ARTIFICIAL INTELLIGENCE

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Unit-1 : Introduction (Covered)

- Introduction to Artificial Intelligence
  - Data vs Information
  - DIKW Pyramid
  - Knowledge Vs Understanding
  - Knowledge VS Intelligence
  - Human Intelligence
  - Attributes of Intelligence
  - What is Artificial Intelligence?
  - Goals of AI
  - Different approaches of Artificial Intelligence
  - View of AI
  - What exactly is AI?
  - Building Intelligent (Rational) Agents
  - AI vs HI

The Foundation of AI
Philosophy, Mathematics, Economics, Neuroscience, Psychology, Computer Science, Linguistics

History of AI
Inductive Learning, LISP programming language, The resolution proof method for FOL, Perceptrons, Logic theorist, GPS, Perceptron Learning, DENDRAL, LUNAR, R1, FRAMES, Backprop, Belief networks

Applications of AI
Gaming, Natural Language Processing, Expert Systems, Vision Systems, Speech Recognition, Handwriting Recognition, Intelligent Robots
Intelligent Agents

Structure of Intelligent Agents

![Diagram of intelligent agent interaction with environment through sensors and effectors.](image)
What is an Agent & its Environment?

• An AI system is composed of an agent and its environment.
• The agents act in their environment.
• The environment may contain other agents.
• An **agent** is anything that
  – can identify its **environment**
    • through **sensors** and
  – acts upon that environment
    • through **effectors**.
What kind of Agents....?

- Human agent
- Robotic agent
- Software agent
Human Agent

• **Sensory organs** such as
  – eyes, ears, nose, tongue and skin
  • Parallel to the **Sensors**

• **Other organs** such as
  – hands, legs, mouth,
  • for effectors.
Robotic Agent

• A **robotic agent** replaces
  — cameras and infrared range finders
    • for the sensors, and
  — various motors and actuators
    • for effectors.

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Software Agent

• A **software** agent has encoded bit strings as its programs and actions.
Agent Terminology

• **Performance Measure of Agent** –
  – It is the criteria, which determines how successful an agent is.

• **Behavior of Agent** –
  – It is the action that agent performs after any given sequence of percepts.

• **Percept** –
  – It is agent’s perceptual inputs at a given instance.

• **Percept Sequence** –
  – It is the history of all that an agent has perceived till date.

• **Agent Function** –
  – It is a map from the precept sequence to an action.
Rationality
(तर्कशक्ति)

Reasonable

Sensible

Judgment
Objective of Rationality

• Rationality is concerned with
  – **expected** actions and results
  – depending upon *what the agent has perceived* (understood).

*Performing actions with the aim of obtaining useful information is an important part of rationality.*
What is Ideal Rational Agent?

• An ideal rational agent is the one, which is capable of doing expected actions to maximize its performance measure, on the basis of –
  – Its percept sequence
  – Its built-in knowledge base
Important Four Factors

1. The **performance measures**, which determine the degree of success.
2. Agent’s **Percept Sequence** till now.
3. The agent’s **prior knowledge about the environment**.
4. The **actions** that the agent can carry out.
What is PEAS?

• A rational agent always performs right action, where the right action means the action that
  – causes the agent to be most successful in the given percept sequence.

• The problem the agent solves is characterized by
  1. Performance Measure,
  2. Environment,
  3. Actuators, and
  4. Sensors
The Structure of Intelligent Agents

Agent’s structure can be viewed as – $A^3$

1. Agent
   = Architecture + Agent Program

2. Architecture
   = the machinery that an agent executes on.

3. Agent Program
   = an implementation of an agent function.
Simple Reflex Agents

• They choose actions only –
  – based on the current percept.

• They are rational only
  – if a correct decision is made only on the basis of current precept.

• Their environment
  – completely observable.
Condition-Action Rule

Environment

Sensors

How is the world like now?

What actions I need to do?

Effectors

Agent

Condition-Action Rule

30/08/2017

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Model Based Reflex Agents

• They use a model of the world to choose their actions. They maintain an internal state.

• Model –
  – The knowledge about how the things happen in the world.

• Internal State –
  – It is a representation of unobserved aspects of current state depending on percept history.

• Updating the state requires the information about –
  – How the world evolves.
  – How the agent’s actions affect the world.
Cont..
Goal Based Agents

• They choose their actions in order to achieve goals.
• Goal-based approach is more flexible than reflex agent since the knowledge supporting a decision is explicitly modeled, thereby allowing for modifications.
• Goal –
  – *It is the description of desirable situations.*
Cont..

Environment

Sensors

How is the world like now?

How world evolves

What happens if I do action A

What my actions do

What actions I need to do?

Goals

Effectors

Agent

State
Utility Based Agents

• They choose actions based on a preference (utility) for each state.

• Goals are insufficient when –
  – There are conflicting goals, out of which only few can be achieved.
  – Goals have some uncertainty of being achieved and you need to weigh likelihood of success against the importance of a goal.
Cont..
Nature of Environments

- Some programs operate in the entirely artificial environment confined to keyboard input, database, computer file systems and character output on a screen.

- In contrast, some software agents (software robots or softbots) exist in rich, unlimited softbots domains.
  - The simulator has a very detailed, complex environment. The software agent needs to choose from a long array of actions in real time.
• The most famous artificial environment is the **Turing Test environment**, in which one real and other artificial agents are tested on equal ground.

• This is a **very challenging environment** as it is highly difficult for a software agent to perform as well as a human.
Turing Test

• The success of an intelligent behavior of a system can be measured with Turing Test.

• Two persons and a machine to be evaluated participate in the test. Out of the two persons, one plays the role of the tester. Each of them sits in different rooms. The tester is unaware of who is machine and who is a human. He interrogates the questions by typing and sending them to both intelligences, to which he receives typed responses.

• This test aims at fooling the tester.
  – If the tester fails to determine machine’s response from the human response, then the machine is said to be intelligent.

→ Properties of Environment
Properties of Environment

- Discrete / Continuous
- Observable / Partially Observable
- Static / Dynamic
- Single agent / Multiple agents
- Accessible / Inaccessible
- Deterministic / Non-deterministic
- Episodic / Non-episodic
• **Discrete / Continuous** – If there are a **limited number of distinct**, clearly defined, states of the environment, the environment is **discrete** (For example, chess); otherwise it is **continuous** (For example, driving).

• **Observable / Partially Observable** – If it is possible to **determine the complete state** of the environment at each time point from the percepts it is **observable**; otherwise it is only **partially observable**.
Cont..

- **Static / Dynamic** – If the environment does not change while an agent is acting, then it is static; otherwise it is dynamic.
- **Single agent / Multiple agents** – The environment may contain other agents which may be of the same or different kind as that of the agent.
Cont..

• **Accessible / Inaccessible** – If the agent’s sensory apparatus can have **access to the complete state** of the environment, then the **environment is accessible** to that agent.

• **Deterministic / Non-deterministic** – If the **next state** of the environment is **completely determined** by the current state and the actions of the agent, then the environment is **deterministic**; otherwise it is **non-deterministic**.
• Episodic / Non-episodic –

– In an episodic environment, each episode consists of the agent perceiving and then acting.
– The quality of its action depends just on the episode itself.
– Subsequent episodes do not depend on the actions in the previous episodes.

– *Episodic environments are much simpler because the agent does not need to think ahead.*