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Chapter 1 Definitions of Artificial Intelligence (AI)

1. Definitions:

- **Artificial intelligence** can be defined as a set of **theories**, **methods** and **techniques** aimed at designing **machines capable of performing tasks** that normally require human intelligence.

- These tasks include, for example, **reasoning**, **learning**, **problem solving**, **perception**, pattern recognition, **natural language understanding** and **decision-making.**

1. Definitions:

- **Artificial Intelligence (AI)** is a branch of computer science dedicated to the automation of intelligent behavior. It aims to design systems capable of performing tasks that normally require human intelligence, such as problem-solving, decision-making, and learning.
- According to ***Minsky (1968), AI is the science of making machines perform tasks that would require intelligence if done by humans***.
- **Boden (1977)** defines ***AI as the use of machines to perform actions considered intelligent by human standards***.

1. Definitions:

- **Bellman (1978)** describes ***AI as the automation of activities associated with human thinking, including reasoning and learning.***
- **(Winston, 1992) "The study of the mechanisms that enable an agent to perceive, reason, and act."** ***(Nilsson, 1998)*****"The study of entities that exhibit intelligent behavior."**
- The term **"artificial"** refers to a human-made creation, designed according to a precise method rather than occurring naturally.

1. Definitions:

- In computer science, this applies to **artificial systems or agents** capable of simulating intelligent behaviors such as **perceiving**, **reasoning**, **learning** and decision-making.
- These agents, whether software or robotic, are designed to be **autonomous, efficient and reliable** illustrating the core role of artificial intelligence in modern computing systems.

2.Historical Overview

- The history of AI can be summarized in key stages:
- **1950 – Alan Turing proposes the Turing Test**
  - Turing asks: *"Can machines think?"*
  - The test evaluates whether a machine can **imitate human behavior** to the point that a human judge cannot distinguish it from a human.
- **1956 – Dartmouth Conference**
  - Organized by John McCarthy and other pioneers.
  - The term **Artificial Intelligence** is officially used for the first time.
  - First programs: solving simple math problems, proving theorems, early chess programs.
  - Marks the **official academic birth of AI**.

2.Historical Overview

- **1960–1970: Early successes**
  - Development of **expert systems** and programs for problem-solving and games.
- **1980–1990: Expert systems and AI revival**
  - Commercial and industrial applications emerge.
  - Introduction of **basic machine learning**.
- **2000–today: Modern AI explosion**
  - **Big Data** and increased computing power drive AI growth.
  - Development of **Machine Learning**, **Deep Learning**, **NLP**, **Computer Vision** and **Robotics**.
  - AI becomes ubiquitous in daily life and industry.

❖ 3. Types of AI

◉ 3.1 Weak AI (Narrow AI)

- Designed for **specific tasks only.**
- Does not possess general intelligence.
- **Examples:**

Simple decision system for grading

```
def grade_decision(score):
    if score >= 10:
        return "Pass"
    else:
        return "Fail"

print(grade_decision(12))
```

- **Explanation**
- The system performs **only one task** (pass/fail decision)
- No learning, no reasoning
- Works only in a **specific context**
- This is **Weak AI** because it imitates decision-making without intelligence.

3. Types of AI

3.2 Strong AI (General AI) :

- **Strong AI** refers to a machine that can:
- Understand
- Reason
- Learn any task
- Adapt like a human
- Strong AI is a **theoretical concept** and does not exist today.
- **Example:** Still theoretical, not yet realized.

❖ 3. Types of AI

◉ 3.3 Symbolic AI

- Based on **logic, rules, and symbols.**
- Used in **expert systems** to solve complex problems using predefined rules.
- **Example:** University expert system: student orientation

```
def orientation(avg):
    if avg >= 15:
        return "Scientific Studies"
    elif avg >= 10:
        return "Technical Studies"
    else:
        return "Vocational Training"

print(orientation(14))
```

- Rules are clear and explainable
- No learning from data
- Easy to validate and modify

❖ 3. Types of AI

◉ 3.3 Symbolic AI

- **Example 02:** Logical reasoning (AND operator)

```
def access_allowed(card, password):
    if card and password:
        return "Access Granted"
    else:
        return "Access Denied"

print(access_allowed(True, True))
```

- This represents **logical reasoning**, a core idea of Symbolic AI.

❖ 3. Types of AI

◉ 3.4 Connectionist AI

- **Examples:** Learning a logical AND function using a Perceptron

```python
from sklearn.linear_model import Perceptron

# Input data
X = [[0,0], [0,1], [1,0], [1,1]]
y = [0, 0, 0, 1]

model = Perceptron(max_iter=1000)
model.fit(X, y)

print(model.predict([[1, 1]]))
```

- The system **learns from examples**
- No IF-THEN rules are written
- Knowledge is stored in **weights**

This is **Connectionist AI.**

4. Concrete Examples of Artificial Intelligence in Everyday Life

- Artificial Intelligence (AI) is present in many everyday activities. It helps machines perform tasks that normally require human intelligence, such as learning, understanding language, recognizing images, and making decisions.

Everyday life examples

- **1. Smartphones :** Face recognition (Apple Face ID, Samsung)
- Voice assistants (Siri, Google Assistant),Predictive text and auto-correction
- **2. Online Services :** Recommendations (Netflix, YouTube, Amazon), Email spam detection (Gmail, Outlook)
- **3. Transportation :** GPS traffic prediction (Google Maps, Waze)
- Autonomous driving (Tesla, Waymo) Smart traffic lights.

4. Concrete Examples of Artificial Intelligence in Everyday Life

Everyday life examples

- **4. Healthcare :** Medical image analysis (X-rays, MRI),Predictive analytics (disease risk) ;Robotic surgery
- **5. Education :** Intelligent tutoring systems ,Automatic grading , Learning analytics
- **6. Industry :** Predictive maintenance , Quality control (defective product detection), Warehouse robots (Amazon)

- **5. AI Domains**

5.1 Machine Learning (ML)

- **Definition**
  Machine Learning enables computers to learn from data and improve their performance without explicit programming.
- **Concrete examples**
- Email spam detection
- Movie and product recommendation systems
- Fraud detection in banking systems

- **5. AI Domains**

5.2 Natural Language Processing (NLP)

- **Definition**
  Natural Language Processing allows computers to understand, process, and generate human language.
- **Concrete examples**
- Voice assistants (Siri, Google Assistant)
- Automatic translation systems
- Chatbots for customer service

- **5. AI Domains**
- **5.3 Computer Vision (CV)**
- **Definition**
  Computer Vision enables machines to interpret and analyze visual information from images and videos.
- **Concrete examples**
- Face recognition on smartphones
- Traffic sign recognition
- Medical image analysis

- **5. AI Domains**
- **5.4 Robotics**
- **Definition**
  Robotics combines AI with mechanical systems to create intelligent machines capable of interacting with the physical world.
- **Concrete examples**
- Robot vacuum cleaners
- Industrial robotic arms
- Autonomous delivery robots
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5. AI Applications in Different Sectors

Medicine

- Disease diagnosis support
- Medical image analysis (X-rays, MRI)
- Robot-assisted surgery

Transportation

- Autonomous vehicles
- Traffic management systems
- Intelligent navigation (GPS)

Education

- Intelligent tutoring systems
- Automatic exam grading
- Student performance analysis

5. AI Applications in Different Sectors

Industry

- Predictive maintenance of machines
- Quality control using computer vision
- Smart factories and automation