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Introduction to AI

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Introduction to AI

- Artificial intelligence (AI) is a field of computer science focused on creating intelligent machines that can perform tasks typically requiring human intelligence, such as learning, problem-solving, and decision-making

CORE CONCEPTS

- **Definition**: AI is the science and engineering of making intelligent machines, particularly intelligent computer programs, according to john mccarthy.
- **Goal**: to create systems that can simulate human-like thinking, learning, and problem-solving.
- **Key abilities**: the goal is to enable machines to learn, reason, perceive, solve problems, and understand language.

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Introduction to AI

Applications

- **Personal assistants**: voice assistants like Siri and Alexa use AI to understand and respond to your commands.
- **Recommendations**: services like Netflix and Youtube use AI to recommend content based on your past choices.
- **Healthcare**: AI assists in analyzing data and making diagnoses.
- **Transportation**: AI powers self-driving cars and other autonomous vehicles.
- **Other uses**: AI is used in e-commerce, finance, and for tasks like optical character recognition (ocr) to extract data from images.

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Introduction to AI

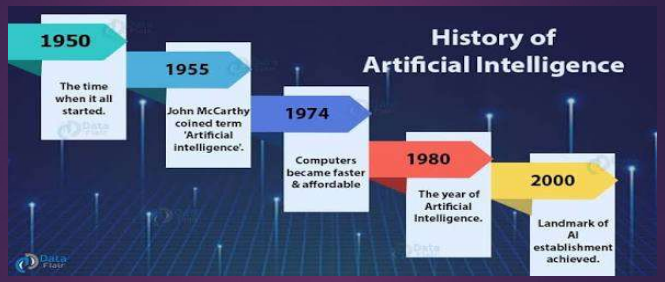
Types of AI

Narrow or weak AI: designed to perform a specific task, such as playing chess or recognizing faces.

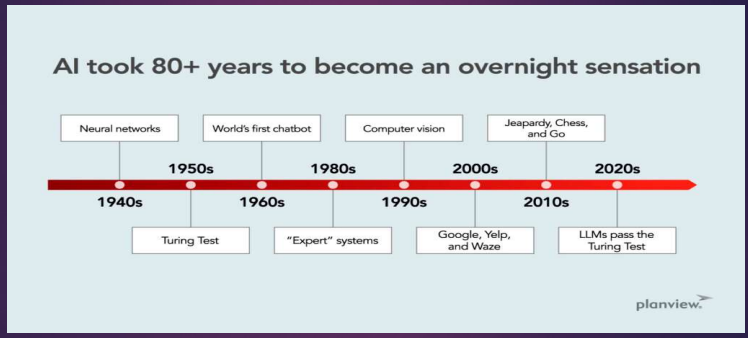
General AI: hypothetical AI that could perform any intellectual task that a human being can.

Super **AI**: hypothetical AI that would surpass human intelligence in all aspects.

History of AI



History of AI



History of AI

1950s

- **1950:** Alan Turing publishes "computing machinery and intelligence," introducing the concept of a test for machine intelligence, now known as the turing test.
- **1952:** Arthur Samuel develops the first self-learning program, a checkers game.
- **1955:** John Mccarthy coins the term "artificial intelligence".
- **1956:** the Dartmouth workshop takes place, officially establishing ai as a field of study.
- **1957:** frank rosenblatt creates the perceptron, an early neural network.

History of AI

- 1960s
- **1965:** Edward Feigenbaum and Joshua Lederberg create the first "expert system".
- **1966:** Joseph Weizenbaum develops Eliza, one of the first chatbots.
- **1969:** Marvin Minsky and Seymour Papert publish "perceptrons," which highlighted some limitations of perceptron neural networks.

History of AI

- 1970s-1990s
- **1974-1980:** the first "AI winter," a period of reduced funding and interest, begins.
- **1987-1994:** the second "AI Winter" occurs.
- **1992:** The program td-gammon learns to play backgammon at a very high level.
- **1997:** Ibm's deep blue chess-playing computer defeats world champion Garry Kasparov.
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History of AI

2000s

- **2004:** the NASA rovers spirit and opportunity are sent to mars with AI to assist with navigation.
- **2005:** the first fully autonomous car, the «!Nav>>stanley», wins the darpa grand challenge.
- **2006:** ai is increasingly adopted by businesses like facebook and twitter.
- **2010:** google's self-driving car passes a legal test on the roads.
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History of AI

- 2010s-present
- **2011:** IBM's Watson wins the game show jeopardy!.
- **2011-2014:** Apple's Siri and Amazon's Alexa are released.
- **2014:** The chatbot "Eugene Goostman" passes the Turing test.
- **2018:** IBM's "Project Debater" debates human masters.
- **2019:** DeepMind's AlphaStar AI reaches the top 0.2% of human StarCraft 2 players.
- **2020:** OpenAI releases GPT-3, a large language model.
- **2021:** OpenAI develops

History of AI

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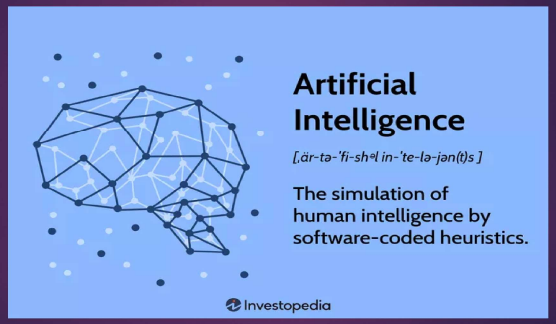
Definition

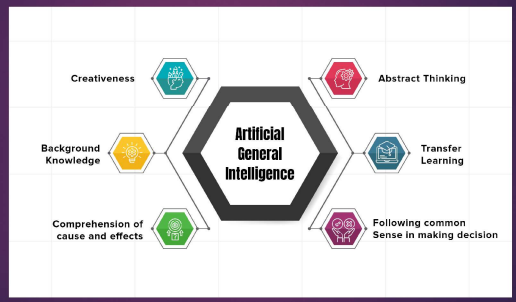
- Artificial intelligence (AI) combines data, algorithms, and computing power to mimic or augment human thinking and problem-solving.
- A subset of artificial intelligence is Machine Learning (ML), a concept that computer programs can automatically learn from and adapt to new data without human assistance.

Definition



Definition

Artificial General Intelligence



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Artificial General Intelligence

Creativeness: the ability of AGI to generate innovative ideas and original solutions by thinking beyond predefined patterns.

Abstract thinking: the capacity to understand complex concepts, identify patterns, and apply logical reasoning to unseen or theoretical situations.

Transfer learning: the ability of agi to apply knowledge gained from one task or domain to solve problems in another.

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Artificial General Intelligence

Background knowledge: the stored information and experiences that help agi understand new situations more effectively.

Comprehension of cause and effects: the skill to recognize relationships between actions and outcomes, enabling logical reasoning.

Common-sense decision-making: the capability to make practical and sensible choices based on everyday reasoning and understanding.

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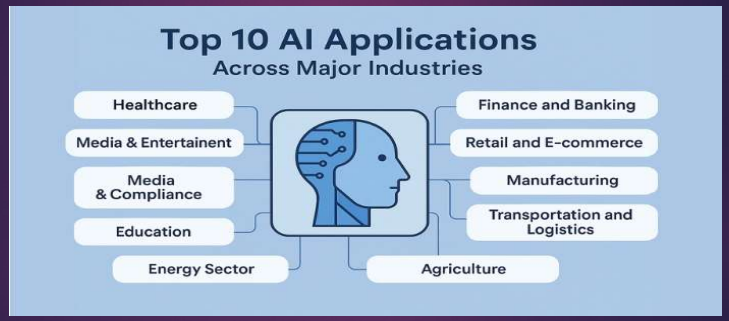
Industry Applications of AI



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Industry Applications of AI

Healthcare: AI assists in disease diagnosis, drug discovery, medical imaging, and personalized treatment plans.

Finance: used for fraud detection, algorithmic trading, credit scoring, and customer service chatbots.

Manufacturing: enables predictive maintenance, quality control, and automation of production lines.

Retail: enhances customer experience through product recommendations, demand forecasting, and inventory management.

Industry Applications of AI

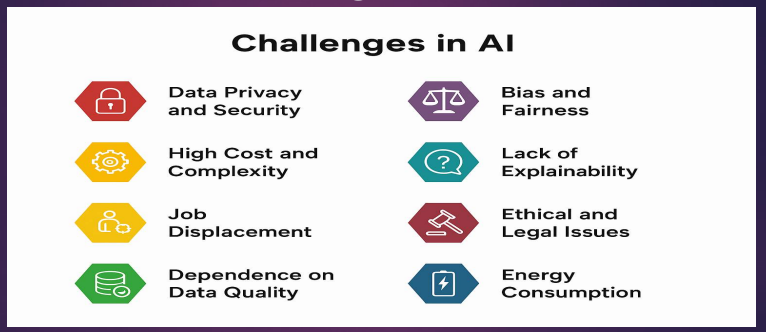
Transportation: powers self-driving vehicles, route optimization, and traffic management systems.

Education: supports personalized learning, automated grading, and intelligent tutoring systems.

Agriculture: helps in crop monitoring, soil analysis, and precision farming for improved yields.

Cybersecurity: ai is used to detect threats, prevent data breaches, and respond to cyberattacks through real-time monitoring and anomaly detection.

Challenges of AI



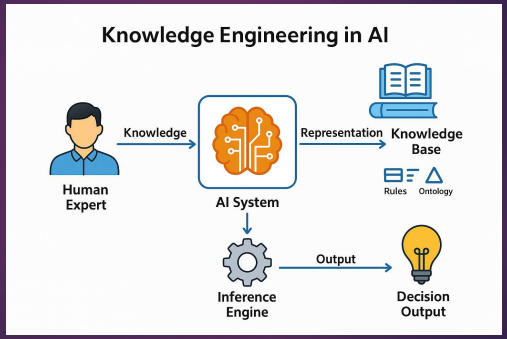
Challenges of AI

- **Data privacy and security:** ensuring sensitive data is protected from misuse and breaches.
- **Bias and fairness:** ai systems may produce unfair results if trained on biased data.
- **High cost and complexity:** developing and maintaining ai systems require significant resources and expertise.
- **Lack of explainability:** many ai models act as "black boxes," making their decisions hard to interpret.

Challenges of AI

- **Job displacement:** automation through AI can lead to reduced employment in certain sectors.
- **Ethical and legal issues:** defining accountability and ethical use of ai remains a major concern.
- **Dependence on data quality:** poor or insufficient data can lead to inaccurate predictions and unreliable outcomes.
- **Energy consumption:** advanced ai models require massive computational power, leading to high energy usage and environmental impact.

Knowledge Engineering



Knowledge Engineering

Knowledge engineering (KE) is the process of creating, organizing, and managing the knowledge base used by AI systems — especially *expert systems*.

It involves acquiring human expertise, representing it in a computer-understandable form, and using it to solve complex problems that usually require human intelligence.

Knowledge Engineering

Steps in knowledge engineering

- **Knowledge acquisition:**
  collecting information from experts, databases, and documents.
- **Knowledge representation:**
  storing knowledge in a structured format (like rules, semantic networks, or ontologies).
- **Knowledge validation:**
  ensuring that the knowledge is correct, consistent, and applicable.

Knowledge Engineering

Steps in knowledge engineering

- **Knowledge Maintenance:**
  Updating the knowledge as new information becomes available.
- **Inference and reasoning:**
  using logic or inference engines to draw conclusions or make decisions from the knowledge base.

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Knowledge Engineering

Applications in knowledge engineering

- Expert systems (medical diagnosis, legal advice)
- Natural Language Understanding
- Robotics decision-making
- Recommendation Systems

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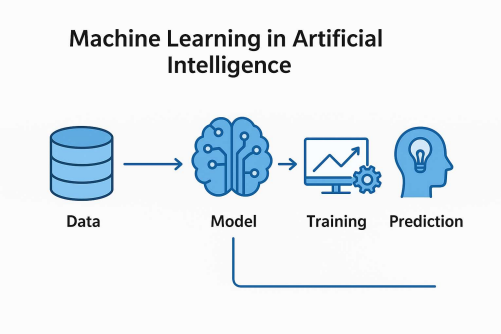
Machine Learning



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Machine Learning

Definition:

- Machine Learning (ML) is a branch of artificial intelligence (AI) that enables systems to automatically learn and improve from experience without being explicitly programmed.
- It focuses on developing algorithms that can analyze data, identify patterns, and make decisions with minimal human intervention.

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Machine Learning

Key steps in machine learning

Data collection:
data is gathered from various sources such as sensors, databases, or online platforms.

Data preprocessing:
the collected data is cleaned, normalized, and transformed into a usable format.

Model selection:
a suitable machine learning algorithm (e.G., Decision tree, neural network, SVM) is chosen.

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Machine Learning

Key steps in machine learning

Training:

the model learns from training data to identify relationships and patterns

Testing & evaluation:

the trained model is tested on new data to evaluate its accuracy and performance.

Prediction/decision making:

the model makes predictions or classifications based on the input data.

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Machine Learning

- **Applications**
- Spam email detection
- Speech and image recognition
- Fraud detection in banking
- Medical diagnosis
- Recommendation systems (netflix, youtube, amazon)

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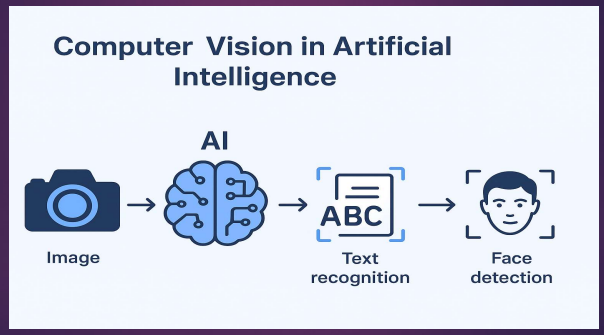
Computer Vision



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Computer Vision

- **Definition:**
  computer vision (CV) is a field of artificial intelligence that enables computers to interpret and understand visual information from the world, such as images and videos.
- **Goal:**
  to make machines "see" and make decisions similar to how humans perceive visual data.
- **Example:**
  facial recognition, medical imaging, self-driving cars.

Computer Vision

Image acquisition:
capturing images or videos using cameras or sensors.

Image processing:
enhancing and cleaning the image (noise removal, filtering).

Feature extraction:
identifying patterns, shapes, colors, or edges.

Classification & decision:
using ai models (like cnns) to recognize or categorize objects.

Computer Vision

- **Techniques used in computer vision**
- **Image segmentation** – dividing an image into meaningful parts.
- **Object detection** – locating and identifying objects within an image.
- **Facial recognition** – identifying people from their facial features.
- **Optical character recognition (ocr)** – reading printed or handwritten text.
- **3d vision** – understanding depth and object structure.

Computer Vision

Applications

Healthcare: tumor detection in medical scans

Automotive: self-driving car navigation

Manufacturing: quality inspection on assembly lines

Retail: product identification and inventory management

Security: surveillance and facial identification

Computer Vision

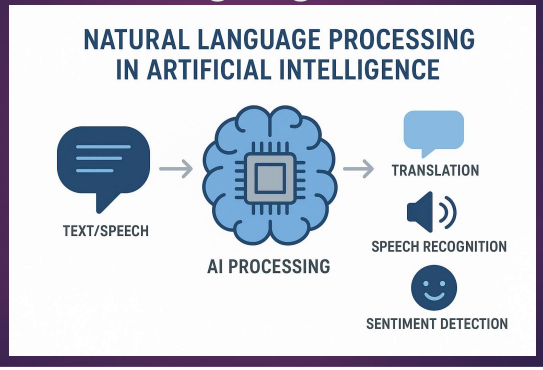
Advantages:

- Reduces human error
- Increases speed and accuracy
- Enables automation in multiple industries

Future scope:

- Integration with augmented reality (AR) and robotics
- Advanced deep learning models for real-time vision systems
- Smarter and safer autonomous systems

Natural Language Processing



Natural Language Processing

Definition:

Natural language processing (NLP) is a branch of artificial intelligence that enables machines to understand, interpret, and generate human language.

Goal:

To bridge the communication gap between humans and computers using natural (spoken or written) language.

Examples:

Chatbots, voice assistants (alexa, siri), language translation tools (google translate).

Natural Language Processing

Major components of NLP

Speech recognition – converts spoken words into text.

Syntax analysis (parsing) – analyzes grammatical structure.

Semantics analysis – determines the meaning of sentences.

Pragmatics – understands context and intent.

Sentiment analysis – detects emotions or opinions in text.

Natural Language Processing

How NLP works

Input: human language (text or voice).

Preprocessing: tokenization, stop-word removal, stemming, etc.

Feature extraction: identifying keywords, parts of speech, entities.

Model application: machine learning/deep learning models (like bert, gpt).

Output: meaningful text, translation, response, or summary.

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Natural Language Processing

- Chatbots and virtual assistants
- Machine translation
- Text summarization
- Spam detection in emails
- Voice command systems
- Customer feedback analysis

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Natural Language Processing

Advantages:

Enables human-computer communication

Improves accessibility (speech-to-text, text-to-speech)

Automates text-based tasks

Future scope:

Real-time multilingual communication

Emotionally intelligent AI

Smarter conversational agents integrated with iot

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Robotics

Definition:

robotics is a branch of artificial intelligence that deals with the design, construction, and operation of robots — intelligent machines capable of performing tasks autonomously or semi-autonomously.

Goal:

to create smart machines that can assist or replace humans in performing repetitive, dangerous, or complex tasks.

Examples:

industrial robots, humanoid robots, autonomous drones.

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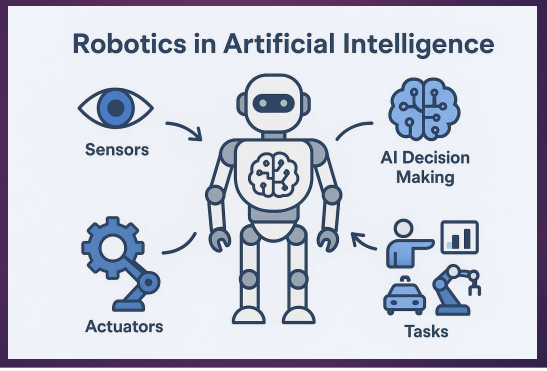
Robotics



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Robotics

Components of an intelligent robot

Sensors: collect information from the environment (e.G., Cameras, LIDAR, infrared).

Actuators: carry out physical actions (motors, arms, wheels).

Controller: the brain of the robot — processes input and sends commands.

Ai algorithms: used for reasoning, decision-making, and learning.

Power supply: provides energy to operate sensors and motors.

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Robotics

Role of artificial intelligence in robotics

Enables **perception** (seeing and understanding surroundings).

Allows **decision-making** based on data.

Supports **learning from experience** through machine learning.

Helps in **natural interaction** using nlp and gesture recognition.

Improves **autonomous navigation** (self-driving vehicles, drones).

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Robotics

Applications of robotics

Industry: assembly line automation, welding, packaging.

Healthcare: surgery assistance, rehabilitation, patient care.

Space exploration: mars rovers, satellite maintenance.

Autonomous vehicles: self-driving cars.

Service robots: cleaning, delivery, and security robots.

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Robotics

Advantages:

Increases efficiency and precision

Reduces human error

Performs dangerous or repetitive tasks safely

Future scope:

Integration with AI and iot for smarter decision-making

Emotionally aware humanoid robots

Advanced robotics for agriculture, defense, and healthcare