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05/05

AIDS Assignment

Q1] What is AI? Considering the COVID-19 pandemic situation how AI helped survive and renovated our way of life with different applications?

Ans AI is a technology that enables computers and machines to simulate human learning, comprehensive problem solving. AI could understand and respond to human language, learn from new information and can act independently.

AI's help during COVID-19:

Amid the crisis of COVID-19, AI emerged as a critical tool for addressing the pandemic multiplicated challenge.

1. During early stages of pandemic, china implemented AI to manage and mitigate virus spread.
2. AI also helped in tracking and diagnostic tools that played key roles in several processes.
3. Major cities employed AI based thermal imaging and facial recognition at transport hubs to efficiently identify symptotic individuals.

Q2] What are AI agents terminology explain with examples.

Ans Performance measure of agent: Determine the success of an agent

Behaviour/action of agent: It is action performed by an agent after any specified sequence of percepts.

Percept - Agent, perceptual inputs at a specified instance

Percept sequence - History of everyday that an agent has perceived till date.

Agent function - Maps the percept sequence to action.

Example: Vacuum cleaner problem
Performance measure - All rooms are well cleaned.
Behaviour - left, right, suck
Percept - location and status
Agent function - Mapping (percept sequence action)
Eg: Percept sequence action

Percept sequence	action
A, clean	right
AB, dirty	suck
B, clean	left

Q 3] How AI techniques is used to solve 8 puzzle problem.
~~AI techniques are used to solve and puzzle problem by applying search algorithms and heuristic functions~~

Ans AI technique search algorithm and heuristic function
1] Problem representation - The 8 puzzle problem is represented as a state space where each state is a 3x3 grid configuration.

Initial state:

1	2	3
4	0	6
7	5	8

Goal state:

1	2	3
4	5	6
7	8	0

Steps to solve 8 puzzle problem by A*
1] Initialize priority queue
2] Insert initial state with $f(n) = g(n) + h(n)$
3] While queue not empty -
Remove state with lowest $f(n)$.
If state goal return solution.
Generate valid moves (up, down, left, right)
Compute $g(n)$ and $h(n)$ for new states and add this to queue.
4] Repeat until goal is reached.

Q4] What is PEAS description. Give PEAS description for following.

Ans PEAS stands for performance, environment, actuators and sensors.

P - criteria to evaluate agent's success.

E - Surrounding / external area where agent operates

A - components with help of which agents take action

S - it helps agent to perceive its environment.

PEAS for following

1] Taxi Driver.

P - Reaching final destination

E - Traffic, Roads.

A - brakes, accelerators.

S - GPS, camera.

2] Medical diagnosis system -

P - Accuracy of diagnosis speed of diagnosis

E - Medical records that results. hospitals.

A - Recommending treatments, sending alerts to patients and doctor, updating medical records.

S - medical imaging

3] Music composer -

P - satisfaction of users.

E - music production studio

A - adjusting pitch and key of compositions

S - music databases, lyrics for melody generation.

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4] Aircraft autolander -
P - smooth and safer landing
E - weather
A - gear, flaps
S - altitude sensor .

5] Essay evaluator -
P - Grading accuracy, feedback quality .
E - Educational institutes, competitive .
A - Highlighting grammar and spelling errors,
S - Text input, NLP, AI assessment tools .

6] ~~Robotic entry gun for keck lab -~~
~~P - correctly identifying threats~~
~~E - Keck lab, facility~~
A - Tracking, alerting
S - cameras motion

Q5] Categorize a shopping bot for an offline bookstore according to each of the six dimensions:

Ans. → Partially observable - The bot cannot fully observe customer preferences or book placement .

→ Stochastic - customer behaviour and book availability are unpredictable .

Dynamic - The bookstore environment constantly changes

~~Dynamic~~ - Discrete - The bot operates with finite set of books, actions and interaction .

Multi-agent - The bot interacts with customer, employees and inventory system

Q6] Differentiate model based and utility based agent.

Ans.

Model based	Utility based agent
1] Uses an internal model of environment to make decision	1] chooses actions based on utility function that measures performance.
2] Decisions are based on past & present percepts	2] Selects action based on maximizing utility.
3] Can be goal based but doesn't necessarily optimize for best outcomes	3] Is goal based and searches for the most optimal solution.
4] Eg: Robot vacuum using a map to navigate	4] Example: self driving car.

Q7] Explain the architecture of a knowledge based agent and learning agent?

Ans Architecture of knowledge based agent –

It uses stored knowledge to make decision and consists of the following.

Knowledge base – stores facts, rules and logic

Inference engine – Uses reasoning to derive conclusions

Perception (sensors) – gather ~~to~~ new information from environment.

Action mechanism – Performs appropriate actions based on reasoning.

Architecture of learning agent –

This agent improves performance over time and consists of the following.

Learning element - updates knowledge based on experience.
Performance element - decides action based on current knowledge.
Critic - provides feedback by evaluating actions.
Problem generator - suggest new actions to improve learning

8] Convert the following to predicates -

a] Anita travels by car if available otherwise travels by bus.

Ans
CarAvailable → TravelsByCar(Anita)
¬CarAvailable → TravelsByBus(Anita)

b] Bus goes via Andheri and Goregaon.
goesvia(Bus, Andheri) ∧ goesvia(Bus, Goregaon)

c] Car has puncture so is not available
Puncture(car)
Puncture(car) → ¬Car available

Will Anita travel via goregaon? Use forward reasoning
from (c)
~~Puncture(car) → ¬CarAvailable~~ Puncture(car) is true
As Puncture(car) ¬ car Available
From (a)
¬ carAvailable we use ¬ carAvailable → TravelsByBus(Anita)
From (b)
GoesVia(Bus, Goregaon)

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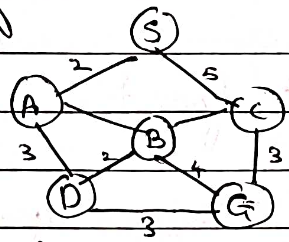
Since Anita travels by bus, she follow this route
Thus Anita will travel via Gorgao.

Q9] Find route from S to G using BFS.

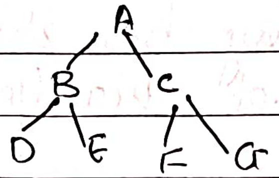


Ans Finding route from S to G using BFS,
Visiting level by level start from S node till goal G.
1] Start as S Queue = [S]
2] From S to its neighbours A, B, C Queue = [A, B, C]
3] Dequeue A & explore its neighbours. Queue = [B, C, D]
4] Dequeue B & explore its neighbours Queue = [C, D, G]
5] Dequeue C & its neighbours Queue = [D, G]
6] Dequeue D Queue = [G]
7] Deque G.
As G is our destination, BFS stops here.
∴ The route is S to G = S → B → G

Q10] What do you mean by depth limited search? Explain iterative deepening search with example.
Ans Depth limited search (DLS) is an uninformed search algorithm that modifies DFS by introducing a depth limit L, preventing exploration beyond the predefined level. This prevents infinite loops in infinite graphs but risks missing goals.

Iterative deepening Search (IDS) combines DLS with BFS by incrementally increasing the depth limit.

Example:



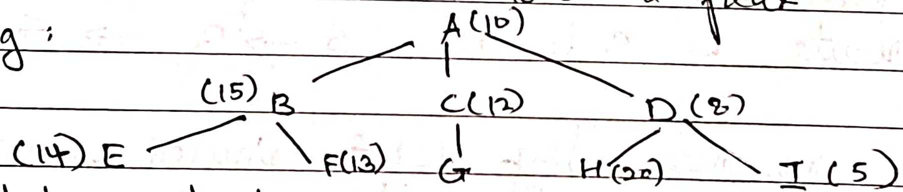
goal = G

Iteration 1 : Dept limit = 0
Node visited : A .
Result : Goal not found
Iteration 2 : L = 1
Node visited A → B → C goal not found .
Iteration 3 : L = 2
Node Visited A → B → D → E → C → F → G
goal G found at L = 2 .

Q11] Explain Hill climbing and its drawbacks in detail with example . Also state limitations of steepest ascent hill climbing.

Ans. Hill climbing is a local search optimization algorithm which moves towards better neighbouring solution until it reaches a peak .

Eg :



Steps : start at root node A(10)
Compare its children B, C and D
Move to child with highest value i.e B(15)
Repeat for B's children E and F
Terminate at E(14)
The algorithm stops at E (14) not reaching the goal G .

Limitations

1] Local maxima - The algorithm greedily selects the best immediate child and can thus get stuck on local maxima

2. Plateaus - If siblings have equal values the algorithm can't decide the next step and gets stuck.

3. Ridges - Narrow uphill paths require backtracking which hill climbing algorithm does not support.

Limitations of Steepest Ascent Hill Climbing

1. Computationally Expensive - Evaluates all neighbours before selecting the best.

2. Can get stuck - It can still get stuck in local maxima plateaus or ridges.

3. No global optimality - It only focuses on immediate improvements.

Q12] Explain simulated annealing and write its algorithm

Ans Simulated annealing (SA) is a probabilistic optimization algorithm inspired by metallurgical process of annealing where materials are heated and cooled to reduce defects. It escapes the local optima by temporarily accepting worse solution with a probability

Algorithm - 1] Initialize - Set an initial solution and define an initial temperature T.

2] Repeat until stopping condition

Generate a new neighbour solution.

Compute change in cost ($\Delta E = E_{new} - E_{current}$).

If new solution is better i.e. $\Delta E > 0$, accept it.

If worse accept it with probability $P = e^{-\Delta E / T}$

Decrease temperature T (cooling schedule).

3. Return best solution.

Example: Travelling salesman Problem.

Q3] Explain A* algorithm with an example.

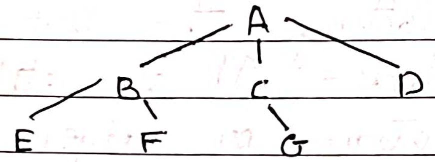
Ans A* is an best search algorithm used in pathfinding and graph traversal. It uses the following formula $f(n) = g(n) + h(n)$

$g(n) \to$ cost to reach node n from start.

$h(n) \to$ heuristic estimate of cost to reach goal from n

$f(n) \to$ total estimated cost.

Example: Goal G



Node	g(A, n)	h(n, G)
A	0	6
B	1	4
C	2	2
D	4	7
E	3	5
F	5	3
G	6	0

Steps -

1] Start at root node A : $f(A) = g(A) + h(A) = 0+6 = 6$

2] Expand neighbours B, C, D $f(B) = 1+4 = 5$.
$f(C) = 2+2 = 4$ $f(D) = 4+7 = 11$

3] Choose lowest value C $f(C) = 4$

4] Expand neighbours of C : G $f(G) = 2+4+0 = 6$

5] Goal reaches at G with total cost 6.

Advantages

1] Efficient in handling shortest path with weighted graph.

2] Balances exploration by considering both g(n) & h(n)

Q14] Explain min-max algorithm and draw game tree for tic-tac-toe game.

Ans. The minimax algorithm is a decision ~~tree~~ making algorithm used in two-player games. It assumes
One player (MAX) tries to maximize the score.
Other player (MIN) tries to minimize the score.
Game tree represent all possible moves.

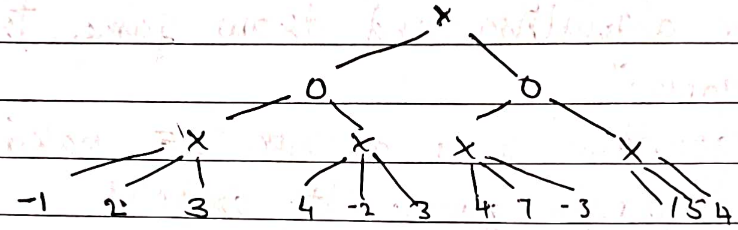
Algorithm
1] Generate game tree
2] Assign score and terminal states (win / loss / draw) get +1, +1, 0.
3] MAX picks highest value from children
MIN picks lowest value
4] Repeat until root node is evaluates.

Q15] Explain Alpha beta pruning algorithms for adversarial search with example.

Ans: Alpha beta pruning is the optimiz-ed version of minima algorithm by skipping unnecessary advances reducing computation.

Algorithm:
1] Initialize $\alpha = -\infty$, $\beta = \infty$
2] Max (x's turn) → update α (highest value)
3] Min (O's turn) → update β (highest value)
4] Prune if $\beta \leq \alpha$ (skip further checks)
5] Repeat recursively

Example:



Max selects the highest min select the lowest.
If min find the move worse than existing we pause the branch.

Advantages - 1] Reduces time complexity from $O(b^d)$ to $O(b^{d/2})$
2] Faster pruning
3] Same optimal moves as MinMax

16] Explain wumpus world environment giving its PEAS & also the percept sequence generation.

Ans 1] P - Maximize Rewards -
1000 for collecting of ~~too~~ gold & exiting grid.
Minimize penalities.
1000 for falling into a pit or being eaten by wumpus
1 point for each action taken.
10 point for using an arrow.

2] E - Grid layout (4×4)
containing pits wumpus gold wall breeze.
Partially observable agent cant see entire grid & must rely on sensory input.

3] A - move left, right, forward
Grab to collect gold shoot (to eliminate wumpus)

4] S - Breeze indicates pit is adjacent stench indicates wumpus in adjacent cell glitter indicates gold.
Bump: indicates a wall has been encountered.

Percept sequence - 1] Initial position - Agent starts at (1,1).

2] Movement - As agent move from one cell to other it uses sensors to gather info about surrounding.

3] Creating percept sequence - Each time agent moves, it records its percepts as sequence.

Eg: After moving to (1,2) : [None, Breeze, None]

After moving to (2,1) [stench, breeze, None]

These indicate no stench glitch glitter yes to nearby dangers respectively. It continues as agent explores more

4] Decision Making - The agent uses these percepts sequences to make decisions about its next actions based on logical reasoning and interface from observations.

Q17] Solve following crypto-arithmatic problem

SEND + MORE = MONEY

Ans 1] To solve this problem we need to assign a unique diagit (0 - 9) to each letter such that the given equation holds true.

```
   S E N D
   M O R E
 ---------
 M O N E Y
```

2] Since M is the leading digit it must be 1. ∴ M = 1

3] D + E = Y (if carry = 0) or D + E = 10 (if carry = 0)

tens place - N + R + carry = E

Hundered's place E + O + carry = N

Thousand's place S + 1 = 1 + carry ∴ S + carry = O

∴ S = 9 since there's no carry

4] Try E = 5 if D = 9 then 7 + 5 = 12 (invalid) O - 2. then Y = 7

5] Y = 7 Assume R = 8 N + R = E 8 + R = 5 (impossible)

N = 6

final S = 9, E = 5, N = 6, D = 7, O = 0, R = 8, Y = 2

SEND → 9 5 6 7
MORE → 1 0 8 6

MONEY → 1 0 6 5 2

18] Consider the axioms -
All people who are graduating are happy
All happy people are smiling
Someone is graduating.
Explain 1: Represent these axioms in first predicate logic.

1) $\forall x$ (Graduating (x) → Happy (x))
2) $\forall x$ (Happy (x) → smiling (x))
3) $\exists x$ (Graduating (x)).

Resolution between C3 and C1
~~Substitute~~ C for x in L1
from graduating (c) Happy (c)
Resolving with C2, smiling (c)

Graduating (A)
Happy (x)
¬ happy (V) v smiling
Smiling (x)
¬ smiling (x)
{ }

∴ Someone is smiling

19] Explain modus ponen with example.

Ans Modus Ponen is a fundamental rule of interference in logic. It states that if P → Q is true P is true then Q must also be true formula.

Formula: $\frac{P \to Q,\ P}{Q}$

Example: if it is raining then it is soggy $(P \to Q)$
if it is raining (P)
it is soggy (Q)

Q20] Explain forward and backward chaining algorithm with example.

Ans Forward Chaining -
It is data driven interface algorithm that starts with known fact and applies interference rules to derive new facts with until the goal is reached

Fact: A, B
Rule: $A \to C$, $B \to D$, $C \wedge D \to I$
Goal state, with A ~~&~~ B we start
Apply $A \to C$ to derive C $B \to D \to$ to derive D
$C \wedge D \to I$ to ~~deriv~~ derive I.
The goal ~~is~~ I is reached.

Backward Chaining -
BC is a goal driven starts with ~~goal~~ goal and works backward to find the facts that support it start with goal.
Fait: A, B   Rule $A \to C$, $B \to D$, $C \wedge D \to I$ goal I
Find the rule of ~~C∧D~~ $C \wedge D \to I$
if C and D are true use $A \to C$ since A is true, C is true
use $B \to D$ as B is true D is true ∴ C&D is true and I is true
Conclusion: I is reached.

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