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AIDS

04/05

Q1) What is AI ? considering the COVID-19 pandemic situation how AI helped to survive and renovate our way of life with different applications ?

Ans :- • AI or Artificial intelligence can be defined as the ability of the computer system i.e hardware and software to do tasks that normally require human beings to use intelligence.

• AI played as crucial role in helping society navigate through pandemic by improving health care, enabling remote work and learning optimizing supply chain for example :-

i) Health care and medicle research :-

→ Drug discovery and vaccine development AI ~~has~~ helped accelerate the search for COVID-19 treatments and vaccines by analysing vast data sets eg :- Deep mind's Alpha fold predicted protein structures of for virus.

→ predictive modeling :- AI models helped governments forecast infection rates hospital resources needs.

ii) contact tracing & Disease surveillance
→ AI powered mobile apps (eg. Aarogya Setu) helped track COVID-19 exposure through bluetooth and location data.

iii) Remote work and education :-
→ AI chatbots and virtual assistants made remote work smoother (eg :- Google meet, zoom)

→ E-learning platforms used AI to personalize education, provide automatic grading, sending result of tests directly to every user etc.

Q2) What are AI agents terminology, explain with examples.

Ans :- The AI agents terminology includes :-
i) performance measure of agent includes :- It determines the success of an Agent.

ii) Behaviour / Action of agent :- It is the action performed by agent after any specified ~~per~~ per sequence of percepts.

iii) percepts :- Agents perceptual inputs at a specified instance.

iv) percept sequence :- History of everything agent has perceived till date.

v) Agent function :-

$$a = F(P)$$

where P is current percept, a is the action carried out and F is the agent function.

F maps percept to action

$$F: P \rightarrow A$$

where P is the set of all percepts and A is set of all actions. Actions may be dependent of all percepts observed, not only the current percept.

$$a_k = F(P_0, P_1, P_2 \cdots P_k)$$

where $P_0, P_1, P_2 \cdots P_k$ is the sequence of percepts recorded till date, a_k is the resulting action carried out and F now maps percept sequence to action

$$F: P \rightarrow A$$

For example the vacuum cleaner problem

percept sequence	Action
[A, clean]	Right
[A, Dirty]	Suck

percept sequence	Action
[B, clean]	Left
[B, dirty]	Suck
[A, Dirty], [A, clean]	Right
[A, clean], [B, Dirty]	Suck
[B, Dirty], [B, clean]	Left
[B, clean], [A, clean]	No operation
[B, clean], [A, dirty]	Suck
[A, clean], [B, clean]	No-operation

performance measure of vacuum cleaner agent :- All rooms are cleaned

Behaviour / action of agent :- Left, Right, suck and no-operation (Do nothing)

percept :- location and status

Agent functioning :- mapping of percept sequence to action.

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Q3) How AI technique is used to solve 8 puzzle problem?

Ans:- The 8 puzzle problem is a state space search problem in AI where a 3 x 3 grids contain 8 tiles numbered from 1 to 8 & 1 empty space.

- objective is to rearrange the tiles to reach a predefined goal state.

AI techniques :- 1) uninformed search methods.
- BFS :- expands the shallowest node first
- DFS :- explores as deep as possible before backtracking
- IDS :- combines BFS and DFS to increase depth limit gradually.

Informed search methods :-

- BFS :- Best first search based on heuristic function that appears closest to the goal.

- A* search :- $f(n) = g(n) + h(n)$. Based on heuristic and cost to node.

Initial state :-

1	2	3
5	6	0
4	7	8

Goal state

1	2	3
4	5	6
7	8	0

i) compute heuristic of each possible move

ii) expand the state with the lowest $f(n)$ & repeat.

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4. What is peas description ? give PEAS description for following :

Ans :- Performance measure :- How success of agent is evaluated ; environment :- surrounding in which agent operates.

Acutators :- components that allow agent to take actions.
Sensors :- components which allow agent to perceive the environment

i) Taxi driver agent :-

performance measure	environment	Acutators	Sensors
- Safe driving	- Traffic Signal	- wheels	- camera
- travel time	- roads	- accelerator	- GPS
- traffic rules	- weathers	- brakes	- fuel guage

ii) Medical Diagnostics Agents :-

perf. measure	environment	Acutators	Sensors
- health of patient	- patient data	- display screen	- heart rate monitor
- accuracy of diagnosis	- symptoms	- alarm screen	
- recommended treatment	- test reports	- robotic arms	- lab results

iii) music composer agent :-

perf. management	environment	Acutators	Sensors
- originality	- music db	- speakers	- microphone
- listeners	- user preference	- digital music	- user feedback
- quality	-		- recognitions

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5.) categorize a shopping bot for an offline according to the following system

Ans.
- observability :- partially observable relies on limited sensors input.
- Deterministic or
- episodic V/S sequential :- Sequential ~~des~~ decisions affect future actions.
- static V/S dynamic :- Dynamic, customer behaviours is always evolving.
- Discrete V/S continuous :- finite no. of choices such as

6.) Differentiate between model based & utility based agent

Ans

model based agent	utility based agent
• Agents that maintains the internal model of the environ to understand its current state & predict future state.	• Agent that selects actions based on utility function aiming to maximize long term satisfaction or benefit.
• model updates its information about the environment.	• measures how desirable different states are.

Model based agent	Utility based agent
• less complex	• more complex
• Doesn't concern long term rewards.	• pauses on long term rewards
• eg :- self driving cars	• eg :- shopping recommendation system.

7) explain the architecture of knowledge based agent & learning agent :-

Ans :-

- Knowledge based agent :- stores knowledge & reasons based on logical inference.
- Knowledge base :- stores facts, rules & heuristic functions about the environment.
- Inference engine :- uses logical reasoning techniques like forward & backward chaining.
- perception :- gathers data from the environment
- actions :- executes actions based on inferred knowledge.
- Knowledge update mechanism :- updates itself as facts are learned.
- Learning based agent :- agent which improves its part overtime by learning from experience, data & feedback.

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8. convert the following to predicate

Ans Anita travels by car if available otherwise travels by bus.

travels (x, y) → person x travels by y.
available (y) → (a vehicle) is available
Goes via (y, z) →
puncture (y) → y (a vehicle)

a. available (car) → travels (Anita, bus)

b. Bus goes via andheri & goregaon
goes via (bus, andheri)
goes via (bus, goregaon).

c. car has a puncture, so its not available
puncture (car)
~Available (car)

9) what do you mean by depth limit search?

Ans DLS is depth limited search DFS variant with a fixed depth L. preventing infinite loop & saving memory

Advantage
1) Avoids infinite recursion
2) memory effective

Disadvantage :-
1) may miss less deeper solutions
2) Need for good L choice (limit)
eg search level by level until the goal appears

10) explain hill climbing & its drawback in detail with eg. Also state limitations of steepest ascent hill climbing.

Ans:- It is an optimization algorithm that moves towards higher values (better solutions) until a peak (local - optimum) is reached.

Algorithm
1. Start with an initial state
2. Move to the best neighbouring state.
3. Repeat until no strictly better neighbour exists.

eg Adjust queens position to minimize conflicts
Stop when no improvements are possible

Drawbacks
Local maxima stuck at suboptimal peaks
plateau no directions, Ridges needs special move to progress.

Variations & Solutions
Steepest - Ascent - Evaluates all neighbours

11) explain simulated Annealing & write its example.

Ans SA improves hill climbing by allowing occasionally bad moves to escape local maxima inspired by metal annealing.

Algorithm :-

1. Start with an initial solution & temperature T
2. Accept S is better ; otherwise with probability
$$p = e^{\wedge}(-\Delta E/T)$$
3. Reduce T until stopping condition

Advantages

1) escape local maxima
2) Handles large problems
3) Near - optimal solutions

Disadvantages :-

Tricky cooling schedule
No ~~eg~~ guarantee of best solutions

12) Explain A* algorithm.

Ans A* is a best first search algorithm for pathfinding combining

1) uniform cost search (cheapest path)
2) greedy best first search (heuristic - based)

Speed key formula

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

$g(n)$: cost from start to

$h(n)$ = cost from n to goal state.

Steps :-

1. Start with the initial node, compute $f(n)$
2. expand is reached, return the path, use update & continue

Advantages :-
1. optimal path
2. efficient in AI applications

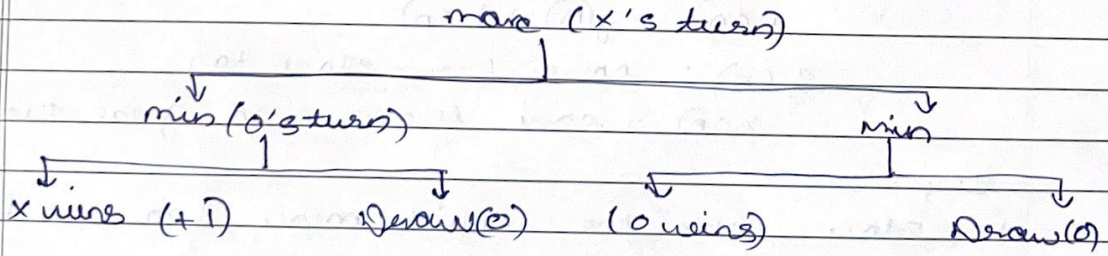
Disadvantages :-
1. High memory usage.
2. Depends on heuristics.

13) Explain min max algorithm and Draw a game tree for tic tac toe game.

Ans Min max is a game strategy for 2 players games like tic tac toe

How it works :-
Maximize (X) aims for highest score (+1 for win
Minimize (O) aims for lowest score (-1 for loss.

Explore all possible moves as signs score & picking the best one.



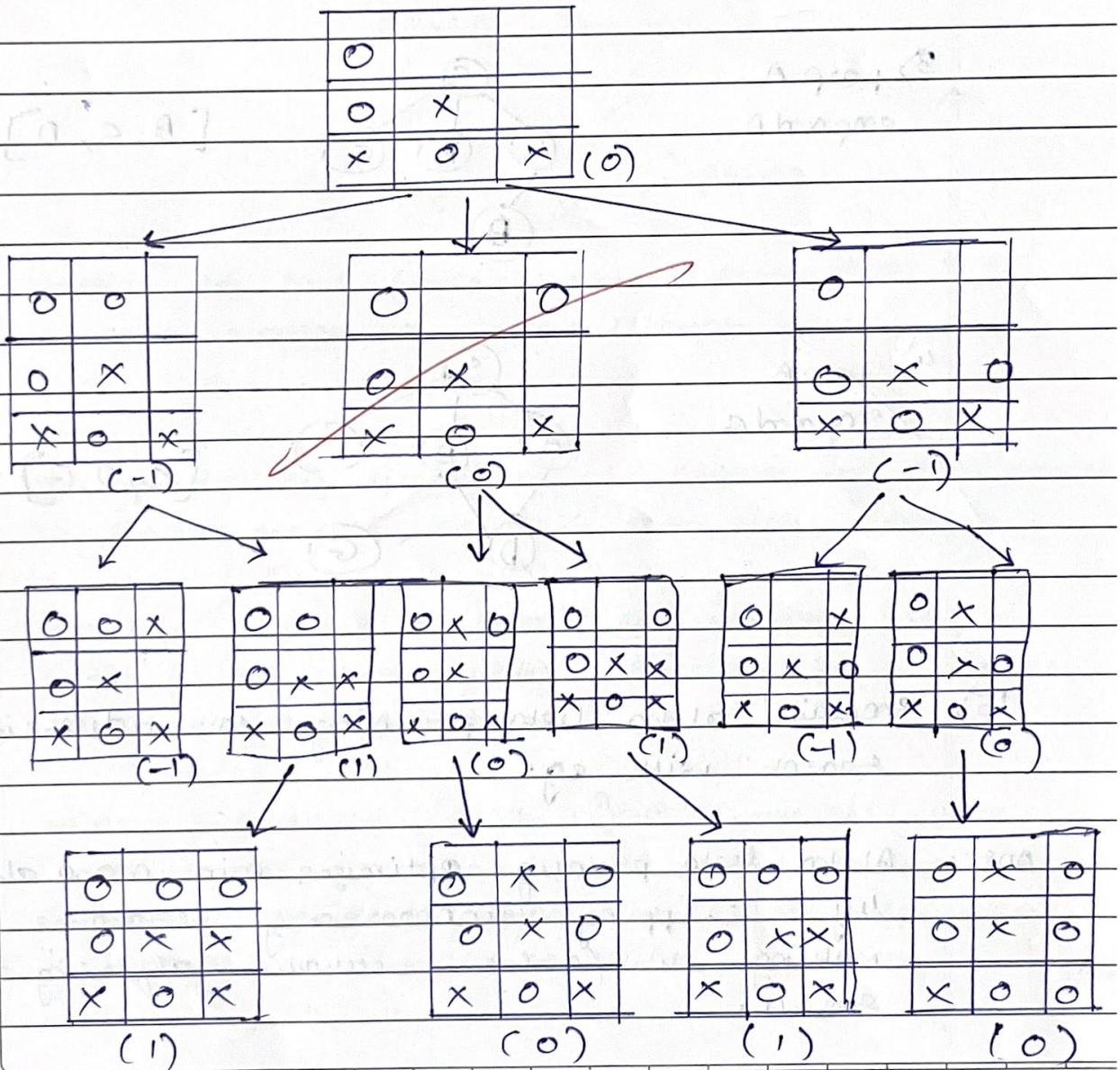
Each level alternates between X & O i.e max & min

Advantage :-

1) Always find the least moves

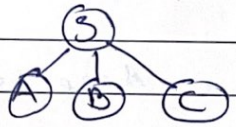
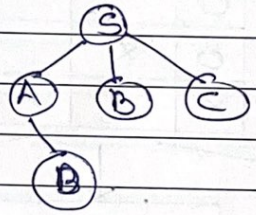
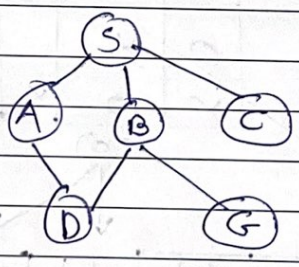
Disadvantages

1) slow for deep tree (Alpha beta pruning)



2 Node options have the optimal choice

14) Find route from S to G using BFS

Steps	Representation	Stack
1) Load S		[S]
2) pop S, A, B, C		[A, B, C]
3) pop A expand D		[B, C, D]
4) pop B expand G		[C, D, G]

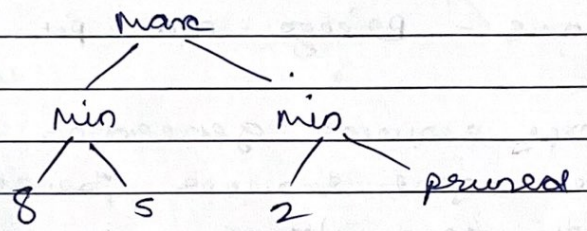
15) explain alpha beta pruning for adversial search with eg.

Ans:- Alpha beta pruning optimizes min max algorithm by skipping unnecessary branches making it faster without affecting the result.

explanation :-

1) Alpha (α) :- best max value found so far.
2) Beta (β) :- minimum value found so far.
3) If a node violates that $\alpha \geq \beta$ then the further exploration is stopped (pruned)

example (simplified game tree)



here if min finds move worse than 5 it stops exploring that branch

adv :-
1) Speeds up min max by ignoring bad choices
2) Same result as min max but faster.

16) explain WUMPUS world environment by its PEAS description. explain how percept sequence is generated.

Ans WUMPUS world is a grid based game environment where an agent navigates a cave to find gold while avoiding pits and the WUMPUS master

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PEAS Description :-

performance measure :- +1000 (Gold), -1000 -1000 (Pit), -1 (Arrow)

environment :- grid world with WUMPUS gold pits & agents.

Actuators :- move, grab, shoot, climb

sensors :- Breeze near pit

percept sequence generator :-
The agent recieves sensory input at each step based on its current location.

eg :- If agent move next to pit, it perceives Breeze. using percept history it infers safe path and avoids danger

17) solve following crypto arithmetic problems

SEND + MORE = MONEY

Each letter represents a unique digit (0-9)

step1 :- evaluation

(1000 S + 100 E + 10 N + D) + (1000 M + 100 O + 10 R + E)

= (10000 M + 10,000 + 100 N + 10 E + Y)

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Step 2 :- constraints

M = 1 (since money is a 5 digit number)

S ≠ 0 (as the first digit is)

All letters have unique values

Step 3:- Assigning digits

Letters	Digit
S	9
E	5
N	6
D	7
M	1
O	0
R	8
E	5

18) i) FUPL

let $G(n) \rightarrow n$ is graduating $H(n) \rightarrow x$ is happy, $S(n) \rightarrow x$ is smiling

Axioms 1. $(G(n) \rightarrow H(n))$

2. $\forall n\ (H(n) \rightarrow S(n))$

3. $\exists x\ G(n)$

2) convert to clause form

$\top\ G(n) \vee H(n)$

$\top\ H(n) \vee S(x)$

G(A) let A be a person graduating

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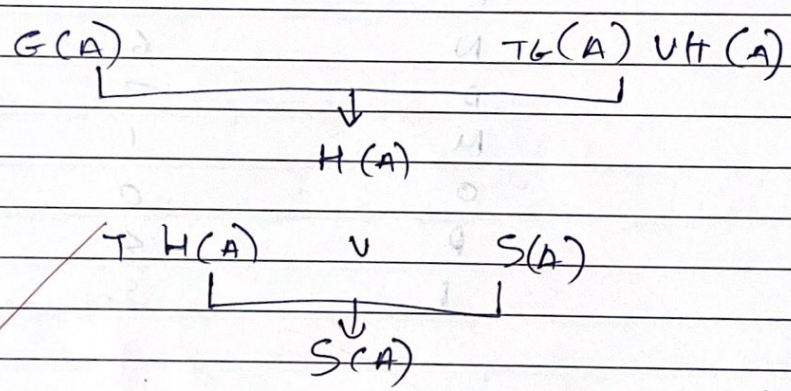
3) prove is someone smiling?

1) G(A) given
2) ¬G(A) ∨ H(A) → axiom 1
3) ¬H(A) ∨ S(A) → axiom 2

Since we derived S(A) the proof confirms that someone is smiling

Resolution tree



19) Explain modus ponen with suitable example

Ans Modus ponen is a fundamental rule of inference in logic. It states

If P → Q (If P, then Q) is true
If P is true, then Q must be true

Symbolically

P → Q P + Q

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eg:- If it rains ground will be wet

It is raining (P)
here, the ground is wet

this rule is widely used in mathematical proofs & AI reasoning systems.

2) explain forward & Backward chaining with eg.

Ans these are inference techniques used in rule based system & AI reasoning

1) Forward chaining (Data driven)
Starts with known facts & applies rules to infer new facts until the goal is reached.
works from cause → effect (bottom up)

eg) If it is raining then ground is wet
If ground is wet then traffic is slow

2) Backward chaining (goal driven)
· Starts with goal driven
· supports facts
works from effect → cause (top down)
W → I is the ground wet
R → W is it raining