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AIDS - 1
Assignment 1

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

Ans AI is simulation of human intelligence in machines enabling them to perform tasks like learning, reasoning, problem solving, decision making. AI uses algorithm, data and computer power to automate process and improve efficiency.
During Covid-19 pandemic, AI played crucial role.
① Healthcare and diagnosis - AI powered tools helped detect COVID-19 cases through medical imaging, symptom analysis and predictive modelling.
② Drug discovery and vaccine development by analyzing protein structures and simulating potential treatment reducing time needed for vaccine development.

o What are AI agents terminology, explain with examples.

An AI agent use perceive their environment process information and take actions to achieve specific goals.
Key terminologies include:
① Agent: An entity that interacts with environment and takes actions.
② Environment - External world in which an agent operates traffic conditions for self driving cars.
③ Perception - How an agent gathers data using sensors.

Teacher's Sign

9 Actuators - Components that execute actions
Autonomy - Degree to which an agent operates without human intervention.

Examples - Simple Reflex agent - Thermostat adjusting temperature.
Model based agent - self driving car using map.
Goal based agent - AI playing chess to win.
Learning Agent Recommendation System improving over time.

3 How AI technique is used to solve a Puzzle Problem:
For 8 puzzle problem is solved using AI search techniques that explore different tile arrangements used

1) Uninformed search algorithms
- Breadth first search (BFS) - Explore all possibilities moves level by level.
- Depth first search - Explores path deeply before backtracking.

2) Informed
A* algorithm - uses cost function
f(n) = g(n) + h(n) where
g(n) is cost from start to current state.
h(n) is heuristic estimating cost ~~of~~ ~~goal~~ goal.
greedy best fit search - uses only h(n) to rank ~~ranking~~ Problems. It will sort items in descending order.

5 Essays Evaluater
P: Accuracy, fairness, consistency, feedback,
E: Essays, grammar rules, writing standards.
A: Providing scores, highlighting errors
S: Text input, Grammar checker, NLP module.

6 Robotic sentry gun for kerb sale
P: Accurate threat detection, quick response
E: Take parameter, intruder, lighting, weather conditions
A: Rotating, aiming, firing, alerting, security
S: Motion sensors, cameras, thermal, imaging
sound detection.

5 Category: a shopping bot for offline bookstore
According to each of six dimensions (fully,
Stochastic, episodic, dynamic, discrete, single
Any A shopping bot for an offline bookstore
Observability: Partially observable (may not
know real time stock.
② Stochastic - Stochastic (customer choice
availability are uncertain
③ Episodic - Sequential (book availability and
customer
④ Discrete - Limited book options, customer
interactions and payments method)
⑤ Single (Multi agent - Interact with customers
and staff

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4 what is PEAS descriptor ? Give PEAS descriptor for following taxi driver. medical diagnosis system, music composer. aircraft Boutlander, essay evaluator, robotic, web Differentiate

Ans: PEAS description performance measure, Environment, Actuators, sensors, define components intelligent PEAS description for given system.

(1) Taxi driver
P - safe driving, timely arrivals, fuel efficiency
E - Roads, traffic, weather, pedestrians.
A - steering, brakes, accelerator
S - GPS, speedometer, cameras, engine, traffic sensors

(2) Medical diagnosis system
P Accurate treatment, patient satisfaction
E Patient symptoms, medical records, test results
A displaying diagnosis, Alerting doctors suggestions
S Patient input, lab reports sensor

(3) Music composer
P Creativity, listener satisfaction, originality
E Musical rules, genres, instruments, Past compositions
A Generate music, composing melodies.
S User preferences, musical patterns, feedback

(4) An aircraft autolander
P Safe, smooth landing, runway precise
E Runway, weather, wind, altitude, aircraft
A Adjusting flaps, throttle, brakes, landing gear
S Altimeter, GPS, radar, airspeed indicator, camera

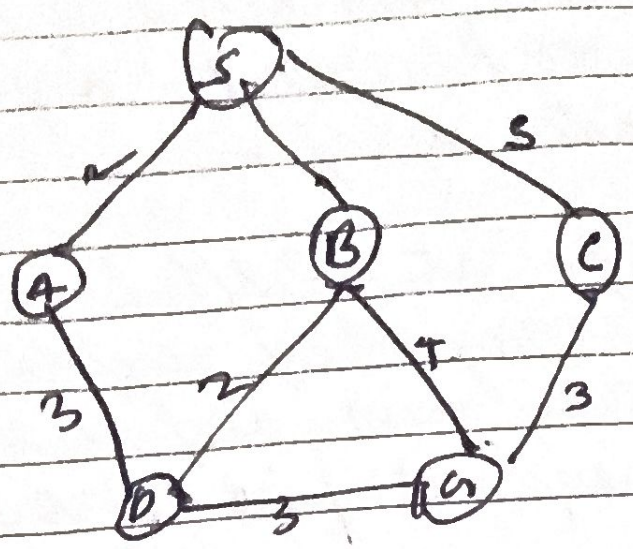
Ans Predicate representation
1 Facts travel (bus)
travelable (car) → travel (bus, car)
travelable (car) → travel (bus, car)

2 Rule rules
travel (bus, brother)
travel (bus, boyfriend)

3 For availability Functional conf = available (car)

Bus route: The bus travels via Gurgaon
Gorakhpur: yes Amita travel via Gurgaon

10 Find route from S to G using BFS



Finding route from S to G using BFS
Steps for BFS

① Start from node S and explore it neighbouring first

② Expand each neighbour before moving to next level.

③ Stop when node G is found.

Step by step execution
Level 1: Start at S, expand A, B, C
Level 2: Expand A → D, B → D, B → G, C → G
Level 3: Found at B → G and C → G

Possible BFS path to G
S → B → G
S → C → G while BFS explores level wise the
route with number of edges is S → B → G

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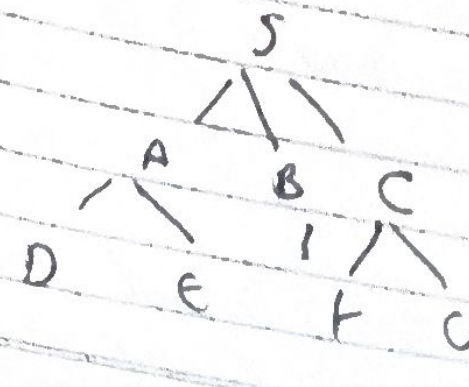
What do you mean by depth limited etc..
Explain iterative deepening search with example

Depth limited search is a variant of DFS where search is restricted to predefined depth limited to prevent infinite loops in deep or infinite graphs

Uses DFS but stops at depth L
Prevents unnecessary deep explorations
Not complete (may miss deeper solutions)
Not optimal (may not find shortest path)

Eg: work

Car available
Function (car
Given Function(car) → available (car)
Iteratively deepening search combines DFS and B/F by running depth limit search repeatedly increasing depth limit. to prevent infinite loops in deep or infinite graphs.



Depth 0 {S} → No destination
Depth 1 {S, A, B, C} → No solution
Depth 2 {S, A, B, C, D, E, I, F, G}
→ found G

Advantages of IDS

3 Car available

12 Explain hill climbing and its drawbacks in detail with example ~~for large~~ Also limitations of steepest ascent hill climbing.

→ Hill climbing is local search algorithm used to find optimal solution by iteratively making small changes and selecting best neighboring state. It moves 'uphill' until it reaches peak state. It makes short sighted decision - It does not consider long term consequences and may miss better solutions. Gets stuck in plateaus and local maxima if no better moves exist. It stops prematurely.

13 Explain simulated annealing and write it algorithm

Ans Simulated annealing is optimization algorithm inspired by annealing process in metallurgy where are heated and once cooled slowly where structure. It determined to escape local optima by allowing occasional downhill moves solutions

Simulated annealing algorithm

① Initialize start an initial solution and initial temperature

Define cooling schedule (temperature reduction functions

② Repeat until stopping condition is met

Generate new solution by making small random changes to calculate change in cost

If is better () move

If is worse accept with probability

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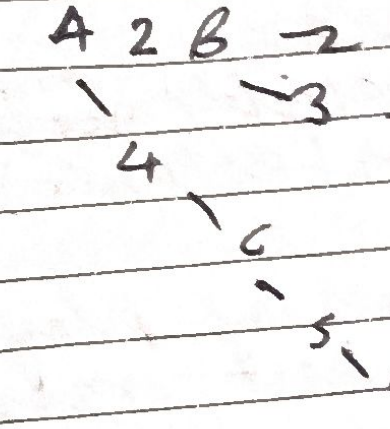
Steepest ascent hill climbing.
Simple hill climbing only considers neighbouring node
Steepest ascent hill climbing examines all neighbouring nodes and selects one closest to solution state as next node
Attempts to maximize its distance from current state by selecting successive states that are progressively higher than the previous one
Stochastic hill climbing chooses at random from among the uphill moves; the probability of selection can vary with the steepness of the uphill move
Local maxima: No algorithm may stop at that is not global maximum because it only considers nearby solutions
Plateau - If a flat area it reached, algorithm has no direction is not, algorithm may struggle to find optimal path
Ridge and Values: If problem has ridges, algorithm may struggle to find optimal path
Termination issues: There is no way to determine if global maximum has been reached unless entire space is explored.
Limitations of steepest ascent hill climbing
Selects best node/move at each step

14 Explain A* algorithm with example.
A* is an informed search algorithm used for pathfinding and graph traversal. It finds the shortest path from start node to goal node by combining
(1) g(n) → The actual cost from start node to current node
(2) h(n) → Estimated cost from current node to goal (heuristic)
(3) f(n) = g(n) + h(n) → total estimated cost.

Example finding shortest path in a graph
Consider a graph where nodes represent cities
an edges represent travel distances
Graph representation. Let say we need to
find shortest path from A to G.



Step by step execution
Start at A calculate
f(n) = g(n) + h(n) Assume

2. Expand lowest f(n) node find

A → B or A → C Suppose h(C) = 0 (good node)

3. Continue exploring nodes with lowest f(n) until we reach G.

4. Find shortest path is determined once we reach with lowest cost.

15 Explain min max Explain algorithm and draw game tree for Tic Tac Toe game.

And the minimum algorithm is a decision making algorithm used in two player games like tic tac toe, chess and checkers. It helps find optimal moves by assuming that one Player. How min max works.

Generate game tree with all possible moves.

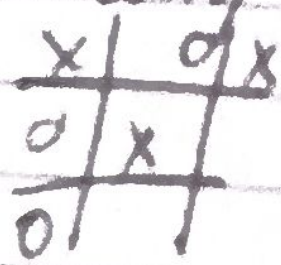
Assign scores +1 for G (max)

minimizing player picks minimum value of.

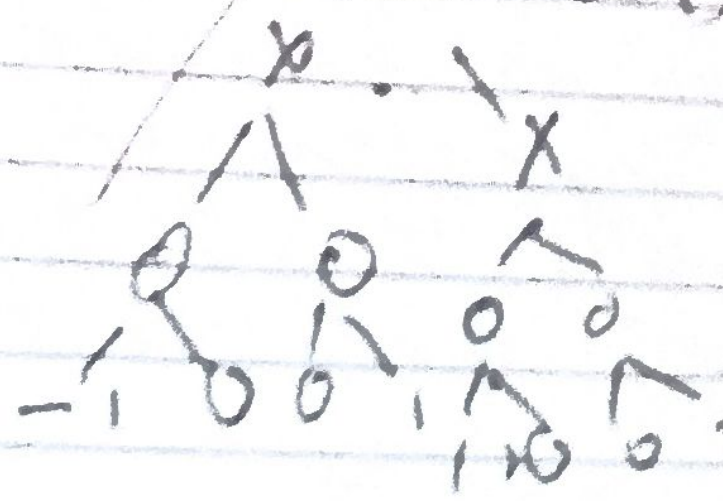
Choose best move based on root node value

Minimax algorithm is a decision making algorithm used in two player games like tic tac toe, chess and checkers where players take turns and each player's goal is minimize the loss and maximize the gain. Consider game tree with all possible moves (states) of tic tac toe and assign values (+1 for win, 0 for draw, -1 for loss) to leaf nodes. Backpropagate the values. Maximizing player picks maximum value & choose best move based on root node value.

Game tree for tic tac toe
Consider nearly complete tic tac toe board where it is X's turn to play



Root (X to move)



Maximizing player (X) chooses highest value from available branches.
Minimizing player (O) chooses lowest value

explain Minimax decision making algorithm for adversarial search with example
Minimax pruning is optimization for minimax algorithm used in adversial game
It prunes branches that do not need exploration, making minimax more efficient
- Alpha (α) : Best already guaranteed
- Beta (β) : Best min can guarantee
- If β ≤ α further branches are pruned (pruning)

Consider game tree with max and min levels,

max (3) ≥ min (2) ≤ Alpha pruning applied

Alpha starts at -∞, Beta at +∞
First branch (3,5) is explored → max chooses 3
Alpha (max) = 3 now all to second branch
Sees a value (2) less than 3 → Beta (min) = 2
Since beta (2) < Alpha (3), pruning happens (no need to explore)

17 Explain WUMPUS world environment giving PEAS description. Explain how percept sequence is generated

→ WUMPUS world is partially observable, stochastic environment used in AI for planning and decision making
Goal of agent navigates the world to WUMPUS: A monster that kills the agent if encountered. Deadly traps. Gold

find and grab it
Walls boundaries that block.
PEAS description
Component | Description
P (Performance measure) | 1000 for grabbing gold
-100 for falling into
E (environment) | Put
9x9 grid with WUMPUS, Pits
A (actuators) | move forward, left right,
grab shoot.
S (sensor) | stench (near WUMPUS), Breeze
near (Pit), Glitter (near gold)

* Percept sequence generation
The percept sequence is series of observations
received by agent as it moves.
Agent starts at (1,1) perceives a breeze (if Pit is
moves to (1,2) senses a stench (if WUMPUS
is adjacent
Reach (2,2) sees glitter (if gold - present) grabs
it.
Navigates back to (1,0) exits the cave)
At each step, agent updates it knowledge
base and decides the next moves based on
logical inference.

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Solve the following cryptoarithmetic problem
SEND + MORE = MONEY

Ans The Cryptoarithmetic problem SEND+MORE=MONEY resolves assigning unique digits to each letter
Assigning values to Letters

S = 9 , E = 5 , N = 6 , D = 7
M = 1 , O = 0 , R = 8 , Y = 2

Solution is
$$\begin{array}{r} 9567 \\ +\ 1085 \\ \hline 10652 \end{array}$$

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

Ans First Order Predicate logic representation
Let
G(x): x is Graduating
H(x): x is happy
S(x) is smiling
Axiom
$\forall x (G(x) \rightarrow H(x))$ Graduating people are happy.

4 ∀x (H(x) → S(x))
5) ∃x S(x) (Someone is graduating)

2) Convert to clause form
1) remove implications
∀x (¬H(x) → ¬G(x)) becomes ¬G(x) ∨ H(x)
∀x (H(x) → S(x)) becomes ¬H(x) ∨ S(x)
∃x S(x) introduces Skolem constant (let x = a, since someone is graduating)
3) standardized clause form
C1 : ¬G(x) ∨ H(a)
C2 ¬H(x) ∨ S(a)
C3: G(a) Someone is graduating

3) Prove "Someone is smiling" using resolution
Resolve C1 and C3
C1 ¬G(a) ∨ H(a)
C3. G(a)
Resolution H(a)
Resolve G(a) with C2
Resolution S(a) since is derived, we have proved. that someone is smiling

Solution tree → S(a) → G(a) ∨ H(a)

S(a)

¬H(a)

H(a)

¬S(a) ⊥

Explain modus ponens with suitable example
Modus ponens (Law of detachment) is a fundamental rule of inference in logic and statistics

If
1 $P \rightarrow q$ (If P, then q)
2 P (P is true)
then we can conclude
q (q must be true)

Example
1 If it rains, the grass will be wet ($P \rightarrow q$)
2 It is raining (P)
3 Therefore the ground is wet (q)
This rule is widely used in mathematical proofs, AI reasoning and programming logic

a) Explain forward chaining and backward chaining algorithm with help of example. Both are inference techniques used in rule based systems and AI.

- Forward Chaining (Data driven Reasoning) starts from known facts and applies rules to derive new facts until the goal is reached.
- Used in expert systems, AI planning and production systems.

example rules
- If it rains (R) then ground is wet (W → R)
- If the ground is wet (W) then grass is slippery (W → S)

Given KB is Tuesday
Apply R → W to see if ground is wet is inferred
Apply W → S to (both is supported to infer)

2 Backward Chaining (goal driven reasoning)
- starts from and works backwards to see if facts support it

example goal is grass slippery (S)?

① check S → W (Grass is slippery if ground is wet)
② check W → R (Ground is where it rained
③ If R (rain) is found is known fact, then it is true