

- a) Define the following terms
  - a. Artificial intelligence
  - b. Turing test
  - c. Intelligent agent - An intelligent agent is a software program that can perceive its environment, reason about it, and take actions to achieve specific goals,
- b) An intelligent agent design is characterized by PEAS. Given a medical diagnosis system demonstrate PEAS

Performance measure: Accuracy of diagnosis

Environment: Patient's medical data

Actuators: Tools for gathering information and recommending treatments

Sensors: Medical sensors, imaging equipment, laboratory tests, and other medical data sources

- c) Briefly explain the following terms
  - a. Breadth first search BFS

#### Depth first search (DFS)

a. Breadth-first search (BFS) is a graph traversal algorithm that explores all the vertices or nodes of a graph in breadth-first order, i.e., visiting all the vertices at the same level before moving to the next level. In BFS, we start from a particular vertex and explore all the vertices at distance one from it, then all the vertices at distance two, and so on until we have explored all the vertices in the graph.

BFS uses a queue data structure to keep track of the vertices that have been visited but not yet explored. The algorithm starts by adding the initial vertex to the queue and marking it as visited. Then, it dequeues the vertex from the front of the queue, explores all its neighboring vertices, and adds them to the back of the queue if they have not been visited before.

BFS is often used for finding the shortest path between two vertices in an unweighted graph or for exploring all the connected components of a graph.

b. Depth-first search (DFS) is a graph traversal algorithm that explores all the vertices or nodes of a graph in depth-first order, i.e., visiting all the vertices along a path from the starting vertex as far as possible before backtracking. In DFS, we start from a particular vertex and explore as far as possible along each branch before backtracking.

DFS uses a stack data structure to keep track of the vertices that have been visited but not yet explored. The algorithm starts by adding the initial vertex to the stack and marking it as visited. Then, it pops a vertex from the top of the stack, explores all its neighboring vertices, and pushes them onto the stack if they have not been visited before.

DFS is often used for detecting cycles in a graph, for finding strongly connected components, and for exploring all the paths in a graph.

- d) Define the following terms as used in Search strategies
  - a. State space - set of all possible states that a search algorithm can encounter during its search
  - b. Start state - is the initial state or configuration of the problem being solved

- c. Goal test - condition or set of conditions that determines whether a given state is the goal state or not
- d. Solution to a search problem - is a sequence of actions or states that lead from the start state to the goal state
- e) With two examples, differentiate between Uninformed and Informed search strategies (6 mks)

#### Uninformed search: Breadth-first search (BFS)

BFS is an example of an uninformed search algorithm because it does not use any specific information about the problem being solved to guide the search. Instead, it explores all the vertices or states in the state space in a breadth-first order, which means it visits all the vertices at the same level before moving to the next level. For example, if we are trying to find a path from a start state to a goal state in a maze

#### Informed search: A\* search

A\* search is an example of an informed search algorithm because it uses heuristic information to guide the search. Heuristic information is domain-specific knowledge that provides an estimate of the distance or cost from a state to the goal state.

For example, if we are trying to find the shortest path between two cities on a map

- f) Discuss at least 3 ways of evaluating the performance of a search strategy (3 marks)

**Completeness:** Completeness refers to whether a search algorithm is guaranteed to find a solution if one exists. A search algorithm is considered complete if it is guaranteed to find a solution if one exists. Completeness is an important measure of the performance of a search strategy because it ensures that the search algorithm will always provide a solution to the problem being solved.

**Optimality:** Optimality refers to whether a search algorithm is guaranteed to find the optimal solution, which is the solution that has the lowest cost or shortest path. A search algorithm is considered optimal if it is guaranteed to find the optimal solution if one exists. Optimality is an important measure of the performance of a search strategy because it ensures that the search algorithm will provide the best solution possible to the problem being solved.

**Time and space complexity:** Time complexity refers to the amount of time required for a search algorithm to find a solution. Space complexity refers to the amount of memory or storage required for a search algorithm to find a solution. The time and space complexity of a search algorithm are important measures of its performance because they affect the efficiency and scalability of the algorithm. A search algorithm that has low time and space complexity is generally considered to be more efficient and scalable than one that has high complexity

- g) What is knowledge representation? Discuss the following knowledge representation schemes (3 marks)
- i. Frames
  - ii. Semantic network
  - iii. Production rules

i. Frames: A frame is a data structure that represents a concept or object in terms of its attributes, values, and relationships with other concepts or objects. A frame consists of slots that represent the attributes of the concept or object, and fillers that represent the values of the attributes. For example, a frame for a car might include slots for the make, model, year, color, and price, with fillers representing the specific values for each attribute. Frames can also include inheritance relationships, which allow frames to inherit attributes and values from other frames in a hierarchy.

ii. Semantic network: A semantic network is a graph-based representation scheme that represents concepts or objects as nodes and their relationships as edges. Nodes in a semantic network represent concepts or objects, and edges represent relationships between them. For example, a semantic network for a family might include nodes for people, with edges representing parent-child relationships and marital relationships. Semantic networks can also include attributes and values associated with each node.

iii. Production rules: Production rules are a knowledge representation scheme that represents knowledge in the form of if-then rules. Each rule consists of a condition (the if part) and an action (the then part). When the condition of a rule is satisfied, the action is executed. Production rules are commonly used in expert systems to represent knowledge in the form of rules that can be used to make decisions or provide advice. For example, a production rule for a medical diagnosis system might be "if the patient has a fever and a rash, then diagnose them with measles." Production rules can also be organized into a rule base, which is a collection