several natural language processing (NLP) tasks, encompassing text classification, sentiment analysis, machine translation, and text synthesis.
- **Fine-Tuning:** Fine-tuning refers to the process of making adjustments to the weights of the pre-trained LS-PLM model on a smaller dataset that is specifically tailored to the goal task. This procedure enables the model to effectively adjust to the intricacies of the given task while still preserving its overall comprehension of language.
- **State-of-the-Art Performance:** LS-PLMs have demonstrated state-of-the-art performance on a multitude of NLP benchmarks and contests, showcasing their efficacy across many domains and languages.
- **Examples:** GPT-3 (Generative Pre-trained Transformer 3), T5 (Text-to-Text Transfer Transformer), and BERT (Bidirectional Encoder Representations from Transformers) are all examples of LS-PLMs.

The Advantages of Pretrained Language Models at a Large Scale:

- **Efficiency:** The utilisation of LS-PLMs leads to a notable reduction in computational resources and time needed for the development of NLP models, as they are pre-trained on extensive datasets.

- **Versatility:** The versatility of these models allows for their fine-tuning in a diverse range of natural language processing tasks, thereby enabling their adaptability to various applications.
- **State-of-the-Art Performance:** The current state of the art in natural language processing (NLP) is characterised by the exceptional performance of LS-PLMs across multiple NLP benchmarks. As a result, LS-PLMs have been the preferred choice for numerous practitioners in the field of NLP.
- **Few-shot and zero-shot:** Few-shot and zero-shot learning have been prominent areas of research in the field of language models. Notably, certain language models, such as GPT-3, have exhibited impressive capabilities in performing tasks with limited task-specific training data. These models have demonstrated exceptional few-shot learning abilities, meaning they can achieve satisfactory performance even with minimal training data. Furthermore, they have also shown promising zero-shot learning abilities.
- **Transferability:** It is possible to fine-tune models that have been pre-trained on one language for use with other languages, facilitating the development of cross-lingual natural language processing (NLP) applications.

The use of large-scale pretrained language models has significantly transformed the landscape of natural language processing (NLP). These models have empowered researchers and developers to construct highly robust and effective NLP systems that exhibit cutting-edge performance. The subject matter remains a prominent field of study and advancement, with continuous endeavours to enhance its functionalities and broaden their potential applications.

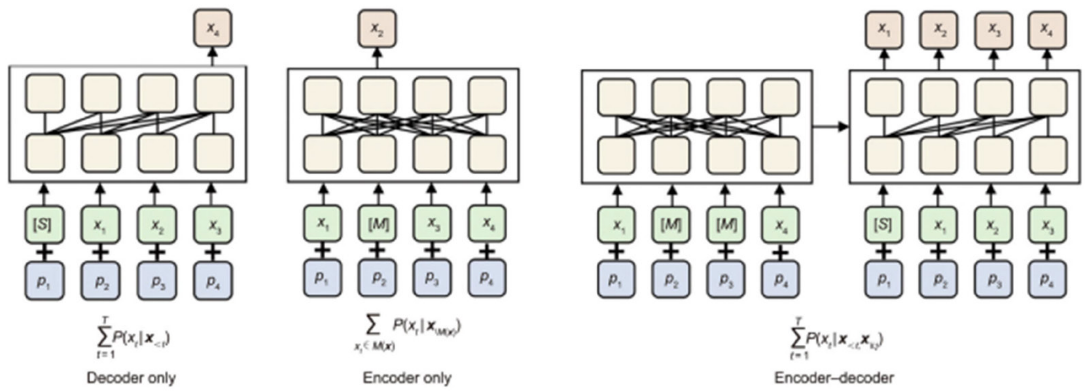


Fig. 1. An illustration of the existing prevalent pre-training frameworks, where $\boldsymbol{x}$ is the original sentence, x_t ($t = 1, 2, \ldots, T$) is the tth token, T is the sequence length, and $M(\boldsymbol{x})$ is the set of masked tokens in $\boldsymbol{x}$. S denotes the start token embedding of a sequence. p_1, p_2, p_3, and p_4 denote the position embeddings of the first to fourth tokens. P is the conditional probability. i and j indicate the start and the end indices of input tokens of the encoder, respectively.

Source: Pre-Trained Language Models and Their Applications Haifeng Wang,Jiwei Li b,Hua Wu a,Eduard Hovy ,Yu Sun

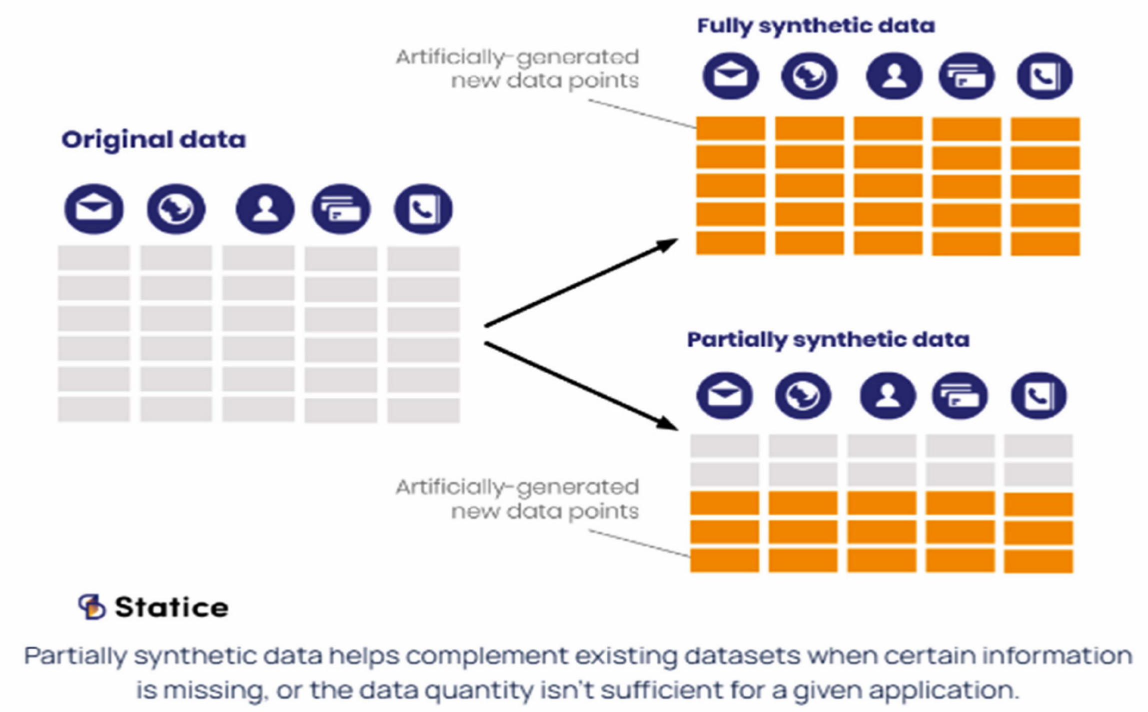
10.8 Synthetic Data:

Synthetic data refers to computer-generated information that is used to enhance or substitute genuine data in order to enhance the performance of artificial intelligence models, safeguard sensitive data, and alleviate bias.

When a substantial amount of data is sent to an individual, it results in a phenomenon known as information overload. However, when applied to computers, the outcome is the development of machine-learning models capable of acquiring the ability to generate sentence completions in real-time as text is typed or identifying tumours in medical scans that frequently elude human detection due to their subtle nature.

Data serves as the fundamental resource driving a significant portion of contemporary advancements in artificial intelligence, facilitating the generation of novel perspectives, unearthing new findings, and enabling evidence-based decision-making. The significance of data in the contemporary economy has reached a point where there is a substantial surge in the need for authentic and superior-quality data. ***Simultaneously, the implementation of more stringent regulations on data privacy, coupled with the proliferation of increasingly complex AI models, has resulted in challenges pertaining to the collection and annotation of authentic data, rendering these processes progressively more arduous or unfeasib***le.

Synthetic data, a sort of computer-generated information, has become an essential component in the testing and training of AI models in our contemporary data-centric society. The production cost of this method is rather low, as it is accompanied by automatic labelling and avoids several logistical, ethical, and privacy concerns associated with training deep learning models using real-world data. According to an estimation from Gartner, a renowned research firm, the utilisation of synthetic data in training artificial intelligence (AI) models is projected to surpass the utilisation of actual data by the year 2030.



Source: statice.ai

There are various categories of synthetic data.

Various categories of synthetic data exist, each fulfilling distinct objectives. Synthetic data possesses the capability to be:

Synthetic Text Synthetic media, encompassing various forms such as video, pictures, or sound, Synthetic tabular data Synthetic Text

Synthetic text refers to text that is produced by artificial means. The process involves constructing and instructing a model to produce textual content. The inherent intricacies of languages have consistently posed significant challenges in the generation of authentic synthetic text. The emergence of novel machine learning models has resulted in the development of highly effective natural language generation systems.

The GPT-3 algorithm is classified under the domain of deep learning, specifically as a big language model. This type of model is characterised by the use of neural networks that have been trained on an extensive corpus of text data. GPT-3 utilised around 700 gigabytes of authentic real-world data sourced from the Internet, encompassing reputable online platforms such as Wikipedia as well as digitised literary works. The GT-3 language model has gained significant recognition and widespread accessibility. Notably, Google, Meta, and DeepMind have independently pursued the development of their respective huge language models in recent years.

A multitude of instances of text generated by the GPT-3 model can be readily accessed, featuring various limitations or predetermined textual inputs, as exemplified in the following illustration.

William Shakespeare ¶

Transformer AI poetry: Poetry classics as reimagined and rewritten by an artificial intelligence.
"Sonnet 18"
William Shakespeare
Shall I compare thee to a summer's day?
Thou art more lovely and more temperate:
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date;
A winter's day, when beams of sun are few,
And skies are grey with clouds intemperate,
Is to thy beauty somehow sordid grown.
Her lovely-lovely eye is quite shut up,
Like windows pale before a sunny shower.
The earth that's cold and moist, like to my mistress,
When once that she unbrac'd, her lovely jewel,
Grows as both ugly and uncourtly.
Poor soul, the center of my motley host,
See, now they request thy sovereign presence;
The din of merry hearts hath brought me thus
To greet thee, thou unsoil'd and saint-like beauty.
A Translation by an Artificial Neural Network that draws inspiration from François Connor's translation.
Soften thou, for showers often stain the daylight,
And longer they torment my Mary's day,

This Shakespeare-like text was generated by the GPT-3 model, after training on original texts. Source: GPT-3 Creative Fiction.

Italian author Italo Calvino is considered a master of metaf iction, a genre of writing in which the author breaks the fourth wall to discuss the act of writing itself. For Calvino, metaf iction is a way of exploring the nature of reality and the ways in which stories can shape our perceptions of the world. His novels often incorporate playful, labyrinthine structures that play with the boundaries between reality and fiction. In If on a winter's night a traveler, for example, the reader is constantly interrupted by meta-level discussions of the act of reading and the nature of storytelling....

Here's what GPT-3 wrote when it was given the prompt: "Write an essay discussing metafiction in Italo Calvino's work." Source: NY Times

The topic of synthetic images and videos is of great interest in the academic community. Synthetic images refer to computer-generated visual content that mimics real-world scenes, objects, or individuals. Similarly, synthetic movies are computer

Synthetic data encompasses various forms, including but not limited to synthetic video, image, or sound. The process involves the creation of media that simulates real-world facts with a high degree of accuracy. The aforementioned resemblance enables the utilisation of synthetic media as a viable substitute for authentic data..

Source: thispersondoesnotexist.com

All of these individuals are fictitious. The synthetic images presented in this study were generated using the Generative Adversarial Network, namely StyleGAN2, which was developed by Karras et al. and Nvidia in December 2019. The system acquired knowledge about the characteristics of photographs of individuals in real-world scenarios, enabling it to produce lifelike representations of human facial features.

This approach is beneficial for enhancing the databases used in the training of machine learning algorithms. In instances where access to training video data is restricted because of privacy concerns, the generation of synthetic video data can serve as a viable solution to address this limitation. In a similar vein, synthetic data can be employed to augment the amount and diversity of datasets during the training process of image recognition algorithms.

*****

CHAPTER - 11

Build Trust & Mature Data and Analytics Culture

11.1 Active Metadata Management:

The concept of "active metadata management" has gained significant attention, mostly attributed to its endorsement by Gartner. Gartner defines this word as:

The ongoing examination of user, system, and infrastructure reports, as well as data governance, facilitates the establishment of consistency and the identification of exceptional instances between data and real-life experiences.

If one is unfamiliar with the phrase but finds this definition recognisable, it is because it essentially pertains to data catalogues.

In essence, the process entails the organisation of data through the collection of metadata, thereby ensuring its currency and accuracy.

This encompasses several types of information, such as names, descriptions, and relationships to other data. It has the potential to enhance organisational procedures, ensure regulatory compliance, develop novel applications, and serve other purposes.

There exist two distinct approaches to activating metadata, namely automatic and human curation, both of which are essential for maximising its utility.

- ***Automatic: The term "automatic" refers to a process or action that is performed without conscious thought or following data analysis, the process involves the automatic extraction of active metadata from the source system. Upon first connection to a source, it is imperative to anticipate the occurrence of certain events. However, it is equally important to continuously monitor for any modifications and then adjust the metadata in a timely manner.***

This particular form of metadata can be classified into four distinct categories:

- **Technical: In the technical context,** it is common to encounter several elements such as names, descriptions, and columns. These elements play crucial roles in organising and presenting information in a structured manner. Names are used to identify and distinguish different entities, while descriptions provide additional details and explanations about these entities.
- **Lineage:** The concept of lineage encompasses its origins, trajectory, and related aspects.
- **Relationships:** The process of developing diagrams and models that visually express the interconnectedness of data within relationships.
- **Usage: The** utilisation of information encompasses the identification of the individuals or groups who are accessing the information, the specific locations

or contexts in which they are accessing it, and the manner in which they are employing it.

The concept posits that all of these elements may be automatically retrieved or computed, devoid of any manual intervention.

- **The process of human curation:** When a table is generated, the data metadata can be automatically retrieved, but the attribution of its creator, the purpose behind its creation, and other relevant information necessitate user input.

In addition, it is necessary to incorporate the contextual information pertaining to the data, a task that necessitates human intervention.

This enables other users of the data to gain a deeper understanding of many aspects.

What is the significance or importance of the subject matter being discussed? In what manner does it facilitate the firm's harnessing of the inherent worth of the data?

The application scenarios in which it is employed and those in which it is not utilised

The value of the automatic is diminished in the absence of human-curated metadata, and conversely, the value of human-curated metadata is diminished without the automatic. This is the reason why both processes are executed using identical workflows and inside the same environment, thereby integrating human involvement and technology to maximise the generated value.

What is the Significance of Active Metadata?

In the context of data governance, active metadata management might be likened to the engine that propels an aeroplane.

In addition to its ability to provide propulsion for aircraft, the power source in question exhibits the potential to energise various other modes of transportation, including automobiles, watercraft, helicopters, and maybe other vehicles.

Active metadata has the capability to empower several additional functionalities:

The topic of concern is the quality of the data. The topic of concern is the accessibility of data. The concept of data literacy refers to the ability to understand, interpret, and effectively use data. It encompasses the skills and knowledge required. The execution of operations on data The field of data engineering encompasses the processes and techniques involved in the collection, transformation, storage, and analysis of large volumes of data. This phenomenon can be attributed to the dependence of these entities on active metadata for their operation, thereby facilitating and expediting the respective processes.

In essence, the use of active metadata enhances operational effectiveness by capturing pertinent information and contextual elements that contribute to the intrinsic value of data. This attribute is also the underlying cause of the ability to effectively search and get the desired data, as opposed to experiencing a sense of difficulty akin to searching for a needle in a haystack for every task.

Active Metadata Management Benefits :

- **Enhanced Data Quality:** As previously discussed, the use of active metadata management is motivated by the significant impact it has on data quality. The absence of a robust level of data quality the significance of this matter lies in the fact that the efficacy of conclusions derived from data analysis is contingent upon the calibre of the underlying data. Inadequate data quality can result in the generation of erroneous insights, the formulation of incorrect decisions, the squandering of resources, and potentially even harm to one's reputation. The implementation of active metadata management practices facilitates the ongoing maintenance and verification of metadata, resulting in enhanced data quality. In the event of a modification in a data source, the metadata can be appropriately modified to accurately represent the alterations, thereby mitigating the occurrence of mistakes and discrepancies.
- **The Enhancement of Operational Effectiveness:** Efficient data management plays a crucial role in enabling organisations to optimally acquire, retain, manipulate, scrutinise, and leverage their data resources. Inefficient data management can result in significant consequences such as time loss, financial burden, compromised security, and non-compliance with regulations. Active metadata management enhances operational efficiency by facilitating seamless discovery, retrieval, and administration of data throughout the entire organisation. For instance, when data is appropriately labelled and categorised with metadata, it may be readily accessed, retrieved, and utilised for analytical purposes, resulting in time and resource savings.
- **Compliance:** The concept of compliance refers to the act of conforming to rules, regulations, or expectations. The discussion of data in the year 2023 necessitates an examination of compliance. Regardless of the specific industry in which an organisation operates, it is inevitable that there will be data laws and regulations that must be followed.

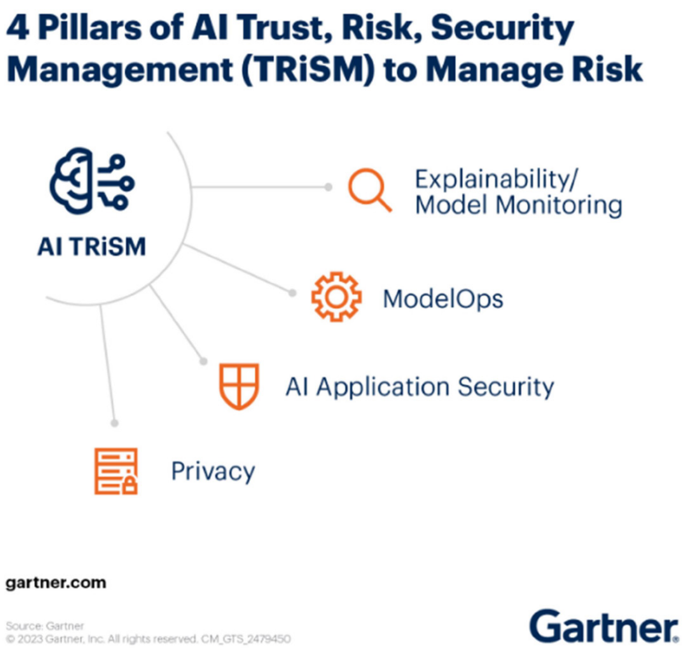
However, achieving compliance is not possible without knowledge regarding the specific data that is considered sensitive.

Active metadata management plays a crucial role in facilitating organisational compliance with rules by enhancing the level of visibility inside the data environment, enabling effective tracking of data lineage, and enhancing the overall governance of data.

This includes sensitive classification data such as personally identifiable information (PII), confidential information, and top-secret information, which can be processed either automatically or manually.

As an illustration, in the context of financial services, the Sarbanes-Oxley Act (SOX) mandates that corporations uphold the obligation to provide precise and comprehensive financial information. Active metadata management facilitates compliance by offering enhanced visibility into the lineage of financial data as well as ensuring the accurate classification and labelling of such data.

11.2 AI TRism:



The field of generative artificial intelligence (AI) has garnered significant attention in the realm of AI experimentation. However, it is common for organisations to overlook the potential hazards associated with AI models or applications until they have already been implemented or put into operation. The implementation of a complete programme for managing trust, risk, and security in artificial intelligence (AI), referred to as TRiSM, facilitates the integration of essential governance measures from the outset. This proactive approach ensures compliance, fairness, reliability, and the protection of data privacy within AI systems.

1. If one harbours any scepticism regarding the necessity of AI TRiSM, ***it is imperative to take into account the following six risk drivers, a significant portion of which arise due to users' limited comprehension of the internal workings of AI models.***

    - Most individuals can't describe what AI is and does to the managers, users, and consumers of AI models. In addition to providing explanations of AI terminology, it is crucial to possess the ability to effectively convey these concepts. This response aims to elucidate the operational mechanisms of a model by providing unique details or arguments that cater to a particular audience.

- ***The benefits and weaknesses of the model***
- ***The behaviour in question is quite probable.***
- ***There may be potential biases.***

Please provide transparency regarding the datasets utilised for training and the methodologies employed for data selection if such information is accessible. This approach has the ability to identify underlying sources of bias.

2. **ChatGPT and other generative AI technologies are accessible to a wide range of individuals.**

   The implementation of GenAI has the potential to significantly alter the competitive landscape and operational practices of organisations. However, it also introduces novel risks that cannot be effectively mitigated using traditional control mechanisms.

   - ***The hazards connected with generative AI applications hosted on cloud platforms are substantial and continuously changing.***
   - ***The use of third-party AI solutions presents potential dangers to data confidentiality.***

   As the organisation incorporates AI models and technologies sourced from third-party sources, it concurrently acquires the extensive datasets employed for training those AI models.

3. The potential ramifications for your organisation include regulatory, commercial, and reputational issues, as users may get unauthorised access to secret data within other AI models.AI models and applications necessitate ongoing surveillance.

   - ***The integration of specialised risk management methods into AI model operations, also known as ModelOps, is necessary in order to ensure compliance, fairness, and ethicality in the use of AI.***
   - ***There is a limited availability of pre-existing tools, thereby necessitating the development of tailored solutions for the AI pipeline.***

4. **Continuous controls must be included across several stages, such as model and application creation, testing and deployment, and ongoing operations. The identification and prevention of adversarial attacks on artificial intelligence necessitate the development of novel methodologies.**

   - **Malicious assaults targeting artificial intelligence systems, whether**

developed internally or incorporated into third-party models, result in several forms of organisational detriment, including financial losses, damage to reputation, and injury to intellectual property, personal information, or private data.

5. **Incorporate specialised mechanisms and methodologies to assess, verify, and enhance the resilience of AI processes, surpassing the conventional approaches employed for other categories of applications.** *The forthcoming regulations will establish certain parameters for compliance controls.*

    - ***The European Union's AI Act, with regulatory frameworks in North America, China, and India, is presently being implemented to construct rules aimed at effectively managing the potential hazards associated with the applications of artificial intelligence.***
    - ***It is advisable to be adequately prepared to adhere to legislation, including those related to the safeguarding of privacy, by going above and beyond the minimum requirements.***

6. **There are three key points to communicate to your peers.**

    - The incorporation of AI TRiSM capabilities is essential in order to guarantee the dependability, credibility, safeguarding, and confidentiality of AI models.
    - These factors contribute to improved results in the context of AI implementation, including the attainment of organisational objectives and the promotion of user satisfaction.
    - ***AI TRiSM can be regarded as a collection of solutions aimed at enhancing the integration of safeguards into the implementation of artificial intelligence and establishing a framework for governing AI systems.***

11.3 Responsible AI:

The domain of AI governance is witnessing the gradual development of responsible AI. The phrase "responsible" encompasses both ethics and democratisation, serving as a comprehensive concept.

Frequently, the utilisation of data sets for the purpose of training machine learning (ML) models inadvertently introduces bias into artificial intelligence (AI) systems. The occurrence of this phenomenon can be attributed to either the presence of incomplete or erroneous data or to the inherent biases that may be introduced during the training process of the machine learning model. When an AI programme exhibits bias, it has the potential to detrimentally impact individuals by unjustly rejecting financial loan applications or providing erroneous diagnoses to patients within the healthcare domain.

With the growing prevalence of software programmes incorporating artificial intelligence (AI) capabilities, it has become increasingly evident that there exists a necessity for standards in AI that extend beyond the framework set by Isaac Asimov, a prominent science fiction author, in his "Three Laws of Robotics."

The incorporation of responsible artificial intelligence (AI) practices can contribute to the mitigation of AI bias, enhance the transparency of AI systems, and foster more confidence among end-users towards these systems.

- **What are the fundamental tenets underlying the concept of responsible artificial intelligence (AI)?**

  The adherence to a set of principles for AI and machine learning models may vary across different organisations.

  For instance, Microsoft and Google both adhere to their respective sets of principles, whereas the National Institute of Standards and Technology (NIST) has released version 1.0 of an AI Risk Management Framework that incorporates several principles similar to those found in the aforementioned lists of Microsoft and Google. ***The National Institute of Standards and Technology (NIST) has compiled a comprehensive list of seven principles, which are as follows:***

- **Accountable and Transparent:** The principles of accountability and transparency are of utmost importance. The objective of enhancing transparency is to foster more confidence in the AI system as well as facilitate the resolution of issues pertaining to the outputs generated by the AI model. This also grants developers increased responsibility for their AI systems.

- **Explainable and Interpretable:** The concepts of explainability and interpretability are important in the context of understanding and comprehending complex systems or models. The concepts of explainability and interpretability aim to offer deeper understanding and enhance the reliability of an artificial intelligence (AI) system. Explainable artificial intelligence (AI) is designed to offer people a comprehensive understanding of the rationale and mechanisms underlying its output.

- **Fair with Harmful Bias Managed:** The management of fairness with harmful prejudice is being addressed. The concept of fairness is intended to tackle concerns pertaining to bias and discrimination in the context of artificial intelligence (AI). This principle places emphasis on the provision of equality and equity, a challenging endeavour due to the variations in values across different organisations and cultures.

- **Privacy-enhancing:** The concept of privacy is intended to promote and uphold practices that protect the autonomy, identity, and dignity of end-users. The development and deployment of responsible AI systems necessitate the incorporation of fundamental principles, including but not limited to anonymity, secrecy, and control.

- **Secure and Resilient:** The system exhibits a high level of security and resilience. It is imperative for AI systems to include responsible attributes, including robust security measures and resilience against potential dangers such as adversarial attacks. The construction of responsible artificial intelligence (AI) systems necessitates the incorporation of measures that prevent, safeguard against, and address potential attacks while also possessing the capability to recuperate from such attacks.
- **Valid and Reliable:** The data collected in this study is considered to be both valid and reliable. It is imperative for AI systems to exhibit responsible behaviour by consistently upholding their performance levels even in unforeseen and challenging situations, thereby avoiding any instances of failure.
- **Safe:** The concept of safety is of paramount importance in various domains and contexts. The implementation of ethical principles in the development and deployment of artificial intelligence (AI) systems is crucial to ensuring the protection of human life, property, and the environment.

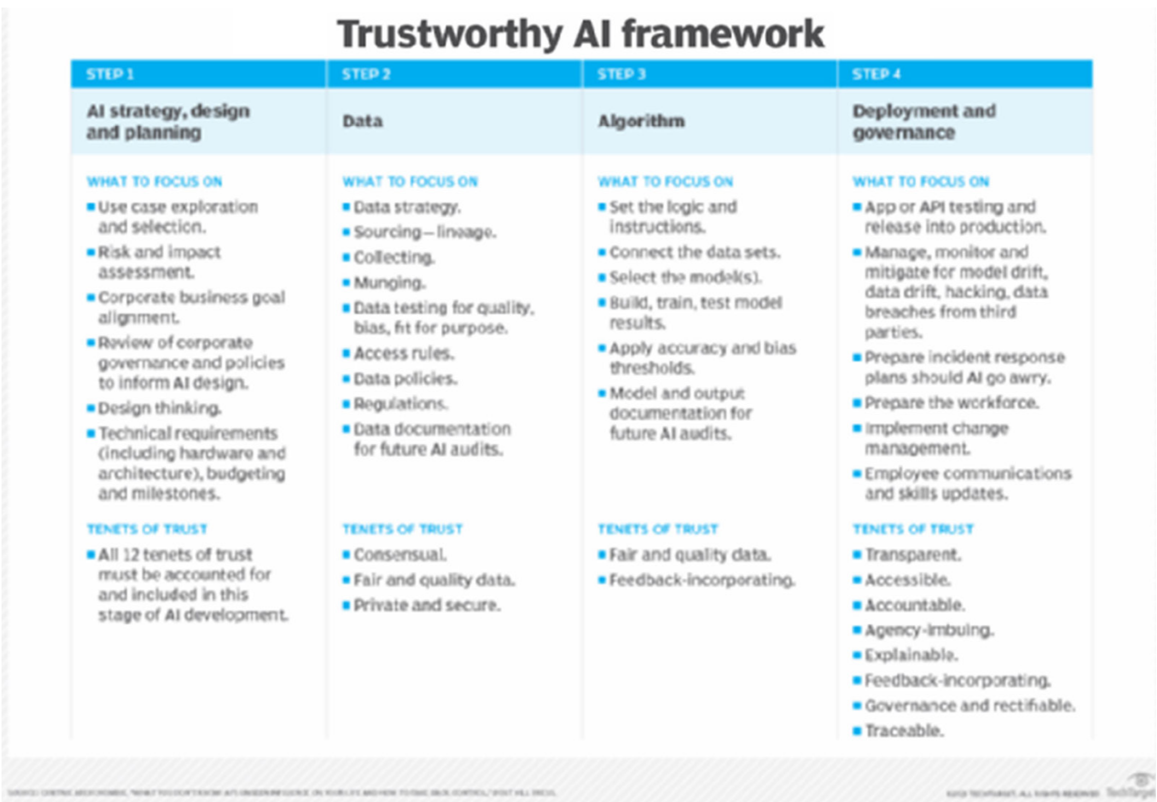


Figure 1. Possible frameworks for responsible AI can differ from company to company.
Source: techtarget

What are the key considerations in the construction of responsible AI?

Continual examination is vital in order to ascertain that an organisation is dedicated to delivering an impartial and reliable artificial intelligence system. The presence of a maturity model is of utmost importance for an organisation while undertaking the design and implementation of an artificial intelligence system.

At a fundamental level, the construction of responsible artificial intelligence (AI) should revolve around the establishment of development standards that prioritise the principles of responsible AI design. Given that these principles vary between organisations, it is imperative to thoroughly evaluate each one. ***Artificial intelligence (AI) systems ought to be constructed using resources in accordance with a comprehensive development standard established by the organisation. This standard necessitates the incorporation of the following components:***

- ***Code repositories that are shared among multiple individuals or teams.***
- ***The model architectures that have been authorised or endorsed.***
- ***The variables that have been officially approved or authorised for use in a particular study or research project are referred to as sanctioned variables.***
- ***Developed bias assessment approaches to ascertain the soundness of assessments for artificial intelligence (AI) systems.***
- ***The establishment of stability standards for active machine learning models is crucial in order to guarantee the proper functioning of AI programming.***

It is imperative to construct AI models with well-defined objectives that prioritise the development of a model that is both secure and reliable while adhering to ethical principles. An organisation has the potential to develop responsible artificial intelligence (AI) by adhering to the goals and principles outlined in Figure 2.

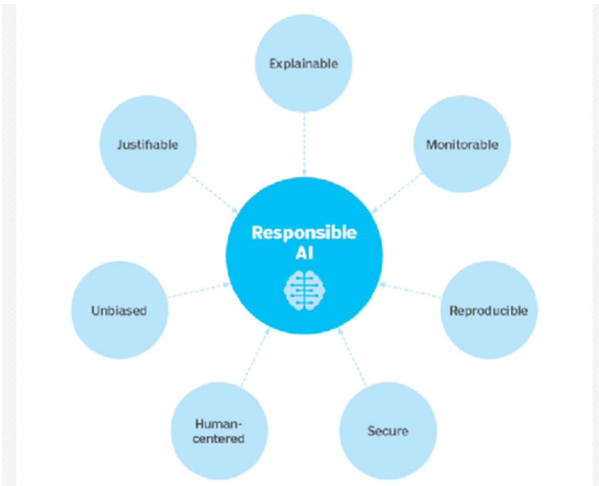


Fig 2- There's no current set standard for responsible AI principles, so organizations can choose from various principles.
Source: techtarget

The present discourse aims to elucidate the implementation process and operational mechanics of the subject matter.

An organisation can effectively adopt responsible artificial intelligence (AI) and showcase its responsible AI system using the following means:

- It is imperative to present facts in a manner that is comprehensible to human interpretation.
- The objective is to thoroughly document the design and decision-making processes in such a manner that, in the event of an error, it becomes possible to analyse and reconstruct the sequence of events that led to the mistake.
- To foster a diverse work culture and address bias, it is imperative to establish an environment that encourages constructive discussion.
- Utilise interpretable qualities in order to facilitate the generation of data that is comprehensible to humans.
- Design a meticulous development methodology that prioritises the disclosure of latent features in every application.
- The primary objective is to mitigate the utilisation of conventional black box artificial intelligence (AI) model development approaches. Alternatively, it is advisable to prioritise the development of a white box or explainable artificial intelligence (AI) system that offers a comprehensive rationale for every choice made by the AI.

The optimal approaches for adhering to responsible AI principles

In the context of responsible AI design, it is imperative to establish governance mechanisms that are characterised by systematicity and repeatability***. Several recommended practices include the following:***

- The implementation of best practices in machine learning is crucial.
- Establish an inclusive and multifaceted environment that fosters assistance and encouragement. This entails the establishment of teams that exhibit gender and racial diversity and are tasked with the development of responsible standards for artificial intelligence (AI). Facilitate the expression of ethical discourse pertaining to artificial intelligence and bias within this cultural context.
- To ensure the development of an explainable AI model, it is imperative to prioritise the promotion of transparency. This approach enables the visibility and ease of rectification of any judgements made by AI.
- Ensure that the effort is quantifiable to the greatest extent possible. The assessment of responsibility is a matter of subjectivity. To address this, it is crucial to establish quantifiable procedures, such as visibility and explainability, and to implement auditable technical and ethical frameworks.

- Utilise conscientious artificial intelligence (AI) techniques for the purpose of scrutinising AI models. There are other options that can be considered, one of which is the TensorFlow toolbox.
- This prompt seeks to identify metrics that can be utilised for the purposes of training and monitoring in order to effectively mitigate errors, false positives, and biases.
- Conducting tests, such as bias testing or predictive maintenance, can contribute to the generation of verifiable outcomes and enhance the level of confidence among end-users.
- It is recommended to maintain ongoing surveillance following the implementation phase. This practice aids in maintaining the responsible and impartial functioning of the AI model.
- Maintain a state of mindfulness and derive knowledge from the ongoing process. The organisation acquires a deeper understanding of the responsible deployment of artificial intelligence (AI), encompassing many aspects such as fairness practices, technical references, and materials pertaining to technical ethics.

There are Numerous Instances of Companies Actively Adopting Responsible Artificial intelligence (AI) practices.

Microsoft has developed a proprietary framework for responsible AI governance in collaboration with its AI, Ethics, and Effects in Engineering and Research Committee and Office of Responsible AI (ORA) teams. These two factions collaborate inside the organisational structure of Microsoft to disseminate and preserve their explicitly delineated principles about responsible artificial intelligence. The primary mandate of ORA is to provide comprehensive guidelines for ethical and responsible use of artificial intelligence (AI) throughout an entire organisation. This objective is achieved by undertaking governance initiatives and engaging in public policy endeavours. Microsoft has integrated a variety of responsible AI standards, checklists, and templates into their practices.

- ***These include the following:***
- Guidelines for Interaction between Humans and Artificial Intelligence
- Guidelines for Conversational AI
- Guidelines for inclusive design
- Checklists for Ensuring Fairness in Artificial Intelligence Systems
- The provision of templates for data sheets.
- Guidance on AI security engineering

A credit scoring organisation is an entity that assesses and evaluates the creditworthiness of individuals and businesses based on various financial factors and historical data. FICO has developed a set of responsible AI governance principles aimed at enhancing the comprehension of its employees and customers regarding the functioning of the machine learning (ML) models employed by the company, as well as the inherent constraints of the programming. The data scientists at FICO are responsible for evaluating the complete lifecycle of their machine learning models and continuously assessing their efficacy and impartiality. ***FICO has established a series of approaches and processes aimed at detecting bias.***

- The process of constructing, implementing, and overseeing interpretable models for artificial intelligence.
- The utilisation of blockchain technology as a governance mechanism for the documentation of an artificial intelligence (AI) model's functionality Disseminating an explainable artificial intelligence toolkit to both staff and clients. The implementation of a comprehensive testing protocol to assess bias.

IBM has established an independent ethics board that is specifically focused on addressing the ethical considerations associated with artificial intelligence. The IBM AI Ethics Board serves as a central governing entity that facilitates the development and implementation of ethical and responsible artificial intelligence (AI) practices throughout the organisation of IBM.

IBM places emphasis on certain guidelines and resources, which encompass the following:

- The topic of interest is the concepts of trust and transparency in the field of artificial intelligence (AI).
- Ethics in Artificial Intelligence on a Daily Basis.
- Resources are available within the open-source community.
- The investigation of trustworthy artificial intelligence (AI) has been the subject of scholarly inquiry.

The responsible utilisation of Artificial Intelligence (AI) within the context of Blockchain Technology:

A distributed ledger can be used to handle transactional data, but it also has a lot of potential as a tool for making an immutable record that explains why a machine learning model made a certain prediction. Hence, certain enterprises are employing blockchain technology, a well-recognised decentralised ledger utilised in the context of the cryptocurrency bitcoin, to record and authenticate their implementation of ethical artificial intelligence.

The utilisation of blockchain technology ensures that every stage of the development process, encompassing the identification of contributors, testing procedures, and decision approvals, is meticulously documented in an immutable and easily comprehensible format.

The standardisation of Responsible AI:

Prominent executives from major organisations, like IBM, have publicly advocated for the implementation of legislation pertaining to artificial intelligence (AI). However, ***it is noteworthy that no universally accepted standards or guidelines have been established thus far. Despite the current surge of generative AI models like ChatGPT, there is a deficiency in the implementation and use of AI applications. The United States, as an illustrative example, has not yet enacted comprehensive federal legislation to control artificial intelligence (AI), giving rise to divergent viewpoints regarding the potential future implementation of AI regulation. Both the National Institute of Standards and Technology (NIST) and the current administration led by President Biden have issued comprehensive rules pertaining to the use of artificial intelligence (AI).***

As an illustration, alongside the Artificial Intelligence Risk Management Framework developed by the National Institute of Standards and Technology (NIST), the Biden administration has released comprehensive plans for an AI Bill of Rights, an AI Risk Management Framework, and a roadmap outlining the establishment of a National AI Research Resource.

11.4 Digital AI:

Digital AI encompasses the incorporation of artificial intelligence (AI) technologies within digital platforms, systems, or services. The application of artificial intelligence (AI) algorithms and models is employed to augment digital experiences, automate processes, offer intelligent insights, and enhance decision-making across many digital domains.

The following are fundamental components and practical implementations of digital artificial intelligence (AI):

- **Digital Transformation:** The integration of digital artificial intelligence (AI) assumes a pivotal function in the endeavours of digital transformation across many industries. The process entails utilising artificial intelligence (AI) to update and enhance digital processes, systems, and consumer interactions.
- **Automation:** Automation is the use of digital artificial intelligence (AI) to streamline and mechanise mundane and repetitive processes, including but not limited to data entry, document processing, and customer service. Robotic Process Automation (RPA) is a widely used technology in this field.
- **Personalisation:** Artificial intelligence algorithms are utilised to customise

digital experiences, including providing tailored content recommendations on streaming platforms, suggesting relevant products in e-commerce, and delivering targeted advertising.

- **Natural Language Processing:** Natural Language Processing (NLP) encompasses a range of approaches that empower artificial intelligence systems to comprehend and produce human language. This capability facilitates the development of various applications, including chatbots, virtual assistants, and sentiment analysis.
- **Computer vision:** Computer vision is a field of study that focuses on enabling computers to interpret and understand visual information from digital images or videos. Artificial intelligence (AI) facilitates the examination of visual data, encompassing photos and videos, to perform various tasks, including facial identification, object detection, and medical image analysis.
- **Predictive analytics:** Predictive analytics involves the use of digital artificial intelligence models that leverage previous data to generate forecasts on forthcoming occurrences or patterns. This analytical approach becomes beneficial in various domains such as demand forecasting, fraud detection, and preventative maintenance.
- **Data analytics:** Data analytics is a field that utilises artificial intelligence (AI) methods to extract valuable insights from extensive databases, enabling organisations to make informed decisions based on data.
- **Recommendation Systems:** AI-powered recommendation engines offer suggestions for products, services, or content by taking into account user preferences, thereby enhancing user engagement and facilitating revenue generation.
- **Cybersecurity:** Digital AI is employed for threat detection, anomaly detection, and behaviour analysis to enhance cybersecurity measures and protect digital assets.
- **Autonomous Systems:** Autonomous systems, such as those found in the fields of autonomous vehicles and drones, rely on digital artificial intelligence (AI) to facilitate self-driving functionalities, thereby allowing these vehicles to independently navigate and make decisions.
- **Health Tech:** The field of health technology utilises artificial intelligence (AI) in many digital health applications, encompassing disease detection, analysis of medical imaging, and the provision of personalised therapy suggestions.
- **Financial Services:** In the realm of financial services, digital AI plays a crucial role by providing assistance in several areas such as fraud detection, algorithmic trading, risk assessment, and the development of customer service chatbots.

- **Smart Cities:** The utilisation of artificial intelligence (AI) plays a significant role in the advancement of smart city solutions, including several aspects such as traffic control, energy optimisation, and waste management.
- **Gaming:** The utilisation of artificial intelligence (AI) in game engines has facilitated the development of digital games that boast lifelike characters, gameplay that adjusts to the player's actions, and environments that are capable of dynamically changing.
- **Customer Insights:** The utilisation of artificial intelligence (AI) enables the analysis of consumer data, hence facilitating the provision of valuable insights pertaining to customer behaviour, preferences, and trends. This, in turn, assists businesses in customising their digital strategies to better align with the needs and expectations of their target audience.
- **Supply Chain:** The implementation of digital artificial intelligence (AI) in supply chain management enhances operational efficiency through the prediction of demand, effective inventory management, and optimisation of logistical processes.
- **Education:** The field of education has been enhanced by the integration of AI-powered digital platforms, which have the capability to deliver personalised learning experiences, alter educational content, and provide valuable feedback to students.

The rapid advancement of digital artificial intelligence (AI) has led to the emergence of revolutionary capabilities across a wide range of businesses and fields. The use of this technology in digital solutions has the potential to improve efficiency, customization, and the overall quality of digital encounters. In the digital era, it serves as a crucial catalyst for innovation.

11.5 Digital Humans :

A digital human refers to an animated representation, commonly known as an avatar that possesses the ability to exhibit a comprehensive spectrum of human body language. Supported by artificial intelligence, which possesses the ability to comprehend the input provided by clients and deliver not only the necessary information but also a suitable non-verbal reaction.

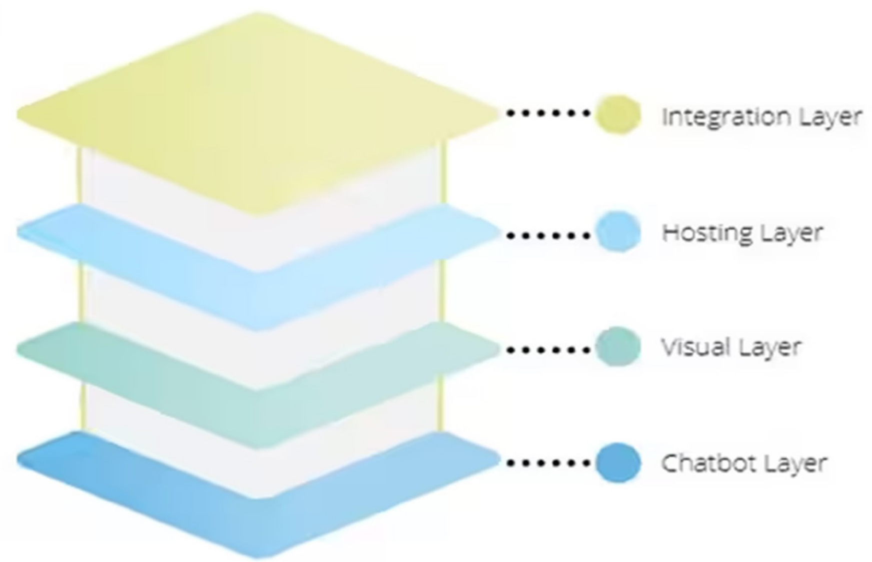
- Artificial intelligence (AI) is what powers digital humans, which are virtual beings with human-like traits. These entities combine the advantages of both human and digital elements. The topic of discussion pertains to the interaction between artificial intelligence (AI) and human beings in the context of dialogue.
- The ability to establish connections with various digital cognitive systems, such as chatbots and natural language processing (NLP) algorithms, facilitates the

seamless exchange of information and knowledge.

- Engage in communication through both verbal and non-verbal channels, encompassing elements such as tone of voice and facial expressions.
- Enabling the replication of authentic human contact on a large scale
- Furthermore, these services are available round the clock, every day of the week, without any breaks.

Technology and how it's used :

Digital beings have the capacity to offer assistance and guidance to clients while also facilitating a genuine emotional bond with humans**. *A digital human is constructed on four foundational pillars.*** The chatbot layer facilitates interaction with a digital human. This is the location where the digital human undergoes training in order to develop the ability to accurately identify and comprehend the inquiries posed by clients, subsequently providing them with the appropriate response. One such solution is to use Google Cloud DialogFlow as an example. The textual content of the chatbot is transformed into audible speech, utilising a voice that is selected according to personal preference. In contrast, the verbal inquiry posed by the consumer is then transcribed into written form in order to be processed by the chatbot. The visual layer encompasses the digital human and its corresponding background. The management of this layer is overseen by Uneeq. *Emotional presence and facial expressions are programmed within the chatbot and visual layer, enabling them to accurately reflect and respond at appropriate junctures.*



Source: Deloitte

When discussing digital people, two potential identities they may embody are:

- A digital human possesses the capacity to function as a digital replica of an actual individual, incorporating their anatomical, physical, and biological characteristics.
- A digital human can encompass a fictitious figure, which may be derived from the physical likeness of an actor or totally computer-generated.

What are the functions and capabilities of digital humans?

The objective of digital people is to replicate human contact on a large scale.

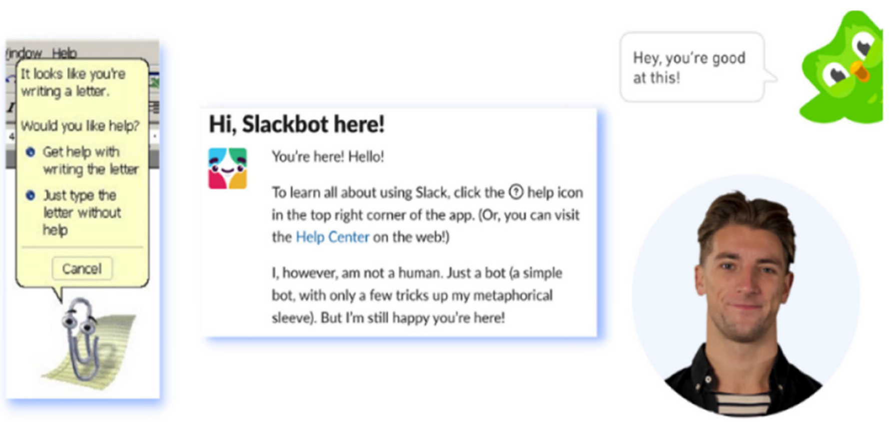
Human beings are inherently social beings, and we possess a strong desire for interpersonal connections and engagements.

Numerous firms have acknowledged the potential benefits associated with including a character or mascot in their communication strategies.

Consider the example of Siri.

Alternatively, Duo, the mascot of the language-learning platform Duolingo, can also be considered.

Another notable example is Clippy, a well-known computer assistant from the 1990s that aided users in navigating computer systems.



People like to interact with others in a human way. With advances in technology, we're

Source: synthesia.io

However, digital people transcend the capabilities of chatbots and digital assistants.

Due to their ability to utilise both verbal and nonverbal clues, they are employed in diverse situations, such as assisting in online information retrieval, providing guidance in complex procedures, offering advisory services, and fulfilling other related functions.

Nevertheless, digital individuals surpass the functionalities of chatbots and digital assistants. Because of their capacity to exploit both verbal and nonverbal cues, they are utilised in a wide range of scenarios, including aiding in online information retrieval, providing guidance in intricate procedures, supplying advisory services, and performing other associated roles.

A digital human has the capability to function as a digital replica of an actual being. In this scenario, the AI system is capable of engaging in many online contexts, mirroring the behaviour of a human individual in offline interactions.

In contemporary society, there is a notable proliferation of digital human entities, particularly in the realm of conversational artificial intelligence, which is increasingly becoming integrated into our daily routines.

Emergen Research has reported that the worldwide digital human market is projected to exhibit substantial growth, with an estimated increase from $10 billion in 2020 to over $530 billion by 2030.

In the near future, there will be an increasing prevalence of digital twins engaging in activities such as trying on garments and cosmetics, socialising with acquaintances, and participating in professional gatherings within the realm of virtual reality.

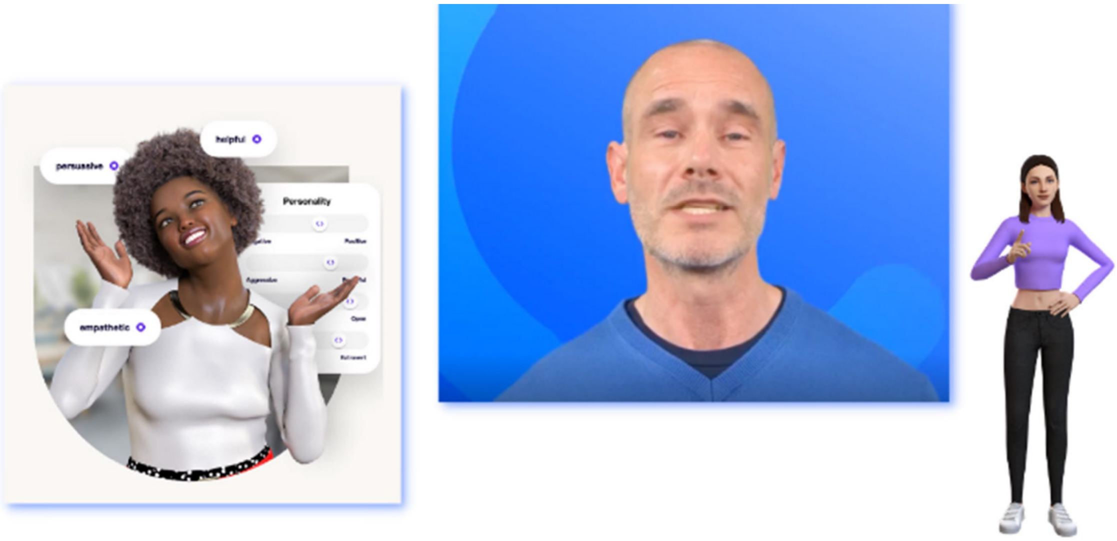
In what contexts are digital humans employed?

In numerous domains, indeed.

The increasing prevalence of digital humans is attributed to their capacity to emulate real-life communication in a wide-ranging manner.

In contemporary times, digital people find their predominant application in the following areas:

- Customer support reps are those that provide assistance and resolve issues for customers.
- Educators for instructional and pedagogical purposes
- The utilisation of virtual assistants in the healthcare industry
- The individuals involved in the entertainment business
- Individuals that deliver presentations in marketing and sales videos.
- ***Digital influencers, also known as social media influencers***, are individuals who have gained a significant following on various digital platforms, such as social media.



As digital humans become increasingly realistic and emotionally intelligent, there will be more use cases for their implementation.

Source: synthesia.io

It is anticipated that in the forthcoming era, it will become commonplace for individuals to possess their own digital replica, **commonly referred to as a "digital twin."** Given the rapid pace of technological advancements, it is anticipated that the ability to produce "replicas" will become accessible to a wider population in the near future.

What Are the Steps Involved in Creating a Digital Person using Artificial intelligence?

The process of building a digital person or virtual assistant, regardless of whether it is intended to resemble oneself or cater to a worldwide market, remains the same.

The generation of a 3D model of an individual can be accomplished by two primary methods:

- **First Step:** The use of a scanner to capture the physical attributes of a person and convert them into a digital representation, or the employment of software tools to construct a 3D model from the ground up.
- **Second Step:** Subsequently, artificial intelligence (AI) is employed to replicate the appearance of reality in a visually accurate manner, simulate lifelike movements, and incorporate a vocal element.

Although it may initially appear intricate, the process of generating one's digital counterpart is, in fact, rather straightforward.

The recommended approach involves utilising a 15-minute video recording of the individual engaging in on-camera discourse, preferably within a professional

studio setting, to ensure enhanced audio-visual fidelity. However, if desired, the webcam can also be used. The user is advised to transmit the task to skilled avatar developers, who will employ their expertise to create a refined outcome. By utilising artificial intelligence technology, the process of generating a digital replica of the user will be expedited, resulting in a completed product within a short span of a few days.

The following elucidates the procedure for generating a personalised representation, sometimes referred to as an avatar that accurately portrays oneself.

However, in the event that an individual does not feel at ease being on camera, they have the option to utilise a pre-existing digital representation of a human, sometimes referred to as a "stock" digital human. The characters in question do not serve as direct reflections of one's own identity but rather are constructed based on the performances of actors.

What are the Technological Components Employed in the Development of Digital Human Entities?

When discussing digital humans, the initial focus is on their visual representation.

It is remarkable how well they resemble actual individuals, replicating human physical postures, subtle movements, facial displays, and more nonverbal signals.

However, another aspect contributing to their efficiency is their exceptional proficiency in verbal communication.

Consequently, the development of these entities necessitates the integration of a sophisticated amalgamation of technologies, including not just their physical likeness but also their capacity to comprehend and employ language with precision. Alternatively, the focus of discussion pertains to various linguistic systems.

The following elucidates some essential technologies that underpin the development of digital people.

- The Utilisation of 3D scanning as a foundational element for the development of 3D modelling.
- The use of 3D modelling techniques in order to generate a three-dimensional representation of an individual.
- The field of natural language processing (NLP) is concerned with the development of computational models and algorithms that enable machines to understand and interpret human language. One specific use of NLP is the understanding of voice commands, where machines are trained to process and comprehend spoken instructions given by users.
- The process of generating responses using natural language is known as natural language generation.

Artificial intelligence (AI) is capable of effectively processing input data and acquiring knowledge through the identification and analysis of patterns.

The primary obstacle encountered in the development of digital humans is the significant challenge they pose.

The Concept of the Uncanny Valley:

The uncanny valley refers to a phenomenon when a synthetic human exhibits a high degree of visual and behavioural resemblance to a real human yet possesses subtle deviations that render them perceptibly artificial. The presence of these entities might elicit a sense of discomfort or aversion in individuals who come across them.

As the advancement of digital human technology progresses, it is anticipated that the uncanny valley phenomenon will shrink, ultimately resulting in digital individuals that are indiscernible from their real-life counterparts.

- **What is The Rationale behind the Necessity of digital Humans?**

  In the forthcoming era, there will be a discernible proliferation of digital entities involved in internet communication.

  What is the basis for our high level of confidence on this matter?

  Virtual assistants and digital employees possess tangible economic value and serve as fundamental components of our digital identities within the virtual realm.

- ***The entities in question are accessible at all times, without the need for breaks, remuneration, or rest.***

  - **Scalability and cost-effectiveness** make them a viable alternative for organisations.

  Online interactions are enhanced through the integration of both verbal and non-verbal cues.

- ***The individuals possess a high level of accessibility due to their ability to effortlessly transition between many languages and cultural environments.***

  - The use of these platforms guarantees the preservation of anonymity during discussions pertaining to sensitive subjects.

They revolutionise the manner in which individuals engage in ***communication through the utilisation of technology and interpersonal interactions.***

In summary, the integration of digital humans into **the virtual realm serves to enhance interpersonal connections, augment communication capabil**ities, and ultimately enhance the quality of our digital existence.

There are five potential hazards associated with the use of digital humans:

Like any emerging technology, the use of digital devices also presents possible risks and hazards.

- **Firstly, the concept of the uncanny valley** When individuals perceive themselves to be engaging with a genuine individual, only to subsequently discover that they are in fact communicating with an artificial entity, they may experience a sense of deception and thus exhibit a decline in their level of trust.
- **Secondly, the issue of user privacy should be considered.** The disclosure of personal information by individuals is more probable when engaging with an online entity that has human-like characteristics, hence necessitating increased regulatory measures.
- **Thirdly, the aspect of ethics should be considered.** The emergence of stereotypes and inaccurate depictions of society might manifest while designing or choosing computerised human representations for various applications.
- **Additionally, human interactions play a significant role.** The implications of decoupling our digital identities from the physical realm remain uncertain, leaving us with a limited understanding of the potential impact on human interactions, which serve as fundamental components of our societal structure.
- **The Fifth aspect to consider is identity.** The availability of digital realms for self-reinvention carries implications pertaining to trust and transparency.
- **The prospective trajectory of human connection**

The advent of digital people has arrived. Furthermore, it is evident that their presence is enduring.

- Individuals may adopt alternative types of identities.
- Business enterprises are expected to expedite their communication processes.
- The advent of a new era of social connection is anticipated for society.
- Undoubtedly, there will be individuals who engage in malicious activities, and as is the case with any novel development, it will be imperative to devise strategies to address their actions.

However, it is certain that there is no possibility of reverting to a previous state.

The contemporary ease of implementing digital humans is attributable to advancements in technology. Is the profession of Cost and Management Accountants well prepared for the challenges it may face?

11.6 Digital Ethics:

Digital ethics are the interpersonal, social, organisational, and national norms that govern how individuals and digital users should conduct themselves and perform in the digital world. It is a paradigm in which digital transformation is impervious to the moral inclinations of those conducting the transformation. It also implies that we do not permit machines to discriminate against and undermine our society's ethical values. Digital ethics operates in both directions, from humans to machines and vice versa.

Digital ethics involves the manner in which users and participants in online environments interact with each other, as well as the tools and platforms employed for engagement. This field of study is rooted in the broader concept of ethics, which pertains to the manner in which groups and people establish relationships, treat one another, and address conflicts.

- How can an online discussion board community effectively manage instances of flaming?
- Is it ethically justifiable to provide assistance or endorsement to websites that engage in piracy?
- What types of photographs are considered suitable for the act of retweeting?
- To what extent should privacy policies maintain confidentiality while consenting to terms of service agreements?

Like many other ethical issues and moral dilemmas, the topic at hand elicits diverse perspectives and a wide range of viewpoints influenced by individuals' political affiliations, personal characteristics, and underlying motivations. ***From a rhetorical standpoint, the examination of digital ethics involves the formulation of a sequence of inquiries pertaining to the realms of textual and visual communication.***

In a given situation, it is important to choose the appropriate vocabulary and tone to employ.

- What are the regulations that dictate the operations of a specific online community?
- In what manner are sources employed, combined, or modified to cater to a specific target audience?
- What is the appropriate method for referencing or citing these sources in a fair manner?
- In what manner do individuals present their identities on digital platforms, such as social media, gaming platforms, avatars, or other comparable mediums? The development and maintenance of online ethos is a subject of inquiry.

- In light of the growing ambiguity between private and public domains, how can individuals navigate this complex boundary? What defines the concept of "public"?

There is no prescribed methodology or rigid set of guidelines governing online communication or engagement, just as there is no fixed code of behaviour dictating the manner in which substantial, in-person discourse should be conducted inside a university setting (McKee 429).

In this study, we aim to investigate the effects of a particular drug on the behaviour of Nevertheless***, it is important to take into account certain norms.***

Ethics can be conceptualised as a set of "appropriate" approaches to conduct and interpersonal interactions within a specific context. The establishment of efficient online communication is contingent upon the accumulation of broad patterns of experiences, which provide guidance and governance. Commencing electronic correspondence with a courteous salutation or exercising discretion in managing images in which one is tagged on the social media ***platform Facebook do not exemplify adherence to universally valid principles. Instead, these practices represent beneficial customs within the realm of digital ethics, as they are driven by the anticipated consequences of impolite emails and inappropriate online photo collections, namely, the likelihood of receiving no response and the potential negative impact on one's professional prospects, respectively.*** Given the conventional and theoretical aspects of netiquette, which fall within the broader domain of digital ethics***, it is advisable not to simply commit to memory a set of netiquette rules (although they may prove useful in certain contexts), but rather to approach the subject through a rhetorical framework in order to comprehend the essence of digital ethics and recognise their significance.***

The significance of digital ethics lies in the impact of persona construction on the reception of communication and intentions. The concept that personal ethics have an influence on our arguments is not a novel one. The contemporary comprehension and classification of argumentation owe a significant debt to Aristotle's "appeals," which are often recognised as the persuasive techniques employed to substantiate arguments tailored to certain audiences. *Aristotle's Rhetoric introduces three fundamental arguments that are employed to categorise the methods of persuasion: logic (logos), passion (pathos), and the speaker's character (ethos). (For additional in*sights into these rhetorical appeals, go to the scholarly article titled "Rhetorical Appeals.") The appeals discussed in this context are not given in a hierarchical manner or in any particular sequence of significance. Instead, Aristotle argued that skilled and persuasive communicators are able to skillfully incorporate parts of all three appeals into their speeches. The proficient speakers were tasked with presenting rational evidence to support their assertions, integrating them within a broader objective of evaluating and influencing the emotional state of the audience while simultaneously establishing their own credibility and trustworthiness and demonstrating their genuine concern for the welfare of the public. The aforementioned rhetorical balancing act assigns equal significance to the logical and coherent aspects of an argument, as well as to the speaker delivering said argument. **To appear believable, one must "display**

(i) practical intelligence (phronêsis),

(ii) (ii) a virtuous character, and (iii) good will (Rhetoric II.1, 1378a6ff). According to the second source, the ultimate determination of the validity of proof pertaining to scientific and political assertions is contingent upon the ethical disposition and integrity of the individual involved.

Digital ethics involves the manner in which users and participants in online settings interact with each other and the technology and platforms employed for engagement, as it pertains to the way groups and people relate to, treat, and resolve difficulties with one another. How can an online discussion board community effectively manage instances of flaming? Is it ethically justifiable to provide assistance or support to websites that engage in piracy? What types of photographs are considered suitable for retweeting? To what extent should privacy policies maintain confidentiality while consenting to terms of service agreements?

Like many ethical issues and moral dilemmas, there exists a diversity of perspectives influenced by individuals' political beliefs, personal characteristics, and objectives. From a rhetorical standpoint, the examination of digital ethics involves the formulation of a sequence of inquiries pertaining to both written and visual forms of communication.

In a given situation, it is important to consider the right words and tone to be employed. ***What are the established principles and regulations that dictate the behaviour and conduct within a specific online community? In what manner are sources employed, combined, or modified to cater to a specific target audience? What is the appropriate method for referencing or citing these sources in a fair manner?*** This inquiry pertains to the manner in which individuals present their identities on digital platforms, encompassing social networking, gaming, avatars, and similar mediums. What are the processes involved in the development and maintenance of an online ethos? In what manner do individuals navigate the ever-indistinct demarcation between the realms of personal and communal domains? What is the concept of "public"? There is no prescribed methodology or rigid set of guidelines governing online communication or engagement, just as there is no rigid code of conduct dictating the conduct of a huge, in-person conversation on a university campus (McKee 429). In this study, we aim to investigate the effects of various factors on the performance of students. Nevertheless, it is important to take into account certain norms. Ethics can be conceptualised as the set of principles and guidelines that govern appropriate conduct and interpersonal interactions within a specific context. The establishment of efficient online communication is contingent upon the accumulation of broad patterns of experiences, which provide guidance and governance. Commencing electronic correspondence with a courteous greeting or exercising discretion in managing one's tagged images on the Facebook platform do not exemplify adherence to universally valid principles. Instead, these practices represent valuable conventions within the realm of digital ethics, as they are informed by observed behavioural patterns in response to impolite emails and unsuitable online photo collections. Specifically, the consequences of disregarding these conventions include non-responsiveness to offensive emails and potential negative professional implications, as well as the potential for adverse outcomes in terms of employment opportunities. Given the conventional and theoretical aspects of netiquette, which fall within the broader domain of digital ethics, it is advisable to refrain from simply memorising a set of netiquette rules (although these may prove useful in certain contexts). Instead, one should strive to comprehend digital ethics from a rhetorical perspective, appreciating their significance and relevance.

The significance of digital ethics lies in the immediate impact of how individuals shape and express their personas, since it directly influences the reception and interpretation of their communication and intentions. The concept that personal ethics have an influence on our arguments is not a novel one. A significant portion of contemporary comprehension and classification of argumentation can be traced back to Aristotle's "appeals." These appeals are often recognised as the methods of persuasion employed to substantiate arguments for particular audiences. Aristotle's Rhetoric presents a classification of argumentation based on three fundamental appeals: logos, which pertains to logic; pathos, which pertains to emotion; and ethos, which pertains to the character of the speaker. (For additional elucidation on the subject of rhetorical appeals, please refer to the source under "Rhetorical Appeals".) The appeals discussed are not given in a hierarchical manner or in any particular sequence of significance. Aristotle said that skilled communicators incorporate components from all three appeals in their speeches to effectively convey their message. Proficient speakers were tasked with presenting rational evidence to support their assertions, strategically incorporating them within the broader objective of evaluating and influencing the emotional state of the audience while simultaneously establishing themselves as trustworthy and authoritative figures with genuine concern for the welfare of the public. This rhetorical endeavour lays equal emphasis on the logical structure and coherence of an argument as it does on the person delivering the argument. In order to establish credibility, it is necessary to exhibit three key attributes: practical wisdom, virtuous character, and good intent, as outlined in Rhetoric II.1, 1378a6ff. ***According to the second source, the ultimate determination of the validity of proof, particularly in the context of scientific and political assertions, hinges upon the ethical and moral attributes of the individual involved.***

The following are several fundamental components of digital ethics:

- **Privacy:** The preservation of individuals' privacy in the digital era is a fundamental focal point within the realm of digital ethics. This encompasses concerns related to the gathering of data, monitoring of user activities, surveillance practices, and the ethical management of individuals' personal information.
- **Security:** The preservation of the integrity and confidentiality of digital systems and data is of utmost importance. Ethical concerns encompass the implementation of measures to mitigate the risks of cyberattacks, ensuring the protection of user data, and adhering to established security protocols.
- **Transparency:** It is imperative to ensure that users are provided with comprehensive information regarding the utilisation of their data and are given the opportunity to make well-informed decisions.
- **Consent:** The acquisition of informed consent is a core ethical criterion. Individuals should be afforded the opportunity to exercise their discretion in either consenting or declining to participate in the collection and dissemination of their personal data, while also possessing a comprehensive comprehension of the potential ramifications associated with their decisions.
- **Fairness:** This encompasses the examination of prejudice within AI algorithms, the promotion of equitable access to digital resources, and the prevention of discriminatory practices based on criteria such as race, gender, or other relevant variables.
- **Accountability:** Accountability is a fundamental aspect of digital ethics, necessitating the imposition of responsibility on both individuals and organisations for their conduct inside the digital realm. This encompasses the responsibility for instances of data breaches, cyberbullying, internet harassment, and unethical conduct.
- **Intellectual Property:** The ethical dimension of intellectual property entails the obligation to uphold and honour the rights associated with creative and innovative works. The subject matter encompasses various concerns, including the act of plagiarism, violations of copyright, and the appropriate acknowledgment of digital work.
- **Cybersecurity:** The field of cybersecurity encompasses various ethical considerations, including the responsible disclosure of vulnerabilities, the adoption of ethical hacking practices, and the prevention of cyberattacks targeting vital infrastructure.
- **Online Behaviour:** The concept of digital ethics promotes the cultivation of online behaviour that is characterised by respect and responsibility. The

platform serves as a deterrent to cyberbullying, trolling, hate speech, and other detrimental behaviours.

- **Digital Divide:** The ethical obligation to tackle the digital gap, characterised by the inequitable availability of digital technology and internet access, is of paramount importance. The objective of digital ethics encompasses the equitable provision of digital resources to all individuals, thereby ensuring equal chances for their benefit.
- **Environmental Impact:** The ethical problem around digital technology encompasses its environmental impact, which encompasses energy consumption and the generation of electronic trash. The promotion of sustainable practices and the proper utilisation of resources are given significant emphasis.
- **Ethical AI:** The significance of ethical considerations in the development and deployment of artificial intelligence is becoming more pronounced as the prevalence of this technology continues to grow. These encompass principles such as equity, openness, responsibility, and the reduction of prejudice in artificial intelligence systems.
- **Online Education:** The ethical implications surrounding online education encompass matters pertaining to academic integrity, privacy within online learning settings, and ensuring accessibility for all learners.

The area of digital ethics is dynamic and adaptive, aiming to address the ever-shifting terrain of technology and online engagements. The task at hand encompasses not only the adherence to ethical standards but also the proactive resolution of ethical dilemmas in the context of the digital era. Various stakeholders, including organisations, technology developers, governments, and individuals, collectively contribute to the advancement and maintenance of digital ethics, thereby fostering a digital realm that is both secure and equitable.

- **Digital Ethics and the Management Accountant Position:**

  The examination of digital ethics holds significant importance in the contemporary business environment, particularly due to the growing dependence of organisations on digital technologies and the adoption of data-driven decision-making processes. ***Management accountants, as financial experts possessing extensive knowledge of an organisation's financial systems and processes, assume a significant responsibility in addressing digital ethics inside their respective organisations. This Guidance Note discusses the potential contributions of management accountants to advancing digital ethics.***

- **Data Governance and Privacy Compliance:** Management accountants play a crucial role in the establishment of comprehensive data governance rules and the enforcement of data privacy requirements, such as the General Data Protection Regulation (GDPR) or the California Consumer Privacy Act (CCPA) or recent **India's DPDP (Digital Personal Data Protection Act).** The individuals in question possess the ability to supervise the conscientious gathering, retention, and utilisation of consumer and staff data, hence mitigating the potential for data breaches and infringements against privacy.

- **Risk Management:** Risk management is a critical area of expertise for management accountants, as they possess the necessary skills to effectively identify and manage risks. The organisation has the ability to recognise potential ethical hazards that may arise from the use of digital technologies and data. This includes the evaluation of risks associated with data security, fraudulent activities, and adherence to regulatory requirements.
- **Ethical Financial Reporting:** The responsibility for financial reporting and the assurance of the accuracy and reliability of financial information lies with management accountants, who are tasked with upholding ethical standards in this domain. It is imperative to advocate for the promotion of ethical financial reporting practices and to establish measures that prevent the manipulation of financial data for unethical intentions.
- **Technology Investment Evaluation:** The evaluation of technology investments: In the context of organisational decision-making on the adoption of novel digital technologies, management accountants possess the ability to assess the ethical ramifications associated with such investments. One can evaluate whether the technologies are in accordance with the ethical principles of the organisation and are employed for valid objectives.
- **Cost-Benefit Analysis:** Cost-benefit analysis is a common practice undertaken by management accountants to evaluate the financial implications of different business actions. Ethical considerations can be incorporated into these studies by evaluating the potential costs and benefits associated with ethical and unethical practices.
- **Ethical Supply Chain Management:** In the context of organisational supply chains characterised by complexity, management accountants possess the ability to scrutinise supply chain operations in order to identify and address ethical issues, including but not limited to labour exploitation and environmental damage. Efforts can be made to guarantee that suppliers comply with ethical norms.
- **Whistle-blower Programs:** Management accountants have the ability to support the implementation of whistle-blower programmes within their respective organisations. These initiatives promote a culture where employees are encouraged to disclose instances of unethical behaviour, such as digital misconduct, without apprehension of reprisal.

- **Education and Training:** Management accountants have the ability to facilitate the implementation of educational and training initiatives focused on digital ethics for employees. These programmes have the potential to enhance understanding of ethical concerns and offer guidance on ethical decision-making within the digital domain.
- **Audit and Internal Controls:** Management accountants frequently assume responsibility for supervising internal audit functions, which encompass the evaluation and monitoring of internal controls. One possible approach to enhancing the comprehensiveness of audits is to place a specific emphasis on digital ethics. This entails evaluating many aspects, such as data handling practices, cybersecurity measures, and adherence to ethical principles.
- **Sustainability Reporting:** Sustainability reporting entails the publication of reports by organisations, wherein management accountants play a crucial role in assuring the accuracy of these reports in reflecting the organisation's ethical convictions and environmental, social, and governance (ESG) practices.
- **Stakeholder Engagement:** Management accountants possess the ability to actively interact with stakeholders, encompassing customers, investors, and regulatory agencies, in order to effectively convey the organisation's dedication to upholding digital ethics and promoting transparency.

The integration of digital ethics into an organisation's culture and operational procedures is crucial to establishing credibility with stakeholders and guaranteeing the organisation's enduring viability. Management Accountants possess a profound understanding of financial matters and company operations, enabling them to assume the role of ethical advocates and leaders within their respective organisations. This capacity equips them to effectively address the ethical dilemmas arising from the advent of the digital age.

11.7 Digital Personal Data Protection Act, 2023- Decoding and the Role of Management Accountant:

The President's assent has allowed the Digital Personal Data Protection (DPDP) Act, which Parliament recently passed during the monsoon session, to become law. This legislation establishes guidelines for organisations regarding the handling of users' data. The legislation empowers individuals with enhanced authority over their data while also permitting corporations to transmit users' data overseas for processing, with the exception of nations and territories that have been limited by the Centre through notice.

According to the DPDP Act, state agencies have the potential to be granted exemptions from its rules based on the discretionary authority of the government. The primary objective of this Act is to enhance data protection measures and promote accountability among various entities, including internet corporations, mobile applications, and enterprises involved in the processing of individuals' data. Additionally, it is important to acknowledge that the DPDP Act would have ramifications for India's economic agreements with other countries. The alignment of this approach with global data protection standards is evident, as it draws influence from established models such as the European Union's General Data Protection Regulation (GDPR) and China's Personal Information Protection Law (PIPL).

The Making Of The Digital Personal Data Protection Act, 2023

July 2017	• MeitY constitutes an expert committee under the chairmanship of Justice BN Srikrishna
August 2017	• Supreme Court, while hearing the Aadhaar-case in Justice KS Puttaswamy vs Indian Govt, recognises right to privacy as a fundamental right; orders govt to introduce relevant law • Justice Srikrishna Committee on data protection constituted
July 2018	• MeitY releases Justice Srikrishna Committee report and proposed draft Bill
December 2019	• Revised Personal Data Protection Bill introduced in Lok Sabha • The Bill referred to Joint Parliamentary Committee (JPC)
December 2021	• JPC submits its report along with a new draft Bill — PDP Bill 2021
August 2022	• The Indian Govt withdraws the draft PDP Bill 2021 from Lok Sabha
Nov 2022	• MeitY releases a fresh new draft called DPDP Bill, 2022 for public consultation
August 2023	• Govt introduces DPDP Bill 2023 in Lok Sabha • Parliament enacts the Bill

Source: Inc42

Inc42

We shall now proceed to outline notable modifications in the DPDP Act, 2023, and elucidate how the ensuing legislation instructs Indian startups to uphold the integrity of user data.

Important Provisions of India's New Personal Data Protection Act, 2023 :

The Digital Personal Data Protection Act, which was first implemented in 2019, carries significant significance as a legal initiative designed to protect the privacy rights of individuals. The main emphasis of this entity is on the regulation of the acquisition, retention, manipulation, and transmission of individuals' personal information within the realm of digital environments. The DPDP Act saw a total of 81 revisions subsequent to its first introduction, leading to a major overhaul that has shaped its current iteration.

The DPDP Act attempts to provide a comprehensive structure that effectively tackles the complexities associated with data management in the era of digitalization, with a particular emphasis on safeguarding privacy and enhancing security measures.

The DPDP Act of 2023 encompasses several significant clauses, which are outlined below:

Definitions: ***While the DPDP Act shares similarities with the EU's General Data Protection Regulation (GDPR) in terms of many ideas, there are distinctions in the use of language.***

a) **Data fiduciary:** This term pertains to the entity that, either autonomously or in conjunction with others, determines both the objective and the techniques for handling personal data (analogous to a data controller). ***The government has the authority to designate any entity or a certain set of entities responsible for handling data as 'significant data fiduciaries' (SDFs).*** The classification as an SDF is determined by various factors, including the nature of processing activities, such as the extent and sensitivity of personal data involved, as well as the potential impact on the rights of data principals. Additionally, broader societal and national considerations, such as the potential effects on India's sovereignty and integrity, electoral democracy, state security, and public order, are also taken into account. The assignment of the SDF label has an increased level of compliance responsibilities, which will be further discussed in the subsequent discussion.

b) **Data Processor:** A data processor refers to an organisational entity that assumes the responsibility of processing digital personal data on behalf of a data fiduciary.

c) **Data Principal:** Data principal refers to individuals from whom personal data is collected and processed, which is analogous to the concept of a data subject. d) **Consent Manager:** The consent manager refers to an individual who is officially registered with the Data Protection Board. Their role is to serve as a central point of contact, facilitating the process for a data principal to provide, manage, evaluate, and withdraw their consent. This is accomplished through the utilisation of an accessible, transparent, and interoperable platform.

- **Applicability:** The applicability of the DPDP Act extends to all forms of data, regardless of their initial format as either online or offline, which subsequently undergo digitization within the jurisdiction of India. Moreover, the Act is applicable to the processing of digital personal data that extends beyond the geographical boundaries of India, namely in cases where it involves the offering of products or services to individuals residing within the territorial jurisdiction of India.
- **Personal Data Breach:** A personal data breach refers to the unauthorised processing of personal data as well as the accidental disclosure, acquisition, sharing, use, alteration, destruction, or loss of access to personal data. Such breaches undermine the confidentiality, integrity, or availability of the personal data in question.
- **Individual consent in relation to the utilisation of data, as well as the corresponding rights of data principals:** According to the newly enacted laws, the inclusion and processing of personal data will be contingent upon obtaining explicit agreement from the subject, unless certain exceptional situations related to national security, law enforcement, and public order necessitate an alternative approach. Within the framework of data principal rights, persons possess certain entitlements, including the right to access information, the right to rectify and erase data, the right to seek redress for grievances, and the right to designate a representative to exercise these rights in the event of the individual's demise or inability. At present, a definitive schedule for the implementation of grievance redressal and data principle rights has not been established.
- **Additional responsibilities of SDF:** Data fiduciaries that are classified as Significant Data Fiduciaries (SDF) are obligated to adhere to additional responsibilities as outlined in the DPDP Act. These requirements are contingent upon the volume and sensitivity of the data that they handle. It is mandatory for every data fiduciary of substantial importance to designate a Data Protection Officer (DPO) who is accountable for handling the queries and apprehensions of data principals, referring to individuals whose data is gathered and processed. In relation to international data transfers, the DPDP Act grants data fiduciaries the authority to transfer personal data for the purpose of processing to any country or territory beyond the borders of India. Nevertheless, the central government has the authority to enforce limitations by means of official announcements. The determination of these restrictions will be made subsequent to the assessment of pertinent variables and the establishment of requisite terms and circumstances, with the aim of guaranteeing the preservation of data protection standards during the process of international data processing.
- **The implementation of a Data Protection Board:** The Data Protection Board will serve as a neutral adjudicatory entity with the responsibility of addressing

privacy-related complaints and conflicts among key stakeholders. In its capacity as an autonomous regulatory body, it will possess the requisite power to identify instances of non-compliance with the rules outlined in the Act and then levy fines commensurate with the violation. The central government would conduct the selection process for the chief executive and board members of the Data Protection Board with the intention of ensuring fairness and transparency. In order to facilitate a mechanism for customers to contest decisions rendered by the Data Protection Board, the government will establish an appellate entity. The appellate body in question might potentially be designated to the Telecom Disputes Settlement and Appellate Tribunal (TDSAT), an entity entrusted with the responsibility of resolving issues pertaining to data privacy and reviewing appeals against rulings issued by the Data Privacy Board.

- **Voluntary endeavour:** In accordance with this stipulation, the Data Protection Board possesses the jurisdiction to acknowledge a voluntary undertaking pertaining to adherence with the terms of the Data Protection and Privacy Act from any entity responsible for handling data at any juncture of the complaint processes. This voluntary endeavour may involve the implementation or avoidance of particular activities by the party involved. Moreover, the Board has the authority to modify the terms of the voluntary endeavour if deemed necessary. The voluntary commitment acts as a legal obstacle to legal actions related to the topic of the commitment, unless the data fiduciary fails to comply with its conditions. In the case of failure to comply, such a violation is regarded as a contravention of the DPDP Act, and the Board is empowered to levy sanctions for this transgression. Furthermore, the Board possesses the authority to mandate the disclosure of the undertaking to the general public.
- **An alternative technique for disclosure:** This mechanism facilitates the resolution of disputes between two parties through the intervention of a mediator.
- **Offence and Penalties:** Non-compliance with the regulations may result in data fiduciaries being subject to penalties amounting to a maximum of INR 2.5 billion. The penalties outlined in the DPDP Act, 2023, and its associated rules encompass various infractions related to data protection. These include a maximum penalty of INR 10,000 for breaching the duty owed to data principals, a fine of up to INR 2.5 billion for failing to implement reasonable security measures to prevent personal data breaches, fines of up to INR 2 billion for neglecting to inform the Data Protection Board and affected data principals in the event of a personal data breach, penalties of up to INR 2 billion for violating additional obligations pertaining to children's data, a penalty of INR 1.5 billion for non-compliance with significant data fiduciary obligations, and a penalty of INR 500 million for contravening any other provision of the DPDP Act, 2023 and its associated rules.

- **Conflict with Existing Laws:** One potential issue that may arise is a conflict between the proposed legislation and current legal frameworks. The requirements outlined in the DPDP Act will serve as supplementary measures and will not override any existing legislation already in force. In the event of a conflict between a provision of this Act and a provision of any other currently effective law, the provision of this Act shall be given priority to the extent of such conflict.

The DPDP Act's exemptions :

The DPDP Act provides the following exemptions:

- In the interest of security, sovereignty, public order, etc., for notified agencies.
- For the objectives of research, archiving, or statistics.
- For startups and other categories of data stewards that have been notified.
- To assert legal claims and privileges.
- To fulfil judicial or regulatory responsibilities.
- To prevent, identify, investigate, or prosecute criminal activity.
- Under a foreign contract, to process personal data of non-residents in India.
- For approved mergers, splits, etc.
- To identify defaulters and their assets, etc.

In what ways can organisations effectively prepare for compliance with the Digital Personal Data Protection Act (DPDP)?

In order to ensure compliance with India's Data Protection and Privacy Act (DPDP Act) and adhere to regulatory rules, firms might undertake the following measures to prepare and safeguard personal data.

Step 1:

- **Assessment and Develop strategies for enhancing data privacy:**
- The objectives include evaluating the existing level of compliance and formulating a comprehensive action plan that encompasses governance, technology, personnel, and procedures.
- Establish a privacy organization with defined roles, including the DPO, especially if your entity's status is an SDF.

Step 2:

- **Inventory of personal data systems, with a specific focus on identifying the essential systems responsible for the storage and processing of crucial data.**

Step 3:

- **Identification of Data Processors:**
- Enumerate the entities involved in the processing of personal data.
- Revision of agreements and the effective communication of respective obligations.

Step 4:

Prepare a Draft that adhere to the requirements outlined in the Digital Personal Data Protection Act (DPDP Act):

- The task at hand involves the development of data privacy policies and processes that have been officially sanctioned.
- It is imperative to ensure that the relevant documentation is updated.
- The task at hand involves the creation of privacy notices, consent forms, and standard contract provisions.

Step 5:

A framework for designing consent systems by first establishing clear definitions for various sorts of permission:

- The objective is to create consent processes that are easily understandable and accessible to users.
- To optimise the management of consent, it is imperative to deploy effective technologies.

Step 6:

The establishment of data-principal rights handling is necessary:

- Establish protocols for addressing the rights of data principals. Formulate protocols for the treatment of requests.
- Utilise various methods to enhance the effectiveness of rights management processes.
- The implementation of a data breach response plan is crucial in addressing and mitigating the consequences of a security incident involving the unauthorised access, disclosure, or loss of sensitive information.

Step 7:

Developing breach management practices is essential in order to effectively respond to and mitigate security breaches.

- Integration with incident management should be implemented.

Step 8:

- **Define Data retention periods:**
- The predetermined durations during which data is stored and maintained by an organisation or entity. These periods are established to ensure compliance with legal and regulatory requirements, as well as to facilitate efficient data management.
- The task at hand involves the classification of data and the establishment of appropriate retention periods in accordance with relevant standards.

Step 9:

- **Assess and Deploy Privacy Technologies:**
- Select appropriate technological solutions.
- This study aims to evaluate the compatibility and scalability of the system under investigation.
- The selected solutions are to be implemented.

Step 10:

- **Implement communication and awareness initiatives:**
- The task at hand involves the creation and formulation of comprehensive strategies and materials.
- Implement awareness campaigns.
- The provision of training to stakeholders is essential.

Keep yourself (I.e. Cost and Management Accountant particularly. Because CMAs are handling most sensitive Information i.e. related to Cost of Product which is most essential competitive sensitive information) informed about notifications issued by the government, particularly those from the Central Government, as well as any upcoming regulations related to the Act. Implement appropriate measures in accordance with governmental directives.

Global Approaches to Data Protection:

- **European Union Model:** The European Union (EU) model is characterised by the implementation of the ***General Data Protection Regulation (GDPR),*** which enforces rigorous obligations on entities to guarantee the meticulous protection of personal data and necessitates the provision of substantiating evidence for such safeguarding measures. The regulatory framework sets forth stringent criteria for acquiring consent, granting customers the authority to exert influence over the handling and safeguarding of personal data. The General Data Protection Regulation (GDPR) is widely seen as a pioneering and essential legislative framework. It provides significant direction to nations in establishing the core rights and obligations that ought to be incorporated into their respective data protection legislation. The major aim of this initiative is to efficiently address the difficulties presented by our progressively digitised and networked global environment.

- **United States (US) model:** The United States (US) model places significant emphasis on the protection of an individual's personal privacy against encroachment by the government. The gathering of personal information is allowed, under the condition that the subject is duly informed about the process of data collection and its intended purpose. In contrast to several other nations, the United States lacks a unified data protection policy. ***Instead, it relies on a blend of federal and state laws that aim to safeguard the personal data of its inhabitants.***
- **China Model:** The Personal Information Protection Law (PIPL) in China has been implemented to provide data principals with expanded rights, with the objective of addressing the inappropriate utilisation of personal data. The legal framework incorporates fundamental concepts, including personal information, sensitive personal information, and processing. Significantly, the jurisdiction of the entity is clearly defined to extend beyond the confines of national boundaries. The Personal Information Protection Law (PIPL) encompasses essential components of data protection, such as principles that regulate the handling of personal information, rules for both consent-based and non-consent-based justifications for processing, systems for transferring data across borders, and the entitlements of individuals whose data is being processed.

Cost and Management Accountants' Role in Protecting the Client in Relation to the Digital Personal and Data Protection (DPDP) Act Applicable to Indian Businesses :

The involvement of cost and management accountants (CMAs) is crucial in assisting their clients in safeguarding personal data and adhering to data protection rules, such as the Digital Personal and Data Protection Act. This is an overview of the potential contributions that Certified Medical Assistants (CMAs) can make in their professional roles.

- **Data Audit and Classification:** The role of Cost and Management Accountants (CMAs) extends to aiding customers in the comprehensive evaluation of their data, with the objective of identifying and categorising personal data present inside their organisational framework. This entails comprehending the patterns of data movement, its origins, and the many operations involved in data manipulation.
- **Impact Assessment:** The objective is to assist clients in conducting Data Protection Impact Assessments (DPIAs) in order to evaluate the potential risks

and consequences of data processing activities on the privacy of individuals. This is of utmost importance, particularly in the context of high-risk processing.

- **Policy Development:** Engage in collaborative efforts with clients to formulate comprehensive data protection policies, processes, and practices that are in accordance with the stipulations outlined in the DPDP Act or other pertinent regulatory frameworks. It is imperative to ensure that these policies are clearly communicated to personnel.
- **The provision of consent mechanisms:** Provide guidance to clients on the establishment of clear and compliant systems for the acquisition and administration of user consent for data processing endeavours. It is imperative to ensure that consent is obtained in a manner that is voluntary, explicit, and capable of being withdrawn.
- **Data Minimisation:** The promotion of data minimization practices is an encouragement to customers to limit their collection and processing of personal data to only what is essential for the intended purpose. Assist in the implementation of data retention and deletion rules.
- **Data Security:** The provision of data security services involves aiding clients in the implementation of comprehensive data security protocols, encompassing encryption, access controls, and routine security assessments, with the aim of protecting personal data from unauthorised access and breaches.
- **Vendor Assessment:** The purpose of this evaluation is to assess third-party vendors and data processors in order to verify their compliance with data protection rules and the adequacy of their data protection procedures. The task at hand involves the critical evaluation and subsequent negotiation of data processing agreements.
- **Data Breach Response:** The primary objective is to assist clients in the development and evaluation of data breach response plans, ensuring their ability to rapidly and efficiently address data breaches in accordance with regulatory requirements.
- **Data Subject Rights:** The clients should be provided with information regarding data subject rights as stipulated by the DPDP Act, which encompass the rights to access, amend, and erase personal data. Assist in the development of protocols for addressing requests made by data subjects.
- **Data Protection Officer (DPO):** The purpose of a Data Protection Officer (DPO) is to assist organisations in fulfilling their requirements for a DPO. This might involve aiding clients in the process of choosing a DPO or assuming the responsibilities of a DPO if the necessary qualifications are met.

- **Training and Awareness:** Organise training sessions aimed at enhancing employees' understanding of data privacy requirements and promoting the adoption of best practices in this domain. This measure can effectively mitigate the potential for non-compliance resulting from human fallibility.
- **Record-Keeping:** It is imperative to ensure that clients uphold the practice of maintaining precise records pertaining to data processing activities, data subject requests, and compliance endeavours, as mandated by data protection rules.
- **Reporting:** As per the DPDP Act or any related laws, the task at hand entails assisting clients in the process of producing and submitting reports on data protection to the appropriate governing bodies.
- **Due Diligence:** The process of conducting due diligence is crucial in the context of mergers and acquisitions or partnerships, as it allows for the assessment of the data protection compliance status of the other party involved, thereby enabling the identification of potential hazards.
- **Financial Implications:** This analysis aims to evaluate the financial consequences associated with compliance activities related to the DPDP Act. It encompasses the expenses incurred in establishing data protection measures as well as the potential penalties that may be imposed in cases of non-compliance.

Cost and Management Accountants (CMAs), due to their specialised knowledge in financial management and risk evaluation, possess the capability to offer significant assistance to customers in effectively managing the intricacies associated with data protection requirements. This includes minimising potential risks and ensuring adherence to the DPDP Act or any other applicable data protection laws in India.

*****

CHAPTER - 12

How AI can be Instrumental in the Office of Chief Adviser Cost- Govt of India

12.1 How AI assists the Office of the Chief Adviser Cost, Government of India: Subsidy determination and verification of MIS and PSS claims for state and central government loss sharing:

Artificial intelligence (AI) has the potential to significantly optimise and improve the procedures involved in subsidy assessment and verification of Market Intervention Scheme (MIS) and Price Support Scheme (PSS) claims, which are essential for the allocation of financial support between the state and central governments in India. This Guideline for Cost Accountant discusses the potential applications of artificial intelligence (AI) in supporting the Office of the Chief Advisor, Government of India.

- **Data Analysis and Processing:** The utilisation of artificial intelligence methods enables the effective processing and analysis of extensive datasets pertaining to agricultural production, market pricing, and subsidy requests. The ability to detect trends, patterns, and inconsistencies within the data enables individuals to make well-informed decisions on subsidies.
- **Predictive Analytics:** Predictive analytics is a field that utilises artificial intelligence (AI) to harness historical data in order to construct models that can forecast crop yields, market changes, and subsidy needs. These models have the potential to enhance the accuracy of future subsidy estimation.
- **Claim Validation:** The validation of subsidy claims can be facilitated by the utilisation of AI algorithms, which possess the capability to cross-reference the information presented in the claims with a multitude of databases and sources. This process can aid in the identification of flaws, discrepancies, and deceptive assertions.
- **Document Processing:** The utilisation of artificial intelligence (AI)-based optical character recognition (OCR) technology facilitates the extraction of data from scanned documents, streamlining the processing of subsidy applications and accompanying documentation.
- **Fraud Detection:** These patterns may include instances when several claims are made for the same crop or when there are abnormal swings observed in production data. The system has the capability to identify claims that may be false and warrant more scrutiny.
- **Real-time Monitoring:** Artificial intelligence (AI) systems have the capability to offer real-time monitoring of subsidy pay-outs and claim processing. Immediate warnings for evaluation might be triggered by any anomalies or deviations from standard procedures.

- **Risk Assessment:** Claims that are considered high-risk may undergo more stringent verification procedures.
- **Data Integration:** Artificial intelligence (AI) has the capability to effectively amalgamate data from several government departments and agencies that are engaged in subsidy programmes, thereby establishing a comprehensive and current data ecosystem that facilitates informed decision-making.
- **Customised Alerts:** Artificial intelligence (AI) tools include the capability to be programmed in order to produce alerts and notifications tailored to certain events or conditions. These events or conditions may include instances such as abnormally high subsidy claims or discrepancies observed in data.
- **Efficiency and Accuracy:** The implementation of AI-driven automation has the potential to greatly decrease the amount of time and resources needed for subsidy determination and verification, thereby enhancing efficiency and accuracy. Additionally, it has the potential to optimise the precision of these procedures, thereby reducing the occurrence of inaccuracies.
- **Policy optimisation:** Policy optimisation is the use of artificial intelligence (AI) to enhance the effectiveness of subsidy programmes by conducting a comprehensive analysis of their influence on agricultural outcomes and the financial well-being of the government. The use of this approach has the potential to enhance the precision of eligibility criteria and subsidy rates, thereby yielding more favourable outcomes.
- **Resource Allocation:** Artificial intelligence (AI) has the potential to offer valuable insights regarding the distribution of subsidies across various regions or crops through data analysis. This can help ensure that resources are allocated to areas where they are most needed.
- **Transparency:** The utilisation of AI-driven solutions enables the establishment of a transparent record of subsidy judgements and claims verification, hence fostering accountability and adherence to regulatory requirements.

The integration of artificial intelligence (AI) into the subsidy determination and verification processes has the potential to enhance the efficiency, transparency, and accuracy of these activities within the Office of the Chief Advisar. This approach not only guarantees the effective distribution of subsidies to their intended recipients but also serves to mitigate the potential for inaccuracies and fraudulent activities, yielding advantages for both the agricultural industry and the government's fiscal administration.

12.2 The Role that AI can play in assisting the Government of India's Office of the Chief Advisor -Cost with Managing large project Delays and budget Overruns:

Artificial intelligence (AI) has the potential to make a substantial contribution to supporting the Government of India's Office of the Chief Advisor (Cost) in effectively addressing the challenges of managing extensive project delays and exceeding budgetary allocations. This AI guideline Note for Cost Professional explores the potential applications of artificial intelligence (AI) in achieving this objective.

- **Predictive Analysis:** Predictive analytics is the use of artificial intelligence (AI) to examine past project data with the objective of identifying recurring patterns and influential elements that contribute to project delays and budgetary exceedances. Project managers can effectively limit risks by proactively taking measures upon recognising early warning indicators.
- **Risk Assessment:** Artificial intelligence has the capability to evaluate project risks and analyse their potential consequences for project schedules and financial resources. The utilisation of risk scores and the prioritisation of hazards can enable project managers to efficiently allocate resources and attention.
- **Project Monitoring:** The utilisation of artificial intelligence (AI) solutions enables the real-time monitoring of project progress, facilitating the comparison between the actual performance and the predetermined milestones. Automated notifications for quick action might be triggered by any deviations from the plan.
- **Optimisation of Resource Allocation:** The optimisation of Resource allocation can be facilitated by the implementation of artificial intelligence (AI) systems. These systems are capable of analysing project needs and assessing the availability of resources in order to determine the most efficient allocation strategy. The allocation of appropriate resources at the appropriate moment can aid in the prevention of delays.
- **Budget Forecasting:** Artificial Intelligence (AI) has the capability to predict project budgets by utilising past data, monitoring project progress, and anticipating potential modifications. This practice facilitates proactive budget management and serves as a preventive measure against budget overruns.
- **Scheduling Optimisation:** Artificial intelligence (AI) has the capability to generate and enhance project schedules by taking into account limitations on resources and interdependencies. The system has the capability to propose alternate timetables in order to mitigate congestion and minimise instances of delays.
- **Root Cause Analysis:** Artificial intelligence has the capability to conduct an analysis of the fundamental elements contributing to delays and budget overruns. This involves the identification of underlying difficulties, such as alterations in project scope, inadequacies in resources, or the influence of external factors. This information has the potential to inform and guide the implementation of corrective measures.

- **Natural Language Processing (NLP):** Natural Language Processing (NLP) refers to the application of artificial intelligence techniques in processing project-related documents and communications. By analysing text data, NLP can extract valuable insights and identify difficulties, concerns, or potential hazards.
- **Supplier and Vendor Performance:** The utilisation of artificial intelligence (AI) enables the assessment of supplier and vendor performance, thereby facilitating project managers in making well-informed decisions regarding contract renewals or modifications.
- **Early Warning Systems:** Artificial intelligence (AI) has the capability to create early warning systems that promptly alert project managers and stakeholders upon reaching crucial thresholds or triggers. This allows for timely reactions to possible concerns.
- **Cost- Benefit Analysis:** The utilisation of artificial intelligence (AI) enables the execution of cost-benefit evaluations for proposed alterations or corrective measures, facilitating project managers in the prioritisation of interventions according to their anticipated influence on project outcomes.
- **Performance Benchmarking:** Benchmarking is a valuable use of artificial intelligence (AI) that enables the comparison of ongoing projects with industry benchmarks and best practices. This process provides valuable insights into areas where changes may be made, thereby enhancing project performance.
- **Data Visualisation:** The use of artificial intelligence (AI) in data visualisation enables the presentation of intricate project data in a format that is accessible and comprehensible to stakeholders. This facilitates a more efficient understanding of project status and the identification of potential areas of concern.
- **Scenario Analysis:** The use of artificial intelligence (AI) in scenario analysis enables the simulation of diverse project scenarios, facilitating the evaluation of the consequences of different decisions on project schedules and budgets. This analytical approach supports the decision-making process by providing valuable insights.
- **Documentation Compliance:** The implementation of artificial intelligence (AI) can effectively guarantee adherence to regulatory and reporting standards in project documentation, thereby mitigating the potential for delays arising from non-compliance concerns, particularly in relation to the CAG Audit Review for the project.

Through the utilisation of artificial intelligence (AI) within project management, the Office of the Chief Advisor—Cost has the potential to strengthen project oversight, optimise decision-making processes, and mitigate the frequency of delays and

budget overruns. This not only leads to enhanced project implementation efficiency but also contributes to the conservation of scarce government resources.

12.3 How AI may help Chief Adviser- Cost, Government of India value Assets and Liabilities of taken-over businesses and public sector undertaking shares:

The utilisation of artificial intelligence (AI) has the potential to greatly aid the Chief Adviser, Cost, Government of India***, in the precise assessment of the worth of assets and liabilities pertaining to company acquisitions and shares of public sector enterprises (PSUs).*** Artificial intelligence (AI) can potentially contribute to this process by fulfilling various functions.

- **Data Integration:** Artificial intelligence (AI) facilitates the process of data integration, which makes it possible to combine and examine sizable datasets derived from various sources. These sources encompass financial records, asset registrations, balance sheets, and market data. This practice guarantees that all pertinent data is taken into account during the assessment procedure.
- **Automated Valuation Models (AVMs):** Automated valuation models (AVMs) refer to the use of artificial intelligence (AI) in the development of estimation tools that employ machine learning algorithms. These models aim to assess the worth of tangible assets, intangible assets, and liabilities by analysing historical data and market patterns.
- **Market Analysis:** Artificial intelligence (AI) has the capability to do real-time market analysis in order to ascertain the equitable market value of shares in public sector undertakings (PSUs). Various elements, such as market mood, economic conditions, and industry benchmarks, can be considered.
- **Natural Language Processing:** Natural Language Processing (NLP) refers to the use of artificial intelligence (AI) techniques to extract and analyse information from various textual sources, such as financial reports, contracts, and legal documents. This enables the acquisition of valuable insights pertaining to assets and liabilities.
- **Asset Tracking:** The utilisation of artificial intelligence (AI) can be employed to facilitate the process of tracking and monitoring physical assets through the ***integration of Internet of Things (IoT) devices and sensors.*** This practice guarantees that the appraisals appropriately depict the condition and whereabouts of assets.
- **Scenario Analysis:** The use of artificial intelligence (AI) enables the simulation of many scenarios, encompassing a range of economic conditions or corporate strategies, with the purpose of evaluating their influence on the values of assets and liabilities. This process aids in the evaluation of potential risks and facilitates the process of making informed decisions.

- **Risk Assessment:** Risk assessment involves the evaluation of potential hazards related to assets and liabilities, taking into account various elements such as market volatility, regulatory modifications, and legal responsibilities. The utilisation of this approach facilitates the identification of potential eventualities.
- **Regulatory Compliance:** The implementation of artificial intelligence (AI) can effectively guarantee regulatory compliance within the valuation process by adhering to pertinent Accounting standards, regulatory obligations, and international valuation norms.
- **Historical Analysis:** Historical analysis entails the use of artificial intelligence (AI) to examine past financial data with the objective of discerning prevailing trends and patterns that possess the potential to influence the values of assets and liabilities. These factors encompass elements such as the increase in revenue, the reduction in value of assets due to depreciation, and the rise in general price levels known as inflation.
- **Due Diligence:** The utilisation of artificial intelligence (AI) has the potential to enhance due diligence procedures by automating the examination of contracts, agreements, and legal documents associated with the assets and liabilities being evaluated.
- **Documentation Management:** The utilisation of artificial intelligence (AI) has the potential to facilitate the management and organisation of extensive documentation pertaining to the value of assets and liabilities. This technology can effectively prevent any inadvertent omissions or oversights in the process.
- **CAG Audit Trail:** The utilisation of AI-driven solutions enables the establishment and maintenance of a comprehensible CAG Audit trail pertaining to the valuation process. This feature contributes to the enhancement of transparency and accountability within the decision-making process.
- **Cost Estimation:** Artificial intelligence (AI) possesses the capability to provide estimations of expenses linked to the procurement, upkeep, or disposal of assets, hence aiding in the process of budgeting and financial planning.
- **Reporting:** In terms of reporting, artificial intelligence (AI) has the capability to provide comprehensive reports and documentation pertaining to the valuation process. This functionality facilitates the dissemination of findings to pertinent stakeholders, such as government agencies and regulatory bodies, thereby streamlining communication efforts.

The utilisation of artificial intelligence (AI) in the assessment of asset and liability valuation procedures enables the Chief Adviser, Cost, to improve the precision, effectiveness, and openness of these activities. Consequently, this process enables well-informed decision-making and guarantees efficient management of government resources in the context of business takeovers or the handling of PSU shares.

12.4 AI Can Help the Chief Adviser-Cost, and Government of India, determine the pricing of items and services given to government departments to facilitate price negotiations with supplying organisations:

Undoubtedly, the utilisation of artificial intelligence (AI) holds significant potential in supporting the Chief Adviser-Cost, Government of India, in the process of deciding the pricing of commodities and services provided to government agencies. The provision of pricing information is crucial in facilitating efficient price negotiations with supplying organisations. Artificial intelligence (AI) can potentially contribute to this process by fulfilling various functions.

- **Price Benchmarking:** Price benchmarking is the utilisation of artificial intelligence (AI) to examine past procurement data and market intelligence in order to establish reference prices for a wide range of goods and services. This facilitates the establishment of realistic price expectations for negotiation purposes.
- **Market Research:** The utilisation of artificial intelligence (AI) enables the ongoing surveillance of market conditions, encompassing the examination of factors such as supply and demand dynamics, fluctuations in commodity prices, and prevailing economic trends. The utilisation of this technology enables the timely acquisition of information regarding market movements, hence influencing pricing dynamics.
- **Supplier Performance Analysis:** The utilisation of artificial intelligence enables the evaluation of supplier performance by considering multiple factors, including quality, timeliness, and pricing. The aforementioned data possesses the potential to facilitate the identification of preferred suppliers for the purpose of negotiations.
- **Cost Estimation:** Artificial intelligence (AI) possesses the capability to calculate the expenses associated with production or service delivery across various providers, taking into account factors such as labour, materials, transportation, and overhead costs. The present cost analysis facilitates comprehension of price frameworks.
- **Contract Analysis:** The analysis of contracts can be facilitated by the use of AI-driven Natural Language Processing (NLP) techniques. By employing NLP, contract terms and conditions can be examined to effectively discover various elements such as pricing systems, discounts, and escalation clauses. This practice ensures that talks take into account all contractual elements.
- **Demand Forecasting:** Demand forecasting involves the use of artificial intelligence (AI) to anticipate forthcoming demand for particular goods and services, thereby facilitating the implementation of more effective negotiation techniques. This practice ensures that the government acquires amounts that are in accordance with the actual requirements.

- **Scenario Modelling:** Scenario modelling is the use of artificial intelligence (AI) to simulate a range of negotiating situations, which encompass diverse pricing strategies and corresponding supplier replies. This facilitates the process of formulating strategic plans and conducting risk evaluations.
- **Historical Pricing Data:** AI has the capability to analyse previous pricing data, enabling the identification of trends and patterns. This analytical process proves beneficial in negotiations as it allows for referencing past agreements and outcomes.
- **Supplier Relationship Management (SRM):** Supplier Relationship Management (SRM) can be enhanced by the use of artificial intelligence (AI), which has the capability to offer valuable insights pertaining to supplier performance, reliability, and compliance. This process aids in the identification and evaluation of appropriate suppliers for the purpose of engaging in negotiations.
- **Real-time Data:** Artificial intelligence has the capability to offer real-time data regarding market conditions and supplier performance, thereby facilitating dynamic pricing negotiations that may effectively adapt to prevailing circumstances.
- **Compliance Assessment:** The use of AI in compliance assessment can effectively verify the adherence of negotiated pricing to governmental regulations and procurement policies, thereby mitigating the potential for non-compliance.
- **Transparency and Auditability:** Transparency and auditability are key features of AI-driven systems, as they enable the maintenance of a clear and traceable record of the negotiating process. This not only promotes accountability but also facilitates the conduct of audits when necessary.
- **Optimization:** The field of optimisation involves the utilisation of artificial intelligence (AI) to provide negotiation methods that are deemed optimal, taking into consideration several criteria such as cost savings, quality assurance, and risk mitigation.
- **Cost-Benefit Analysis:** The utilisation of artificial intelligence (AI) enables the execution of cost-benefit evaluations pertaining to proposed pricing agreements, thereby taking into account the comprehensive effects on government budgets and operational efficiency.
- **Documentation Management:** The utilisation of artificial intelligence (AI) can be advantageous in the realm of documentation management, particularly in the context of pricing negotiations. AI has the capability to effectively manage and organise the vast volume of documents involved in such talks, hence mitigating the risk of overlooking any crucial information.

By utilising artificial intelligence (AI) in the process of determining pricing, the Chief Adviser-Cost has the potential to improve the efficiency and efficacy of negotiations

with supplying organisations. This practice not only facilitates the acquisition of competitive pricing but also guarantees that government departments achieve optimal value for money in their procurement processes.

12.5 How AI helps The Chief Adviser Cost-Government of India is receiving and performing studies in synchronisation with liberalisation Policy in addition to Cost-Price Research:

Artificial intelligence (AI) has the potential to support the Chief Adviser Cost, Government of India, in performing studies that align with liberalisation goals alongside conventional cost-price research. Artificial intelligence (AI) can offer significant advantages in this particular setting due to its numerous benefits.

- **Data Collection and Analysis:** The utilisation of artificial intelligence enables the collection and analysis of enormous quantities of data pertaining to diverse industries and sectors that are influenced by liberalisation policies. The system has the capability to collect data from various sources, such as government papers, industry journals, and social media platforms, in order to obtain valuable knowledge on market dynamics and trends.

- **Market Research:** The utilisation of AI-driven market research tools has the potential to offer timely and up-to-date information regarding market dynamics, the competitive landscape, and consumer preferences. The comprehension of the influence of liberalisation on various industries necessitates the acquisition of this vital information.

- **Policy Analysis:** Artificial intelligence (AI) has the capability to examine policy documents and legislative modifications pertaining to liberalisation, effectively identifying crucial aspects and their probable ramifications for enterprises and the economy.

- **Predictive Modelling:** Predictive modelling entails the use of artificial intelligence (AI) to develop models that can anticipate and project the potential outcomes of liberalisation policies on various sectors, including industry, trade, and overall economic growth. These models have the potential to assist in the process of scenario preparation and facilitate informed decision-making.

- **Sentiment Analysis:** The utilisation of AI-powered sentiment analysis techniques enables the assessment of public and industry sentiment towards liberalisation initiatives. This can facilitate comprehension of public views and identify potential areas of concern.

- **Cost-Benefit Analysis:** The utilisation of artificial intelligence (AI) holds the potential to do comprehensive cost-benefit evaluations pertaining to liberalisation policies, encompassing an evaluation of the immediate and enduring economic consequences. This facilitates the assessment of the efficacy of policy modifications.

- **Customised Insights:** Artificial intelligence has the capability to produce personalised reports and analyses that are specifically designed to address particular research inquiries or policy goals. This approach optimises the research procedure and offers pertinent information.
- **Real-time Updates:** Artificial intelligence (AI) has the capability to offer real-time updates regarding fluctuations in market conditions, policy advancements, and industry trends. This ensures that research remains up-to-date and pertinent.
- **Scenario Planning:** Scenario planning is the use of artificial intelligence (AI) to simulate a range of scenarios in order to evaluate the possible consequences of implementing liberalisation policies under different circumstances. This process facilitates the identification of potential dangers and opportunities.
- **Document Summarization:** The utilisation of artificial intelligence (AI) in conjunction with natural language processing (NLP) enables the summarization of extensive policy documents and research reports. This technological advancement facilitates policymakers' access to crucial information, hence enhancing their ability to comprehend and utilise the content effectively.
- **Resource Allocation:** The utilisation of artificial intelligence (AI) has the potential to enhance the efficiency of resource allocation in research projects by identifying and prioritising areas of exploration that are likely to yield significant outcomes.
- **Stakeholder Engagement:** Utilising AI-driven solutions enables the identification of relevant stakeholders and their respective positions on policies pertaining to liberalisation. This facilitates the involvement of pertinent stakeholders in research collaboration or dialogue.
- **Visualization:** The utilisation of artificial intelligence (AI) in data visualisation technologies enables the presentation of research findings in a comprehensible manner, hence enhancing effective communication with policymakers and the general public.
- **Publication Assistance:** The use of artificial intelligence (AI) has the potential to aid in the creation of research reports and papers by enhancing the clarity and coherence of the presentation of research findings.
- **Compliance Monitoring:** The utilisation of artificial intelligence (AI) holds the potential to effectively monitor compliance within industries, particularly in relation to liberalisation policies and regulations. By employing AI technology, valuable insights can be obtained regarding the enforcement of these policies and regulations, as well as identifying possible areas of concern that require attention.

By integrating artificial intelligence (AI) into research procedures, the Chief Adviser Cost can enhance the scope and timeliness of investigations, aligning them with liberalisation policies. This facilitates the making of policy decisions that are more

well-informed, enhances economic planning, and fosters a more comprehensive comprehension of the effects of liberalisation on different sectors of the economy.

12.6 How AI can help Direct Benefit transfer to Bank Account of Government minimum guaranteed work day's recipient with Aadhar connection:

The integration of artificial intelligence (AI) has the potential to greatly improve the effectiveness and precision of the Direct Benefit Transfer (DBT) system, specifically for individuals who are eligible for the government's minimum guaranteed workday benefits and have successfully linked their Aadhar accounts with their bank accounts. Artificial intelligence (AI) can assume a pivotal function in this particular setting.

- **Identification and Verification:** The utilisation of artificial intelligence (AI) facial recognition technology enables the verification of beneficiaries' identities throughout the process of workday registration. This measure guarantees that only those who meet the necessary criteria are granted access to benefits.
- **Data Integration:** Artificial intelligence has the capability to effectively link Aadhar and bank account data with government databases, thereby enabling instantaneous verification of beneficiary information. This approach reduces the occurrence of errors in beneficiary lists.
- **Fraud Detection:** The utilisation of Artificial intelligence algorithms enables the identification of abnormalities and irregularities in Direct Benefit Transfer (DBT) transactions***, specifically pertaining to instances of repeated registrations or atypical transaction patterns.*** The system has the capability to identify and highlight possibly fraudulent activity, prompting further investigation.
- **Personalised Support:** Artificial intelligence chatbots or virtual assistants have the capability to furnish individuals with pertinent details regarding their rights, payment schedules, and transaction history, hence enhancing transparency and facilitating ease of access.
- **Payment Optimisation:** Artificial intelligence has the capability to analyse beneficiary data and transaction history in order to enhance payment schedules and disbursements, hence guaranteeing prompt and effective transfers.
- **Predictive Analytics:** Predictive analytics, a field within artificial intelligence (AI), has the capability to anticipate the demand for Direct Benefit Transfer (DBT) benefits by using historical data and socioeconomic aspects. This ability is valuable in facilitating efficient resource allocation and effective budget planning.
- **Data Security:** The implementation of artificial intelligence (AI) in encryption and cybersecurity measures can effectively ensure the protection of beneficiary data and financial transactions, thereby preventing unauthorised access to sensitive information.

- **Error Reduction:** Artificial intelligence has the capability to detect and correct inaccuracies present in beneficiary data, hence diminishing the probability of payment delays or incorrect allocation of funds.
- **Real-time Monitoring:** Artificial intelligence (AI) has the capability to offer real-time monitoring of DBT (Direct Benefit Transfer) transactions, enabling authorities to effectively monitor disbursements and swiftly react in the event of any difficulties.
- **Communication Enhancement:** The use of AI-powered chatbots can effectively enhance communication between government entities and beneficiaries by immediately resolving their inquiries and concerns.
- **Analysis of Feedback:** Artificial intelligence (AI) has the capability to analyse feedback and complaints received from beneficiaries in order to uncover underlying systemic flaws and enhance the Direct Benefit Transfer (DBT) process.
- **Cost Reduction:** The implementation of AI-driven automation leads to a reduction in expenses by eliminating the need for manual verification and processing of DBT transactions, thereby streamlining administrative processes.
- **Audit Trail:** The implementation of an audit trail in the context of artificial intelligence enables the establishment of comprehensive and verifiable documentation of all transactions related to the use of database technology, specifically Direct Benefit Transfer (DBT). This feature not only promotes transparency but also serves as a mechanism for ensuring accountability and enabling the conduct of audits.
- **Beneficiary Profiling:** Artificial intelligence has the capability to generate beneficiary profiles by analysing transaction history and demographic information. This enables policymakers to customise programmes in order to effectively address the unique requirements of individuals.
- **Biometric Authentication:** The integration of artificial intelligence (AI) has the potential to bolster security measures through the utilisation of biometric authentication techniques, like the analysis of fingerprints or iris scans, for the purpose of verifying the identity of beneficiaries.

By utilising artificial intelligence (AI) within the process of direct benefit transfer (DBT), the government has the potential to optimise the distribution of minimum guaranteed workday benefits to eligible recipients. This can be achieved through the reduction of fraudulent activities and errors, the enhancement of transparency, and the efficient and secure transfer of money to the intended beneficiaries. This ultimately enhances the efficacy of social welfare programmes.

*****

CHAPTER - 13
Annexure:
The Digital Personal Data Protection Act, 2023

रजिस्ट्री सं॰ डी॰ एल॰—(एन)04/0007/2003—23 REGISTERED NO. DL—(N)04/0007/2003—23

भारत का राजपत्र
The Gazette of India

सी.जी.-डी.एल.-अ.-12082023-248045
CG-DL-E-12082023-248045

असाधारण
EXTRAORDINARY
भाग II — खण्ड 1
PART II — Section 1
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं॰ 25] नई दिल्ली, शुक्रवार, अगस्त 11, 2023/ श्रावण 20, 1945 (शक)
No. 25] NEW DELHI, FRIDAY, AUGUST 11, 2023/SRAVANA 20, 1945 (SAKA)

इस भाग में भिन्न पृष्ठ संख्या दी जाती है जिससे कि यह अलग संकलन के रूप में रखा जा सके।
Separate paging is given to this Part in order that it may be filed as a separate compilation.

MINISTRY OF LAW AND JUSTICE
(Legislative Department)

New Delhi, the 11*th August,* 2023/*Sravana* 20, 1945 (*Saka*)

The following Act of Parliament received the assent of the President on the 11th August, 2023 and is hereby published for general information:—

THE DIGITAL PERSONAL DATA PROTECTION ACT, 2023

(No. 22 of 2023)

[11*th August*, 2023.]

An Act to provide for the processing of digital personal data in a manner that recognises both the right of individuals to protect their personal data and the need to process such personal data for lawful purposes and for matters connected therewith or incidental thereto.

Be it enacted by Parliament in the Seventy-fourth Year of the Republic of India as follows:—

CHAPTER I

Preliminary

1. (*1*) This Act may be called the Digital Personal Data Protection Act, 2023. Short title and commencement.

(*2*) It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different provisions of this Act and any reference in any such provision to the commencement of this Act shall be construed as a reference to the coming into force of that provision.

Definitions.

2. In this Act, unless the context otherwise requires,—

(*a*) "Appellate Tribunal" means the Telecom Disputes Settlement and Appellate Tribunal established under section 14 of the Telecom Regulatory Authority of India Act, 1997; 24 of 1997.

(*b*) "automated" means any digital process capable of operating automatically in response to instructions given or otherwise for the purpose of processing data;

(*c*) "Board" means the Data Protection Board of India established by the Central Government under section 18;

(*d*) "certain legitimate uses" means the uses referred to in section 7;

(*e*) "Chairperson" means the Chairperson of the Board;

(*f*) "child" means an individual who has not completed the age of eighteen years;

(*g*) "Consent Manager" means a person registered with the Board, who acts as a single point of contact to enable a Data Principal to give, manage, review and withdraw her consent through an accessible, transparent and interoperable platform;

(*h*) "data" means a representation of information, facts, concepts, opinions or instructions in a manner suitable for communication, interpretation or processing by human beings or by automated means;

(*i*) "Data Fiduciary" means any person who alone or in conjunction with other persons determines the purpose and means of processing of personal data;

(*j*) "Data Principal" means the individual to whom the personal data relates and where such individual is—

(*i*) a child, includes the parents or lawful guardian of such a child;

(*ii*) a person with disability, includes her lawful guardian, acting on her behalf;

(*k*) "Data Processor" means any person who processes personal data on behalf of a Data Fiduciary;

(*l*) "Data Protection Officer" means an individual appointed by the Significant Data Fiduciary under clause (*a*) of sub-section (*2*) of section 10;

(*m*) "digital office" means an office that adopts an online mechanism wherein the proceedings, from receipt of intimation or complaint or reference or directions or appeal, as the case may be, to the disposal thereof, are conducted in online or digital mode;

(*n*) "digital personal data" means personal data in digital form;

(*o*) "gain" means—

(*i*) a gain in property or supply of services, whether temporary or permanent; or

(*ii*) an opportunity to earn remuneration or greater remuneration or to gain a financial advantage otherwise than by way of legitimate remuneration;

(*p*) "loss" means—

(*i*) a loss in property or interruption in supply of services, whether temporary or permanent; or

(*ii*) a loss of opportunity to earn remuneration or greater remuneration or to gain a financial advantage otherwise than by way of legitimate remuneration;

(*q*) "Member" means a Member of the Board and includes the Chairperson;

(*r*) "notification" means a notification published in the Official Gazette and the expressions "notify" and "notified" shall be construed accordingly;

(*s*) "person" includes—

(*i*) an individual;

(*ii*) a Hindu undivided family;

(*iii*) a company;

(*iv*) a firm;

(*v*) an association of persons or a body of individuals, whether incorporated or not;

(*vi*) the State; and

(*vii*) every artificial juristic person, not falling within any of the preceding sub-clauses;

(*t*) "personal data" means any data about an individual who is identifiable by or in relation to such data;

(*u*) "personal data breach" means any unauthorised processing of personal data or accidental disclosure, acquisition, sharing, use, alteration, destruction or loss of access to personal data, that compromises the confidentiality, integrity or availability of personal data;

(*v*) "prescribed" means prescribed by rules made under this Act;

(*w*) "proceeding" means any action taken by the Board under the provisions of this Act;

(*x*) "processing" in relation to personal data, means a wholly or partly automated operation or set of operations performed on digital personal data, and includes operations such as collection, recording, organisation, structuring, storage, adaptation, retrieval, use, alignment or combination, indexing, sharing, disclosure by transmission, dissemination or otherwise making available, restriction, erasure or destruction;

(*y*) "she" in relation to an individual includes the reference to such individual irrespective of gender;

(*z*) "Significant Data Fiduciary" means any Data Fiduciary or class of Data Fiduciaries as may be notified by the Central Government under section 10;

(*za*) "specified purpose" means the purpose mentioned in the notice given by the Data Fiduciary to the Data Principal in accordance with the provisions of this Act and the rules made thereunder; and

(*zb*) "State" means the State as defined under article 12 of the Constitution.

3. Subject to the provisions of this Act, it shall— Application of Act.

(*a*) apply to the processing of digital personal data within the territory of India where the personal data is collected—

(*i*) in digital form; or

(*ii*) in non-digital form and digitised subsequently;

(*b*) also apply to processing of digital personal data outside the territory of India, if such processing is in connection with any activity related to offering of goods or services to Data Principals within the territory of India;

(*c*) not apply to—

(*i*) personal data processed by an individual for any personal or domestic purpose; and

(*ii*) personal data that is made or caused to be made publicly available by—

(*A*) the Data Principal to whom such personal data relates; or

(*B*) any other person who is under an obligation under any law for the time being in force in India to make such personal data publicly available.

Illustration.

X, an individual, while blogging her views, has publicly made available her personal data on social media. In such case, the provisions of this Act shall not apply.

CHAPTER II

OBLIGATIONS OF DATA FIDUCIARY

Grounds for processing personal data.

4. (*1*) A person may process the personal data of a Data Principal only in accordance with the provisions of this Act and for a lawful purpose,—

(*a*) for which the Data Principal has given her consent; or

(*b*) for certain legitimate uses.

(*2*) For the purposes of this section, the expression "lawful purpose" means any purpose which is not expressly forbidden by law.

Notice.

5. (*1*) Every request made to a Data Principal under section 6 for consent shall be accompanied or preceded by a notice given by the Data Fiduciary to the Data Principal, informing her,—

(*i*) the personal data and the purpose for which the same is proposed to be processed;

(*ii*) the manner in which she may exercise her rights under sub-section (*4*) of section 6 and section 13; and

(*iii*) the manner in which the Data Principal may make a complaint to the Board,

in such manner and as may be prescribed.

Illustration.

X, an individual, opens a bank account using the mobile app or website of Y, a bank. To complete the Know-Your-Customer requirements under law for opening of bank account, X opts for processing of her personal data by Y in a live, video-based customer identification process. Y shall accompany or precede the request for the personal data with notice to X, describing the personal data and the purpose of its processing.

(*2*) Where a Data Principal has given her consent for the processing of her personal data before the date of commencement of this Act,—

(*a*) the Data Fiduciary shall, as soon as it is reasonably practicable, give to the Data Principal a notice informing her,—

(*i*) the personal data and the purpose for which the same has been processed;

(*ii*) the manner in which she may exercise her rights under sub-section (*4*) of section 6 and section 13; and

(*iii*) the manner in which the Data Principal may make a complaint to the Board,

in such manner and as may be prescribed.

(*b*) the Data Fiduciary may continue to process the personal data until and unless the Data Principal withdraws her consent.

Illustration.

X, an individual, gave her consent to the processing of her personal data for an online shopping app or website operated by Y, an e-commerce service provider, before the commencement of this Act. Upon commencement of the Act, Y shall, as soon as practicable, give through email, in-app notification or other effective method information to X, describing the personal data and the purpose of its processing.

(*3*) The Data Fiduciary shall give the Data Principal the option to access the contents of the notice referred to in sub-sections (*1*) and (*2*) in English or any language specified in the Eighth Schedule to the Constitution.

Consent.

6. (*1*) The consent given by the Data Principal shall be free, specific, informed, unconditional and unambiguous with a clear affirmative action, and shall signify an agreement to the processing of her personal data for the specified purpose and be limited to such personal data as is necessary for such specified purpose.

Illustration.

X, an individual, downloads Y, a telemedicine app. Y requests the consent of X for (*i*) the processing of her personal data for making available telemedicine services, and (*ii*) accessing her mobile phone contact list, and X signifies her consent to both. Since phone contact list is not necessary for making available telemedicine services, her consent shall be limited to the processing of her personal data for making available telemedicine services.

(*2*) Any part of consent referred in sub-section (*1*) which constitutes an infringement of the provisions of this Act or the rules made thereunder or any other law for the time being in force shall be invalid to the extent of such infringement.

Illustration.

X, an individual, buys an insurance policy using the mobile app or website of Y, an insurer. She gives to Y her consent for (*i*) the processing of her personal data by Y for the purpose of issuing the policy, and (*ii*) waiving her right to file a complaint to the Data Protection Board of India. Part (*ii*) of the consent**,** relating to waiver of her right to file a complaint, shall be invalid.

(*3*) Every request for consent under the provisions of this Act or the rules made thereunder shall be presented to the Data Principal in a clear and plain language, giving her the option to access such request in English or any language specified in the Eighth Schedule to the Constitution and providing the contact details of a Data Protection Officer, where applicable, or of any other person authorised by the Data Fiduciary to respond to any communication from the Data Principal for the purpose of exercise of her rights under the provisions of this Act.

(*4*) Where consent given by the Data Principal is the basis of processing of personal data, such Data Principal shall have the right to withdraw her consent at any time, with the ease of doing so being comparable to the ease with which such consent was given.

(*5*) The consequences of the withdrawal referred to in sub-section (*4*) shall be borne by the Data Principal, and such withdrawal shall not affect the legality of processing of the personal data based on consent before its withdrawal.

Illustration.

X, an individual, is the user of an online shopping app or website operated by Y, an e-commerce service provider. X consents to the processing of her personal data by Y for the purpose of fulfilling her supply order and places an order for supply of a good while making payment for the same. If X withdraws her consent, Y may stop enabling X to use the app or website for placing orders, but may not stop the processing for supply of the goods already ordered and paid for by X.

(*6*) If a Data Principal withdraws her consent to the processing of personal data under sub-section (*5*), the Data Fiduciary shall, within a reasonable time, cease and cause its Data Processors to cease processing the personal data of such Data Principal unless such processing without her consent is required or authorised under the provisions of this Act or the rules made thereunder or any other law for the time being in force in India.

Illustration.

X, a telecom service provider, enters into a contract with Y, a Data Processor, for emailing telephone bills to the customers of X. Z, a customer of X, who had earlier given her consent to X for the processing of her personal data for emailing of bills, downloads the mobile app of X and opts to receive bills only on the app. X shall itself cease, and shall cause Y to cease, the processing of the personal data of Z for emailing bills.

(*7*) The Data Principal may give, manage, review or withdraw her consent to the Data Fiduciary through a Consent Manager.

(*8*) The Consent Manager shall be accountable to the Data Principal and shall act on her behalf in such manner and subject to such obligations as may be prescribed.

(*9*) Every Consent Manager shall be registered with the Board in such manner and subject to such technical, operational, financial and other conditions as may be prescribed.

(*10*) Where a consent given by the Data Principal is the basis of processing of personal data and a question arises in this regard in a proceeding, the Data Fiduciary shall be obliged to prove that a notice was given by her to the Data Principal and consent was given by such Data Principal to the Data Fiduciary in accordance with the provisions of this Act and the rules made thereunder.

Certain legitimate uses.

7. A Data Fiduciary may process personal data of a Data Principal for any of following uses, namely:—

(*a*) for the specified purpose for which the Data Principal has voluntarily provided her personal data to the Data Fiduciary, and in respect of which she has not indicated to the Data Fiduciary that she does not consent to the use of her personal data.

Illustrations.

(*I*) X, an individual, makes a purchase at Y, a pharmacy. She voluntarily provides Y her personal data and requests Y to acknowledge receipt of the payment made for the purchase by sending a message to her mobile phone. Y may process the personal data of X for the purpose of sending the receipt.

(*II*) X, an individual, electronically messages Y, a real estate broker, requesting Y to help identify a suitable rented accommodation for her and shares her personal data for this purpose. Y may process her personal data to identify and intimate to her the details of accommodation available on rent. Subsequently, X informs Y that X no longer needs help from Y. Y shall cease to process the personal data of X;

(*b*) for the State and any of its instrumentalities to provide or issue to the Data Principal such subsidy, benefit, service, certificate, licence or permit as may be prescribed, where—

(*i*) she has previously consented to the processing of her personal data by the State or any of its instrumentalities for any subsidy, benefit, service, certificate, licence or permit; or

(*ii*) such personal data is available in digital form in, or in non-digital form and digitised subsequently from, any database, register, book or other document which is maintained by the State or any of its instrumentalities and is notified by the Central Government,

subject to standards followed for processing being in accordance with the policy issued by the Central Government or any law for the time being in force for governance of personal data.

Illustration.

X. a pregnant woman, enrols herself on an app or website to avail of government's maternity benefits programme, while consenting to provide her personal data for the purpose of availing of such benefits. Government may process the personal data of X processing to determine her eligibility to receive any other prescribed benefit from the government;

(*c*) for the performance by the State or any of its instrumentalities of any function under any law for the time being in force in India or in the interest of sovereignty and integrity of India or security of the State;

(*d*) for fulfilling any obligation under any law for the time being in force in India on any person to disclose any information to the State or any of its instrumentalities, subject to such processing being in accordance with the provisions regarding disclosure of such information in any other law for the time being in force;

(*e*) for compliance with any judgment or decree or order issued under any law for the time being in force in India, or any judgment or order relating to claims of a contractual or civil nature under any law for the time being in force outside India;

(*f*) for responding to a medical emergency involving a threat to the life or immediate threat to the health of the Data Principal or any other individual;

(*g*) for taking measures to provide medical treatment or health services to any individual during an epidemic, outbreak of disease, or any other threat to public health;

(*h*) for taking measures to ensure safety of, or provide assistance or services to**,** any individual during any disaster, or any breakdown of public order.

Explanation.—For the purposes of this clause, the expression "disaster" shall have the same meaning as assigned to it in clause (*d*) of section 2 of the Disaster
53 of 2005. Management Act, 2005; or

(*i*) for the purposes of employment or those related to safeguarding the employer from loss or liability, such as prevention of corporate espionage, maintenance of confidentiality of trade secrets, intellectual property, classified information or provision of any service or benefit sought by a Data Principal who is an employee.

General obligations of Data Fiduciary.

8. (*1*) A Data Fiduciary shall, irrespective of any agreement to the contrary or failure of a Data Principal to carry out the duties provided under this Act, be responsible for complying with the provisions of this Act and the rules made thereunder in respect of any processing undertaken by it or on its behalf by a Data Processor.

(*2*) A Data Fiduciary may engage, appoint, use or otherwise involve a Data Processor to process personal data on its behalf for any activity related to offering of goods or services to Data Principals only under a valid contract.

(*3*) Where personal data processed by a Data Fiduciary is likely to be—

(*a*) used to make a decision that affects the Data Principal; or

(*b*) disclosed to another Data Fiduciary,

the Data Fiduciary processing such personal data shall ensure its completeness, accuracy and consistency.

(*4*) A Data Fiduciary shall implement appropriate technical and organisational measures to ensure effective observance of the provisions of this Act and the rules made thereunder.

(*5*) A Data Fiduciary shall protect personal data in its possession or under its control, including in respect of any processing undertaken by it or on its behalf by a Data Processor, by taking reasonable security safeguards to prevent personal data breach.

(*6*) In the event of a personal data breach, the Data Fiduciary shall give the Board and each affected Data Principal, intimation of such breach in such form and manner as may be prescribed.

(*7*) A Data Fiduciary shall, unless retention is necessary for compliance with any law for the time being in force,—

(*a*) erase personal data, upon the Data Principal withdrawing her consent or as soon as it is reasonable to assume that the specified purpose is no longer being served, whichever is earlier; and

(*b*) cause its Data Processor to erase any personal data that was made available by the Data Fiduciary for processing to such Data Processor.

Illustrations.

(*I*) X, an individual, registers herself on an online marketplace operated by Y, an e-commerce service provider. X gives her consent to Y for the processing of her personal data for selling her used car. The online marketplace helps conclude the sale. Y shall no longer retain her personal data.

(*II*) X, an individual, decides to close her savings account with Y, a bank. Y is required by law applicable to banks to maintain the record of the identity of its clients for a period of ten years beyond closing of accounts. Since retention is necessary for compliance with law, Y shall retain X's personal data for the said period.

(*8*) The purpose referred to in clause (*a*) of sub-section (*7*) shall be deemed to no longer be served, if the Data Principal does not—

(*a*) approach the Data Fiduciary for the performance of the specified purpose; and

(*b*) exercise any of her rights in relation to such processing,

for such time period as may be prescribed, and different time periods may be prescribed for different classes of Data Fiduciaries and for different purposes.

(*9*) A Data Fiduciary shall publish, in such manner as may be prescribed, the business contact information of a Data Protection Officer, if applicable, or a person who is able to answer on behalf of the Data Fiduciary, the questions, if any, raised by the Data Principal about the processing of her personal data.

(*10*) A Data Fiduciary shall establish an effective mechanism to redress the grievances of Data Principals.

(*11*) For the purposes of this section, it is hereby clarified that a Data Principal shall be considered as not having approached the Data Fiduciary for the performance of the specified purpose, in any period during which she has not initiated contact with the Data Fiduciary for such performance, in person or by way of communication in electronic or physical form.

Processing of personal data of children.

9. (*1*) The Data Fiduciary shall, before processing any personal data of a child or a person with disability who has a lawful guardian obtain verifiable consent of the parent of such child or the lawful guardian, as the case may be, in such manner as may be prescribed.

Explanation.—For the purpose of this sub-section, the expression "consent of the parent" includes the consent of lawful guardian, wherever applicable.

(*2*) A Data Fiduciary shall not undertake such processing of personal data that is likely to cause any detrimental effect on the well-being of a child.

(*3*) A Data Fiduciary shall not undertake tracking or behavioural monitoring of children or targeted advertising directed at children.

(*4*) The provisions of sub-sections (*1*) and (*3*) shall not be applicable to processing of personal data of a child by such classes of Data Fiduciaries or for such purposes, and subject to such conditions, as may be prescribed.

(*5*) The Central Government may, if satisfied that a Data Fiduciary has ensured that its processing of personal data of children is done in a manner that is verifiably safe, notify for such processing by such Data Fiduciary the age above which that Data Fiduciary shall be exempt from the applicability of all or any of the obligations under sub-sections (*1*) and (*3*) in respect of processing by that Data Fiduciary as the notification may specify.

Additional obligations of Significant Data Fiduciary.

10. (*1*) The Central Government may notify any Data Fiduciary or class of Data Fiduciaries as Significant Data Fiduciary, on the basis of an assessment of such relevant factors as it may determine, including—

(*a*) the volume and sensitivity of personal data processed;

(*b*) risk to the rights of Data Principal;

(*c*) potential impact on the sovereignty and integrity of India;

(*d*) risk to electoral democracy;

(*e*) security of the State; and

(*f*) public order.

(*2*) The Significant Data Fiduciary shall—

(*a*) appoint a Data Protection Officer who shall—

(*i*) represent the Significant Data Fiduciary under the provisions of this Act;

(*ii*) be based in India;

(*iii*) be an individual responsible to the Board of Directors or similar governing body of the Significant Data Fiduciary; and

(*iv*) be the point of contact for the grievance redressal mechanism under the provisions of this Act;

(*b*) appoint an independent data auditor to carry out data audit, who shall evaluate the compliance of the Significant Data Fiduciary in accordance with the provisions of this Act; and

(*c*) undertake the following other measures, namely:—

(*i*) periodic Data Protection Impact Assessment, which shall be a process comprising a description of the rights of Data Principals and the purpose of processing of their personal data, assessment and management of the risk to the rights of the Data Principals, and such other matters regarding such process as may be prescribed;

(*ii*) periodic audit; and

(*iii*) such other measures, consistent with the provisions of this Act, as may be prescribed.

CHAPTER III

Rights and duties of Data Principal

Right to access information about personal data.

11. (*1*) The Data Principal shall have the right to obtain from the Data Fiduciary to whom she has previously given consent, including consent as referred to in clause (*a*) of section 7 (hereinafter referred to as the said Data Fiduciary), for processing of personal data, upon making to it a request in such manner as may be prescribed,—

(*a*) a summary of personal data which is being processed by such Data Fiduciary and the processing activities undertaken by that Data Fiduciary with respect to such personal data;

(*b*) the identities of all other Data Fiduciaries and Data Processors with whom the personal data has been shared by such Data Fiduciary, along with a description of the personal data so shared; and

(*c*) any other information related to the personal data of such Data Principal and its processing, as may be prescribed.

(*2*) Nothing contained in clause (*b*) or clause (*c*) of sub-section (*1*) shall apply in respect of the sharing of any personal data by the said Data Fiduciary with any other Data Fiduciary authorised by law to obtain such personal data, where such sharing is pursuant to a request made in writing by such other Data Fiduciary for the purpose of prevention or detection or investigation of offences or cyber incidents, or for prosecution or punishment of offences.

Right to correction and erasure of personal data.

12. (*1*) A Data Principal shall have the right to correction, completion, updating and erasure of her personal data for the processing of which she has previously given consent, including consent as referred to in clause (*a*) of section 7, in accordance with any requirement or procedure under any law for the time being in force.

(*2*) A Data Fiduciary shall, upon receiving a request for correction, completion or updating from a Data Principal,—

(*a*) correct the inaccurate or misleading personal data;

(*b*) complete the incomplete personal data; and

(*c*) update the personal data.

(*3*) A Data Principal shall make a request in such manner as may be prescribed to the Data Fiduciary for erasure of her personal data, and upon receipt of such a request, the Data Fiduciary shall erase her personal data unless retention of the same is necessary for the specified purpose or for compliance with any law for the time being in force.

Right of grievance redressal.

13. (*1*) A Data Principal shall have the right to have readily available means of grievance redressal provided by a Data Fiduciary or Consent Manager in respect of any act or omission of such Data Fiduciary or Consent Manager regarding the performance of its obligations in relation to the personal data of such Data Principal or the exercise of her rights under the provisions of this Act and the rules made thereunder.

(*2*) The Data Fiduciary or Consent Manager shall respond to any grievances referred to in sub-section (*1*) within such period as may be prescribed from the date of its receipt for all or any class of Data Fiduciaries.

(*3*) The Data Principal shall exhaust the opportunity of redressing her grievance under this section before approaching the Board.

Right to nominate.

14. (*1*) A Data Principal shall have the right to nominate, in such manner as may be prescribed, any other individual, who shall, in the event of death or incapacity of the Data Principal, exercise the rights of the Data Principal in accordance with the provisions of this Act and the rules made thereunder.

(*2*) For the purposes of this section, the expression "incapacity" means inability to exercise the rights of the Data Principal under the provisions of this Act or the rules made thereunder due to unsoundness of mind or infirmity of body.

Duties of Data Principal.

15. A Data Principal shall perform the following duties, namely:—

(*a*) comply with the provisions of all applicable laws for the time being in force while exercising rights under the provisions of this Act;

(*b*) to ensure not to impersonate another person while providing her personal data for a specified purpose;

(*c*) to ensure not to suppress any material information while providing her personal data for any document, unique identifier, proof of identity or proof of address issued by the State or any of its instrumentalities;

(*d*) to ensure not to register a false or frivolous grievance or complaint with a Data Fiduciary or the Board; and

(*e*) to furnish only such information as is verifiably authentic, while exercising the right to correction or erasure under the provisions of this Act or the rules made thereunder.

CHAPTER IV

SPECIAL PROVISIONS

Processing of personal data outside India.

16. (*1*) The Central Government may, by notification, restrict the transfer of personal data by a Data Fiduciary for processing to such country or territory outside India as may be so notified.

(*2*) Nothing contained in this section shall restrict the applicability of any law for the time being in force in India that provides for a higher degree of protection for or restriction on transfer of personal data by a Data Fiduciary outside India in relation to any personal data or Data Fiduciary or class thereof.

Exemptions.

17. (*1*) The provisions of Chapter II, except sub-sections (*1*) and (*5*) of section 8, and those of Chapter III and section 16 shall not apply where—

(*a*) the processing of personal data is necessary for enforcing any legal right or claim;

(*b*) the processing of personal data by any court or tribunal or any other body in India which is entrusted by law with the performance of any judicial or quasi-judicial or regulatory or supervisory function, where such processing is necessary for the performance of such function;

(*c*) personal data is processed in the interest of prevention, detection, investigation or prosecution of any offence or contravention of any law for the time being in force in India;

(*d*) personal data of Data Principals not within the territory of India is processed pursuant to any contract entered into with any person outside the territory of India by any person based in India;

(*e*) the processing is necessary for a scheme of compromise or arrangement or merger or amalgamation of two or more companies or a reconstruction by way of demerger or otherwise of a company, or transfer of undertaking of one or more company to another company, or involving division of one or more companies, approved by a court or tribunal or other authority competent to do so by any law for the time being in force; and

(*f*) the processing is for the purpose of ascertaining the financial information and assets and liabilities of any person who has defaulted in payment due on account of a loan or advance taken from a financial institution, subject to such processing being in accordance with the provisions regarding disclosure of information or data in any other law for the time being in force.

Explanation.—For the purposes of this clause, the expressions "default" and "financial institution" shall have the meanings respectively assigned to them in
31 of 2016. sub-sections (*12*) and (*14*) of section 3 of the Insolvency and Bankruptcy Code, 2016.

Illustration.

X, an individual, takes a loan from Y, a bank. X defaults in paying her monthly loan repayment instalment on the date on which it falls due. Y may process the personal data of X for ascertaining her financial information and assets and liabilities.

(*2*) The provisions of this Act shall not apply in respect of the processing of personal data—

(*a*) by such instrumentality of the State as the Central Government may notify, in the interests of sovereignty and integrity of India, security of the State, friendly relations with foreign States, maintenance of public order or preventing incitement to any cognizable offence relating to any of these, and the processing by the Central Government of any personal data that such instrumentality may furnish to it; and (*b*) necessary for research, archiving or statistical purposes if the personal data is not to be used to take any decision specific to a Data Principal and such processing is carried on in accordance with such standards as may be prescribed.

(*3*) The Central Government may, having regard to the volume and nature of personal data processed, notify certain Data Fiduciaries or class of Data Fiduciaries, including startups, as Data Fiduciaries to whom the provisions of section 5, sub-sections (*3*) and (*7*) of section 8 and sections 10 and 11 shall not apply.

Explanation.—For the purposes of this sub-section, the term "startup" means a private limited company or a partnership firm or a limited liability partnership incorporated in India, which is eligible to be and is recognised as such in accordance with the criteria and process notified by the department to which matters relating to startups are allocated in the Central Government.

(*4*) In respect of processing by the State or any instrumentality of the State, the provisions of sub-section (*7*) of section 8 and sub-section (*3*) of section 12 and, where such processing is for a purpose that does not include making of a decision that affects the Data Principal, sub-section (*2*) of section 12 shall not apply.

(*5*) The Central Government may, before expiry of five years from the date of commencement of this Act, by notification, declare that any provision of this Act shall not apply to such Data Fiduciary or classes of Data Fiduciaries for such period as may be specified in the notification.

CHAPTER V

DATA PROTECTION BOARD OF INDIA

Establishment of Board.

18. (*1*) With effect from such date as the Central Government may, by notification, appoint, there shall be established, for the purposes of this Act, a Board to be called the Data Protection Board of India.

(*2*) The Board shall be a body corporate by the name aforesaid, having perpetual succession and a common seal, with power, subject to the provisions of this Act, to acquire, hold and dispose of property, both movable and immovable, and to contract and shall, by the said name, sue or be sued.

(*3*) The headquarters of the Board shall be at such place as the Central Government may notify.

Composition and qualifications for appointment of Chairperson and Members.

19. (*1*) The Board shall consist of a Chairperson and such number of other Members as the Central Government may notify.

(*2*) The Chairperson and other Members shall be appointed by the Central Government in such manner as may be prescribed.

(*3*) The Chairperson and other Members shall be a person of ability, integrity and standing who possesses special knowledge or practical experience in the fields of data governance, administration or implementation of laws related to social or consumer protection, dispute resolution, information and communication technology, digital economy, law, regulation or techno-regulation, or in any other field which in the opinion of the Central Government may be useful to the Board, and at least one among them shall be an expert in the field of law.

Salary, allowances payable to and term of office.

20. (*1*) The salary, allowances and other terms and conditions of service of the Chairperson and other Members shall be such as may be prescribed, and shall not be varied to their disadvantage after their appointment.

(*2*) The Chairperson and other Members shall hold office for a term of two years and shall be eligible for re-appointment.

21. (*1*) A person shall be disqualified for being appointed and continued as the Chairperson or a Member, if she— Disqualifications for appointment and continuation as Chairperson and Members of Board.

(*a*) has been adjudged as an insolvent;

(*b*) has been convicted of an offence, which in the opinion of the Central Government, involves moral turpitude;

(*c*) has become physically or mentally incapable of acting as a Member;

(*d*) has acquired such financial or other interest, as is likely to affect prejudicially her functions as a Member; or

(*e*) has so abused her position as to render her continuance in office prejudicial to the public interest.

(*2*) The Chairperson or Member shall not be removed from her office by the Central Government unless she has been given an opportunity of being heard in the matter.

22. (*1*) The Chairperson or any other Member may give notice in writing to the Central Government of resigning from her office, and such resignation shall be effective from the date on which the Central Government permits her to relinquish office, or upon expiry of a period of three months from the date of receipt of such notice, or upon a duly appointed successor entering upon her office, or upon the expiry of the term of her office, whichever is earliest. Resignation by Members and filling of vacancy.

(*2*) A vacancy caused by the resignation or removal or death of the Chairperson or any other Member, or otherwise, shall be filled by fresh appointment in accordance with the provisions of this Act.

(*3*) The Chairperson and any other Member shall not, for a period of one year from the date on which they cease to hold such office, except with the previous approval of the Central Government, accept any employment, and shall also disclose to the Central Government any subsequent acceptance of employment with any Data Fiduciary against whom proceedings were initiated by or before such Chairperson or other Member.

23. (*1*) The Board shall observe such procedure in regard to the holding of and transaction of business at its meetings, including by digital means, and authenticate its orders, directions and instruments in such manner as may be prescribed. Proceedings of Board.

(*2*) No act or proceeding of the Board shall be invalid merely by reason of—

(*a*) any vacancy in or any defect in the constitution of the Board;

(*b*) any defect in the appointment of a person acting as the Chairperson or other Member of the Board; or

(*c*) any irregularity in the procedure of the Board, which does not affect the merits of the case.

(*3*) When the Chairperson is unable to discharge her functions owing to absence, illness or any other cause, the senior-most Member shall discharge the functions of the Chairperson until the date on which the Chairperson resumes her duties.

24. The Board may, with previous approval of the Central Government, appoint such officers and employees as it may deem necessary for the efficient discharge of its functions under the provisions of this Act, on such terms and conditions of appointment and service as may be prescribed. Officers and employees of Board.

25. The Chairperson, Members, officers and employees of the Board shall be deemed, when acting or purporting to act in pursuance of provisions of this Act, to be public servants within the meaning of section 21 of the Indian Penal Code. Members and officers to be public servants.

45 of 1860.

Powers of Chairperson.

26. The Chairperson shall exercise the following powers, namely:—

(*a*) general superintendence and giving direction in respect of all administrative matters of the Board;

(*b*) authorise any officer of the Board to scrutinise any intimation, complaint, reference or correspondence addressed to the Board; and

(*c*) authorise performance of any of the functions of the Board and conduct any of its proceedings, by an individual Member or groups of Members and to allocate proceedings among them.

CHAPTER VI

POWERS, FUNCTIONS AND PROCEDURE TO BE FOLLOWED BY BOARD

Powers and functions of Board.

27. (*1*) The Board shall exercise and perform the following powers and functions, namely:—

(*a*) on receipt of an intimation of personal data breach under sub-section (*6*) of section 8, to direct any urgent remedial or mitigation measures in the event of a personal data breach, and to inquire into such personal data breach and impose penalty as provided in this Act;

(*b*) on a complaint made by a Data Principal in respect of a personal data breach or a breach in observance by a Data Fiduciary of its obligations in relation to her personal data or the exercise of her rights under the provisions of this Act, or on a reference made to it by the Central Government or a State Government, or in compliance of the directions of any court, to inquire into such breach and impose penalty as provided in this Act;

(*c*) on a complaint made by a Data Principal in respect of a breach in observance by a Consent Manager of its obligations in relation to her personal data, to inquire into such breach and impose penalty as provided in this Act;

(*d*) on receipt of an intimation of breach of any condition of registration of a Consent Manager, to inquire into such breach and impose penalty as provided in this Act; and

(*e*) on a reference made by the Central Government in respect of the breach in observance of the provisions of sub-section (*2*) of section 37 by an intermediary, to inquire into such breach and impose penalty as provided in this Act.

(*2*) The Board may, for the effective discharge of its functions under the provisions of this Act, after giving the person concerned an opportunity of being heard and after recording reasons in writing, issue such directions as it may consider necessary to such person, who shall be bound to comply with the same.

(*3*) The Board may, on a representation made to it by a person affected by a direction issued under sub-section (*1*) or sub-section (*2*), or on a reference made by the Central Government, modify, suspend, withdraw or cancel such direction and, while doing so, impose such conditions as it may deem fit, subject to which the modification, suspension, withdrawal or cancellation shall have effect.

Procedure to be followed by Board.

28. (*1*) The Board shall function as an independent body and shall, as far as practicable, function as a digital office, with the receipt of complaints and the allocation, hearing and pronouncement of decisions in respect of the same being digital by design, and adopt such techno-legal measures as may be prescribed.

(*2*) The Board may, on receipt of an intimation or complaint or reference or directions as referred to in sub-section (*1*) of section 27, take action in accordance with the provisions of this Act and the rules made thereunder.

(*3*) The Board shall determine whether there are sufficient grounds to proceed with an inquiry.

(*4*) In case the Board determines that there are insufficient grounds, it may, for reasons to be recorded in writing, close the proceedings.

(*5*) In case the Board determines that there are sufficient grounds to proceed with inquiry, it may, for reasons to be recorded in writing, inquire into the affairs of any person for ascertaining whether such person is complying with or has complied with the provisions of this Act.

(*6*) The Board shall conduct such inquiry following the principles of natural justice and shall record reasons for its actions during the course of such inquiry.

(*7*) For the purposes of discharging its functions under this Act, the Board shall have
5 of 1908. the same powers as are vested in a civil court under the Code of Civil Procedure, 1908, in respect of matters relating to—

(*a*) summoning and enforcing the attendance of any person and examining her on oath;

(*b*) receiving evidence of affidavit requiring the discovery and production of documents;

(*c*) inspecting any data, book, document, register, books of account or any other document; and

(*d*) such other matters as may be prescribed.

(*8*) The Board or its officers shall not prevent access to any premises or take into custody any equipment or any item that may adversely affect the day-to-day functioning of a person.

(*9*) The Board may require the services of any police officer or any officer of the Central Government or a State Government to assist it for the purposes of this section and it shall be the duty of every such officer to comply with such requisition.

(*10*) During the course of the inquiry, if the Board considers it necessary, it may for reasons to be recorded in writing, issue interim orders after giving the person concerned an opportunity of being heard.

(*11*) On completion of the inquiry and after giving the person concerned an opportunity of being heard, the Board may for reasons to be recorded in writing, either close the proceedings or proceed in accordance with section 33.

(*12*) At any stage after receipt of a complaint, if the Board is of the opinion that the complaint is false or frivolous, it may issue a warning or impose costs on the complainant.

CHAPTER VII

Appeal and alternate dispute resolution

Appeal to Appellate Tribunal.

29. (*1*) Any person aggrieved by an order or direction made by the Board under this Act may prefer an appeal before the Appellate Tribunal.

(*2*) Every appeal under sub-section (*1*) shall be filed within a period of sixty days from the date of receipt of the order or direction appealed against and it shall be in such form and manner and shall be accompanied by such fee as may be prescribed.

(*3*) The Appellate Tribunal may entertain an appeal after the expiry of the period specified in sub-section (*2*), if it is satisfied that there was sufficient cause for not preferring the appeal within that period.

(*4*) On receipt of an appeal under sub-section (*1*), the Appellate Tribunal may, after giving the parties to the appeal, an opportunity of being heard, pass such orders thereon as it thinks fit, confirming, modifying or setting aside the order appealed against.

(*5*) The Appellate Tribunal shall send a copy of every order made by it to the Board and to the parties to the appeal.

(*6*) The appeal filed before the Appellate Tribunal under sub-section (*1*) shall be dealt with by it as expeditiously as possible and endeavour shall be made by it to dispose of the appeal finally within six months from the date on which the appeal is presented to it.

(*7*) Where any appeal under sub-section (*6*) could not be disposed of within the period of six months, the Appellate Tribunal shall record its reasons in writing for not disposing of the appeal within that period.

(*8*) Without prejudice to the provisions of section 14A and section 16 of the Telecom Regulatory Authority of India Act, 1997, the Appellate Tribunal shall deal with an appeal under this section in accordance with such procedure as may be prescribed. 24 of 1997.

(*9*) Where an appeal is filed against the orders of the Appellate Tribunal under this Act, the provisions of section 18 of the Telecom Regulatory Authority of India Act, 1997 shall apply. 24 of 1997.

(*10*) In respect of appeals filed under the provisions of this Act, the Appellate Tribunal shall, as far as practicable, function as a digital office, with the receipt of appeal, hearing and pronouncement of decisions in respect of the same being digital by design.

Orders passed by Appellate Tribunal to be executable as decree.

30. (*1*) An order passed by the Appellate Tribunal under this Act shall be executable by it as a decree of civil court, and for this purpose, the Appellate Tribunal shall have all the powers of a civil court.

(*2*) Notwithstanding anything contained in sub-section (*1*), the Appellate Tribunal may transmit any order made by it to a civil court having local jurisdiction and such civil court shall execute the order as if it were a decree made by that court.

Alternate dispute resolution.

31. If the Board is of the opinion that any complaint may be resolved by mediation, it may direct the parties concerned to attempt resolution of the dispute through such mediation by such mediator as the parties may mutually agree upon, or as provided for under any law for the time being in force in India.

Voluntary undertaking.

32. (*1*) The Board may accept a voluntary undertaking in respect of any matter related to observance of the provisions of this Act from any person at any stage of a proceeding under section 28.

(*2*) The voluntary undertaking referred to in sub-section (*1*) may include an undertaking to take such action within such time as may be determined by the Board, or refrain from taking such action, and or publicising such undertaking.

(*3*) The Board may, after accepting the voluntary undertaking and with the consent of the person who gave the voluntary undertaking vary the terms included in the voluntary undertaking.

(*4*) The acceptance of the voluntary undertaking by the Board shall constitute a bar on proceedings under the provisions of this Act as regards the contents of the voluntary undertaking, except in cases covered by sub-section (*5*).

(*5*) Where a person fails to adhere to any term of the voluntary undertaking accepted by the Board, such breach shall be deemed to be breach of the provisions of this Act and the Board may, after giving such person an opportunity of being heard, proceed in accordance with the provisions of section 33.

CHAPTER VIII

Penalties and Adjudication

Penalties.

33. (*1*) If the Board determines on conclusion of an inquiry that breach of the provisions of this Act or the rules made thereunder by a person is significant, it may, after giving the person an opportunity of being heard, impose such monetary penalty specified in the Schedule.

(*2*) While determining the amount of monetary penalty to be imposed under sub-section (*1*), the Board shall have regard to the following matters, namely:—

(*a*) the nature, gravity and duration of the breach;

(*b*) the type and nature of the personal data affected by the breach;

(*c*) repetitive nature of the breach;

(*d*) whether the person, as a result of the breach, has realised a gain or avoided any loss;

(*e*) whether the person took any action to mitigate the effects and consequences of the breach, and the timeliness and effectiveness of such action;

(*f*) whether the monetary penalty to be imposed is proportionate and effective, having regard to the need to secure observance of and deter breach of the provisions of this Act; and

(*g*) the likely impact of the imposition of the monetary penalty on the person.

Crediting sums realised by way of penalties to Consolidated Fund of India.

34. All sums realised by way of penalties imposed by the Board under this Act, shall be credited to the Consolidated Fund of India.

CHAPTER IX

MISCELLANEOUS

Protection of action taken in good faith.

35. No suit, prosecution or other legal proceedings shall lie against the Central Government, the Board, its Chairperson and any Member, officer or employee thereof for anything which is done or intended to be done in good faith under the provisions of this Act or the rules made thereunder.

Power to call for information.

36. The Central Government may, for the purposes of this Act, require the Board and any Data Fiduciary or intermediary to furnish such information as it may call for.

Power of Central Government to issue directions.

37. (*1*) The Central Government or any of its officers specially authorised by it in this behalf may, upon receipt of a reference in writing from the Board that—

(*a*) intimates the imposition of monetary penalty by the Board on a Data Fiduciary in two or more instances; and

(*b*) advises, in the interests of the general public, the blocking for access by the public to any information generated, transmitted, received, stored or hosted, in any computer resource that enables such Data Fiduciary to carry on any activity relating to offering of goods or services to Data Principals within the territory of India,

after giving an opportunity of being heard to that Data Fiduciary, on being satisfied that it is necessary or expedient so to do, in the interests of the general public, for reasons to be recorded in writing, by order, direct any agency of the Central Government or any intermediary to block for access by the public or cause to be blocked for access by the public any such information.

(*2*) Every intermediary who receives a direction issued under sub-section (*1*) shall be bound to comply with the same.

(*3*) For the purposes of this section, the expressions "computer resource", "information" and "intermediary" shall have the meanings respectively assigned to them in
21 of 2000. the Information Technology Act, 2000.

Consistency with other laws.

38. (*1*) The provisions of this Act shall be in addition to and not in derogation of any other law for the time being in force.

(*2*) In the event of any conflict between a provision of this Act and a provision of any other law for the time being in force, the provision of this Act shall prevail to the extent of such conflict.

Bar of jurisdiction.

39. No civil court shall have the jurisdiction to entertain any suit or proceeding in respect of any matter for which the Board is empowered under the provisions of this Act and no injunction shall be granted by any court or other authority in respect of any action taken or to be taken in pursuance of any power under the provisions of this Act.

Power to make rules.

40. (*1*) The Central Government may, by notification, and subject to the condition of previous publication, make rules not inconsistent with the provisions of this Act, to carry out the purposes of this Act.

(*2*) In particular and without prejudice to the generality of the foregoing power, such rules may provide for all or any of the following matters, namely:—

(*a*) the manner in which the notice given by the Data Fiduciary to a Data Principal shall inform her, under sub-section (*1*) of section 5;

(*b*) the manner in which the notice given by the Data Fiduciary to a Data Principal shall inform her, under sub-section (*2*) of section 5;

(*c*) the manner of accountability and the obligations of Consent Manager under sub-section (*8*) of section 6;

(*d*) the manner of registration of Consent Manager and the conditions relating thereto, under sub-section (*9*) of section 6;

(*e*) the subsidy, benefit, service, certificate, licence or permit for the provision or issuance of which, personal data may be processed under clause (*b*) of section 7;

(*f*) the form and manner of intimation of personal data breach to the Board under sub-section (*6*) of section 8;

(*g*) the time period for the specified purpose to be deemed as no longer being served, under sub-section (*8*) of section 8;

(*h*) the manner of publishing the business contact information of a Data Protection Officer under sub-section (*9*) of section 8;

(*i*) the manner of obtaining verifiable consent under sub-section (*1*) of section 9;

(*j*) the classes of Data Fiduciaries, the purposes of processing of personal data of a child and the conditions relating thereto, under sub-section (*4*) of section 9;

(*k*) the other matters comprising the process of Data Protection Impact Assessment under sub-clause (*i*) of clause (*c*) of sub-section (*2*) of section 10;

(*l*) the other measures that the Significant Data Fiduciary shall undertake under sub-clause (*iii*) of clause (*c*) of sub-section (*2*) of section 10;

(*m*) the manner in which a Data Principal shall make a request to the Data Fiduciary to obtain information and any other information related to the personal data of such Data Principal and its processing, under sub-section (*1*) of section 11;

(*n*) the manner in which a Data Principal shall make a request to the Data Fiduciary for erasure of her personal data under sub-section (*3*) of section 12;

(*o*) the period within which the Data Fiduciary shall respond to any grievances under sub-section (*2*) of section 13;

(*p*) the manner of nomination of any other individual by the Data Principal under sub-section (*1*) of section 14;

(*q*) the standards for processing the personal data for exemption under clause (*b*) of sub-section (*2*) of section 17;

(*r*) the manner of appointment of the Chairperson and other Members of the Board under sub-section (*2*) of section 19;

(*s*) the salary, allowances and other terms and conditions of services of the Chairperson and other Members of the Board under sub-section (*1*) of section 20;

(*t*) the manner of authentication of orders, directions and instruments under sub-section (*1*) of section 23;

(*u*) the terms and conditions of appointment and service of officers and employees of the Board under section 24;

(*v*) the techno-legal measures to be adopted by the Board under sub-section (*1*) of section 28;

(*w*) the other matters under clause (*d*) of sub-section (*7*) of section 28;

(*x*) the form, manner and fee for filing an appeal under sub-section (*2*) of section 29;

(*y*) the procedure for dealing an appeal under sub-section (*8*) of section 29;

(*z*) any other matter which is to be or may be prescribed or in respect of which provision is to be, or may be, made by rules.

Laying of rules and certain notifications.

41. Every rule made and every notification issued under section 16 and section 42 of this Act shall be laid, as soon as may be after it is made, before each House of Parliament, while it is in session, for a total period of thirty days which may be comprised in one session or in two or more successive sessions, and if before the expiry of the session immediately following the session or the successive sessions aforesaid, both Houses agree in making any modification in the rule or notification or both Houses agree that the rule or notification should not be made or issued, the rule or notification shall thereafter have effect only in such modified form or be of no effect, as the case may be; so, however, that any such modification or annulment shall be without prejudice to the validity of anything previously done under that rule or notification.

Power to amend Schedule.

42. (*1*) The Central Government may, by notification, amend the Schedule, subject to the restriction that no such notification shall have the effect of increasing any penalty specified therein to more than twice of what was specified in it when this Act was originally enacted.

(*2*) Any amendment notified under sub-section (*1*) shall have effect as if enacted in this Act and shall come into force on the date of the notification.

Power to remove difficulties.

43. (*1*) If any difficulty arises in giving effect to the provisions of this Act, the Central Government may, by order published in the Official Gazette, make such provisions not inconsistent with the provisions of this Act as may appear to it to be necessary or expedient for removing the difficulty.

(*2*) No order as referred to in sub-section (*1*) shall be made after the expiry of three years from the date of commencement of this Act.

(*3*) Every order made under this section shall be laid, as soon as may be after it is made, before each House of Parliament.

Amendments to certain Acts.

24 of 1997. **44.** (*1*) In section 14 of the Telecom Regulatory Authority of India Act, 1997, in clause (*c*), for sub-clauses (*i*) and (*ii*), the following sub-clauses shall be substituted, namely:—

"(*i*) the Appellate Tribunal under the Information Technology Act, 2000; 21 of 2000.

(*ii*) the Appellate Tribunal under the Airports Economic Regulatory Authority of India Act, 2008; and 27 of 2008.

(*iii*) the Appellate Tribunal under the Digital Personal Data Protection Act, 2023.".

(*2*) The Information Technology Act, 2000 shall be amended in the following manner, namely:— 21 of 2000.

(*a*) section 43A shall be omitted;

(*b*) in section 81, in the proviso, after the words and figures "the Patents Act, 1970", the words and figures "or the Digital Personal Data Protection Act, 2023" shall be inserted; and 39 of 1970.

(*c*) in section 87, in sub-section (*2*), clause (*ob*) shall be omitted.

(*3*) In section 8 of the Right to Information Act, 2005, in sub-section (*1*), for clause (*j*), the following clause shall be substituted, namely:— 22 of 2005.

"(*j*) information which relates to personal information;".

THE SCHEDULE

[*See* section 33 (*1*)]

Sl. No.	Breach of provisions of this Act or rules made thereunder	Penalty
(1)	(2)	(3)
1.	Breach in observing the obligation of Data Fiduciary to take reasonable security safeguards to prevent personal data breach under sub-section (*5*) of section 8.	May extend to two hundred and fifty crore rupees.
2.	Breach in observing the obligation to give the Board or affected Data Principal notice of a personal data breach under sub-section (*6*) of section 8.	May extend to two hundred crore rupees.
3.	Breach in observance of additional obligations in relation to children under section 9.	May extend to two hundred crore rupees.
4.	Breach in observance of additional obligations of Significant Data Fiduciary under section 10.	May extend to one hundred and fifty crore rupees.
5.	Breach in observance of the duties under section 15.	May extend to ten thousand rupees.
6.	Breach of any term of voluntary undertaking accepted by the Board under section 32.	Up to the extent applicable for the breach in respect of which the proceedings under section 28 were instituted.
7.	Breach of any other provision of this Act or the rules made thereunder.	May extend to fifty crore rupees.

DR. REETA VASISHTA,
Secretary to the Govt. of India.

UPLOADED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, MINTO ROAD, NEW DELHI–110002
AND PUBLISHED BY THE CONTROLLER OF PUBLICATIONS, DELHI–110054.

MGIPMRND—288GI—11-08-2023.

Notes

ICMAI

THE INSTITUTE OF COST ACCOUNTANTS OF INDIA

(Statutory body under an Act of Parliament)

HQ: CMA Bhawan, 12, Sudder Street, Kolkata-700 016
Delhi Office: CMA Bhawan, 3, Institutional Area, Lodhi Road, New Delhi-110003