

# Artificial Intelligence

## unit - 01.

Q [18]  
Q1]

Define AI and explain typical task Domains of AI.

Ans AI refers to the simulation of human intelligence process by machines especially computer system. It involves creating algorithms and software that enable computer to perform tasks that typically require human intelligence, such as understanding natural languages, patterns solve complex problem etc.

the typical task domains of AI .

- 1] Machine learning :- Analytical model building it use methods from neural networks, statistics, operations research and physics to find hidden insights .
- 2) Deep learning :- Uses a huge neural network of many layers of processing unit taking advantages of computing power.
- 3) Natural language processing :- (NLP)  
It is a ability of computer to analyze understand and generate human language to perform certain tasks .
- 4) the IoT :- Generate the massive amount of data from connected devices, most of its unanalyzed . Automating models with AI will allows us to use more of it .
- 5) Advanced Algorithms :-  
They are developed and combined in new ways to analyze more data faster and at multiple levels .

- Q2] why to learn AI. Different goal of AI.  
Ans. The AI enhances the
- 1] Speed.
  - 2] Efficiency.
  - 3] Precision.

- The different goal of AI :-
- 1] Replication of human Intelligence.
  - 2] Problem solving ability.
  - 3] Building a machine that can do human work [Play Games, Proving theorem.
  - 4] Advice giving capacity.
  - 5] Robotics are transformed thanks to AI, that help robots acquire the intelligence and perform tasks.

Q3] → Give brief history of AI of how it evolved over the time

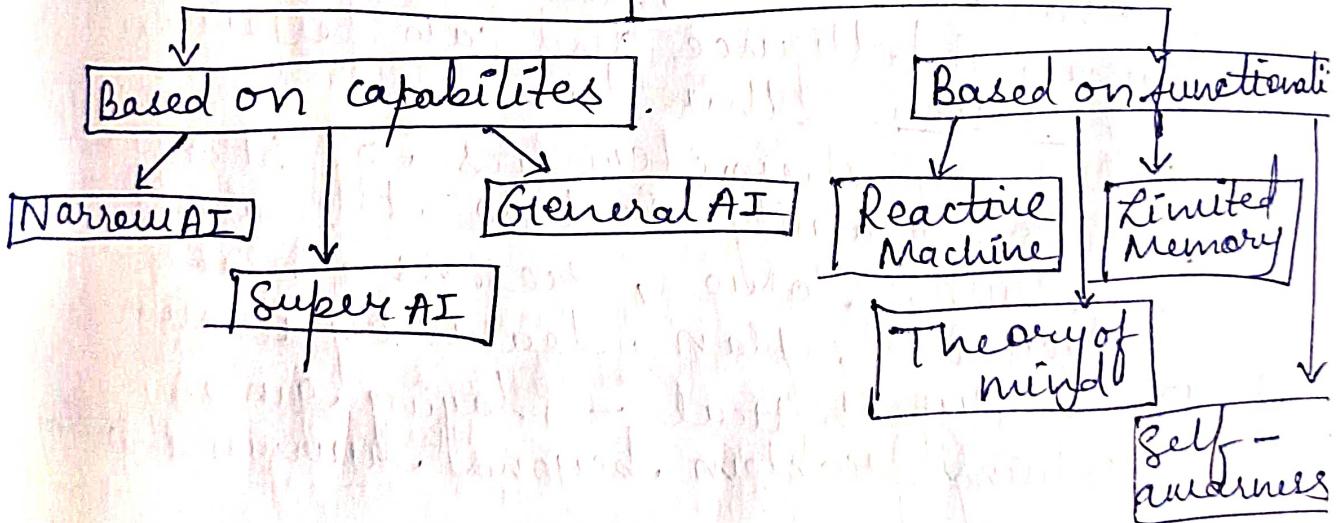
- Ans 1] 1950s → The birth of AI.  
→ The term AI was coined by John McCarthy, who organized a famous Conference in 1956, considered a birth of AI.
- 2] 1960s → Symbolic AI and expert system  
Researcher developed symbolic AI system capable of manipulating symbols and solving mathematical problem.
- 3] 1970s → 1980s - AI under said knowledge based system  
→ AI research faced challenges due to the unrealistic expectation and lack of progress. This period is known as AI winter gave reduced funding and interest in AI.
- 4] 1990s → Rise of Machine learning:-  
A shift to the statistical method and machine learning algorithm.

- 5] 2000s → Big Data and Deep learning  
 → Advances in computational power (aided by availability of large datasets) fueled the development of more sophisticated ML algo.
- 6] 2010s → AI in everyday life.  
 AI technologies became integrated into everyday life. Virtual assistance [Siri, Alexa]
- 7] 2020s → Continued advancements and ethical concerns.  
 → AI continue to advance rapidly, with breakthroughs in NLP, reinforcement learning etc.

#### (Q4) Types of AI.

Ans.

#### Types of AI



#### ① Weak / Narrow AI

- ① Can perform a dedicated task with intelligence. The most common and currently available AI is in Narrow AI in the world.
- ② It cannot perform beyond the field or limitations, it has only trained for specific tasks.
- ③ Apple 'Siri's'

## \* General AI :-

- 1] It is type of AI which can perform an intellectual task with efficiency like a human.
- 2] The idea is to make a system which could be smarter and think like a human.
- 3] The worldwide researcher are now focused on developing machines with General AI.
- 4] Ex :- Not success so far [ Due to fast processing - K computer by fujitsu and Titan ] .

## \* Super AI :-

- 1] Super AI is a level of Intelligence of System at which machines could surpass Human intelligence and can perform task better than human.
- 2] Some key characteristics of Strong AI include capability to include the ability to think, solve, reason, make judgements, plan, learn by its own.
- 3] Ex :- Hypothetical - Playing games, solving problem beyond Human thinking

(B)

## Based on functionality :-

### Reactive Memory :-

- 1] It is most basic type of AI.
- 2] Such AI do not store memories or past experience for future action.
- 3] only focus on current scenarios and react on it as per possible best action.
- 4] Ex :- IBM Deep blue, Google alphago

## Limited Memory :-

- 1] Limited Memory can store fast experiences or some data for a short period of time.
- 2] This machine can store the data for the limited time only.
- 3] Ex:- self - driving cars.

## Theory of Mind

- 1] Theory of mind AI should understand the human emotion, people, beliefs and able to interact socially.
- 2] This type of machine are still not developed. But researcher are making a lot of efforts.
- 3] Ex:- Kismet, Sophia.

## Self - Awareness

- 1] Self - Awareness AI is the future of AI. These machine will be super intelligent & will have their own consciousness, sentiments and self awareness etc.
- 2] These machines will be smarter than human mind.
- 3] It is hypothetical concept.

(Q5)

How Agents help in AI. Agent architecture and types of agents.

Ans.

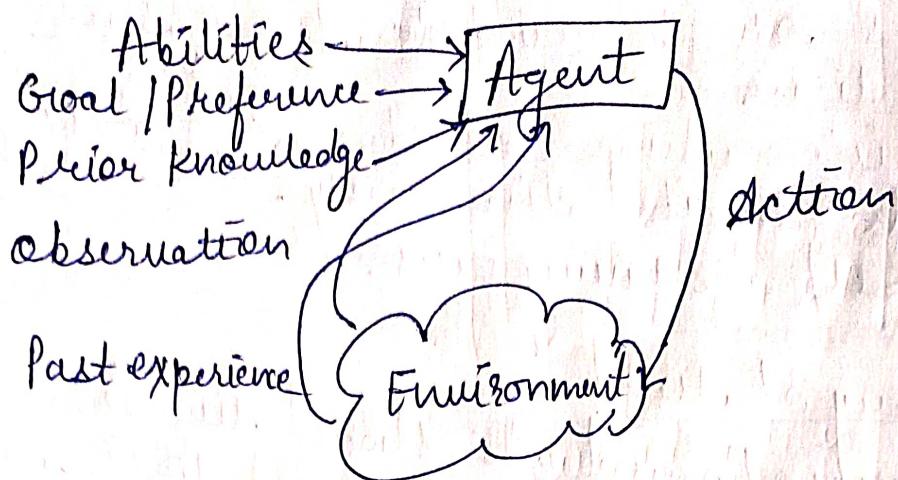
The AI is defined as the study of logical agents.

(Q5)

The agents could be anything that make decisions, as a person, firm, machine or a software. It carries out the action with the best outcome after considering past and current percepts.

The AI system composed of its agent and its environment.

## • Agent Architecture



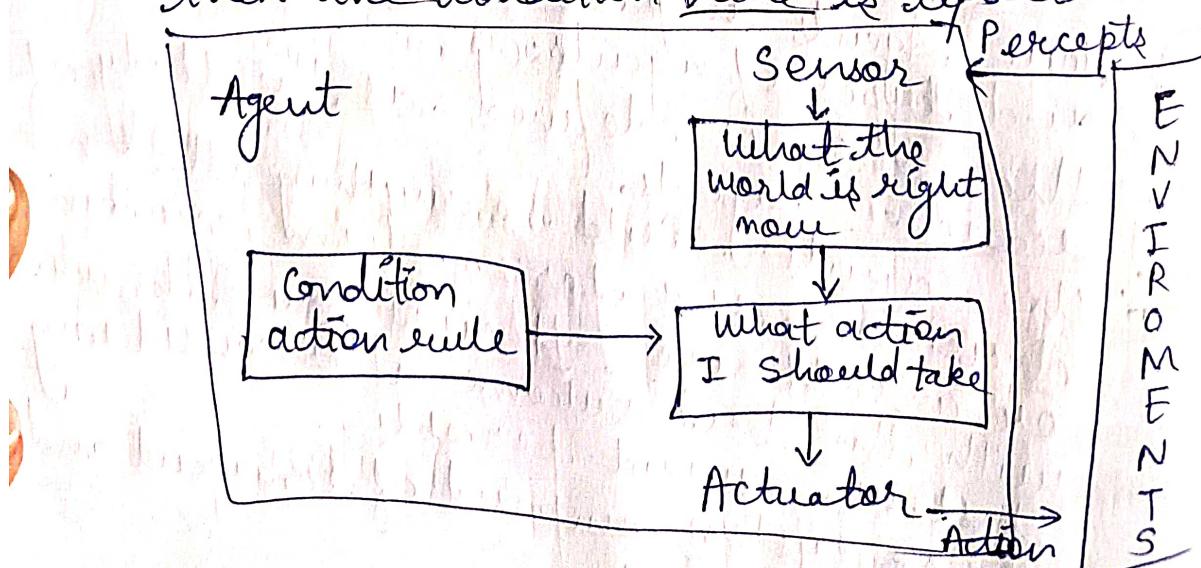
### • Types of Agents

#### 1] Simple reflex Agent :-

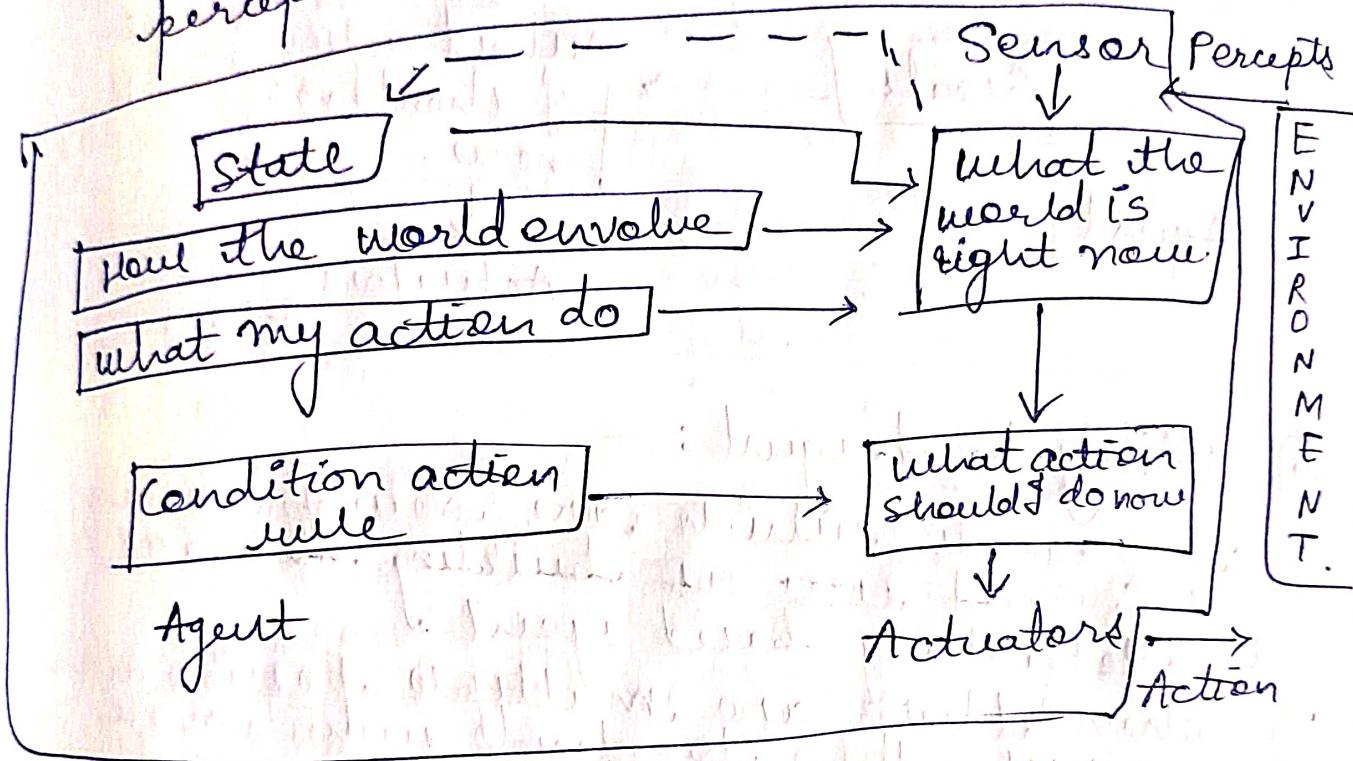
- 1) Simple reflex Agent ignore the rest of the history and act only on the basis of current percept.
- 2) Percept history is history of all that an agent has perceived to date.
- 3) The ~~condition action rule~~ is based agent function is based on condition action rule.

#### \* Disadvantages

- 1] very limited intelligence
- 2] usually too big to generate and store.
- 3] if there is update in environment, then the condition rule is updated.

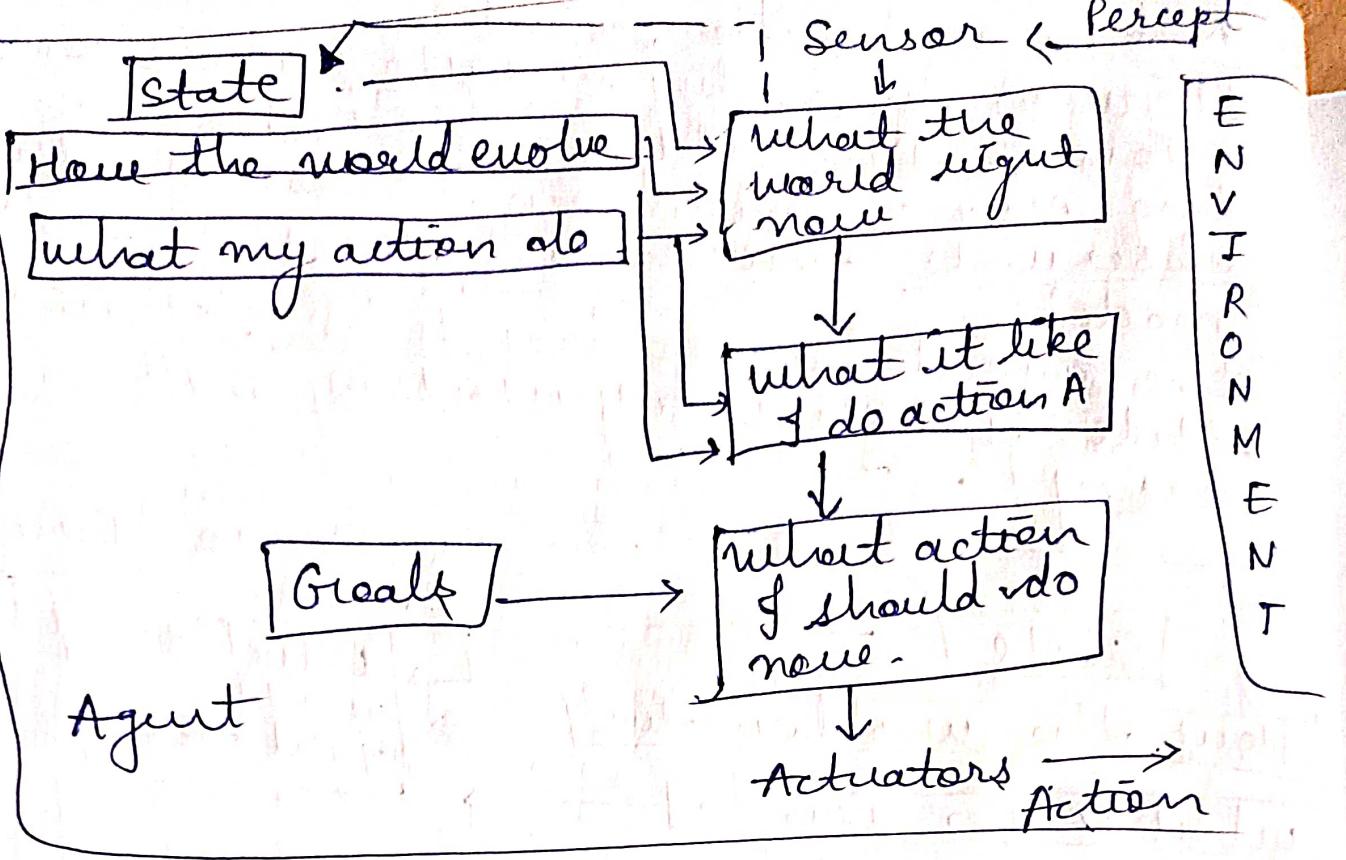


- 2] Model based reflex agent
- 1) It work by finding a rule whose condition matches the current situation.
  - 2) The model based can handle partially observable environment by the use of model.
  - 3) The agent has to keep track of internal state which is adjusted by each percept.



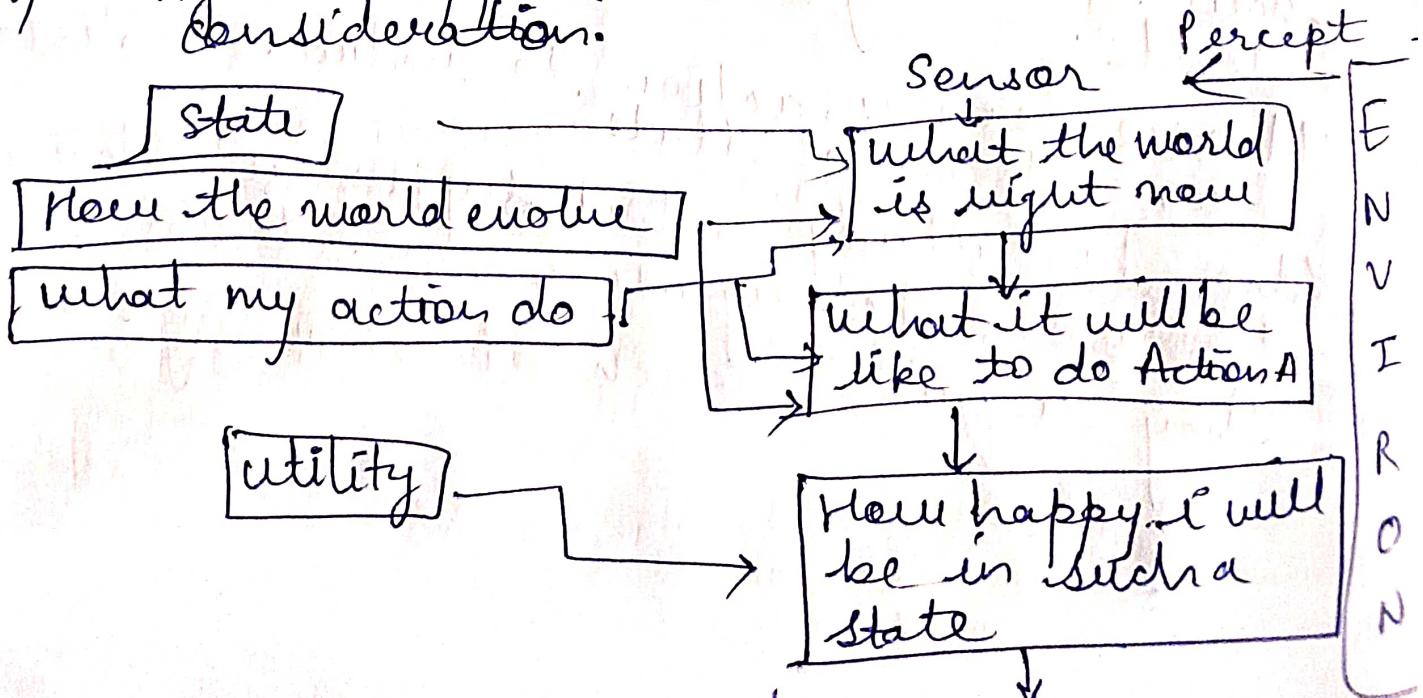
### ③ Goal - based Agent :-

- 1) These kind of agents take decision based on how far they are currently from their goal.
- 2) There every action to reduce the distance from the goal state.
- 3) The knowledge that support its decisions.
- 4) These make agents more flexible. They require search and planning.



#### ④ Utility based agent :-

- 1) The agents which are developed having their end uses as building block and called utility based agent.
- 2) When there are multiple possible alternatives, then to decide which one is best, utility based agent are used.
- 3) They choose actions based on preference for each state.
- 4) Agent happiness should be taken into consideration.



## Q) Learning Agent :-

- 1) the learning agent in AI is the type of agent that can learn from its past experiences or it has learning capabilities.
- 2) A learning agent has 4 components .
- i) Learning Element:-  
→ It is responsible for making improvements by learning from the environments .
- 2) Critic :-  
→ The learning element takes feedbacks from critic which describes how well the agent is doing .
- 3) Performance element:-  
→ It is responsible for selecting external action .
- 4) Problem Generator:-  
→ Responsible for suggesting actions that will lead to new and informative experiences .

Q6] what is significance of PEAS, give example

- Ans) 1) The PEAS is used to group the similar agent together .
- 2) We know that there are different agent in AI the PEAS is used to group the similar agents together .
- 3) The PEAS system delivers the performance measure about the environment , actuators and sensors . Most of highest performing agent is natural agent .

4) PFAAS stands for -  
P → Performance measure  
[It is the unit to define the success of an agent]. Performance values w.r.t agents based on their different percept.

2) E → Environment.  
Environment is the surrounding of a agent at every instant. It keep changing with time if the agent is set in motion.

- 1) Fully observable
- 2) Episodic / sequential
- 3) Static / Dynamic
- 4) Discrete
- 5) Deterministic.

3) Actuators :-  
It is part of agent that deliver the output of actions to the environment.

4) Sensor :-  
It the part of agent that takes the input for the agent.

Ex :- Agent → Hospital management system.

1] Performance measure  
→ Patient's health, Admission process, Payment.

2] Environment

→ Hospital, doctor, patients.

3] Actuator :-

→ Prescription, Diagnosis, Scan report.

4] Sensor :-

Symptoms, patient's response.

- Q7 what are advantage and dis of AI.
- Sol:-
- 1) Increased efficiency.
  - 2) Data Analyze → large data analyze.
  - 3) 24/7 Availability [AI Power system can operate continuously].
  - 4) Accuracy.
  - 5) Faster decisions.
  - 6) Safety and risk reduction.  
[AI can be used for tasks that are hazardous to humans, reducing risks and increase safety].

### \* Disadvantage -

- 1) Job displacement.
- 2) Ethical concerns [AI raise the ethical issues, including the data privacy, algo].
- 3) Lack in creativity [As a human].
- 4) Cost and complexity.
- 5) Trust [It is not always fully reliable].
- 6) Dependency of Technology.

Q8] what are different Application of AI .

Sol:- ① AI application in E-commerce

- 1) Personalized shopping.
- 2) AI powered assistant  
→ Virtual shopping assistant and chatbot help to improve the user experience.
- 3) Fraud prevention  
→ Credit card fraud and fake reviews.

② AI in Education

i) To increase the productivity in the sector as it is the all manual work of human to perform there. More productivity as the faculties and help them concentrate more on students than office work.

③ AI in Lifestyle :-

→ Automobile manufacturing companies like Toyota, Audi, Volvo and Tesla use ML to train computers to think and evolve like humans when it comes to driving in any environments.

④ → Facial recognition in laptop, mobile

→ Spam filters.

→ [such as email spam filters]

⑤ AI in Robotics :-

→ Robotics is another field where AI is commonly used. AI uses real-time updates to sense obstacles in its path and preplanned its journey.

→ It can used

- 1) carrying good to hospital, factories
- 2) Cleaning offices etc.

⑥ AI in Human Resources :-

→ AI is used for blind hiring. Using machine learning software, you can examine application based on specific parameters. AI driven system can scan job candidate profiles and resume to provide Recruiters an understanding of talent pool.

## ⑥ AI in Social Media :-

### Instagram

→ On Instagram, AI considers your likes and the accounts you follow to determine what posts you are shown on your explore tab.

### Facebook

→ AI is used along with a tool called DeepText. Facebook can understand the conversion better. It can be used to translate posts.

## ⑦ AI in Healthcare

Q9

Q15

what is production system? Explain its characteristics and types.

Ans :- Production system or production rule system is a computer program typically used to provide some form of AI, which consists of primarily of a set of rules about behaviour but it also include the mechanisms necessary to follow those rules as the system respond.

### • Characteristics of Production rule :-

#### 1] Rules :-

Production sys consist of set of rules. Each rule has condition and an associated action. When the condition of rule matches that current state of system is executed.

#### 2] Inference engine :-

The inference engine is responsible for apply the rule to current state of system.

3) Working Memory :-  
→ Working memory is known as short term memory & holds the current state of system. It contains information about current situation, facts etc.

4) Conflict resolution :-  
→ When multiple rule are activated conflict resolution mechanism decide which rule to execute first. Different strategies can be used.

5) Declarative knowledge :-  
→ Production system rely on the declarative knowledge, which is explicit knowledge about facts, rules and relationship in problem.

\* Types of Production System :-

1] Forward chaining :-  
→ the system starts with the available data and uses the rules to deduce new information until the goal is reached. It is a data-driven approach where the system derives conclusion from initial data.

2] Backward chaining :-  
→ the system starts with goal and work backward to find the rules that lead to goal. It's a goal-driven approach where the sys tries to satisfy the condition.

3] Hybrid systems :-  
→ Hybrid system are combination of both forward and backward chaining. They can be more efficient in certain situations.

- Q10]. Explain different problem characteristics with example.
- Q14] Q21] Q20]
- Ans:- To choose the appropriate method for a particular problem first we need to categorize the problem based on following characteristics :-

- 1] Is the problem decomposable into small sub-problems which are easy to solve?
- 2] Can solution steps be ignored or undone?
- 3] Is the universe of problem predictable?
- 4] Is a good solution to the problem is absolute or relative?
- 5] Is the solution to the problem a state or path?
- 6] What is the role of knowledge in solving a problem using artificial intelligence?
- 7] Does the task of solving a problem require a human interaction?

Ex:- Water Jug:-

<u>Problem char.</u>	<u>Satisfied</u>	<u>Reason</u>
1) Is the problem decomposable?	No	One single solution.
2) Can solution steps be ignored or undone?	Yes	
3) Is the problem universe predictable?	Yes	Problem universe is predictable bcz it required only <u>one person</u> . We can predict the next step.

4) Is the good sol. is absolute or relative?	absolute	water Jug prob. may have no of solution, but once the solution is found, no need to bother about other solution.
5] Is the Solu. a state or path	Path	Path to Solution
6] what is role of knowledge?		Lots of knowledge helps to control the search sol.
7] Does the task require human interaction.	Yes	Additional assist - it is required like to get Jug etc pump.

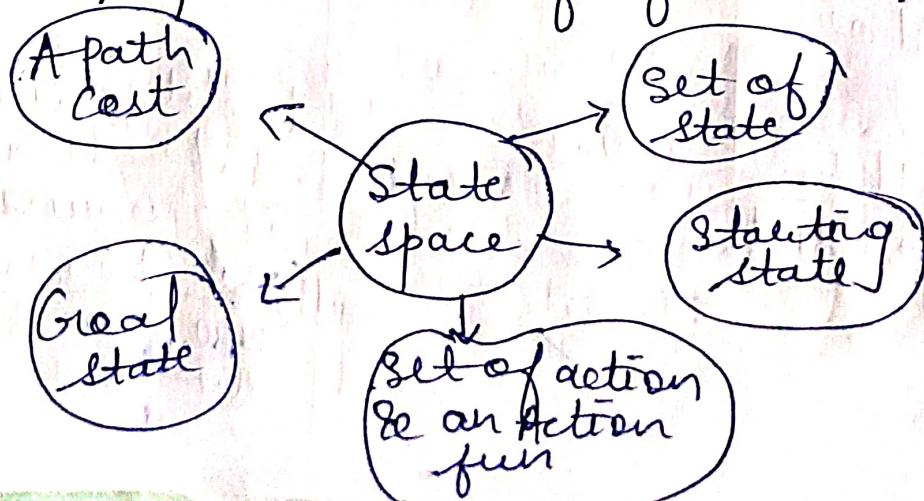
Q16

Q11] what is State Space? Example?

Ans. The state space of problem can be defined as the set of state in which the problem can be represented and solve.

The state space consist of following.

- 1] Set of states.
- 2] Starting state
- 3] Set of action and a action function.
- 4] Set of goal state
- 5] A path cost of function.



Ex:-

1	2	3
4	5	6
7	8	

Goal State.

Initial State.

5	2	1
4		6
8	7	3

5	2	1
4	7	6
8		3

5	2	1
4	6	
8	7	3

5	2	1
4	6	
8	7	3

This will extend till and on till all the states are represented.

### Advantages

- 1) It defines a set of all possible states.
- 2) It helps us to trace the path taken start from goal state.

### Disadvantage

- 1) It is impossible to explore all states.
- 2) Due to huge combinational states in state space we need high amount of CPU resources.

Q28]

Q12] Discuss AI techniques in details.

Ans. AI techniques is a method that achieves knowledge. The main AI techniques are :-

### Search :-

- 1) Search provide a way to solve the problem for which no more direct approach is available as well as a framework to get solution. A search program finds a solution for a problem by trying various sequences of actions.

- Advantages :-
  - 1) It is the best way so far to solve the problem.
- Disadvantages :-
  - 1) Most problem search space is too large that is it impossible to search for whole space.

### (2) Use of knowledge :-

- 1] The use of knowledge provides a way of solving complicated problem by manipulating the structure of the objects.
- 2] It should be represented in such a way that it can be understood by the people who must prepare it.
- 3] Adjust the error to demonstrate changes in the world.

### (3) Abstraction :-

- 1) Abstraction finds a way of separate the imp. features and notifications from the unimportant ones. Otherwise the confusion in process.
  - 2) Ex :- Header files use in program we use only readymade functions we are not bother about their definition.
- Search Algo in AI.

- Q13] Discuss the role of production sys in Problem solving system.
- Ans. The production systems play a crucial role in problem solving system, especially in the AI.

## I] Representation of knowledge :-

The production sys provide a knowledge in the form of rules, complex problem solving logic can be little way of both understandable to humans & processable by computers.

## 2] Inference and Decision Making :-

By applying rules to the current problem state, the system can deduce new information or actions, leading to effective decision-making. This process allows the system to infer conclusion, solve problem and derive new knowledge.

## 3] Flexibility and Modularity :-

The modularity enhances the system's flexibility. New rules can be added or existing rules can be modified to get changes in problem solving and get effective solution.

## 4] Problem Diagnosis / Troubleshooting :-

→ By matching observed symptoms to predefined rules, production system can diagnose issues recommended for solution or guide troubleshooting.

## 5] Automation and Decision Support :-

→ Automation reduces the need for human tasks intervention in routine decision making tasks.

## 6] Expert System :-

→ It utilize the production rules to emulate the decision making process of human experts.

Ex :- field of medicine, where the expert system can assist doctors in diagnosing diseases based on symptoms and medical history.

Q34]

Q15] Production rule in water Jug problem.

$$\text{Solu}^h \rightarrow x = 4 \text{ L}$$

$$y = 3 \text{ L}$$

Goal state :  ~~$\exists$~~   $\langle 2, 0 \rangle$ .

Solu<sup>h</sup> →  $\langle 0, 0 \rangle$  // Init.

$\langle 0, 3 \rangle$  // fill Y of 3 lit

$\langle 3, 0 \rangle$  // Pour in 4L jug

$\langle 3, 3 \rangle$  // Fill 3 lit jug

$\langle 4, 2 \rangle$  // Pour water of 3L to 4L Jug

$\langle 0, 2 \rangle$  // Remove 4 lit water

$\boxed{\langle 2, 0 \rangle}$  // Pour water to Jug 1

Q19] How does AI differ from traditional computer program? Explain with Ex.

Ans.

Data driven learning.

### AI

1) AI system can learn patterns & relationship from large amount of data. ML algorithm can analyze customer purchasing data to predict future buying behaviour.

### Traditional CP.

1) developer will write the explicit instructions to perform task. For ex:- In bank lending developer need to write the code to calculate the interest rate.

## Flexibility

- 2) AI system update the new data and environment.  
Ex:- Speech recognition system can improve their accuracy by interaction.

2) It operate based on fixed instruction. If there's is a need to change function -ality. Developer must modify the code.

## Decision making.

- 3) AI algorithm can make decision by learning from example. e.g. spam filters can learn to differentiate between spam and legitimate emails.

3) It relay on predefined rule and conditions  
Ex:- In a game if player's health drop to zero. the game end.

## Handling uncertainty

- 4) System can handle the uncertainty or incomplete data  
For ex:- In autonomous vehicle AI algo process sensor data to make decisions about driving.

4) It struggle with uncertainty. If the program encounter unexpected input, it might process error.

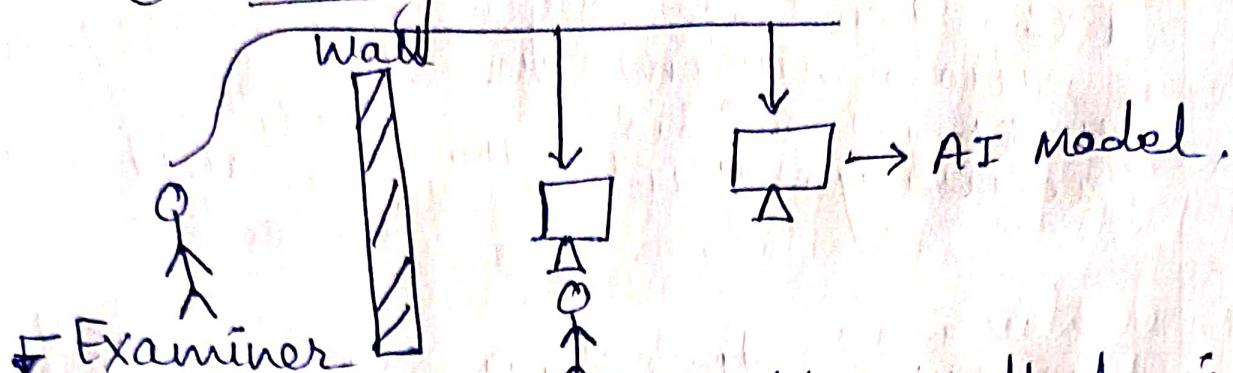
## Complex Problem solving

- 5) It can solve the complex problem that are difficult for traditional algo.  
Ex:- Chess at high level.

5) It can solve many complex problem it might struggle with tasks that require extensive patterns.

Q22] What is Turing test and Chinese Room Test.

Ans. ① Turing Test :-



[He/she cannot find out the output is given by human or machine]

- 1] It is coined by Alan Turing 1950.
- 2] Turing test is used to determine whether or not machine can think intelligently like humans.
- 3] There will be human [Examiner] on one side of wall and human/machine on other side.
- 4] When the human interrogator can't distinguish the response given by other side that called Turing test.
- 5] Turing test tried ~~to~~ to trace the reasoning step to trace of human subjects solving the same problem.

② Chinese Room Test.

I/o chinese



Database, knowledge. It has Chinese.

O/p chinese.

→ Knows Only English.

- It is also known as Chinese room argument.
- 1] It is also known as Chinese room argument.
  - 2] Proposed by Mr. John Searle in 1980
  - 3] Argued that "Turing test could not be used to determine whether the machine is considered as intelligent."
  - 4] Turing test simply by manipulating symbol, without any understanding of those symbol.
  - 5] A person / machine can be considered an intelligent if an only if they are having understand that what they are doing.
  - 6] A person knowing English not Chinese sits its book with huge volume of Chinese literature.
- $\rightarrow$  Chinese symbol  $\xrightarrow{\text{return Y}}$  rules  $\xrightarrow{\text{return X}}$
- 

### Q23] AI Problem Representation types.

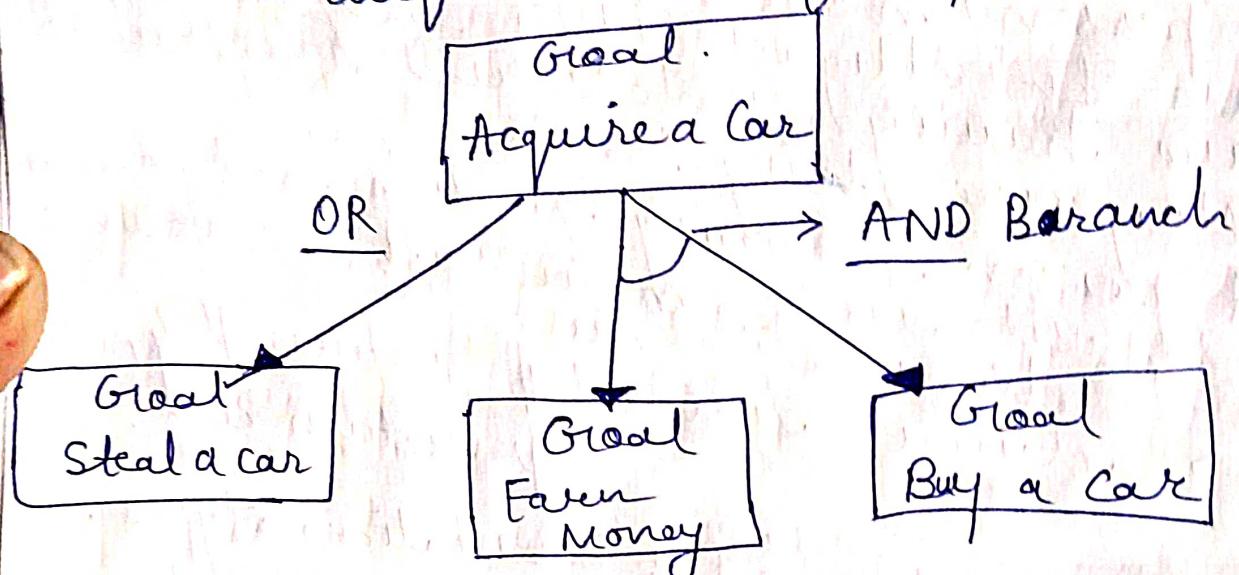
Ans Before the gathering of relevant info of the problem, we need to first define and represent the problem in very precise manner. This can be done using one of commonly used approaches in AI.

- 1] State space representation [Refer Q11]
  - 2] Problem reduction.
  - 3] Problem reduction.
- $\rightarrow$  It is not easy task to find the search space for all problem.

When the problem get complex in nature it become easy to solve the problem in smaller problem which would be easier to solve as compared to the problem as a whole. This is where problem reduction method is used.

→ The structure to keep the problem is known as an AND OR Graph / Tree

Ex: - Assume the situation where we acquire a car for yourself -



- AND branch → we have to consider both successor node as combined sol. for parent node.
- OR Branch → simply select one alternatives.

Q24] Describe the architecture of an intelligent agent. What are the components that make up an agent's architecture?  
remaining.

Q29] Explain the concept of problem representation paradigms in AI. How does the choice of representation impact problem solving?

Ans. for half refer to ques 23.

- The choice of problem representation in AI significantly impacts the problem solving process.

1] Expressiveness:-

→ The expressive power of a representation determines the complexity of the problem that can be effectively solved.

2] Solvability:-

→ Some representations are better suited for specific algorithms, affecting the solvability of problem.

3] Ease of Manipulation:-

→ Representations that are easy to manipulate simplify the implementation of algorithms.

4] Efficiency:-

→ The efficiency of problem-solving algorithms can be significantly affected by the choice of representation.

5] Interpretability:-

→ Some representations provide human understandable solutions, in interpreting the result of problem solving.

Q30] Compare and contrast the advantages and disadvantages of different problem representation paradigms.

Ans. 1] State Space representation.

- Advantages

- 1] It defines the set of all possible state, operation and goal state.
- 2] It helps us to trace the path taken starting from the initial state to the goal state.

- Disadvantage :-

- 1] It is practically impossible to explore all the states for a given problem.
- 2] Due to huge <sup>combinational</sup> states in state space we need a high amount of CPU resources.

② Problem Reduction.

- Advantages

- 1] Simplifies complex problems.
- 2] Problem reduction helps in focusing the search space.
- 3] Problem reduction helps or supports divide and conquer algorithm.

- Disadvantages :-

- 1] Problem reduction assumes independence between subproblems.
- 2] Incomplete problem reduction that leads to the oversight - combining solutions from subproblem are complex.

Q32] Illustrate 8 puzzle

Ans: - Initial state :  $\{1\ 2\ 3\} \{4\ 8, 0\} \{7\ 6\ 5\}$

Action :- Blank space can remove right, left, up, down.

successor

If we apply down operator to start resultant state has 5 position switch.

$\begin{matrix} 1 & 2 & 3 \\ 4 & 8 & - \\ 7 & 6 & 5 \end{matrix} \Rightarrow$

$\begin{matrix} 1 & 2 & 3 \\ 4 & 8 & 5 \\ 7 & 6 & - \end{matrix} \Rightarrow \begin{matrix} 1 & 2 & 3 \\ 4 & - & 5 \\ 7 & 8 & 6 \end{matrix}$

$\begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & - \end{matrix} \leftarrow \begin{matrix} 1 & 2 & 3 \\ 4 & 5 & - \\ 7 & 8 & 6 \end{matrix}$

Goal state :  $\{1\ 2\ 3\} \{4\ 5\ 6\} \{7, 8, 0\}$

Path cost :- Each step costs 1 so the Path cost is the no of steps in the path.

Q3] How the problem characteristics help in selecting appropriate AI techniques for problem solving?

Ans:- 1] Algorithm selectability :-  
knowing the problem type allows you to narrow down the choice of algorithm, ensuring that you select one capable of handling the problem's inherent complexities.

2] Data requirement :-  
→ Some AI techniques, like deep learning, require large amounts of labeled data for training, while others like expert systems, rely on structured knowledge bases.

3] Computational complexity :-  
→ Certain AI algorithms have higher computational complexity and may not be suitable for real-time or resource-constrained applications.

4] Problem constraints :-  
→ Some problems have specific constraints, such as real-time processing, interpretability or fairness.

5] Human-interaction.  
→ Problems that involve human interaction, such as chatbots or recommendation systems, require techniques that can model and respond to human behaviour.