DISC
58

05/05

DATE:

AIDS ASSIGNMENT

Q1) What is AI? AI's Role in COVID-19 Pandemic

-) AI in machines refers to the simulation of human intelligence in machines. AI systems can perform tasks such as learning, reasoning, problem solving, perception and language understanding. AI is categorized in various types also.

AI played a crucial role in various aspects of healthcare and daily life, such as:

Early and diagonosis: AI-based models detected and analyzed patterns

Medical research and drug discovery: It discovers potential treatments.

Remote work and learning: online learning and remote collaboration.

Q2: What are AI Agents terminology, explain with example.

-) An AI agent is an entity that provided. percives its environment through sensors.

Agent Function - The agent function of an agent in response to any perfept.

Performance Measure - It evaluates the behaviour of the agent in a environment.

Rational Agent - A rational agent acts so as to maximize the expected value of performance measure.

Task Environment - It includes the performance measure, the external environment, sensor and accutators.

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Q3] How AI agents are used to solve 8 puzzle problems

-) The 8 puzzle problem is a sliding problem puzzle consisting of 3x3 grid with 8 tiles and one empty space. Techniques to solve are:

- Breadth - First - Search: Explores all possible moves ~~level~~ level by level.
- Depth First Search - Explores all deeper path first.
- A* Algorithm - Uses a heuristic function to find optimal path.

Q5] Categorize a shopping bot for an bookstore according to 6 dimensions

-> Observable - Partially observable

Determinism/Stochastic : ~~Determin~~ Deterministic

Episodic / Sequential : Sequential

Static / Dynamic - Dynamic

Discrete / Continuous - Discrete

Single / Multi agent - Single agent.

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Q4) Describe PEAS Framework

| AI System | Performance | Environment | Actuator | Sensor |
|---|---|---|---|---|
| Taxi Driver | Safety, Speed | Roads, traffic | Steering, breaking | GPS, cameras |
| Medical Diagonis | Accuracy, treatment success | Symptoms, Diseases | Prescription | Test, patient history |
| Music composor AI | Harmony | Instruments, Music notes | Speakers | Genre data, user preference |
| ~~Aircraft Autolander~~ | ~~landing~~ precision | Runway wind, altitude | Flaps, engine | GPS, gyroscope |
| Essay Evaluator | Accuracy, grammar check | Essay | Score System | Text reconition |
| Robotic sentry gun | Threat detection, accuracy | Security area | Gun movement | Camera Motion sensor. |

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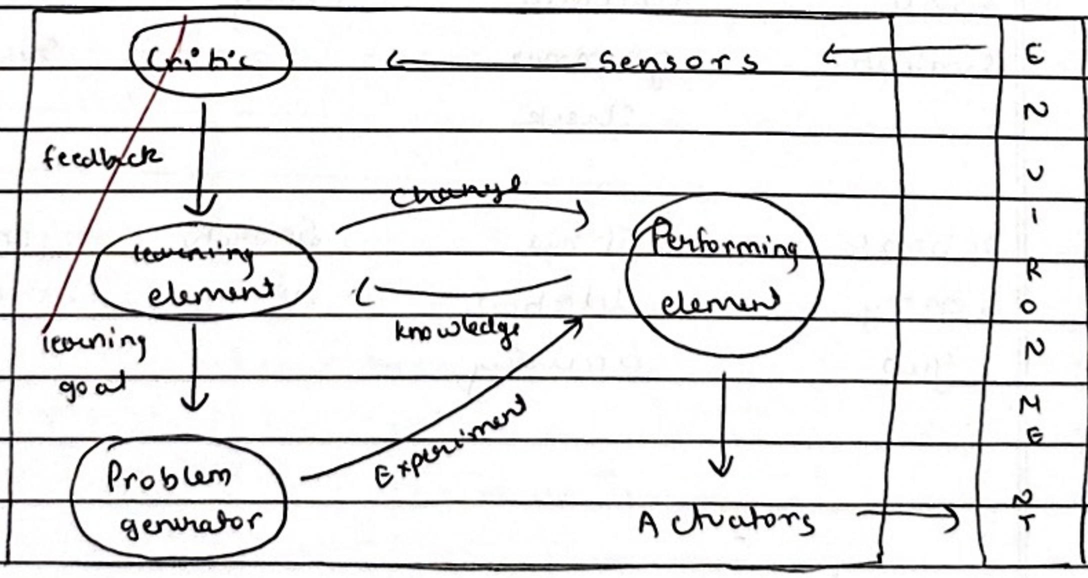
Q6) Difference between Model and Utility based agent.

| Feature | Model Based | Utility Based |
|---|---|---|
| Internal Model | Maintains an internal model of world | Evaluates actions based on utility |
| Decision making | Uses past state | Selects actions to maximize utility |
| Example | Self driving car | AI recommendation |
| Goal-Oriented | Yes, works towards achieving specific goals. | Yes, but focuses on maximizing satisfaction. |

Q7) Architecture of knowledge based and Learning Agents.

Learning Agent -

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A learning agent improves performance by learning from experiences.

Components:-

- Learning Element - Learns from past actions.
- Performance Element - Takes decisions.
- Critic - Evaluates and gives feedback.
- Problem Generator - suggests new actions.

Example - AI chess bot learns from past games to improve strategy.

Benefit - Adapts over time and makes better decision.

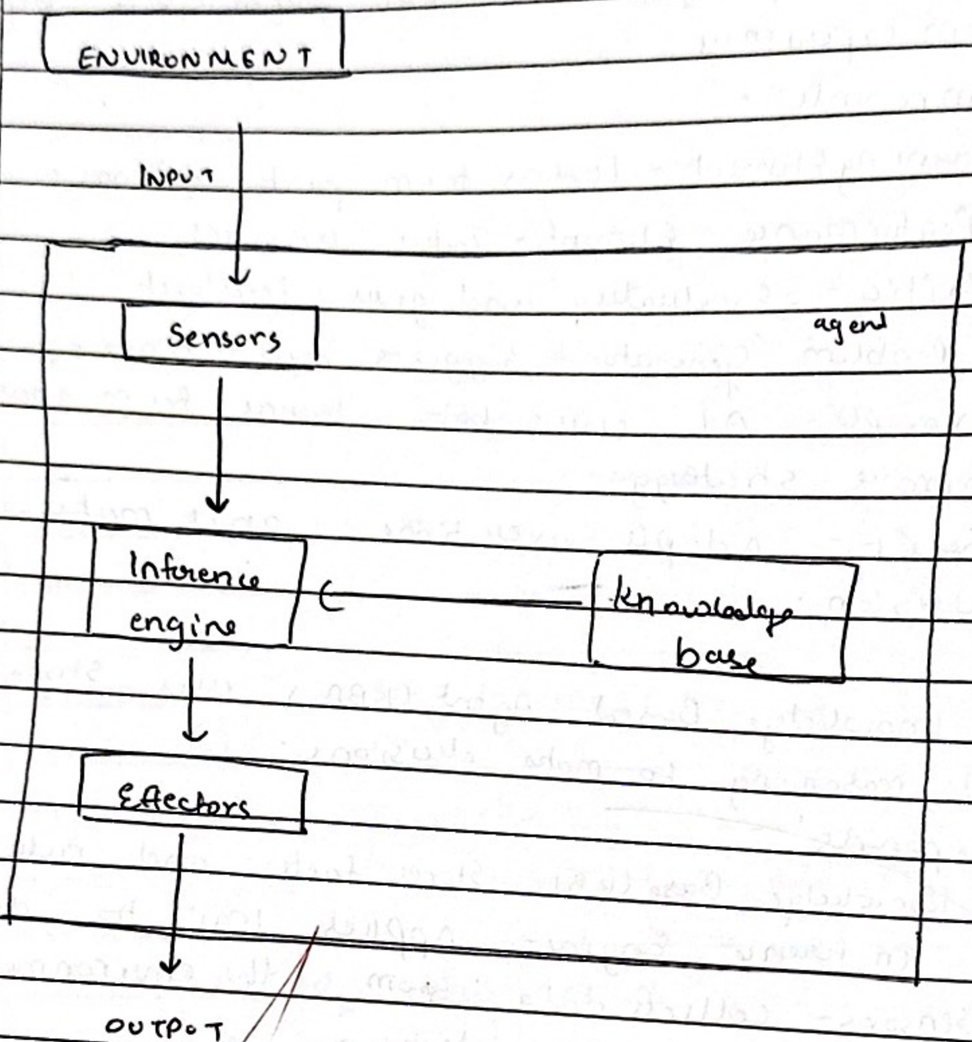
A Knowledge Based Agent (KBA) uses stored knowledge and reasoning to make decisions.

Components:-

1. Knowledge Base (KB) - Stores facts and rules.
2. Inference Engine - Applies logic to derive conclusi
3. Sensors - collects data from the environment.
4. Actuators - Executes decision.

Example - A medical diagonis system matches sympt to diseases using knowledge base.

Benefit - solves complex problem using logical reasoning.




Q8) What is AI? Considering the COVID-19 pandemic situation, how AI helped to survive and renovated our way of life with different applications)

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Q4) Convert the following to predicate:

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

-> Car Available: The car is available

TravelByCar (x): x travels by car

TravelByBus (x): x travels by bus.

CarAvailable -> TravelByCar (Anita) ∧ ~CarAvailable -> TravelByBus (Anita)

b) Bus goes via Andheri and Goregaon.

GoesVia (x, y): x goes via y.

-> GoesVia (Bus, Andheri) ∧ GoesVia (Bus, Goregaon).

c) Car has punture so not available.

HasPunture (car) -> ~CarAvailable.

Forward Reasoning:

① Given: HasPunture (Car).

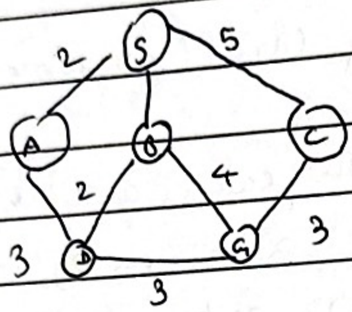
② From the 3rd statement, we infer: ~CarAvailable

③ From the 1st line, since Car is not available -

TravelBy ByBus

④ From the 2nd line, since Anita is travelling by bus, the bus goes via Goregaon, we conclude Anita will travel by Goregaon.

Q(O) Using BFS, travel from S to G




S -> A (cost 2)
S -> B (cost 5)
S -> C (cost 5)
A -> D (cost 3)

A -> G (cost 3)
C -> G (cost 4)

Queue,
Queue [S]
S -> Queue [A, B, C]
Dequeue A and explore its neighbours : ~~A, B~~,
Queue [B, C, D]
Dequeue B and explore its neighbours
Queue [C, D, G]

Dequeue C and queue neighbours
Queue = [D, G]
Dequeue D
Queue = G
Dequeue G
As G is our destination, BFS stops here

Route from S to G: S -> B -> G.

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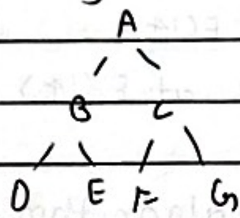
Q11 What do you mean by depth limited search ? Explain Iterative depening search with example.

-> 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 beyond L.

Iterative depening search (IDS) combines DLS with BFS by incrementally increasing the depth limited

Example:




Goal : G

Iteration 1 : Depth limit = 0

Nodes visited = A

Result : goal not found.

Iteration 2 : L = 1

Nodes visited : A -> B -> C

goal not found.

Iteration 3 : L = 2

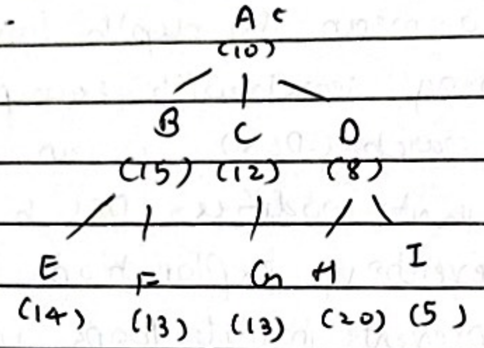
Nodes visited : A -> B -> D -> E -> C -> F -> G

Goal G found at L=2.

Q12) Explain Hill Climbing and its drawbacks in detail with example. Also state limitations of steepest - ascend hill climbing.

-> Hill climbing is a local search optimization algorithm which moves towards better neighboring solutions until it reaches a peak.

Example:-




goal = g

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.

Drawbacks:

1. Local Maxima - The algorithm gredily 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 back tracking 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 focusses on immediate improvements.

Q13) Explain simulated Annealing & write its algorithm.

→ Simulated Annealing (SA) is a probabilistic optimi-tion algorithm inspired by metallurgy process of annealing, where materials are heated and cooled to reduce defects. It escapes the local optimal by ~~temperat~~ temporarily accepting worse sol with a probabili

Algorithm:-

1. Initialize
   - Set an initial solution and define an initial temp.
2. Repeat until stopping condition.
   - Generate a new neighbour sol.
   - 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

Swap two cities in a route Accept a longer route early (high T) but reject it later (low T)

Q14) Explain A* algorithm with an example.

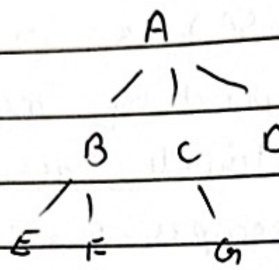
→ A* is a best first search algorithm used in path finding and graph traversal. It uses the following formula $f(n) = g(n) + h(n)$

$g(n) \rightarrow$ cost to reach n from start

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

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

Eg - 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 val that is C ($f(C) = 4$)
4. Expand neighbours of C : G
   $f(G) = 2 + 4 + 0 = 6$
5. Goal reached at G with total cost 6.

Advantages :-

- efficient for finding shortest paths in weighted graphs
- balances exploration by considering both g(n) & h(n)

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Q15 Explain Min-Max algorithm and draw game tree for TicTac Toe Game.

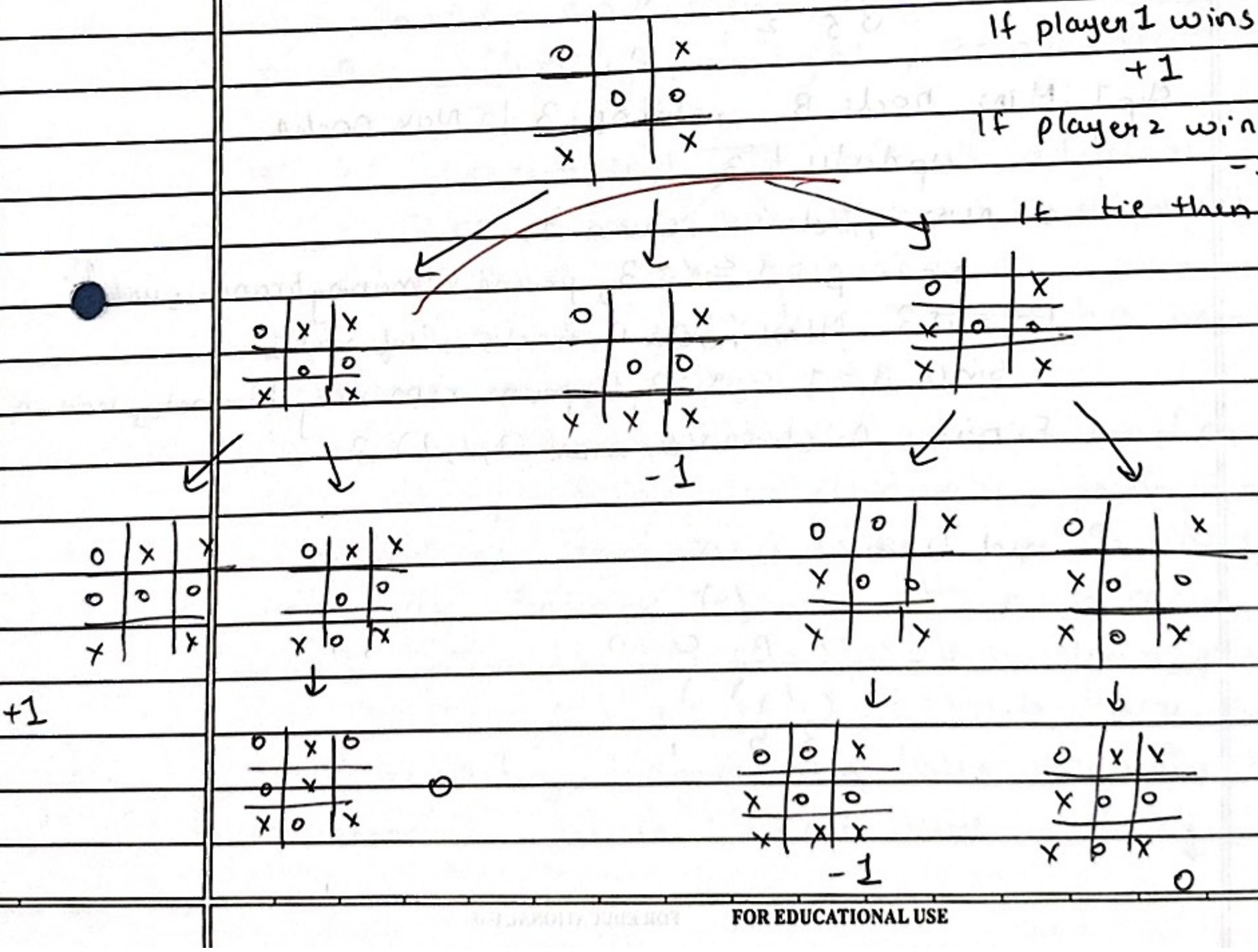
-) The Min max algorithm is a decision making algorithm used in two-player games. It assumes
- One player (MAX) tries to maximize the score.
- Other player (MIN) tries to minimize the score.
- Game tree represents all possible moves.

Algorithm -
(1) Generate game tree.
(2) Assign scores
(3) MAX picks highest value from children
MIN picks lowest value
(4) Repeat until Root Node is evaluated

If player 1 wins i.e. 'O' then +1

If player 2 wins i.e. 'X' then -1

If tie then 0



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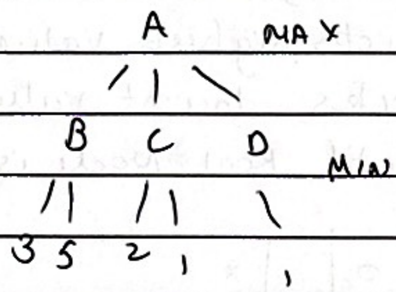
Q16) Explain Alpha-beta pruning algorithm for adversal search with example.

-) Alpha-beta pruning is an optimization technique for the minimax algorithm used in adverseal search purpose like game playing AI. It reduces computational complexity by pruning branches of game tree that donot influence the final decision.

$\alpha$ - best value maximizing player can guarantee

$\beta$ - best value minimizing player can guarantee.

Example-




Step1: MIN node B returns 3 to Max node A

updates to 3

2: MIN node C return 1

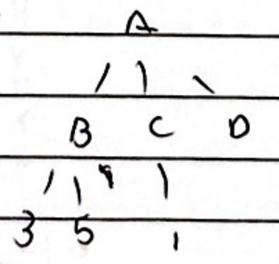
since $\beta = 1 \le \alpha = 3$, prune remaning branches under C

Final 3. MIN node D finds leaf val 1

Since $\beta = 1 \le \alpha = 3$, prune remaining branches under D

Final: A chooses max (3, 1, 1) = 3

Pruned Tree -



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

-> PEAS for WUMPUS world problem-

1. P - · Maximize Rewards
   +1000 for collecting gold & exiting grid
   · Minimize penalties
   -1000 for falling into a pit or being eaten by WUMPUS.
   -1 pt for each action taken
   -10 pts for using arrow
2. E - Grid Layout (4x)
   containing pits, WUMPUS, gold, walls, breez,
   · Partially observable - agent cannot see entire grid and must rely on sensory inputs.
3. A - Move left, right, forward, Grab (gold), shoot
4. S - Breeze - indicates pit is adjacent
   Stench - indicates Wumpus is adjacent
   Glitter - gold indication
   Bump - indicates a wall has been encountered

Generating percept sequence -

· Initial position - Agent starts at a defined pos usually (1,1)

· Movement & perception - While moving, sensors detects surroundings (eg - breeze means a pit is in adjacent cell).

· Creating Percept Sequence - After each move, it records percepts. Example - At (1,2) -> [None, Breeze, None]
At (2,1) -> [Stench, Breeze, None]

· Decision Making: Agent uses these sequences for logical reasoning to decide its next move.

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Q18) Solve the following crypto-arithmetic prb.

SEND + MORE = MONEY.

1. Set up the Eqn

```
  SEND
+ MORE
------
 MONEY
```

2. Since M is leading digit, it must be 1, because sum of 2 four-digits cannot exceed 19998.

$\therefore M = 1$

```
  SEND
+ 1ORE
------
 1ONEY
```

3. $D + E = Y$ (if carry = 0)

or $D + E = 10$ (if carry = 1)

Tens place

$N + R +$ carry $= E$

Hundreds place : $E + O +$ carry $= N$

Thousands place : $S + 1 = 1 +$ carry

$S +$ carry $= 0$

$\therefore S = 9$ since there is no carry.

4. Try $E = 5$

If $D = 7$ then

$Y = 7 + 5 = 12$ (invalid)

$D = 2$ then

$\underline{Y = 7}$.

5. $Y = 7$

Assume $N = 8$

$N + R = E$

$8 + R = 5$ (impossible) $\therefore \boxed{N = 6}$

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

| | | | | | |
|---|---|---|---|---|---|
| SEND | | 9 | 5 | 6 | 7 |
| +MORE | → | 1 | 0 | 8 | 5 |
| MONEY | 1 | 0 | 6 | 5 | 2 |

Q1a) Consider the axioms.

→ 1. $\forall x\,[\text{Graduating}(x) \rightarrow \text{Happy}(x))$
2. $\forall x\,(\text{Happy}(x) \rightarrow \text{smilling}(x))$
3. $\exists x\,(\text{Graduating}(x))$

2. convert each to clause form
1. $\forall x\,(\sim \text{Happy}(x) \vee \text{smiling}(x))$
$\{\sim \text{Happy}(x), \text{Smiling}(x)\}$
2. $\forall x\,(\sim \text{Happy}(x) \vee \text{Graduating}(x))$
$\{\sim \text{Graduating}(x), \text{Happy}(x)\}$
3. Grduating (c)

3. Prove "Is someone smiling?" using resolution
$\exists x\,(\text{smiling}(x))$
Clause Form: ($A$ = Smiling (y))
$C_1 = \{\sim \text{Graduating}(x), \text{Happy}(x)\}$
$C_2 = \{\sim \text{Happy}(y), \text{smiling}(y)\}$
$C_3$ = graduating (c)
Resolution btw $C_3$ & $C_1$
substitute c for x in $C_1$:
From graduating (c)
Happy (c)
Resolving with $C_2$ Smiling (c)

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Graduating (A)

$\sim$ graduating (x) $\vee$ happy (x)

Happy (x)

$\sim$ happy (x) $\vee$ smiling (x)

Smiling (x)

$\sim$ Smiling (x)

{ }

→ someone is smiling.

Q20) Explain Modus Ponen with example.

→ Modus Ponen is a fundamental rule of interference in logic. It states that if $P \to Q$ is true P is true, then Q must also be true Formula: $\frac{P \to Q, P}{Q}$

Ex, if it is raining, then it is soggy ($P \to Q$)

it is raining (P)

$\therefore$ it is soggy (Q)

Q21) Explain forward & backward chaining algo with

→ Forward chaining - It is data driven, inference algorithm that starts with known facts & applies inference 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 I

Start with A & B

apply $A \to C$ to derive C

$B \to D$ to derive D

$C \land D \to I$ to derive I

The goal I reached.

Backward Chaining:

BC is a goal driven, starts with goal & works backward to find the facts that support it starts with goal.

fact : A, B

rule : $A \to C$, $B \to D$, $C \land D \to I$

goal : I

find the rule $C \land D \to I$

if C & D are true

use $A \to C$ since A is true, C is true

use $B \to D$ since B is true, D is true

C & D are true, I is true.

conclusion : I is reached.