جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية العلوم
قسم الكيمياء الحياتية

Lecture: (4)

Introduction to AI

Subject: Computer Science (II)
Level: Second
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Introduction to AI:-

- **Introduction to AI**
- **Definition of AI**
- **History of AI**
- **AI techniques and Approaches**
- **Challenges and Ethical Considerations.**
- **AI in Chemistry Science**
- **AI in Biology Science**

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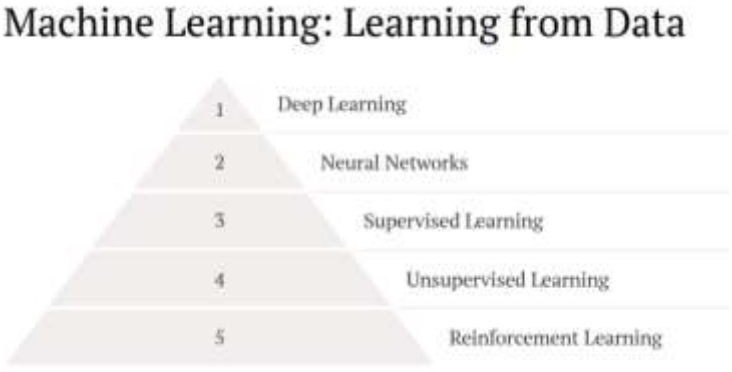
Introduction to Artificial Intelligence (AI)

Artificial Intelligence (AI) is the field of computer science dedicated to creating systems capable of performing tasks that typically require human intelligence. These tasks include problem-solving, decision-making, learning, understanding language, and recognizing patterns. AI has evolved significantly over the past decades, influencing various industries, from healthcare and finance to autonomous vehicles and entertainment.

Key Concepts of AI

1. **Machine Learning (ML)** – A subset of AI that enables systems to learn from data and improve over time without being explicitly programmed.
2. **Deep Learning (DL)** – A more advanced form of ML using neural networks to process complex patterns, often applied in image recognition and natural language processing.
3. **Natural Language Processing (NLP)** – The ability of AI to understand, interpret, and generate human language, seen in chatbots and voice assistants.
4. **Computer Vision** – AI's capability to analyze and interpret images and videos, used in facial recognition and medical imaging.
5. **Expert Systems** – AI applications designed to mimic human decision-making, used in medical diagnosis and financial forecasting.



Applications of AI

- **Healthcare**: AI assists in diagnosing diseases, analyzing medical images, and personalizing treatment plans.
- **Finance**: AI is used in fraud detection, algorithmic trading, and risk assessment.
- **Autonomous Systems**: AI powers self-driving cars and robotic automation.
- **Customer Service**: AI-driven chatbots and virtual assistants improve user interactions.

History of Artificial Intelligence (AI)

The development of Artificial Intelligence (AI) spans decades, evolving through multiple stages of innovation, breakthroughs, and challenges. Below is an overview of AI's historical progression.

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1. Early Foundations (Pre-1950s)

The idea of intelligent machines dates back centuries, with myths and philosophical discussions about artificial beings. Some key early influences include:

- **Ancient Philosophies**: Greek myths about automatons and mechanical beings.
- **Mathematical Foundations**: In the 19th century, **George Boole** developed Boolean algebra, forming the basis of logical reasoning in AI.
- **Alan Turing (1936)**: Introduced the concept of the "Turing Machine" and later proposed the **Turing Test (1950)** to assess machine intelligence.

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2. Birth of AI (1950s–1960s)

The field of AI officially began in the mid-20th century:

- **1956 – Dartmouth Conference**: Organized by **John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon**, this event is considered the birth of AI.
- **Early Programs**:
  - **Logic Theorist (1955)** – First AI program by Allen Newell and Herbert Simon.
  - **General Problem Solver (1957)** – An early AI system designed for solving logic problems.
- **McCarthy coined the term "Artificial Intelligence"**, emphasizing machine-based problem-solving.

3. AI Boom and Challenges (1960s–1970s)

- **Successes**:
  - Development of **expert systems** that could mimic human decision-making.
  - **ELIZA (1966)** – An early chatbot by Joseph Weizenbaum, simulating human conversation.
- **Limitations**:
  - AI struggled with **natural language understanding and real-world applications** due to limited computing power.
  - Government funding declined, leading to the first **AI winter** (1970s).

AI Techniques and Approaches

1. Symbolic AI (Rule-Based Systems)

- Uses logic and predefined rules (e.g., expert systems).
- Strength: Transparent decision-making.
- Weakness: Struggles with complex, uncertain data.

2. Machine Learning (ML)

- AI learns from data without explicit programming.
- Types:
  - **Supervised Learning** (labeled data, e.g., classification).
  - **Unsupervised Learning** (finds patterns, e.g., clustering).
  - **Reinforcement Learning** (learns through rewards, e.g., robotics).

3. Deep Learning (DL)

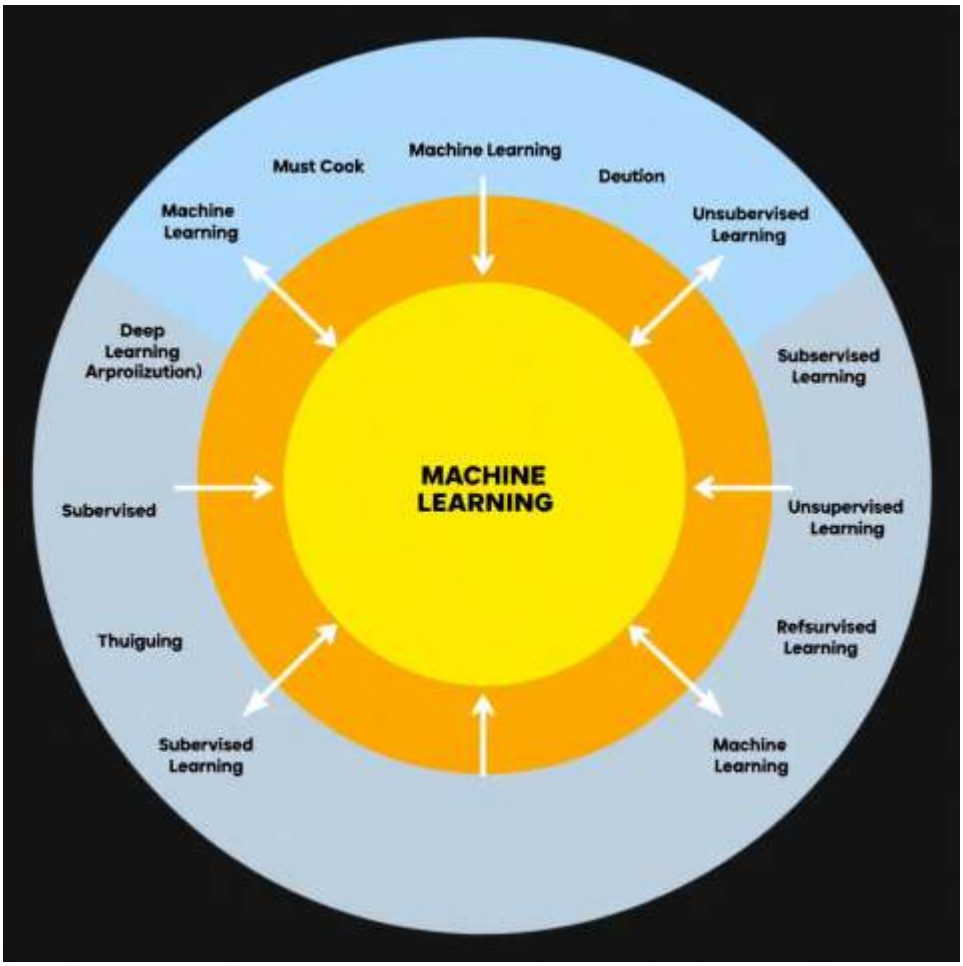
- Uses neural networks to process complex data (e.g., images, speech).
- Examples: CNNs (image recognition), RNNs (sequential data), Transformers (NLP).

4. Evolutionary Algorithms (EA) & Swarm Intelligence

- Inspired by natural selection and group behavior (e.g., genetic algorithms, ant colony optimization).
- Used for optimization problems.

5. Hybrid AI

- Combines multiple AI techniques for better performance (e.g., Neuro-Symbolic AI, AI + IoT).



Challenges and Ethical Considerations in AI

Challenges:

- **Data Issues**: Poor quality, bias, privacy concerns.
- **Computational Costs**: High energy consumption and expensive hardware.
- **Interpretability**: Many AI models are "black boxes" with unclear decision-making.
- **Bias & Generalization**: AI may inherit biases and struggle with real-world adaptation.
- **Lack of Human Reasoning**: AI lacks common sense and causal understanding.

Ethical Considerations:

- **Bias & Fairness**: AI can reinforce discrimination.
- **Privacy & Surveillance**: AI can violate user privacy.
- **Job Displacement**: Automation may replace human jobs.
- **Misinformation**: AI-generated deepfakes and fake news.
- **Military Use**: Ethical concerns in autonomous weapons.
- **Regulation**: Lack of global AI policies and governance.

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AI in Chemistry Science

1. Drug Discovery

- Speeds up the identification of new drug candidates.
- Optimizes drug properties for better effectiveness and safety.

2. Materials Science

- Helps discover novel materials with specific properties.
- Accelerates material design and testing.

3. Chemical Synthesis

- Optimizes reaction conditions and synthesis pathways.
- Improves efficiency while reducing waste and costs.

AI in Biology

AI is increasingly applied in biology to accelerate research and improve understanding of biological systems.

1. Genomics

- AI analyzes genetic data to identify mutations, gene expressions, and disease markers.
- It aids in **personalized medicine** by tailoring treatments based on genetic profiles.

2. Drug Discovery

- AI speeds up the identification of new drug candidates and optimizes drug properties.
- It helps predict molecular interactions and repurpose existing drugs.

3. Medical Diagnostics

- AI improves diagnostic accuracy through image recognition (e.g., X-rays, MRIs) and predictive analytics.
- It assists in early detection of diseases like cancer, diabetes, and neurological disorders.

4. Proteomics and Metabolomics

- AI analyzes protein structures, functions, and interactions, enabling insights into diseases and potential treatments.
- It also helps in studying metabolites in biological systems for disease biomarkers.

5. Ecology and Environmental Biology

- AI models ecosystems and predicts the impact of environmental changes on biodiversity.
- It assists in wildlife conservation by analyzing species population dynamics.