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Unit 1 - Artificial Intelligence

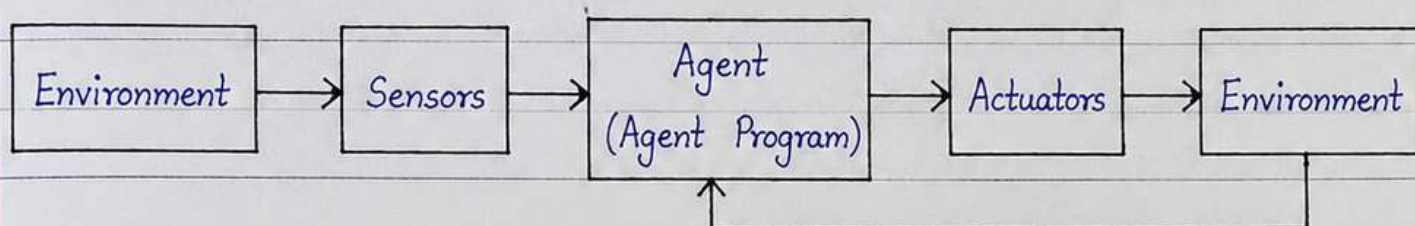
Page No. : 1

Date : 19 / 05 / 2025

Q.1 Explain the structure of an Intelligent Agent.

An Intelligent Agent is a system that observes its environment using sensors and performs actions using actuators.

Structure :



1. Sensors : Collect information from the environment.

Example : Camera, microphone, temperature sensor.

2. Agent Program : Processes the information received from sensors.

3. Agent Function : Maps percepts to appropriate actions.

4. Actuators : Perform actions in the environment.

Example : Motor, speaker, robotic arm.

5. Environment : The world in which the agent operates.

Example : A self-driving car uses cameras and sensors to observe roads, processes the information, and controls steering, brakes and accelerator.

Note : An Intelligent Agent continuously interacts with the environment through sensors and actuators to achieve its goals in a rational way.

Unit 1 - Artificial Intelligence

Page No. : 2

Date : 19 / 05 / 2025

Q.2 Explain Simple Reflex Agent and Model-Based Agent.

1. Simple Reflex Agent :

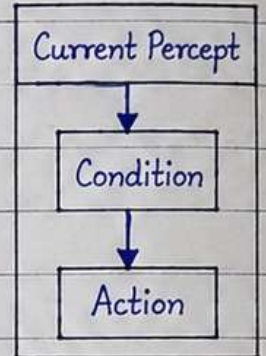
- A Simple Reflex Agent selects an action based only on the current percept.
- Working : Current Percept $\rightarrow$ Condition $\rightarrow$ Action
- It uses condition-action rules.
- Example : If temperature is high $\rightarrow$ Turn ON fan.

Advantage :

- Simple to design.
- Fast response.
- Easy to implement.

Limitations :

- Cannot remember past events.
- Works poorly in partially observable environments.



2. Model-Based Agent :

- A Model-Based Agent maintains an internal model/state of the environment.
- It considers :
 1. Current percept
 2. Previous information
 3. Current internal state
 4. How the environment changes
- Example : A robot remembers the location of obstacles even when they are temporarily outside its camera view.
- Advantage : Works better in partially observable environments.

Q.3 Define Artificial Intelligence and explain its applications.

- Definition : Artificial Intelligence (AI) is a branch of computer science that develops systems capable of performing tasks that normally require human intelligence.
- These tasks include :
 1. Learning
 2. Reasoning
 3. Problem solving
 4. Decision making
 5. Understanding language
 6. Recognizing images

Unit 1 - Artificial Intelligence

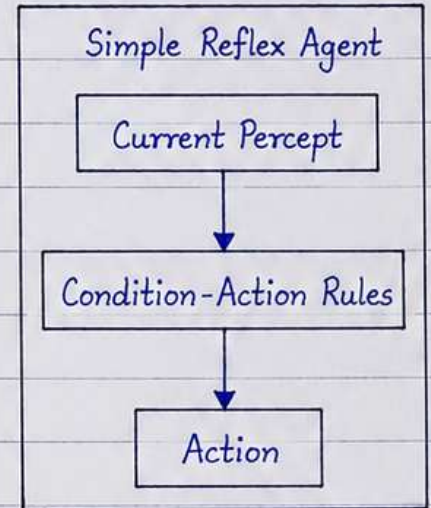
Page No. : 3

Date : 19 / 05 / 2025

Q.4 Explain any three types of Intelligent Agents.

1. Simple Reflex Agent :

- Acts according to the current percept using condition-action rules.
- Does not store any past information.
- Example : Automatic door.



2. Model-Based Agent :

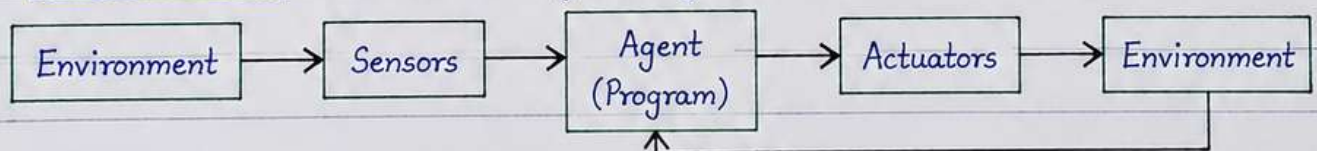
- Maintains an internal model/state of the environment.
- Considers current percept, previous information and how environment changes.
- Example : Robot navigation system.

3. Goal-Based Agent :

- Chooses actions that help achieve a specific goal.
- It searches for a sequence of actions to reach the goal.
- Example : GPS finding a route to a destination.

Q.5 What is an Intelligent Agent? Explain with an example.

- An Intelligent Agent is an entity that perceives its environment through sensors and acts upon that environment through actuators.
- Basic structure of an Intelligent Agent :



Example : Vacuum Cleaner Agent

- **Sensors** : Detect dirt and location.
- **Agent** : Decides whether to clean or move.
- **Actuators** : Motor and cleaning mechanism.
- **Environment** : Rooms / floor.
- If the sensor detects dirt, the agent performs the action Clean.

Unit 1 - Artificial Intelligence

Page No. : 4

Date : 19 / 05 / 2025

Q.3 Define Artificial Intelligence and explain its applications.

• Definition :

Artificial Intelligence (AI) is a branch of computer science that develops systems capable of performing tasks that normally require human intelligence.

• Tasks performed by AI :

1. Learning

2. Reasoning

3. Problem solving

4. Decision making

5. Understanding language

6. Recognizing images

• Applications of AI :

1. Healthcare : Disease prediction, medical diagnosis and medical image analysis.

2. Education : Personalized learning and intelligent tutoring systems.

3. Banking : Fraud detection and credit assessment.

4. Transportation : Self-driving vehicles and traffic prediction.

5. Robotics : Industrial and service robots.

6. Entertainment : Recommendation systems.

7. Agriculture : Crop monitoring and disease detection.

8. Customer Service : AI chatbots and virtual assistants.

Q.4 Explain the foundations of Artificial Intelligence.

1. Philosophy : Provides concepts of reasoning, knowledge and logic.

2. Mathematics : Provides probability, statistics, logic and algorithms.

3. Economics : Helps in decision-making and utility theory.

4. Neuroscience : Provides knowledge about the human brain and neural networks.

5. Psychology : Helps understand learning, perception and human behavior.

6. Computer Engineering : Provides hardware and computational systems required for AI.

7. Control Theory : Helps systems make decisions and achieve desired states.

8. Linguistics : Helps AI understand and generate human language.

Unit 1 - Artificial Intelligence

Page No. : 5

Date : 19 / 05 / 2025

Q.5 What is an Intelligent Agent ? Explain with an example.

- An Intelligent Agent is an entity that perceives its environment through sensors and acts upon that environment through actuators.

Basic Structure :



Example : Vacuum Cleaner Agent

- Sensors : Detect dirt and location.
- Agent : Decides whether to clean or move.
- Actuators : Motor and cleaning mechanism.
- Environment : Rooms / Floor.
- Working : If the sensor detects dirt, the agent performs the action Clean.

Q.6 Explain the foundations of Artificial Intelligence.

1. Philosophy : Provides concepts of reasoning, knowledge and logic.
2. Mathematics : Provides probability, statistics, logic and algorithms.
3. Economics : Helps in decision-making and utility theory.
4. Neuroscience : Provides knowledge about the human brain and neural networks.
5. Psychology : Helps understand learning, perception and human behavior.
6. Computer Engineering : Provides hardware and computational systems required for AI.
7. Control Theory : Helps systems make decisions and achieve desired states.
8. Linguistics : Helps AI understand and generate human language.

Note : These foundations together help in building intelligent systems that can think, learn and act like humans.

Unit 1 - Artificial Intelligence

Page No. : 6

Date : 19 / 05 / 2025

Q.5 What is an Intelligent Agent ? Explain with an example. (contd.)

Vacuum Cleaner Agent - Working :

- The sensors detect the current location and whether dirt is present.
- The agent processes this information.
- If dirt is present → the agent performs Clean.
- If no dirt is present → the agent moves to another location.
- This continues until the entire environment is clean.

Diagram :



Q.6 Explain the foundations of Artificial Intelligence.

AI is based on ideas and concepts from several fields.

The main foundations are :

1. Philosophy : Provides concepts of reasoning , knowledge , logic and intelligence.
2. Mathematics : Provides probability , statistics , logic and algorithms for solving problems.
3. Economics : Helps in decision-making , utility theory and resource management.
4. Neuroscience : Studies the human brain and inspires technologies such as neural networks.
5. Psychology : Helps understand learning , perception , memory and human behavior.
6. Computer Engineering : Provides hardware , software and computational systems required for AI.
7. Control Theory : Helps systems make decisions and achieve desired states.
8. Linguistics : Helps AI understand , generate and process human language.

Unit 1 - Artificial Intelligence

Page No. : 7

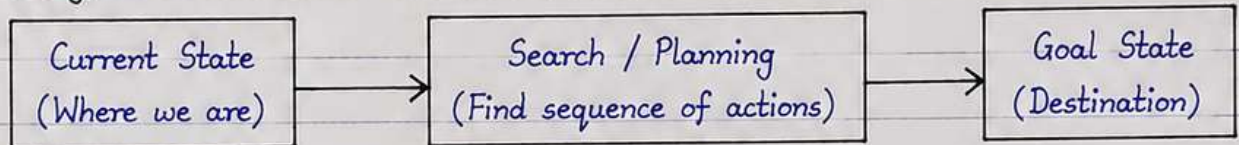
Date : 19 / 05 / 2025

Q.7 Explain Goal-Based and Utility-Based Agents.

1. Goal-Based Agent :

- A Goal-Based Agent chooses actions according to a goal.
- It searches for a sequence of actions that reaches the desired goal state.
- It does planning and search to achieve the goal.
- Example : A GPS system finds a route from Pune to Mumbai.

Working :



2. Utility-Based Agent :

- A Utility-Based Agent chooses an action based on the utility/value of possible outcomes.
- It tries to select the action that provides the highest utility.
- It is useful when there are multiple possible solutions.
- Example : A self-driving car may choose a route considering :
 - Time
 - Distance
 - Traffic
 - Safety
 - Fuel consumption
 - Comfort

Difference :

	Goal-Based Agent	Utility-Based Agent
Focus	Focuses on achieving a goal.	Focuses on the best outcome.
Goal	Goal is usually achieved / not achieved.	Outcomes can have different values.
Approach	Finds any one path that achieves the goal.	Finds the path with the highest utility.
When used	Less suitable when multiple solutions exist.	Better when multiple choices exist.
Example	GPS system reaching a destination.	Self-driving car choosing the best route.

Unit 1 - Artificial Intelligence

Page No. : 8

Date : 19 / 05 / 2025

Q.8 Explain the PEAS framework with an example.

- PEAS stands for :

P - Performance Measure , E - Environment , A - Actuators , S - Sensors

- It is used to specify the task environment of an intelligent agent.
- It helps in designing effective agents by defining what the agent should do, where it operates, what actions it can perform and what information it gets.

Example : Self-Driving Car

P - Performance Measure	E - Environment	A - Actuators	S - Sensors
• Safety of passengers and others • Reach destination in minimum time • Fuel efficiency • Comfort of ride • Follow traffic rules	• Roads and highways • Other vehicles • Pedestrians • Traffic signals • Road signs • Weather conditions	• Steering • Accelerator • Brake • Gear system • Indicator/Lights • Horn	• Camera • GPS • Radar • LiDAR • Speedometer • Ultrasonic sensors

Q.9 Write a short note on the future of AI.

- AI will have a major impact on our lives in the coming years.
- It will become more intelligent, safe and widely used.
- Some important developments in the future are :
 1. Healthcare : AI will help in early disease detection, personalized treatment and drug discovery.
 2. Transportation : Autonomous vehicles and smart traffic systems will become common.
 3. Education : Personalized learning and intelligent tutoring systems will improve education.
 4. Robots : Robots will perform dangerous, boring and repetitive tasks.
 5. Assistants : AI assistants will understand natural language better and help in daily tasks.
 6. Research & Science : AI will help in discovering new medicines, materials and technologies.
 7. Generative AI : It will create content like text, images, music and videos more accurately.
 8. Ethics & Safety : Issues like privacy, security, fairness and job loss will become important and need proper attention.

Conclusion : AI has great potential to improve human life, but it should be developed and used responsibly with proper rules and ethics.

Unit 1 - Artificial Intelligence

Page No. : 9

Date : 19 / 05 / 2025

Q.10 Explain the types of AI.

1. Narrow AI (Weak AI) :

- This type of AI is designed to perform a specific task.
- It cannot perform tasks outside its limited domain.
- Example : Voice assistants like Siri, Alexa.

2. General AI (Strong AI) :

- This type of AI can understand, learn and apply knowledge across a wide range of tasks like humans.
- It can perform any intellectual task that a human can do.
- Example : Self-driving car with human-like understanding.

3. Super AI :

- This is a theoretical form of AI that is far more intelligent than humans.
- It can solve complex problems beyond human ability.
- It does not exist yet and is only a future concept.

Q.11 Explain Machine Learning.

- Machine Learning (ML) is a branch of AI.
- It allows computers to learn from data and improve their performance without being explicitly programmed.
- ML uses algorithms and statistical models to identify patterns in data.
- It is widely used in spam detection, recommendation systems, image recognition, etc.

Q.12 Write a short note on Deep Learning.

- Deep Learning (DL) is a subset of Machine Learning.
- It uses Artificial Neural Networks with multiple hidden layers to learn from large amounts of data.
- It is inspired by the structure and function of the human brain.
- DL is used in image recognition, voice recognition, self-driving cars, natural language processing, etc.

Note : AI is a broad field. ML and DL are its important subsets that help in building intelligent systems.

Unit 1 - Artificial Intelligence

Page No. : 10

Date : 19 / 05 / 2025

Q.13 What is Problem Solving in AI? Explain the steps.

- Problem Solving is the process of finding a sequence of actions that leads from the initial state to the goal state.
- AI agents use search techniques to find optimal or best solutions.
- It is one of the most important areas in AI.

Steps in Problem Solving :

1. Define the Problem : Understand the problem and define initial state and goal state.
2. Formulate the Problem : Represent the problem in a way that can be solved by an AI agent.
3. Search for Solution : Use suitable search strategies to explore possible solutions.
4. Evaluate Solutions : Check the solution for correctness and efficiency.
5. Implement Solution : Apply the solution and reach the goal state.

Q.14 Explain Search Algorithms in AI.

- Search algorithms are used to find a sequence of actions that leads from initial state to goal state.
- They explore different paths in the search space to find the best solution.

Types of Search Algorithms :

Algorithm	Description	Example
1. Breadth First Search (BFS)	Explores all nodes at the current depth before moving to the next depth.	Finding the shortest path in an unweighted graph.
2. Depth First Search (DFS)	Explores as far as possible along each branch before backtracking.	Solving maze problems.
3. Uniform Cost Search (UCS)	Expands the node with the lowest path cost.	Finding least cost path in weighted graph.
4. Greedy Best First Search	Expands the node that appears to be closest to the goal.	Route finding in GPS.
5. A* Search (A-Star)	Combines actual cost and heuristic to find the optimal path.	Path finding in maps and games.

Note : Choice of search algorithm depends on the problem type, cost, and required efficiency.

Unit 1 - Artificial Intelligence

Page No. : 11

Date : 19 / 05 / 2025

Q.15 Explain applications of AI in different fields.

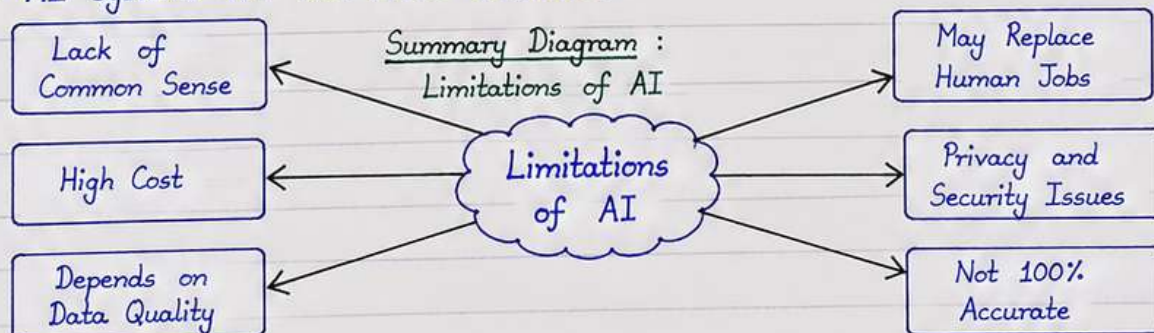
AI is used in many fields to make work easier, faster and more accurate.

Some important applications are :

Field	Applications of AI
Healthcare	- AI helps in disease prediction, diagnosis and treatment. - Used in robotic surgery and drug discovery.
Education	- Intelligent tutoring systems, online learning platforms. - Helps in student performance analysis.
Transportation	- Self-driving cars, traffic prediction and route optimization. - AI helps in vehicle safety and maintenance.
Banking & Finance	- Fraud detection, risk assessment and credit scoring. - Chatbots for customer support.
Entertainment	- Movie recommendations, gaming AI, virtual assistants. - Used in animation and special effects.
Agriculture	- Crop monitoring, disease detection and yield prediction. - Helps in smart irrigation and farming.
Industry	- Robotics for automation, quality control and maintenance. - Predictive maintenance reduces downtime.

Q.16 What are the limitations of AI?

- AI systems lack common sense and real understanding.
- They cannot think or behave like humans.
- High cost of development and maintenance.
- AI depends on data; wrong data gives wrong results.
- AI may replace some human jobs.
- It raises privacy and security concerns.
- AI systems are not 100% accurate.



Note : AI is a powerful tool, but it should be used wisely and ethically for the benefit of humans.

Unit 1 - Artificial Intelligence

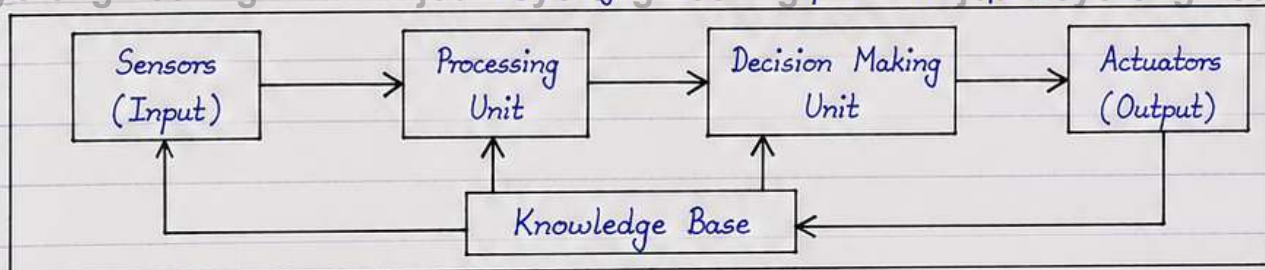
Page No. : 12

Date : 19 / 05 / 2025

Q.17 Explain the components of an AI system.

An AI system is made up of the following main components :

1. **Sensors (Input)** : Sensors collect data from the environment.
Example : Camera , Microphone , Temperature sensor.
2. **Knowledge Base** : It stores knowledge , facts , rules and information about the world.
3. **Processing Unit** : The AI algorithm processes the input data and uses knowledge to make decisions.
4. **Decision Making Unit** : It decides the best action to achieve the goal based on the processing.
5. **Actuators (Output)** : Actuators perform the action in the environment. Example : Motor , Speaker , Display.
6. **Feedback Loop** : The output action changes the environment and new data is again sensed. This helps the system to improve its performance.



Q.18 Differentiate between Narrow AI , General AI and Super AI.

Feature	Narrow AI (Weak AI)	General AI (Strong AI)	Super AI
Definition	AI designed to perform a specific task.	AI that can understand, learn and apply knowledge in any task like humans.	AI that is far more intelligent than humans in every way.
Scope	Limited to one task.	Human level intelligence in all tasks.	Beyond human intelligence.
Examples	Voice assistants , spam filters , recommendation systems .	Not available yet .	Not available yet , only a future concept .
Learning	Learns only for specific task .	Can learn anything like humans .	Learns and improves faster than humans .
Existence	Exists today .	Does not exist yet .	Does not exist yet .

Note : Narrow AI is used in daily life. General AI and Super AI are still in research and theory.