

## Assignment No: 1

Q.1 Give one definition on AI for each of the following approaches :

i) Acting Humanly

⇒ The study of how to make computers do things at which, at the moment, people are better.

ii) Thinking Humanly

⇒ The exciting new effort to make computers think... machines with minds, in the full and literal sense.

iii) Acting Rationally

⇒ Computation Intelligence is the study of the design of intelligent agents.

iv) Thinking Rationally

⇒ The study of mental facilities through the use of computational models.

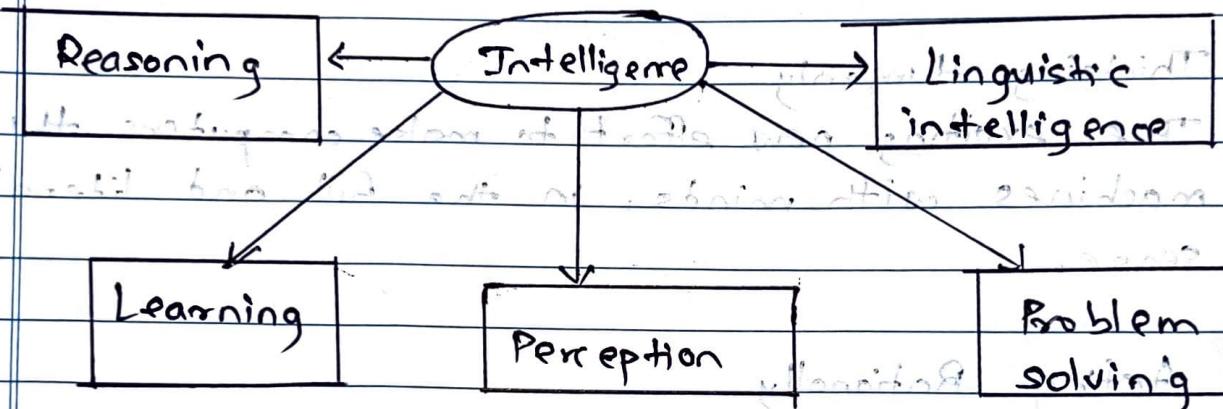
Q.2 Explain the components of AI system in detail.

- AI is a vast field for research and it has got applications in almost all possible domains.

- By keeping this in mind, components of AI can be identified as follows:

- 1) Perception
- 2) Knowledge representation
- 3) Learning

- 4) Reasoning
- 5) Problem Solving
- 6) Natural Language Processing (NLP)



### ⇒ Perception

- ⇒ In order to work in the environment, intelligent agents need to scan the environment and the various objects in it.
- Agents scans the environment using various sense organs like camera, temperature sensor, etc.

### 2) Knowledge representation

- ⇒ The information obtained from various environment through sensors may not be in the format required by the system.
- Hence, it need to be represented in standard formats for further processing like learning various patterns, deducing inference, etc.

### 3) Learning

⇒ Learning is a very essential part and it happens in various forms. The simplest form of learning is by trial and error.

- In this form the program remembers the action that has given desired output and discards the other trial actions and learns by itself.
- It is also called as unsupervised learning.

### 4) Reasoning

- ⇒ Reasoning is also called as "logic" or generating "inference" from the given set of facts.
- Reasoning is carried out based on strict rule of validity to perform a specified task.

### 5) Problem-solving

- ⇒ AI addresses huge variety of problems. For example, finding out winning moves on the board games, planning actions in order to achieve the defined task, identifying various objects from given images, etc.

### 6) NLP

- ⇒ Natural Language Processing, involves machine or robots to understand and process the language that human speak, and infer knowledge from the speech input.

Q.3 Write short note on categorization of AI.

- ⇒ 1) Based on capabilities
  - 1) Weak AI
    - ⇒ Weak AI is AI that specializes in one area. It is not a general purpose intelligence.
  - 2) An Intelligent agent is built to solve a particular problem or to perform a specific task is termed as narrow intelligence or weak AI.
- 2) Strong AI
  - ⇒ Strong AI or general AI refers to an intelligence demonstrated by machines in performing any intellectual task that a human can perform.
  - ⇒ Developing strong AI is much harder than developing weak AI.
- 3) Artificial Super Intelligence
  - ⇒ As defined by leading AI thinker Nick Bostrom, "Super intelligence is an intellect that is much smarter than the best human brains in practically every field, including scientific creativity, general wisdom and social skills."
  - ⇒ Artificial super intelligence is the ultimate power of AI.

### • Based on functionalities

#### 1) Reactive AI

- Reactive AI systems operate based on predefined rules and respond to specific inputs with predetermined outputs.
- Chess-playing programs that follow fixed algorithms are examples of reactive AI.

#### 2) Limited Memory AI

- Limited Memory AI systems, also known as narrow AI, with memory, can learn and make decisions based on historical data.
- Self-driving cars, which learn from real-world driving scenarios, exemplify limited memory AI.

#### 3) Theory of Mind Machines

- Theory of Mind refers to the ability to understand and attribute mental states, such as beliefs and intentions, to oneself and others.
- Theory of Mind Machines aim to develop AI systems capable of understanding and predicting human emotions, thoughts and intentions.

#### 4) Self-Aware AI

- Self-Aware AI represents the highest level of artificial intelligence, where machines possess consciousness and self-awareness.

Q.4 Explain problem formulation with the help of example.

⇒ Problems can be defined formally using five components as follows:

- 1) Initial state
- 2) Actions
- 3) Successor function
- 4) Goal state
- 5) Path cost

1) Initial state

⇒ The initial state is the one in which the agent starts in it to begin execution.

2) Actions

⇒ It is the set of actions that can be executed or applicable in all possible states. A description of what each action does; the formal name for this is the transition model.

3) Successor function

⇒ It is a function that returns a state on executing an action on the current state.

4) Goal test

⇒ It is a test to determine whether the current state is goal state. In some problems the goal state can be carried out just by comparing current state with the defined

goal state, called as explicit goal state.

- Whereas, in some of the problems, state cannot be defined explicitly but needs to be generated by carrying out some computations, it is called implicit goal test.
- For e.g., In Tic-Tac-Toe game making diagonal or vertical or horizontal combination declares the winning state which can be compared explicitly; but in the case of chess game, the goal state cannot be predefined but it's a scenario called as "Checkmate", which has to be evaluated implicitly.

### b) Path cost

⇒ It is simply the cost associated with each step to be taken to reach goal state. To determine the cost to reach to each state, there is a cost function, which is chosen by the problem solving agent.

- A general solution sequence followed by a simple problem solving agent is, first it formulates the problem with the goal to be achieved, then it searches for a sequence of actions that would solve the problem, and then executes the actions one at a time.

Q.5 Explain PEA's properties in detail.

⇒

- PEA's stands for Performance Measure, Environment, Actuators, and Sensors.
- It is the short form used for performance issues grouped under Task environment.

#### 1) Performance Measure

- ⇒ It is the objective function to judge the performance of the agent.
- For example, in case of pick and place robot, number of correct parts in a bin can be the performance measure.

#### 2) Environment

- ⇒ It is the real environment where the agent need to deliberate actions.

#### 3) Actuators

- ⇒ These are the tools, equipments or organs using which agent performs actions in the environment. This works as the output of the agent.

#### 4) Sensors

- ⇒ These are the tools, equipments or organs using which agent captures the state of the environment. This works as the input of the agent.

- For e.g.: ~~To make the car intelligent~~  
Automated Car driving agent

### 1) Performance

⇒ ~~Safety~~

- a) safety: Automated system should be able to drive the car safely without dashing anywhere.
- b) Optimum speed: Automated system should be able to maintain the optimal speed depending upon the surroundings.

### 2) Environment

⇒ ~~Environment~~

#### a) Roads

- ⇒ Automated car driver should be able to drive on any kind of a road ranging from city roads to highway.

#### b) Actuators

⇒ ~~Actuators~~

- a) steering wheel: which can be used to direct car in desired direction.

- b) Brake: is used to stop the car.

#### c) Sensors

- ⇒ To take input from environment in car driving examples cameras, sonar system, GPS, engine sensors, etc. are used as sensors.

Q.6 Describe different types of environments with suitable examples.

Environment Types

Fully vs Partially observable

Deterministic vs stochastic

Episodic vs sequential

static vs dynamic

Discrete vs continuous

Single-agent vs multi-agent

⇒ Fully observable vs Partially Observable

⇒ In fully observable environments agents are able to gather all the necessary information required to take actions.

Also in case of fully observable environments agents don't have to keep records of internal states.

- Environments are called partially observable when sensors cannot provide errorless information at any given time for every internal states, as the environment is not seen completely at any point of time.

### 2) Single agent vs multi-agent

- The second type of an environment is based on the number of agents acting in the environment.  
- Whether the agent is operating on its own or in collaboration with other agents decides if it is a single agent or a multi-agent environment.

### 3) Deterministic vs stochastic

- An environment is called deterministic vs stochastic environment, when the next state of the environment can be completely determined by the previous state and the action executed by the agent.  
- Stochastic environment generally means that the indecision about the actions is enumerated in terms of probabilities.  
- That means environment changes while agent is taking actions, hence the next state of the world does not merely depends on the current state and agent's action.

#### 4) Episodic vs Sequential

- An episodic task environment is the one where each of the agent's action is divided into an atomic incidents or episodes.
- the current incident is different than the previous incident and there is no dependency between the current and the previous incident.
- In sequential environments, as per the name suggests, the previous decision can affect all future decisions.

#### 5) Static vs dynamic

- Dynamic environment changes over time, while static environments remain constant - dynamic environment could be traffic system while static environment might be a fixed puzzle.

~~Follow~~  
~~Ex~~  
~~163~~