Department of Computer Engineering

T.E. (Computer Sem VI) Assignment -1 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

AI ASSIGNMENT-1

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 the goals based on the given information and available 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 behaviour of agents in their environments in the sense that rational agents will adapt their behaviour based on feedback from their environment to improvement 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:
(i) Self-driving cars: These can be considered rational if they navigate safely and efficiently to its destination while obeying traffic rules and pedestrian activity to make real-time decisions about speed, lane changes and navigation routes.
(ii) AI Chess: 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 leads to the most favourable outcome.

2) The nature of environments in which intelligent agents operate are fully observable vs partially observable, deterministic vs stochastic, competitive vs collaborative, single-agent vs multi-agent, static vs dynamic, discrete vs continous, episodic vs sequential, etc.
The key characteristics that define an environment and how do they influence the design and behaviour of agents are as follows:

(i) Percept : An enviroment provides perceptual input to the agent, which includes any information the agent can obtain through its sensors.

(ii) Action : 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.

(iii) 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.

(iv) 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.

(v) Spatio-temporal characteristictis : Spatial characteristics include dimensions, topology and accessibility, while temporal aspects involve factors such as timing, sequencing, and duration of events.

Examples :

(i) Chess : Chess is deterministic, fully observable environment with a discrete State space of a limited set of actions. The challenge for agents lies in exploring the vast space state to anticipate opponents' moves and devise winning strategies.

(ii) Stock Market : The stock market is a dynamic, stochastic environment with partially observable information. Agents must analyze market trends, news and economic indicators to make informed decisions about buying, selling or holding stocks amidst uncertainty and volatility.

3) Structure of Intelligent Agents :

(i) Perceptual Component : Enables agent to perciene its environment through sensors, capturing relevant information. Ex: Autonomous vehicles, cameras, lidar, etc.

(ii) Knowledge Base : It is the memory where information is stored about the environment, past experiences and learned behaviours. Ex: Virtual personal assistant

(iii) Decision-Making Component : It processes perceptual input and knowledge to make decisions and select action. Ex : Healthcare diagnostic system

(iv) Action Component : Based on the decisions made, the agent executes actions in the environment through actuations or effectors. Intelligent Agents are :

(i) Reactive Agents: These agents respond directly to environmental stimuli without maintain an internal state or memory. Ex: Obstacle-avoidance Robot
(ii) Deliberate Agents: They employ internal models of the environment, reasoning, and planning to make decisions. Ex: AI Chess Player.
(iii) Learning Agents: They improve their performance over time through learning from experience. Ex: Reinforcement learning algorithms.
(iv) Hybrid Agents: They combine characteristics of multiple types, leveraging reactive, deliberative and learning approaches as needed. Ex: Autonomous vehicles.

4) (i) Role of Problem-Solving Agents :-
→ Identify and solve problems to achieve their goals.
→ Analyse the current state, goal state, and possible actions to reach goal.
→ Employ various search algorithms to explore the space of possible solutions efficiently.

(ii) Formulation of Problems :-
→ By defining initial state, goal state, actions, and constraints.
→ Provides structural representation of the problem, enabling to analyze and solve it systematically.

(iii) Analyzing and Approaching Problems :-
→ To understand structure, constraints and possible solutions.
→ Employ heuristics, domain knowledge, and problem-specific strategies to guide the search process effectively.
→ Agents may decompose complex problems into smaller subproblems for easier resolution.

(iv) Methods used for Searching Solutions:

→ Uninformed Search: Agents explore the problem space systematically w/o considering domain-specific knowledge. Ex: BFS, DFS.

→ Informed Search: Domain-specific knowledge or heuristics to guide the search towards promising solutions. Ex: A* search, greedy Best first search.

→ Local Search: Agents iteratively improve candidate solutions by making small modifications. Ex: Hill Climbing, Simulated Annealing.

(v) Examples:

→ Routing Planning: In navigation systems, problem-solving agents search for the shortest path b/w two locations on a map. They analyze the road network, consider traffic conditions and employ algorithms like A* search to find optimal routes.

→ Puzzle Solving: In sudoku/Rubik's cube, agents aim to find solutions satisfying certain constraints. They analyze the puzzle's initial state, explore possible moves, and use strategies like constraint propogation or backtracking to solve the puzzle.

→ Automated Planning: In robotics or automated systems, problem-solving agents plan sequences of actions to achieve desired outcomes. They analyze the environment, consider constraints, and employ Planning algorithms like STRIPS or PDSL to generate action sequences.