AI MODULE 1

Introduction to Artificial Intelligence

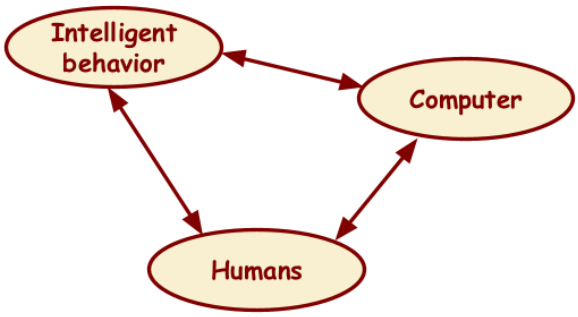
-SAMI THAKUR

1] Artificial Intelligence (AI):

- AI is an attempt of reproduction of human reasoning and intelligent behavior by computational methods.
- AI try to mimic human cognitive functions to perform tasks, learn from experiences, adapt to new information, and automate processes, significantly impacting various aspects of life and industries.

Examples of Artificial Intelligence

1. **Virtual Personal Assistants**: Popular examples like Siri, Google Assistant, and Amazon Alexa utilize AI to understand and respond to user commands.
2. **Autonomous Vehicles**: AI powers the development of self-driving cars, trucks, and drones. Companies like Tesla, Waymo, and Uber are at the forefront of this technology, using AI algorithms to analyse sensory data from cameras, radar, and lidar to make real-time driving decisions.
3. **Healthcare Diagnosis and Treatment**: AI algorithms are used to analyse medical data, including patient records, imaging scans, and genetic information, to assist healthcare professionals in diagnosing diseases and planning treatments.
4. **Recommendation Systems**: Online platforms like Netflix, Amazon, and Spotify utilize AI to analyse user behaviour and preferences.



2] AI Perspectives:

Discipline that systematizes and automates reasoning processes to create machines that:

Act like humans	Act rationally
Think like humans	Think rationally

1. **Acting Humanly**:
    - This perspective focuses on creating AI systems that mimic human behavior. The Turing Test, proposed by Alan Turing, is a classic example. If a machine can engage in a conversation that is indistinguishable from a conversation with a human, it is said to be acting humanly. Examples include chatbots and virtual assistants that try to simulate human-like interactions.
2. **Thinking Humanly**:
    - This perspective is concerned with creating AI that thinks like humans. Cognitive modeling aims to understand and replicate human thought processes. It involves studying how humans think and solve problems and then designing algorithms that mimic these cognitive processes. This approach often involves interdisciplinary research, combining insights from psychology, neuroscience, and computer science.
3. **Acting Rationally**:
    - This perspective focuses on building AI systems that act rationally to achieve their goals. Rational agents are designed to make decisions that maximize their expected utility based on the information available. This approach is closely related to decision theory and game theory. Examples include AI systems used in strategic games, autonomous vehicles, and recommendation systems.
4. **Thinking Rationally**:
    - This perspective emphasizes creating AI that reasons logically. The goal is to develop systems that can make correct inferences and solve problems using formal logic. This approach draws heavily on fields such as mathematics and formal logic. Examples include expert systems and theorem provers that use logical rules to derive conclusions from given premises.

In summary, AI can be designed to either act or think like humans or to act or think rationally. Each perspective offers unique insights and applications, contributing to the broader understanding and development of AI technologies.

3] History of AI: A Brief Overview:

1943: Early Beginnings

- **McCulloch & Pitts**: Proposed the Boolean circuit model of the brain, laying the groundwork for neural networks.

1950: Turing's Contributions

- **Alan Turing**: Published "Computing Machinery and Intelligence," introducing key concepts such as the Turing Test, machine learning, genetic algorithms, and reinforcement learning.

1956: Birth of AI

- **John McCarthy**: Organized the Dartmouth College conference, where the term "Artificial Intelligence" was adopted, marking the official start of AI as a field.

1950s: Initial Promise

- **Early AI Programs**:
    - **Samuel's Checkers Program**: Demonstrated machine learning in games.
    - **Newell & Simon's Logic Theorist**: First program to mimic human problem-solving.

1955-1965: Great Enthusiasm

- **Newell & Simon**: Developed the General Problem Solver (GPS), aimed at solving a wide range of problems.
- **Gelertner**: Created the Geometry Theorem Prover.
- **McCarthy**: Invented LISP, a programming language still used in AI.

1966-1973: Reality Dawns

- Realization that many AI problems are more complex and intractable than initially thought.
- Limitations of early neural network methods became apparent, leading to a temporary decline in neural network research.

1969-1985: Adding Domain Knowledge

- Development of knowledge-based systems and rule-based expert systems like DENDRAL (for chemical analysis) and MYCIN (for medical diagnosis). However, these systems were brittle and did not scale well.

1986: Rise of Machine Learning

- Neural networks regained popularity.
- Significant advances in machine learning algorithms and applications emerged.

1990: Role of Uncertainty

- Introduction of Bayesian networks as a framework for knowledge representation, allowing AI to handle uncertainty more effectively.

1995: AI as Science

- Integration of learning, reasoning, and knowledge representation.
- AI methods began to be widely applied in fields such as computer vision, natural language processing, and data mining.

This timeline highlights the key milestones in the development of AI, showcasing its evolution from early theoretical models to practical applications and advanced learning algorithms.

5] The State of The Art in AI:

Game Playing:

- **Deep Blue**: In 1997, IBM's Deep Blue defeated the reigning world chess champion, Garry Kasparov, showcasing the power of AI in strategic game playing.

Autonomous Planning and Scheduling:

- **NASA's Autonomous Planning Program**: Controlled the scheduling of operations for a spacecraft, demonstrating AI's capability in managing complex tasks autonomously.

Autonomous Control:

- **ALVINN (Autonomous Land Vehicle In a Neural Network)**: A computer vision system trained to steer a car, achieving "No Hands Across America" by driving autonomously 98% of the time from Pittsburgh to San Diego.

Logistics Planning:

- **DART (Dynamic Analysis and Replanning Tool)**: Used by US forces during the 1991 Gulf War for logistics planning and scheduling, managing up to 50,000 vehicles, cargo, and personnel efficiently.

Language Understanding and Problem Solving:

- **Proverb**: An AI system that solves crossword puzzles better than most humans, illustrating advancements in natural language understanding and problem-solving capabilities.

Diagnosis:

- **Medical Diagnosis Systems**: AI systems using probabilistic analysis have achieved expert-level performance in various medical fields, aiding in accurate diagnosis and treatment planning.

These examples highlight the diverse and powerful applications of AI across different domains, reflecting the significant advancements in AI technology and its practical impact on real-world problems.

6] Ethics in AI

1. Fairness and Bias:

- **Fairness**: Ensuring AI systems treat all individuals and groups equitably, without favoritism or prejudice.
- **Bias**: Addressing biases in AI models that can result from biased training data or algorithmic design, which can lead to unfair outcomes for certain groups.

2. Transparency and Explainability:

- **Transparency**: Making AI systems and their decision-making processes understandable to users and stakeholders.
- **Explainability**: Ensuring that AI decisions can be explained in a way that humans can understand, fostering trust and accountability.

3. Privacy and Data Protection:

- **Privacy**: Safeguarding the personal data used by AI systems to prevent misuse and unauthorized access.
- **Data Protection**: Implementing measures to ensure that data is securely stored, processed, and shared in compliance with relevant regulations.

4. Accountability and Responsibility:

- **Accountability**: Identifying who is responsible for the actions and decisions made by AI systems, including developers, operators, and organizations.
- **Responsibility**: Ensuring that there are mechanisms in place for addressing harm or errors caused by AI systems.

5. Safety and Security:

- **Safety**: Ensuring that AI systems operate reliably and do not cause harm to humans or the environment.
- **Security**: Protecting AI systems from malicious attacks, such as hacking or manipulation, which could compromise their integrity and functionality.

6. Human-Centered AI:

- **Human-Centered Design**: Designing AI systems that enhance human capabilities and well-being, rather than replacing or undermining human roles.
- **Human Oversight**: Maintaining human oversight and control over AI systems, especially in critical areas such as healthcare, finance, and law enforcement.

Main Areas of AI

- Knowledge representation (including formal logic)
- Search, especially heuristic search (puzzles, games)
- Planning
- Reasoning under uncertainty, including probabilistic reasoning
- Learning
- Agent architectures
- Robotics and perception
- Natural language processing