AI Assignment

Q-1. Explain the characteristic of AI techniques with examples.

Ans.

→ AI techniques exhibit the following characteristics:

- Flexibility :- AI can adapt to new situations.

Example :- Self-driving cars adjust to traffic conditions.

- Learning from Experience :- AI improves over time.

Example :- Chatbots like ChatGPT learn from interaction.

- Handling Incomplete Information :
AI can work with missing data.

Example :- AI in medical diagnosis.

- Parallel Processing : AI can process multiple inputs simultaneously.

Example :- Image recognition is real time.

Q-2 Describe the major areas of AI and their real-life applications.

-> Major areas of AI are as follows:

- Machine Learning (ML)
  -> Application :- Spam email filtering

- Natural Language Processing (NLP)
  -> Application :- Virtual assistants (e.g, Siri, Alexa)

- Computer Vision
  -> Application :- Facial recognition in smartphones

- Robotics
  -> Application :- Autonomous robots in warehouse

- Expert Systems
  -> Application :- AI-based medical diagnosis systems.

Q-3 Discuss the challenges solving AI problems with examples.

Ans.

1) Data Quality Issues -
-> AI requires large, high-quality datasets.
Example : Bias in facial recognition systems.

2) High Computation Costs -
-> AI models need expensive hardeware
Example : Deep learning training costs.

3) Lack of Common Sense -
-> AI struggles with reasoning.
Example : Chatbots misinterpreting human sarcasm

- Ethical Concerns -

-> AI can be biased.

Example: Unfair hiring decisions in AI recruitment tools.

Q-4 How do AI techniques differ from tradition programming approaches?

Ans. Artificial Intelligence (AI) and Traditional Programming (Rule-Based Programming) are fundamentally different in how they solve problems. Traditional programing relies on explicitly defined rules and logic, while AI techniques use learning-based approaches to make decisions.

Aspect	Traditional Programming	AI Techniques.
Approach	Uses pre-defined rules and logic (IF-Else conditions, loops)	Learns from data and improves over time
Adaptability	Cannot handle new situations without reprogramming	Adapts and learns ~~from~~ from experience
Data Dependency	Does not learn from data, follows fixed rules	Uses data for training and decision-making
Decision Making	Deterministic (produces the same output for given inputs)	Probabilistic (predicts based on patterns in data)
Error Handling	Errors must be explicitly handled by the programmer.	AI models can generalize and handle uncertainty.

Q-5 Explain the application of AI in healthcare and education.

Ans.

* AI in Healthcare

- Disease Diagnosis :-
  AI helps doctors analyze medical images (e.g., detecting cancer in X-rays).

- Drug Discovery :-
  AI accelerates drug development (e.g., predicting how molecules interact).

- Robotic Surgery :-
  AI-assisted robotic arms perform complex surgeries with precision.

* AI in Education

- Personalized Learning :-
  AI adapts lesson plans based on student performance.

- Automated Grading :-
  AI grades essays and exams efficiently.

- Virtual Tutors :-
  AI chatbots assist students with homework.

Q-6 Define the state space search with example. How it is used in problem solving?

Ans. State Space search is a fundamental problem-solving technique in Artificial Intelligence (AI), where a problem is represented as a set of states and possible transitions between them. AI explores these states to find a path from the initial state to the goal state.

*Example : 8- Puzzle Problem.

- Initial State :

-> A shuffled 3x3 grid with numbers 1-8 and a blank tile.

- Goal State :

-> Arrange the tiles in ascending order.

- State Space :

-> Every possible arrangement of tiles.

- AI Solution :

-> Algorithms like BFS, DFS, or A* explore possible moves to reach the goal.

Q-7 Compare and contrast BFS, DFS and bidirectional search with suitable examples.

Ans.

Search Algorithm	Approach	Best Use Case
BFS (Breadth-First Search)	Expands nodes level-by-level	Finding the shortest path in a maze
DFS (Depth-First Search)	Explores deep paths first	Solving puzzles with deep branching
Bidirectional Search	Searches from start and goal simultaneously	Efficient path finding (e.g., GPS navigation)

Q-8 What is heuristic search? Explain hill climbing with a detailed example.

Ans. A heuristic search is a search algorithm that uses a heuristic function to guide the search process toward the goal more efficiently than uninformed search methods (like BFS or DFS.

* Examples of Heuristics Search Algorithms.

- Greedy Best-First Search
- A Search Algorithm *
- Hill Climbing Algorithm.

* Hill Climbing Algorithm

-> Hill Climbing is a heuristic search algorithm that continuously moves in the direction of increasing value to find an optimal solution.

-> Hill climbing always moves toward the best immediate option.

*Example :-
Suppose a robot is trying to climb a mountain with peaks of different heights. The algorithm always moves toward a higher peak but might get stuck on a local maximum instead of reaching the highest peak.

Q-9 Describe the A* search algorithm. Provide a practice application where it can be used.

-> A* is an informed searched algorithm that finds the shortest path from an initial state to a goal state using a combition of :

- g(n) -> Cost from the start node to the current node.
- h(n) -> Estimated cost from the current node to the goal
- f(n) = g(n) + h(n) -> Total estimated Cost.

* Example Application: Pathfinding in Google Maps.

- Nodes: Location on the map
- Edges: Roads between locations
- g(n): Distance traveled so far.
- h(n): Estimated distance to the destination.
- f(n): Total estimated travel cost
- Result: Finds the optimal shortest route between two points.

Q-10 Explain the time and space complexity of search algorithm (BFS, DFS, A*).

Algorithm	Time Complexity	Space Complexity
BFS	O(b^d)	O(b^d)
DFS	O(b^d)	O(d)
A*	O(b^d)	O(b^d)

Q-11 What is Knowledge representation in AI and why it is important.

Ans. Knowledge representation (KR) in AI refers to the way information is structured and stored so that machines can reason, infer, and make decisions like humans.

* Why is Knowledge Representation Important?

1) Enables AI to "Understand" Data

AI systems need structured Knowledge to reason and learn.

2] Facilitates Problem Solving
-> AI can make logical decisions based on stored knowledge

3] Improves Machine Learning Models
-> More structured data leads to better predictions.

4] Allows AI to Explain Its Decisions
-> Helps in building explainable AI systems

* Real-World Applications.

- Chatbots & Virtual Assistants
- Expert Systems
- Autonomous Vehicles
- Recommendation Systems.

Q-12 Compare proportional logic and predict logic with examples.

Ans.

* Propositional Logic

-> "It is raining".
(Simple true / false statement)

* Predicate Logic

-> "All cats are mammals:
$\forall x$ (Cat(x) -> Mammal(x))"
(Uses variables and relations).

Q-13 Explain semantic network and frame-based Knowledge representation with suitable diagram.

Ans.

* Semantic Network:
-> A graph representation of relationship between concepts (e.g. "A dog is a mammal").

* Frame - Based Representation:
Uses data structures to store knowledge (e.g., "A car has wheels, an engine, and seats").

Q-14 Write an explain a predicate logic representation for a family tree.

Ans.

Parent (John, Mary).
Parent (Mary, Alice).
Grandparent (X, Y) :- Parent (X, Z),
Parent (Z, Y).

This logic allows AI to infer relationships (e.g., "John is Alice's grandparent").

Q-15 How does knowledge representation influence the efficiency of AI system.

Ans.

Well-Structured Knowledge :-
-> Faster decision-making and learning

Poor Knowledge representation :-
-> Inefficient AI performance

* Example :- AI in medical diagnosis improves with structured symptom-disease mappings.