Q1) Analyze the diversity of Environments in which Intelligent agents operate, ranging from deterministic to Stochastics, observable to partially observable and discreate to continous. Discuss how the characteristics of Environment influence the design and behaviour of agents, including their sensing capability, action space and decision - making Processes. Evaluate the challanges posed by dynamic and uncertain environments and the startegies agents employ to adapt and succeed.

Q2) Analyze the relanstionship between the nature of the Environment and the Structure of an intelligents agent. How does the complexity, observability and dynamics of the Environment influences the design and functionalities of agents? discuss various agent. architecture and their suitability for different type of environments.

Q3 Develop a PEAS description of the task environment of the following agents and list out all of its characteristics

a. Medical Diagonsis System

b. Part picking Robot

Q1)

1. Types of Environments

⇒ Deterministic : Outcome are predictable

⇒ Stochastic : Involves randomness

⇒ Fully Observable : Complete Environment is given

⇒ Partially Observable : Limited visibility, Agent must infer.

⇒ Discrete : Finite State / Actions.

⇒ Continuous : Infinite States / Actions.

2. Key of Agent Design:

⇒ Sensing : Partially Observable Environments need to

Sensing or internal models

⇒ Action Space : Continuous Spaces require precise control

⇒ Decision making : Stochastic Environments need probabilistic approaches

Challenges

⇒ Dynamic Environment : Require fast, adaptive responses

⇒ Uncertain Environment : need Agents to handle complex

Utility and incomplete info.

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Strategies for Success:

⇒ Reinforcement Learning for adaptation
⇒ Probabilistic Models to manage uncertainty
⇒ Replanning Algorithms to adjust action on the fly
⇒ Sensor Fusion for improved perception

Q2) Answer

i) Nature of Environment vs Agent structure:

The Complexity observability, and dynamic of the Environment directly impact the internal structure and behavior of Intelligent agent

ii) Influence on Agent Design

⇒ Complex Environment: Requires agent with advanced Precaption, memory and planning.

⇒ Observable Environments: Simple Sensors and reflex-based Agent may suffice.

⇒ Partially Observable: need agents with internal state.

⇒ Dynamic Environment: Demand real-time processing and Continuous learning.

iii) Agent Architectures and Suitability.

- Simple Reflex Agent: Suitable for fully observable and Static Environment.
- Model-Based Reflex Agents: Ideal for Complex and dynamic Environment.

- model - Based Reflex Agent : Fit for Partially observable Settings
- Goal based Agent : Ideal for Complex and dynamic Environment.
- Utility - Based Agents : Handle trade - offs in uncertain and dynamic Contexts.
- Learning Agents : Adapt to unknown and changing Environment.

Conclusion:

The Structure and Capabilities of an agent must align with the Environment's nature for optimal Performance

Q3) Answer

A. Medical Diagonosis System

PEAS Description

⇒ Performance measure : Accuracy of diagonosis, treatment Success rate patient Safty, speed of diagonosis.

⇒ Environment: Patient records Symptoms, lab reports, historical medical data

⇒ Actuators: Diagnosis reports, alerts treatments recomends

⇒ Sensor : Input from doctors, Sensors, 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, parts bin, conveyour belt.

⇒ Actuators: Robotic arms, grippers

⇒ Sensors: Cameras, Proximity sensors, weight sensors.

Characterstics

⇒ fully observable (with cameras/sensors)

⇒ Dynamic or stochastic (depends on design)

⇒ Dynamic.

⇒ Sequential

⇒ Continuous (position, motion).

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

2) Explore the search 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 queens attack any of the others. A configuration of 8 queen on the board as shown in the figure below, but this does not represent a solution as the queen in the first coloumn is on the same diagonal as the queen in the last coloumn.

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? Explict assumptions: A jug can be filled from pump, water can be poured out of a jug can be onto the ground water can be poured from one jug to another. that there is no

measuring device

Answer:

Properties of Environment

The Environment for a vacuum cleaner includes various surface, obstacles and dirt or debris. It can be static or dynamic

Perception of Environment:

A vacuum cleaner perceives its environment using sensors like intrared, ultra sonic and camaras. ~~These Infrared, Ultrasonic~~ and these sensors helps identify floor type, detecting obstacles and locating dirt.

Sensing mechanisms:

- Intrared Sensors. detect obstacles and edges
- ultra sonic sensors helps in measuring distance to nearby objects
- Dirt sensors detect dust and particles on the floor.

Role of Sensors: These sensors guide the cleaner to avoid collision, detect dirtier areas, and navigate efficiently

Prime Actuators:

- motors for wheels (movement)
- Vacuum motor for suction.
- Brush actuators for rotating brushes
- Servo motors

Facilitation by Actuators: Actuators convert control signals into physical action, enabling the vacuum cleaner to move, clean, avoid obstacles and adapt to different surfaces.

Decision-making in Action selection

The on board processor uses sensors data to make real-time decision - such as changing direction when an obstacle is detected or increasing suction or dirty areas. This helps in efficient Path planning and optimized cleaning

2)

Problem Components

1. State space
   - All possible arrangements of 0 to 8 queens on the board such that no two attack each other.
   - Each state can be represented by an array of size 8, where the index is the row number and the values the column number

2. Initial state:
   - An empty board

3. Operators
   - Place a queen in row such that it does not attack any previously placed queens.

4. Goal State

   8 queen placed on the board satisfying all constraints.

Search Strategy

- Backtracking.
  - Place a queen row by row and backtrack when a conflict is found.
- Heuristic search
  - Start with a complete state and minimize the number of conflicts.
- Genetic Algorithm / Constraints Programming

  For advanced approches.

Example conflict Explanation

"A configuration of 8 queen on the board is shown, but this is not a solution as the queen in the first column is on the same diagonal as the queen in last column"

This highlights the importance of checking diagonal conflicts. Two queens are on the same diagonal if:

$|row_1 - row_2| == |col_1 - col_2|$

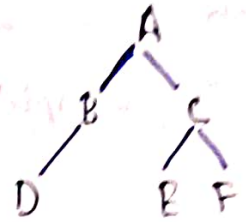
3)

i) fill the 3-gallon jug completly from the pump
ii) Pour water from the 3-gallon jug into 4 gallon jug
iii) fill the 3-gallon jug again
iv) Pour water from the 3-gallon jug into the 4-gallon jug
v) Now Empty the 4-gallon jug onto the ground
vi) Pour the remaining 2 gallon from the 3-gallon jug into the 4-gallon jug

Goal

measure exactly 2 gallon of water in 4-gallon jug.

4) Show how BFS & DFS works on the search tree for given state space graph




i) Breadth - First Search

BFS explore nodes level by level

Traversal order

$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G$

Start at A
Visit children of A: B, C
visit children of B and C: D, E, F, G.

ii) Depth - First search (DFS)

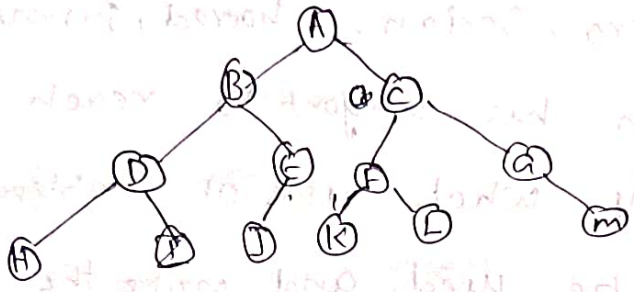
DFS explore as deep as possible along each branch before backtracking

Traversal order

$A \rightarrow B \rightarrow D \rightarrow E \rightarrow C \rightarrow F \rightarrow G$

- start at A
- Go deep into B. → D (no children) → backtrack to E
- Back track to $C \rightarrow F \rightarrow G$

5) Discuss uniformed searching Strategies - BFS and DFS with its advantages and disadvantage using the following graph to reach the goal




BFS

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

Goal L is found depth 3 [S.P]

Advantage

Complete: will always find Solution one exist.

Disadvantage: memory - intensive: store all node to current before deeper.

DFS

A → B → D → H → I → E → J → L → F → K - L

DFS (not shortest path)

Advantage: low memory usage

Good for deep solution.

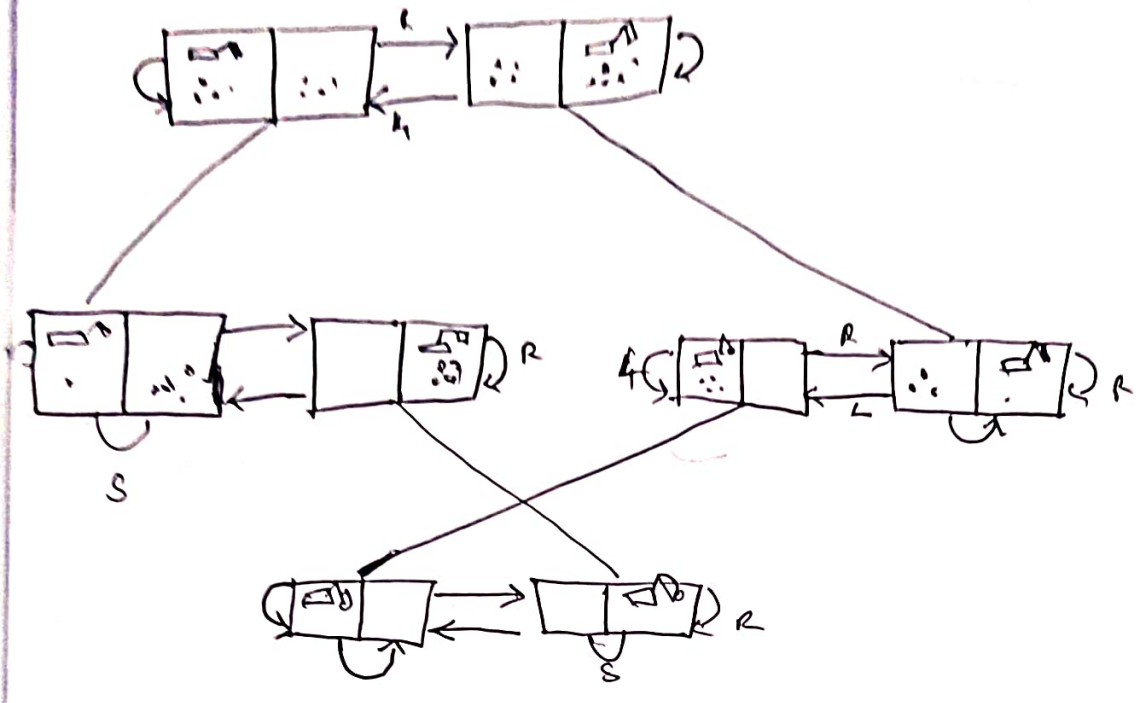
Disadvantage :- not complete

not optional.

6) A Customer want 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, Sedan, 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.

```
Function BookCab (start, destination)
    Cab type → {mini, micro, sedan}
        best cab → null.
        best score → -∞
For each cab in cab types:-
    eta → GetETA (cab, start)
    Comfort → Get Comfort (cab)
    Store → (Comfort *2) - eta - cost
    IF Score > best store
        best ←
        Store → best
    best cab ← cab
Print " Booked cab type " best cab
```

1) Diagram




cryptarithmetic as a csp

variables

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