T.E. (Computer Sem VI)<u>**Assignment -1**</u> **Artificial Intelligence (CSC604)**

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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 isminimal (1)	Discussion focused on some points and covers themadequately (2)	Information is presented indepth and is accurate (4)	

Total				

Signature of the Teacher

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Assignment - 1

Q. 1

Rationality in the context of intelligent agents refers to the ability of an agent to make decisions that maximize its expected utility or achieve its agents goals given the available information and resources. A rational agent is one that consistently chooses the best action or sequence of actions from among the available options to achieve its objectives.

Rationality is closely related to the behavior of agents in their environments in the sense that rational agents will adapt their behavior based on feedback from their environment to improve their decision-making process and achieve better outcomes. This adaption may involves learning from past experience, updating beliefs based on new information, and adjusting strategies to better align with goals

Examples:

1. Chess-playing AI: In the game of chess, an AI agent can be considered rational if it selects moves that maximize its chances of winning the game. The agent evaluates the potential outcomes of different moves based on its knowledge of the game rules and board position, and then selects the move that loads to the most favorable outcome.

2. Self-driving Cars: A self-driving car can be considered

rational if it navigates safely and efficiently to its destination while obeying traffic jams patterns, and pedestrian movements, to make real-time decisions about speed, lane changes and navigation routes.

Q.2] **1. Percept:** An environment provides perceptual input to the agent, which includes any information the agent can obtain through its sensors. The nature and quality of perceptual input significantly affect the agent's ability to perceive and understand its surroundings accurately.

2. Actions: Agents interact with their environments by executing actions. The set of possible actions an agent can take depends on the environment's dynamics and the agent's capabilities. The diversity and complexity of available actions influence the range of behaviors the agent can exhibit.

3. State Space: The state space represents all possible configurations of the environment. It encompasses the current state as well as potential future states resulting from agent actions or environmental changes. The size and complexity of the state-space impact the agent's decision making process and the effectiveness of its stratergies.

4. Dynamicity: Environments can be static or dynamic, meaning they may or may not change over time. Dynamic environments present challenges such as uncertainty and unpredictability requiring agents to adopt their strategies and decisions in real-time to cope with changes.

5. Determinism Vs Stochasticity: Environments can be deterministic, where actions lead to predictable outcomes, or stochastic where outcomes are influenced by random factors. Stochastic

environments introduce uncertainty, making it challenging for agents to reliably predict future states and outcomes.

6. Accessibility of Information: Some environments provide agents with complete information about their state and the consequences of actions, while others only offer partial or incomplete information. Limited information can pose challenges for agents, requiring them to make decisions under uncertainity and ambiguity.

7. Spatio-temporal Characteristics: Environments can have spatial and temporal attributes that influence agent behavior. spatial characteristics include dimensions, topology and accessibility, while temporal aspects involve factors such as timing, sequencing and duration of events.

8. Multi-agent interactions: In multi-agent environments, agents interact not only with the environment but also with other agents. These interactions introduce competition challenges for agent.

Examples:

1. Chess: Chess is deterministic, fully observable environment with a discrete state space and a limited set of actions. This challenge for agents lies in exploring the vast state space to anticipate opponents moves and desire winning strategies.

2. Stock market: The stock market is a dynamic stochastic environment with partial observable information. Agents must analyze market trends, news and economic indices to make informed decisions about buying, selling or holding stocks amidst uncertain and volatility.

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Q.3] Structure of Intelligent agents:

1. **Perceptual Component:** This component enables the agent to perceive its environment through sensors, capturing relevant information for instance, in autonomous vehicles, cameras, lidar and radar serve as sensors capturing data about the vehicle's surroundings.

2. **Knowledge Base:** The agent possesses a knowledge base or memory where it stores information about the environment, post experiences, and learned behaviors. In virtual personal assistance like siri or Alexa, the knowledge base includes user preferences, post interactions and relevant information retrieved from the web

3. **Decision-Making Component:** This component processes perceptual impact and knowledge to make decisions and selections In healthcare diagnosis systems, this component analyzes patient symptoms, medical history, and knowledge about diseases to recommend treatment plans.

4. **Action Component:** Based on decisions made, the agent executes actions in the environment through actuators or effectors.

Types of Intelligent Agents:

1. **Reactive Agents:** These agents respond directly to environmental stimuli without maintaining an internal state or memory. An example is a simple obstacle-avoidance robot that navigates by sensory input.

2. **Deliberative Agents:** These agents employ internal models of the environment, reasoning and planning to make decisions. An example is a chess-playing AI that evaluate possible moves and plans on expected outcomes.

3. Learning Agents: The agents improve their performance over time through learning from experience. Examples include reinforcement which learn optimal strategies by trial and error.

4. Hybrid Agents: These agents combine characteristics of multiple types, leveraging reactive, deliberative and learning approaches as needed.

Q.4 Ⓐ Role of Problem-Solving agents :-

1. Problem-solving agents identify and solve problems to achieve their goals.

2. They analyze the current state, goal state and possible actions to reach the goal.

3. Problem-solving agents employ various search algorithms to explore the space of possible solutions efficiently.

Ⓑ Formulation of Problems:-

1. Problems are formulated by defining the initial state, goal state, actions, and constraints.

2. This formulation provides a structural representation of the problem, enabling agents to analyze and solve it systematically.

Ⓒ Analyzing and Approaching Problems: -

1. Problem-solving agents analyze the problem space to understand its structure and possible solutions.

2. They employ heuristics, domain knowledge, and problem-specific strategies to guide the search process effectively.

3. Agents may decompose complex problems into smaller subproblems to easier resolution.

Ⓓ Methods Used for Searching Solutions:

1. Uninformed Search: Agents explore the problem space systematically without considering domain-specific knowledge.

2. Informed Search: Agents use domain-specific knowledge or heuristics to guide the search towards promising

solutions.

Ex: A* Search, greedy best first Search.

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

Ex: Hill climbing, simulated annealing.

(E) Illustrative Examples:

1. Routing Planning: In navigation systems, problem-solving agents search for the shortest path between two locations on a map.

2. Puzzle solving: In games like sudoku or Rubrik's Cube, agents aim to find solutions satisfying certain constraints.

3. Automated Planning: In robotics or automated systems, problem-solving agents plan sequences of actions to achieve desired outcomes.