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04/05

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Assignment - 1

(1) What is AI? considering the covid-19 pandemic situation, how AI help to survive and renovated way of life with different application.

→ AI is the ability of computer to perform task that require human intelligence learning, Problem solving, ~~NLP~~, reasoning.

AI Help during covid-19.

(1) Healthcare.
→ (i) AI Powered digonosis tool like CT scan.
(ii) AI driven drug discovery.
(iii) chatbot and virtual assistance.

(2) contact Tracing and survelliance.
(i) AI powered contact tracing apps.
(ii) AI - based face recognization and temperature detection.
(iii) AI driven drone and cameras.

(3) Education and remote work
(i) AI powered virtual meeting platform
(ii) AI driven e-learning platform.
(iii) AI powered speech to text language translator tools.

2) What is AI agent terminology
i) Performance measure
→ Different success of agent
→ Ex. Vacuum cleaner

ii) Percept
→ The inputs receive from environment
→ Ex. Self driving car

iii) Agent function
→ Maps the percept sequence to an agent
→ A spam filter

iv) Actuators
(i) Components used by an agent to perform action
(ii) Example: Robotic Vaccum cleaner

v) Sensors
(i) Device that allow an agent to perceive environment
(ii) Example: Smart thermostat

vi) Environment
→ External system where an agent operates
→ Ex. Smart thermostat

(3) ~~AI~~ How AI used to solve 8-puzzel problem.

→ 8-puzzle problem is a classic 3×3 grid with 8 numbered and one empty space must be arranged by sliding tiles

AI techniques

(1) Uninformed Search techniques (Blind Search).

(a) Breadth ~~first~~ first search.

→ Explore all moves

→ Guarantees finding shortest ~~st~~ solution

(b) Depth First Search.

→ Explore one branch completely before backtracking.

(c) Uniform cost Search.

(2) Informed Search techniques.

(a) Best first search

(2) A* search algorithm

(3) IDA

(3) constraint Satisfaction

→ (a) Simulated Annealing.

(b) Genetic Algorithm.

Q. What is PEAS Discriptor? Give PEAS discriptor for the following:

(1) Taxi driver

(i) Performance agent:- Accuracy, speed, safety

(ii) Environment:- trafic signal, another cars, road, weather

(iii) medical diagnosis Actuators:- accelerator, breakes, GPS system

(iv) Sensors:- camera, GPS, Radar

(2) Medical diagonosis system.

(i) Performance measure - correct dignosis, timely treatement, minimizing medical errors

(ii) Environment:- Patients symptoms, medical records, test symptoms, test results,

(iii) Actuators:- Display screen, alarm for critical conditions.

(3) Music composer.

(1) Performance measure:- Melody quality, harmony, creativity, audience ~~engage~~ engagement.

(2) Environment:- theory rules, user preference, historical data.

(3) Actuators:- ~~Diti~~ Digital music synthesis, MIDI generator, Sound output devices.

(4) Sensors:- User input, AI feedback, lapy.

(4) ~~Aircraft~~ Aircraft autolander.
(i) Performance Measure: Safe landing, precision, smooth descent.
(ii) Environment :- Runway conditions, ~~the~~ weather, air traffic, aircraft, attitude.
(iii) Actuators:- Flaps, landing gear, brakes, thrust,
(iv) Sensors:- radar, GPS, gyroscopes.

(5) ~~(e)~~ Essay Evaluators.
(i) Performance Measure:- Grammar accuracy, content relevence, originality.
(ii) Environment :- Student essays, predefined grading rubrics.
(iii) Actuators:- Screen display, comment Suggestions.
(iv) Sensors:- optical Charater Recognization (OCR), Natural language Processing engine.

(6) Robotic Sentry Gun for the keck lab.
(i) Performance measure:- Accuracy, threat ~~det~~ detection speed, response time.
(ii) Environment:- Survillance area, weather condition
(iii) Actuators:- firing mechanism, alarm System

Sensors- Cameras, radar, infrared sen...

Q.5 Categorize a shopping bot for an

- six dimensions

(i) Partially observable

-) The bot can't see the entire state of the book store.

(ii) Stochastic:

-) The environment is not fully predictable. Ex. a customer might change their ~~mind~~ mind or another computer customer.

Sequential:

-) The bot's actions are not isolated but rather form a sequence of interaction with the environment

Dynamic.

-) The environment changes over time Books are added deleted, removed.

Discrete.

-) the actions the bot can take (e.g. suggesting a book, asking a question).

Single agent:- Bot operate independently.

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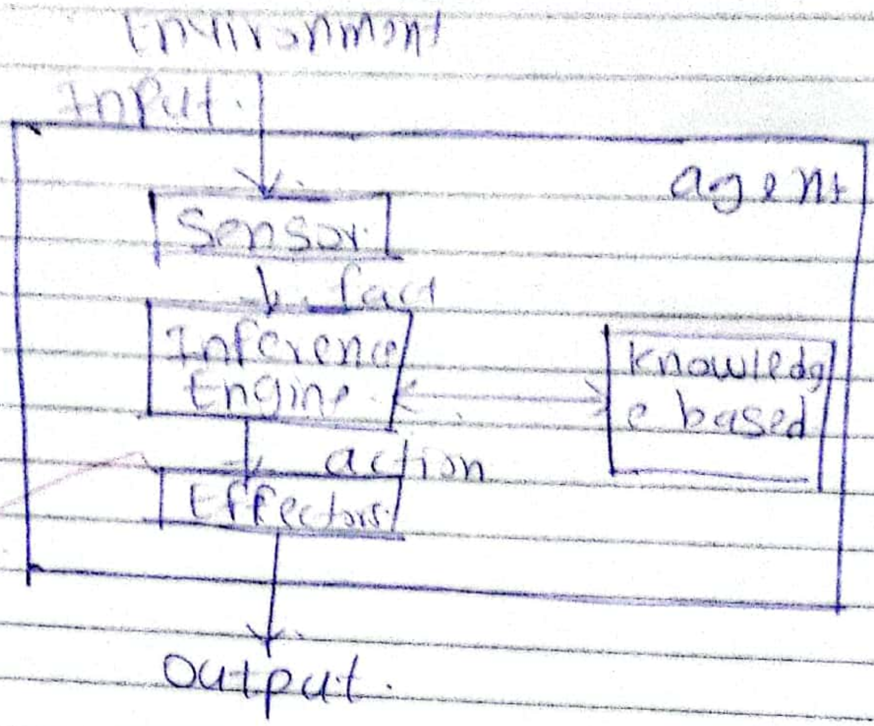
(6) Model based agent vs utility based agent

Model based agent	utility base agent
(1) use internal model of environment	(1) use utility function to evaluate different possible action
(2) Maintain past percepts and updates its knoledge about environment.	(2) maximize utility base on preference function.
(3) choose action based on internal state	(3) choose action which are provided by utility function
(4)	
(5) Goal depend on percept history and internal state	(4) Goal depend on action provide by utility function

Q Architecture of knowledge base agent and learning agent

(1) knowledge base agent



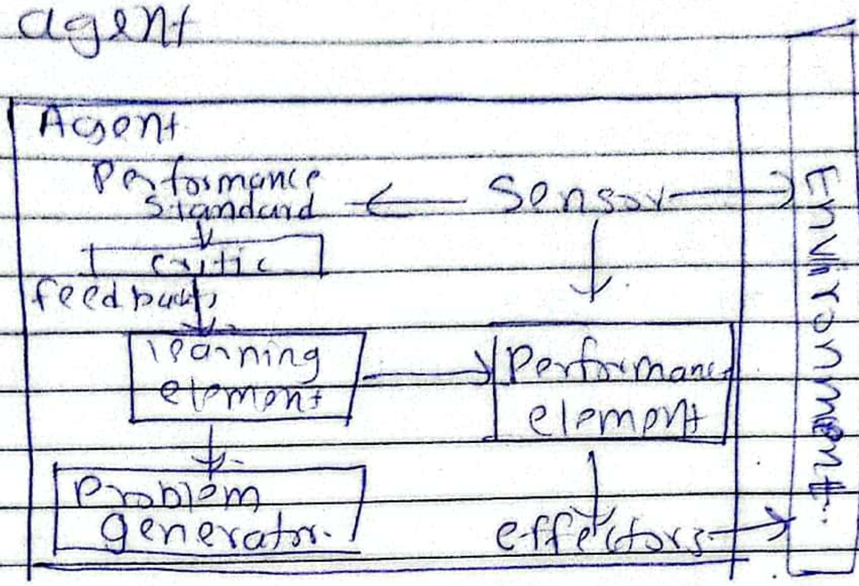
→ Sensor :- takes input from environment.

→ Inference engine :- It is knowledge base system engine used to refer new knowlege in the system

→ Effectors :- perform action on environment

→ knowledge base :- It is key component of knoledge base agent. this deal with fact of world.

Learning agent



(1) Sensor:- Sensor collect information from environment.

(2) Critic :- How well agent is perform-a based on fixed performance standard

3) learning element:- This part act as a central cognitive hub of an age

(4) ~~Learning~~ element: (Performance):- Performance element required learning element and critic feedback

(5) ~~Act~~ Actuators:- Effector who called actuator to carry out task selected by performance element

(6) Problem generator:- the problem generator is a charge of creatin challenges or activities for the agent

(Q) convert the following to predicates
(a) Anita travels by car if available otherwise travels by bus.
(b) Bus goes via andheri and goregaon.
(c) Car has pucture so is not available
will anita travel via Goregaon?
use forward reasoning.
convert into predicate logic.

1) • Available(car) → Travels(Anita, car).
• ¬Available(car) → Travels(Anita, bus).
2) • GoesVia(Bus, Andheri).
• GoesVia(Bus, Goregaon).
3 • Puncture(car).
Puncture(car) → ¬Available(car).

Step 2.1 Apply forward reasoning
→ Given Puncture(car), we conclude ¬Available(car).
Step 2.2
Since ¬Available(car) is true,
Apply ¬Available(car) → Travels(Anita,bus)
Hence, Travels(Anita,bus) is true.
Step 2.3
~~Step~~
• We already know that GoesVia(Bus, Goregaon) is true.
• Since Anita travel by bus, She must travelled via goregaon

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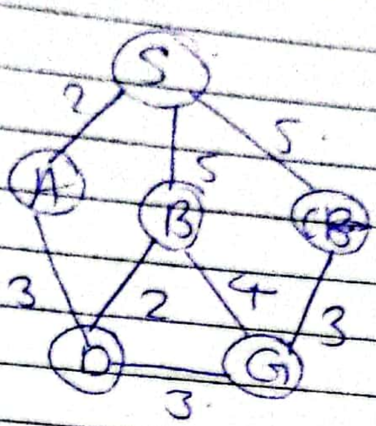
Hence, Anita travelled via goregaon is true.

(10) Find route via S to G.



BFS algorithm steps.

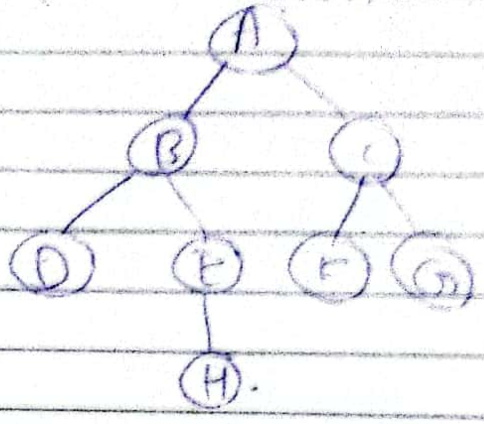
(1) Start from the initial node S.
(2) Explore all its neighbouring nodes before moving to next level
(3) use a queue (FIFO) to keep a track of visited nodes.

BFS traversal

(1) Start at S → Add neighbours to queue: (A, B, C)
(2) Visit A → Add D to queue (B, C, D).
(3) Visit B → Add G to queue (C, D, G).
(4) Visit C → G is already in the queue.
(5) Visit D → G is already in the queue.
(6) Visit G → Destination reached.

(1) What do you mean by depth limited search? Explain Iterative Deepening search with example.

→ Depth-Limited Search is a variant of Depth-First Search (DFS) which have limit L



Case 1:- Depth limit L=2.
Start at A:
Expand A → {B, C}.
Expand B → {D, E}.
Expand C → {F, G};
Stop at depth = 2. (limit reached
H is not found.

Case 2:- Depth limit L=2.
Start at A.
Expand A → {B, C}.
Expand B → {D, E}
Expand E → {H}.
Goal found at depth = 3.
Path found A → B → E → H.

Application
- Game trees:-
- Web crawlers:-
- large graphs:-

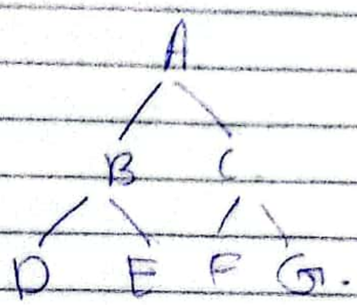
* Iterative Deepening Search (IDS).

-> Iterative deepening search is a graph traversal and search algorithm that combines depth first search and breadth first search.

Why IDS:-

Step 1.

Depth limit = 0.
Search only root Node - A.
Goal not found -> increase depth.



Depth limit = 1.
Expand A -> (B, C)
Goal not found -> Increase depth.

Depth limit = 2
B -> (D, E)
C -> (F, G)
Goal G is found at depth 2.

Final Solution path A -> C -> G
Time complexity :- $O(b^d)$.
Space complexity $O(bd)$.

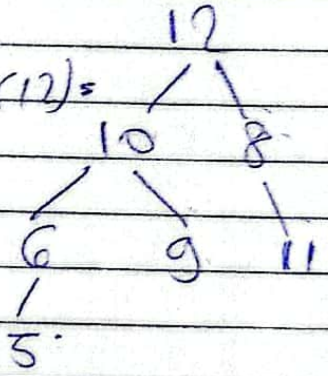
Advantages.
(1) Memory efficient
(2) Avoids infinite loops
(3) Finite optimal solution.

(12) Explain Hill climbing and its drawback in details with example. Also state limitations of steepest-ascent hill climbing.

→ (1) Hill climbing is an informed search algorithm used for optimization problems where the goal is to find best possible solution.

- Hill climbing is a greedy algorithm
- ~~Hil~~ that continously moves forward the best neighbor.
- It only consider limited gains, does not backtrack.

Start at Node = 5.
Goal = Find highest value (12).



(1) Start at 5, neighbours are 6.
(2) Move to 6, neighbors are 10, 9.
(3) Move to 10 (highest value)
(4) Move to 12 (highest value)
(5) Stop (no higher neighbor).

Solution Path :- 5 → 6 → 10 → 12

Disadvantages of hill climbing
(1) Get stuck in local maxima :- cannot backtrack
(2) Plateau Problem :- Flat areas make stop.
(3) Ridge Problem :- Can struggle with complex landscape.

(13) Explain Simulated annealing and write its algorithm.

→ (1) Evaluate intinitial state, if it is Goal State return it and quit

(2) Initialize Best-So-Far to the current State

(3) Initialize T according to annealing Schedule

(4) loop untill solution is found.

(5) ~~Se~~ (a) Select operator that has not yet been applied to the current States

(b) Evaluate the new States,

ΔE = (value of current) - (value of new)

- If new state is a goal State then return and quit.
- If it is not better than current States, then make it current State.

(c) Revise T as necessary according to annealing schedule

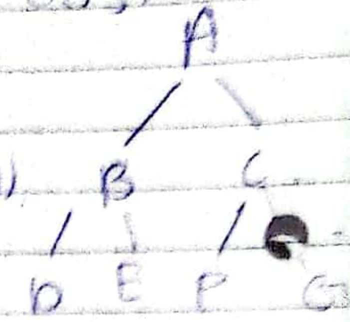
(d) Return Best-So-Far, on the answer.

(14) Explain A* algorithm with example.

→ A* Search algorithm finds the shortest path from a start node to a goal node while considering path cost and heuristic function.

A* is optimal.

A* is complete, $f(n) = g(n) + h(n)$.



Cost & Heuristic Value

Node	$g(n)$	$h(n)$	$f(n) = g(n) + h(n)$
A	0	6	6
B	1	4	5
C	2	3	5
D	3	7	10
E	4	5	~~10~~ 9
F	3	2	~~9~~ 5
G	4	0	~~5~~ 4 Goal

* Step-by-step

Start at A → Calculate f(A) = 6

Expand A → {B, C}, {both have f = 5}.

Expand C → {F, G}. (G has the lowest f).

Goal reached at G.

Final Path: A → C → G.

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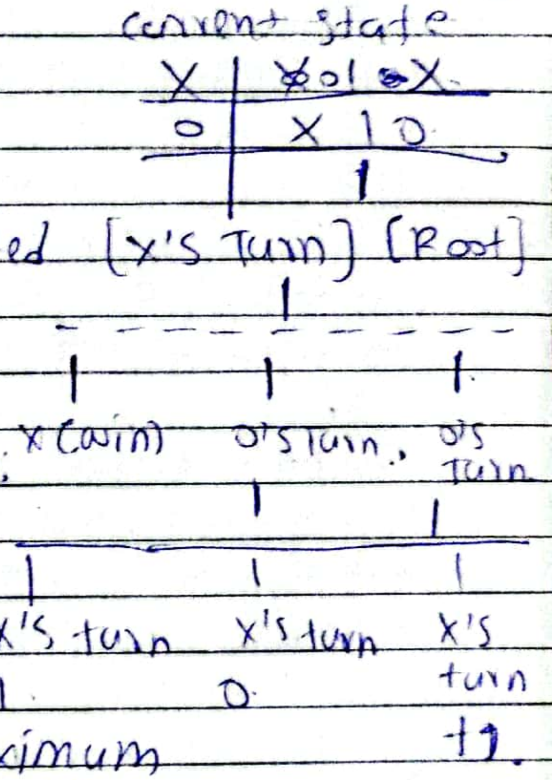
(5). Explain Min max Algorithm and draw game tree for Tic tac toe Game.

→ What is the Min-Max algorithm.

- MinMax algorithm is a decision making strategy used in adversarial search, particularly in two player zero sum games like - Tic tac toe, chess

• one player (MAX) maximize advantages
• other player (Min) Minimize advantage.



Step 1:- AI (X) generates all possible moves.

Step 2:- At each terminated State
- If x wins → Assign +1
- If o wins → Assign -1
- If it's draw → Assign 0.

Step 3:- Min Select minimum Value in its branches.

Step 4:- Max Select Maximum value from min's Selection

(16) Explain Alpha beta pruning algorithm for adversarial Search with example.

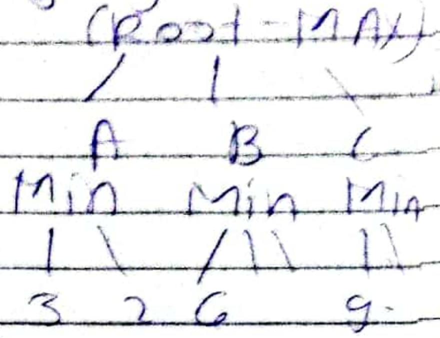
-) An optimization technique to the max minimax algorithm that reduce the number of nodes evaluated.

• Pruning process

Alpha(α): Best option available for maximizer

Beta(β):- Best option available for minimizer

$\beta \leq \alpha$, prune the remaining branches.



Step by step

(1) Start at Root

1. $\alpha = -\infty$, $\beta = +\infty$.

(2) Evaluate Node A: (Min's turn)

(1) Evaluate child values: 3,3,5,2,3

(2) Min select lowest value (2).

(3) Update $\beta = 2$ for this branch.

(3) Move to Node B (Min's turn).

(1) Evaluate the first child 6.

(2) Since $6 > 2$ (β of A)

(3) Max never pick B since already have A with $\beta = 2$.

(4) Move to Node C (Min's turn).

(1). Evaluates 9.

(2) Since $9 > 2$

(5) Final decision.

-) Max picks Node A with value 2.

(17). Explain wumpus world environment giving its PEAS description. Explain how percept sequence generated

Performance measure
The agent goal is to collect the gold and exit the cave safely, maximizing rewards and minimizing penalties like falling into pits or encountering wumpus.

Environment.
Pit
wumpus
gold.
breez.

Actuators.
move forward
Turn left
Turn right
Shoot arrow.

Sensor.
Breez - Presence of pit in adjecent room.
Strench - presence of ~~s~~ strench in adjecent room
Glitter - presence of gold in adjecent room.
Bump - when move forward
Scream :- Heard wumpus killed. every where

Q1) Solve the following crypto-arithmatic Problems ~~1~~ Send + money.

1 Send + More = Money

S ~~E N D~~ S E N D
+ M O R E (5)
M' O N E Y.
(1) (0)

	S → 0 1 2 3 4 5 6 7 8 9
	E → 0 1 2 3 4 5 6 7 8 9
	N → 0 1 2 3 4 5 6 7 8 9
	D → 0 1 2 3 4 5 6 7 8 9
	M – 0 1 2 3 4 5 6 7 8 9
	O – 0 1 2 3 4 5 6 7 8 9
	R – 0 1 2 3 4 5 6 7 8 9
	Y – 0 1 2 3 4 5 6 7 8 9.

(9) 5 (6) (7)
S E N D.
+
M O R E.
1 1 (0). (8). (5)
M O N E Y.
(1). (0). (6) (5). (7)

Q2)

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(19) Consider the following axioms:-
All people who are graduating are happy
All ~~pe~~ happy people are smiling
Someone is graduating

Explain the following:
(1) Represent these axioms in first order predicate logic.
(2) Convert each formula to clause form.
(3) Prove that "is Someone Smiling?" using resolution technique.

Step 1:- ~~$x \rightarrow$ people.~~
~~$G(x) \rightarrow$ 'x is graduating'~~
$H(x) \rightarrow$ 'x is happy'.
$S(x) \rightarrow$ 'x is smiling'.

Representing Axioms in FOPL.
(1) All people who are graduating are happy.
$\forall x (G(x) \rightarrow H(x))$.
(2) All happy people ~~a~~ are Smiling:
$\forall x (H(x) \rightarrow S(x))$.
(3) Someone is graduating
$\exists x (G(x))$.

Convert each $P \rightarrow Q \equiv \neg P \vee Q$.
(1) $\forall x (G(x) \rightarrow H(x))$ becomes
~~$\exists G$~~ $\neg G(x) \vee H(x)$.
(2) $\forall x (H(x) \rightarrow S(x))$ becomes
$\neg H(x) \vee S(x)$

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$\exists x G(x)$ means:

$G(A)$ (Skolem constant).

Step 2.2. Represent in clause form.

(1.) $\neg G(x) \vee H(x)$.

(2.) $\neg H(x) \vee S(x)$.

(3). $G(A)$.

Assume the negetion $\neg S(x)$ & resolve.

$\exists x S(x)$.

Assume the negetion $\neg S(x)$ and resolve.

Steps	clause	Resolution
1	$G(A)$	Given.
2	$\neg G(x) \vee H(x)$	Given.
3	$\neg H(x) \vee S(x)$	Given.
4	$H(A)$	from (1) and (2)
5	$S(A)$	resolve (4) & (3).

Since we derived $S(A)$, Some one is Smiling.

(20) Explain modus ponen with suitable example:

→ Modus Ponens, a fundamental rule of logic state that if ~~the~~ a conditional Statement ("If P, then Q") is true, and the antecedent (P) is also true, then consequent (Q) must also be true.

Here's a breakdown with an example.

- Conditional Statement (Premise 1)
  If it is raining (P), then the ground is wet(Q)
- Antecedent (Premise 2):- It is raining (P).
- Conclusion (modus ponens): Therefore, the ground is wet. (Q).

(21) Explain forward chaining and backward.

→ Forward chaining algorithm.

(1) Data driven approach
→ Data driven start with available data

(2) Iterative process
→ The inference engine iteratively examines knowledge base.

(3) Rule application.
→ When a rule's antecedent is true, the engine infers the consequent.

(4) Goal achievement
→ Process continues till goal state is reached.

~~(5) Example~~

Backward chaining algorithm

(1) Start with the goal.
(2) Find a Rule that can prove goal
(3) Check Antecedents are true
(4) Check fact
(5)