ARTIFICIAL INTELLIGENCE ASSIGNMENT 01

(1) Rationality refers to the ability of an agent to make decisions that optimize its goals or objectives given the available information and resources

- OBJECTIVE-DRIVEN: Rational agents consistently select actions are likely to achieve their objectives based on their understanding of the environment and consequences of their actions
- MAXIMIZING UTILITY: Selecting actions that maximize expected utility or minimize expected costs, aiming to achieve the best possible outcome given the circumstances
- ENVIRONMENT INTERACTION: Guides agents to interact with their environments by analyzing available information, predicting outcomes, and selecting actions that lead to desirable results.

Eg: In self-driving cars, rationality means navigating through traffic while minimizing risk of accidents and reaching the destination efficiently.

- DECISION-MAKING PROCESS - Rational agents consider their beliefs about the world, their goals, potential consequences of their actions when making decisions.
- OUTCOME-ORIENTED: Rationality focuses on achieving desirable outcomes in various domains, including physical navigation, strategic decision-making and personalized recommendation

(2) An environment is the context in which an agent operates, consisting of everything outside the agent that can potentially affect its behaviour.

- Some environments provide agents with complete information about their state

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- Deterministic environments have predictable outcomes for given actions, while stochastic environments involve randomness or uncertainty.
- In episodic environments, each episode is independent of others, while in sequential environments, actions influence future states
- Static environments remain unchanged while the agent is acting, whereas dynamic environments may change during execution
- Environments can have discrete states and actions or continuous ones
- The characteristics of the environment heavily influence the design of agents, affecting their perception, decision-making and learning mechanisms.
- Agents must adapt their strategies and behaviours based on the nature of the environment to achieve their objectives effectively.

Eg: Chess: The game environment is fully observable, deterministic, sequential, and discrete: Agents like chess-playing programs utilize search algorithms to explore possible future states and make optimal moves.

- Uncertainty - CHALLENGES:
  (1) Uncertainty - Dealing with incomplete or uncertain information
  (2) Complexity - Navigating complex environments with numerous possible states and actions.
  (3) Dynamics - Adapting to changes in the environment over time
  (4) Trade-offs - Balancing exploration (trying new actions) with exploitation (using known actions).

(3) STRUCTURE OF INTELLIGENT AGENTS:
- Perception - Receives inputs from the environment through sensors
- Decision-Making: Processes information to select actions
- Action: Executes actions to affect the environment.
- Knowledge Base: Stores information for decision-making
- Goal: Objectives or tasks the agent aims to achieve

TYPES OF AGENTS:
- Simple reflex agents: Act based solely on current percept, mapping directly to actions
- Model-based reflex agents: Maintain internal state to track aspects of the world that are not directly observable

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- Goal-Based agents: Plan actions to achieve specific goals, considering future states
- Utility-based agents: Evaluate actions based on utility functions to maximize outcomes
- Learning agents: Improve performance over time through learning from experience.

INTERACTION OF COMPONENTS:
- Perception gathers information from the environment
- Knowledge base stores information used for decisions
- Decision-making processes information to select appropriate actions.
- Actions are executed to affect the environment, leading to new perceptions.

Eg: Simple Reflex Agents: Automated vacuum cleaners that change direction when encountering obstacles

(4) ROLE OF PROBLEM-SOLVING AGENTS:
- Aim to find solutions to given tasks or objectives
- Analyse problems, formulate them into a suitable representation, and search for solutions using various methods

FORMULATION OF PROBLEMS:
- Problems are typically formulated by defining the initial state, possible actions, transition model, goal test and path cost.
- Formulation provides a structured representation of the problem that problem-solving agents can work with.

PROCESS OF PROBLEM-SOLVING BY SEARCHING:

- Analysis: Problem-solving agents analyze the given problem to understand its structure and requirements.
- Formulation: They formulate the problem into a suitable representation, such as a state space or a graph.
- Search: Problem-solving agents use various search algorithms to explore problem space and find solutions
- Evaluation: They evaluate potential solutions based on criteria such as optimality, completeness, and efficiency.
- Execution: Execute set of actions to achieve goal

METHODS USED FOR SEARCHING:

- Uninformed search algorithms - BFS, DFS
- Informed search algorithms - A* search, Heuristic
- Local search algorithms - Hill Climbing, simulated annealing
- Adversarial search algorithms - Minimax, alpha-beta pruning

Eg: Route Planning: Finding the shortest path between two locations using algorithms like Dijkstra's or A* search

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