

Name:- Piyush kamrani

Roll No:- 62

Div:- D15C

AI&DS-I

04/05

Assignment - 23

Q.1) What is AI? considering the COVID-19 pandemic situation, how AI helped to survive and renovated our way of life with different applications?

→ Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think, learn, and perform tasks like humans. It enables machines to perform tasks such as decision making, problem-solving, speech recognition, and image recognition without direct human intervention. AI system can improve their performance over a time through machine learning & deep learning techniques.

During the COVID-19 pandemic, AI played a crucial role in helping the world survive and adapt in various ways, such as:-

1) Healthcare & Diagnosis:-

- AI-based tools like CT scan analysis & x-ray detection helped in identifying COVID-19 infection.
- chatbots like "Aarogya setu" provided self-assessment & COVID-19 information.

The first step in solving a problem is to identify the problem. This involves understanding the problem and what is being asked. Once the problem is identified, the next step is to plan a solution. This involves deciding on a strategy to solve the problem. The third step is to execute the plan. This involves carrying out the steps of the solution. The final step is to check the solution. This involves verifying that the solution is correct and that it satisfies the problem.

1.3 Problem Solving

A problem is a situation that requires a solution. Problems can be solved using a variety of strategies. Some common strategies include:

- Identify the problem.
- Plan a solution.
- Execute the plan.
- Check the solution.

Example of Problem Solving

If x is a real number, then x can be written as $x = a + b\sqrt{2}$, where a and b are rational numbers.

$$\text{Let } x = a + b\sqrt{2}$$

$$\text{Then } x^2 = (a + b\sqrt{2})^2 = a^2 + 2ab\sqrt{2} + 2b^2$$

$$\text{Since } x^2 \text{ is rational, } 2ab\sqrt{2} \text{ must be rational.}$$

SO, SEND = 3567, MORE = 1085, MONEY = 10652

Q: consider the following axioms:

→ 1) All people who are graduating are happy.

$$\forall x (\text{Graduating}(x) \rightarrow \text{Happy}(x))$$

$$\forall x (\text{Happy}(x) \rightarrow \text{Smiling}(x))$$

$$\exists x \text{ Graduating}(x)$$

using forward Reasoning to infer new facts.

from Axiom 2: There exists some person (say, p) who is graduating.

$$\text{Graduating}(p)$$

$$\text{Happy}(p)$$

$$\text{Smiling}(p)$$

using minimax, X will choose the winning
at (2, 1)

16 Explain Alpha beta pruning algo. for adversarial search with example.

→ Alpha-Beta pruning is an optimization technique used in the minimax algorithm for two-player games. It helps eliminate branches that won't affect the final decision, reducing the number of nodes evaluated and improving efficiency.

1) Alpha (α): The best (highest) value found so far for MAX.

2) Beta (β): The best (lowest) value found so far for MIN.

3) Pruning conditions:

- If a MIN node finds a value $\leq \alpha$, stop evaluating further.
- If a MAX node finds a value $> \beta$, stop evaluating further.

This avoids unnecessary computation and speeds up the minimax search.

→ Finding the route from node S to G using BFS
Applying BFS Algorithm:

- 1) Start at node S and expand on its direct neighbours first.
 - 2) The immediate neighbours of S are A, B and C so they are added to the queue.
 - 3) Next, expand A and add its neighbours D to the queue.
 - 4) Expands D, which connects to E and F and G is found, the search stops.
 - 5) The shortest BFS path from S to G is determined.
- The BFS traversal finds the path S → A → D → G with a total cost of 3.

What do you mean depth limited search? Explain.
Iterative Deepening search with Example.
Also state limitations of recursive - ~~depth~~ - ~~limit~~ climbing.

1. Answer question and answer the question

by using answer the question

2. Answer in your own words

3. Answer the question in your own words

4. Answer the question in your own words

5. Answer the question in your own words

6. Answer the question in your own words

7. Answer the question in your own words

8. Answer the question in your own words

9. Answer the question in your own words

10. Answer the question in your own words

11. Answer the question in your own words

Q1. "Anita travels by car if available, otherwise by bus."

Available(car) \rightarrow 1 Travels (Anita, car)

Available(car) \rightarrow 0 Travels (Anita, Bus)

Q2. "Bus goes via Andheri and Ghatkopar"

1 Goes via (Bus, Andheri)

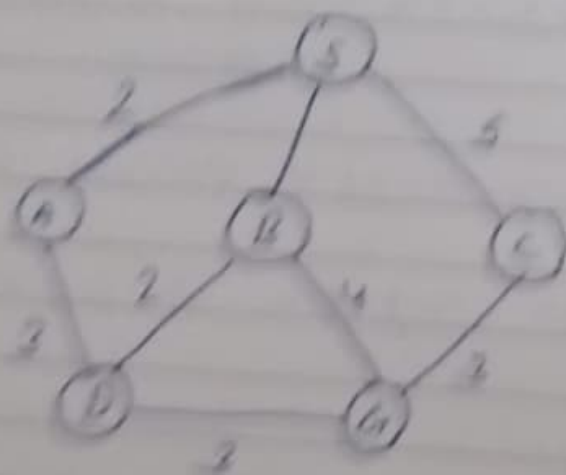
0 Goes via (Bus, Ghatkopar)

Q3. "Car has a puncture so is not available"

Has puncture(car)

Has puncture(car) \rightarrow 1 Available(car)

Q4. Find the route from S to G using BFS.



- A Algorithm (A-star)* : uses the cost

$$f(n) = g(n) + h(n)$$

→ $g(n)$ = cost to reach the current state

→ $h(n)$ = Estimated cost to reach the goal

- Greedy Best-first search : uses only the heuristic function $h(n)$

3> Optimization Techniques:-

- Branch & Bound : prunes unnecessary paths to optimize search space.
- Iterative Deepening A* (IDA*) : Reduces memory usage compared to A*.

1 What is PEAS descriptor? Give PEAS for following.

→ PEAS descriptor:-

The PEAS descriptor (Performance, Environment, Actuators & sensors) is used to define the structure of an AI agent. It helps in understanding how an AI system interacts with its environment and makes decisions.

Q2. What are AI Agents terminology, explain with examples.

→ AI Agent :-

An AI Agent is an intelligent entity that perceives its environment through sensors and acts upon that environment using actuators to achieve specific goals. It can be software-based or hardware-based.

Terminology :-

Agent :- An entity that perceives the environment and takes actions to achieve a goal.

Environment :- The surroundings in which the agent operates.

Percept :- The data collected from the environment by sensors at any given time.

Actuators :- The components through which the agent performs actions in the environment.

Sensors :- Devices used by the agent to collect information from the environment.

Example A* algorithm with example:

A* Algorithm - (A-Star Search)

A* is an informed search algorithm used for finding the shortest path in a weighted graph. It combines:

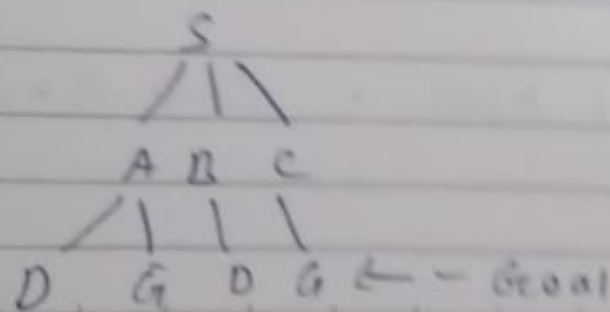
- Greedy Best-First search (choosing the node with lowest estimated cost).
- Uniform cost search (ensuring the shortest path is found).

It uses the function:

$$f(n) = g(n) + h(n)$$

- $g(n)$ = Actual cost from the start node to n .
- $h(n)$ = Heuristic
- $f(n)$ = Total Estimated cost.

Example of A* Algo.



2:15 Explain min max. Explain minimax Algorithm & draw game tree for TIC TAC TOE game.

→ Minimax Algorithm :-

Minimax is a decision-making algorithm used in two-player zero-sum games, where one player's gain is another's loss. It helps find the best moves by assuming that the opponent plays optimally.

Example : minimax in Tic-Tac-Toe

Assume it's X's turn (max) and the board looks like this:

X	O	X
O	X	
	O	

Possible moves for X :

- 1) move at (2,1)
- 2) move at (2,2)

- If X chooses (2,1) O has a move, and X wins
- If X chooses (2,2) O can block leading to a draw.

Q.1 Explain Architecture of a Knowledge Based and Learning Agent.

→ Architecture of Knowledge Based Agent (KBA)

A KBA uses stored knowledge and logical reasoning to make decisions.

Components:-

- 1) Knowledge Base: stores facts and rules.
- 2) Inference Engine: Applies logical reasoning.
- 3) Sensors: collects data from the environment.
- 4) Actuators: Execute actions.
- 5) Knowledge update mechanism: Learn new facts.

Example: IBM Watson, Medical Diagnosis System.

Learning Agent Architecture:-

A Learning Agent improves its performance over time by learning from experience.

Components:-

- 1) Learning Element: Learns from past actions.
- 2) Performance Element: Executes decisions.

SEND
+ MORE

MONEY

Each letter represents a unique digit

- S & M cannot be 0
- $M = 1$

Solve ~~the~~ Digit by Digit

$$(S + M = M) :-$$

1) $M = 1$

2) S must be 9

$$S = 9$$

$$E = 5$$

$$N = 6$$

$$D = 7$$

$$M = 1$$

$$O = 0$$

$$R = 8$$

$$Y = 2$$

Thus, the solution is,

$$\begin{array}{r} 9587 \\ + 1085 \\ \hline 10652 \end{array}$$

FOR EDUCATIONAL USE

Q.17 Explain Wumpus world environment used grid in AI to demo. Intelligent agent behavior in uncertain environment.

→ Game Rules:-

- The world is a 4×4 grid.
- The agent starts at (1,1) and must find gold while avoiding the wumpus (a monster) and pits.
- The agent can move, turn left/right, grab gold, shoot an arrow, or climb out.
- The goal is to grab gold exit safely.

REAS for Wumpus

- P:- +1000 for grabbing gold, -1000 for falling in a pit or encountering wumpus, -1 per move, -10 for shooting an arrow.

E:- A 4×4 grid with pits wumpus, and gold

A:- The agent can move, turn, grab, shoot and climb.

S:- The agent perceives stench, breeze, glitter, bump, and scream.

Assume the following costs:-

- g values (actual cost):-

- $S \rightarrow A = 2$, $S \rightarrow B = 5$, $S \rightarrow C = 5$,

- $A \rightarrow D = 3$, $A \rightarrow G = 4$

- $B \rightarrow D = 2$, $B \rightarrow G = 4$

- $C \rightarrow G = 3$

- h values (heuristic estimate to G)

- $A = 4$, $B = 2$, $C = 3$, $D = 3$, $G = 0$

$$S \rightarrow f(S) = 0 + h(S)$$

- $f(A) = g(A) + h(A) = 2 + 4 = 6$

- $f(B) = g(B) + h(B) = 5 + 2 = 7$

- $f(C) = g(C) + h(C) = 5 + 3 = 8$

Pick the lowest f -value \rightarrow Expand A

- $f(D) = g(D) + h(D) = (2+3) + 3 = 8$

- $f(G) = g(G) + h(G) = (2+4) + 0 = 6$

(Goal found)

Optimal path : $S \rightarrow A \rightarrow G$ (Cost = 6)

and heuristic functions are used to solve it efficiently.

AI Techniques for solving the 8-puzzle problem.

1) State Representation:

- Each arrangement of tiles is considered a state.
- The blank tile represents the possible moves.
- The goal state is a predefined configuration.

2) Search Algorithms:

AI uses different search techniques to explore possible moves and reach the goal state efficiently.

a) Uninformed search:

- BFS: Explores all possible moves level by level.
- DFS: Explores a path deeply before backtracking.
- IDS: Combines BFS & DFS find optimal solution.

b) Informed search is:

- Best-first search: uses heuristics to decide which path to explore first.

- A: calculate an accurate gas output during
- E: the surroundings where the output is being
- A: mechanism the output used to have
- S: devices or inputs the output used to
- perceive the environment

17 Taxi Driver AI

- P: safety, passenger satisfaction, fuel efficiency, shortest route, avoiding traffic jams
- E: roads, traffic, pedestrians, weather conditions, passengers
- A: steering wheel, accelerator, brake, indicator horn, doors
- S: GPS, cameras, spectrometer, fuel gauge, proximity sensors, traffic light detection

27 Medical Diagnostic system

- P: Accurate diagnosis, patient safety, fast response
- E: Hospitals, patients, medical records, physicians, test results

Example :-

~~Self-driving car~~

Self-driving car :-

- Agent : self-driving car
- Environment : Roads, Traffic signals
- Percept : Camera detects traffic lights, GPS tracks location
- Sensors : Camera, GPS, Radar
- Actuators : wheels, steering, Brake system
- Agent program : path-finding algorithm
- Performance measure : Reaching the destination safely & quickly

Q:3 How AI technique is used to solve 8 puzzle problem?

→ The 8-puzzle problem is a classic artificial intelligence (AI) problem that involves arranging numbered tiles in a 3x3 grid to reach a goal state. AI techniques such as search algorithms

2) Drug Discovery :-

- AI helped in discovering potential vaccines and medicines by analyzing protein structure of the virus.
- e.g. Google's "Deepmind" used AI to predict the protein structure of virus.

3) Contact Tracing :-

- Apps used AI algorithms to trace people who came in contact with infected individuals.

4) Robotics & Automation :-

- Robots were used in hospitals to deliver medicines and disinfect rooms without human contact.

5) Online Education :-

- AI-powered platform like Google classroom & Zoom helped in remote learning.

25

The percept sequence is a list of all sensor readings the agent receives over time.

Example.

S				P	
			W		
					G
P					

- S = start
- P = Pit
- W = Wumpus
- G = Gold

1) At (1,1) : move right

2) At (1,2) : move down

3) At (2,2) : move right

4) At (2,3) : Grab Gold & exit.

∴ solve the following

→ Crypto - Arithmetic problem : SEND + MORE = MONEY.

- 3) Critic : Evaluates outcomes and gives feedback
4) Problem Generator :- Explores new strategies.

Example:- Google Deepmind (AlphaGo).
Self-Driving cars.

Convert the following to predicates:-

- a) Anita travels by car if available otherwise travels by bus.
- b) Bus goes via Andheri and Goregoan.
- c) Car has puncture so is not available.
- $\text{Travels}(x, y) \rightarrow$ Person x travels by y
 - $\text{Available}(y) \rightarrow$ mode of transport y is available.
 - $\text{Goes.via}(y, z) \rightarrow$ mode of transport y goes via location z
 - $\text{Has-puncture}(y) \rightarrow$ Vehicle y has a puncture.
 - $\text{Not}(A) \rightarrow$ Negation of A (A is false).

A: Display screen for doctors, prescription generation, report generation.

S: Patient symptoms, lab reports, X-rays, etc.

3) Music composed :-

- P: Quality of composition, creativity, user preference matching, uniqueness.

- E: Musical notes, styles, user performance, existing music database.

- A: Generating music notes, playing sounds, creating audio files.

S: user inputs, past compositions, musical notes.

4) Aircraft Autolander :-

- P: Safe landing, accuracy in approach, passenger comfort, minimizing turbulence.

- E: Airplane, runway, weather, altitude, wind speed.

- A: flaps, landing gear, brakes, engine thrust, rudder.

Q: Explain modus ponens with suitable example.

→ Modus ponens is a fundamental rule of inference in logic - It states that.

If $P \rightarrow Q$ is true, and P is true, then Q must be true.

Formal representation

$$P \rightarrow Q, P$$

Example,

1) Rain & Wet Roads.

If it rains, the roads will be wet →

$$\text{Rain} \rightarrow \text{Wet Road}$$

It is raining → Rain.

Therefore, the roads are wet → Wet Road.

2) Exam and Study.

If you study, you will pass the exam.

→ Study → pass Exam.

2) Backward chaining :

- starts with the goal (query) and works backwards to check if known facts supports the conclusion.
- Moves from conclusions to facts.
- used in AI planning and diagnostic systems.

Example,

Query :-

- can Tweety fly?

Execution :-

1) Query : can fly (Tweety)

2) Check rule 1:

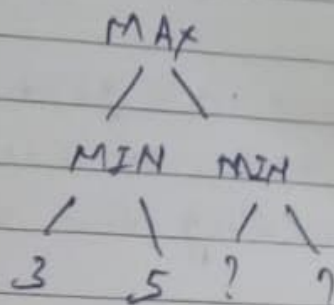
3, Fact Exists : Bird (Tweety) (Given fact)

4) Conclusion: can fly (Tweety).

Example 2 Alpha-Beta pruning:-

23

Consider minimax game tree where MAX want to maximize and MIN want to minimize.



1) first MIN node (left subtree)

- Evaluates 3 and 5 \rightarrow chooses 3
- updates $\text{Beta}(\beta) = 3$ for the MAX node

2) second MIN node (Right sub tree):

- first child = 4 $\rightarrow \text{Beta}(\beta) = 4$ for this node
- Since $4 > 3$, MAX won't pick this branch (Pruning occurs)
- No need to evaluate the next child.

3) MAX selects 3 as the best move.