


M1L3. Data Analytics and AI for Decision-Making

Slide #1



The slide cover is divided into two main sections. The left section has a dark background with white and yellow text. The right section is a grayscale image of a person standing with their back to the camera, looking at a large, curved screen. The screen displays a complex network graph on the left and several hexagonal icons on the right, each containing a different data visualization (bar chart, line graph, network diagram, and area chart).

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Data Analytics and AI
for Decision-Making

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TCMT 612 | Technical Management
Decision Making

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Slide #2



THE ROLE OF DATA ANALYTICS AND AI IN DECISION-MAKING

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Data analytics tools, including recent artificial intelligence, AI, applications, have played a pivotal role in enhancing the decision-making process by evaluating complex data and variables for decades. Computing technological progress empowers companies and organizations to make quicker and more well-informed decisions compared to human driven problem solving.

The recent impacts of consumer AI applications such as Chat GPT and e-commerce recommenders clearly demonstrate the huge potential of data driven systems in transforming industries and lives. But its rapid growth also created a mixed perception of realistic and speculated possibilities. Also, the terminology of AI is widely abused as businesses market conventional, powerful data analytics tools under AI labels to attract customers.

Agenda

- Data analytics and AI analytics
- Examples of AI in decision-making
- Challenges of AI in decision-making
- Human cognitive process in data-driven decision-making

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We will discuss the following topics,

Data analytics and AI analytics.

Examples of AI in decision-making.

Challenges of AI in decision-making.

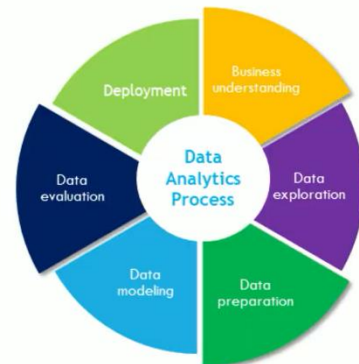
Human cognitive process in data-driven decision-making.

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Data Analytics and AI Analytics

Data analytics involves constructing mathematical models through statistical analysis of historical data to uncover patterns and trends for informed decision-making.

Artificial Intelligence (AI) analytics integrates machine learning models with traditional analytics, to automate and enhance the analysis processes.



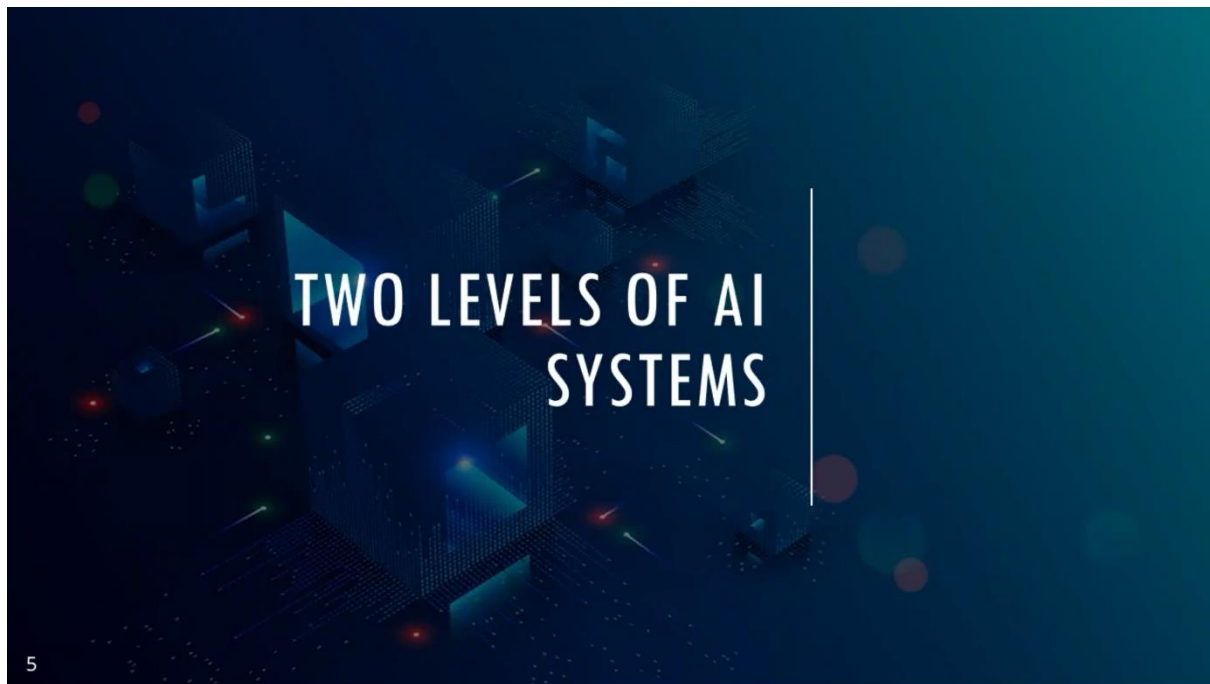
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It's worthwhile to first clarify data analytics and AI analytics.

Data analytics involves constructing mathematical models through statistical analysis of historical data to uncover patterns and trends for informed decision-making. It heavily relies on human analysts to define models and interpret results, making it suitable for structured data and well-defined problems.

AI analytics integrates machine learning models with traditional analytics to automate and enhance the analysis processes. AI analytics are particularly useful for unstructured and complex data where traditional analytics may fall short, such as image recognition, natural language processing, and recommendation systems.

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To gain a comprehensive understanding of artificial intelligence and its impact on decision-making, it is crucial to understand the two distinct levels of AI and their varied capabilities and potential applications.

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General AI (FUTURE)

Machines with the ability to understand and apply knowledge across a wide range of tasks at a level comparable to human intelligence.

Handles diverse tasks without specific programming for each function.

Currently theoretical.

General AI refers to machines with the ability to understand, learn, and apply knowledge across a wide range of tasks at a level comparable to human intelligence. GAI possesses a broad spectrum of cognitive abilities allowing it to handle diverse tasks without specific programming for each function. General AI is currently theoretical and represents the concept of machines exhibiting intelligence equivalent to humans across various domains. So, there are no practical applications of general AI yet as it's still in the research stage.

Specialized AI (TODAY)

Currently available in market.

Excels in performing well-defined tasks and is specialized in a particular domain.

Most AI currently in use falls under the category of specialized AI.



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The AI applications currently available in the market or in the public domain are in fact specialized AI, which is also known as narrow AI or weak AI, referring to AI systems designed and trained for a specific task or limited set of tasks.

Specialized AI excels in performing well-defined tasks and is specialized in a particular domain, lacking the versatility of general AI.

Most AI applications currently in use, such as natural language processing, voice assistance, image recognition, and recommendation systems fall under the category of narrow AI.

Presently, general AI has not reached a stage where it can autonomously make decisions with a profound understanding of its environment and objectives.

Additionally, AI lacks the ability to comprehend and respond to human emotions or incorporate common sense intuitive reasoning into its decision-making processes.

Researchers continue to work towards the goal of achieving general AI, but it remains an area of active exploration and debate within the AI community.

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Data Analytics and AI in Decision-Making

Data analytics tools lack human wisdom and judgment.

The purpose of analytics tools is to **assist** humans in making faster and improved decisions.

The roles of data analytics applications in decision-making support are rapidly evolving.

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In the field of decision-making, it's crucial to recognize that data analytics tools lack the capacity for human wisdom and judgment. Consequently, maintaining a level of personal human involvement remains essential.

The purpose of integrating data analytics tools into decision-making processes is not to achieve complete automation. Instead, the objective is to assist humans in making faster and improved decisions by optimizing processes and leveraging data effectively. These limitations underscore that data analytics, including AI, has its current boundaries and emphasize the need to acknowledge both its capabilities and constraints for decision support.

As narrow or specialized AI has already made significant advancements transforming various aspects of our daily lives and work environments. It is important to note that the roles of data analytics applications in decision-making support are rapidly evolving. Regular and close examination of these roles is necessary to stay abreast of developments and ensure effective integration into decision-making processes.

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Natural Language Processing (NLP)

- Enables computers to automatically analyze and comprehend human language and generate responses to textual data.
- Chatbots like ChatGPT use NLP to understand and respond to human prompts.
- **Marketing organizations:**
 - Sentiment analysis to gauge consumer reactions.
 - Text classification to organize marketing data.
- **Everyday tasks:**
 - Swiftly obtaining answers to queries
 - Summarizing extensive documents
 - Efficiently planning trips



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Natural Language Processing, NLP, represents a transformative capability in computer science, enabling computers to automatically analyze and comprehend human language in a conversational manner. NLP refers to a computer's ability to analyze and process language in a way that mimics human conversation. It empowers machines to comprehend, interpret, and generate human-like responses to textual data.

Conversational chatbots, like ChatGPT, utilize NLP to understand and respond to human prompts. NLP techniques are pivotal in decision-making processes involving text data, such as sentiment analysis, contract review, or customer feedback analysis. Marketing organizations leverage NLP for managing programs across channels to optimize revenue. Sentiment analysis, for instance, helps gauge consumer reactions to marketing campaigns. While text classification aids in organizing marketing data for strategic planning. In our tech savvy world, individuals increasingly rely on generative AI tools for a broad range of everyday decision-making tasks.

From swiftly obtaining answers to queries and summarizing extensive documents to efficiently planning trips, the integration of natural language processing in generative AI allows users to extract relevant information and make informed choices. As these

tools continue to evolve, their influence on decision-making expands across various domains.

It is crucial for professionals to understand the capabilities, applications, and ethical concerns of NLP.

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Computer Vision Applications

- Computer vision empowers machines to interpret and understand visual information, transforming the way we perceive and interact with the world.
- Examples of computer vision applications in decision making include
 - Medical Imaging Diagnosis
 - Operations
- Ethical concerns in computer vision AI encompass issues of privacy infringement, algorithmic bias and challenges related to transparency and accountability

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Computer vision, a field within artificial intelligence, empowers machines to interpret and understand visual information, transforming the way we perceive and interact

with the world. Key components include image acquisition, preprocessing, feature extraction, image recognition, and interpretation.

Examples of computer vision applications in decision-making include the following.

Medical imaging diagnosis. Computer vision aids medical professionals in diagnosing conditions by analyzing medical images such as x rays, MRIs, and CT scans. It provides insights into decision-making in treatment plans.

Operations. Computer vision systems read, inspect, and analyze key operation parameters on manufacturing lines to abnormal conditions. This information guides decisions on operation processes and improvements. Ethical concerns in computer vision AI encompass issues of privacy infringement, algorithmic bias leading to unfair outcomes, and challenges related to transparency and accountability.

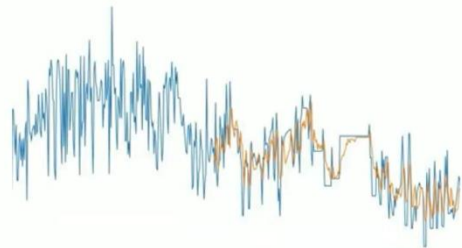
The use of facial recognition technology raises dilemmas surrounding consent, potential misuse, and the creation of surveillance state. Addressing these ethical considerations is crucial to fostering responsible development and deployment of computer vision AI, ensuring fairness, transparency, and the protection of individual rights.

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Predictive Analytics

Predictive analytics enables decision makers to anticipate future outcomes and make proactive decisions in various domains.

- Popular forms of predictive analysis include
 - Regression analysis
 - Time-series analysis



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Predictive analytics enables decision-makers to anticipate future outcomes and make proactive decisions in various domains, such as sales forecasting and demand planning. Through predictive analytics, you can learn how to develop predictive models, preprocess data, and better define the problems and issues that your company faces.

Popular forms of predictive analysis include regression analysis and time series analysis. It's important to note that, strictly speaking, these analytical tools are classified as statistical methods rather than forms of artificial intelligence.

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Regression Analysis

Models the relationship between a dependent variable and one or more independent variables.



FINANCE: Predicting stock prices based on various financial indicators.



MARKETING: Forecasting sales based on advertising spend and other marketing factors.



HEALTHCARE: Predicting patient outcomes based on medical history and treatment variables.

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Regression analysis, for instance, is a statistical technique employed to model the relationship between a dependent variable and one or more independent variables. Regression analysis helps analysts understand how changes in one variable may affect another and is particularly useful when there's a need to make predictions based on historical or known data.

Use cases.

Finance. Predicting stock prices based on various financial indicators.

Marketing. Forecasting sales based on advertising spend and other marketing factors.

Healthcare. Predicting patient outcomes based on medical history and treatment variables.

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Time Series Analysis

Analyzes data points collected sequentially over time to identify patterns, trends, and seasonality within the data.



ECONOMICS: Predicting economic indicators like GDP, inflation, or unemployment rates.



WEATHER FORECASTING: Analyzing historical weather data to predict future weather patterns.

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Time series analysis is a statistical method that focuses on analyzing data points collected sequentially over time. It aims to identify trends, and seasonality within the data, making it especially suitable for time ordered data sets.

Use cases.

Economics. Predicting economic indicators like GDP, inflation, or unemployment rates.

Weather forecasting. Analyzing historical weather data to predict future weather patterns.

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AI Predictive Analytics

AI models involve using algorithms and machine learning techniques to analyze data and make predictions about future outcomes.

Examples of AI predictive analysis:

- Predictive maintenance
- Employee attrition prediction

It's essential to validate AI predictive systems' effectiveness in practical settings and ensure their ethical considerations are rigorously addressed

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While statistical methods like regression analysis can be part of the toolkit used in developing AI models, powerful applications of artificial intelligence involve using algorithms and machine learning techniques to analyze data and make predictions about future outcomes.

Here are some examples of AI predictive analysis in various industries.

Predictive maintenance. Analyze sensor data from machinery to predict when equipment is likely to fail. Historical breakdown analysis is combined with real time process metrics and operational schedules to determine the most cost-effective times to shut equipment down for necessary maintenance.

One application is Pipeline Maintenance Management System. Employee attrition prediction. Data analytics tools, particularly recent AI models, can analyze HR data, employee engagement surveys, and other factors to predict the likelihood of employees leaving the company, allowing proactive retention strategies.

It's noteworthy that many AI predictive systems are presently in the early stages of deployment.

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Optimization and Resource Allocation

Optimization algorithms enable decision makers to allocate resources efficiently, optimize processes, and solve complex optimization problems.

Linear optimizer involves maximizing or minimizing a linear goal function of decision variables that decision-makers can control.

Applications in Decision Making include:

- Resource Allocation
- Production Planning
- Financial Planning

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However, their extensive implementation requires real world validation and thorough ethical review. As we explore the potential of these systems, it's essential to emphasize the significance of validating their effectiveness in practical settings and ensuring their ethical considerations are rigorously addressed before widespread deployment.

Optimization algorithms enable decision-makers to allocate resources efficiently, optimize processes, and solve complex optimization problems. This can help in areas such as workforce scheduling, supply chain optimization, or route planning. Linear optimization, also known as linear programming, is a powerful mathematical technique used for decision-making in a variety of fields, ranging from operations research and logistics to finance.

and manufacturing. Linear optimizer involves maximizing or minimizing a linear goal function of decision variables that decision-makers can control. Linear programming also involves constraints that limit the feasible values of the decision variables reflecting the real-world limitations or requirements.

Applications in decision-making include resource allocation. Linear optimization is used to allocate resources efficiently, such as assigning manpower, machines, or funds to maximize output or profit.

Production planning. It helps optimize production schedules, considering factors like production capacities, resource availability, and demand constraints.

Financial planning. In finance, linear optimization is applied to portfolio optimization, risk management, and capital budgeting.

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AI Optimization and Resource Allocation

- AI is increasingly employed in supply chain management to automate the creation of optimized routes
- Companies in e-commerce rely on AI-driven route optimization to ensure timely and cost-efficient deliveries
- The effectiveness of AI optimization relies on the quality of the input data



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AI is increasingly employed in supply chain management to automate the creation of optimized routes. Supply chain managers utilize AI algorithms to improve route optimization for delivery drivers.

By inputting a list of stops into the system, AI considers dynamic factors like real time traffic conditions and consumer demand. The system then calculates the most efficient and cost-effective routes for the drivers, minimizing transportation time and expenses. For instance, companies in e commerce rely on AI driven route optimization to ensure timely and cost-efficient deliveries.

The effectiveness of AI optimization relies on the quality of the input data. Decision-makers must ensure that the data used for analysis is accurate and up to date.

Emerging AI Applications

- Fraud detection in finance
- Automated trading for financial trading and investments.
- AI recommender for personalized marketing
- Legal research



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Fraud detection in finance. AI systems analyze transaction data to detect anomalies and patterns associated with fraudulent activities.

They can identify unusual behavior and trigger alerts for further investigation. For example, credit card companies use AI to monitor large abnormal transactions made outside of your frequent locations, even overseas. They flag the transaction for review and may temporarily block the card until you confirm whether the transaction is legitimate.

Automated trading for financial trading and investments. AI algorithms analyze market trends, news, and historical data to inform trading decisions. Automated trading systems can execute trades at high speeds based on predefined criteria. AI Recommender for personalized marketing. AI Algorithms analyze customer behavior and preferences to create personalized marketing strategies.

This includes recommending products, sending targeted advertisements, and tailoring content to individual preferences. Legal Research. AI powered legal research tools, particularly NLP and Decision Tree, analyze vast databases of legal documents to assist lawyers in preparing cases, finding relevant precedents, and predicting legal outcomes.