

# INTRODUCTION TO AI AND APPLICATIONS

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Module 1

# Outline

## Module 1:

### 1. Introduction to AI

1. Definition of Artificial Intelligence
2. How Does AI Work?
3. Advantages and Disadvantages of Artificial Intelligence
4. History of Artificial Intelligence
5. Types of Artificial Intelligence:
  - a. Weak AI vs. Strong AI
  - b. Reactive Machines
  - c. Limited Memory
  - d. Theory of Mind
  - e. Self-Awareness
6. Is Artificial Intelligence the Same as Augmented Intelligence and Cognitive Computing?

### 2. Machine Intelligence

1. Defining Intelligence
2. Components of Intelligence
3. Differences Between Human and Machine Intelligence
4. Knowledge Representation and it's types

# Module 1:

## Definition of Artificial Intelligence

- **Artificial Intelligence (AI)** is the science and engineering of making intelligent machines, especially intelligent computer programs, *John McCarthy (2004)*.
- **Historical Background:** The concept of AI was first explored in 1950 by Alan Turing, a British mathematician and computer scientist, who asked the question "Can machines think?" This was a groundbreaking idea and led him to propose the Turing Test.
- **The Role of John McCarthy (2004):** Later, in 2004, John McCarthy defined AI as the science and engineering of making intelligent machines—basically, how we can program computers to act smart like humans.
- **A Researcher's Perspective:** For researchers, AI refers to a set of algorithms (step-by-step instructions) that help a machine make decisions and act without being explicitly told what to do each time.
- **Understanding AI from a Simple View:** Think of AI as machines or software that are designed to learn from their environment, just like humans learn from their experiences. For example, an AI program can be trained to recognize your face.
- **Everyday AI Examples:** Some well-known examples of AI include chess-playing computers or self-driving cars. These systems depend on deep learning (a type of AI that mimics the human brain) and natural language processing (helping computers understand human language, like Siri or Google Assistant).

# Module 1:

## How Does AI Work?

- AI works by processing large datasets, recognizing patterns, and making decisions using algorithms.
- It involves learning, reasoning, and self-correction:
  - a. Learning - AI learns from data
  - b. Reasoning - AI chooses the correct algorithm
  - c. Self-Correction - AI refines algorithms for accuracy

# Module 1:

## Advantages and Disadvantages of AI

### Advantages:

1. Performs well on tasks that uses detailed data.
2. Takes less time to perform tasks that needs to process huge volumes of data.
3. Generates consistent and accurate results.
4. Can be used 24 X 7.
5. Optimizes tasks by better utilizing resources.
6. Automates complex processes.
7. Minimizes downtime by predicting maintenance needs.
8. Enables companies to produce new products having better quality and speed.

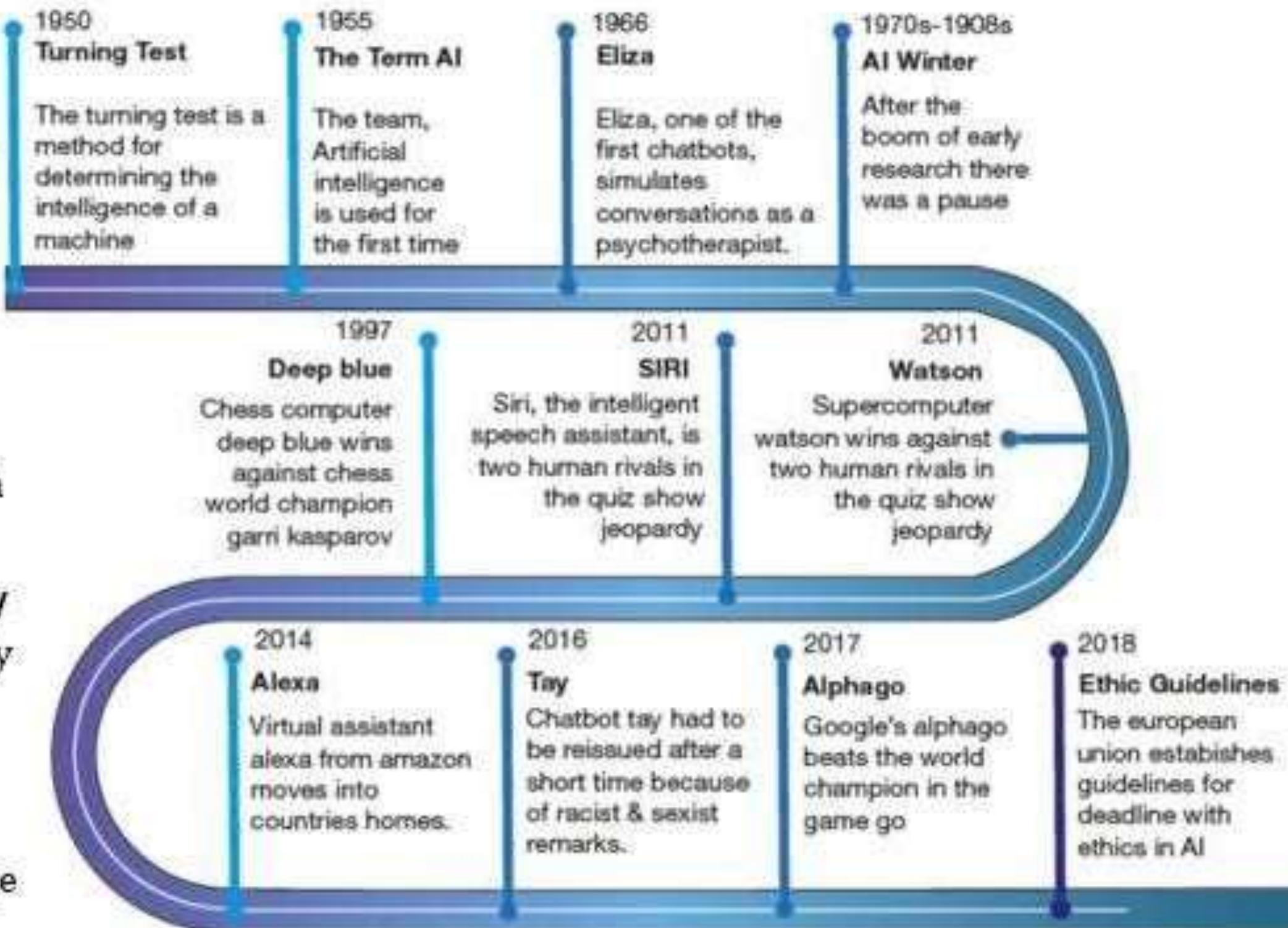
### Disadvantages:

1. Involves more cost.
2. Technical expertise required to develop and use AI applications.
3. Lack of trained professionals.
4. Incomplete or inaccurate data may result in disastrous results.
5. Lacks the capability to generalize tasks

# Module 1: Introduction to Artificial Intelligence

## History of AI

- 1943 - First Neural Network Model Proposed:** By Warren McCullough and Walter Pitts to lay the foundation for artificial neural networks and machine learning.
- 1950 - Turing Test Introduced:** By Alan Turing to measure a machine's ability to exhibit intelligent behavior indistinguishable from humans.
- 1956 - John McCarthy Coins the Term 'Artificial Intelligence':** By John McCarthy during the Dartmouth Conference, marking the birth of AI as a formal field.
- 1997 - IBM Deep Blue Defeats Chess Champion Garry Kasparov:** By IBM's team to demonstrate AI's capability in strategic decision-making through computational power.
- 2011 - Siri Introduced by Apple:** By Apple to revolutionize personal assistants using natural language processing and AI for everyday tasks.

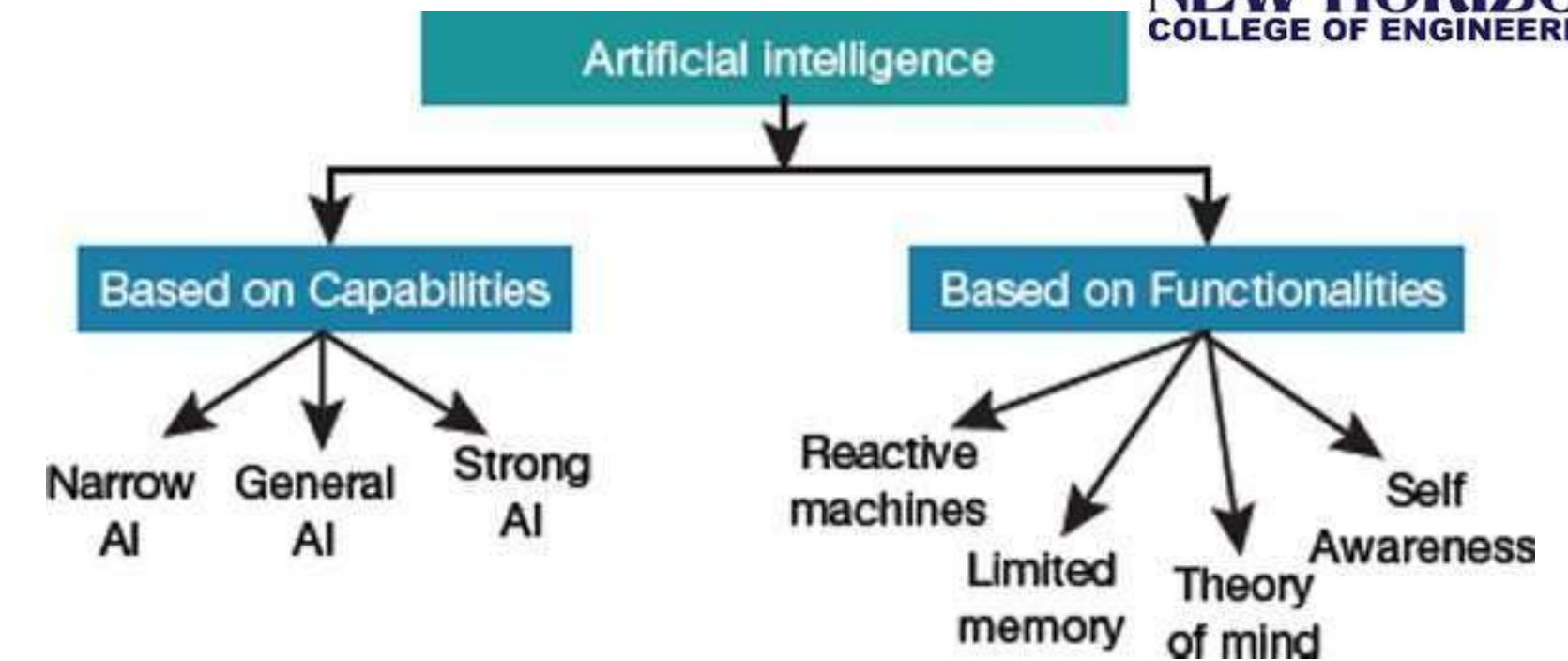


# Module 1:

## Types of AI

AI can be categorized into:

- **Weak AI (Narrow AI)**
  - Weak AI, also known as narrow AI, is designed to do one specific task.
  - Siri and Alexa are examples.
- **Strong AI (Artificial General Intelligence)**
  - Strong AI, also called Artificial General Intelligence (AGI) or Superintelligence (ASI), tries to mimic human thinking.
  - Can perform tasks it hasn't been specifically trained for.
  - Requires abilities like visual perception, speech recognition, decision-making, and language translation.
- **Reactive Machines**
  - Reactive Machines are the simplest type of AI that react to situations based on immediate input, but they have no memory or ability to learn from past experiences.
  - Examples: IBM's Deep Blue (chess-playing computer) is a reactive machine. It makes decisions based on the current state of the game but doesn't remember past games.



# Module 1:

## Types of AI

AI can be categorized into:

- **Based on Functionalities**
  - **Reactive Machines**
    - Reactive Machines are the simplest type of AI that react to situations based on immediate input, but they have no memory or ability to learn from past experiences.
  - **Limited Memory**
    - Limited memory AI systems can remember data for a short time and use it to make decisions, but they don't keep data permanently.
  - **Theory of Mind**
    - The Theory of Mind in AI aims to create machines that can understand thoughts, emotions, and memories—just like humans.
  - **Self-Awareness**
    - Self-awareness in AI means machines that have a human-level consciousness—they can understand their own existence and feelings.

# Module 1:

## Types of AI

### 1. Weak AI (Narrow AI)

- Weak AI, also known as narrow AI, is designed to do one specific task.
- **Examples:**
  - Siri and Alexa are examples. When you tell Alexa to play a song, it does so because it's trained to understand that specific command.
  - Other examples include weather forecasting, predicting stock prices, and Google search.
- **How it works:** These systems are great at doing one thing really well, but they don't work outside their specific task. For example, Alexa can't drive a car; it's just built for voice commands.
- **Why it's important:** Weak AI has helped make many tasks easier and more efficient, and it is the most common type of AI in use today.

# Module 1:

## Types of AI

### 2. Strong AI (Artificial General Intelligence – AGI)

- Strong AI, also called Artificial General Intelligence (AGI) or Superintelligence (ASI), tries to mimic human thinking.
- Can perform tasks it hasn't been specifically trained for.
- Requires abilities like visual perception, speech recognition, decision-making, and language translation.
- **Future potential:** Experts believe that Strong AI might one day surpass human intelligence, but it's not expected to happen anytime soon.
- **Concerns:** While some fear that Strong AI could be dangerous, experts say we don't need to worry about it in the near future, as it's still far from becoming a reality.

# Module 1:

## Types of AI

### 3. Reactive Machines

- **Reactive Machines** are the simplest type of AI that react to situations based on immediate input, but they have no memory or ability to learn from past experiences.
  - **Examples:** IBM's Deep Blue (chess-playing computer) is a reactive machine. It makes decisions based on the current state of the game but doesn't remember past games.

# Module 1:

## Types of AI

### 4. Limited Memory

- What it is: Limited memory AI systems can remember data for a short time and use it to make decisions, but they don't keep data permanently.
  - **Examples:**
    - Autonomous vehicles use limited memory to track information like speed of nearby cars, distance between cars, and speed limits to navigate safely.
    - AlphaGo, the AI that defeated the world champion in the game Go, also used limited memory to play and improve during the game.
  - These systems learn and improve continuously by analyzing new data and adjusting based on feedback.
  - **Key Models:**
    - **Reinforcement Learning:** AI learns by trial and error, improving over time.
    - **Long Short-Term Memory (LSTM):** AI uses past data to predict the next step, but it focuses more on recent data.
    - **Evolutionary GANs (E-GAN):** The AI evolves over time, using data and feedback to make better decisions and predict outcomes.

# Module 1:

## Types of AI

### 5 Theory of Mind

- The Theory of Mind in AI aims to create machines that can understand thoughts, emotions, and memories—just like humans.
- **How it works:** AI would need to understand feelings and emotions that influence decisions. These machines would make choices by considering both reason and emotional context.
- **Current Status:** This is still theoretical, meaning it's an idea for the future, but it could become a reality soon.

# Module 1:

## Types of AI

### 6 Self-Awareness

- **What it is:** Self-awareness in AI means machines that have a human-level consciousness—they can understand their own existence and feelings.
- **How it works:** These machines would not only understand what someone says but also how they feel based on the way they communicate. They could learn and adapt their responses to the emotions of others.
- **Current Status:** Self-awareness in AI doesn't exist yet, but it might happen in the future.

# Module 1:

## Is AI the Same as Augmented Intelligence and Cognitive Computing?

### AI vs Augmented Intelligence:

- Some people think AI and augmented intelligence are the same, but they are different.
- Augmented intelligence is a type of weak AI that assists humans to improve tasks or decisions.
  - Example: Automatically highlighting important information in a report.
- True AI / Strong AI / AGI is future AI that aims to surpass human intelligence, capable of performing tasks that humans can do, like reasoning and decision-making.
- **AI in Machines:** AI makes machines simulate human intelligence by learning, sensing, processing, and reacting to information.
- **Cognitive Computing:** This refers to systems or products that mimic human thought processes to enhance decision-making.

# Module 1:

## Defining Intelligence

- **Linguistic Intelligence:**
  - The ability to speak and understand language (e.g., narrators, orators).
- **Musical Intelligence:**
  - The ability to create and understand music, like recognizing rhythm and pitch (e.g., musicians, singers).
- **Logical-Mathematical Intelligence:**
  - The ability to understand abstract concepts and use logic (e.g., mathematicians, scientists).
- **Spatial Intelligence:**
  - The ability to visualize and manipulate images in your mind (e.g., map readers, astronauts).
- **Bodily-Kinesthetic Intelligence:**
  - The ability to use your body to solve problems or manipulate objects (e.g., dancers, athletes).
- **Intrapersonal Intelligence:**
  - The ability to understand your own feelings and motivations (e.g., spiritual leaders, philosophers).
- **Interpersonal Intelligence:**
  - The ability to understand other people's feelings and intentions (e.g., mass communicators, interviewers).
- **Artificial Intelligence (AI):** A system or machine is said to be artificially intelligent if it can exhibit one or more of these types of intelligence.



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# Module 1:

## Components of Intelligence

- Reasoning
- Learning
- Problem solving
- Perception
- Linguistic intelligence

# Module 1:

## Components of Intelligence - 1. Reasoning

Reasoning is the process used to make decisions and predictions. It involves analyzing information and drawing conclusions based on evidence. There are two main types of reasoning:

- **1. Inductive Reasoning:**
  - What it is: Making generalizations based on specific observations or examples.
  - How it works: Starts with specific facts or observations and moves to a general conclusion.
  - Example: If you see 10 white swans, you might conclude that all swans are white.
- **2. Deductive Reasoning:**
  - What it is: Drawing a specific conclusion based on general principles or facts.
  - How it works: Starts with a general statement or premise, and moves to a specific conclusion.
  - Example: All swans are birds. A swan is a bird. Therefore, the swan is a bird.

# Module 1:

## Components of Intelligence - 2. Learning

Learning is the process of gaining knowledge or skills by studying, practicing, or experiencing something. It helps humans, animals, and even AI systems to improve their understanding of different subjects.

There are different types of learning:

1. Auditory Learning:
2. Episodic Learning:
3. Motor Learning:
4. Observational Learning:
5. Perceptual Learning:
6. Relational Learning:
7. Spatial Learning:
8. Stimulus-Response Learning:

# Module 1:

## Components of Intelligence - 2. Learning

There are different types of learning:

### 1. Auditory Learning:

- Learning by hearing and listening.
- Example: Listening to recorded lectures to understand a concept.

### 2. Episodic Learning:

- Learning by remembering events or experiences in a specific order.
- Example: Recalling what happened in a sequence, like remembering steps in a recipe.

### 3. Motor Learning:

- Learning through physical movement of muscles.
- Example: Learning how to pick up objects correctly.

### 4. Observational Learning:

- Learning by watching and imitating others.
- Example: Children learn by copying their parents' actions.

# Module 1:

## Components of Intelligence - 2. Learning

### 5. Perceptual Learning:

- Learning by recognizing things that have been seen before.
- Example: Identifying objects and situations based on prior experiences.

### 6. Relational Learning:

- Learning by recognizing patterns in relationships between things.
- Example: Adjusting the amount of spices in a dish after remembering how much was used last time.

### 7. Spatial Learning:

- Learning through visual stimuli like images, maps, and colors.
- Example: Creating a mental map of a route before actually driving.

### 8. Stimulus-Response Learning:

- Learning by reacting to a specific stimulus.
- Example: Shouting when touching a hot pan, because it causes pain.



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## Module 1:

### Components of Intelligence - 3. Problem Solving

Problem solving is the process of finding a solution to a challenge or issue. It involves:

- Identifying the problem: Understanding the situation and recognizing the obstacles (either known or unknown).
- Making decisions: Choosing the best approach or method to overcome the obstacles and reach the goal.

# Module 1:

## Components of Intelligence - 4. Perception

Perception is the process of:

- Acquiring information through the senses (like sight, hearing, etc.).
- Interpreting that information to understand what's happening around us.
- Selecting important details and organizing them to form a clear picture.
- Humans use sensory organs (like eyes, ears) to perceive the world.
- AI systems use sensors (like cameras, microphones) to gather data and understand their environment.

## Components of Intelligence - 5.Linguistic Intelligence

It is used in interpersonal communication and defines one's ability to use, comprehend, speak and write the verbal and written language



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# Module 1:

## Differences Between Human and Machine Intelligence

Aspect	Human Intelligence	Machine Intelligence
Perception	Perceives through patterns	Perceives by analyzing data with rules
Memory and Recall	Recalls information by patterns	Uses search algorithms to find information
Handling Missing Information	Can deduce missing or distorted information accurately	Struggles with incomplete data, less accurate

## Knowledge Representation

### Introduction

Artificial intelligence as technology has always fascinated human beings. Multiple science fiction novels and movies have demonstrated the use of AI-powered systems (like robots) that can think, act, understand complex information and make smart decisions based on it.

Although this all looks like a fantastic development, we agree that it is not easy to make machines that behave exactly like humans. This is because humans have conscience and this conscience develops gradually in us with our knowledge, experiences and memories.

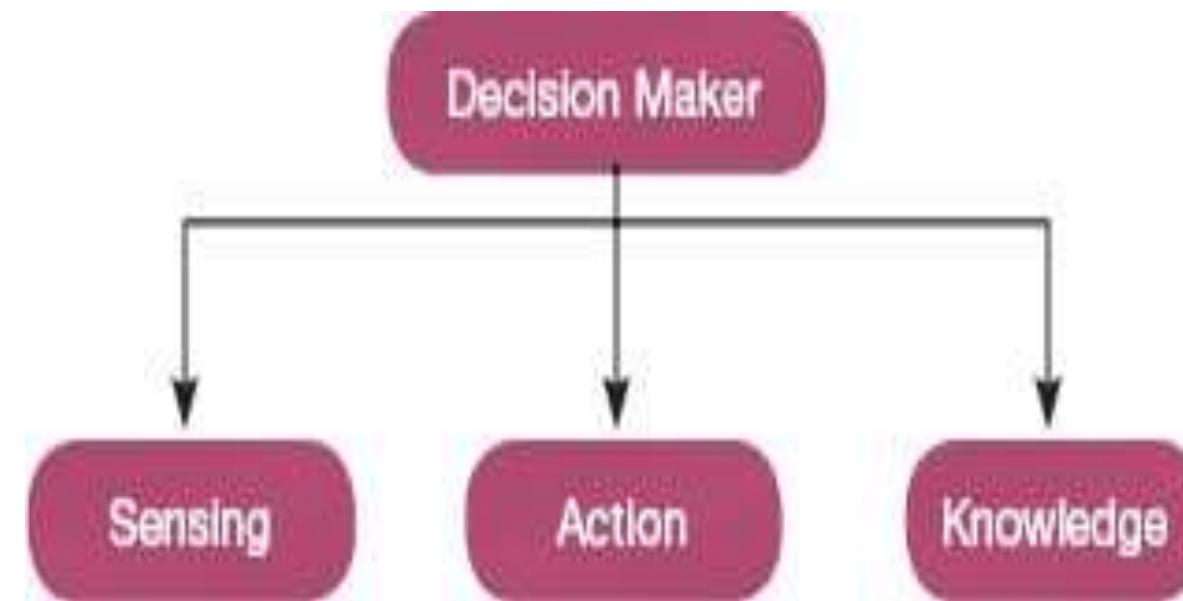
To build AI systems that have conscience, we need to inculcate knowledge in them. This chapter is, therefore, dedicated towards representing knowledge in machines.

# Module 1:

## Knowledge Representation

### Knowledge and Intelligence

Knowledge of real world plays a crucial role in intelligence and creating AI agents that demonstrate intelligent behaviour. Such an agent acts by sensing its environment and using knowledge to act intelligently. However, for this, the knowledge or experience about the input is mandatory. The relationship between knowledge and intelligence can be clearly understood from [Fig. 4.1](#). You can see that if we remove the knowledge component, then the decision maker will not be able to sense the environment accurately and take appropriate decisions



**FIGURE 4.1** Relationship between Knowledge and Intelligence

Humans are best at understanding, reasoning and interpreting things they know (knowledge). Humans use their knowledge to perform various actions in the real world. ***But how machines perform actions, comes under the domain of knowledge representation and reasoning.*** Knowledge representation and reasoning (KR, KRR) is a part of artificial intelligence which focuses on how AI agents think and how their thinking contributes to intelligent behaviour. A knowledge-based system represents information about the real world in such a way that a computer can easily understand and utilize this knowledge to solve complex real-world problems like diagnosing a medical condition or communicating with humans in natural language.

Knowledge representation represents knowledge available in the form of beliefs, intentions and judgments that an intelligent agent must possess for automated reasoning. One of the primary purposes of knowledge representation includes modelling intelligent behaviour for an agent.

Knowledge representation is not just storing data in a database. It goes beyond this aspect to facilitate an intelligent machine to learn from that knowledge and experiences so that it can behave intelligently like a human.

## What Knowledge Needs to be Represented?

Humans have intuition, intentions, prejudices, beliefs, judgments, common sense, etc. apart from knowledge about certain facts. We need to incorporate all this information in a machine-understandable format and make the AI system truly intelligent. For this, we need to represent the following knowledge in AI systems:

**Object:** Information and facts about all objects (relevant in context). For example, in a self-driving car, vehicles and roads are objects.

**Events:** Information and facts about actions which occur in the real world. For example, in a self-driving car, an event can be applying breaks when an object comes in front of it.

**Performance:** The manner in which actions are performed. It describes the behaviour related to how to do things.

**Meta-knowledge:** It is the knowledge about knowledge (what we know).

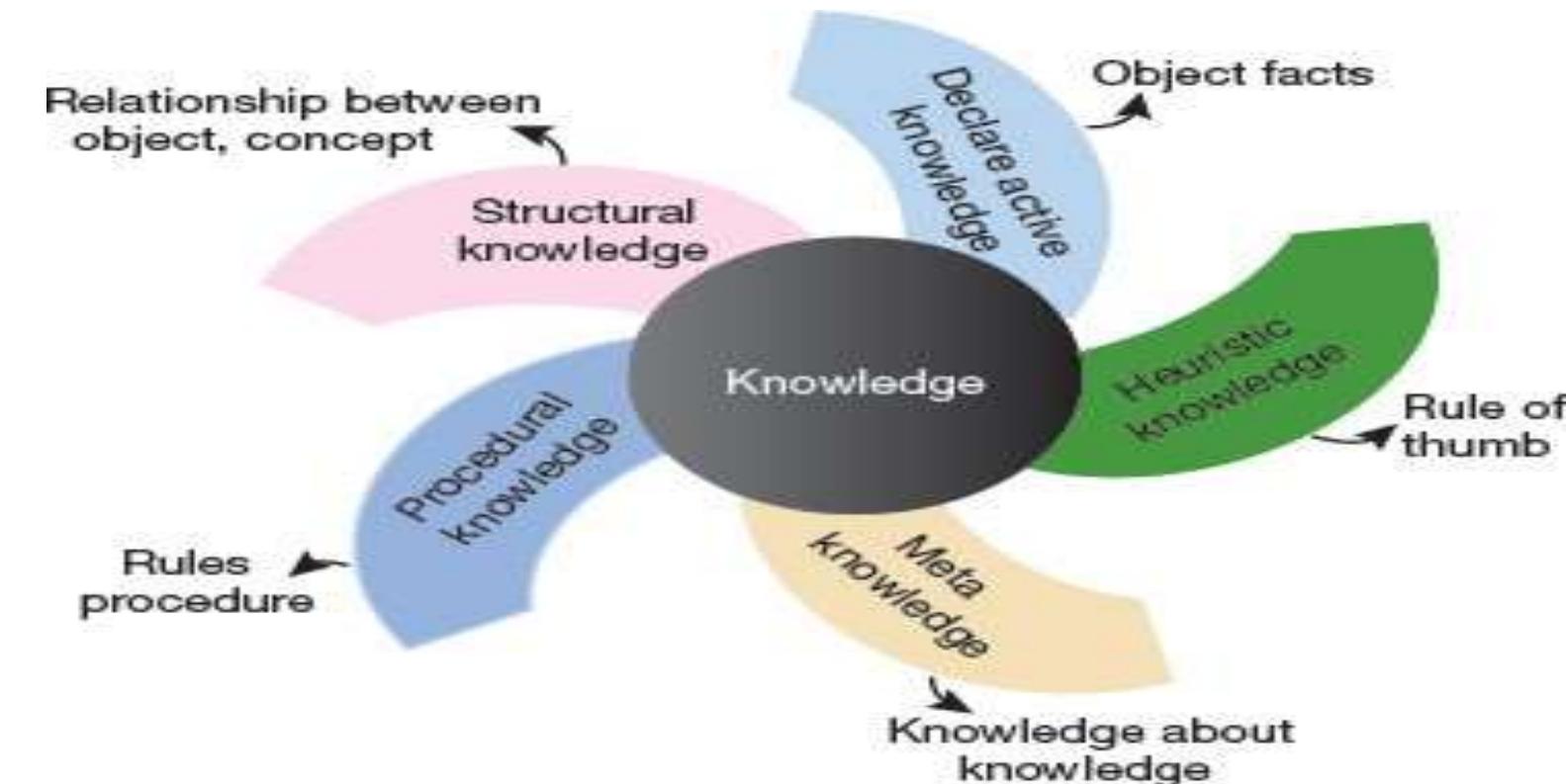
**Facts:** Facts are the truths about the real world that needs to be represented for an intelligent agent.

**Knowledge base:** It is the most important component of a knowledge-based agent that stores a group of sentences (technical sentences, not simple English language ones)

## What is Knowledge?

We know that knowledge is the basic element of our brain as it helps us to know and understand the things logically and is gained by experiences of facts, data and situations. A knowledgeable person performs all the actions in a better way. Everyone has five types of knowledge illustrated in [Fig. 4.2](#) and enumerated as follows.

1. **Meta knowledge** is the knowledge about knowledge.
2. **Heuristic knowledge** is the knowledge about a specific topic. For example, it can be knowledge of some experts in a filed or subject. Heuristic knowledge is treated as the rule of thumb as it is based on previous experiences and awareness of approaches, which are good to work but not guaranteed



**FIGURE 4.2** Types of knowledge

**3. Procedural knowledge**, also known as imperative knowledge, gives information about how to achieve or do something. This knowledge includes rules, strategies, procedures, agendas, etc. that can be directly applied to perform any task.

**4. Declarative knowledge** is the information that we have about an object. This knowledge helps us to describe a particular concept, fact, object and its attributes. Declarative knowledge is simpler than procedural language and is also called descriptive knowledge as it is usually represented using declarative sentences.

**5. Structural knowledge** is the basic knowledge to solve complex problems. It describes relationships between various concepts or objects such as kind of, part of, and grouping of something

## What is Logic?

Logic is the main component of any knowledge as it facilitates a person to draw conclusion by filtering required information from large volumes of sentences.

In AI, knowledge is represented using logic. Every logic has three main elements.

### Syntax

Every language has its own syntax to specify the sequence of constructs that makes a complete sentence in that language. It is therefore not wrong to say that syntax is the representation of a language.

### Semantics

Semantics is used to check if a syntactically correct sentence is logically correct and meaningful or not. Therefore, semantics defines the sense of the sentence which relates to the real world.

For example, consider the statement:

*Ram is riding a bike.*

This sentence is syntactically as well as semantically correct. However, the sentence, *Bike is riding Ram.* is syntactically correct but semantically incorrect

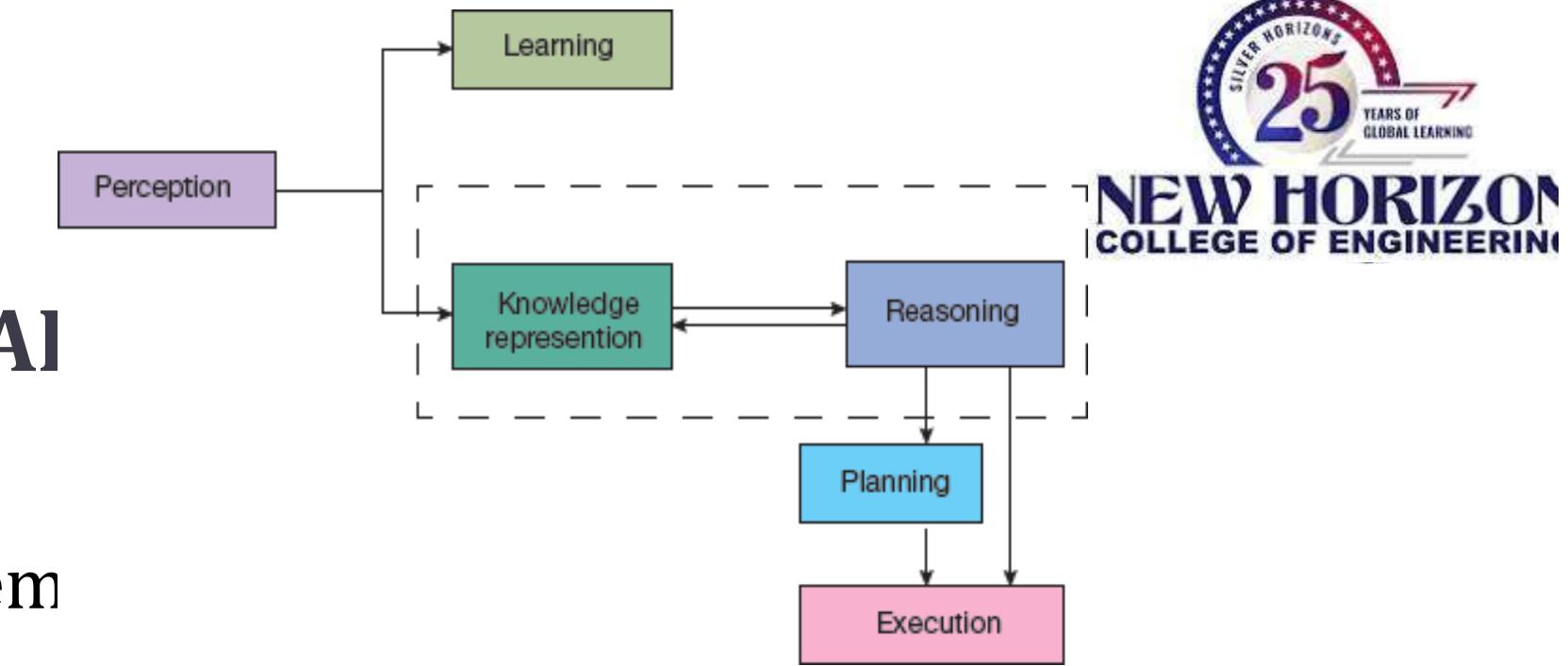
### Logical Inference

Inference means to deduce conclusions in the context of some fact or problem. Correspondingly, logical inference uses inference algorithms to think all the possible reasons that can give a proper result

# Module 1:

## Knowledge Representation

### Cycle of Knowledge Representation in AI



**FIGURE 4.3** Components of an AI system

An AI system has several components ([Fig. 4.3](#)) that helps it to exhibit an intelligent behaviour. These components include the following:

#### Perception

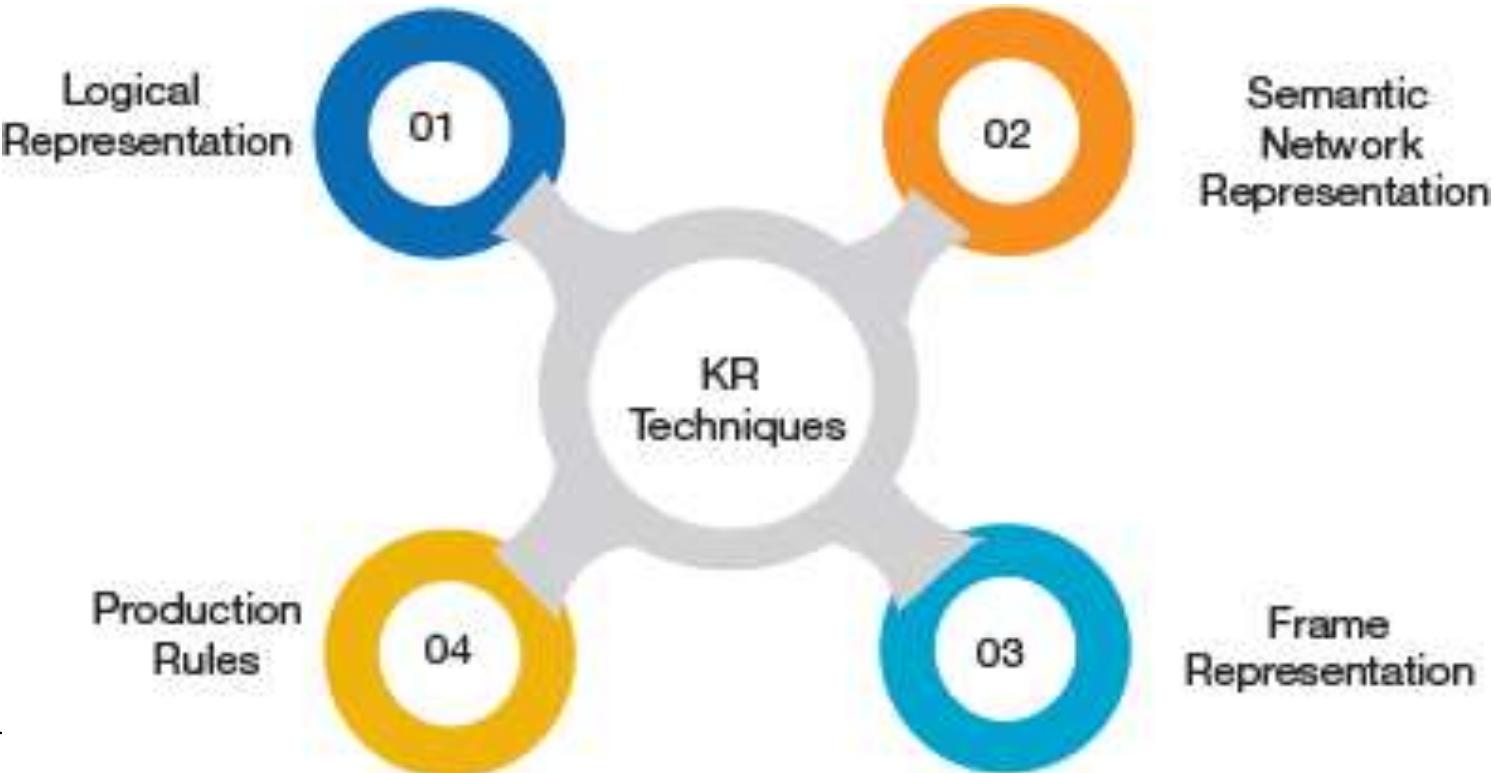
The perception component retrieves data from the environment, discovers the source(s) of noise, checks if the AI was damaged by anything and defines response to be given when any sense has been detected. Data from the environment is gathered using different types of sensors in the form of video, audio, text, time, temperature or any other sensor-based input.

#### Learning

The learning component learns from the data that is captured by the perception component. The aim here is to develop a system that can be taught instead of being programmed. With learning, the system focuses on self-improvement through knowledge acquisition, inference, acquisition of heuristics, faster searches, etc.

## Knowledge Representation and Reasoning

This is the main component which shows human-like intelligence in the machines. Knowledge representation techniques (refer [Fig. 4.4](#)) are designed to understand using a top-down approach focussing in detail, what an agent needs to know to behave intelligently. The KRR component also defines how automated reasoning procedures can make this knowledge available as needed



**FIGURE 4.4** Forms of Knowledge Representa

## Planning and Execution

This component analyses knowledge representation and reasoning. The planning component selects an initial state, enumerates preconditions and effects, and a sequence of actions to achieve the goal state. Once planning is done, actions are executed to get the desired results

## Knowledge Representation Requirements

A good knowledge representation system must have the following properties.

1. Representational accuracy, to ensure that the system represents all kinds of required knowledge.
2. Inferential adequacy to manipulate the representational structures to produce new knowledge corresponding to the existing structure.
3. Inferential efficiency to direct the inferential knowledge mechanism to generate appropriate results.
4. Acquisitional efficiency that helps the knowledge representation system to easily acquire new knowledge using automatic methods.

# Module 1: Introduction to Artificial Intelligence



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# Module 1: Introduction to Artificial Intelligence



## MODEL QUESTIONS

1. Define AI and give advantages and disadvantages of this technology.
2. How do AI systems work?
3. Differentiate between Weak AI and strong AI
4. Differentiate between Reactive machines and limited memory AI systems
5. Differentiate between Augmented and artificial intelligence
6. How will you categorize AI systems based on their functionality?
7. Briefly discuss the History of AI
8. Define the types of intelligence
9. Explain the components of intelligence
10. Differentiate between human and Machine Intelligence
11. Discuss the relationship between knowledge and intelligence
12. Discuss the knowledge to be represented in AI systems
13. Explain the types of Knowledge
14. Explain the cycle of knowledge representation in AI and the requirements

Thank You

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Module 1 - Completed



# INTRODUCTION TO AI AND APPLICATIONS

## Module 2

# Outline

## Module2:Introduction to Prompt Engineering

### 1. Introduction to Prompt Engineering

- 1. Overview of Prompt Engineering
- 2. The Evolution of Prompt Engineering
- 3. Types of Prompts
- 4. How Does Prompt Engineering Work?
- 5. The Role of Prompt Engineering in Communication
- 6. The Advantages of Prompt Engineering
- 7. The Future of Large Language Model (LLM)

Communication

### 2. Prompts for Creative Thinking

- Introduction to Creative Thinking with Prompts
- Unlocking Imagination and Innovation

### 3. Prompts for Effective Writing

- Introduction to Writing with Prompts
- Igniting the Writing Process with Prompts

# Outline

## Module2:Introduction to Prompt Engineering

### 1. Introduction to Prompt Engineering

1. Overview of Prompt Engineering
2. The Evolution of Prompt Engineering
3. Types of Prompts
4. How Does Prompt Engineering Work?
5. The Role of Prompt Engineering in Communication
6. The Advantages of Prompt Engineering
7. The Future of Large Language Model (LLM) Communication

# Module 2: Introduction to Prompt Engineering

## What is AI?

- AI is the broad field of making machines think and act like humans.
- Teach computers to learn, reason, and make decisions. Everyday
- Examples:
  - Google Maps → Finds the fastest route.
  - Netflix → Recommends movies based on your past choices.
  - ATM Machines → Detects fraud automatically.
  - Key Point: AI is the umbrella term. Everything else, including LLMs and GenAI, comes under AI.

# Module 2: Introduction to Prompt Engineering

## LLM (Large Language Model)

- LLMs are a type of AI model designed to understand, process, and generate human-like language. How It
- Works: Trained on huge amounts of text (books, articles, websites) so it learns patterns of language.
- Examples:
  - ChatGPT → Answers questions like a human.
  - Google Gemini / Bard → Summarizes long documents.
  - Simple Analogy:
    - Think of an LLM like a very smart English dictionary + storyteller.
    - If you ask, “Explain photosynthesis,” it writes an answer as if a teacher explained it.

# Module 2: Introduction to Prompt Engineering

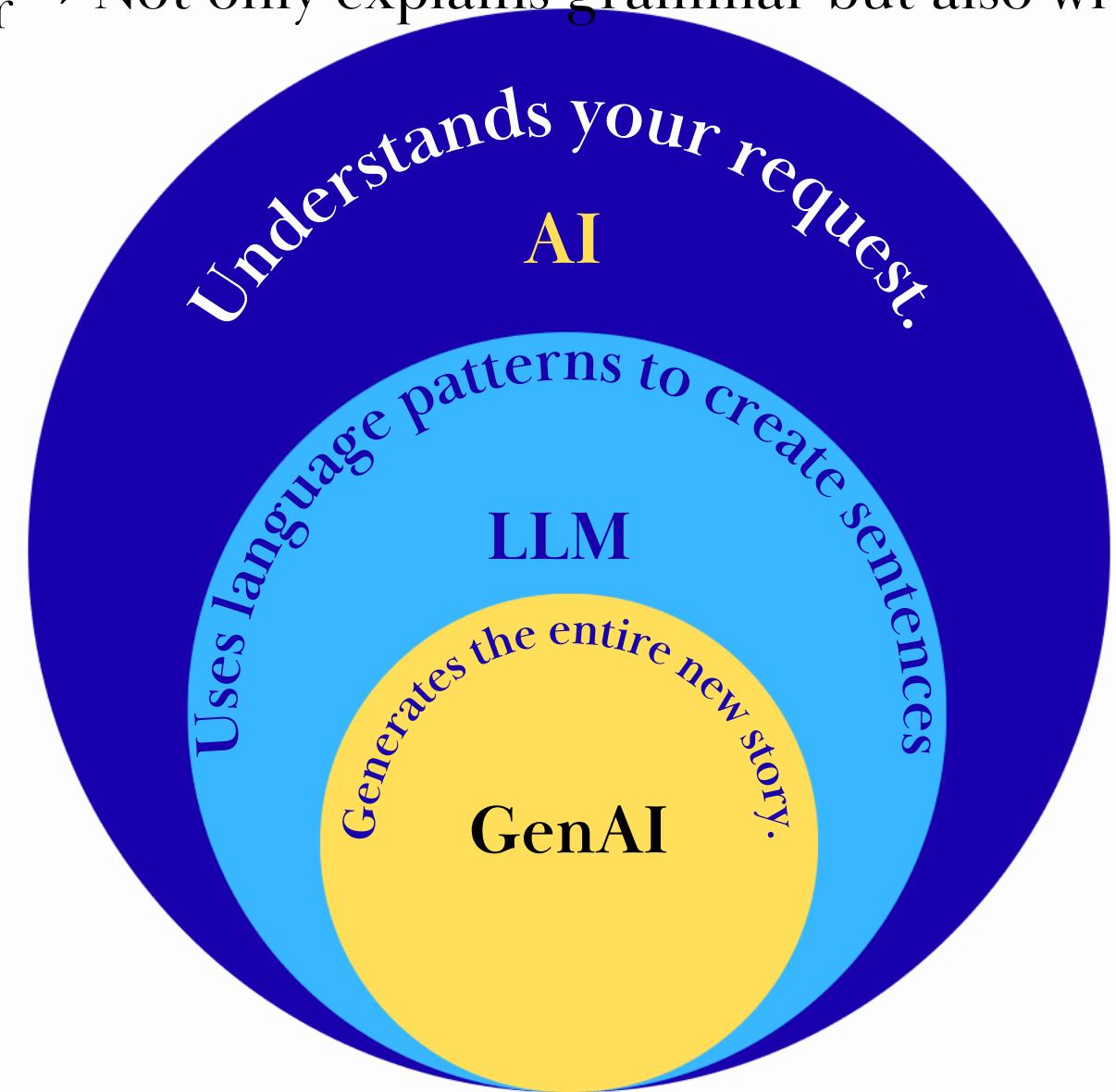
## GenAI (Generative AI)

- A special branch of AI that can create new content like text, images, audio, or video. How It Works:
- Uses models like LLMs to generate something new based on patterns it has learned.
- Examples:
  - Text → ChatGPT writes essays or poems.
  - Images → DALL·E or MidJourney creates paintings from descriptions.
  - Music → AI composes songs.
  - Simple Analogy:
    - If AI is the brain, and LLM is the language expert,
    - GenAI is the artist that creates new things.

# Module 2: Introduction to Prompt Engineering

## GenAI (Generative AI)

- Imagine you're in a classroom:
- AI = The entire school → Many teachers for different subjects.
- LLM = The English teacher → Specializes in understanding and writing language.
- GenAI = A creative writing teacher → Not only explains grammar but also writes poems, stories, and essays for you.



# Module 2: Introduction to Prompt Engineering

## 1. Overview of Prompt Engineering

- A prompt is simply the input instruction you give to an AI model. It can be a question, command, or example that guides the model to produce the desired response.
- **Key idea:** The better and clearer the prompt, the better the output.

### Why is a Prompt Required?

- **Guides the AI:** A prompt helps the AI understand the context and generate a relevant response.
- **Directs the Output:** The quality of the AI's response depends on how well the prompt is crafted. A good prompt leads to better, more accurate results.
- **Contextual Clarity:** It ensures the model responds to a specific task, reducing ambiguity in what is expected.

### Example of a Good Prompt:

- **Good Prompt:**
- "*Write a short story about a dragon and a knight who become friends.*"
- This prompt is clear, specific, and gives the model a clear task, so it can generate a relevant story.

### Example of a Wrong Prompt:

- **Wrong Prompt:**
- "*Tell me about dragons.*"
- This prompt is too vague, and the AI might give a general response about dragons without focusing on the specific task of creating a story or narrative.

Think of an LLM as a knowledgeable chef.

- If you say: "Make food" → The chef is confused.
- If you say: "Make a vegetarian pasta with mushrooms, spinach, and cheese" → The chef gives you exactly what you want.

# Module 2: Introduction to Prompt Engineering

## 1. Overview of Prompt Engineering

### Why Are Prompts Important?

- **Guides the AI:** Prompts tell the AI what you want it to do. Without a clear prompt, the AI might give you something completely unrelated.
- **Helps Generate Accurate Results:** The more specific and detailed your prompt is, the more accurate and useful the AI's output will be.

### How is Prompt Engineering Useful?

- **Optimizing Output:** By crafting better prompts (known as prompt engineering), we can improve the quality of the AI's responses.
- **Control the AI:** You can direct the AI to write stories, summarize text, generate images, and more, based on how well you ask for it.

### Simple Example:

- **Bad Prompt:** "Tell me about cats." - (Because the prompt is: 1. Too Vague, 2. Lack of Focus & 3. Can Lead to an Unfocused Answer)
- **Good Prompt:** "Write a fun short story about a cat who travels to the moon."

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## 1. Overview of Prompt Engineering

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### How is Prompt Engineering Useful?

- **Optimizing Output:** By crafting better prompts (known as prompt engineering), we can improve the quality of the AI's responses.
- **Control the AI:** You can direct the AI to write stories, summarize text, generate images, and more, based on how well you ask for it.

### Simple Example:

- **Bad Prompt:** "Tell me about cats." - (Because the prompt is: 1. Too Vague, 2. Lack of Focus & 3. Can Lead to an Unfocused Answer)
- **Good Prompt:** "Write a fun short story about a cat who travels to the moon."

# Module 2: Introduction to Prompt Engineering

## Instructions Prompt Technique

The Instructions Prompt Technique involves providing specific guidelines to guide the AI model's output. This helps ensure that the generated text aligns with the desired objectives and meets the task's requirements.

- This technique ensures that AI responses are focused and appropriate for the task at hand by giving clear instructions.

### Examples:

- Customer Service:

- **Instruction:** "Responses should be professional and provide accurate information."
- **Result:** The AI will generate responses that are formal and factually correct.
- **Example Prompt:** User Query: "How can I reset my password?"

- Legal Document:

- **Instruction:** "The document should comply with relevant laws and regulations."
- **Result:** Ensures the document follows legal standards. **Example Prompt:** User Query: "Please create a non-disclosure agreement."

- Product Review:

- **Instruction:** "The review should be unbiased and informative."
- Combined with role prompting (tech expert) and seed-word prompting (smartphone features), it generates a detailed and balanced review.
- **Example Prompt:** User Query: "Write a product review for the new smartphone."

### Combining Techniques:

- Instructions can be paired with other techniques (like role prompting or seed-word prompting) to increase the precision and control of the model's output.

# Module 2: Introduction to Prompt Engineering

## 2 The Evolution of Prompt Engineering

Year	Milestone	Description
1966	ELIZA	Developed by Joseph Weizenbaum, ELIZA was a chatbot that used simple pattern-matching to simulate a conversation, marking the beginning of prompt-based interaction.
1970s	SHRDLU	Created by Terry Winograd, SHRDLU was a natural language processing system capable of interpreting commands and reasoning about a virtual environment.
1990s	Mad Hatter Dialogue Systems	Systems like Jabberwacky and ALICE used humor and open-ended conversations, pushing the boundaries of natural language interaction.



# Module 2: Introduction to Prompt Engineering

## 2 The Evolution of Prompt Engineering

Year	Milestone	Description
2000s	Template-based Approaches	Models like Madalyn and Galatea used user input to fill predefined templates, setting the foundation for structured prompt engineering.
2017	The Transformer Revolution	The introduction of the Transformer architecture sparked a revolution in NLP, leading to models like GPT-3 and Jurassic-1 Jumbo, which brought prominence to prompt engineering.
2020s	Adjusting and Refining LLMs	Refinement and fine-tuning of large language models for specific tasks, using techniques like few-shot learning and conditional generation for precise control.



# Module 2: Introduction to Prompt Engineering

## Types of Prompts

1

### Natural Language Prompts

These prompts are written in natural human language, making them more intuitive for developers to interact with the model. The goal is to provide instructions that mimic human speech, making the communication more natural.

**Prompt:** "Can you explain how photosynthesis works?"

**Output:** "Photosynthesis is the process by which plants convert light energy into chemical energy stored in glucose."

Prompt

2

### System Prompts

System prompts are pre-written instructions or templates that guide the AI model on how to respond. These prompts can direct the format, style, or tone of the output, providing a clear framework for the model to follow.

**Prompt:** "Write a formal email explaining the delay in project delivery."

**Output:** "Subject: Project Delivery Delay Dear [Recipient], I regret to inform you that due to

3

### Conditional Prompts

Conditional prompts involve setting specific conditions or limitations that direct the model's behavior based on certain criteria. These conditions can be framed as logical statements, like "If X, then Y", guiding the model on what to produce in different scenarios.

**Prompt:** "If the user asks about weather, provide a weather update. If the user asks about sports, provide the latest sports news."

**Input:** "What's the weather like today?"

**Output:** "The weather today is sunny with a high of 25°C."

## Module 2: Introduction to Prompt Engineering

### 4. How Does Prompt Engineering Work?

Prompt engineering is a systematic process that involves crafting effective instructions for Large Language Models (LLMs) to get the best output. The process is iterative, meaning you might need to refine your prompts multiple times to achieve the desired results.

#### Steps for Effective Prompt Engineering

##### Step 1: Understand the Task Thoroughly

- Goal: Know exactly what you want the LLM to do before crafting the prompt.
- Questions to ask yourself:
  - What outcome am I expecting?
  - What kind of answer am I looking for (e.g., creative, factual, instructional)?
- Example:
  - If you want a poem, understand if you need it to be creative or educational. If you need the model to generate a formal email, the prompt needs to be task-specific.

## Module 2: Introduction to Prompt Engineering

### 4. How Does Prompt Engineering Work?

#### Step 2: Use Precise and Simple Language

- Goal: Make sure the LLM understands your prompt clearly.
- Tip: Avoid using technical jargon or overly complex terms. Your language should be direct and simple.

#### Example:

- Vague Prompt: "Create a response to the user's inquiry."
  - Precise Prompt: "Write a formal email apologizing for a delayed response."
- The second prompt gives clear, understandable directions, leaving no room for confusion.

## Module 2: Introduction to Prompt Engineering

### 4. How Does Prompt Engineering Work?

#### Step 3: Add Specific Details

- Goal: The more detailed the prompt, the better the response.
- Tip: Provide enough context or constraints to guide the model effectively. Specificity helps the model understand your exact requirements.

#### Example:

- General Prompt: "Write a poem."
- Specific Prompt: "Write a poem about the joy of summer, with imagery of the beach and sunshine."

The second prompt gives the LLM more to work with, increasing the chance of generating a relevant poem.

# Module 2: Introduction to Prompt Engineering

## 4. How Does Prompt Engineering Work?

### Step 4: Provide Examples

- Goal: Help the LLM understand the type of output you're expecting.
- Tip: If possible, provide a sample output that demonstrates the desired style or format. This helps the model align its output with your expectations.

#### Example:

- **Prompt:** "Write a summary of the following article in bullet points."
- **Example Output:**
  - "Article Summary:
    - Discusses the impact of climate change.
    - Explores renewable energy solutions."

Providing an example shows the model exactly how you want the summary to look.

## Module 2: Introduction to Prompt Engineering

### 4. How Does Prompt Engineering Work?

#### Step 5: Experiment and Refine

- Goal: Prompt engineering isn't perfect from the first try.
- Tip: Test different prompts to find the one that works best. Experimentation and iteration are key to discovering the most effective approach.

#### Example:

- If you're not getting the right answer, try rephrasing the prompt or adding more context to see if the response improves.

# Module 2: Introduction to Prompt Engineering

## 4. How Does Prompt Engineering Work?

Step	Explanation	Example
1. Understand the Task	Be clear about your expectations and goals.	"Write an apology email for a delayed response."
2. Use Precise Language	Avoid jargon, keep it simple, and be clear.	"Write a formal letter" vs. "Create a letter to apologize."
3. Add Specific Details	Include enough context or constraints for better results.	"Write a poem about summer with imagery of the beach and sunshine."
4. Provide Examples	Show the LLM the type of output you're expecting.	"Write a summary of this article in bullet points like this: ..."
5. Experiment and Refine	Keep refining your prompts by experimenting with different versions.	Adjusting wording or adding extra context to improve model output.



## Module 2: Introduction to Prompt Engineering

### 5. The Role of Prompt Engineering in Communication

Function	Explanation	Example
Improving Specificity & Clarity	Clear, precise prompts ensure unambiguous communication.	"Write an email apologizing for the delay in the meeting and offer a rescheduled time."
Increasing Creativity & Engagement	Prompts spark creativity, generating engaging and thought-provoking outputs.	"Write a short story about a young artist who discovers a magical paintbrush."
Adapting Communication Styles	Prompts adjust the tone to match different contexts (formal, casual, persuasive).	"Write a formal email requesting a meeting."
Overcoming Linguistic Barriers	Prompts help LLMs translate languages with accuracy and cultural sensitivity.	"Translate into Spanish: 'Could you please provide me with the details by tomorrow?'"
Ethical Issues	Ethical prompt design ensures fairness, inclusivity, and prevents manipulation or bias.	Avoiding prompts that generate biased, harmful, or discriminatory content.



## Module 2: Introduction to Prompt Engineering

### 6. The Advantages of Prompt Engineering

Task	Benefit	Example
Question Answering	Increases accuracy in providing factual responses.	"What is the capital of France?" → "Paris"
Creative Writing	Enhances creativity and produces engaging, imaginative content.	"Write a poem about a sunset" → Creative poem generation.
Machine Translation	Improves precision and ensures context-aware translations.	"Translate 'Hello' to French" → "Bonjour"
Coding	Helps in generating accurate and effective code.	"Write a Python function for factorial" → Generates correct Python code.

## Module 2: Introduction to Prompt Engineering

### 7. The Future of Large Language Model (LLM) Communication

- As LLM technology progresses, prompt engineering will continue to evolve, shaping the way we interact with AI models.
- Ongoing research into adaptive prompts and AI behavior control will make communication with LLMs more sophisticated and contextually aware than ever before.
- The future holds exciting possibilities for AI-powered communication, improving everything from language translation to creative collaboration.



## Module 2: Introduction to Prompt Engineering

### 7. The Future of Large Language Model (LLM) Communication

Trend	Description	Example
AI-Powered Negotiation Tools	AI assists in real-time negotiations, providing balanced solutions for win-win agreements.	AI suggesting compromises during a business meeting to ensure a fair deal.
Real-Time Language Translation	LLMs translating languages with understanding of cultural nuances and context.	Seamless cross-lingual communication in a global business meeting.
Customized News Updates	Personalized news feeds tailored to individual interests and preferences.	A personalized news feed focusing on environmental and technological topics.
Automated Prompt Generation	AI systems that generate optimized prompts for tasks.	Automated generation of prompts based on task descriptions.
Adaptive Prompts	Prompts adjust dynamically based on user interactions, improving personalization over time.	An AI assistant adapting its suggestions based on past interactions.
Subtle Cues for Complex Tasks	AI that responds to subtle cues, managing multi-step tasks intuitively.	AI handling multi-step creative projects with minimal input.

# Module 2: Prompts for Creative Thinking

## 1. Introduction

- In today's world, creativity is essential for innovation and problem-solving across various fields.
- Prompts act as tools to ignite imagination, spark new ideas, and help overcome mental blocks.
- **Types of Prompts:**
  - Open-ended questions challenge conventional thinking.
  - Playful prompts encourage unconventional associations.
- **Benefits of Prompts:**
  - Help expand imagination and discover new possibilities.
  - Guide you to connect unrelated ideas and embrace curiosity.
- **Practical Strategies:** The chapter offers practical exercises that encourage exploration and creative thinking.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

#### Key Principles for Fostering Innovation:

1. Encourage Brainstorming: Regular sessions to generate and discuss new ideas.
2. Embrace Failure: View failure as a learning opportunity, not a setback.
3. Foster Curiosity and Experimentation: Promote a culture where exploration is encouraged.
4. Cross-disciplinary Collaboration: Bring together diverse teams with different skill sets and perspectives.
5. Diversity and Inclusion: Ensure diverse voices and viewpoints are included in the innovation process.
6. Continuous Learning and Adaptation: Stay updated with emerging trends and technologies to stay relevant.
7. Clear Goal-Setting and Autonomy: Provide employees with freedom and recognition to pursue creative ideas.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

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## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

**Top 10 Prompts for Unlocking Imagination and Innovation:**

#### 1. How can unlocking creativity lead to breakthrough innovations?

- This prompt encourages you to explore how fostering creative thinking can lead to significant advancements and innovations in your field or industry.
- Usefulness: It helps organizations understand that creativity is essential for achieving major breakthroughs.

#### 2. The impact of a creative mindset on problem-solving and innovation.

- This prompt examines how a creative mindset helps overcome challenges and leads to new solutions.
- Usefulness: It highlights that the way we approach problems affects the quality and novelty of solutions.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

**Top 10 Prompts for Unlocking Imagination and Innovation:**

#### 3. Strategies for cultivating a culture of innovation through imagination.

- This prompt focuses on methods for creating a work environment where creativity and imagination are at the forefront of the organization's values.
- Usefulness: It provides strategies to build a culture of innovation that encourages new ideas to flourish.

#### 4. The role of play and experimentation in stimulating imagination for innovation.

- This prompt stresses the importance of play and experimentation in generating new ideas and innovative thinking.
- Usefulness: It emphasizes that taking risks and testing new concepts can stimulate creativity and lead to innovation.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

#### Top 10 Prompts for Unlocking Imagination and Innovation:

##### 5. Inspiring a sense of wonder to fuel creative thinking in the workplace.

- This prompt suggests ways to bring a sense of curiosity and awe to the workplace to inspire creative exploration.
- Usefulness: It encourages leaders to cultivate an environment where wonder and curiosity drive creative thinking.

##### 6. Can education systems enhance or inhibit imagination and innovation?

- This prompt invites discussion on whether traditional education systems foster or limit creative thinking and innovation.
- Usefulness: It can lead to conversations about how education impacts creativity and innovation in the real world.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

#### Top 10 Prompts for Unlocking Imagination and Innovation:

##### 7. How embracing failure can foster a culture of innovation through imagination.

- This prompt explores how learning from failure and treating it as an opportunity can enhance innovation and encourage creativity.
- Usefulness: It helps organizations understand that failure is not something to avoid, but a learning experience that fosters innovation.

##### 8. Integrating technology to amplify creative thinking and innovation.

- This prompt looks at how technology can enhance and support creative processes and innovation.
- Usefulness: It guides organizations to leverage new technologies that can facilitate idea generation and problem-solving.

## Module 2: Prompts for Creative Thinking

### 2. Unlocking Imagination and Innovation

#### Top 10 Prompts for Unlocking Imagination and Innovation:

##### 9. The importance of interdisciplinary collaboration in unlocking innovation.

- This prompt highlights the value of bringing together people from different disciplines to create innovative solutions.
- Usefulness: It encourages collaboration between teams with diverse backgrounds, leading to new perspectives and ideas.

##### 10. The role of leadership in fostering a culture of imagination and innovation.

- This prompt explores how leaders can play a vital role in encouraging creativity and establishing an innovative culture.
- Usefulness: It shows that leadership plays a crucial role in creating an environment where innovation thrives

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# Module 2: Prompts for Effective Writing

## Introduction

- A prompt for effective writing is a specific instruction, question, or idea that helps guide the writer in generating creative, focused, and coherent content.
- Prompts can serve as a starting point when you're unsure how to begin writing or need inspiration.
- They encourage you to explore different writing styles, overcome writer's block, and tackle a wide range of topics.
- **Types of Writing Prompts:**
  - **Creative Writing Prompts:** These prompts encourage imagination and creativity. They're perfect for writers working on fiction, poetry, or storytelling.
  - **Descriptive Writing Prompts:** These focus on developing skills to describe people, places, or objects in detail.
  - **Problem-Solving Writing Prompts:** These help you tackle challenges or work through critical thinking in your writing.
  - **Reflective Writing Prompts:** These encourage you to explore your thoughts, experiences, and feelings.
  - **Persuasive Writing Prompts:** These help you practice convincing readers of your viewpoint on a particular issue.

## Module 2: Prompts for Effective Writing

### Igniting the Writing Process with Prompts

"Igniting the Writing Process with Prompts" is a helpful guide designed to kickstart your writing journey. It provides creative prompts and practical strategies to help writers of all levels overcome obstacles like writer's block and improve their writing skills.

#### 1. Encourages Creativity

- Prompts inspire new ideas and spark imagination for writing. They give you a starting point when you don't know where to begin.
- Example:
  - Prompt: "Write about a character who discovers a hidden door in their house."
  - This prompt gets you thinking about mystery and adventure, helping you start a story even when you're stuck.

## Module 2: Prompts for Effective Writing

### Igniting the Writing Process with Prompts

#### 2. Overcomes Writer's Block

- If you're struggling to write, prompts help you break through writer's block by giving you a clear direction for your writing.
- Example:
  - Prompt: "Describe a place where you feel most at peace."
  - This prompt helps you focus on writing a peaceful scene, even if you feel stuck with ideas.

# Module 2: Prompts for Effective Writing

## Igniting the Writing Process with Prompts

### 3. Refines Storytelling Skills

- Prompts help you develop storytelling skills by encouraging you to think about different characters, settings, and conflicts.
- Example:
  - Prompt: "Write a dialogue between two people who have just met for the first time."
  - This prompt helps you focus on creating characters and conversation, improving your dialogue-writing skills.

# Module 2: Prompts for Effective Writing

## Igniting the Writing Process with Prompts

### 4. Enhances Expression

- Prompts encourage you to express yourself in new ways, whether you're writing fiction, essays, or poetry.
- Example:
  - **Prompt:** "Write a poem about a rainy day."
  - This prompt helps you explore descriptive language and develop your creative expression.

## Module 2: Prompts for Effective Writing

### Igniting the Writing Process with Prompts

#### 5. Provides Clear Pathways for Writing

- Prompts act as guides that lead you through the writing process, making it easier to organize thoughts and ideas.
- Example:
  - Prompt: "Write an essay arguing why online education is the future."
  - This helps you structure your thoughts, guiding you to create a clear argument for the essay.

# Module 2: Prompts for Effective Writing

## Igniting the Writing Process with Prompts

### 6. Builds Confidence

- By using prompts, writers gain confidence because they know exactly where to start and can practice regularly.
- Example:
  - **Prompt:** "Write a letter to your future self."
  - Writing something personal like this can make you feel more comfortable with expressing your thoughts and ideas.

### Why These Prompts Are Helpful:

- Stimulate Creativity: Help you think of new ideas and ways to approach writing.
- Improve Writing: Develop better storytelling, descriptive writing, and expression.
- Build Confidence: Encourage regular practice and creativity, making writing feel easier.

## MODEL QUESTIONS

1. Illustrate the LLM. Describe it's working
2. Illustrate the Gen AI. Describe the relation between AI, LLM and Gen AI
3. Explain why are the prompts important and how is prompt engineering important
4. Discuss briefly the evolution of Prompt Engineering
5. Illustrate the types of prompts
6. Describe the different steps for effective prompt engineering
7. Explain the role of prompt engineering in communication
8. Discuss the advantages of Prompt Engineering
9. Describe the future of LLM communication
10. Illustrate the key principles of fostering Innovation
11. Discuss the top 10 prompts for unlocking imagination and innovation
12. Discuss the Types of writing prompts
13. Explain how writing process is ignited with prompts

Thank You Module 2 -  

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Completed

# INTRODUCTION TO AI AND APPLICATIONS

## Module 3

# Module 3: Prompt Engineering Techniques for ChatGPT

## 1. Introduction to Prompt Engineering Techniques

- Prompt engineering involves crafting specific instructions (prompts) to guide how an AI model generates responses.
- By providing clear and structured prompts, developers can direct the AI's output to be relevant, accurate, and high-quality for a wide range of tasks.
- Goal:
  - The main goal of prompt engineering is to shape the model's behavior, ensuring that the responses meet the desired standards and objectives for a given task
- Key Techniques in Prompt Engineering
  - Standard Prompts: Simple prompts that directly ask the AI to perform a specific task.
  - Role Prompting: The model is given a specific role to play, influencing the tone, style, or behavior of the response.
  - Seed-Word Prompting: The prompt provides a seed word or phrase that the model should build upon, guiding its response based on that initial cue.
  - Conditional Prompting: Conditions or limitations are set for the model, such as "If this, then that".

# Module 3: Prompt Engineering Techniques for ChatGPT

## 1. Introduction to Prompt Engineering Techniques

- Why is Prompt Engineering Important?
  - Relevance: Well-crafted prompts ensure the model produces relevant responses, making them more aligned with the task's objectives.
  - Accuracy: Prompt engineering helps the model generate responses that are factually correct and appropriate for the given context.
  - Versatility: Different types of prompts can be used to adapt the models output to fit a wide variety of tasks, from casual conversations to formal reports.
- The Future of Prompt Engineering
  - As AI continues to advance, prompt engineering will become increasingly important for optimizing language models. Future developments may involve:
    - Automated prompt generation to streamline the process.
    - Dynamic prompts that adjust based on user interactions or context.
    - Contextual awareness in prompts, allowing the AI to respond more naturally and flexibly.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 2. Instructions Prompt Technique

- The Instructions Prompt Technique is a method used to guide the output of natural language processing models like ChatGPT by providing specific instructions that the model must follow. This ensures the generated text aligns with the desired objectives and requirements of the task.
- **Purpose:** Directs the model to produce outputs based on specific guidelines or criteria.
- **Customization:** Allows for tailoring the model's response to meet particular goals, such as professionalism, accuracy, or legal compliance.
- **How It Works:**
  - **Step 1:** Provide clear instructions to the model. These instructions specify how the model should approach the task or the style of the output.
  - **Step 2:** The model follows these instructions to generate responses that meet the set criteria.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 3.Zero,One, and Few Shot Prompting

- Zero, One, and Few Shot Prompting are techniques in prompt engineering that help guide AI models, like ChatGPT, to generate responses based on different amounts of context or examples. These techniques are useful when you want the model to produce responses with limited information.
  - a.Zero Shot Prompting
  - b.One Shot Prompting
  - c.Few Shot Prompting

# Module 3: Prompt Engineering Techniques for ChatGPT

## 3. Zero, One, and Few Shot Prompting

### 1. Zero Shot Prompting

- The model generates a response without any examples or context. You simply give a prompt or instruction, and the model uses its pre-existing knowledge to generate an answer.
- Example:
  - Prompt: "Write a poem about nature." Output: A poem generated by the model based on its general knowledge.
- When to Use:
  - When you want the model to think creatively without any specific examples. Useful for open-ended tasks or when you want to explore the models generalization abilities.
- Limitation:
  - Sometimes results may be less accurate or relevant without context.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 3. Zero, One, and Few Shot Prompting

### 2. One Shot Prompting

- **What It Is:**
- The model generates a response based on one example you provide. This single example helps guide the model in understanding the context or task.
- **Example:**
  - **Prompt:** "Summarize the following paragraph: 'The sun rises in the east and sets in the west.'"
  - **Output:** "The sun moves across the sky from east to west."
- **When to Use:**
  - When you have one clear example but still need the model to generate a response with some level of accuracy.
- **Limitation:**
  - If the task is complex, one example might not be enough, and you may need more examples.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 3. Zero, One, and Few Shot Prompting

### 3. Few Shot Prompting

- The model generates a response based on a few examples you provide. This gives the model more context and helps it generate more accurate and relevant responses.
- Example:
  - Prompt: "Write a product review based on these features:
    - Battery life: 10 hours
    - Camera: 12 MP
    - Screen: .5 inches"
  - Output: A detailed product review based on the provided features.
- When to Use:
  - When you need more context or examples to help the model generate precise and relevant responses.
- Limitation:
  - You need to ensure that the examples are relevant and complete to get the best results.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 3. Zero, One, and Few Shot Prompting

Technique	Description	Example
<b>Zero Shot Prompting</b>	The model generates a response without any example or context.	"Write a poem about nature."
<b>One Shot Prompting</b>	The model uses one example to understand the task and generate a response.	"Summarize this sentence: 'The sun rises in the east.'"
<b>Few Shot Prompting</b>	The model uses a few examples to generate a more accurate and relevant response.	"Write a product review based on these features..."

# Module 3: Prompt Engineering Techniques for ChatGPT

## 4Self-ConsistencyPrompt

- The Self-Consistency Prompt is a sophisticated technique used in prompt engineering to ensure that the generated text remains coherent and logically consistent with the information provided.
- This technique is particularly useful when you want the AI model, such as ChatGPT, to adhere to specific facts, opinions, or constraints throughout a conversation or task.
- **How It Works:**
  - The main aim of the Self-Consistency Prompt is to maintain coherence and logical consistency in the model's responses.
- **Process:**
  - You provide the model with a prompt that contains key information or facts that the model must remain consistent with during the interaction. This could include background knowledge, established facts, or constraints that the model should adhere to while generating text.



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# Module 3: Prompt Engineering Techniques for ChatGPT

## 4Self-ConsistencyPrompt

### Key Features of Self-Consistency Prompts:

- Incorporates Key Information:
  - The prompt includes critical facts, statements, or context that guide the model to maintain consistency.
- Guides Logical Flow:
  - Ensures that the model's responses remain logically aligned with the established context throughout the conversation.
- Balances Detail and Flexibility:
  - While it's important to provide enough context, it's crucial not to over-restrict the prompt, as that could limit the model's creativity and diversity in responses.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 4Self-ConsistencyPrompt

Example:

### 1. Topic: Climate Change

- **Prompt:**
  - "Climate change is driven by human activity, particularly the burning of fossil fuels. Scientists agree that the Earth's average temperature has risen by 1.1C since the late 19th century. Based on this scientific consensus, explain the impact of rising global temperatures on ecosystems."
- **Generated Response:**
  - The model, guided by the self-consistency prompt, would provide an answer that aligns with the scientific consensus and remains consistent with the data about climate change.

# Module 3: Prompt Engineering Techniques for ChatGPT

## 4Self-ConsistencyPrompt

### When to Use Self-Consistency Prompts:

- Educational Content:
  - Ensures the information presented is accurate and aligned with established knowledge, making it useful for creating educational materials.
- Technical Discussions:
  - When discussing specialized topics, like engineering or medicine, where accuracy and adherence to known facts are critical.
- Decision-Making:
  - In scenarios where decisions rely on consistent data or logical reasoning, like business strategies or technical choices

## Module 3: Introduction to ChatGPT



ChatGPT is an AI-powered chatbot developed by OpenAI based on the GPT (Generative Pre-trained Transformer) architecture. It is designed to understand and generate human-like text, making it capable of engaging in natural conversations, answering questions, providing explanations, and assisting with a wide range of tasks.

GPT stands for Generative Pre-trained Transformer, a type of AI model that:

- Generates text (e.g., stories, emails, summaries)
- Is pre-trained on vast amounts of internet data
- Uses a Transformer architecture, a type of neural network optimized for language tasks



## Module 3: Introduction to ChatGPT

ChatGPT can:

- Answer questions and explain concepts
- Write essays, stories, and poems
- Help with coding and debugging
- Translate languages
- Summarize long texts
- Simulate characters or personalities
- Act as a tutor, brainstorming partner, or assistant

ChatGPT was trained on massive datasets from books, articles, websites, and conversations.

It predicts the next word in a sentence, allowing it to generate coherent and relevant responses.

The model does not "know" facts like a human, but it is excellent at mimicking understanding based on patterns in data.

## Module 3: History from GPT-1 to GPT-4



### GPT-1 (2018)

Paper: *Improving Language Understanding by Generative Pre-Training*

Parameters: 117 million

Architecture: Transformer decoder (12 layers)

Training Objective: Two-phase:

Unsupervised pre-training on Books Corpus (unsupervised language modeling)

Supervised fine-tuning on specific tasks (e.g., question answering, classification)

Significance:

Demonstrated that **unsupervised pre-training** followed by supervised fine-tuning could create task-specific models.

Laid the foundation for transfer learning in NLP using generative models.

## Module 3: History from GPT-1 to GPT-4

GPT-2 (2019)

**Paper:** *Language Models are Unsupervised Multitask Learners*

**Parameters:** 1.5 billion (largest version; smaller variants also released)

**Training Data:** WebText (~8 million documents scraped from outbound Reddit links)

**Architecture:** Larger transformer with 48 layers

**Key Features:**

Trained to predict the next word in a sentence (causal language modeling)

Could perform a range of NLP tasks **zero-shot** (e.g., summarization, translation, question answering)

without task-specific training

**Controversy:**

Initially withheld due to concerns about misuse (e.g., fake news generation)

Eventually fully released

## Module 3: History from GPT-1 to GPT-4



### GPT-3 (2020)

Paper: *Language Models are Few-Shot Learners*

Parameters: 175 billion

Training Data: Massive dataset including Common Crawl, books, Wikipedia, and more

#### Key Innovation:

Strong **zero-shot, one-shot, and few-shot learning** capabilities

Could generalize to new tasks with just a few examples in the prompt

#### Limitations:

No grounding in real-world facts (prone to hallucination)

No memory of past interactions

Bias and ethical concerns

## Module 3: History from GPT-1 to GPT-4



### GPT-4 (2023)

Paper: *Details limited (OpenAI did not release full technical paper)*

Parameters: Not publicly disclosed (rumored to be in the range of 500B+ or multimodal architecture)

#### Multimodal Capabilities:

Can process **text and image inputs** (GPT-4 Vision)

#### Performance:

More **factual, reliable, and steerable** than GPT-3.5

Strong performance on standardized tests (e.g., Bar Exam, SAT)

## Module 3: History from GPT-1 to GPT-4



### Features:

Better **context handling** (up to 128K tokens for some versions)

Used in tools like **ChatGPT-4 (Pro)**, **Bing Chat**, **Microsoft Copilot**

**Tool use:** Can browse the web, write code, generate images (via plugins like DALL·E, Python tools)

### Steerability:

Better at adhering to system instructions and user preferences

Introduced “**Custom Instructions**” and memory features in ChatGPT

# Module 3: History from GPT-1 to GPT-4

## Summary Table

<u>Model</u>	<u>Year</u>	<u>Parameters</u>	<u>Key Innovation</u>	<u>Input Modality</u>
GPT-1	2018	117M	Pre-training + fine-tuning	Text
GPT-2	2019	1.5B	Zero-shot capabilities	Text
GPT-3	2020	175B	Few-shot learning	Text
GPT-4	2023	Undisclosed	Multimodal, better reasoning & memory	Text & Images

## Module 3: How to install ChatGPT

### Use ChatGPT (No Installation Needed)

The easiest way is to just use ChatGPT directly via your browser or mobile app — no installation required:

#### ◆ Web App

Go to: <https://chat.openai.com>

Sign in or create an OpenAI account.

Start chatting (GPT-3.5 is free; GPT-4 is available with **ChatGPT Plus** subscription).

#### ◆ Mobile Apps (iOS & Android)

You can install ChatGPT like any app:

iOS:

Open the App Store

Search: "ChatGPT – OpenAI"

Download the official app by OpenAI

## Module 3: How to install ChatGPT



**Android:**

Open the **Google Play Store**

Search: "**ChatGPT – OpenAI**"

Install the official app

**Use ChatGPT via Microsoft Products**

ChatGPT is also built into:

**Microsoft Edge browser** (via Bing Chat)

**Microsoft Word / Excel** as Copilot

No installation is required if you're using updated Microsoft software

## Module 3: How to install ChatGPT



### Install/OpenAI API Locally (Developers Only)

If you're a developer and want to build your own app using ChatGPT, you can use the OpenAI API.

#### Requirements:

A programming environment (Python, Node.js, etc.)

OpenAI API key (get it from <https://platform.openai.com>)

#### What You *Can't* Install:

You can't install GPT-4 locally (it runs on powerful servers in the cloud).

OpenAI has not released GPT-4 weights (not open-source).

Local models like LLaMA, Mistral, or GPT4All can be installed instead, but they are not the same as ChatGPT.

## Module 3: How to Configure ChatGPT

### Configuring ChatGPT (Web or Mobile App)

If you're using [chat.openai.com](https://chat.openai.com) or the mobile app:

#### Use Custom Instructions (Web & App)

This lets you customize how ChatGPT responds to you.

 How to set it up:

Go to ChatGPT (web or mobile)

Click your name or the three-dot menu

Choose "Custom Instructions"

Fill in:

What would you like ChatGPT to know about you?

How would you like ChatGPT to respond?

Save

## Module 3: How to Configure ChatGPT



You can tell it:

Preferred tone (e.g., casual, formal)

Areas of focus (e.g., tech, fitness)

Specific writing formats (e.g., Markdown, bullet points)

### Enable/Disable Memory (Web Only, for now)

This lets ChatGPT remember facts about you across chats.

To check or configure:

Go to [chat.openai.com](https://chat.openai.com)

Click your name > Settings

Go to Personalization > Memory

Toggle memory on/off and manage stored information

# Module 3: How to Configure ChatGPT



## Configuring ChatGPT via the API (Developers)

If you're using the **OpenAI API**, configuration happens through code

### Key Config Options:

model: Choose "gpt-3.5-turbo" or "gpt-4"

temperature: Controls randomness (0 = deterministic, 1 = creative)

max\_tokens: Response length limit

system message: Define assistant behavior or role

tools: Add tool use (e.g., functions, code interpreter)

## Module 3: How to Configure ChatGPT



### Using ChatGPT in Microsoft Copilot / Bing Chat

These versions use ChatGPT under the hood, but **you can't directly configure it like in the OpenAI platform.**

However, you can **influence behavior with good prompts**, such as:

"Explain this as if I'm a beginner."

"Give me a summary in bullet points."

"Use a professional tone."

## Model Questions

1. Discuss about instructions prompt Technique used to guide NLP
2. What is zero, one and few shot prompting. Discuss in detail
3. What is Self consistency prompting. Discuss in detail
4. Describe the abilities of ChatGPT
5. Discuss about the history from GPT-1 to GPT-4
  - . Describe the process of installing ChatGPT in various platforms
7. Discuss the process of configuring ChatGPT

Thank You Module 3 -  

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Completed

# INTRODUCTION TO AI AND APPLICATIONS

## Module 4

## MODULE 4: ETHICS AND TRENDS IN ARTIFICIAL INTELLIGENCE

### 8.1 AI and Ethical Concerns

8.1.1 Ethical Use of Artificial Intelligence

8.1.2 Is AI Dangerous? Will Robots Take Over the World?

8.1.3 Ethics in AI

8.1.4 AI and Bias

8.1.5 Towards Ethical and Trustworthy AI

8.1.6 Why is Ethical AI Important?

### 8.2 AI as a Service (AIaaS)

8.2.1 Factors Triggering Growth of AIaaS

8.2.2 The Growth of AIaaS

### 8.2.3 Challenges of AIaaS

8.2.4 Vendors of AIaaS

### 8.3 Robotics

8.3.1 Artificially Intelligent Robot

8.3.2 Characteristics of Robots

8.3.3 Types of Robots

8.3.4 Types of Robots Based on  
Degree of Human Control

8.3.5 Components of a Robot

8.3.6 AI Technology Used in  
Robotics

8.3.7 Planning and Navigation

### 8.4 Recent Trends in AI

8.4.1 Collaborative Systems

8.4.2 Machines Assisting Humans

8.4.3 Algorithmic Game Theory and  
Computational Social Choice

8.4.4 Multi-Agent Reinforcement  
Learning (MARL)

8.4.5 Neuromorphic Computing

# Module 4: Current Trends in Artificial Intelligence

## Chapter 9 Where AI Is Heading Today?

### 9.1 Expert System

9.1.1 Popular Examples of the Expert System

9.1.2 Characteristics of an Expert System

9.1.3 Components of an Expert System

9.1.4 Participants in the Development of Expert System

9.1.5 Capabilities of the Expert System

9.1.6 Advantages of Expert Systems

9.1.7 Limitations of Expert Systems

9.1.8 Applications of Expert Systems

9.1.9 Expert System Technology

9.1.10 Development of Expert Systems

### 9.2 Internet of Things

9.2.1 Examples of Applications of IoT

9.2.2 IoT Products 9.2.3 Challenges

9.2.4 Sensors

### 9.3 Artificial Intelligence of Things (AIoT)

9.3.1 How Does AIoT Work?

9.3.2 Where Does AI Unlock IoT?

9.3.3 Applications and Examples of AIoT

9.3.4 Benefits and Challenges of AIoT

9.3.5 Future of AIoT

# Module 4: Current Trends in Artificial Intelligence

## 8.1 AI and Ethical Concerns

**Understanding AI Ethics and Its Importance** AI ethics addresses the moral obligations and responsibilities of AI systems, their creators, and their users. It involves ensuring that AI technologies align with human values and societal norms.

1. Roboethics
2. Machine Ethics

# Module 4: Current Trends in Artificial Intelligence

## 8.1 AI and Ethical Concerns

### 1. Roboethics:

- Roboethics focuses on human responsibility when it comes to designing, building, using, and interacting with artificial beings (like robots).
- It covers a wide range of ethical questions regarding how humans should treat AI entities.
- Some of the critical areas include:
  - **Designing ethical robots:** Ensuring that robots are built with features that align with human morals, including their capabilities and limitations.
  - **Treatment of robots:** Addressing how humans should interact with AI entities, especially those designed to resemble humans.

# Module 4: Current Trends in Artificial Intelligence

## 8.1 AI and Ethical Concerns

### 2. Machine Ethics:

- Machine ethics, on the other hand, concerns the moral behavior of AI systems or **Artificial Moral Agents (AMAs)**, especially those designed to interact with humans or make important decisions.
- These systems need to make moral decisions independently, without direct human intervention.
- Examples of AMAs include self-driving cars or AI systems used in healthcare. This includes:
  - **Decision-making systems:** AI algorithms that affect people's lives directly, like automated loan approvals, criminal sentencing, or hiring decisions.
  - **Moral programming:** Developing frameworks that allow AI systems to make ethical decisions based on societal norms, laws, and ethics.

# Module 4: Current Trends in Artificial Intelligence

## 8.1 AI and Ethical Concerns

### Key Ethical Concerns in AI

#### 1. Can AI Make Human-like Decisions?

- AI generates human-like outputs (e.g., loan approvals, healthcare decisions).
- Do AI systems understand the consequences of their actions like humans do?

#### 2. Are AI Decisions Truly Human-like?

- AI decisions are based on data and probabilities. But do they fully
- comprehend human context behind those decisions?

#### 3. Justification of AI's Decisions

- Is the reasoning behind AI decisions justifiable? Transparency is crucial for aligning
- AI decisions with ethical and legal frameworks.

#### 4. Fairness in AI Decisions

- Are AI decisions fair and free from bias? AI systems should respect
- individual rights and avoid discrimination.

#### 5. Trustworthiness of AI

- Can we trust AI systems (e.g., self-driving cars) to make safe decisions?
- AI must be reliable, transparent, and accountable to earn trust.

# Module 4: Current Trends in Artificial Intelligence

## 8.1.1 Ethical Use of Artificial Intelligence

- **Bias-Free AI**
  - AI systems should be free from bias, especially with complex algorithms like deep learning and GAN.
- **Explainability**
  - AI decisions, especially in regulated industries, must be explainable (e.g., credit decisions in finance).
  - "Black box" AI systems that can't explain decisions are problematic.
- **Key Features of Responsible AI**
  - a. **Explainable:** AI decisions should be understandable.
  - b. **Monitorable:** AI should be trackable and auditable.
  - c. **Reproducible:** AI systems must yield consistent results.
  - d. **Secure:** AI systems must be safe from attacks.
  - e. **Human-Centered:** AI should prioritize human well-being.
  - f. **Unbiased:** AI must avoid discrimination.
  - g. **Justifiable:** Decisions should be defendable and ethical.
- **Challenges in Regulation**
  - Formulating laws for AI is difficult due to rapid advancements in technology. Existing laws (e.g., privacy) may not cover new AI technologies like voice assistants (e.g., Alexa, Siri), which can be exploited by malicious actors.

## Module 4: Current Trends in Artificial Intelligence

### 8.1.2 Is AI Dangerous? Will Robots Take Over the World?

- **AI's Potential for Harm**
  - AI could be risky if specifically programmed for harm (e.g., autonomous weapons).
  - Autonomous drones and self-driving cars can become dangerous if misused or hacked.
- **Lack of Clear Accountability**
  - Current laws don't cover AI's role in society, especially in terms of liability.
  - **Questions arise like:** Who is responsible for AI's actions? Can AI systems be held accountable?
- **Job Automation Risk**
  - AI might replace many jobs, especially low-skilled, repetitive tasks. This could lead to
  - unemployment for millions, particularly in industries like retail, hospitality, and warehouse work.

## Module 4: Current Trends in Artificial Intelligence

### 8.1.2 Is AI Dangerous? Will Robots Take Over the World?

- Biased Algorithms
  - AI systems are vulnerable to bias if trained with biased data. Biased AI can produce unfair results, impacting crucial decisions like hiring or loan approvals.
- Privacy Concerns
  - AI systems collect large amounts of personal data, leading to privacy invasion. Facial recognition technology can track individuals without consent, creating privacy risks.
- Unreliable Information
  - AI can be used to create fake content (e.g., deepfakes, fake news). Manipulated videos or images can spread misinformation or be used maliciously

# Module 4: Current Trends in Artificial Intelligence

## 8.1.3 Ethics in AI

- **Ethical AI Definition**

- Ethical AI refers to AI systems designed to be fair, just, and unbiased.
- It focuses on ensuring AI's actions align with moral principles.

- **Importance of Ethical AI**

- Ethical AI ensures the technology benefits society while avoiding harm or unfair treatment.
- It guarantees AI decisions are transparent and responsible.

- **Bias in AI**

- AI systems can produce **biased results if trained on biased data**. Unchecked bias in AI can
- lead to unethical decisions, such as unfair hiring or loan approval.

- **Example of Unethical AI**

- Tay Chatbot: Microsoft's Tay learned negative and harmful behaviors after interacting with trolls on Twitter.
- The bot started spreading hate and offensive messages, forcing Microsoft to shut it down within 24 hours.

- **Features of Ethical AI**

- a.Uses unbiased data for training.
- b.Follows the right learning model for the problem at hand.
- c.Continuously monitored to ensure its outputs are right and fair.

# Module 4: Current Trends in Artificial Intelligence

## 8.1.4 AI and Bias

- **What is AI Bias?**
  - AI bias occurs when an algorithm produces results that are **unfair** or prejudiced towards a particular group.
  - Example: If AI frequently misidentifies people of color in computer vision systems, it's biased.
- **Examples of AI Bias**
  - Doctors in Images: Search results for "doctor" mostly show white men.
  - Gender Bias in Professions: "Doctor" is often male, while "nurse" is female in many images and videos.
  - Voice Assistants: Virtual assistants like Siri and Alexa use female voices, reinforcing gender bias.
  - Recognition Failures: Computer vision struggles with recognizing people of different skin colors accurately.

## Module 4: Current Trends in Artificial Intelligence

### 8.1.5 Towards Ethical and Trustworthy AI

- Challenges with AI in Recruitment:

- Issue: Some AI hiring platforms show biased results, like women being disproportionately rejected based on years of biased data in male-dominated sectors. Solution: Addressing these biases by
  - regulating AI practices and continuously monitoring recruitment algorithms.

- Regulating Ethical AI:

- European Commission (April 2021):
  - Launched a legal framework to ensure AI safety, protecting fundamental rights. Introduced a risk-based approach to set requirements and ban AI systems that could harm people's rights, such as systems that manipulate human behavior.

- Australia (June 2021):
  - Launched a similar AI ethics framework to guide businesses and governments on ethical AI usage.

# Module 4: Current Trends in Artificial Intelligence

## 8.1.5 Towards Ethical and Trustworthy AI

- Company and Organizational Engagement:
  - Building Trust: Organizations are implementing:
    - Cultural programs to raise awareness. Risk assessments to
    - identify potential AI issues. Third-party audits to ensure
    - compliance with ethical standards.
  - Framework: AI systems should be monitored using a prevention, detection, and response framework (like anti-corruption measures).
- Role of Rights and Activist Groups:
  - Human-Centric AI: AI systems must prioritize human rights and be developed with social responsibility.
  - Challenge: Civil rights groups should challenge AI practices and amplify the voices of those most affected by technology.
  - Questions to Ask:
    - Is the technology necessary? Is there
    - an alternative? Does the benefit
    - outweigh the harm?

# Module 4: Current Trends in Artificial Intelligence

## 8.1.5 Towards Ethical and Trustworthy AI

- Ensuring Data Privacy:
  - Data Protection: Essential for ethical AI.
  - Encryption: Ensures data is secure.
  - Secure Computation: Prevents AI developers from accessing private data.
  - Dataset Boundaries: AI should not learn beyond its provided dataset.
  - Prevent Reverse Engineering: Ensures data used in AI models is inaccessible to users.
- Diversify Your Team to Prevent Bias:
  - Diverse Teams: Forming teams with varied backgrounds (e.g., data scientists, business leaders, lawyers, sociologists, and ethicists) can help in identifying and preventing bias in AI systems.
  - Fairness Checks: Regular analysis of data and algorithms ensures that biases are spotted early.
  - Bias Mitigation Tools: Tools like Bias Analyzer help automate the detection of bias and analyze the effectiveness of mitigation actions.

## Module 4: Current Trends in Artificial Intelligence

### 8.1.6 Why is Ethical AI Important?

- **Critical Areas of Application:**
  - AI is used in medicine, law enforcement, recruitment, data privacy, military defense, and self-driving vehicles.
  - These systems must produce accurate, transparent, and understandable results, aligned with societal ethical standards.
- **Risks of Unethical AI:**
  - Biased or incorrect outputs can:
    - Erode privacy (e.g., misusing personal data).
    - Lead to decisions that are impossible to understand.
    - Cause harm without clear accountability for damages.

## Module 4: Current Trends in Artificial Intelligence

### 8.1.6 Why is Ethical AI Important?

- **Importance of Fairness & Accuracy:**
  - AI must be unbiased and accurate Without ethical design, AI systems can be misused,
  - leading to disastrous consequences for humanity.
- **Examples of Unethical AI Outputs:**
  - **Medical Bias:** An algorithm used in US hospitals to predict patients needing extra care favored white patients over black patients due to biased data regarding medical billing and facilities.
  - **Hiring Bias:** Amazon's AI hiring algorithm discriminated against women due to a data bias from previous male-dominated applications.

# Module 4: Current Trends in Artificial Intelligence

## 8.1.6 Why is Ethical AI Important?

- Efforts to Ensure Ethical AI:
  - IEEE Global Initiative and other committees focus on making AI systems more ethical.
  - **Ethically Aligned Design (2016)**: A publication providing guidelines for ethical AI solutions.
- Guiding Principles for Trustworthy AI (European Commission High-Level Expert Group):
  - **Support Human Autonomy**: AI should enhance human decision-making.
  - **Robust & Safe**: AI must be technically sound with a fallback plan for failure.
  - **Data Privacy**: Protect user data and maintain data quality.
  - **Transparency**: AI should avoid biased data and be transparent about its models.
  - **Fairness**: Train AI systems with non-discriminatory, diverse data to avoid bias.
  - **Benefiting Everyone**: AI should promote societal and environmental wellbeing.
  - **Accountability**: AI must be responsible for accurate, unbiased outcomes.
  - **Data Security**: Ensure confidentiality, transparency, and safety in data management.
  - **Accountability for Decisions**: Ensure organizational responsibility for AI decisions.

# Module 4: Current Trends in Artificial Intelligence

## 8.2 AI as a Service (AIaaS)

### 8.2.1 Factors Triggering Growth of AIaaS

- **Cloud Platforms:** Availability of affordable cloud platforms for enterprise data management.
- **Improved Data Storage:** Cost-effective and reliable data storage technologies.
- **Data Generation:** Streaming devices and IoT generate massive data that can be analyzed for competitive advantage.
- **Automation Tools:** Semi or fully automated data management and analytics tools simplify business analysis.

# Module 4: Current Trends in Artificial Intelligence

## 8.2 AI as a Service (AIaaS)

### 8.2.2 The Growth of AIaaS

- **Accessibility:** Cloud services make AI available to more companies, reducing the need for massive investment in talent and resources.
- **Key Benefits:**
  - **Focus on Core Business:** Companies can focus on their core business instead of learning AI.
  - **Cost Reduction:** AIaaS lowers operational costs and avoids expensive infrastructure.
  - **Minimized Investment Risk:** No huge upfront costs or resource commitments.
  - **Quick Deployment:** AIaaS offers fast solutions with pre-built algorithms.
  - **Data Insights:** Gain competitive edge by analyzing trends and improving data usage.
  - **Scalability:** Companies can start small and scale AI projects as needed.

## Module 4: Current Trends in Artificial Intelligence

### 8.2 AI as a Service (AIaaS)

#### 8.2.3 Challenges of AIaaS

1. **Security:** Sharing data with third-party vendors can raise security concerns.
2. **Reliance on Third Parties:** Dependence on vendors for services can lead to delays.
3. **Reduced Transparency:** Lack of insight into the internal workings of AI systems.
4. **Data Governance:** Industry-specific data policies may restrict the use of third-party AIaaS.

# Module 4: Current Trends in Artificial Intelligence

## 8.2 AI as a Service (AIaaS)

### 8.2.4 Vendors of AIaaS

- Major AIaaS Providers:
  - **Amazon Web Services (AWS)**: Offers machine learning services like bots, APIs, and frameworks.
  - **Microsoft Azure**: Provides AI and ML solutions, including cognitive services and bot services.
  - **Google Cloud Platform (GCP)**: Helps data scientists and developers create and deploy machine learning projects.
- Other AIaaS Providers:
  - **Monkey Learn**: Simplifies text analysis using no-code tools.
  - **IBM Watson**: Offers a suite of AI tools for building virtual assistants and text analysis.
  - **Microsoft Azure**: Provides cognitive services for computer vision and text extraction.
  - **Google Cloud ML**: Facilitates data scientists in creating and deploying ML models.

## Module 4: Current Trends in Artificial Intelligence

### 8.2 AI as a Service (AIaaS)

#### 8.2.5 Market Growth

- SaaS Market: Valued at \$133 billion.
- AI Platform-as-a-Service (AIPaaS): Expected to grow from \$11 billion in 2023 to \$88.5 billion by 2025.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.1 Collaborative Systems

- Machine-Human Collaboration:
  - AI and humans work together to complement each other's strengths.
- Examples:
  - Foldit: AI and humans collaborate to fold proteins.
  - AI in Chess: Amateurs and AI beat grandmasters.
  - AI in Business: AI elected to company boards.
  - Military: Drones and humans working together.
  - Exoskeletons: Power suits assist soldiers in the field.
- Challenges:
  - Over-reliance on AI could lead to job loss and skill degradation.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.2 Machines Assisting Humans

- **AI Helps Humans Enhance Abilities:**
  - AI boosts creativity, decision-making, and interactions.
- **Examples:**
  - SEB Bank's AI Assistant: Helps customers with tasks and understands tone.
  - AI improves efficiency in various sectors like healthcare, customer service, and homes.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.3 Algorithmic Game Theory

- **Game Theory with AI:**
  - AI helps machines play games ethically using predefined rules.
- **Types of Games:**
  - **Cooperative vs. Non-cooperative:** Alliances or no alliances.
  - **Symmetric vs. Asymmetric:** Same vs. different goals.
  - **Perfect vs. Imperfect Info:** Full visibility vs. hidden moves.
  - **Zero-sum vs. Non-zero sum:** One loses, one wins vs. all gain.
- **Key Concepts:**
  - **Nash Equilibrium:** No player can improve their situation by changing strategies.
  - **Inverse Game Theory:** Designing games based on players' strategies.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.4 Multi-Agent Reinforcement Learning (MARL)

- **Multiple Agents Learning:**
  - Multiple AI agents interact and learn together.
- **Example:**
  - Self-driving cars: Cars learning to manage traffic flow.
- **Challenges:**
  - Increased complexity with more agents interacting.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.5 Neuromorphic Computing

- **Brain-like AI Systems:**
  - Neuromorphic computing mimics the brain's structure for efficient processing.
- **Features:**
  - Parallel processing, low power consumption, flexibility, fault-tolerance.
- **Applications:**
  - Real-time processing, energy-efficient systems, adaptive AI.
- **Difference:**
  - Uses spiking neural networks (SNNs) for processing.
- **Examples:**
  - Intel's Loihi and IBM's TrueNorth chips.

# Module 4: Current Trends in Artificial Intelligence

## 8.4 Recent Trends in AI

### 8.4.6 Challenges in Neuromorphic Computing

- Difficult Transition:
  - Moving from Von Neumann architecture to neuromorphic computing is challenging.
- Needs:
  - New programming languages, sensors, and storage technologies.
- Programming:
  - Requires new development for neuromorphic systems.

### Impact of AI Trends

- Mainstream AI:
  - AI is becoming standard across industries.
  - New opportunities with challenges in ethical implementation.

# Module 4: Current Trends in Artificial Intelligence

## Chapter 9 Where AI Is Heading Today?

### 9.1 Expert System

9.1.1 Popular Examples of the Expert System

9.1.2 Characteristics of an Expert System

9.1.3 Components of an Expert System

9.1.4 Participants in the Development of Expert System

9.1.5 Capabilities of the Expert System

9.1.6 Advantages of Expert Systems

9.1.7 Limitations of Expert Systems

9.1.8 Applications of Expert Systems

9.1.9 Expert System Technology

9.1.10 Development of Expert Systems

### 9.2 Internet of Things

9.2.1 Examples of Applications of IoT

9.2.2 IoT Products

9.2.3 Challenges

9.2.4 Sensors

### 9.3 Artificial Intelligence of Things

9.3.1 How Does AIoT Work?

9.3.2 Where Does AI Unlock IoT?

9.3.3 Applications and Examples of AIoT

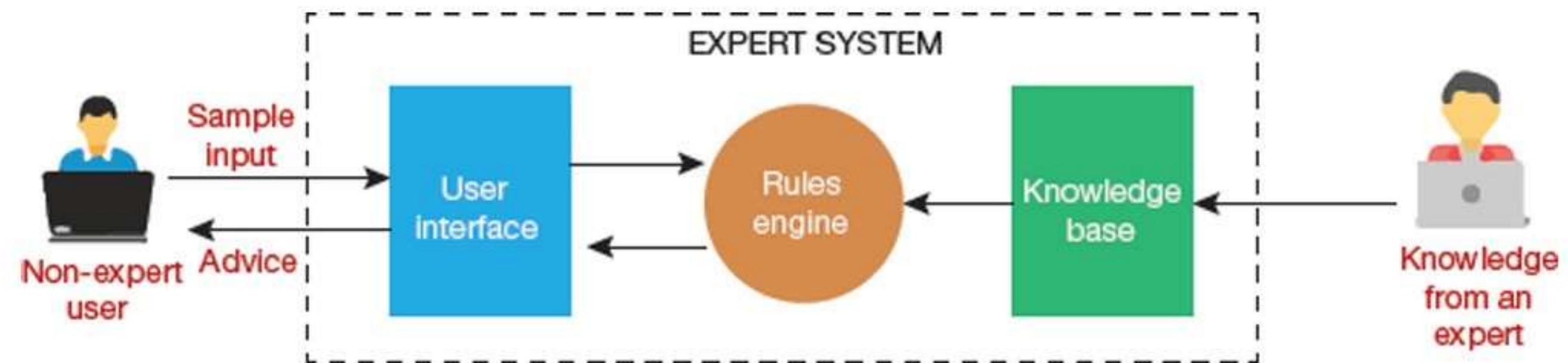
9.3.4 Benefits and Challenges of AIoT

9.3.5 Future of AIoT

# Module 4: Current Trends in Artificial Intelligence

## 9.1 Expert System

- A computer program designed to solve complex problems with human-like expertise. Used to assist, not replace, human decision-making in specific domains (e.g., medicine, science). **Key Components:**
- a. User Interface: Allows interaction with the system.
- b. Knowledge Base (KB): Stores expert knowledge for decision-making.
- c. Inference Engine: Applies reasoning rules to extract knowledge and provide decisions.
- **How it Works:**
  - Expert systems analyze user queries. Extract knowledge from the knowledge base. Use reasoning and inference rules to generate results.



# Module 4: Current Trends in Artificial Intelligence

## 9.1.1 Popular Examples of Expert Systems

- DENDRAL:
  - A chemical analysis system. Used in organic chemistry to identify unknown molecules
    - by analyzing mass spectra.
- MYCIN:
  - Designed to diagnose blood clotting diseases and bacterial infections.
  - Recommends antibiotics and drugs based on the patient's condition.
- PXDE
  - S:◦ Determines the type and level of lung cancer using images of the upper body.
- CaDeT:
  - Diagnostic support system to detect cancer at early stages.
- R1/XCON:
  - Customizes computer systems based on user requirements.
- DXplain:
  - Clinical support system that suggests diseases based on doctor's findings.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.2 Characteristics of an Expert System

- **High Performance:**
  - Solves complex domain problems with high efficiency and accuracy.
  - Dependent on a well-updated knowledge base.
- **Understandable:**
  - Results are provided in a human-understandable format.
  - Takes input and gives output in natural language.
- **Reliable:**
  - Generates efficient and accurate output consistently.
- **Highly Responsive:**
  - Provides fast results, faster than human experts.
- **No Memory Limitations:**
  - Can store and process huge amounts of data.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.2 Characteristics of an Expert System

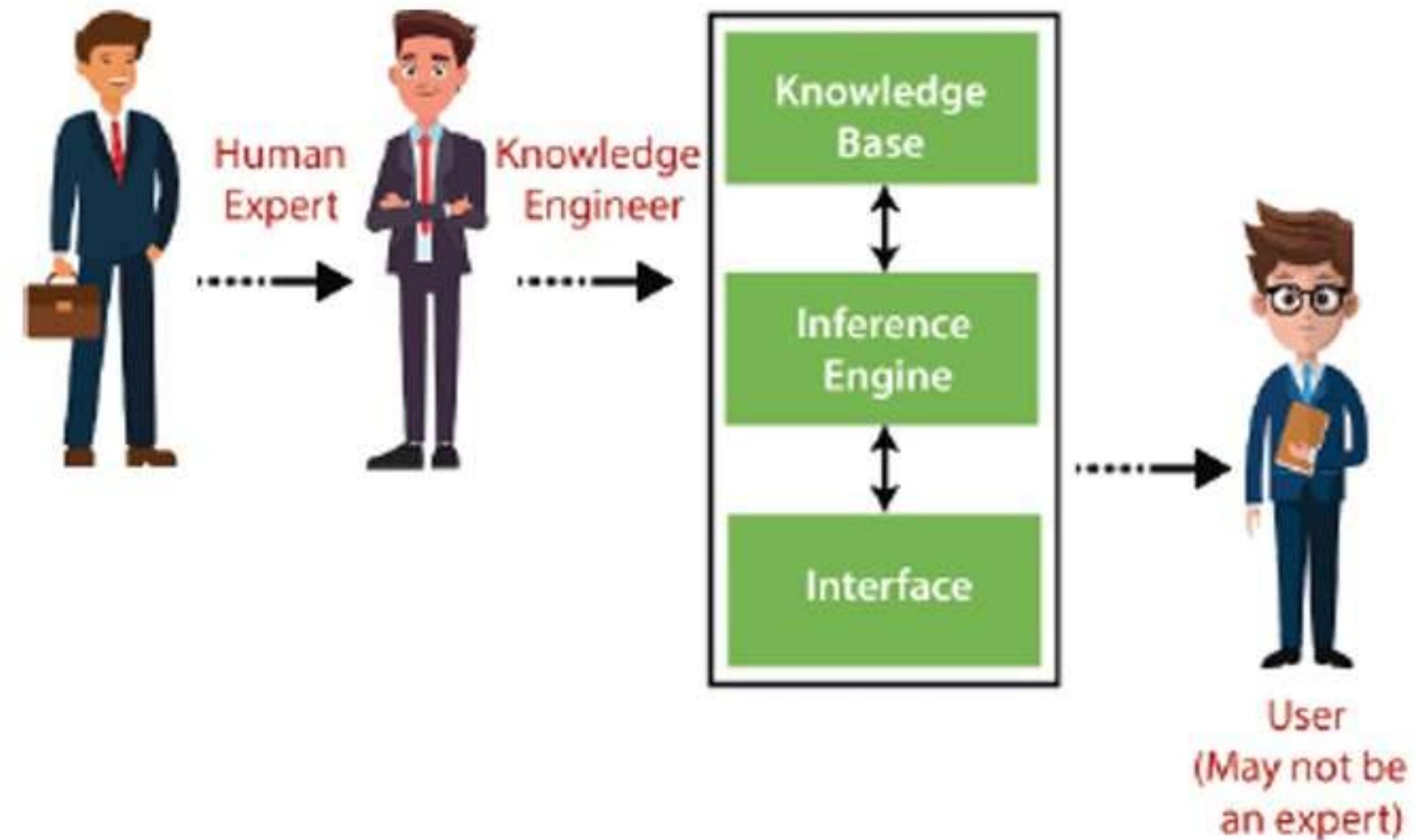
- **Expertise in a Domain:**
  - Integrates knowledge from multiple human experts in specific areas.
- **Not Affected by Emotions:**
  - Consistent performance without the influence of fatigue, stress, or emotions.
- **Not Biased:**
  - Checks all facts before making decisions, ensuring impartial results.
- **Reduce Cost:**
  - Much cheaper than hiring human experts for repeated consultations.
- **Non-perishable:**
  - Can be used indefinitely once developed, unlike human experts.
- **Intelligent:**
  - Uses knowledge and inference rules to deduce new facts and solve problems.

## Module 4: Current Trends in Artificial Intelligence

### 9.1.3 Components of an Expert System

An expert system mainly consists of three components—

1. User interface,
2. Inference engine and
3. Knowledge base



# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### 1. User Interface

- **Role:** Allows users to interact with the system.
- **Function:** Accepts user queries in natural language and provides understandable results.
- **Key Features:**
  - Helps users accomplish tasks quickly.
  - Customizable for user requirements.
  - Efficiently handles user input.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### 2. Inference Engine (Rules Engine)

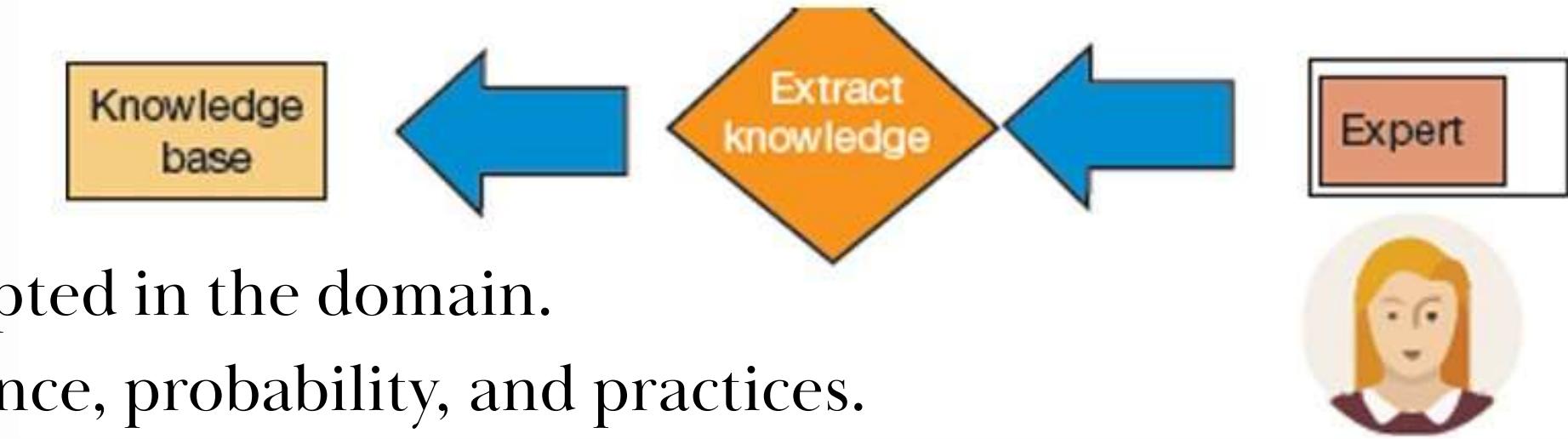
- **Role:** The "brain" of the expert system.
- **Function:** Processes information from the knowledge base to draw conclusions.
- **Types:**
  - **Deterministic:** Draws conclusions with certainty.
  - **Probabilistic:** Deals with uncertainty and probability.
- **Strategies:**
  - **Forward Chaining:** Starts with known facts to predict what can happen next (e.g., predicting stock prices).
  - **Backward Chaining:** Starts with the goal to work backward and understand the cause (e.g., diagnosing diseases).

# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### 3. Knowledge Base

- **Role:** Stores domain-specific knowledge.
- **Types of Knowledge:**
  - **Factual Knowledge:** Based on facts accepted in the domain.
  - **Heuristic Knowledge:** Based on experience, probability, and practices.
- **Representation:** Knowledge is typically represented using If-Else Rules.



### Case Study: MYCIN (Expert System)

- Step 1: Knowledge base about bacterial infections is created.
- Step 2: The system is updated with new information.
- Step 3: The doctor inputs details of a patient (e.g., symptoms, medical history).
- Step 4: The system applies If-Then rules using the inference engine.
- Step 5: Output is provided through the user interface, guiding diagnosis and treatment.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### Inference Engine (Rules Engine)

- The Inference Engine is the core processing unit of an expert system, often referred to as its "brain." It
- processes knowledge from the knowledge base and draws conclusions based on inference rules.

### Types of Inference Engines:

#### 1. Deterministic Inference Engine:

- **How it works:** Uses facts and rules to draw conclusions. **Output:**
- Conclusions are assumed to be true based on the given data.

#### 2. Probabilistic Inference Engine:

- **How it works:** Deals with uncertainty and draws conclusions based on probability.
- **Output:** Conclusions have some level of uncertainty attached.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### Inference Engine (Rules Engine)

- Functions of Inference Engine:
  - Efficient Processing: Applies rules and procedures to generate correct solutions. Conflict
  - Resolution: If multiple rules apply, the engine selects the best rule based on the current context.
  - Explanation and Debugging: Can explain how conclusions are reached, ensuring transparency.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.3 Components of an Expert System

### Inference Engine (Rules Engine)

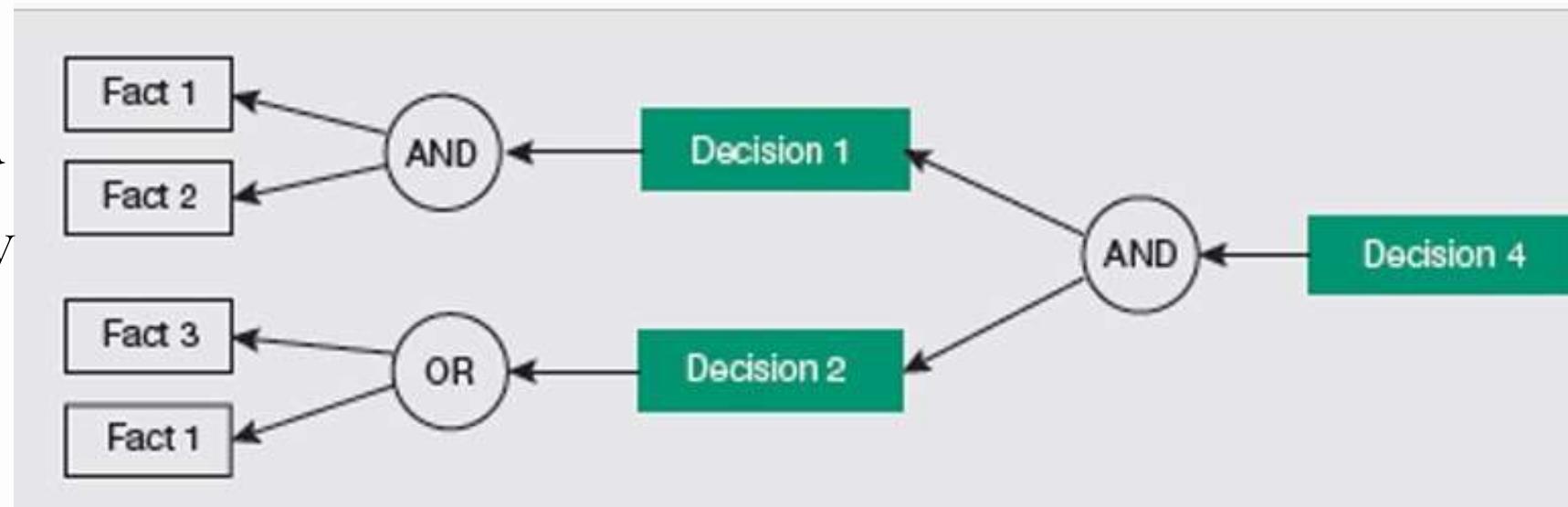
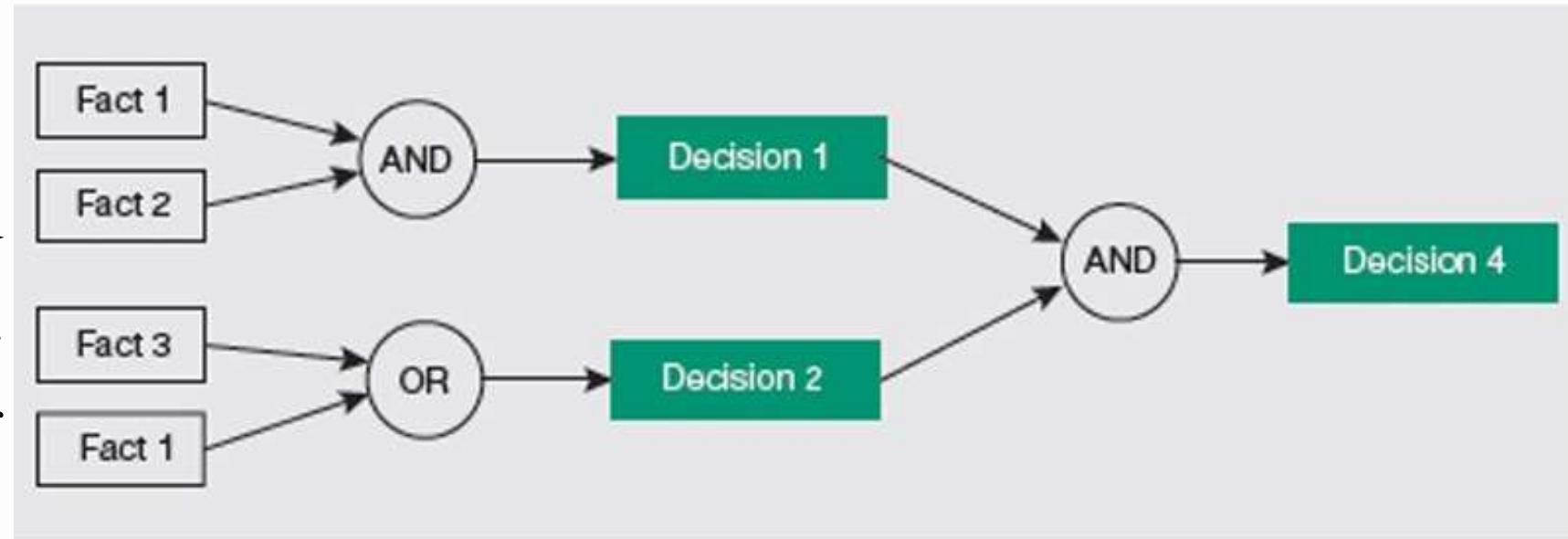
- Strategies for Knowledge Acquisition:

- Forward Chaining:

- **How it works:** Starts with known facts and rules to predict what can happen next.
    - **Example:** Predicting stock prices after interest rate changes.

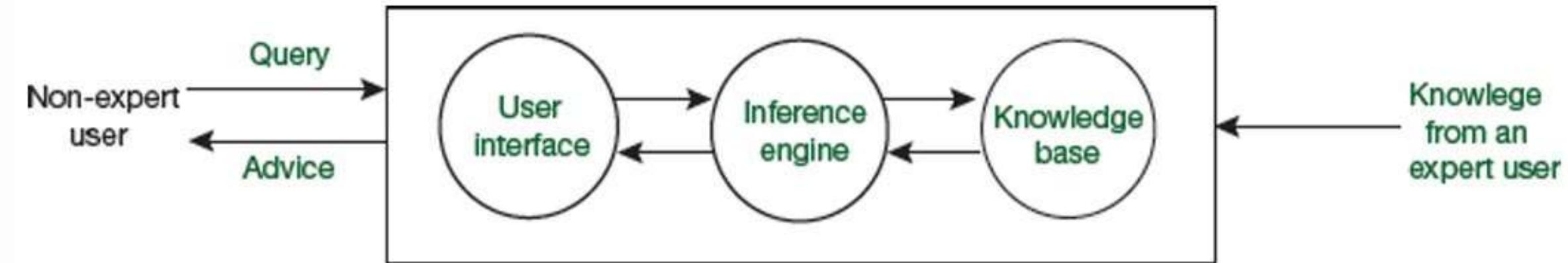
- Backward Chaining:

- **How it works:** Starts from the goal and works backward to prove the facts that lead to it. **Example:** Diagnosing blood cancer by tracing the cause from the symptoms.
    - **How it works:** Starts from the goal and works backward to prove the facts that lead to it. **Example:** Diagnosing blood cancer by tracing the cause from the symptoms.



# Module 4: Current Trends in Artificial Intelligence

## 9.1.4 Participants in the Development of Expert System



### Expert:

- **Role:** Provide the domain-specific knowledge that feeds into the expert system's knowledge base. **Importance:** The accuracy and performance of the expert system rely on the quality and depth of knowledge provided by the experts.

### Knowledge Engineer:

- **Role:** Responsible for building the expert system by acquiring, organizing, and structuring knowledge.
- **Importance:** The knowledge engineer ensures the knowledge is represented in a format that the expert system can use effectively to solve problems.

### End User:

- **Role:** The person who interacts with the expert system to get solutions or advice for specific queries. **Importance:** They may not have deep knowledge in the domain but rely on the expert system to address complex issues or tasks.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.5 Capabilities of the Expert System

- **Advise:** Provides advice for any query within its domain.
- **Decision-Making:** Makes complex decisions in fields like finance, medicine, etc.
- **Demonstrate Devices:** Demonstrates features, specifications, and usage of new products.
- **Problem-Solving:** Solves complex problems within its domain.
- **Explain a Problem:** Offers detailed descriptions of input problems.
- **Interpret Input:** Interprets user input for further processing.
- **Predict Results:** Predicts outcomes based on historical data.
- **Assist in Decision-Making:** Assists humans in making informed decisions.
- **Diagnose:** Used in medical fields to diagnose diseases.
- **Justify Conclusions:** Explains the reasoning behind the conclusions drawn.
- **Suggest Alternatives:** Suggests alternative solutions to problems.

## Module 4: Current Trends in Artificial Intelligence

### 9.1.5 Capabilities of the Expert System

#### Limitations of the Expert System

- **Cannot Substitute Human Decision-Makers:** It does not replace human judgment.
- **Lacks Human Capabilities:** Cannot replicate human emotions or intuitive thinking.
- **Inaccurate Output with Inadequate Knowledge Base:** Performance depends on the quality of the knowledge base.
- **Cannot Refine Knowledge Base:** It cannot autonomously improve or update its knowledge.
- **Cannot Use Emotions in Decisions:** Decisions are purely logical, without emotional influence.

## Module 4: Current Trends in Artificial Intelligence

### 9.1.6 Advantages of Expert Systems

- **Reproducible Results:** Results are consistent and can be reproduced each time.
- **Safe in Risky Environments:** Can be used in hazardous places where human presence is risky.
- **Accuracy:** Provide accurate results, especially with regularly updated knowledge bases.
- **Consistent and Fast Performance:** They perform consistently without being affected by emotions or fatigue.
- **Easily Available:** Mass-produced software makes expert systems widely available.
- **Affordable:** Production costs are reasonable, making them cost-effective.
- **High Speed:** Operate at high speed, reducing human effort and time.
- **Explainable Results:** Capable of explaining how conclusions or solutions were reached.
- **Improved Decision Quality:** Enhance the quality of decisions made.
- **Efficient Use of Expert Knowledge:** Efficiently gather and use scarce expertise for better solutions.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.7 Limitations of Expert Systems

- **Wrong Results:** Incorrect or outdated knowledge leads to wrong results.
- **Different Solutions:** Human experts may give different answers from the system.
- **Lack of Creativity:** Can't handle unusual or creative scenarios.
- **High Cost:** Expensive to develop and maintain.
- **Hard to Gather Knowledge:** Collecting the right knowledge is difficult.
- **Depend on Experts:** Success relies on expert knowledge input. **No Self-Learning:** Can't learn from experience, needs manual updates.  
**Needs Plenty of Knowledge:** Can't work with limited information.
- **Training Intensive:** Requires extensive training to function well.
- **No Emotions:** Cannot understand or use emotions in decisions.
- **No Common Sense:** Lacks human-like reasoning.
- **Domain-Specific:** Only works for a specific area.
- **Struggles with Unusual Situations:** Can't make decisions in rare cases.
- **Garbage In, Garbage Out (GIGO):** Poor data leads to poor results. **High Maintenance Cost:** Regular updates and maintenance are expensive.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.8 Applications of Expert Systems

- **Design & Manufacturing:** VLSI systems, camera lenses, automobiles.
- **Knowledge Publishing:** Tax advisors and other advisory systems.
- **Finance:** Detect fraud, suspicious activities, stock trading, loan approvals.
- **Medical Diagnosis:** Used extensively for diagnosing diseases and treatment.
- **Planning & Scheduling:** Project goals, airline scheduling, cargo, manufacturing.
- **Software Development:** Tracking project progress.
- **Monitoring Systems:** Detect leaks in pipelines, continuous data comparison.
- **Process Control:** Control physical processes through monitoring.
- **Automobile & Electronics:** Fault detection in vehicles and computers.
- **Complex System Diagnosis:** Electronic, electromechanical, diesel-electric systems.

# Module 4: Current Trends in Artificial Intelligence

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# Module 4: Current Trends in Artificial Intelligence

## 9.1.9 Expert System Technology

- **ExpertSystem Development Environment:**
  - **Hardware:** Workstations, minicomputers, mainframes.
  - **Programming Languages:** LISP, PROLOG (high-level symbolic programming).
  - **Databases:** Large databases for storing information.
- **Tools:**
  - **Powerful Editors:** Help developers efficiently create systems.
  - **Debugging:** Multi-window debugging for easy identification of errors.
  - **Rapid Prototyping:** Fast development and testing.
  - **Predefined Models:** In-built knowledge representation and inference design.
- **Shells:**
  - **Definition:** Expert systems without a knowledge base, providing essential modules.
  - **Modules:** Knowledge acquisition, inference engine, user interface, and explanation.
  - **Popular Shells:**
    - **JESS:** Java Expert System Shell, used with Java API.
    - **Vidwan:** Enables encoding knowledge in IF-THEN rules.

# Module 4: Current Trends in Artificial Intelligence

## 9.1.10 Development of Expert Systems

- Identify Problem Domain:
  - Identify the problem to solve. Ensure it is solvable by an expert system. Collaborate with human experts and assess cost-effectiveness.
- Design the System:
  - Choose hardware, tools, and shells. Plan system integration with other systems and databases.
  - Design a framework for representing knowledge.
  -
- Develop the Prototype:
  - Acquire domain knowledge from experts.
  - Represent knowledge in If-THEN-ELSE rules.
  - Integrate heuristic knowledge for reasoning.
- Test and Refine the Prototype:
  - Test the prototype with sample cases. Work with end-users to find errors and discrepancies. Refine the system based on test results.
- Develop and Complete the System:
  - Test the system with end-users and databases.
  - Integrate the system with other information systems.
  - Document the system and train users.
- Maintain the System:
  - Regularly review and update the knowledge base.
  - Integrate new requirements and interfaces as systems evolve.

# Module 4: Current Trends in Artificial Intelligence

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# Module 4: Current Trends in Artificial Intelligence

## 9.2 Internet of Things

IoT is a system of interrelated computing devices, machines, objects, animals, or people with unique identifiers that can transfer data over a network without human-to-human or human-to-computer interaction.

### Examples of IoT Devices:

- People: Heart monitor implants.
- Animals: Biochip transponders.
- Automobiles: Sensors for monitoring tyre pressure.
- Objects: Any device assigned an IP address to transfer data.

### Applications of IoT:

- Precision Agriculture: Monitoring crops, soil, and environment.
- Building Management: Automating lighting, heating, and security systems.
- Healthcare: Remote patient monitoring with wearable devices.
- Energy: Smart grids and energy management systems. Transportation:
- Traffic management, vehicle monitoring, etc.

# Module 4: Current Trends in Artificial Intelligence

## 9.2.1 Examples of Applications of IoT

- Smart Car Navigation:
  - Car suggests the best route, updates on traffic, and sends notifications if delayed.
- Smart Home Automation:
  - Alarm rings, and coffee machine starts brewing automatically.
- Wearable Fitness Trackers:
  - Smartwatch tracks activity and productivity, providing insights.
- Self-Driving Cars:
  - Equipped with sensors for detecting objects and ensuring safe navigation.
- Smart Football:
  - Tracks distance and speed, records stats for training.
- Smart Refrigerator:
  - Notifies when groceries run out or when food is expired.
- Smart Air Conditioner:
  - Controlled remotely via smartphone to set the desired temperature before arrival
- Smart Cities:
  - IoT helps in reducing traffic congestion, managing resources efficiently, and reducing pollution and crime.

# Module 4: Current Trends in Artificial Intelligence

## 9.2.2 IoT Products

- **Amazon Echo (Alexa):**
  - Voice assistant for smart homes.
  - Can perform various tasks like playing music, providing weather reports, or ordering an Uber.
- **Fitbit One (Wearables):**
  - Tracks physical activities (steps, calories, sleep). Syncs with smartphones and computers to monitor progress.
- **Barcelona - Smart City:**
  - Implemented IoT solutions for smart parking and environmental improvements.
  - One of the leading smart cities globally.
- **Popular IoT Platforms:**
  - Amazon Web Services (AWS)
  - Microsoft Azure IBM Watson
  - Cisco IoT Cloud Connect
  - Salesforce IoT Cloud Oracle
  - Integrated Cloud GE Predix
- **AT&T - Connected Car:**
  - Added 1.3 million connected cars to its network in 2016. Brings the total to 9.5 million connected cars.

# Module 4: Current Trends in Artificial Intelligence

## 9.2.3 Challenges in IoT

- Security:
  - Privacy and data sharing concerns. Hackers target connected devices (e.g., cars, homes). Lack of encryption in communication can cause security vulnerabilities.
- Scalability:
  - Huge volumes of data generated need big data analytics and cloud storage.
  - Devices must be scalable to process and store ever-increasing data.
- Interoperability:
  - Lack of common standards for IoT devices.
  - Difficulty integrating with legacy systems.
- Lack of Standardization:
  - Standardization issues hinder IoT device compatibility.
  - Prevents achieving truly connected systems.
- Lack of Government Support:
  - Regulatory bodies (e.g., FDA) lack IoT-specific safety and security regulations.
  - Limited governmental oversight.

# Module 4: Current Trends in Artificial Intelligence

## 9.2.3 Challenges in IoT

- **IoT Malware and Ransomware:**
  - IoT devices vulnerable to malware and ransomware attacks.
  - Hackers can take control of devices and demand ransom.
- **Connectivity:**
  - Poor internet connectivity affects IoT device performance. IoT devices require stable connections for effective monitoring and control.
- **Privacy Policies:**
  - Lack of clear regulations on what data is private or public. Example: IoT toys collecting children's data without parental consent.
- **Bandwidth Strain:**
  - Growing number of IoT devices creates strain on network bandwidth.
  - Increased data flow demands higher bandwidth and powerful servers.
- **IoT Skills Gap:**
  - Shortage of trained professionals in IoT network management.
  - Difficulty in training new staff due to rapid IoT development.

# Module 4: Current Trends in Artificial Intelligence

## 9.2.4 Sensors

Sensor Type	Description	Example
Oxygen Sensor Motion	Detects the gasoline/oxygen ratio	Detects Car emission control system
Sensor	interruption in energy flow	Home security lights, automatic doors
Vision and Imaging Sensor	Detects objects or colors in view	Measures Cameras for object detection
Temperature Sensor	thermal parameters	Industrial processes for gases, liquids, and solids
Radiation Sensor	Detects alpha, beta, or gamma	Surveys and sample counting
Proximity Sensor	Detects presence of objects without contact	Manufacturing operations
Pressure Sensor	Detects force per unit area in gases/liquids	Control and display devices
Position Sensor	Senses position of objects like valves or doors	Control systems for machinery
Photoelectric Sensor	Detects objects and can sense color	Manufacturing and material handling

# Module 4: Current Trends in Artificial Intelligence

## 9.2.4 Sensors

Sensor Type	Description	Example
Particle Sensor	Detects airborne particulates	
Motion Sensor Metal	Senses movement or stoppage Senses the presence of metal	Bin and baghouse monitoring Conveyor detection, stalling bearings
Detector Level Sensor	Determines height of substances in tanks	Security checks Control and display systems
Leak Sensor	Detects unwanted discharge of liquids/gases	Monitoring gas leaks
Humidity Sensor Gas and Chemical	Measures water content in the air Detects gases/chemicals	Control systems for temperature regulation Environmental monitoring
Force Sensor Flow Sensor	Measures forces like weight or torque Detects movement of gases/liquids/solids	Control systems for load measurement Industrial processing systems
Flaw Sensor	Detects inconsistencies on surfaces	Manufacturing processes like welding

# Module 4: Current Trends in Artificial Intelligence

## 9.2.4 Sensors

Sensor Type	Description	Example
Flame Detector	Senses fire presence and quality Detects	Combustion control systems
Electrical Sensor	electrical parameters like current and voltage	Monitoring electrical systems
Contact Sensor	Detects physical touch or contact	Alarm systems for doors/windows
Non-contact Sensor	Does not require physical touch	Radar guns for speed detection
Speed Sensor	Measures speed of an object/vehicle	Vehicle monitoring
Ultrasonic Sensor	Measures distance using high-frequency sound waves	Object distance measurement in robotics

## Module 4: Current Trends in Artificial Intelligence

### 9.3 Artificial Intelligence of Things (AIoT)

- AIoT combines Artificial Intelligence (AI) with the Internet of Things (IoT) to enhance efficiency, improve decision-making, and enable better data management. AI simulates human intelligence,
- while IoT connects devices to transfer data over networks without human intervention. AIoT improves IoT by adding machine learning algorithms to enhance decision-making.
- 

#### 9.3.1 How Does AIoT Work?

- AI is embedded in IoT devices and connected through IoT networks. Devices collect data, which is analyzed using AI techniques to improve productivity and efficiency. Edge AI reduces bandwidth needs and minimizes delays in data processing.

## Module 4: Current Trends in Artificial Intelligence

### 9.3 Artificial Intelligence of Things (AIoT)

- 9.3.2 Where Does AI Unlock IoT?
  - AI enhances the Analysis step in IoT, which directly impacts efficiency.
  - AIoT helps: Manage, analyze, and obtain meaningful insights from
    - data.
    - Provide fast, accurate data analysis.
    - Balance localized and centralized intelligence. Ensure data privacy and
    - security.

## Module 4: Current Trends in Artificial Intelligence

### 9.3 Artificial Intelligence of Things (AIoT)

- **9.3.3 Applications and Examples of AIoT**
- AIoT is widely used in various fields:
  - **Smart Cities:** Enhances operational efficiency, improves traffic management, and optimizes resource use.
  - **Smart Retail:** Uses smart cameras to track customers and optimize store operations.
  - **Smart Homes:** Devices analyze user habits to provide customized support.
  - **Manufacturing:** Monitors equipment and detects malfunctions.
  - **Autonomous Vehicles:** Uses real-time data to make driving decisions.
  - **Healthcare:** Devices monitor patient data, enabling remote care and accurate diagnoses.
  - **Smart Thermostats:** AI-powered devices adjust temperature based on user preferences and schedules.
  - **Fleet Management:** Monitors vehicles, tracks fuel usage, and identifies driver behavior.

## Module 4: Current Trends in Artificial Intelligence

### 9.3 Artificial Intelligence of Things (AIoT)

- 9.3.4 Benefits and Challenges of AIoT

- Benefits:

- Increases operational efficiency by analyzing and adjusting system operations in real-time.
    - Enables on-the-fly decision-making with real-time data analysis.
    - Reduces workload and saves time by automating data analysis.
    - Scalable systems that connect more devices as needed.
    - Better risk management by predicting potential problems in advance.
    - Improves products and services through real-time data analysis.

# Module 4: Current Trends in Artificial Intelligence

## 9.3 Artificial Intelligence of Things (AIoT)

- 9.3.4 Benefits and Challenges of AIoT

- Benefits:

- Increases operational efficiency by analyzing and adjusting system operations in real-time.
    - Enables on-the-fly decision-making with real-time data analysis.
    - Reduces workload and saves time by automating data analysis.
    - Scalable systems that connect more devices as needed.
    - Better risk management by predicting potential problems in advance.
    - Improves products and services through real-time data analysis.

- Challenges:

- **Security:** Protection of sensitive data is a significant concern.
    - **Scalability:** Managing large volumes of data from multiple devices.
    - **Interoperability:** Lack of standardization among different IoT devices.
    - **Privacy:** Handling user data and ensuring privacy compliance.

## Module 4: Current Trends in Artificial Intelligence

### 9.3 Artificial Intelligence of Things (AIoT)

- 9.3.5 Future of AIoT
  - Growth with 5G: 5G will boost AIoT by providing faster data transfer and lower latency.
  - Revolutionizing Industries: AIoT will improve supply chains, operational efficiency, and decision-making.
  - Exponential Data Growth: With more devices connected, AI will help manage the massive amount of data generated.
    - By 2025, the number of IoT devices is expected to rise to 42 billion, and AI will help process and analyze the increasing data efficiently.

### MODEL QUESTIONS

1. Discuss the ethical concerns in Artificial Intelligence with respect to privacy, sustainability, reliability, and bias.
2. What is bias in AI systems? Explain its causes, effects, and solutions with examples.
3. Define AI as a Service (AlaaS). Explain its advantages, disadvantages, and applications in modern industries.
4. Discuss recent trends in Artificial Intelligence and their applications in various domains.
5. What is an Expert System? Explain its architecture, working, and applications.
6. Discuss the components of an expert system with suitable examples.
7. Define AloT. Explain how AI and IoT integration improves decision-making and automation.
8. Define Internet of Things (IoT). Explain its applications in healthcare, smart homes, agriculture, and industry.
9. Define AloT. Explain how AI and IoT integration improves decision-making and automation.
10. Discuss the applications of AloT in smart cities, healthcare, and autonomous vehicles.
11. What are the benefits, challenges and Future of AloT in modern society?

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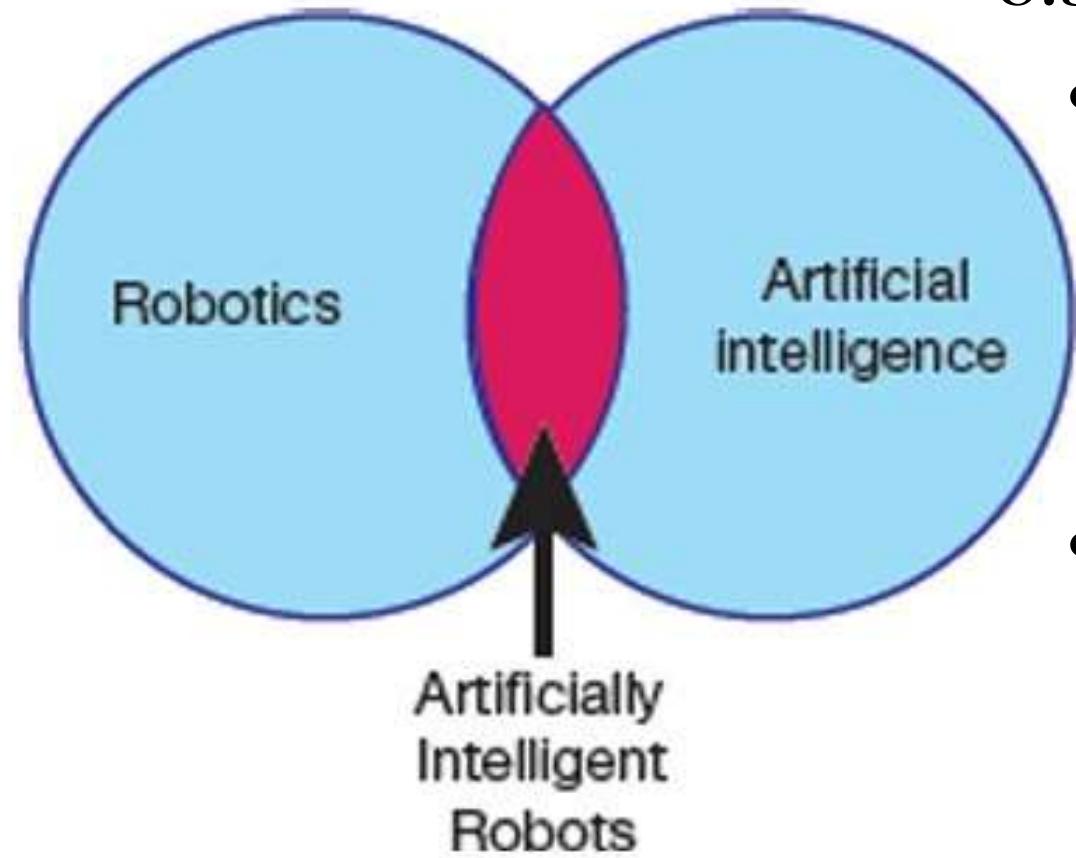
C o m p l e t e d

# INTRODUCTION TO AI AND APPLICATIONS

## Module 5

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics



#### 8.3.1 Artificially Intelligent Robot

- **AI vs Robotics:** AI and robotics are often confused, but they are not synonymous. AI involves programming machines to simulate human-like decision-making, whereas robotics involves designing and developing machines that perform physical tasks. **Artificially Intelligent Robots (AIRs):** These robots bridge the gap between AI and robotics. AIRs use AI algorithms to perform complex tasks that require decision-making, such as:
  - **Warehouse robots:** Use path-finding algorithms for navigation.
  - **Drones:** Use autonomous navigation to return home when their battery is low.
  - **Self-driving cars:** Detect and avoid hazards using AI.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.3 Types of Robots

##### 1.Pre-Programmed Robots:

- Perform simple, repetitive tasks in controlled environments.
- Example: Robots on automotive assembly lines.

##### 2.Humanoid Robots:

- Mimic human behavior and actions (e.g., walking, carrying objects).
- Example: Sophia by Hanson Robotics.

##### 3.Autonomous Robots:

- Operate independently without human intervention. Examples: Roomba vacuum, autonomous drones, medical assistant bots.

##### 4.Teloperated Robots:

- Semi-autonomous robots controlled remotely by humans. Example: Drones used for landmine detection or fixing underwater pipe leaks.

##### 5.Augmenting Robots (VR Robots):

- Enhance human abilities, like robotic prosthetics or exoskeletons.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.4 Types of Robots Based on Degree of Human Control

- Independent Robots:
  - Operate autonomously to replace humans in dangerous or mundane tasks.
  - Example: Bomb disposal robots, deep-sea exploration robots.
- Dependent Robots:
  - Require human interaction or guidance. Example:
  - Prosthetic limbs controlled by human signals.
- Chatbots:
  - Software robots that simulate conversation and are commonly used in customer service.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.5 Components of a Robot

##### 1. Control System:

- Acts as the robot's brain, directing its tasks through computations.

##### 2. Sensors:

- Allow robots to interact with their environment by detecting changes and events.
- Examples: Cameras (vision), microphones (sound), photoresistors (light).

##### 3. Actuators:

- Motive components that enable robot movement based on signals from the control system.
- Examples: Electric motors for rotational movement.

##### 4. Power Supply:

- Powers robots using batteries or external sources (e.g., solar, hydraulic, or pneumatic power).

##### 5. End Effectors:

- Physical components (like robotic hands, grippers) that complete tasks.
- Example: Gripping claws used in factories for handling materials.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.6 AI Technology Used in Robotics

- **Computer Vision:** Extracts useful information from images and videos for robots to act on.
- **Natural Language Processing (NLP):** Allows robots to understand and respond to human language.
- **Edge Computing:** Helps integrate robots with better data management and processing capabilities .
- **Complex Event Processing (CEP):** Processes multiple real-time events, crucial for robotic applications like healthcare or security.
- **Transfer Learning:** Utilizes pre-trained models for related tasks, reducing the training time and cost.
- **Reinforcement Learning:** Robots learn optimal behaviors through trial and error based on feedback.
- **Affective Computing:** Adds emotional intelligence to robots to simulate human-like emotions.
- **Mixed Reality:** Combines physical and virtual worlds for interactive robotic programming and demonstrations.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.7 Planning and Navigation

- **Cognition:** Refers to a robot's ability to make purposeful decisions to achieve its goals. In mobile robots, this means moving towards a goal efficiently and reliably.
- **Path Planning:** Identifies the best route from the start to the goal, avoiding obstacles.

##### 8.3.7.1 Competencies for Planning

- **Strategic Problem Solving:** Involves planning the best trajectory to reach a goal.
- **Tactical Problem Solving:** Involves avoiding obstacles and reacting to real-time data.

##### 8.3.7.2 Key Terms in Trajectory Planning

- **Trajectory Planning:** Moving from point A to point B while considering time, velocity, and obstacles.
- **Configuration Space:** The set of all possible positions a robot can occupy.  
**Free Space:** The area in configuration space that the robot can navigate without collisions.

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### 8.3 Robotics

#### 8.3.7.3 Problem Constraints in Trajectory Planning

- **Holonomicity:** Describes whether the robot has the ability to move freely in all directions.
- **Dynamic Environments:** In real-world situations, obstacles may move, making trajectory planning more challenging.

#### 8.3.7.4 Planning Algorithms

1. **Artificial Potential Field:** Directs the robot to the goal while avoiding obstacles using an attractive force for the goal and repulsive forces for obstacles.
2. **Sampling-based Planning:** Selects sample configurations and uses search algorithms to find a path to the goal.
3. **Grid-based Planning:** Divides the environment into a grid, checking for collision-free paths to the goal.
4. **Reward-based Planning:** Aims to maximize future rewards by selecting the best actions, often used in reinforcement learning.

## 8.3 Robotics

### 8.3.7.5 Visibility Graph

- **Visibility Graph:** Connects visible vertices in the environment to form a path, finding the shortest route while avoiding obstacles.

### 8.3.7.6 Voronoi Diagram

- **Voronoi Diagram:** Maximizes the distance between the robot and obstacles, helping in safe path planning.

### 8.3.7.7 Cell Decomposition Path Planning

1. **Exact Cell Decomposition:** Divides the environment into cells and checks for free space.
2. **Approximate Cell Decomposition:** Uses fixed grid sizes for simpler and faster path planning, though it may miss narrow passageways.

### 8.3.7.8 Potential Field Path Planning

- **Potential Field:** Uses forces to guide the robot to its goal, similar to gravity, with attractive forces for the goal and repulsive forces for obstacles.

## 8.3 Robotics

<b>Topic AI vs</b>	<b>Description</b> AI: Programming machines to simulate human decision-making.
<b>Robotics</b>	Robotics: Designing machines to perform physical tasks. AIRs: Combination of both.
<b>Artificially Intelligent Robots</b>	Robots controlled by AI algorithms to perform complex tasks. Examples: warehouse robots, drones, self-driving cars.
<b>Characteristics of Robots</b>	1. Electrical components for control and power. 2. Control systems with programmed instructions for tasks.

## 8.3 Robotics

Types of Robots	1. Pre-programmed Robots: Simple tasks (e.g., industrial robots). 2. Humanoid Robots: Mimic human behavior (e.g., Sophia). 3. Autonomous Robots: Operate independently (e.g., Roomba). 4. Teleoperated Robots: Controlled remotely (e.g., drones for landmine detection). 5. Augmenting Robots: Enhance human capabilities (e.g., robotic prosthetics).
Types of Robots (Human Control)	1. Independent Robots: Fully autonomous (e.g., bomb disposal robots). 2. Dependent Robots: Require human guidance (e.g., prosthetics controlled by signals). 3. Chatbots: Software robots for conversation.
Components of a Robot	1. Control System: Brain of the robot. 2. Sensors: Detect environmental changes (e.g., cameras, microphones). 3. Actuators: Enable movement (e.g., motors). 4. Power Supply: Provides energy (e.g., batteries). 5. End Effectors: Components to complete tasks (e.g., grippers, hands).

## 8.3 Robotics

AI Technology in Robotics	<p>1. Computer Vision: Extracts information from visual inputs. 2. NLP: Allows voice commands. 3. Edge Computing: Enhances data processing. 4. Complex Event Processing (CEP): Handles multiple real-time events. 5. Transfer Learning: Uses previous knowledge for related tasks. 6. Reinforcement Learning: Learns from actions and feedback. 7. Affective Computing:</p>
Planning and Navigation	Path planning for efficient robot movement. Cognition: Decision-making capability to reach goals. Planning: Strategically navigate obstacles, Reacting: Adjusts based on sensor feedback.
Competencies for Planning	<p>1. Strategic: Make decisions to reach goals. 2. Tactical: Avoid obstacles.</p>

## 8.3 Robotics

<b>Topic</b>	<b>Description</b> <b>1. Trajectory Planning:</b> Moving with velocity, time, and obstacles in
<b>Key Terms in Trajectory Planning</b>	<b>mind.</b> 2. Configuration Space: Set of all possible positions a robot can occupy. 3. Free Space: Areas without obstacles. 4. Target Space: Desired area robot aims to navigate.
<b>Problems in Trajectory Planning</b>	<b>Holonomicity:</b> Relation between controllable and total degrees of freedom. <b>Dynamic Environments:</b> Moving obstacles make planning more challenging.
<b>Planning Algorithms</b>	1. Artificial Potential Field: Robot moves based on attractive and repulsive forces. 2. Sampling-based Planning: Uses milestones to find paths. 3. Grid-based Planning: Uses grid to plan paths. 4. Reward-based Planning: Uses rewards for optimal decisions.

## 8.3 Robotics

Topic	Description
Visibility Graph	Connects visible points in the environment to form a path, finding the shortest route.
Voronoi Diagram	Maximizes distance between robot and obstacles for safe navigation.
Cell Decomposition Path Planning	1. Exact Cell Decomposition: Divides space into cells for path planning. 2. Approximate Cell Decomposition: Uses fixed grids for faster planning.
Potential Field Path Planning	Uses artificial forces (attractive for goals, repulsive for obstacles) to guide the robot towards its goal.

## 8.3 Robotics

Topic	Description
Visibility Graph	Connects visible points in the environment to form a path, finding the shortest route.
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Potential Field Path Planning	Uses artificial forces (attractive for goals, repulsive for obstacles) to guide the robot towards its goal.

# AI in Drones

- **Unmanned Aerial Vehicles (UAVs):** Drones are autonomous or remotely piloted aircraft that combine AI, computer vision, thermal imaging, and object avoidance technologies. **Applications:** Drones are widely used for both commercial and industrial purposes, including emergency response, agriculture, and environmental monitoring.

- **Emergency Response:**
  - **Thermal Imaging:** Drones with thermal cameras help rescue teams locate victims in difficult-to-access areas.
  - **Search & Rescue:** Used in natural disaster zones to assess damage and identify victims.
- **Humanitarian Aid & Disaster Relief:**
  - Drones are used to deliver aid, conduct damage assessments, and monitor disaster zones to help prevent further devastation.

# AI in Drones

## Drones in Environmental Conservation & Disease Control

- **Conservation:**
  - Drones equipped with geospatial imaging are used for tracking wildlife, preventing poaching, and monitoring climate change effects on ecosystems.
- **Disease Control:**
  - Drones monitor mosquito populations to detect and control infectious diseases, preventing epidemics in high-risk areas.
  - Used for delivering medical supplies to remote locations.

# AI in Drones

## Drones in Agriculture & Weather Forecasting

- **Agriculture:**
  - Drones are used to gather crop data, predict harvests, monitor soil health, and improve irrigation efficiency, leading to cost savings and higher crop yields.
- **Weather Forecasting:**
  - Drones collect climatic data such as temperature, humidity, and wind speed, improving weather predictions.

# AI in Drones

## Drones in Military, Surveillance & Security

- **Military Use:**
  - Drones are used for air strikes and surveillance, often in conflict zones.
  - Surveillance: Drones equipped with thermal cameras help monitor areas for forest fires, illegal activities, or security breaches.
- **Bomb Detection:**
  - Small drones can penetrate dangerous spaces to detect and disable bombs.

# AI in Drones

## Drones in Construction, Mining & Energy

- **Construction Planning:**
  - Drones help in monitoring construction sites, surveying land, and tracking topography and soil conditions.
- **Mining:**
  - Used to survey mines, assess ore stockpiles, and improve safety by reducing the need for manual inspections.
- **Energy:**
  - Drones inspect energy sites, detect gas leaks, and survey for new oil, gas, and solar energy installations.

# AI in Drones

## Drones in Transportation, Telecommunications & Internet

- Personal Transportation:
  - Companies like EHANG and Uber are developing autonomous aerial vehicles (AAVs) for urban personal transportation.
- Telecommunications:
  - Drones are used to inspect telecommunication towers, ensuring reliability and safety.
  - Used to provide internet access in remote areas, like Facebook's Aquila project.

# AI in Drones

## Drones in Journalism, Entertainment & Tourism

- **Journalism:**
  - Drones are used for news coverage in areas that are hard to access due to safety or cost reasons (e.g., natural disasters).
- **Entertainment:**
  - Drones are used in live events for light shows and synchronized performances (e.g., Disney's drone performances).
- **Tourism:**
  - Drones offer luxury travel experiences by reaching remote areas for sightseeing or package delivery.

# AI in Drones

## Challenges of Drone Usage

- **Regulations:**
  - Drones are subject to strict airspace regulations that can limit their use in certain regions.
- **Privacy Concerns:**
  - The use of drones for surveillance raises significant privacy issues, especially in public spaces.
- **Battery Life & Range:**
  - Drones are limited by battery life and operating range, which affects their ability to perform long-duration tasks.
- **Ethical Concerns:**
  - The use of drones in military operations and surveillance raises ethical questions about accountability and privacy.

# Outline

SaptarsiGoswami,AmitKumarDas and Amlan Chakrabarti, “AI for Everyone – A Beginner’s Handbook for Artificial Intelligence”, Pearson, 2024.

## Robotics & Drones

- Robotics,
- Robotics-an Application of AI,
- Drones Using AI,
- No Code AI,
- Low Code AI.

## Industrial Applications of AI:

- Application of AI in Healthcare, Application
- of AI in Finance, Application of AI in Retail,
- Application of AI in Agriculture,
- Application of AI in Education,
- Application of AI in Transportation, AI in
- Experimentation and Multi-disciplinary
- research,

## Module 5: Application of AI

1. AI in Healthcare
2. AI in Finance
3. AI in Retail
4. AI in Agriculture
5. AI in Education
6. AI in Transportation

# Module 5: Application of AI - in Healthcare (1)

## 1. AI in Healthcare

- AI in Healthcare refers to the integration of Artificial Intelligence technologies to enhance the diagnosis, treatment, and management of medical conditions.
- AI is revolutionizing healthcare by improving patient outcomes, optimizing administrative tasks, and providing personalized medical care.
- **Role of AI in Medical Diagnosis:**
  - AI algorithms help in diagnosis by analyzing large datasets of medical images and health records. These systems can identify patterns and anomalies that human doctors might miss, improving diagnostic accuracy.
  - Machine learning (a subset of AI) is commonly used in radiology, imaging, and pathology to analyze images (X-rays, MRIs, CT scans) and detect diseases like cancer, heart conditions, and brain disorders.

# Module 5: Application of AI - in Healthcare (1)

## 1. AI in Healthcare

- Applications in Imaging and Radiology:
  - AI algorithms assist radiologists by detecting abnormalities in medical images such as X-rays, MRIs, and CT scans. For instance, AI is used for breast cancer detection, where it helps in early identification, significantly improving survival rates.
  - AI can speed up the examination process, allowing doctors to focus on diagnosis rather than time-consuming tasks.
- Retinal Imaging and Disease Detection:
  - AI is used to detect conditions such as diabetic retinopathy and age-related macular degeneration by analyzing retinal scans. These conditions can cause blindness, and AI helps in their early detection, allowing for timely intervention.
  - AI also aids in glaucoma diagnosis and cataract surgery planning by analyzing specific eye parameters, improving the accuracy of treatment outcomes.

# Module 5: Application of AI - in Healthcare (1)

## 1. AI in Healthcare

- Pathology and Histopathology:
  - In pathology, AI assists by analyzing tissue samples and pathology slides, helping pathologists identify cancer cells and other abnormalities efficiently. This results in faster and more accurate diagnoses.
- Dermatology and Skin Conditions:
  - AI applications in dermatology help diagnose skin conditions such as melanoma, psoriasis, and eczema by analyzing skin images. AI algorithms can classify various skin conditions based on their appearance, providing doctors with more tools for accurate diagnosis.
- Cardiology and ECG Analysis:
  - AI is playing a significant role in cardiology by analyzing electrocardiograms (ECGs) to detect heart conditions like arrhythmias.  
It also helps in patient monitoring, ensuring continuous tracking of heart health.
  - This AI-powered analysis ensures timely diagnosis and better management of cardiovascular health.

# Module 5: Application of AI - in Healthcare (1)

## 1. AI in Healthcare

- Benefits of AI in Healthcare:
  - Improved Accuracy: AI can detect patterns and anomalies with higher precision than traditional methods.
  - Faster Diagnosis: AI automates the process of analyzing medical data, speeding up diagnosis and allowing healthcare professionals to make quicker decisions.
  - Personalized Medicine: AI tailors medical treatments and procedures to individual patients based on their unique genetic makeup and health data, enhancing treatment efficacy.
  - Cost Efficiency: By reducing manual labor, automating repetitive tasks, and optimizing processes, AI can significantly lower healthcare costs.
- Challenges:
  - Data Privacy: The use of AI in healthcare involves sensitive patient data, which needs to be protected.
  - Integration: Integrating AI into existing healthcare infrastructure can be complex and costly.
  - Bias: AI models trained on biased data may perpetuate healthcare disparities.
-

## Module 5: Application of AI - in Healthcare (1)

### 2. Early Disease Detection and Intervention

- **AI in Early Detection:** AI plays a key role in predicting health risks by analyzing large datasets. It enables healthcare professionals to identify potential health issues in their early stages, allowing for timely intervention.
- **Preventive Healthcare:** The early detection of diseases is one of the primary applications of AI in predictive analytics, helping to reduce the burden of diseases by providing early warnings.

## Module 5: Application of AI - in Healthcare (1)

### 2. Early Disease Detection and Intervention

- **Personalized Risk Assessment and Prevention:**
  - **Customized Risk Profiles:** AI algorithms can create risk profiles for individuals by analyzing their medical history, lifestyle choices, and other relevant factors. This personalized approach helps healthcare professionals tailor prevention strategies specific to each person.
  - **Preventive Measures:** These strategies may include targeted interventions, lifestyle adjustments, and screening protocols to proactively manage health risks before they become severe.
  - **Predicting Disease Aggravation:** By analyzing behaviors like medication adherence and lifestyle choices, AI can predict if a disease will worsen. This allows healthcare providers to intervene early with treatments or recommendations for lifestyle changes to prevent further complications.

## Module 5: Application of AI - in Healthcare (1)

### 2. Early Disease Detection and Intervention

- **Disease Surveillance and Outbreak Prediction:**
  - **Monitoring Public Health:** AI is used to monitor data sources such as travel patterns, climate conditions, and social media activity to predict the likelihood of disease outbreaks. This helps in real-time tracking of health risks and disease spread.
  - **Example of COVID-19:** During the COVID-19 pandemic, AI algorithms tracked the spread of the virus, predicting areas at high risk of outbreaks. This information was critical in allocating resources and implementing preventive measures to control the disease's spread.
  - **Public Health Response:** The AI-driven predictions enable authorities to take timely actions, such as increasing healthcare resources in specific areas, and alerting the population, which can reduce the overall impact of an outbreak.

## Module 5: Application of AI - in Healthcare (1)

### 3. AI in Drug Discovery

- **Accelerates Drug Development:** AI speeds up identifying promising drug candidates, reducing time and cost.
- **Target Identification:** AI analyzes data to identify new biological targets for drug intervention.
- **Drug Screening:** AI predicts drug efficacy by virtually screening millions of compounds.  
**Toxicity Prediction:** AI models predict drug toxicity, reducing the risk of adverse effects.
- **Molecule Optimization:** AI refines drug molecules to enhance effectiveness and minimize side effects.
- **Clinical Trials:** AI optimizes trial design and patient selection, improving success rates.

## Module 5: Application of AI - in Healthcare (1)

### 3. AI in Drug Discovery

- **Clinical Trials:** AI optimizes trial design and patient selection, improving success rates.
- **Personalized Medicine:** AI tailors treatments based on individual patient data (e.g., genetic profiles).
- **Drug Repurposing:** AI identifies new uses for existing drugs, speeding up treatment availability.
- **Examples:** Atomwise, Insilico Medicine, Exscientia are leading AI-powered drug discovery platforms.
- **Future Potential:** AI offers faster, cost-effective pathways to new therapies, enhancing healthcare.

## Module 5: Application of AI - in Healthcare (1)

### 4. AI for Virtual Medical Assistants

- **24/7 Availability:** AI-powered assistants provide round-the-clock support for patients, answering health-related queries anytime.
- **Symptom Checker:** AI analyzes symptoms entered by patients and suggests possible conditions, improving initial diagnosis.
- **Appointment Scheduling:** Virtual assistants manage and schedule doctor appointments, sending reminders to patients.
- **Personalized Health Guidance:** AI offers personalized advice based on medical history, lifestyle, and condition-specific data.

**Medication Management:** AI tracks medication schedules, sends reminders, and alerts patients about refills.

## Module 5: Application of AI - in Healthcare (1)

### 4. AI for Virtual Medical Assistants

- **Virtual Consultations:** Facilitates video or chat-based consultations, reducing the need for in-person visits.
- **Health Monitoring:** AI integrates with wearable devices to track vital signs, and offers real-time health monitoring.
- **Data Integration:** Virtual assistants integrate data from medical records, lab results, and wearable devices for comprehensive care.
- **Cost Reduction:** AI assistants reduce healthcare costs by handling routine tasks and providing efficient care. Examples: Google Assistant, Apple's Siri in healthcare, and specialized medical bots like Babylon Health and Ada.

## Module 5: Application of AI - in Healthcare (1)

### 5. AI-powered Robotics in Healthcare

- **Surgical Assistance:** Robots assist in minimally invasive surgeries, improving precision and reducing recovery time (e.g., da Vinci Surgical System).
- **Robotic Prosthetics:** AI-driven prosthetics adapt to individual movements, providing better functionality and comfort for patients.
- **Patient Care Robots:** Robots like Carebots assist elderly or disabled patients with daily activities, improving independence.
- **Rehabilitation:** AI-powered robotic exoskeletons help in physical therapy and rehabilitation, improving recovery after injuries or strokes.
- **Robotic Surgery Navigation:** AI improves surgical planning and navigation, ensuring accurate incision and tissue manipulation.

## Module 5: Application of AI - in Healthcare (1)

### 5. AI-powered Robotics in Healthcare

- **AI-Enhanced Diagnostics:** Robots equipped with AI algorithms assist in analyzing medical images (e.g., robotic biopsy systems).
- **Robotic Telemedicine:** Remote-controlled robots allow healthcare providers to interact with patients in hard-to-reach areas.
- **Drug Delivery:** Robots can deliver medication directly to specific organs or tissues, optimizing treatment efficacy.
- **Cost Efficiency:** AI robotics can reduce healthcare costs by automating repetitive tasks, improving workflows, and increasing efficiency.
- **Examples:** RoboDoc, Mazor X Stealth, CyberKnife System.

## Module 5: Application of AI - in Healthcare (1)

### 5. AI-powered Robotics in Healthcare

#### Robotic Surgery and Precision Processes

- **Enhanced Precision:** Robotic systems provide surgeons with increased accuracy in performing delicate procedures, minimizing human error.
- **Minimally Invasive:** Robots allow for smaller incisions, leading to less pain, quicker recovery, and reduced infection risks for patients.
- **Real-time Imaging:** AI-driven systems provide real-time, high-definition visualizations during surgery, allowing for more informed decision-making.
- **Precision Movement:** Robotic arms with AI guidance can execute microscopic movements with greater dexterity than human hands.
- **Surgical Planning:** AI algorithms analyze patient data, creating customized surgical plans for optimal results.

## Module 5: Application of AI - in Healthcare (1)

### 5. AI-powered Robotics in Healthcare

#### Robotic Surgery and Precision Processes

- **Tissue Manipulation:** Robots help in fine tissue manipulation during complex surgeries, enhancing surgical outcomes.
- **Reduced Fatigue:** Robots assist surgeons by offloading repetitive or strenuous tasks, reducing physical strain and increasing focus.
- **Tele-surgery:** Surgeons can operate remotely using robotic systems, allowing access to expert care regardless of location.
- **Examples:** da Vinci Surgical System, Mazor X Stealth, RAS (Robotic-Assisted Surgery).

## Module 5: Application of AI - in Finance (2)

### AI in Algorithmic Trading:

- AI analyzes market trends and predicts price movements to make faster, data-driven trading decisions.
- Uses machine learning algorithms to identify patterns and optimize trading strategies.
- High-frequency trading (HFT) benefits from AI to execute large volumes of trades in milliseconds.

## Module 5: Application of AI - in Finance (2)

### AI in Financial Risk Management:

- AI helps in identifying, analyzing, and mitigating financial risks (market, credit, operational).
- Predictive models analyze historical data to forecast potential market fluctuations and credit defaults.
- Enhances fraud detection and anomaly detection by monitoring transaction data in real-time.

## Module 5: Application of AI - in Finance (2)

### AI-based Customer Service:

- AI-powered chatbots and virtual assistants provide 24/7 customer support for banking, investments, and other financial services.
- AI helps in personalized financial advice, providing tailored recommendations based on user behavior and financial history. AI analyzes customer queries and automates routine transactions (balance checks, fund transfers).

## Module 5: Application of AI - in Finance (2)

### Challenges:

- **Data Privacy:** Handling sensitive financial data securely while complying with regulations (e.g., GDPR).
- **Model Interpretability:** AI models can be “black boxes,” making it hard to explain their decision-making process, especially in finance.
- **Bias in Algorithms:** If AI systems are trained on biased data, they may perpetuate or amplify existing inequalities (e.g., in credit scoring).
- **Regulation:** The rapidly evolving AI landscape in finance needs clear regulatory frameworks to ensure transparency and accountability.

## Module 5: Application of AI - in Retail: (3)

### Inventory & Store Layout Management:

- **Demand Forecasting:** AI predicts future demand by analyzing historical sales data, weather patterns, and market trends, helping retailers avoid stockouts and overstocking.
- **Automated Restocking:** AI systems automatically trigger restocking orders when inventory reaches a predefined threshold, improving efficiency and reducing human errors.
- **Optimized Store Layouts:** AI analyzes customer movement patterns to optimize store layouts, ensuring high-demand items are easily accessible and increasing sales.

## Module 5: Application of AI - in Retail: (3)

### Personalized Shopping:

- **Product Recommendations:** AI analyzes customer behavior, preferences, and purchase history to provide personalized product recommendations, enhancing customer satisfaction.
- **Dynamic Pricing:** AI adjusts prices in real-time based on factors like customer demand, competitor pricing, and inventory levels, optimizing profitability.
- **Virtual Try-ons & Fitting Rooms:** AI-driven augmented reality (AR) allows customers to virtually try on products, enhancing the shopping experience and reducing returns.

## Module 5: Application of AI - in Retail: (3)

### Customer Support:

- **AI Chatbots:** AI-powered chatbots provide instant customer support for queries, product information, and order tracking, reducing wait times and enhancing customer experience.
- **Sentiment Analysis:** AI analyzes customer feedback, reviews, and social media to detect sentiment trends, helping retailers improve products and services.
- **24/7 Availability:** AI ensures customer service is available round-the-clock, providing support across different channels like website chat, voice, and email.

## Module 5: Application of AI - in Retail: (3)

### Supply Chain Optimization:

- **Real-Time Tracking:** AI improves logistics and supply chain management by providing real-time tracking of shipments and inventory across multiple locations.
- **Route Optimization:** AI analyzes traffic, weather, and delivery schedules to determine the most efficient delivery routes, saving time and reducing costs.
- **Demand-Supply Balance:** AI predicts demand across regions and aligns supply chain efforts, reducing excess inventory and enhancing operational efficiency.

## Module 5: Application of AI - in Retail: (3)

### Fraud Prevention:

- **Transaction Monitoring:** AI continuously monitors transactions for signs of fraudulent behavior, helping retailers protect themselves and their customers.
- **Behavioral Analytics:** AI tracks customer behavior patterns and identifies anomalies to prevent credit card fraud or account takeovers.

## Module 5: Application of AI - in Retail: (3)

### Challenges:

- **Data Privacy Concerns:** Retailers must handle sensitive customer data responsibly, ensuring compliance with regulations like GDPR to avoid breaches.
- **Integration Complexity:** Incorporating AI into legacy retail systems can be complex and requires significant investment in infrastructure and training.
- **Bias in AI Models:** AI recommendations may be biased if the data used for training isn't diverse or accurate, leading to misleading recommendations or customer dissatisfaction.
- **High Initial Investment:** Implementing AI technologies requires a substantial upfront cost, which may deter smaller retailers.

## Module 5: Application of AI - in Agriculture: (4)

### Precision Farming:

- **Data-Driven Decisions:** AI analyzes soil conditions, weather patterns, and crop health to optimize farming practices.
- **Yield Prediction:** AI predicts crop yields based on historical data, environmental factors, and genetic information, helping farmers plan harvests and market strategies.
- **Automated Equipment:** AI-powered machines (e.g., drones and tractors) autonomously plant, weed, and harvest crops, improving efficiency.

## Module 5: Application of AI - in Agriculture: (4)

### Crop Management & Monitoring:

- **Crop Health Monitoring:** AI uses satellite imagery and drones to detect diseases, pests, and nutrient deficiencies early, enabling targeted interventions.
- **Growth Monitoring:** AI-powered systems track crop growth in real-time, providing farmers with valuable insights into optimal harvesting times and potential yield.
- **Pest & Disease Detection:** AI models analyze visual data to detect pests and diseases early, preventing crop damage and reducing pesticide use.

## Module 5: Application of AI - in Agriculture: (4)

### Smart Irrigation System:

- **Water Optimization:** AI-driven irrigation systems analyze soil moisture, weather forecasts, and crop type to apply the right amount of water, reducing water wastage.
- **Automated Irrigation:** AI systems automate irrigation schedules based on real-time data, ensuring crops receive optimal water levels.
- **Energy Efficiency:** AI minimizes energy consumption by optimizing irrigation cycles and using weather forecasts to predict water requirements.

## Module 5: Application of AI - in Agriculture: (4)

### Challenges:

- **Data Accessibility:** Accessing reliable and high-quality data, such as weather data, soil information, and crop performance, remains a significant challenge.
- **Technology Adoption:** Many farmers, especially in developing regions, face barriers like high upfront costs, lack of technical knowledge, and inadequate infrastructure.
- **Data Privacy & Security:** Collecting large amounts of data from farms raises concerns about data ownership, privacy, and how it's used or shared.
- **Weather Variability:** While AI can predict weather patterns, extreme weather events (e.g., floods, droughts) remain unpredictable, posing challenges for AI systems to adapt in real-time.

## Module 5: Application of AI - in Education: (5)

### Personalized Learning

- **Customized Content:** AI tailors lessons and materials based on individual student's learning pace, strengths, and weaknesses, providing personalized education.
- **Adaptive Learning Systems:** AI-powered platforms like Intelligent Tutoring Systems (ITS) adapt in real-time to a student's progress and provide additional resources where needed.
- **Learning Analytics:** AI tracks student performance over time and predicts future learning outcomes, helping educators intervene when necessary.

## Module 5: Application of AI - in Education: (5)

### Administrative Tasks:

- **Automated Grading:** AI automates grading of assignments, quizzes, and exams, saving teachers time and ensuring consistent and unbiased assessments.
- **Student Data Management:** AI helps in organizing student records, tracking attendance, and maintaining academic histories, streamlining administrative workflows.
- **Scheduling & Resource Allocation:** AI optimizes class schedules, faculty assignments, and resource usage, ensuring efficient school operations.

## Module 5: Application of AI - in Education: (5)

### Language Processing Tools:

- **AI-powered Language Tools:** Tools like chatbots and speech recognition systems assist in language learning, offering real-time translation and personalized feedback.
- **Text-to-Speech & Speech-to-Text:** AI helps dyslexic students by converting text into speech or transcribing spoken words into text for easier learning.
- **Natural Language Processing (NLP):** NLP algorithms help in grading essays, understanding student queries, and providing immediate responses, enhancing the learning experience.

## Module 5: Application of AI - in Education: (5)

### Challenges:

- **Data Privacy Concerns:** The use of AI in education involves collecting vast amounts of personal data, raising concerns about data security and student privacy.
- **Technology Access:** Not all students have access to AI-powered tools due to varying levels of technological infrastructure and internet connectivity.
- **Bias in Algorithms:** AI models can inherit biases from training data, leading to unintended discrimination or inaccurate assessments.
- **Teacher Training:** Teachers may face challenges in adapting to AI tools and technologies, requiring comprehensive training to effectively integrate them into the classroom.

# Module 5: Application of AI - in Transportation: (6)

## Traffic Management

- **AI-powered Traffic Control:** AI optimizes traffic signals based on real-time traffic data, reducing congestion and improving traffic flow.
- **Predictive Analytics:** AI analyzes historical traffic patterns to predict traffic jams, road blockages, and plan efficient routes in advance.
- **Smart Traffic Cameras:** AI-driven cameras monitor traffic and detect accidents or violations (e.g., speeding, illegal parking), improving enforcement.

## Module 5: Application of AI - in Transportation: (6)

### Ride Sharing & Mobility Services:

- **Dynamic Routing:** AI algorithms optimize routes in real-time, considering traffic conditions, weather, and rider preferences, ensuring faster and more efficient rides.
- **Demand Forecasting:** AI predicts peak hours and areas with high demand, allowing ride-sharing services (e.g., Uber, Lyft) to allocate vehicles and adjust pricing dynamically.
- **Autonomous Vehicles:** AI enables the development of self-driving cars and autonomous ride-sharing fleets, reducing the need for human drivers and improving convenience.

## Module 5: Application of AI - in Transportation: (6)

### Safety & Security:

- **Collision Detection:** AI sensors and cameras in vehicles detect obstacles and potential collisions, providing automated braking or alerting drivers for enhanced safety.
- **Driver Monitoring:** AI monitors driver behavior (e.g., drowsiness, distraction) and can alert or intervene to prevent accidents.
- **Predictive Maintenance:** AI tracks vehicle health and predicts when maintenance is needed, preventing breakdowns and enhancing vehicle safety.

## Module 5: Application of AI - in Transportation: (6)

### Challenges:

- **Data Privacy & Security:** AI systems in transportation collect vast amounts of personal and location data, raising privacy concerns and the need for robust security measures.
- **Infrastructure Limitations:** Integrating AI technologies into existing transportation infrastructures can be challenging due to legacy systems and high implementation costs.
- **Ethical and Legal Issues:** The use of autonomous vehicles and AI in ride-sharing raises legal and ethical concerns around liability and accountability in case of accidents.
- **Bias in AI Algorithms:** AI algorithms may develop biases in route selection, pricing, or driver recommendations, affecting certain groups unfairly.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Introduction

- AI accelerates data-driven experimentation and decision-making.
- Enables automation of hypothesis generation, testing, and analysis.
- Integrates multi-disciplinary knowledge from healthcare, engineering, finance, biology, and social sciences.

## Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

### Role of AI in Multi-Disciplinary Research

- **Bridging Knowledge Gaps** → Combines domain expertise across disciplines.
- **Automated Experimentation** → AI models simulate and test hypotheses faster.
- **Enhanced Collaboration** → Integrates tools and datasets from multiple domains.
- **Scalable Insights** → Supports large-scale, high-dimensional, multi-source data.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Applications

- Scientific Experimentation
  - AI-driven drug discovery & vaccine development.
  - Protein structure prediction (e.g., AlphaFold). Climate modeling and environmental simulations.
- Healthcare & Life Sciences
  - Predictive diagnosis and personalized treatments.
  - Wearable device analytics for patient monitoring. Lifestyle
  - disease prediction using adaptive models.
- Engineering & Industry 4.0
  - Autonomous robotics and intelligent manufacturing.
  - Digital twins for simulation-based optimization.
  - Predictive maintenance for IoT-enabled systems.
- Social Sciences & Business
  - Consumer sentiment analysis and market predictions.
  - Policy modeling for smart cities and sustainability.
  - AI-supported behavioral and cognitive studies.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Approaches to AI-Driven Experimentation

- **Data-Centric AI** → Focus on cleaning, curating, and balancing datasets.
- **Model-Centric AI** → Choosing architectures suitable for the problem:
  - Deep Learning: CNNs, RNNs, Transformers.
  - Hybrid AI: Neuro-symbolic reasoning, fuzzy logic, Bayesian models.
- **Simulation & Digital Twins** → For controlled experimental testing.
- **Reinforcement Learning** → To optimize strategies dynamically.
- **Automated Machine Learning (AutoML)** → Reduces manual tuning and speeds up experimentation.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Security & Privacy Concerns

- Data Security: Protecting sensitive datasets from breaches. Privacy:
- Ensuring compliance with GDPR, HIPAA, etc. Adversarial Attacks:
- Safeguarding AI systems against manipulation. Federated Learning:
- Decentralized experimentation to preserve privacy.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Best Practices & How to Approach

- **Start Small** → Begin with domain-specific pilot experiments.
- **Build Multi-Disciplinary Teams** → Include experts from relevant fields.
- **Use Explainable AI (XAI)** → Improve trust and transparency.
- **Leverage Cloud & HPC** → Utilize scalable computational infrastructure.
- **Implement Continuous Experimentation** → Iterative improvements via real-time feedback loops.

# Module 5: Application of AI - Experimentation and Multi-disciplinary research (7)

## Future Directions

- **AI-Augmented Scientists** → AI as a collaborative research partner.
- **Autonomous Labs** → Self-driven robotic experimentation.
- **Generative AI in Research** → Hypothesis generation and simulation.
- **Cross-Domain Knowledge Graphs** → Unified AI models for multi-disciplinary understanding.

# Outline

## MODULE5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

SaptarsiGoswami,AmitKumarDas and Amlan Chakrabarti, “AI for Everyone – A Beginner’s Handbook for Artificial Intelligence”, Pearson, 2024.

### Robotics & Drones

- Robotics,
- Robotics-an Application of AI,
- Drones Using AI,
- No Code AI,
- Low Code AI.

### Industrial Applications of AI:

- Application of AI in Healthcare,
- Application of AI in Finance, Application of AI in Retail, Application of AI in Agriculture,
- Application of AI in Education, Application of AI in Transportation, AI in Experimentation
- and Multi-disciplinary research,

## MODULE 5: INDUSTRIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE

### MODEL QUESTIONS



1. Explain in detail the applications of Artificial Intelligence in healthcare with reference to diagnosis, medical imaging, drug discovery, and patient care.
2. Discuss how AI is transforming the finance sector through fraud detection, risk management, algorithmic trading, and customer service.
3. Describe the role of AI in the retail industry. How does it support personalized shopping, inventory management, and dynamic pricing?
4. Explain the applications of AI in agriculture with examples of precision farming, crop monitoring, pest detection, and automated machinery.
5. Discuss the role of AI in education. How is it used in personalized learning, automated grading, administration, and immersive classrooms?
6. Write a detailed essay on the applications of AI in transportation, highlighting autonomous vehicles, traffic management, aviation, and logistics.
7. Explain how AI is contributing to experimentation and multi-disciplinary research. Illustrate with examples from space exploration, climate modeling, and material science.
8. Discuss the applications of AI in robotics. Explain with examples from industry, healthcare, defense, and humanoid robots.
9. Describe the applications of AI-powered drones in agriculture, defense, disaster management, logistics, and environmental monitoring.