Name: SHIVEN BANSAL ROLL NO: 03 CLASS- D15C

05/05

AIDS Assignment-1

Q1.) What is AI? Considering the Covid-19 Pandemic situation, how AI helped to survive and revovate our way of life with different applications?

Ans- Artificial Intelligence (AI) is the simulation of human intelligence in machines, enabling them to learn reason and perform task without explicit programming. AI can access large amounts of data, recognising patterns and make informed decisions making them highly useful in various fields.

During the covid-19 pandemic AI played a crucial role in healthcare by aiding early virus detection, predicting outbreaks and accelerating vaccine development. AI powered chatbots reduced the burden on healthcare workers by providing reliable health information.

In education, AI driven platforms enabled remote learning through virtual classrooms automated grading and personalised learning experiences ensuring continuity despite school closures.

Businesses leveraged AI for automation, remote work supply chain optimisation and customer support through chatbot helping them adapt new work environments.

Additionally AI powered e-commerce and delivered services ensured the availability of essential goods by optimising logistics and reducing human contact.

The pandemic accelerated AI adoption, making industries more efficient and transforming daily life with contactless & digital solution.

Teacher's Sign.: _____

Q2.) what are AI Agent terminologies, explain with examples.

Ans- AI agent is an autonomous entity that perceives its environment through sensors and take actions using actuators to achieve specific goals. AI agent operate based on predefining rules or learning models.

Key terminologies :-

1.) Agent - AI agent perceives & acts.
Eg- self driving car perceives traffic & adjust speed.

2.) Environment - External system in which AI agent operates.
Eg- Chess game's board & rules.

3.) Perception - Data collected through sensors.
Eg robot's camera capturing images to detect obstacles.

4.) Actuators - Mechanism through which AI agent interact with environment. Eg- Robots arm in factory assembling products.

5.) Sensors - Device that collects data from environment for the agent. Eg- Speedometer for car.

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

Ans- the 8 puzzle problem is solved using AI techniques to find optimal arrangement.

AI techniques used :-

1.) Brute force methods
- BFS - Explores level by level, ensuring the shortest path.
- DFS - Explores deeply but not optimal.

Teacher's Sign.:

2.) Heuristic Search Methods

- Greedy search - Chooses the closest path move but not optimal.
- A* algorithm - Uses heuristic for best path.
  Misplaced tiles - count tiles in wrong position.
  Manhattan distance - Measures total tile movement needed.

Q4.) What is PEAS description? Give PEAS for the following:-

a.) Taxi driver
b.) Medical diagnosis system
c.) A music composer.
d.) Aircraft antiskander.
e.) Essay evaluator.
f.) Robotic sentry gun for Keck lab.

Ans- a.) Taxi driver

P - Safety, time efficiency, fuel consumption, customer satisfaction
E - Roads, traffic, weather, passenger.
A - Steering, acceleration, braking, signalling
S - GPS, Speedometer, camera, sensors.

b.) Medical diagnosis system.

P - Accuracy of diagnosis, treatment effectiveness.
E - Patient data, medical records system.
A - Displaying results, recommending treatments.
S - Patient reports, lab result, doctor inputs.

Teacher's Sign.: _____

c.) AI music composer.
P - Creativity, harmony, user prefences.
E - Music libraries, user inputs, trends.
A - Generating melodies, arranging instruments.
S - User fedback, music theory rules, dataset analysis.

d.) Aircraft Autolander.
P - Safe landing, smoothness, precision.
E - Runway, weather, wind spid, altitude.
A - Flaps, landing gears, brakes.
S - Radar, altimeter, gyroscope, airspid sensor.

e.) Essay evaluator
P - Grammar accuracy, relevance, coherence.
E - Student essays, writing standards.
A - Scoring system, fedback generation.
S - NLP tools, grammar checkers, semantic analyser.

f.) Robotic Sentry ~~Gun~~ Gun
P - Accuracy, threat detection efficiency.
E - Lab premises, security threats.
A - Rotating turrent, firing mechanism, alarms
S - Motion detectors, cameras, thermal sensors.

Q5) Categorise a shopping bot for an offline bookstore according to each of the 6 dimensions (fully, partially observable, deterministic / stochastic, episodic / sequential, static / dynamic discrete / continuous, single / multi agent

Teacher's Sign.: _____

Ans-1) Observability : Partially Observable
The bot may not have complete info about stock levels, customer preferences or ongoing transactions.

2.) Deterministic / Stochastic - Book availability, customer behaviour external factors (like delayed shipments) introduce uncertainty.

3.) Episodic / Sequential - Each interaction like customer inquiries or stock updates affects future decisions.

4.) Static / Dynamic - Dynamic - Environment changes due to customer purchases, new arrivals & external factors like demand fluctuations.

5.) Discrete / Continuous - The bot works without a finite set of actions, such as checking inventory, responding to queries, updating stock.

6.) Single / Multi agent - Multiagent : Bot interacts with multiple customers, staff & possibly suppliers making it a multi agent system.

Q6.) Differentiate model based & utility based agent.

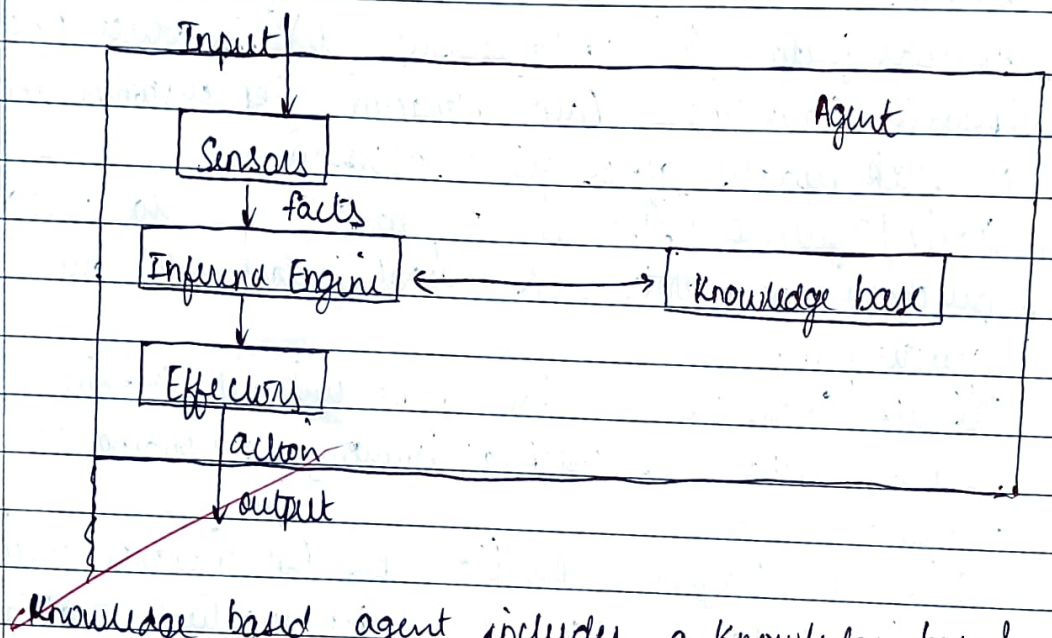
Ans-

Model based	Utility Based
1.) Uses an internal model of the environment to make decisions	1.) Chooses actions based on a utility function to maximise performance.
2.) Maintains knowledge of world & updates with new info.	2.) Evaluates multiple possible actions & selects the one with highest utility
3.) Moderately complex as it maintains an internal node.	3.) Higher complexity as it requires evaluating multiple possibilities
4.) Eg - A robot vacuum remembering room layout for efficient cleaning.	4.) Eg- Stock market AI selecting the most profitable investment

Teacher's Sign.: _____

Q7.) Explain the architecture of a Knowledge & learning based agent.

Ans- Knowledge based Agent



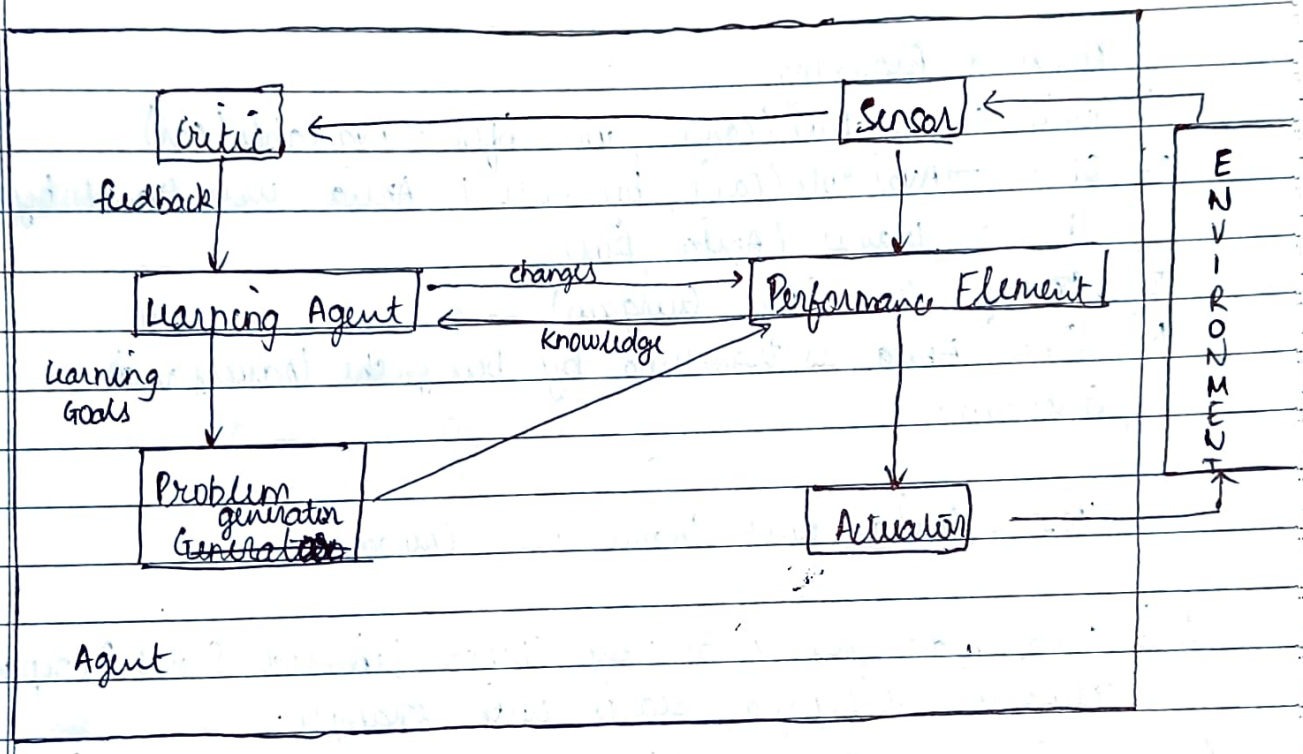
Knowledge based agent includes a knowledge base & an inferenc engine system. A knowledge base is a set of representations of facts of the world.
The agent operates as follows:-

1.) It tells the knowledge base what it perceives
2.) It tells the knowledge base what actions should be performed.

- Learning agent-

By actively exploring & experimenting with their environment, the most powerful agents are able to learn. An agent can be divided into 4 conceptual components.

Teacher's Sign.:



Q9.) Converting the following to predicates :-

a-) Anita travels by car if available otherwise by bus.

b-) Bus goes via Andheri & Gurgaon.

c-) Car has puncture so is not available.

Will Anita travel via Gurgaon ? Use forward reasoning.

Ans a-)

Available (car) → Travels (Anita, car)

¬ Available (car) → Travels (Anita, Bus)

b-) Goes (Bus, Andheri)

Goes (Bus, Gurgaon)

c-) Puncture (car)

Puncture (car) → ¬ Available (car)

Teacher's Sign.: _____

Forward Reasoning :-

1.) Given : Puncture (car), we infer ¬Available (car)
2.) Since ¬Available (car), by rule 1, Anita will travel by bus : Travels (Anita, Bus)
3.) Goes (Bus, Gurgaon)
4.) Since Anita is travelling by bus, she travels via Gurgaon.

Yes, Anita will travel via Gurgaon.

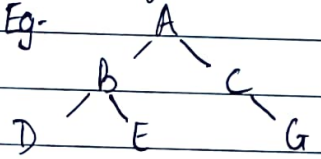
Q11.) What do you mean by Depth Limited Search? Explain Iterative Deepening Search with example.

Ans- DLS is a modified DFS with a predefined depth limit to prevent infinite exploration. It explores nodes upto the given depth.

Adv - & Prevents getting stuck in deep or infinite paths.
Disadv - May fail if goal is beyond depth limit.

Iterative Deepening Search combines DLS & & BFS by incrementally increasing the depth limit until the goal is found.

Eg-



Goal → G

1.) Depth : 0 → Explore A (No goal)
2.) Depth : 1 → Explores (A → B, C) (No goal)
3.) Depth : 2 → Explores (A → B, C → D, E, G) Goal found.

Teacher's Sign.: _____

Q12) Explain Hill climbing and its drawbacks in details with examples. Also state limitations of steepest ascent hill climbing

Ans- Hill climbing is an optimisation algorithm that moves towards the best solution by selecting the neighbouring state with highest value based on a heuristic function.
Eg- A mountain climbing problem, the algo moves step by step but may stop at a local peak instead of reaching the highest point.

- Drawbacks of Hill Climbing
1.) Local maxima - May stop at a local peak instead of the best solution
2.) Plateau Problem - No improvement causing search to halt.
3.) Ridges - Requires diagonal movement, which basic Hill climbing cannot handle.
4.) No backtracking - Cannot undo previous step even if a better path exists.

- Steepest Hill Climbing Limitations
1.) Chooses the best neighbour but is computationally expensive.
2.) Still suffers from local maxima, plateau & ridges.
3.) Slow in large search spaces.

Q13) Explain simulated annealing & write its algorithm.

Ans- Simulated Annealing is an optimisation algorithm inspired by the metal annealing process where materials are heated & gradually cooled to reach a stable state. It helps find global optimum by sometimes accepting worse solutions to escape local maxima.

Teacher's Sign.: _____

Algorithm :-

1. Initialise Solution S & Temperature T.
2. Repeat until T is very low:
   a.) Select a neighbouring solution S'.
   b.) If S' is better accept it.
   c.) If worse, accept it with probability $P = e^{-\Delta E/T}$
   d.) Reduce T (cooling schedule).
3. Return the best solution found.

Q14) Explain A* algorithm with an example.

Ans- A* is a graph/tree search algorithm used in pathfinding & optimisation. It combines & Greedy Best First search & Dijkstra Algorithm

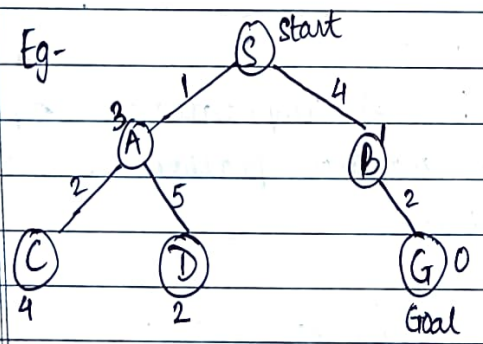
$$f(n) = g(n) + h(n)$$

$g(n) \rightarrow$ Cost from start node to n.

$h(n) \rightarrow$ Estimated cost from n to goal (heuristic)

$f(n) \rightarrow$ Total estimated cost.

Eg-



$f(A) = g(A) + h(A) = 1+3 \Rightarrow 4$ (SA)

$f(B) = g(B) + h(B) = 4+1 \Rightarrow 5$ (SB)

Teacher's Sign.: _____

path SA→C

$f(C) = g(C) + h(C) = 1+2+4 \Rightarrow 7$

path SA→D

$f(D) = g(C) + h(C) = 1+5+2 \Rightarrow 8$

path SB→G

$g(G) + h(G)$

$4+2+0 \Rightarrow 6$ (minimum)

Q15.) Explain min max algorithm & draw a game tree for Tic Tac Toe game.

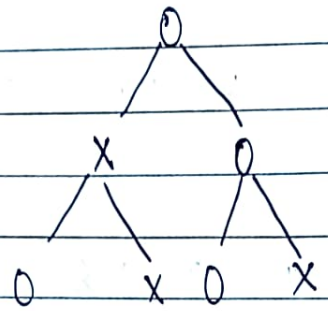
Ans- Min max is a decision making algorithm used in 2 player turn based games like tic tac toe, chess, checkers. It is designed to minimise opponents best possible score while maximising players score. The algorithm assumes both player play optimally.

Steps :-

1.) Generate Game tree.
2.) Assign score to terminal nodes: +1 → Win, -1 → Loss, 0 → Draw.
3.) Back propagate scores : choose the max score in case of maximising turn for X player & choose min score for minimising player O.
4.) Repeat until root node.

Eg- Tic Tac Toe game tree.

Teacher's Sign.:



This algorithm evaluates each outcome & select the best move for the current player.

Q16.) Explain Alpha beta pruning algorithm for adversial search with example.

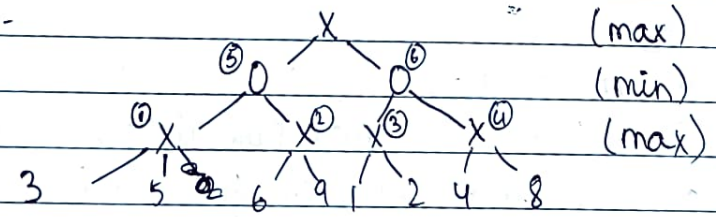
Ans - Alpha beta pruning is an optimisation technique for minmax algo used in adversial search. It helps eliminate unnecessary nodes in the game tree reducing the no. of evaluations & making the search process more efficient.

$\alpha \rightarrow$ Best value that maximising player can get

$\beta \rightarrow$ Best value that minimum player can get.

Prune $\rightarrow$ Ignoring the subtree.

Eg-



Node ① $\rightarrow$ Takes value 3, check max(3,5) better than 3? Yes? ∴ Update 4 ∴ ① $\rightarrow$ 5

Node ⑤ $\rightarrow$ Takes 5 value, check min (5, right subtree)
right subtree ② $\rightarrow$ max (6,9) $\Rightarrow 9 = \alpha$
∴ For ⑤ node it takes min (5,9) $\Rightarrow 5 = \beta$

Teacher's Sign.:

For node ③ → max (1,2) ⇒ $\alpha = 2$

For node ⑥, it takes values 2 & checks if right subtree gives value < 2 If Yes ∴ accept else prune.

node ④ → max (4,8) ⇒ $\alpha = 8$
✗ ∵ 8 > 2 ∴ prune the tree.

∴ For node ⑥ ⇒ $\beta = 2$

For root node take max (5,2) ⇒ 5

Q17.) Explain WUMPUS world environment giving its PEAS description. Explain how percept sequence is generated.

Ans- WUMPUS world is a simple grid based environment used in AI to model decision making under uncertainity. It consist of a 4 x 4 grid where an agent must find gold while avoiding wumpus & deadly pits.

4,1 Stench	4,2	4,3 Breze	4,4 PIT
3,1	3,2 GOLD	3,3 PIT	3,4 Breze
2,1 Stench	2,2	2,3 Breze	2,4
1,1	1,2 Breze	1,3 PIT	1,4 Breze

Teacher's Sign.: _____

PEAS description

1.) Performance measure
- +100 if agent comes out with gold
- -10 for every action of agent.
- -10 if arrow is used
- -200 if agent dies.

(2) Environment
- Empty rooms
- Room with Wumpus
- Stenchy room
- Breezy rooms
- Room with gold
- Arrow

(3) Actuators
- Motor to move right / left
- Robotic arm to grab gold
- Robotic mechanism to shoot arrows.

(4) Sensor
- Camera
- Odor Sensors
- Audio sensors.

• How percept sequence is generated
1.) Start at (1,1) → No percept
2.) Move to (1,2) → Feels breeze (Bit nearby)
3.) ~~Move to (2,1) → No percept (Safe)~~
4.) Move to (2,3) → Feels breeze ~~(Bit nearby)~~

Teacher's Sign.: _____

Since breeze is felt ∴ pit is nearby ∴ backtrack

3.) move to (1,1) → no percept

4.) move to (2,1) → Stench felt ∴ wumpus nearby.
(2,2) is safe ∵ both wumpus & pit cannot be there.

5.) move to (2,2) → no percept (safe)

6.) move to (2,3) → breeze ∴ pit nearby (1,3)

7.) move to (2,2) backtrack → no percept.

8.) move to (3,2) → Gold found.

9.) Agent grabs Gold & exits safely.

Each step updates the percept sequence based on sensors detecting Stench, Breeze, Glitter etc.

Q18.) Solve the following Crypto Arithmetic problems

$$\begin{array}{r} SEND \\ +\ MORE \\ \hline MONEY \end{array}$$

Ans-

$$\begin{array}{r} S9\ \ E5\ \ N6\ \ D7 \\ +\ M1\ \ O0\ \ R8\ \ E5 \\ \hline M1\ \ O0\ \ N6\ \ E5\ \ Y2 \end{array}$$

$M = 1$

$S + M$, if $m = 1$, $S + M \geq 10$, $S = 9$ & $O = 0$

$E + 0 = N$ (0 → zero) } If $C_2 = 0$ then $E = N$ ✗
$\therefore C_2 = 1$

Teacher's Sign.: _____

Let E = 5

$E + O + C_2 = N \Rightarrow 5 + 0 + 1 = 6$

$\boxed{N = 6}$

$N + R = E$

$6 + R = 5$

Let $R = 9$ } $S = 9$ X

$6 + 9 = 15$

↳ E

$\therefore N + R + C_1 = E$

$6 + 8 + 1 = 15$

$\therefore \boxed{R = 8}$

$D + E = Y$

$D + 5 = Y$

$D \geq 5$

$\therefore$ D — 5 — E
D — 6 — N
D — 7 — V
D — 8 — R
D — 9 — S

$\therefore \boxed{D = 7}$ & $\boxed{Y = 12}$

Q19.) Consider the following axioms :-

All people who are graduating are happy.

All ~~people~~ happy people are smiling

Someone is graduating.

Explain the following :-

1.) Represent these assions in first order predicate logic.
2.) Convert each formula to clause form
3.) Prove that "is someone smiling?" using resolution technique. Draw the resolution tree.

Ans- 1.) let $G(x) \rightarrow x$ is graduating
$H(x) \rightarrow x$ is happy
$S(x) \rightarrow x$ is smiling.

1.) All people who are graduating are happy.
$\forall x \ (G(x) \rightarrow H(x))$

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

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

2.) Clause form
i.) Converting to CNF
a.) $G(x) \rightarrow H(x)$ becomes
$\neg G(x) \vee H(x)$

b.) $H(x) \rightarrow S(x)$ becomes
$\neg H(x) \vee S(x)$

c.) $\exists x \ G(x)$ is a fact meaning atleast 1 individual say 'a' is graduating $\rightarrow G(a)$
ii.) Convert to clause Form
Clause 1 : $\neg G(x) \vee H(x)$
Clause 2 : $\neg H(x) \vee S(x)$
Clause 3 : $G(a)$ Existential instantiation.

Teacher's Sign.:

3) To prove $\exists x\, S(x)$

Resolution steps :-

Clause 1 : $\neg G(x) \vee H(x)$

Clause 2 : $\neg H(x) \vee S(x)$

Clause 3 : $G(a)$

Resolution Process :

- Resolving Clause 1 with clause 3

  Sub $x = a$

  $\neg G(a) \vee H(a)$

  Since we have $G(a)$ we get $H(a)$

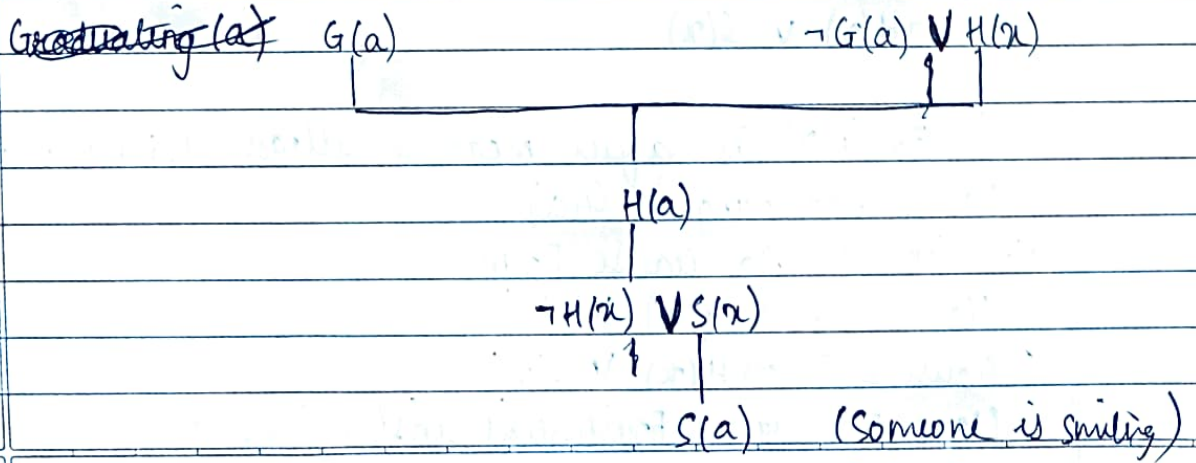
- Resolving $H(a)$ with clause 2

  Sub $x = a$ we get $\neg H(a) \vee S(a)$

  Since $H(a)$ is true, we get $S(a)$.

Thus someone is smiling, ie $S(a)$ is proved.

Resolution Tree :



Teacher's Sign.: _____

Date
Page 10

Q20 Explain Modus ponen with suitable example.

Ans- Modus Ponen is a fundamental rule of inference in propositional logic. It states that if a conditional statement ("If P, then Q") is true and the antecedent (P) is true, then the consequent (Q) must also be true.

$P \rightarrow Q$ (If P then Q)
P (P is true)
Conclusion : Q (∴ Q is true)

Eg-
1.) If a student studies hard, they will pass the exam ($S \rightarrow P$)
2.) The student studies hard (S)
3.) Conclusion : The student will pass the exam. (P).

Q21) Explain forward & backward chaining algorithm with the help of example.

Ans- Forward chaining is a data driven reasoning technique. It starts with known facts and applies inference rules to derive new facts until the goal is found.

Eg-
Rule 1 : If it rains, the ground becomes wet. ($R \rightarrow W$)
Rule 2 : If the ground is wet, the road is slippery ($W \rightarrow S$)
Fact : It is raining.

Process :
1.) Given : R (it is raining)
2.) Apply rule 1 : $R \rightarrow W \rightarrow W$ (ground is wet).
3.) Apply rule 2 : $W \rightarrow S \rightarrow S$ (road is slippery)

Teacher's Sign.: _____

4.) Goal reached : S ✓

Backward Chaining is a goal driven reasoning technique. It starts with goal & works backward to check if the known facts support it.

Eg -

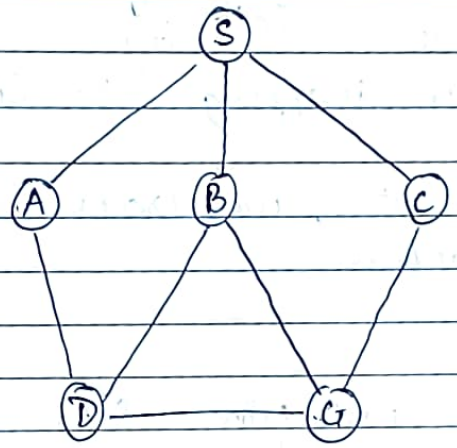
Goal : Is the road slippery ? (S?)
Rule 1 : W → S (If ground is wet, road is slippery)
Rule 2 : R → W (If it rains, the ground is wet.)
Fact : R (it is raining)

Process :

1.) Goal : Is S true?
2.) Check Rule 1 : W → S, so we need W.
3.) Check Rule 2 : R → W, so we need R.
4.) Given fact : R is true.
5.) Derive W (Ground is wet)
6.) Derive S (Road is slippery) ✓.

Teacher's Sign.:

Q10.) Find the route from S to G



Ans- BFS explores the graph level by level starting from the source nodes.

Step1 :

1.) Start at S : Add S to the queue.

Queue : [S]

Expand S : Visit its neighbour

Queue : [A, B, C]

Parent Mapping

S → A , S → B , S → C

Expand A : Visit D

Queue : [B, C, D]

Parent Mapping : A → D

Expand B : Visit G (goal found)
Queue : [C, D, G]
Parent mapping : B → G

Since we found G, we trace back the path using parent mapping

Step 2 :

Shortest path from S to G is
S → B → G