Artifical Intelligence

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 the characteristics of environments influence the design and behaviour of agents, including their sensing capabilities, action space and decision-making processes. Evaluate the challenges posed by dynamic and uncertain environments and the strategies agents employ to adapt and succeed.

2. Analyze the relationship between the nature of the environment and the structure of an intelligent agent. How does the complexity, observability, and dynamicity of the environment influence the design and functioning of agents? Discuss various agent architectures and their suitability for different types of environment.

3. Develop a PEAS description of the task environment for the following agents and list out all of its characteristics.
   a) Medical Diagnosis System
   b) Part Picking Robot.

1. Ans

1. Types of Environments:

* Deterministic: Outcomes are predictable.
* Stochastic: Involves randomness.
* Fully Observable: Complete environment is visible.
* Partially Observable: Limited visibility; agent must infer.
* Discrete: Finite states/ actions.
* Continuous: Infinite states/ actions.

2. Effect on Agent Design:

* Sensing: Partially observable environments need better sensing or internal models.
* Action space: Continuous spaces require precise controls.
* Decision-Making: Stochastic environments need probabilistic approaches.

3. Challenges:

* Dynamic Environments: Require fast, adaptive responses.
* Uncertain Environments: Need agents to handle unpredictability and incomplete info.

4. Strategies for Success:

* Reinforcement Learning for adaptation.
* Probabilistic Models to manage uncertainity.
* Replanning Algorithms to adjust action on the fly.
* Sensor fusion for improved perception.

2. Ans

1. Nature of Environment vs Agent Structure:
   * The complexity, observability, and dynamics of the environment directly impact the internal structure and behavior of intelligent agents.

2. Influence on Agent Design:
   * Complex Environments: Require agents with advanced perception, memory and planning.
   * Observable Environments: Simple sensors and reflex-based agents may suffice.

* Partially Observable: Need agents with internal state (eg., model-based agents).

* Dynamic Environments: Demand real-time processing and continuous learning.

3. Agent Architectures and Suitability:

* Simple Reflex Agents: Suitable for fully observable and static environments.

* Model-Based Reflex Agents: Fit for partially observable settings.

* Goal-Based Agents: Ideal for complex and dynamic environments.

* Utility-Based Agents: Handle trade-offs in uncertain and dynamic contexts.

* Learning Agents: Adapt to unknown and changing environments.

4 Conclusion:

The structure and capabilities of an agent must align with the environment's nature for ~~a~~ optimal ~~p~~ performance.

3. Ans:

a) Medical Diagnosis System

PEAS Description:

* Performance Measure: Accuracy of diagnosis, treatment success rate, patient safety, speed of diagnosis.

* Environment: Patient records, symptoms, lab reports, historical medical data.

* Actuators: Diagnosis reports, alerts, treatment recommendations.

* Sensors: Input from doctors, sensors (like temperature, ECG), test reports.

Characteristics:

* Partially Observable.
* Stochastic.
* Static.
* Sequential.
* Episodic.
* Discrete.

b) Part-Picking Robot

PEAS Description;

-> Performance Measure: Picking accuracy, speed, minimal, damage, correct placement.

-> Environment: Factory floor, partsbin, conveyour belt.

-> Actuators: Roboticarms, grippers.

-> Sensors: Cameras, proximity sensors, weight sensors.

Characteristics:

-> Fully observable (with cameras/sensors)

-> Dynamic or stochastic (depends on design)

-> Dynamic

-> Sequential

-> Continuous (position, motion).

Analytical

1) Discuss the properties of environment. How does the vaccum cleaner perceive its environment? ~~Lost~~ What sensing mechanisms are employed and their role in detecting dirt, obstacles and other relevant features. What are the primary actuators used in the vaccum cleaner and how do they facilitate its ~~environment~~ movement and cleaning action for decision making process involved in action selection.

Sol Properties of Environment:

The environment in the context of a robotic vaccum cleaner to the space in which operates typically residental.

Structure:

Compared & walks, door, furniture & other stationary.

Surface type:

Various across hard floor carpet etc....

Dynamic element:

Movable people, pets and movable objects.

Lighting & Visibility:

May very bot generally affects optical sensors & concerns.

Dirt & Debris Distribution:

Uneven region, requiring, pending & adaptive cleaning.

Boundaries:

Edges, stairs and other accept offer must be prevent fall.

2. Explore the search space using search strategies and formulate the problem components for the 8-Queens problem using the following information. Place 8 queens on a chessboard such that none of the queen's attack any of the others. A configuration of 8 queens on the board as shown in the figure below, but this does not represent a solution as the queen in the first column is on the same diagonal as the queen in the last column.

Ans Formulating the 8-Queen Problem:

The 8-queen problem is a classical contraist statisfaction from (CSP) in ai. The goal is ai to place 8 queen 8×8 clean board such that no two queen attack each other queen other piece in same row column or diagonal.

A) Initial state
State space
Action
Transition Model
Goal State
Path Cost

} Components

Search space:

To escape the search space, act state con viewed or partial assignment on queen on board.

* The search space contain all permutation 7 queen position row & column.

* Total permutation without considering diagonal 8! = 40320.

3. Solve the water jug problem: you are given 2 jugs, a 4-gallon one and 3-gallon one. Neither has any measuring maker on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into 4-gallon jug? Explicit assumptions: A jug can be filled from the pump, water can be poured out of a jug onto the ground, water can be poured from one jug to another and that there are no other measuring devices are available.

Sol To solve the water jug problem:

Jug A : 4-gallon capacity.

Jug B : 3-gallon capacity

Goal: Get exactly 2 gallon in the gallon Jug (Jug x)

Were allows:

* Fill a jug from the pump.
* Empty a jug onto the ground.
* Pour water from the jug to another one is full.

Initial State:

=> (0,0)

=> Fill the gallon (jug B) -> (0,3)

=> Pour jug B to jug A (3,0)

=> Fill jug B again (3,3)

=> Pour jug B into jug A (1 gallon) (4,2)

=> Empty jug A (0,2)

=> Pour water jug B to jug A (2,0)

Final state:

(2,0) - a gallon jug.

4. Show how BFS & DFS work on the search tree for given state space graph.

```
      A
     / \
    B   C
   /   / \
  D   E   F
```

Sol BFS - FIFO (queue)

A → B → C → D → E → F

Start A

Deque A, enque chil [B, C]

Deque B, enque chil [C, D]

C = [D, E, F]

D = [E, F]

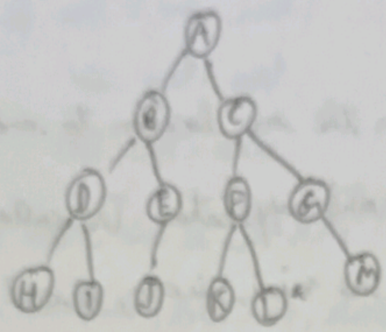
E = [F]

F = [ ]

DFS = [LIFO] - Start

S.NO	B.F.S	D.F.S
1.	A	A
2.	B, C	B
3.	C, D	C
4.	D, E, F	D
5.	E, F	E
6.	F	F

5. Discuss Uninformed searching strategies BFS and DFS with its advantages and disadvantages using the following graph to reach the goal L.



BFS : A→B→C→D→E→F→G→H→I→J→K→L

Breadth-First Search (BFS):

* Explore all nodes at the current level before moving to the next level.
* Uses a queue (FIFO).
* Finds the shortest path (if all steps have equal cost).

Advantages:

* Complete (will find a solution if one exists).
* Optimal (finds the shallowest solution).

Disadvantages:

* High memory usage.
* Slow if the tree is deep or wide.

DFS : A→B→E→F→I→C→G→D→H→J→K→L

Depth-First Search (DFS):

* Explores as deep as possible before backtracking.
* Uses a stack (LIFO) or recursion.
* May find a solution faster if it lies deep.

Advantages:

* Low memory usage.
* Simple to implement.

Disadvantages:

* Not guaranteed to find the shortest path.
* Can get stuck in infinite loops (if cycle exists).

6. A customer wants to travel from the one location to another location using OLA Cab booking mobile application. The customer can select the any of the cab type as mini, micro, shared, prime and so on based on his comfort to reach the destination. Identify what type of problem-solving agent can be used and write the pseudocode for the above problem.

Sol Types of Problem-solving Agent:

* Model-Based, Goal-Based Agent

Reason:

* It has a model of the world (location, cab, availability, traffic).
* It selects actions (cab type) based on the goal (reach destination comfortably).
* It uses search and planning to choose the best option.

Pseudocode:

```
Function OLA_Cab_Booking (start_location, destination, preferences):
cab_types = [mini, micro, sedan, shared, prime]
available_cabs = getAvailableCabs (start_location, cab_types)
    if available_cabs is empty:
        return "No cabs available"
    best_cab = None
    min_cost = ∞
```

```
for cab in available_cabs:
    if matchesPreference(cab, preferences):
        cost = estimateCost(cab, start_location, destination)
        if cost < min_cost:
            min_cost = cost
            best_cab = cab
    if best_cab is not None:
        bookCab(best_cab, start_location, destination)
        return "Cab booked:" + best_cab
    else:
        return "No suitable cab found".
```

Cryptarithmetic as a CSP

$$\begin{array}{r} TWO \\ +\ TWO \\ \hline FOUR \end{array}$$

Variables

$T \in \{0, \ldots, 9\}$; $W \in \{0, \ldots, 9\}$, $O \in \{0, \ldots, 9\}$;

$F \in \{0 \ldots 9\}$; $U \in \{0, \ldots, 9\}$, $R \in \{0, \ldots 9\}$;

$x_1 \in \{0 \ldots 1\}$; $x_2 \in \{0 \ldots 1\}$; $x_3 \in \{0, \ldots, 1\}$; ← Actual Variable

Constraints:

$O + O = R + 10 * x_1$

$x_1 + W + W = U + 10 * x_2$

$x_2 + T + T = O + 10 * x_3$

$x_3 = F$

Each letter has a different digit ($F \neq T$, $F \neq U$, etc ...).