1) Analyze the diversity of environments in which intelligent agents operate, ranging from deterministic to stochastic, observable to partially observable, and discrete to continuous. Discuss how characteristics of environments influence the design and behavior of agent, including the evaluate the challenges posed by dynamic and uncertain environments and strategies agents employe to adapt and succed.

2) Analyze relationship b/w nature of environment and structure of intelligent agent. How does complexity, observability, and dynamicity of environment influence design and functioning of agent? Discuss various architectures and their suitability different types of environment.

3) Develop a PEAS description of task of environment for following agents

a. medical diagnosis system.
b. Part picking Robot.

1) type of environment.

* Deterministic : out come are predictable
* Stochastic: involves randomniss
* discrete: finite state/actions.
* continuous: ininite states/actions.

challanges:

* Dynamic environment: Require fast, adaptive response
* uncertain environment: need agents to handle unpredictability and incomplete info.

strategies for success:

* Reinforcement learning for adaptation.
* Probabilistic models to manage uncertainity
* Replanning Algorithm to adjust action on ~~the~~ fly
* sensor fusion for improved perception.

2) the environment's complexity, observability and dynamic nature directly impact how intelligent agents are designed.

* complex environment need smarter agent with memory and planning.

* fully observable environments are easier to manage partially observable one prediction.
* Dynamic environments change over time, so agents must react quickly.

3) medical os

PEAS description:

* performance measure.
* Accuracy of diagnosis
* speed of decision
* Reduced false positives
* Patient satisfaction.

Environment:

Hospital or clinics patient medical history lab reports and symptons.

Actuators:

Display screen Report generation Alerts/to doctor.

sensors:

cameras; Barcode reduces, proximity and weight sensors.

characteristics:

fully observable, Deterministic, static, Episodic.

Exercise - 1

Properties of environment (for Robotic vacuum cleaners)

* physical surfaces (floors, tiles).
* obstacles (walls, pets, people)
* Boundaries (stairs, doorways)
* Dirt/dust of varying concentrations and particle sizes.
* navigational markers or maps (i.e. using SLAM or Room mapping)

<u>How a vaccum cleaner perceives its environment:</u>

1. infrared (IR) sensors.
   used for: detecting nearby obstacles and drop-offs
2. ultrasonic sensors.
   used for: distance measurement to obstacles
3. LiDAR (Light Detection and Ranging)
   used for: 360° mapping and localization.

4. Bump sensors.

used for: Detecting physical contact with the objects.

5. camera/vision sensor.

used for: visual mapping, dirt or detection, room recognition.

Exercise-2

what is 8-queens problem?

- No two queens are on same row
- No two queens are on same column
- No two queens are on same diagonal

formulate the problem:

- A state represents a configuration of the queens on the board.

This means:

* Row 0: queen in column 1
* Row 1: queen in column 3

So, a full state for 8 queens has 8 values one for each row.

* Actions:

At each step (row), place a queen in a column doesn't attack any previously placed queens.

* Goal state:

A list of 8 numbers where:

- No queens are in same column.
- No queens are in same diagonal.

eg: [0, 4, 7, 5, 2, 6, 1, 3]

Backtracking (Depth-First search) - common method:

- try column 0 to 7 in current row
- if safe → move to next row.
- if stuck → go back (backtrack) and try a different column.

Exercise 3

3) Initial state:

* Jug A (4-gallon): 0 gallons
* Jug B (3-gallon): 0 gallons

Steps:

1. Fill jug B (3-gallon) from the pump.

   → A: 0, B: 3

2. Pour jug B into jug A.

   → A: 3, B: 0

3. Fill jug B again

   A: 3, B: 3

4. Pour from jug B into jug A until jug A is full.

   - jug A needs 1 gallon to reach 4 gallons

5. Empty jug A.

   A: 0, B: 2

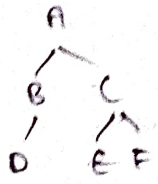
Final stat:

* jug A (4-gallon): 2 gallons
- jug B (3-gallon): 0 gallons.

we have exactly 2 gallons in the 4-gallon jug, using allowed operations.

Exercise - 4

4) Tree structure:



Breadth - first search (BFS):

BFS explores level by level, from left to right at each level.

order of traversal:

1. A
2. B, C
3. D, E, F

BFS Result:

A → B → C → D → E → F.

Depth - First Search (DFS):

DFS explores as far down a path as possible before back tracking

order of traversal:

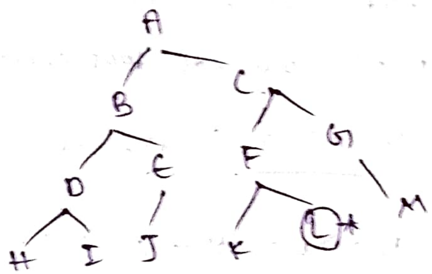
1. A
2. B
3. C
4. D
5. E
6. F

DFS - Result:

A → B → D → C → E → F.

Exercise - 5

5) **Tree summary:**



BFS (Breadth-first search):

How it works:

- Explores all nodes at the current depth before going deeper.
- uses a queue (FIFO).

BFS traversal order:

A → B → C → G → D → E → F → J →
K → L → M → H → I → *

Advantages:

- Complete: Guarantees to find the goal if it exists
- Optimal (in unweighted): finds the shortest path.

Disadvantages:

- Memory-intensive: stores all the nodes at a level.
- Can be slow for deep trees.

DFS traversal order (one possible path):

A → B → D → H → I → E → J → K ←

Goal found here.

Advantages:

- Only needs to store a single path (space is O(d) in best case).
- Good for problem where solution are deep in the tree.

Disadvantages:

- Not guaranteed to find shortest path.
- Can get stuck exploring long or the infinite paths.

6. Type of Agent: Goal-Based Agent.

A goal-based agent works by:

* Having a specific goal (reaching a destination)
* evaluating possible actions (cab types, routes).
* selecting the most suitable action that helps achieve the goal effectively.

Explanation of key steps:

* Get Available cabs: Finds cabs near the user's location.
* match preferences: Filters out cabs not matching user's comfort/cost/time
* estimate fare/estimate travel time: calculates travel estimates.
* Book with option: sends a booking Request to the system.

4/16/25