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23CO315   - TE - B.

Assignment - AI.

(Q1). Explain planning in non deterministic domain.

→ Planning in a non-deterministic domain refers to creating plans for environments where actions do not always have predictable outcomes.

• However in non deterministic planning actions may have multiple possible outcomes, meaning the outcome of an action is uncertain and varies according to probabilities or different conditions.

Key characteristics -

1) Uncertainty - The state resulting from an action is not fully predictable. An action may result in one of several possible states.

2) Multiple outcomes - Instead of having a single resulting state, actions might lead to several possible states. each with different possibilities.

3) Partial knowledge - Planners often have complete information about the environment, which makes planning difficult.

4) Contingency planning - In a non deterministic domain, the planner often needs to account for contingencies

and devise plans that account for multiple possible outcomes.

(Q2). Explain with example, How planning is different from problem solving -

→ 1. **Problem solving -**
- It is the process of figuring out how to go from an initial state to goal state. It generally involves searching through a state space to find a solution path.
- It can be seen as solving a puzzle where goal is defined and solution involves is a single path or sequence of actions.

Example — A chess player solving a specific checkmate problem where the solution involves a series of predefined moves.

2. **Planning:**
- It is a broader process where the goal is to create a sequence of actions (a plan). to acheire a goal. It involves creating a strategy for acheiving goal in uncertain, dynamic environments.

- It also considers what ifs (eg. what happens if an action fails or has different outcomes).

- Example- A robot planning a path to move through a maze, taking into account obstacles, potential

errors and changing conditions.

Key differences –
- Structure –
- Flexibility.
- Action selection.

(Q3) Explain types of planning in detail.

→ There are several types of planning that can be distinguished based on the complexity of the domain, the level of uncertainty, and problem solving used –

(a). Classical planning. (deterministic planning).

In classical the environment is fully known, and the outcome of every action is deterministic. The task is to find a sequence of actions that transform the initial state into goal state.

(b). Contingent planning.
- Actions may have different outcomes depending on the state of the world. The planner must consider various contingencies and create plans that handle multiple possible future states.

(c). Partial order planning –
- Does not assume a strict sequence of actions but rather allows actions to be ordered only when necessary. This type of planning focuses on satisfying the constraints without specifying exact order of actions.

(d) **Heirarchical planning -**

- Decomposes complex goals into smaller, more manageable sub goals. The planner creates a heirarchy of tasks. breaking down larger tasks into smaller actions.
- Top down decomposition.
- Effective for large scale problems.

(e). **Temporal Planning -**
Involves actions that take place over time and may have durations or deadlines. The goal is to plan actions while respecting time constraints.

(f) **Ressource contrained planning-** Considers resource limitations of computing power, fuel or memory.

(Q4) Explain Algorithm for classical planning.

→ **Steps in classical planning -**

1) Define initial state - State at start of planning process. It is a starting point.

2) Define goal state - The desired end state that planner needs to reach.

3) Define actions - Actions that can be performed along with their pre-conditions and effects.

4) **State space representation** - Represented as graph. nodes represent state, node represent action.

5) **Search for a plan** - Start from initial state and explore actions that lead to new states.

6) **Construct plan** - Extract sequence of actions that were taken to reach the goal.

(Q5.) Explain with example - State space planning.

→ In state space planning, the planner explores all possible states that can be reached from initial state using a series of actions.

• It searches through the state space to find a sequence of actions that lead from initial state to the goal state.

Example -

Consider a block starting stacking problem. where a robot must stack blocks on table.

• Initial state: Block A and Block B are on table.

◦ Goal - Block A is on top of Block B.

Actions:

◦ 1. Pick up block A: Block A is held by robot.

2. Put down block A on B.

— Block is placed on block B.

- <u>State Space representation</u> —

- Each state is represented as a plan.
- The state space includes all configurations of blocks. and edges between states represent actions that change the configuration.

- <u>Search for a plan</u> —

  - Check available actions.
  - Choose a search strategy.

- State space diagram is generated and edges represent actions.
  Searching through graph helps find the sequence of actions to acheive a goal.

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