Atharv Sanjay Nikam
Roll No: 36
TE(INFT) SEM VI

DISC
36

05/05

AIDS
Assignment - 1

1) What is AI? Considering the COVID-19 pandemic situtation how AI helped to survive and renovate our way of life with different application)

Ans Artifical Intelligence is the simulation of human intelligence in machine that can perform tasks typically requiring human cognition, such as learning, problem-solving, decision-making and understanding natural language. AI systems use algorithms, neural networks and deep learning technique to analyze data, recognize patterns, and make autonomous decisions.

How AI helped during Covid-19.

① Healthcare - AI diagnosed COVID-19, assisted in drug discovery, and powered chatbots for medical guidance
② Contact Tracing - AI-powered apps (Aarogya Setu) tracked exposure and ensured social distancing.
③ Remote Work and Education - AI enhanced tools like Zoom and google meet enabled virtual enabled work and learning.
④ Robotics and Automation - AI robots disinfected hospitals and automated supply chains.
⑤ Misinformation control - AI fact-checked and remove fake COVID-19 news.
⑥ Entertainment and Mental health - AI driven platform kept people engaged and supported mental health.

2) What are AI Agent terminology, explain with examples?

Ans The AI agents terminology includes:

(i) Performance Measure of Agent: It determines the success of the Agent.

(ii) Behaviour / action of Agent: It is the action performed by an agent after any specified sequence of precept.

(iii) Percept: Agents perpetual inputs at a specified instance.

(iv) Percept sequence: History of everything agent has percieved till date

(v) Agent Function: Map from percept Sequence to an Action.

Agent function, $a = F(P)$

where P is current percept, a is the action carried out and F is the agent Function

F maps percept to action.

$F : P \rightarrow A$

where P is the set of all percept and A is set of all actions Action may be depent on all the percept observed not only the current percept

$a_R = F(p_0, p_1, p_2 \ldots p_R)$

where $p_0, p_1, p_2, \ldots p_R$ is the sequence of

of percepts recorded till date, ab is the resulting action carried out and F now maps percept sequence to action.

$$F: P^* \rightarrow A$$

For example the vacuum cleaner problem:

Percept sequence	Action
[A, clean]	Right
[A, Dirty]	Suck
[B, clean]	Left
[B, Dirty]	Suck
[A, Dirty], [A, clean]	Right
[A, clean], [B, Dirty]	Suck
[B, Dirty] [B, clean]	left
[B, clean] [A, clean]	No operation.
[A, clean] [A, clean]	No-operation

Performance measure of vacuum cleaner agent:
All rooms are cleaned.

Behaviour/action of agent: left, Right, Suck and no-operation (No-nothing).

Percept: Location and status, for example[A, Dirty]

Agent functioning: Mapping of percept sequence to an action.

(3) How AI technique is used to solve 8 puzzel problem

Ans The 8 puzzle problem is a state space search problem in AI where a 3×3 grid contains 8 tiles numbered from 1 to 8 and 1 empty space. Objective is to rearrange titles to reach a predefined goal state.

AI techniques:

(1) Uniformed search methods:
BFS: Expand the shallow node first
DFS: Expand the deepest node as possible before back tra...
IDS: Combine DFS and BFS to increase dept limit gradually.

(2) Informed search methods.
BFS: Best first search based on heuristic function that appears closet to the goal.
- Search. $f(n) = g(n) + h(n)$ Based on heuristic cost to node

Initial State :

1	2	3
4		6
7	8	5

Goal state :

1	2	3
4	5	6
7	8	

(i) Compute heuristic of each possible move
(ii) Expand the state with the lowest f(n) and repeat

4) What is PEAS description? give PEAS for following!

→ ① Performance Measure : How Sucess of agent in evaluated ② Environment : Surrounding in which agent operates
③ Actuators : Component that allows agent to take actions
④ Sensors : Component that allows agent to perceive the enviornment

(i) Taxi driver agent :

Performance Measure	Environment	Actuators	Sensors
- Safe driving	- Traffic signal	- Steering wheel	- Camera
- Travel time	- roads	- accelelator	- GPS
- traffic rule	- Weather	- brakes	- Fuel gauge

(ii) Medical Diagnostic Agents :

Performance Measure	Enviornment	Actuators	Sensors
- health of patient	- patient	- display screen	- heart rate monitor
- accuracy of diagons	- symptoms	- alarm system	- lab result
- recommended treatement	- test reports		

(iii) Music component Agent:

Performance measure	Environment	Actuator	Sensor
- Originality - quality - listener	- Music db - user preference	- Speaker - mixer	- microphone - user feedback

(iv) An aircraft autolander

Perf measure	Environment	Actuator	Sensors
Smooth landing - accuracy in touchdown	- Runway - wind condition - Air traffic	- landing gear - flap - air brakes	- GPS - Camera - Altmeter

(v) Essay evaluator

Performance measure	Environment	Actuator	Sensors
- grading - grammer - paradigm check	- plagiarism - rubric criteria	- display screen - text to speaker	- Optimal character Recognition (OCR)

vi) Robotic sentry gun for the Rock Lab

performance measure	Environment	Actuators	Sensor
- neutralize threats - target f. - false alarms	- lab area - potential intruders	- gun mechanism - alarm.	- Camera - thermal sensor.

(5) Categorize a shopping bot for a shopping bot for an offline bookstore according to the following system

Ans Observability : Partially observable Relies on limited sensor input.

- Deterministic or stochastic - Stochastic customer prefrence is unpredictable.

- Episodic vis sequential : Sequential affects future actions

- Static vis dynamic - Dynamic, customer behaviour is always evolving.

- Discrete vis continuous : ~~finite~~ Discrete - The bot work with finite set of actions.

- Single vs Multi Agent : Multi-Agent
The interacts with multiple entites, including customers, bookstore staff.

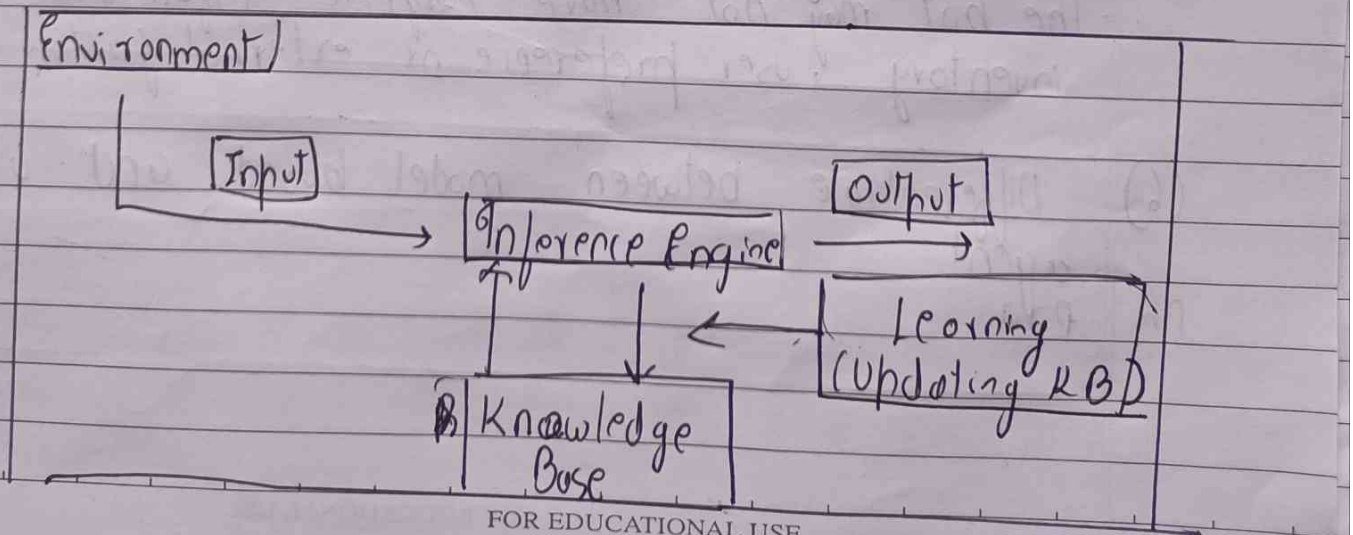
- Observability : Partially Observable.
- The bot may not have complete information about inventory, user preference or external factors like stock upd

(6) Differentiate between model based and utility based agent

Ans pto

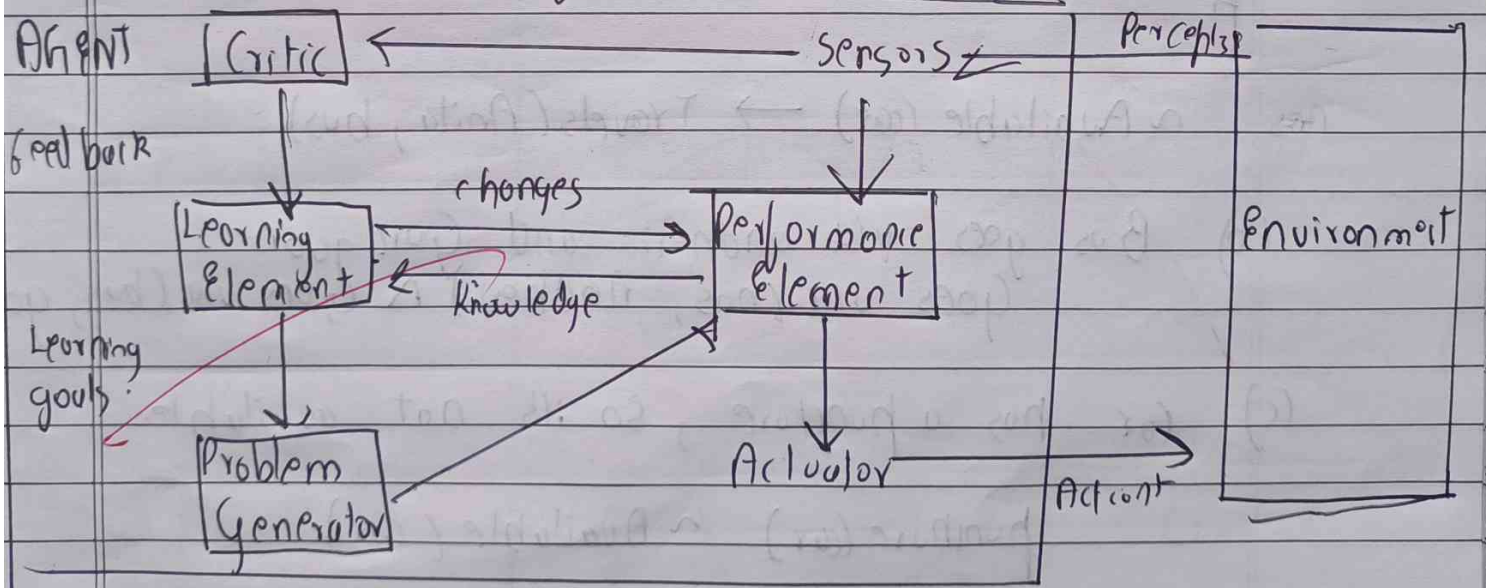
Model Based Agent	Utility Based Agent
Agent that maintains the internal model of the env to understand its current state and predicate future states	- Agents that selects actions based on the utility function aiming to maximize long term satisfaction or benefit.
Model updates its information about the environment	- Measures how desirable different states are
- less complex	- More complex
- Doesn't concern long term rewards	- Focuses on long term reword.
- Eg- self driving cars	- eg- Shopping recomendation system.

Explain the architecture of knowledge based agent and learning agent



Knowledge based agent - Stores knowledge and reason based on logical inference.
- Knowledge base - Stores fact, rules and heuristic function about the environment
- inference engine - uses logical reasoning techniques like forward and backward chaining
- perception - gathers data from the environment
- actions - executes actions based on a infered knowle
- Knowledge update mechanism - Update itself as new facts are learned.

learning based agent : Agent that improves its performance over time by learning from experience, data



- learning element responsible for improving agents perby analyzing past experience using ML technique
- Critic - provide feedback on agents actions by

evaluating success or failure.
problem generation: Supports new experience for learning and explanation

(8) Same as question 1

(9) Convert the following to predicate:

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

Ans travels (x, y) → person x travels by y.
Available (y) → y (a vehicle) is available.
Goes via (y, z) → vehicle goes via z

P

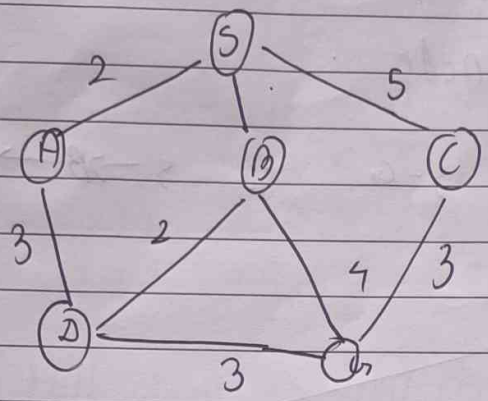
Ans ~ Available (car) → Travels (Anita, bus).

(b) Bus goes via andheri and Goregaon
Goes via (bus, Andheri) ∧ Goes via (bus, goregaon)

(c) Car has a puncture, so it's not available.

puncture (car) ~ Available (car).

(v)

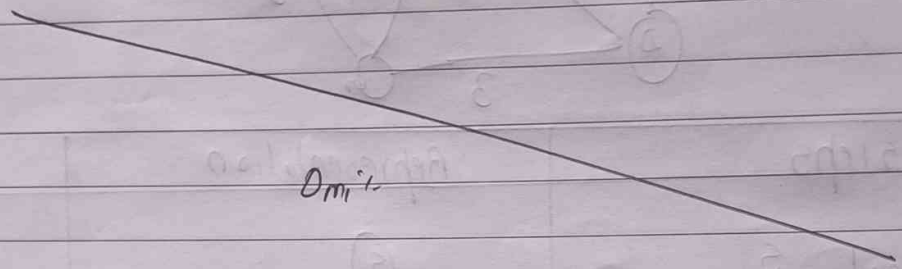


Ans

steps	Representation	stack
(i) Load S	S	[S]
(ii) Pops, Load A, B, C	S, A, B, C	[A, B, C]
(iii) Pop A Expand D	S, A, B, C, D	[B, C, D]
(iv) Pop B, Expand G	S, A, B, C, D, G	[C, D, G]

G is the goal node.

∴ Route from S-G is S → B → G.



(11) What do you mean by depth limited search? Explain Iterative Deepning Search with example

Ans Depth Limited Search (DLS)

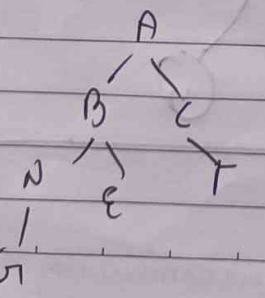
DLS is a variation of DEPTH-FIRST-SEARCH (DFS) that limits the depth of exploration to a predefined level L to prevent infinite loops in deep or infinite search space.

Pros: Prevents infinite recursion.

Cons: May miss the goal if ilies beyond depth L

IDS combines DFS and BFS by repeadtedly applying DLS with increasing depth limits until goal is found.

Eg



To find G

IDS runs DLS multiple time with increasing de

DLS with $L=0$ → A (goal not found)
DLS with $L=1$ → ABC (goal not found)
DLS with $L=2$ → A, B, C, D, E, F (goal not found
DLS with $L=3$ → A, B, C, D, E, F, G (goal found)

Explain Hill climbing and its drawback in det with example also state limitation of stee -ascent hill climbing

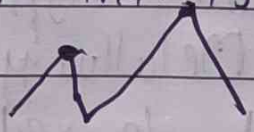
Hill climbing Algorithm

Hill climbing is a heuristic search algorithm use for optimization problems. It continuously mov toward the best neighbouring state until no be move exists.

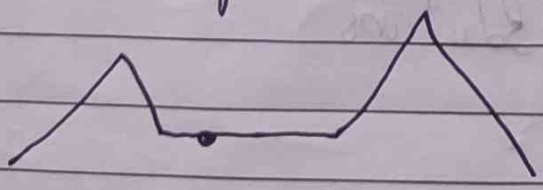
Example: A blindfolded climber moves uphill unti no higher step is possible, but may get stuck a local peak instead of global peak.

Drawbacks of Hill Climbing

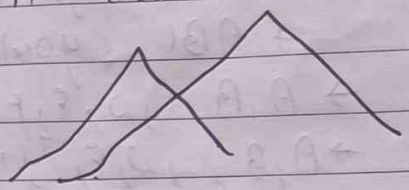
Local maxima - Stops at a peak that is not the highest.



Plateau - Flat region cause the algorith to stop



iii) Ridges :- needs to move down first before climbing higher which it cannot do



Steepest Ascent Hill climbing and Limitations

a) In this it evaluates all neighbours and picks the best move.

Limitation :- (1) Computationally expensive in large space.

(2) Still gets stuck in local maxima, plateau and ridges

(3) Slow convergence due to evaluating all paths.

(13) Explain simulated annealing and write its algorithm.

Ans Simulated Annealing (SA) is a heuristic optimization algorithm inspired by the annealing process in Metallurgy, where metals are heated and slowly cooled to reduce defects. It is used to avoid local optima by allowing controlled random jumps to explore better solutions

Algo :

1) Initilize:
- Set initial state S and temp T.

2) Repeat until stopping condition (T > 0)
- Generate an neighbouring state S'.
- Compute the energy difference $\Delta E = f(S') - f(S)$
- if S is better ($\Delta E > 0$) accept it.
- if S is worse ($\Delta E < 0$) accept it with probability.
$$P = e^{(\Delta E / T)}$$
- Reduce T

3) Retur best solution found.

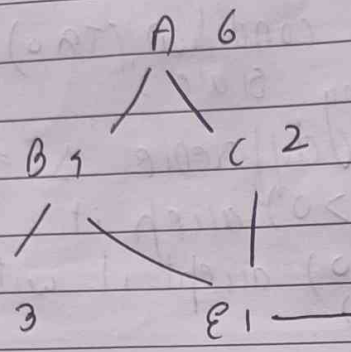
13) Explain A* Algorithm with an example.

A* is a algorithm is used in AI for path finding and graph traversal it combines
- g(n) - cost from the start node to the current node.
- h(n) - Heuristics (estimated cost from the current node to goal)
- f(n) = g(n) + h(n) → Total estimated cost.

steps of A* Algo.

i) Intilize ope list (nodes to explore) and closed list (explored nodes)
ii) Start from the initial node, calculate f(n) = g(n) + h(n)
iii) Pick the node with the lowest f(n) and expand it
iv) Add neighbor to the open list, update the g(n), h(n), f(n)

Repeate until goal node is reached.



start at A, compute $f(n) = g(A) + h(A) = 0 + 6 = 6$

Expand A, B, C

Pick C lowest (h) expand to G.

goal reached with shortest path as A → C → G

15) Explain Min max and algorithm and draw game tree for TIC TAC TOE Game

Ans Minimax is a decision making algorithm used in game playing (Tic-Tac-Toe, chess). It helps find the optimal move by assuming:

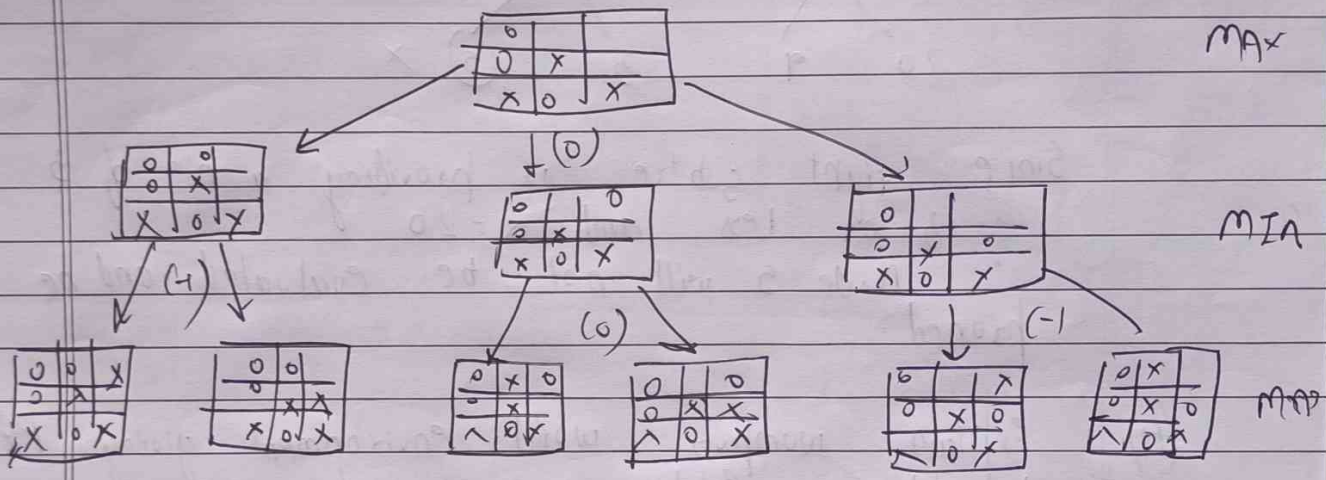
- The AI (max players) tries to maximize to its score.
- The opponent (MIN player) tries to minimize the AI.

Min Max Algo.

(i) Generate the game tree up to a certain depth

(2) Evaluate terminal nodes using a heuristic function.
(3) Propagate values upward:
- Max player picks the highest value
- Min player picks the ~~highest~~ lowest value.
(4) Choose the best move at the root node

TIC-TAC-TOE - Game Tree.



16) Explain Alpha beta pruning algorithms for adversarial search with example

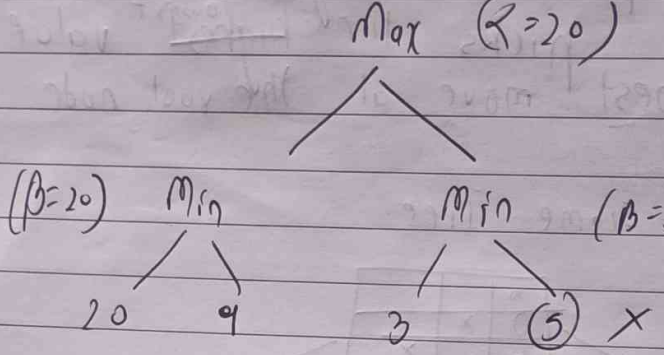
Ans It's an optimization technique for minmax algorithm. It reduces no of nodes evaluated in game tree by eleminating unnecessary branches

Algorithm:- Set two values α and β for MAX and Min respectively.

If $\alpha \geq \beta$ for any subtree or node, stop eval and prune it.

All nodes which do not influence the final decision.

Ex



Since right subtree is providing a min of 3
∴ 3 or less and $\alpha = 20$
∴ Node 5 will not be evaluated and be pruned.

(11) Explain wumpus world environment giving PEAS description. Explain how percept sequence is generated.

Ans The wumpus is a grid based environment used to demo AI agents, logic based reasoning and desision making.

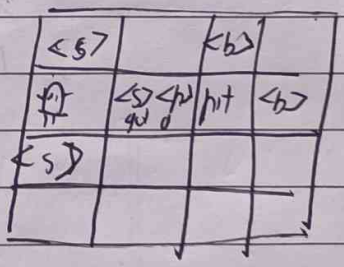
Environment components.
- 4×4 grid of rooms
- Rooms contain pits or the wumpus
- One room contains (goal)

- Agent starts at (1,1) and can move horizontally and vertically
- One arrow to kill the wumpus.
- Rooms surrounding the wumpus have stench and rooms surrounding the pit have breeze

Pos

Perf measure	Environment	Actuators	sensors
- Find gold in min action - Avoid wumpus and pits	- 4x4 grid - Wumpus pits, gold.	- move front, back, up, down grab, shoot, climb	- detect stench on breeze - glitter (gold)

Percept sequence :
- Assume agent starts at (1,1) and gold at (3,2)
- Move to (1,2) → perceive only breeze
- Move back and up (2,1) → Perceive only stench
- logically infer that (2,2) contains no pit or wumpus
- Similarly continue till reaching (3,2) goal



(13) Solve the following crypto arith metic problem.

SEND + MORE = MONEY.

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

Since carry is generated, M = 1

S + M = 0 generate carry.

S + 1 = 0

S = 9

O = 0

Now . E + 0 = N

But E + N ∴ 2 numbers cannot have same value.

E + 0 + generated carry and E + 1 = N

N + R = E, generated carry.

- Consider R = 8 and N = 2

Result in E = 0, not possible

If N = 3, Result = E = 1, not poss

only case possible is

N = 6 and E = 5

Now U + 5 = 4 should generate carry

N = 7 and ~~N~~ = 2

9567 + 1085 = 10652 //

0	0
1	M
2	~~N~~ Y
3	
4	
5	E
6	N
7	D
8	R
9	S

19) Consider the following axioms.

All people who are graduating are happy.

$\forall x$ (graduating (x) → happ (x))

All happy people are smiling.

$\forall x$ happ (x) → smiling (x).

Someone is graduating $\exists x$ (graduating (x))

Convert to clause form

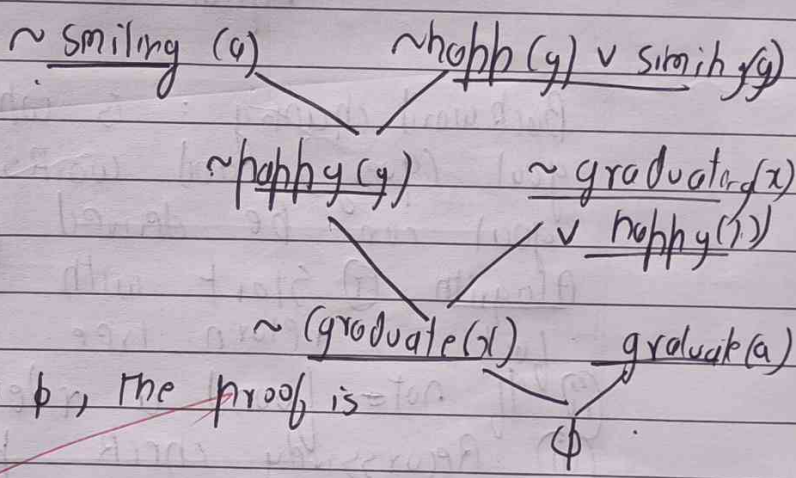
~graduating (x) ∨ happy (x)

~ happy (y) ∨ smiling (y)

graduating (a).

- Prove 'is someone smiling' → ~smiling (a)

Resolution tree



Since the tree result in ϕ, the proof is validated

∴ Someone is smiling is true.

20) Explain modes ponen with suitable example

→ It is a fundamental rule of logic stating $P \rightarrow Q = P \rightarrow Q$. If P implies Q and P is true, then Q also must be true.

Eg

- If It rains, the ground will be wet.

  Rains → wet ground.

- It is raining.

  Rains → True.

  The conclusion is that the ground is wet.

21) Explain forword and backword chaining with the help of example.

→ Forword chaining is when reasoning starts with known fact and applies inference rules to new fact until the goal is reached.

Algorithm : Start with a set of known facts.
- Apply inference rules that match current facts
- Derive new facts and add them to the KB
- Repeat until goal is achieved.

Backword chaining : is when reasoning starts with the goal (query) and works backwards to check if the goal can be derived from known facts.

Algorithm (i) Start with the goal. If goal is a known fact, return true.
(ii) If not found a rule where the goal appears.
(iii) Recursively check premises of the rule.
(iv) If all premises are true, return goal = true

Eg : (i) If person has fever and cough they have flu.
(ii) If person has flu, they should take rest.
Facts : John has fever, John has cough.
Prove - John should take rest.

Forword chaining : Fever(John), Cough(John)
Fever(x) ∧ Cough(x) → Flu(x)
∴ Flu(John) → Rest(John)

Reverse chaining : Rest(John) ∴ Flu(John)
∴ Fever(John) and Cough(John) both are true, hence statement is proved.