Assignment No 1

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Date :- 20/02/2024

Q1) Explain the concept of rationality in context of intelligent agents used. How does rationality relate to the behavior of agents in their environments? Provide examples and also illustrate your examples.

Soln: Rationality refers to the ability of an agent to make decisions that maximize its expected utility or acheive its goals given the available information and resources.

2) Rationality is about making the best possible decisions given the circumstances even if those decisions are not always perfect.

3) Rationality relates to the behaviour of agents in the environments by guiding them to select actions that lead to desirable outcomes or goals.

4) An agent is considered rational if it consistently chooses actions that are expected to maximize the utility or acheive the objectives.

5) Examples :- A chess-playing agent

- A rational chess playing agent would choose moves that are expected to lead to victory or atleast avoid defeat. It evaluates potential moves based on its understanding

of the game state and selects the one that maximizes its chances of winning.

- In a self-driving car, rationally involves making decisions that prioritize safety and efficiency. The car must navigate through traffic, obey traffic laws and avoid accidents all while reaching its destination in a timely manner. A rational self-driving car would choose routes and driving behaviours that minimize the risk of accidents and optimize travel time.

Q2) Discuss the nature of environments in which intelligence agents operate. What are the key characteristics that define an environment and how do they influence the design and behaviour of agents? Provide Examples.

Soln: The nature of environments and challenges they have in which intelligent agents operate is diverse and can vary greatly depending on factors such as complexity, dynamics, episodity, observability and determinicism.

1] Complexity :- Environments can range from simple deterministic environments with a few states and actions to complex and stochastic environments with countless possible states and actions.

2] Dynamics :- Environments may be static, where the agents actions do not change the state or dynamic, where the environment evolves even without the agents intervention.

3] Observability :- Environments can be fully observable where the agents has access to complete information about the current state or partially observable where the agent has limited or

incomplete information.

4) Determinism :- Environments may be episodic where each action leads to an immediate reward and resets the environment to an initial state or sequential where actions taken now can affect future states and rewards.

5) Episodicity :- Environments may be deterministic, where the outcome of an action is fully determined by the current state and the action taken or to the chastic where there is an uncertainity's outcome.

* Examples :- Stock Market
A stock market is a stochastic partially observable sequential environment with high complexity. Agents may analyze historical data, predict future market movements and adapt their strategies in real-time to the changing conditions.

* Example :- Robot Navigation
A dynamic observable sequential environment with moderate complexity. Agents need to perceive their surroundings through sensors, plan triggers and trajectories to navigate obstacles and updates their plans as new information becomes available.

Q3) Describe the structure of intelligent agents and the types of agents commonly used in artificial intelligence. What are the components of an agent and how do they intent to

achieve intelligent behaviour? Provide examples of different types of agents and their applications in real-world scenarios.

Soln: Intelligent agents in artificial intelligence typically consist of five main components :-

a] Perception :- This component involves sensing the environment using sensors to gather information. It's about how an agent perceives the surroundings.

b] Reasoning :- Agents use reasoning mechanism to make decisions and plan actions based on information they have gathered. This involves processing and analyzing the data to come up with solutions or responses.

c] Actuation :- Once a decision is made, the agent must act upon it. Actuators are mechanisms through which the agent interacts with the environment to carry out actions.

d] Knowledge :- Agents posses knowledge or information about the environment, themselves and the tasks they need to perform. This knowledge can be pre-defined, learned or inferred from past experiences.

e] Learning :- Intelligent agents can improve their performance over time through learning mechanisms. This could involve aquiring good knowledge adapting technology and strategy based on feedback.

* Types of Intelligent Agents include :-

1] Simple Reflex Agents

- These agents take actions based on solely a current percept without considering the history of past percepts. An example is the thermostat that adjusts the temperature based on the

current readings.

2] Model Based Reflex Agents

- They maintain an integral model of an environment and use it to make decisions. For Example :- A vaccum cleaning robot that has a map of room to decide where to clean next.

3] Goal Based Agents

- These agents have goals or objectives that they aim to acheive and take actions to acheive and take actions to move towards these goals. An example :- A delivery drone that navigates to deliver packages to specific locations.

4] Utility Based Agents

- They evaluate the desirability of various actions based on a utility function and chooses the action that maximizes expected utility. For Example :- A personal assistant app that schedules tasks based on user preference and priority

5] Learning Agents

- These agents improve their performance over time through learning from experience. Examples :- Include recommendation systems that learn user prefercences from interactions and adapt their recommendations accordingly.

Q4) Outline the process of problem-solving by searching, including the role of problem-solving agents and the formulation of problems. How do problem-solving agents analyze and the

formulation of problems. How do problem-solving agents analyze and approach problems and what methods do they use to search for solutions?

Soln: Role of Problem-solving agents :-

1] Problem-solving agents operate independently making decisions and taking actions to acheive desired goals without human intervention.

2] These agents are designed to efficiently explore and also navigate problem spaces to find optimal or satisfactory the solutions.

3] Promblem-solving agents can adopt to changes in their environment or problem domain adjusting their strategies to accomdate new information or new constraints.

4] They can handle a wide range of problem types and also the complexities from simple puzzles to complex real-world scenarios.

* Formulation of Problems

- Problem formulation involves abstracting real-world scenarios into a formal representation that can be understood and processed by problem-solving agents.
- Problems are represented in a way that captures essential elements such as initial state, goal states action and the constraints.
- Formulating problems provides a structured approach to the problem-solving, breaking down complex issues into a smaller, more manageable components.

* Methods Used for Searching Solutions

1] Uninformed Search :- Agents explore the problem space systematically without consideration of domain specific knowledge.
Example :- Breadth First Search, Depth First Search.

2] Informed Search :- Agents use domain specific knowledge or heuristics to guide the search towards promising solutions.
Example :- A* search, greedy, Best First Search.

3] Local Search :- Agents iteratively improve candidate the solutions by making small modifications.

* Examples :-

a) Routing Planning
- In navigation systems, problem-solving agents search for the shortest path between two locations and they analyze the road network consider traffic considerations and the employ algorithms like ask to find optimal routes.

b) Puzzle Solving
- In games solving like Sudoko or Rubik's cube agents aim to find solutions satisfying certain constraints. They analyze the puzzles initial state explore possible moves and use strategize like constant propogation or the backtracking to solve this error.