

SECTION A

- a. The evolution of Artificial Intelligence began in the 1950s with the idea of creating machines that could think like humans. Early AI focused on symbolic logic and rule-based systems. In the 1980s, expert systems emerged, but they lacked adaptability. With the rise of machine learning in the 2000s, AI systems began learning from data. Now, modern AI uses deep learning, neural networks, and natural language processing, leading to applications like autonomous systems, speech recognition, and robotics.
- b. The goals of Artificial Intelligence are to create systems capable of reasoning, learning, and acting autonomously. It aims to develop machines that can mimic human intelligence, solve complex problems, make logical decisions, and adapt to new situations. Other goals include automation, natural communication with humans, and improving efficiency across industries through smart systems.
- c. An intelligent agent is an entity that perceives its environment through sensors and acts upon it using actuators to achieve specific goals. Examples include self-driving cars, vacuum-cleaning robots, and AI assistants like Siri or Alexa. These agents can analyze their surroundings, plan actions, and continuously improve their performance through learning.
- d. The main characteristics of an agent include autonomy, meaning it can operate without human help; reactivity, which allows it to respond to environmental changes; goal orientation, meaning it works toward specific objectives; and adaptability, which enables it to learn and improve over time. Some agents also have social ability, allowing interaction with other agents or humans.
- e. Uninformed search strategies explore the search space without using domain-specific knowledge, such as Breadth-First Search (BFS) and Depth-First Search (DFS). Informed search strategies, on the other hand, use heuristic information to guide

the search toward the goal more efficiently, such as A* and Greedy Best-First Search. The key difference is that informed searches use additional knowledge to reduce the search time and cost.

SECTION B

Q2 (a)

Artificial Intelligence plays a vital role in modern society through applications like healthcare diagnosis, speech recognition, financial analysis, robotics, and autonomous vehicles. It enhances efficiency, accuracy, and decision-making in industries. However, it also faces challenges such as data privacy concerns, ethical issues, potential bias in algorithms, and high implementation costs. Another major challenge is ensuring transparency and accountability in AI systems to prevent misuse or unfair decisions.

Q3 (a)

Depth-Limited Search (DLS) is a variation of Depth-First Search where the search is limited to a specific depth level. This means the algorithm explores nodes only up to a predefined limit and stops beyond that depth. The advantage of DLS is that it prevents infinite loops in infinite-depth search spaces and reduces memory consumption. However, its limitation is that it may fail to find a solution if the goal lies beyond the depth limit, and choosing the right limit can be difficult.

Q4 (a)

Hill Climbing is a heuristic search technique that continuously moves in the direction of increasing value, assuming it will lead to the goal. It evaluates neighboring states and chooses the one with the best evaluation function. The main drawback of hill climbing is that it can get stuck in local maxima, plateaus, or ridges, where no better neighboring state exists even though the global solution is still far away. This makes it unreliable for complex search spaces where multiple peaks exist.

SECTION C

Q5 (b)

An intelligent agent in AI is a system that can perceive its environment and act intelligently to achieve its goals. The types of intelligent agents include simple reflex agents that respond directly to stimuli, model-based reflex agents that use internal states, goal-based agents that act to achieve specific goals, and utility-based agents that aim to maximize overall performance. Architecturally, these agents consist of sensors, actuators, and reasoning units that work together to perceive, analyze, and respond effectively to environmental conditions.

Q6 (b)

The A* search algorithm is an informed search method that combines the advantages of uniform-cost and greedy search by using both actual cost from the start and estimated cost to the goal. It uses the evaluation function $f(n) = g(n) + h(n)$, where $g(n)$ is the path cost and $h(n)$ is the heuristic estimate. A* is admissible because it always finds the optimal path if the heuristic never overestimates the true cost. It is also optimal under these conditions since it expands the least costly path first.

Q7 (a)

Informed search uses problem-specific knowledge to find solutions more efficiently. Heuristics are functions that estimate how close a state is to the goal and guide the search process. They improve efficiency by reducing the number of unnecessary nodes explored and directing the search toward promising areas. Good heuristics can drastically reduce time and space complexity, making informed searches like A* and Greedy Best-First much faster and more practical than uninformed methods.