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AIDS Assignment

04/05

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

→

AI is a branch of computer science that focuses on creating intelligent systems capable of performing tasks that typically requires human intelligence. AI systems uses techniques such as machine-learning, NLP, etc.

AI can be categorised into:-

1. Narrow AI (weak AI):-
2. General AI
3. Super AI.

Role in securing & renovating life during covids.

i) Healthcare & medical diagnosis.

- CTScan analysis & x-ray diagnosis helped in rapid detection of COVID. cases.

ii) Virus spread control.

- Social distance monitoring tools helped to monitor & enforce laws in public places

iii) remote work & education.

- Work from home optimization & AI in online education help people continue with their work.

2. What are AI agents terminology & explain with exam

→

- Environment:-

• Everything which surrounds the agent & influences its action. It can be complete or partially observable.

Initial State :- 1 2 3 Goal State :- 1 2 3
5 6 0 4 5 6
4 7 8 7 8 0.

i) Compute heuristic of each possible move.
ii) Expand the state with the lowest f(n) & repeat.

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

→ Performance Measure :- How success of agent in evaluated
Environment :- Surrounding in which agent operates.
Actuators :- Component that allows agent to take actions
Sensors :- Component that allows agent to perceive the environment

i) Taxi driver agent :-

performance measure	Environment	Actuators	Sensors.
- safe driving.	- Traffic Signal	- Steering wheel	- camera,
- travel time.	- roads.		- GPS
- traffic rules	- Weather	- accelerator	- fuel gauge.
		- brakes	

ii) Medical Diagnostic Agent :-

perf. measures	Environment	Actuator	sensors.
-health of patient	- patient data.	display screen	-heart rate monitor
- accuracy of diagnosis	- symptoms.	alarm system	
- recomended treatment	- test reports.	robotic arms	- lab results.

iii) Music component Agent :-

perf. measure.	Environment	Actuator	Sensors.
- originality	- music db	- Speaker	- microphones.
- listener engagement	- user preferences	- digital music interface	- user feedback
- quality			- recognition sys.

iv) Aircraft autolander.

perf. measure	Environment	Actuator	Sensors
- Smooth landing	- runway.	- landing gear	- altmeter
- accuracy in touchdown.	- wind conditions - air traffic	- flap - air brakes	- GPS - camera

v) Essay evaluator.

pref. measure	Environment	Actuator	Sensors.
- grading - grammar. - paradigm check.	- plagarism database - rubric criteria.	- display screen. - text to Speech system.	- optical character recognition (OCR).

vi) Robotic sentry gun.

pert. measure	Environment	Actuators	Sensors.
- neutralize threats - target tracking - false alarms.	- lab area. - potential intruders	- gun mechanism. - alarm sitter. - tracking system.	- camera - thermal Sensors.

5. Categorize a shopping bot for a shopping bot for an offline bookstore according to the following system.

→ - observability: Partially observable. Relies on limited sensors input.

- Deterministic or stochastic:- stochastic customer pref. is unpredictable

- Episodic v/s sequential:- Sequential decisions affect future actions.

- static v/s dynamic:- Dynamic, customer behaviour is always evolving

- Discrete v/s continuous:- Finite no. of choices such as books

SDS | Page No.
Date

6. Differentiate between model based & utility based agent.

→

Model Based Agent	Utility Based Agent
- Agent that maintains the internal model of the env. to understand its current state & predict future states	- Agent that selects actions based on the utility function aiming to maximize long term satisfaction or benefit
- Model updates it's information about the environment	• measures how desirable different states are.
- less complex	• More complex.
- Doesn't concern long term rewards	• Focuses on long term reward.
- e.g:- Self driving cars.	• e.g:- Shopping recomendation system

7. Explain the architecture of knowledge based agent & learning agent.

→ - knowledge based agents:- Stores knowledge & reasons based on logical inference
- knowledge base:- Stores facts, rules & heuristic function about the environment
- inference engine:- Uses logical reasoning techniques like forward & Backward chaining.
- perception:- gathers data from the environment
- actions:- executes actions based on intered knowledge.
- knowledge update mechanism:- updates itself as new facts are learned.

- learning Based agents:- Agent that improves perf. overtime by learning from experience, using & feedback.

- learning element:- responsible for ~~importing~~ improving agents perf by analyzing past experience using ML techniques.
- critic:- provides feedback on agents actions by evaluating success or failure
- problem generation:- supports new experiences for learning & explanation.

8. Convert the following to predicates.

→

Anita travels by car if available otherwise travels by bus.

travels(x,y) → person x travels by y.
Available(y) → y (a vehicle) is available
Goesvia(y,z) → vehicle goes via z
punctured(y) → y (a vehicle).

a. ~Available(car) → Travels(Anita, bus).

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

c. car has a puncture, so it's not Available.
puncture(car)
~Available(car).

SDS Page No.
Date / /

10 What do you mean by depth limit search? Explain iterative Deepening search with example.

→ Depth Limit Search (DLS):-
DLS is a DFS variant with a fixed depth L. preventing infinite loop & saving memory.
Advantages.
1) Avoids infinite recursion.
2) Memory-efficient.

Disadvantages:-
1) May miss less Deeper solutions
2) Need for good L choice (Limit).

Iterative Deepening Search (IDS):-
IDS runs DLS repeatedly, increasing L until the goal is found.

Advantages:-
1) Completes the whole search.
2) Gives most optimized answer.
3) Memory efficient

Disadvantages:-
1) Redundant computation.
2) Higher time cost.

example:- Searches level by level until the goal appears

11) Explain Hill climbing & its drawback in det... with example. Also state limitations of steepest ascent hill climbing.

→. It is an optimization algorithm problem that moves tow... ard 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

Example:- (8-Queens problem):-
- Adjust queens position to minimize conflicts.
- Stop when no improvements are possible

Drawbacks:-
- Local maxima:- stuck at suboptimal peaks.
- plateau:- no directions for improvement
- Ridges:- needs special move to progress.

variations & solutions:-
- Steepest-Ascent:- Evaluates all neighbours but still get stuck.

12) Explain simulated Annealing & write its example.

→. 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. pick a random neighbour S, compute ΔE.
3. Accept S is better ; otherwise with probability
$P = e^{(-\Delta E / T)}$
4. Reduce T until stopping condition

Advantages:-
1) Escapes local maxima.
2) Handles large problems
3) Near-optimal solutions

Disadvantages:-
1) Tricky cooling schedule.
2) No Guarantee of best solution.

12) Explain A* algorithm with an example.

→ A* is a best-first search Algorithm for path finding, 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 n.
- h(n): cost from n to goal. (estimated).

Steps:-
1. Start with the initial node, compute f(n).
2. Expand the node with lowest f(n).
3. if goal is reached, return the path; else, update & continue.

Advantages:-
1) Optimal paths. 2) Efficient in AI applications

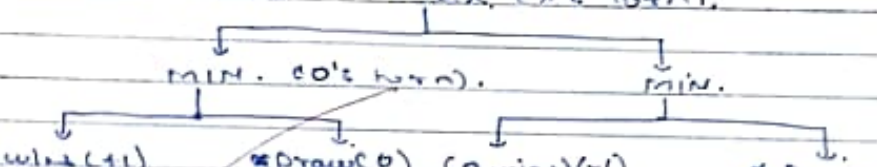
Disadvantages:-
1) High memory usage.
2) Depends on Heuristic.

14) Explain minimax algorithm & draw game tree for TIC-TAC-TOE Game.

→ Minimax is a game strategy for 2 player games like TIC-TAC-TOE.

How it works?

- Maximizer(X) aims to increase the score (+1 for win).
- minimizer(O) aims for lowest score (-1 for loss).
- Explore all possible moves, assigns score & picking the best one.
- Game Tree:-



Each level alternates between (X) & (O). i.e. Max & Min.

Advantage:-

1) Always finds the best moves

Disadvantages:-

1) Slow for deep tree (Alpha-beta pruning helps).

15) Explain alpha beta pruning for adversarial search. with example.

→ Alpha Beta pruning optimizes the minimax algorithm by skipping unnecessary branches, making it faster without affecting the result.

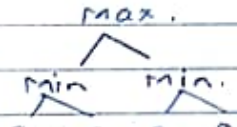
- Explanation:-

1) Alpha(α):- Best Max value found so far.

2) Beta (β): Best min value found so far

3) If a move worse than α or β is found then the further exploration is stopped. (pruned).

Example (simplified Game tree):-



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

Advantages:-

1) Speeds up minimax by ignoring bad choices.
2) Same result as minimax but faster

16) Explain Wumpus world environment giving its PEAS description. Explain how percept sequence is generated?

→. Wumpus world is a grid based game environment where an agent navigates a cave to find gold while avoiding pits & the wumpus a monster.

PEAS description:-

P (performance measure):- +1000 (Gold), -1000 (Wumpus) -1000 (pit), -1 (move).

E (Environment):- Grid world with Wumpus, Gold, Pits & Agents.

A (Actuators):- Move, Grab (Gold), Shoot (Arrow), Climb.

S (Sensors):- a) Breeze (near pit) b) Stench (near wumpus) c) Glitter (near Gold)

Percept Sequence Generation:-

- The agent receives sensory input at each step based on its current location

2. Example:- If agent move next to pit, it perceive Breeze.

3. Using percept History it infers safe path & avoid danger.

17) Solve the following crypto arithmetic problems.

1. ~~Solve~~ SEND + MORE = MONEY.

→ Each letter represents a unique digit (0-9)

Step 1:- Equation setup

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

$= (10000M + 10000O + 100N + 10E + Y)$.

Step 2:- Constraints.

- $M = 1$. (Since MONEY is a 5 digit number)
- $S \neq 0$ (It's the first digit in SEND).
- All letters have unique values.

Step 3:- Assigning Digits.

Letter	Digits.
S	9
E	5
N	6
D	7
M	1
O	0
R	8
Y	2

19) Consider the following axioms.
All people who are graduating are happy.
All happy people are smiling.
Someone is graduating.
Explain the following:-
1) Represent these axioms in first order predicate
2) Convert each formula to clause form
3) prove that "is someone smiling?" using resolution technique. Draw the resolution tree

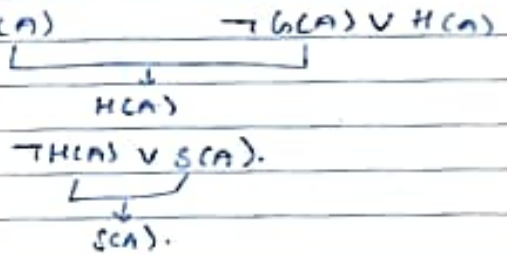
→ 1) FOPL:-
Let G(x) → x is graduating, H(x) → x is happy, S(x) → x is smiling.
axioms:- 1. $\forall x (G(x) \rightarrow H(x))$
2. $\forall x (H(x) \rightarrow S(x))$
3. $\exists x\, G(x)$

2. Convert to clause form
1. $\neg G(x) \vee H(x)$.
2. $\neg H(x) \vee S(x)$.
3. G(A) let A be a person graduating

3. prove "is someone smiling?"
1. G(A) given.
2. $\neg G(A) \vee H(A)$ → axiom 1
3. $\neg H(A) \vee S(A)$ → axiom 2.

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

Resolution tree



SDS | Page No | Date / /

20) Explain Modus Ponen with suitable example.

→ Modus ponen is a fundamental rule of inference in logic. It states:
If $P \rightarrow Q$ (if P, then Q) is true.
& P is true., Then Q must be true.
Symbolically:-

$$P \rightarrow Q, \quad P \vdash Q$$

example:-
1) If it rains, ground will be wet
2) It is raining. (P)
3) There, the ground is wet. (Q).

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

21) Explain Forward & Backward chaining with an example.

→ These are inference techniques used in rule-based systems & 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 approach).

Ex:-
1. If it is Raining then the ground is wet ($R \rightarrow W$)
2. If ground is wet then traffic is slow ($W \rightarrow T$)

2. Backward Chaining (Goal driven).
- Starts with the goal & goes backwards to find supporting facts.
- Works from effect to cause. (top-down approach).

ex:- $W \rightarrow T$: Is the ground wet
$R \rightarrow W$:- Is it raining