

## 1. (a) Explanation of Terms

### i. Agent:

An agent is an entity that perceives its environment through sensors and takes actions using actuators to achieve specific goals. It can be a software-based or hardware-based system designed to interact with its surroundings. Examples include a self-driving car, a chatbot, or an industrial robot.

### ii. Percepts:

Percepts refer to the inputs an agent receives from the environment through its sensors. These inputs help the agent understand its surroundings and make informed decisions. For example, a self-driving car perceives data from cameras, LiDAR, and GPS to navigate the road safely.

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## 1. (b) PEAS Descriptions

### i. Robot Taxi Driver

- **Performance Measure:** The agent should drive safely, obey traffic rules, minimize travel time, optimize fuel efficiency, and ensure passenger comfort.
- **Environment:** The agent operates in a dynamic environment, including roads, traffic, pedestrians, weather conditions, and passenger requests.
- **Actuators:** The robot taxi uses steering controls, brakes, accelerator, indicators, and wipers to interact with its environment.
- **Sensors:** The taxi driver agent relies on cameras, LiDAR, GPS, radar, and speedometers to perceive the surroundings and make decisions.

### ii. Windshield Wiper Agent

- **Performance Measure:** The agent should effectively clean the windshield, adjust wiping speed based on rain intensity, and avoid unnecessary operation.
- **Environment:** The windshield, rain, dirt, and external lighting conditions form the environment in which the agent operates.
- **Actuators:** The agent controls wiper blades, motors, and water sprayers to remove dirt and rain from the windshield.
- **Sensors:** The system includes rain sensors, cameras, and optical sensors to detect water levels and dirt accumulation.

### iii. Medical Diagnosis System

- **Performance Measure:** The system should provide accurate diagnoses, suggest appropriate treatments, and ensure patient safety while minimizing errors.

- **Environment:** It interacts with patient records, symptoms, lab test results, and medical knowledge databases.
  - **Actuators:** The system provides results through a display screen, printed reports, or electronic prescriptions.
  - **Sensors:** It gathers inputs from patient data, medical test results, and imaging devices like X-rays and MRIs.
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## 2. (a) Task Environment Types

### i. Episodic:

In an episodic environment, the agent makes decisions based on individual episodes, where past actions do not affect future actions. Each episode is independent, and the agent does not need memory or long-term planning. For example, a quality inspection robot in a factory examines different products separately without considering previous inspections.

### ii. Deterministic:

A deterministic environment is one in which the outcome of an agent's actions is fully predictable and does not involve randomness. If the same action is performed under the same conditions, the result will always be identical. For example, a calculator operates in a deterministic environment because it always produces the same output for the same mathematical operation.

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## 2. (b) True or False Statements

### i. Vacuum cleaner agent is dynamic – True

A dynamic environment changes over time, even if the agent does nothing. A vacuum cleaner operates in a dynamic environment because dust may appear at any time, people may move objects, and obstacles may change positions. This means the vacuum cleaner must continuously perceive changes and adjust its actions accordingly.

### ii. Crossword puzzle is partially observable – False

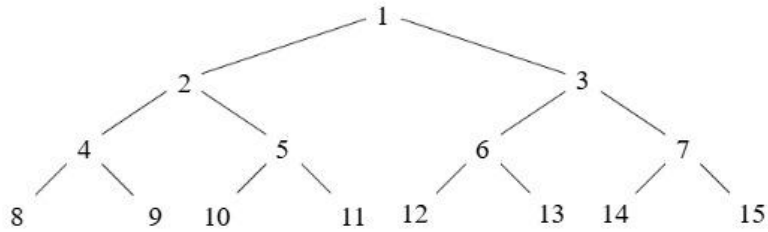
A fully observable environment provides complete information needed for decision-making. In a crossword puzzle, all clues and the grid are visible from the beginning, meaning the solver has full knowledge of the problem. There are no hidden elements or uncertainties affecting decision-making, making it a **fully observable** environment rather than a **partially observable** one.

3.

1. Consider a state space where the start state is number 1 and each state  $k$  has two successors numbered  $2k$  and  $2k+1$  respectively.

(a) Draw the portion of the state space for states 1 to 15.

ANSWER:



- (b) Suppose the goal state is 11. List the order the nodes will be visited for breadth-first search, depth-first search to a depth limit of 3, and iterative deepening depth-first search.

ANSWER: The search always stops when it finds a goal state. This is problem-solving, not graph traversals.

- BFS: 1, 2, 3, . . . , 11
- DFS: 1, 2, 4, 8, 9, 5, 10, 11
- IDS: 1; 1, 2, 3; 1, 2, 4, 5, 3, 6, 7; 1, 2, 4, 8, 9, 5, 10, 11