COMPUTER ENGINEERING DEPARTMENT

AI&SC Assignment 1

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DEPT: **Computer Engineering**

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Sr. No.	Questions
1	Define Artificial Intelligence, Intelligent Agent and its types.
2	Explain PEAS Descriptors and properties of the task environment with an example.
3	Explain steps in the problem formulation with the water jug problem.
4	Explain the working of the A* algorithm with an example.
5	Consider the following facts about the dolphins. Whoever can read is literate. Dolphins are not literate. Some Dolphins are intelligent. A. Represent the above sentence in FOL. B. Convert them to clause form. C. Prove that "some who are intelligent cannot read" Using the resolution technique.
6	Illustrate forward and backwards chaining with suitable examples.

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Signature of Student

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Q1. Define Artificial Intelligence, Intelligent Agent and its types.

Ans:

- Any system capable of simulating human intelligence and thought processes is said to have "Artificial Intelligence".
- Artificial Intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI includes expert systems, natural language processing, speech recognition and machine vision.

Intelligent Agents:

- An intelligent agent is an autonomous entity which act upon an environment using sensors and actuators for achieving goals.
- An intelligent agent may learn from the environment to achieve their goals.
- A thermostat is an example of an intelligent agent.

Following are the main four rules for an AI agent.

1. Rule 1: An AI agent must have the ability to perceive the environment.
2. Rule 2: The observation must be used to make decisions.
3. Rule 3: Decision should result in an action.
4. Rule 4: The action taken by an AI agent must be a rational action.

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Types of Intelligent Agents:

① Simple Reflex Agents

- They function only in current state and do not have ability to store past state.

② Model - based Agents

- It can be respond to events based on the pre-defined conditions and it can also store the internal state based on previous events. It updates internal state at each step.

③ Goal - based Agents

- The action taken by its agents depends on distance from their goal.
- The actions are intended to reduce the distance between current state and desired state.

④ Utility Agents:

- The actions taken by the agents depends on end objectives it is used when there are multiple solutions to a problem and best alternative is to be chosen.

⑤ Learning Agents

- They have abilities to learn from past experienle. These types of agents can start from scratch, can acquire knowledge from envisonment.

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Q2. Explain PEAS descriptors and properties of the task environment with an example.

Ans:

- PEAS is a type of model on which an AI agent works upon. When we define an AI agent or rational agent, then we can group its properties under PEAS representation model.
- It is made up of four words
  1. P : Performance measure
  2. E : Environment
  3. A : Actuators
  4. S : Sensors.
- Here performance measure is the objective for the success of an agent's behavior.

- PEAS stands for Performance Measure, Environment, Actuators and sensors.

1. Performance Measure
- It is the objective function to judge the performance of an agent.

2. Environment:
- It is the real environment where the agent need to take deliberate action

3. ~~Actuators~~ Sensors
- These are the tools equipment or organs using which agent captures the state of the environment

4. Actuators:
- These are the tools, equipments or organs using which agent performs actions in the environment.

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Properties of task environment

① Fully Observable vs Partially observable

Example:

→ Chess board is fully observable, so are opponents moves.

→ Driving - environment is partially observable as whats on corner is not known.

② Deterministic vs stochastic

Example!

→ Chess - there would be only a few possible moves for a piece at current state and moves can be determined

→ Self driving cars - Actions of a self driving cars are not unique, it varies time to time.

③ Competitive vs Collaborative

Example:

→ Chess - Agents compete with each other to win multiple.

→ Self driving cars - Agents work together to avoid collision.

④ Single Agent vs Multiple Agent

Example:

→ Person left alone in a maze is an single agent.

→ Game of football is multi-agent as it involves 11 players in each team.

⑤ Dynamic vs static

Example

→ Roller coster ride is dynamic, set in motion and environment changes every instant.

→ Empty house is static as there is no change when agent enters.

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(6) Discrete vs Continuous

Example

→ Chess - discrete as it has finite number of moves

→ Self - driving cars - Actions like parking, driving cannot be numbered

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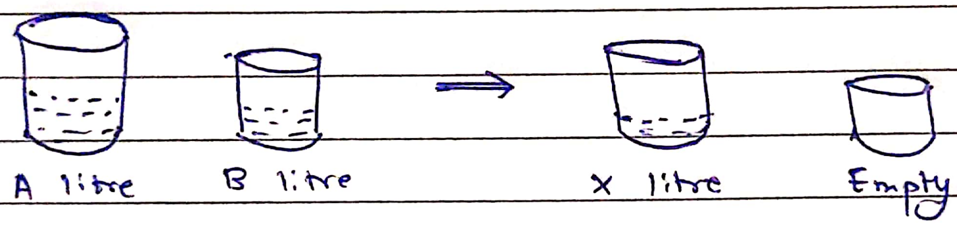
Q8. Explain steps in the problem formulation with the water jug problem.

Ans:

- Problem can be defined using five components.
  1. Initial state
  2. Actions
  3. Successor Function
  4. Goal test
  5. Path Cost

Water Jug Problem:

- There are two jugs of volume A & B like neither has meaning marked on it. There is a pump that can be used to fill jug with water. How can you get exactly x liters into A litre jug



1. Initial state
   - State in which agent starts in.
   - Initial state = Amount of water into both jugs

2. Actions
   - Set of tasks that can be executed
   - Empty large, empty small, Pour large to small, Pour small to large

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③ Successor Function

- Returns a state on executing an action.
- Change in volume of the jugs

④ Goal test

- To determine current state in goal state
- specified amount of water in both jugs

⑤ Path cost

- Cost associated with each step taken.
- Path cost = Total number of actions applied

Q4. Explain the working of the A* algorithm with example

Ans:

- A* algorithm is a searching algorithm that searches for the shortest path between the initial and the final state.
- It is used in various applications, such as maps.
- In Maps, the A* algorithm is used to calculate the shortest distance between the source (initial state) and destination (final state).

Working of A* algorithm

- Imagine a square grid which possesses many obstacles, scattered randomly. The initial and the final cell is provided. The aim is to reach the final cell in the shortest amount of time.

- A* algorithm has 3 parameters

① g: The cost of moving from the initial cell to the current cell. Basically, it is the sum of all the cells that have been visited since leaving the first cell.

② h: Also known as heuristic value, it is the estimated cost of moving from the current cell to the final cell. The actual cost cannot be calculated until the final cell is reached. Hence, h is the estimated cost.

③ f: It is the sum of g and h. So, $f = g + h$

- The way that the algorithm makes its decision is by taking the f-value into account. The algorithm selects the smallest f-valued cell and moves to that cell. This process continues until the algorithm reaches its goal cell

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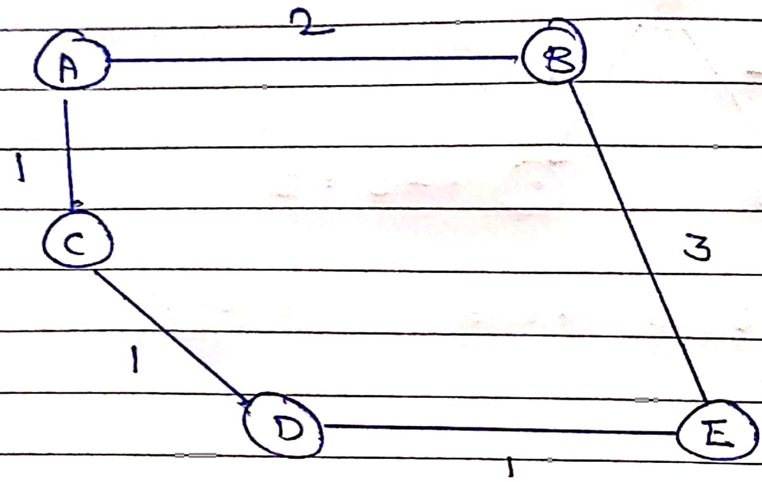
Example:

- Suppose you have the following graph and you apply A* algorithm on it.
  The initial node is A.
  The goal node is E.



- At every step, the f-value is being recalculated by adding together the g and h values
- The minimum f-value node is selected to reach the goal state
- Notice how B is never visited.

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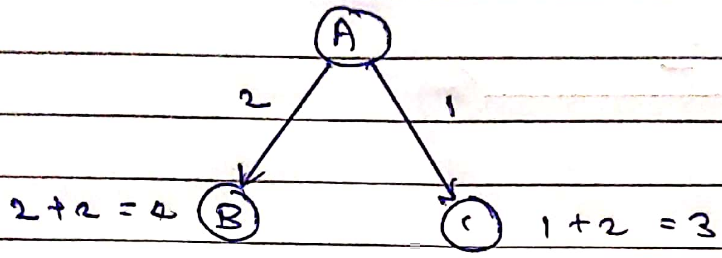
Step - 1

A

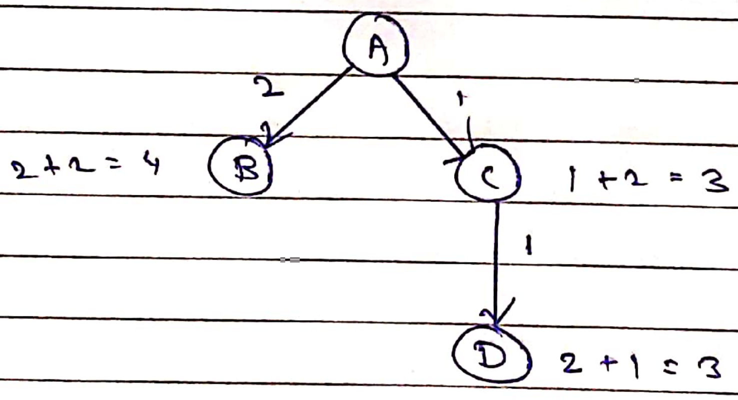
Root node A

Step - 2



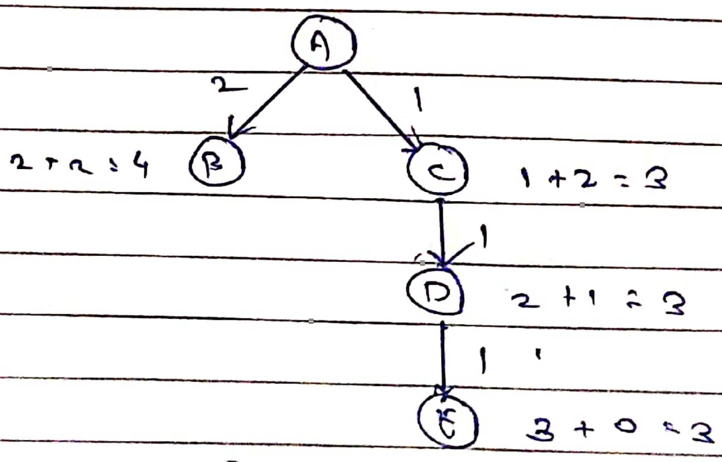
Node C is chosen

Step - 3



Node D is chosen

Step - 4



Goal

Node E is chosen

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Q5.

Ans:

(1) Given

→ $\forall x$ [Read (x) $\Rightarrow$ literate (x)]

→ $\forall x$ [Dolphin (x) $\Rightarrow$ $\sim$ literate (x)]

→ $\exists x$ [Dolphin (x) $\land$ Intelligent (x)]

Prove: $\Rightarrow$ $\exists x$ [Intelligent (x) $\land$ $\sim$ Read (x)]

(2) → $\sim$ Read (x) $\lor$ literate (x)

→ $\sim$ Dolphin (y) $\lor$ $\sim$ literate (y)

→ Dolphin (A)

→ Intelligent (A)

→ $\sim$ $\exists x$ [Intelligent (x) $\land$ $\sim$ Read (x)]

→ Intelligent (Z) $\lor$ Read (Z)

(3) Intelligent (A) $\sim$ Intelligent (Z) $\lor$ Read (Z)

↓

Read (A) ← z/A $\sim$ Read (x) $\lor$ literate (x)

↓

literate (A) ← x/A $\sim$ Dolphin (y) $\lor$ $\sim$ literate (y)

↓

$\sim$ Dolphin (A) ← y/A Dolphin A

↓

NIL

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Q6. Illustrate forward and backwards chaining with example

Ans:

Forward Chaining

- It starts from known facts and applies inference rule to extract more data until it reaches the goal
- It is a data driven inference technique as we reach to the goal using the available data
- Example:
  → Rule : human (A) → mortal (A)
  → Data : human (Mandela)
  → To Prove : Mortal (Mandela)
- Forward Chaining solution:
  → Human (Mandela) matches LHS, therefore A = Mandela
  → Based on rule, we got mandela as mortal (Mandela)

Hence Proved

Backward Chaining

- Starts from goal and works backward through inference rules to find required facts that support the goal.
- It is a goal driven technique, as we start from goal and divide into sub goal to extract facts.
- Example: (Same as above)
- Backward chaining solution
  → Mortal (Mandela) will match mortal (A) which gives human (A) i.e human (Mandela) which is also a proven fact.

Hence Proved