Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

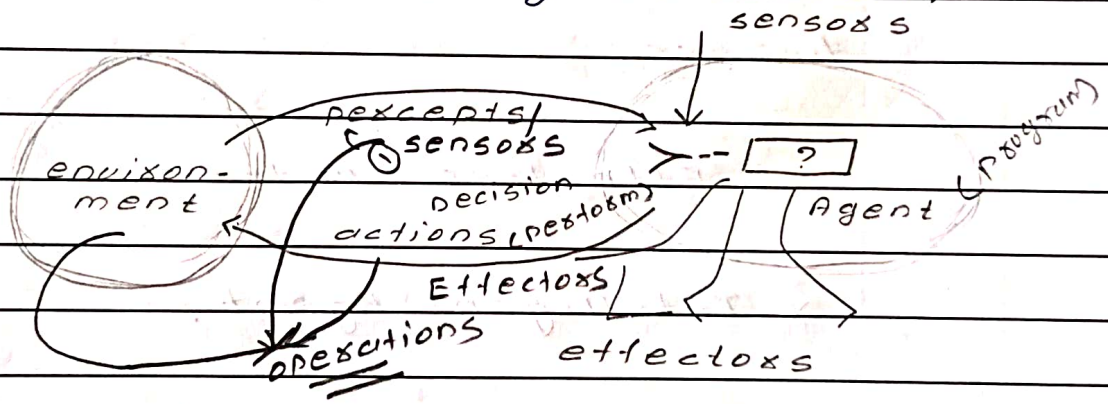
2. Intelligent Agents.

2.1 Agents and Environments, The concepts of rationality, The nature of environment, The structure of Agents Types of Agents, Learning Agents.

* Agents and Environments -

* Agents:

- An "Agents" is anything that can be viewed as perceiving its environment through sensor and Acting upon the environment through effectors.



Agent → Percepts → Decision → Action.

- Example

1. A Human Agent
2. A Robotics Agent
3. A. SIW Agent

2. Human.

- sensors: Eyes (vision), ears (hearing, skin (touch), tongue (gustation), nose (olfaction), neuromuscular system (proprioception).

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- Effectors: limbs, eyes, tongue.
- Percepts:
  - At the lowest level: electrical signals from these sensors.
  - After preprocessing objects in the visual field (location, textures, colors), auditory streams (pitch, loudness, direction),
- Actions: - lift a finger, turn left, walk, run, carry an object. ---

3. Robotics:
   - Sensors: camera, infrared range finders.

   - Effectors: motors.

* Intelligent Agent.

- Intelligent Agent is one which can take input from the environment through its sensors and act upon the environment through its actuators. Its actions are always directed to achieve a goal.
- The basic abilities of an intelligent agent are to exist to be self-governed, responsive, goal-oriented, etc.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

- Generally observed capabilities of an intelligent agent can be given as follows:
  1. Ability to remain autonomous.
  2. Responsive
  3. Goal-oriented.

- Intelligent agent is the one which can take i/p from the environment through its sensors and act upon the environment through its actuators. Its actions are always directed to achieve a goal.

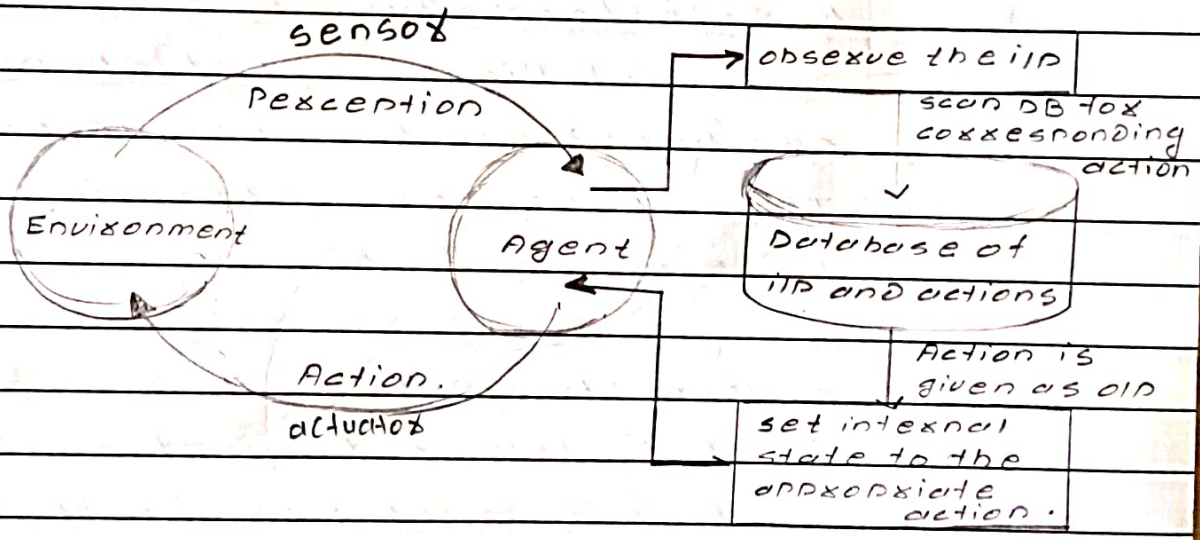

Fig. General structure of Intelligent Agent.

More features of an intelligent agent :-

1. Reactiveness -

It means giving reaction to a situation in a stipulated time frame. An agent can perceive the environment and respond to the situation in a particular time frame.

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3. Pro-activeness - goal acheive

It is controlling a situation rather than just responding to it. Intelligent agent show goal directed behavior by taking the initiative.

3. Social ability:

Intelligent agents can interact with other agents (also human). Take automatic car drivers.

4. Self-Learning: past experience → update

An intelligent agent changes its behaviour based on its previous experience. This agent keeps updating its knowledge base all the time.

5. Movable / Mobile: A 1m → 2m move

An intelligent agent can move one machine to another while performing action

6. Self-governing:

An Intelligent agent has control over its own actions.

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decision Right logic

The agent should be

** Rationality / Rational Agent :-

- It is an entity thats acts to acheive the best outcome.
- And if there is uncertainty, then best possible outcom.
-

Rationality depends on four main criteria.

1) Performance measure (success criteria) high
2) Prior knowledge of its surrounding.
3) Best possible action that an agent can perform.
4) perception of environment / sur

example -

If agent hurts his finger while using nail and hammer, then while using it for the next time agent will be more careful and the probability of not getting hurt will increase. In short agent will be able to use the hammer and nail more efficiently.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

* The Nature of Environments and PEAS Properties of Agents.

1) Fully observable Vs. Partially observable
2) Deterministic Vs. stochastic
3) Episodic Vs. sequential
4) Single-agent Vs. multi-agent
5) static Vs. Dynamic
6) Discrete Vs. continuous.

* Environment is part of the universe that surrounds intelligent system.

1) Fully observable
- An agent can always see the entire state of an environment
- e.g. chess

Partially observable
- An Agent can never see the entire state of an environment
- eg. card game.

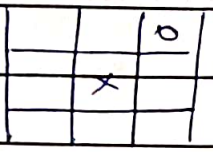
2) Deterministic
- An agent's current state and selected action can completely

stochastic
- A stochastic environment is random in nature

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

determine the next state of the environment

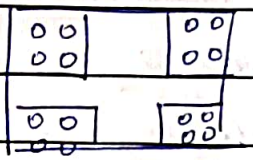
- e.g. Tic tac toe



Next step

and cannot be determined completely by an agent.

e.g. Ludo



Random

3) Episodic

- only the current perceept is required for the action.

- Every episode is independent of each other.

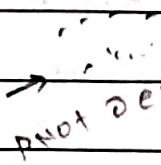
- e.g. Part picking robot.

Sequential.

An Agent requires memory of past actions to determine the next best actions.

The current decision could affect all future decisions.

- e.g. chess.

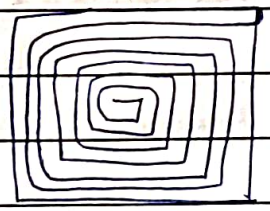


Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

4) Single Agent

- If only one agent is involved in an environment and operating by itself then such an environment is called single agent environment.

- e.g. maze



Multi Agent.

If multiple agents are operating in an environment then such an environment is called a multi-agent environment

e.g. Football.

5) Static (fixed)

- The environment does not change while an agent is acting.

- e.g. crossword Puzzles, News paper.

Dynamic change

The environment may change over time.

e.g. roller coaster, ride Taxi driving, car driving

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

6) Discrete — Continuous.

- The environment consists of a finite number of actions that can be deliberated in the environment to obtain the o/p.
- The environment in which the actions performed cannot be numbered i.e is not discrete, is said to be continuous
- e.g. chess (steps known: finite steps) — e.g. self-driving car.

7) Known — Unknown.

- In a known environment the results for all actions are known to the agent.
- In unknown environment, agent needs to learn how it works in order to perform an action
- e.g. card game — e.g. A new video game.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

PEAS Properties of Agent :-

- PEAS - (Performance measure, Environment, Actuators and sensors)

- example :-

☆ => Automated car driving Agent:

i) Performance measure :-
- safety
- optimum speed (speed breaker)
- comfortable Journey (A → B)
- Maximize profits.

ii) Environment
- Road
- Traffic conditions
- clients

iii) Actuators
- steering wheel
- Break
- Accelerator, gear
- Lights, horn.

iv) Sensors
- camera
- GPS trackers
- sonar system.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

Q - Medical diagnosis system

Q - Soccer Player Robot.

☆ Types of Agents.

- Depending upon the degree of intelligence and ability to achieve the goal, agents are categorized into five basic types.

1) Simple reflex agents
2) model-based reflex agents
3) goal-based agents
4) Utility-based agents
5) learning agents.

1) Simple reflex Agents (Fully observable)

→ immediately
OR
spontaneously

without doing any calculations or checking the past, we have to perform action instantly That is called reflex.

→ Act only on the basis of current perception

→ Ignore the rest of percept History

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

→ Based on If - Then Rules
→ Environment should be fully observable

Def° → → An agent which performs actions based on the current input only by ignoring all the previous i/p is called as simple reflex agent.
→ It is a totally uncomplicated type of agent. The simple reflex ~~example~~ agent's function is based on the situation ~~is based on the~~ and its corresponding action. If the condition is true, then matching action is taken without considering the percept history.
- Real life example, say some object approaches eye then you will blink your eye. This type of simple reflex is called natural / innate reflex.

2. Model-based Reflex Agents - (Partially obs
knowledge
→ Model-based reflex agents are that maintain an internal memory or 'state', which helps them make decisions in situations where they cannot see or sense the entire environment directly

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

→ Purpose: This memory helps them handle situations where they have only partial visibility of the environment.
→ challenge: Sometimes, agents don't have a complete view of the world around them.
Example - A self-driving car agent can't see every vehicle on the road at once.
→ ~~Exam~~ A security robot that patrols a building.
→ An agent which performs actions based on the current input and one previous input is called as model-based agent.

→ Benefits of model based Reflex agent
2. They handle partial observability better than simple Reflex agents, as they retain context from previous observation.

3. This makes them better suited for complex ~~tak~~ tasks, like driving or surveillance, where the agent can't always see the entire environment.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

⇒ Limitations of model based Reflex agent

1. They may still struggle with environments that change unpredictably or situations that require extensive planning or reasoning.

2. Additionally, creating and maintaining an accurate model can be challenging and requires more computational power.

3. ~~Utility Based Agents :-~~

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

3. Utility-Based Agents :-

→ These agents are similar to the goal based agent but provide an extra component of utility (performance) measurement which makes them different by providing a measure of success at a given state.

→ The utility-based agent is useful when there are multiple possible alternatives and an agent has to choose in order to perform the best action.

→ The utility function maps each state to a real number to check how efficiently each action achieves the goals.

→ ☆ Strengths :-

- These AI agents are flexible and adaptive.
- They can incorporate the agent's performance and priorities into their decision-making process.
- Utility-based agents can consider factors like risk, time and effort when evaluating different options.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

→ weakness :-

- Designing the utility fun^n is complex
- Evaluating the utility of all possible outcomes can be computationally expensive
- There is a degree of uncertainty about the outcomes.

→→ Example :-

You might have used google maps to find out a route which can take you from source location to your destination location in least possible time.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

4. Learning Agents :-

Why Do you give mock tests? when you get less marks for some question you come to know that you have made some mistake in your ans answer. Then you learn the correct ans answer and when you get that same question in further examinations, you write the correct answer and avoid the mistakes which were made in the mock test. This same concept is followed by the learning agent.

→ A learning agent in AI is the type of agent which can learn from its past experiences or it has learning capabilities.

→ It starts to act with basic knowledge and then able to act and adapt automatically through learning.

→ A learning agent has mainly four conceptual components.

1. Learning elements :- It is responsible for making improvements by learning from environment.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

3. Critic :- Learning element takes feedback from critic which describes that how well the agent is doing with respect to a fixed performance standard.

2. Performance element :- It is responsible for selecting external action

4. Problem generator :- This component is responsible for suggesting actions that will lead to new and informative experiences.

Hence, Learning agents are able to learn, analyze performance and looks for new ways to improve the performance.

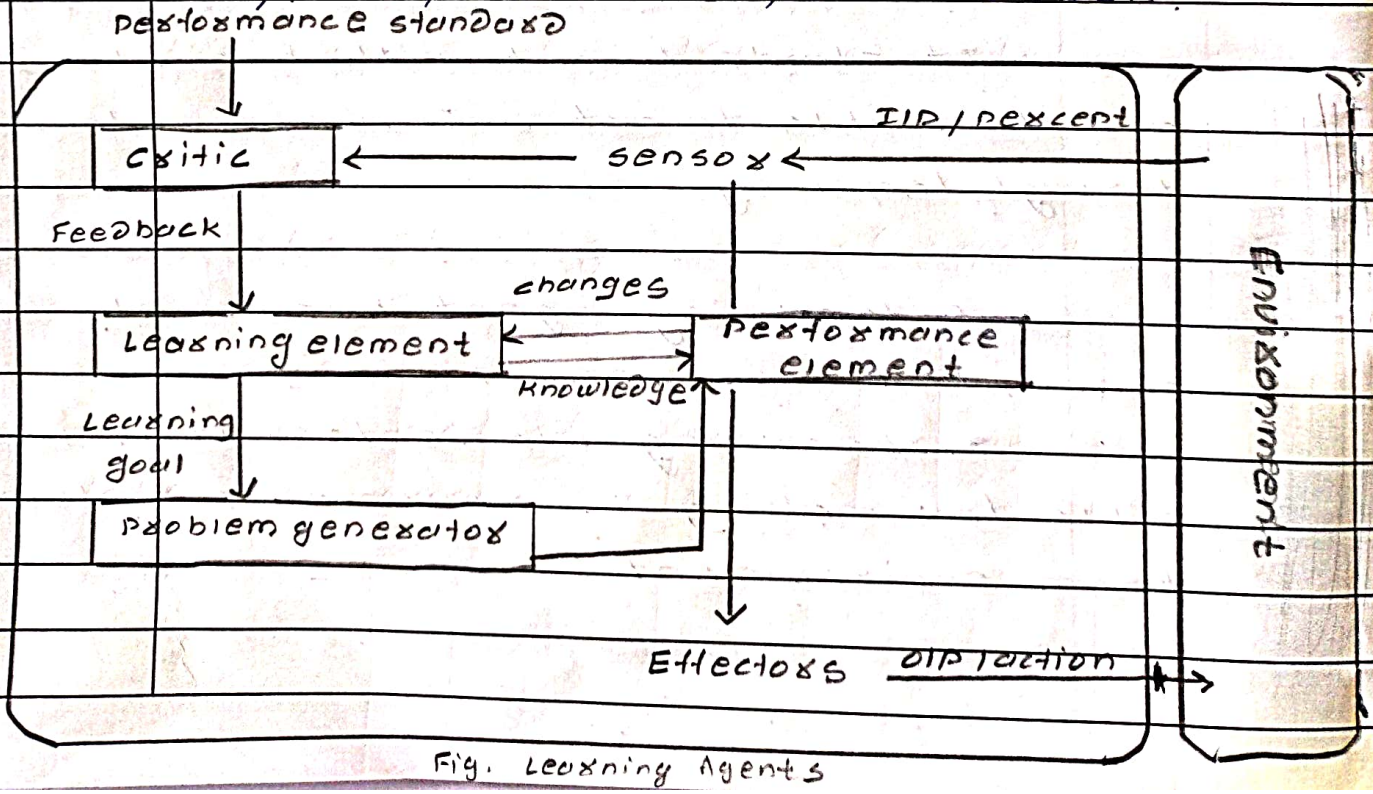


Fig. Learning Agents

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

2.2 Solving problem by searching : Problem solving Agent, Formulating Problems, Example Problems:

(6) Problem solving agents :-

Is the one who finds the goal state from start state in optimal way by following the shortest path, thereby saving the memory & time.

Searching techniques can be used in game playing like Tic-Tac-Toe or Navigation problems like Travelling salesman problem.

First, we will understand the representation of given problem so that appropriate searching techniques can be applied to solve the problem.

(6) Formulating Problems :-

Given a goal to achieve, problem formulation is the process of deciding what states to be considered and what action to be taken to achieve the goal. This is the 1st step to be taken by any problem solving agent.

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

2. state space :-

The state space of a problem is the set of all states reachable from the initial state by executing any sequence of actions. state is representation of all possible outcom

3. state space search -

Searching in a given space of states pertaining to a problem under consideration is called a state space search

3. Path :-

A path is a sequence of states connected by a sequence of actions in a given state space.

④ Components of Problem Formulation :-

2. Initial state :-

The starting point of agent.

3. Actions :-

The set of actions the agent can take from each state

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

3. Successor Function:

It is a function that returns a state on executing an action on the current state.

4. Goal state :-

A condition that checks if the goal is achieved.

5. Path cost :-

A measure of how costly a path is helping choose the best one

(B) Example of 8 Puzzle problem :-

It has a 3×3 board with tiles having 1 through 8 numbers on it. There is a blank tile which can be moved forward, backward, to left and to right. The aim is to arrange all the tiles in the goal state from by moving the blank tile minimum number of times.

1	2	3		1	2	3
4	8	–		4	5	6
7	6	5		7	8	–

Initial state Goal state

Space for Marks	Question No.	Examiner / Moderator	Question No.	a	b	c	d	e	f	Total

* States - States can represent by a 3×3 matrix Data structure with blank denoted by 0

2. Initial state - {(1,2,3), (4,8,0), (7,6,5)}

3. Actions - The blank space can move in Left, Right, UP and Down directions specifying the actions.

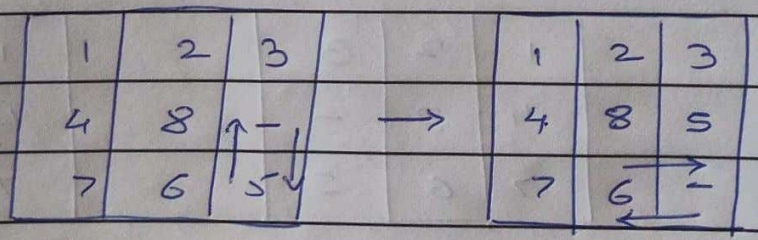
3. Successor Function -

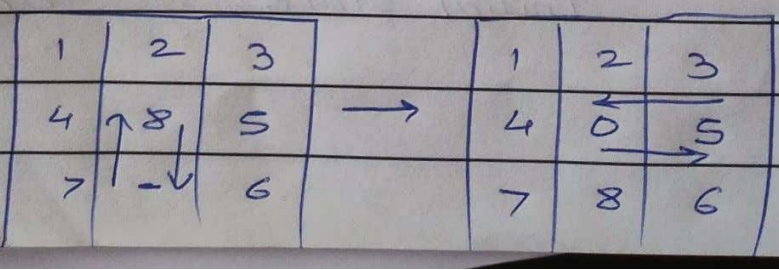
If we apply "Down" operator to the start state the resulting state has the 5 & the blank switching their positions.

4. Goal state - {(1,2,3), (4,5,6), (7,8,0)}

5. Path cost -

No of steps to reach to the final state.





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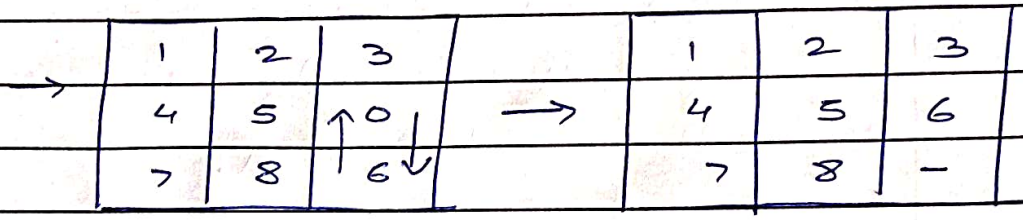

Soln :-

{(1,2,3),(4,8,0),(7,6,5)} →

{(1,2,3),(4,8,5),(7,6,0)} → 1

{(1,2,3),(4,8,5),(7,0,6)} → 2

{(1,2,3),(4,0,5),(7,8,6)} → 3

{(1,2,3),(4,5,0),(7,8,6)} → 4

{(1,2,3),(4,5,6),(7,8,0)} → 5

Path cost = 5 steps