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CO Addressed:—CSC604.1 -To conceptualize the basic ideas and techniques underlying the design of intelligent systems.

Assignment 1:

1. Explain the concept of rationality in the context of intelligent agents. How does rationality relate to the behavior of agents in their environments? Provide examples to illustrate your explanation.
2. Discuss the nature of environments in which intelligent agents operate. What are the key characteristics that define an environment, and how do they influence the design and behavior of agents? Provide examples of different types of environments and the challenges they present to agents.
3. 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 interact to achieve intelligent behavior? Provide examples of different types of agents and their applications in real-world scenarios.
4. 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 approach problems, and what methods do they use to search for solutions? Illustrate your explanation with examples of problem-solving tasks and the strategies employed by agents to solve them.

Rubrics for the First Assignments:

Indicator	Average	Good	Excellent	Marks
Organization (2)	Readable with some missing points and structured (1)	Readable with improved points coverage and structured (1)	Very well written and fully structured	
Level of content(4)	All major topics are covered, the information is accurate (2)	Most major and some minor criteria are included. Information is accurate (3)	All major and minor criteria are covered and are accurate (4)	
Depth and breadth of discussion and representation(4)	Minor points/information maybe missing and representation is minimal (1)	Discussion focused on some points and covers them adequately (2)	Information is presented indepth and is accurate (4)	
Total				

Signature of the Teacher

AI

Assignment 1

Q1)

In the context of Intelligent Agents, rationality refers to the ability of an agent to make decisions that maximize its expected utility or achieve its goals, given its knowledge and beliefs about the world. Rationality does not necessarily imply perfect decision-making or omniscience, but rather making the best possible decisions based on available information and goals.

① Goal-Directed Behaviour : Rational agents are typically designed to achieve certain goals or objectives.

Exp:

A robotic vacuum cleaner's goal might be to clean a room.

② Decision making under Uncertainty : Rational agents must make decisions even in the face of uncertainty, by considering probabilities and unexpected outcomes.

Exp:

A self driving car must decide whether to stop down at an intersection based on its assessment.

③ Adaptation to changing Environments : Environments can be dynamic. Rational agents need to adapt their behaviour to these changes to remain effective.

Exp:

An intelligent thermostat adjusts the temperature settings in a house based on factors such as the time of day, occupancy patterns and outdoor weather conditions.

Q2).

The environments in which intelligent agents operate can vary widely each presenting unique characteristics and challenges.

Key characteristics:

- ① Data Availability: The availability and quality of data significantly impact the performance and training of AI/ML models. High quality, labelled data is essential for supervised learning tasks while unsupervised or reinforcement learning may require less structured data.
- ② Feature Space: The feature space defines the dimensions or variables within the data that the dimensions or variables within the data that the AI/ML model can use to make predictions or decisions.
- ③ Complexity: The complexity of the problem and the underlying patterns within the data influence the choice of algorithms and the model's architecture. Some problems may require deep learning techniques for handling complex relationships, while others may be solvable with simple models.

- ④ Noise and Uncertainty : Real-world data often contains noise and uncertainty, which can affect the performance of AI/ML models.

Examples :

- ① In a partially observable environment like a card game agents must use memory and inference to make optimal decisions with incomplete information.
- ② In stochastic environments like financial markets, agents must employ probabilistic models and risk management strategies to adapt to uncertain outcomes.
- ③ Sequential environments such as navigating a maze require agents to plan ahead and consider the long term consequences of their actions.

Q3)

The structure of intelligent agents in AI typically consists of several components that work together to perceive the environment, make decisions and take actions.

The components include:

- ① Perception : This component gathers information about the environment using sensor or data inputs. In the context of AI, perception involves pre-processing and feature extraction from raw data.

- ② Knowledge Base: The knowledge base stores relevant information about the environment including past experiences, rules or models learned from data.
- ③ Reasoning / Inference Engine: The reasoning or inference engine processes the information from the perception component and the knowledge base to make decisions and infer solutions to problems.
- ④ Decision Making: This component selects actions based on the information procured by the reasoning engine and the goals of the agent.
- ⑤ Actuators / Actions: Actuators are responsible for executing the actions chosen by the decision-making component, influencing the environment based on the agent's decision.

Examples of Agents:

- ① Reactive Agents: These agents make decisions based solely on the current state of the environment without maintaining an explicit internal state or history.
- Example:
Simple rule-based systems for tasks like playing or robotic navigation.
- ② Learning Agents: Learning agents improve their performance over time by learning from experience. They use techniques such as supervised learning, reinforcement learning

- ③ Deliberate Agents: Deliberative agents maintain an internal state representing their beliefs, goals and plans. They use this internal state to reason about the environment and make decisions.

Q4)

Role of Problem Solving Agents:

- ① Analysis of Problem: Problem-solving agents analyze the characteristics of a problem, such as its initial state, possible actions and goal state.
- ② Formulation of Problem: Once the problem is analyzed, problem solving agents formulate it into a representation that can be understood and solved by computational methods.
- ③ Search for Solutions: Problem solving agents apply search algorithms to explore the space of possible solutions systematically.

Methods Used:

- ① State Space Search: Problem-solving agents represent the problem as a state space, where each state corresponds to a configuration of the environment, and transitions between states are defined by actions. They use search algorithms such as breath-first search (BFS), depth-first search (DFS) or A* search.

② Heuristic Search: This algorithm guides the exploration of the state space by using heuristic functions to estimate the cost or quality of potential solutions.

③ Local Search: These algorithms iteratively improve a candidate solution by making small changes to it, coming to search a better solution.

Ex:

Path finding: In path finding problems, such as finding the shortest path between two points on a map, problem-solving agents use search algorithms like A* search to explore the space of possible paths efficiently.