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Div : D15C R.No: 15 AIDS - Assignment - 1

Assignment - I : →

Q1) What is AI ? Considering the COVID - 19 pandemic situation, how AI helped to survive and renovated our way of life with different applications?

→ Artificial Intelligence (AI) enables machines to think, learn and make decisions like humans. It includes technologies like machine learning, NLP and robotics.

Applications:
1) Healthcare: AI helped in early diagnosis, vaccine development, and chatbot-based health assistance.
2) Contact Tracing: AI-powered apps tracked COVID-19 exposure ensuring public safety.
3) Remote work and education: AI enhanced logistics and virtual meetings, online learning and productivity tools.
4) Supply Chain and Delivery: AI optimized logistics and enabled autonomous deliveries.
5) Mental Health Support: AI-driven apps provided emotional and fitness assistance.

Q2) What are agents terminology, explain with examples.
→ 1) Agent: An entity that interacts with the environment and makes decision based on inputs.
ex: a self-driving car perceives traffic signals and adjusts speed accordingly.

2) Performance measures: Defines how successful an agent is in achieving it's goal.

ex: A self-driving cars performance measures, cou minimizing accidents, fuel efficiency and travel time

b) Behavior action of agent: The action an agent takes based on its percepts.
ex. a robotic vacuum cleaner moves around obstacl after detecting them.

4) percept: The data an agent receives at a specific moment from sensors. ex: A spam filter receives an email and detects keywords, sensor info, and attachmen

5) percept sequence: The entire history of percepts receive by an agent. ex: A chess playing AI remembers all previ moves in the game before making its next move.

6) Agent Function: A mapping from the percept sequence to an action. ex: A smart thermostat analyzes past temperature changes and adjusts heating accordingly.

Q3) How AI technique is used to solve the 8 puzzle problem?
→ It consists of a 3×3 grid with numbered tiles and one empty space, where the objective is to move the tiles around to match a predefined goal configuration.

Initial state:

1	2	3
4		6
7	5	8

This is the random starting configuration of the 8-puzzle

with the tiles placed in a non-goal configuration.

2) Goal state: The goal is to arrange the tiles in a specific order with the blank space at bottom right

Goal state:
1 2 3
4 5 6
7 8

Solving the puzzle problem
- AI search algorithms, such as Breadth-first search (BFS), depth first search (DFS) and A* are commonly used.

1) Breadth First Search (BFS):
- BFS is an uninformed search algorithm that explores all possible states level by level, starting from initial state.
- BFS guarantees that the solution found is the shortest in terms of no. of moves, but it can be very slow.

Advantages: Guaranteed to find optimal solution
Disadvantages: BFS has a high memory requirement, as it must store all the states at each level of explora-tion.

2) Depth-First Search (DFS)
DFS is another uninformed search algorithm that explores one branch of the state space tree as deep as possible, before backtracking.

Advantages: DFS is more memory efficient than BFS.
Disadvantages: DFS can get stuck in deep, non-optimal paths and may not find the shortest solution.

Steps using A*
- compute manhattan distance for each possible move
- choose best move (lowest F(n))
- repeat until reaching goal state.

Q7 What is PEAS descriptor? Give peas descripter for following

→ 1) Taxi Driver
P: Minimize travel time, fuel efficiency, passenger safety, obey traffic rules.
E: Roads, traffic, passengers, weather, ~~obedient~~ obstacles, pedestrians.
A: Steering, accelerator, brakes, turn signals, horn
S: Camera, GPS, speedometer, radar, LiDAR, microphone

2) Medical Diagnostic System
P: Accuracy of diagnosis, treatment success rate, response time
E: Patient records, symptoms, medical tests, hospital database.
A: Display screen, printed prescriptions, notifications.
S: Patient input, lab reports, electronic health records.

3) Medical diagnosis system
P: Accuracy of diagnosis, speed, reduced misdiagnosis rate.
E: Hospital database, patient records, symptoms, medical history.
A: Display screen, reports, alerts to doctors/patients

then BFS
2-optim

S: User inputs, patient history, test results, electronic health records.

3) Music composer.
P: Harmony, creativity, user satisfaction, adherence to style.
E: Musical styles, melody rules.
A: ~~M~~ Music notes' generation, play sounds
S: User feedback, existing music datasets

4) Aircraft Autolander.
P: Safe landing, smooth descent, fuel efficiency
E: Airport runway, wind speed, air traffic
A: adjust flaps, landing gear, braking system.
S: Altimeter, radar, GPS.

5) An Essay Evaluator (Automated Grading System)
P: Accuracy in grading, fairness, consistency.
E: Essays, grammar rules, grading rubrics.
A: ~~P~~s Feedback generation, score assignment, highlighting errors, suggesting improvement.
S: optical character recognition, NLP, gramar and spell checkers

6) A robotic sentry gun for the Keck Lab.
P: Target accuracy, threat deflection efficiency, response spee
E: Keck lab premises, intruders, lighting conditions
A: Gun aiming system, camera panning, alert syster
S: Motion detectors, infrared sensors, cameras, LIDAR.

Q.5) Categorize a shopping bot for an offline bookstore according to each of six dimensions (fully / partially observable, deterministic / stochastic, episodic / sequential, static / dynamic, discrete / continuous, single / multi agent).

→ 1) Partially observable: Bot may not have complete visibility.
2) Stochastic: The environment is unpredictable.
3) Sequential: Each decision bot makes affects future states.
4) Dynamic: The bookstore environment changes over time.
5) Discrete: Bot chooses discrete choices (selecting books)
6) Multi-agent: Bot interacts with multiple agents.

Q.6) Differentiate b/w Model based and utility based agent.

→

Model Based Agent	Utility Based Agent
1) Maintains an internal model of env. to make decisions	1) uses a utility function to measure performance and make choices
2) Relies on stored knowledge and updates model.	2) Chooses actions based on maximizing expected utility.
3) can adapt to changing environment by updating internal mode	3) More flexible and goal-oriented, adapting to changes dynamically.
4) Moderate complexity due to model maintainance.	4) Higher complexity due to the need to compute utilities for different actions.

5) Ex - self-driving car that predicts pedestrian move-ment

5) A self driving car that evaluates and selects the best one.

Q.7) Explain architecture of Knowledge based agent and learning agent.

→ 1) Knowledge based Agent Architecture.

A Knowledge based agent is an intelligent agent that makes decisions using Knowledge base (KB) and reasoning mechanism.

Architecture component:

1) Knowledge Base: Stores fact, rules and heuristics about the world.

2) Inference Engine: Use logical reasoning (FOL) to derive new knowledge from the KB.

3) Perception Module: Collects data from sensor and update the KB.

4) Action Selection Module: Chooses appropriate actions based on reasoning outcomes

5) Communication Module: Allows interaction with other agents.

Working Process:

- The agent perceives the environment and updates its KB
- The Interference engine applies logical rules to infer new knowledge.
- The agent decides an action and executes it.
- The KB is continuously updated to improve decision making.

2) Learning Agent Architecture:
A Learning agent improves it's performance over by learning from past experiences and interactions the environment.

Architecture components
1) Learning Element: Analyzes feedback from the environment and improves Knowledge.
2) Performance: Make decisions and executes actions
3) Critic: Evaluates the agent's action and provides feedback
4) Problem generator: Suggests exploratory actions to improve learning.

Working process:
- The performance element selects an action.
- The critic evaluates the action and provides feedback.
- The learning element updates the agents' knowledge to improve future decisions.
- The problem generator suggests new strategies to explore better solutions.

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

→ Artificial Intelligence is the simulation of human intelligence in machines that can learn, reason and make decisions. AI systems process large datasets, recognize patterns and automate tasks, enhancing efficiency across industries.

AI's role in COVID-19 pandemic.
1) Healthcare & Diagnosis: AI analyzed CT scans and detected COVID-19 faster.
2) Chatbots and virtual assistants: provided instant medical advice.

Q.9) Convert the following to predicates:
a) Anita travels by car if possible, otherwise by bus.
car available → travels by Car(Anita)
¬ car Available → Travels by Bus(Anita)

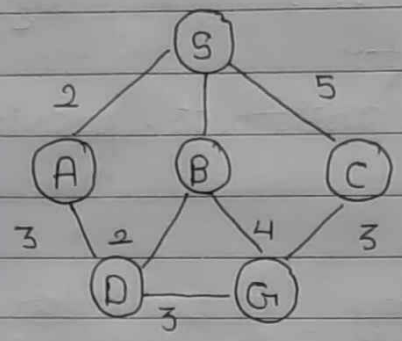
Bus goes via Andheri and goregaon
goes Via(Bus, Andheri) ∧ goes Via(Bus, Goregaon)

car has puncture, so not available
puncture(car), puncture(car) → ∅ ¬ car Available

will Anita travel via gurgaon? use backward ~~chaining~~ reasoning.
From (c)
puncture(car) is true
As puncture(car) → ¬ (car Available
From (a)
¬ Car Available, we use ¬ car Available → Travels by Bus (Anita)
from (b)

goes via(Bus, Goregaon)
Since, Anita travels by bus, she will follow this route
Thus, Anita will travel via gurgaon.

Q.10) Find the route from S to G using BFS



Correct Node	Queue	Visited Node
S	A B C	S
A	B C D G	S → A
B	C D G	S → A → B
C	D G	S → A → B → C
D	G	S → A → B → C → D
G		S → A → B → C → D → G

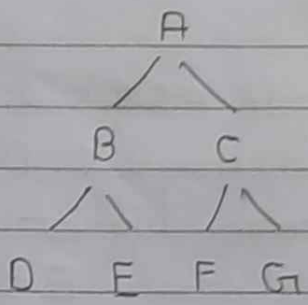
The path is : S → A → B → C → D → G

Q.11) What do you mean by depth limited search? Explain iterative deepening 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 defined level. This prevents infinite loops in graphs but risks missing goals beyond L.

Iterative Deepening search (IDS) combines DF DLS with BFS by incrementally increasing the search level.

example:



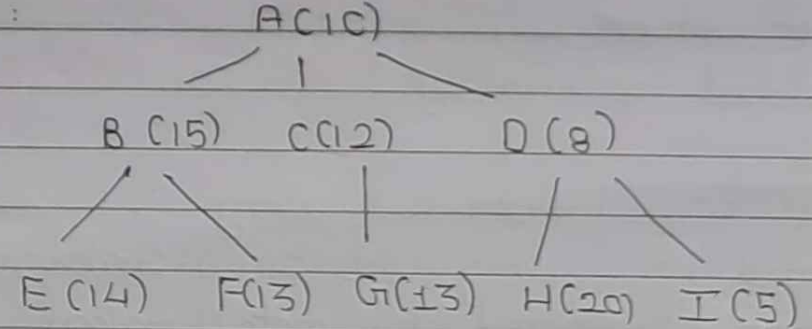
goal = G

Initially, the depth level is 0 for iteration - 1.
Nodes visited = A (goal not found)
Iteration 2, limit = 1
Nodes visited = A → B → C (goal not found)
Iteration 3, limit = 2
Nodes visited : A → B → D → E → C → F → G
Goal : G is found.

12] Explain Hill climbing and its drawbacks in detail with example. Also ~~state~~ limitations of steeper ascent hill climbing.

→ Hill climbing is a local search optimization algorithm which moves forward towards a better neighboring solution until it reaches a peak.

example:



goal : G.

Steps:
1) Start at root node A(10)
2) Compare its children B, C, D.
3) Move to child with highest value i.e. B(15).
4) Repeat for B's children E and F.
5) Terminate at E(14)

The algorithm stops at E(14) not reaching goal G

Drawbacks:
1) Local maxima: The algorithm greedily 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 backtracking which hill climbing algorithm does not support.

4) Limitations of steepest ascent hill climbing.
- Computationally expensive: evaluates all neighbors before selecting the best.
- can get stuck.
- no global optimality.

13) Explain simulated annealing and write the algorithm.
→ Simulated annealing is a probabilistic optimization algorithm inspired by metallurgical process of annealing where materials are heated and cooled to

reduce defects. It escapes the local optima by temporarily accepting worse solution with a probability.

Algorithm

1) Initialize: Set an initial solution and define an initial temperature T.
2) Repeat until stopping condition.
   - Generate new neighbour soln.
   - compute changes in cost.
   - If new soln is better then accept it.
   - If worse, accept it with probability.
   - Decrease temp. T.
3) Return best solution.

ex: travelling salesman problem

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14) Explain A* algorithm with an example.

→ A* is a best first search algorithm used in pathfinding and graph traversal. It uses the foll. formulas:

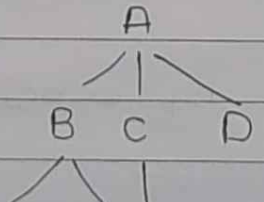
$f(n) = g(n) + h(n)$

$g(n)$ → cost to reach n from start.

$h(n)$ → heuristic estimate

$f(n)$ → total estimated cost.

Goal G:



Node	g(A,n)	h(n, G)
A	0	6
B	1	4
C	2	2
D	~~3~~ 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 neighbors B, C, D

$f(B) = 1 + 4 = 5$, $f(C) = 2 + 2 = 4$, $f(D) = 4 + 7 = 11$

3) Choose lowest value that is f(C)

4) Expand neighbors of C.

$f(G) = 2 + 4 + 0 = 6$

5. Goal reached at G with total cost 6.

Advantages :→

Efficient for finding shortest path in weighted graphs.

balances exploration by considering both g(n) and h(n)

17 Explain minmax algorithm and draw game trees for tic-tac-toe.

→ The minmax algo is a decision making algorithm used in 2 players games. It assumes

- one player (MAX) tries to maximize score
- other player (min) tries to minimize score.

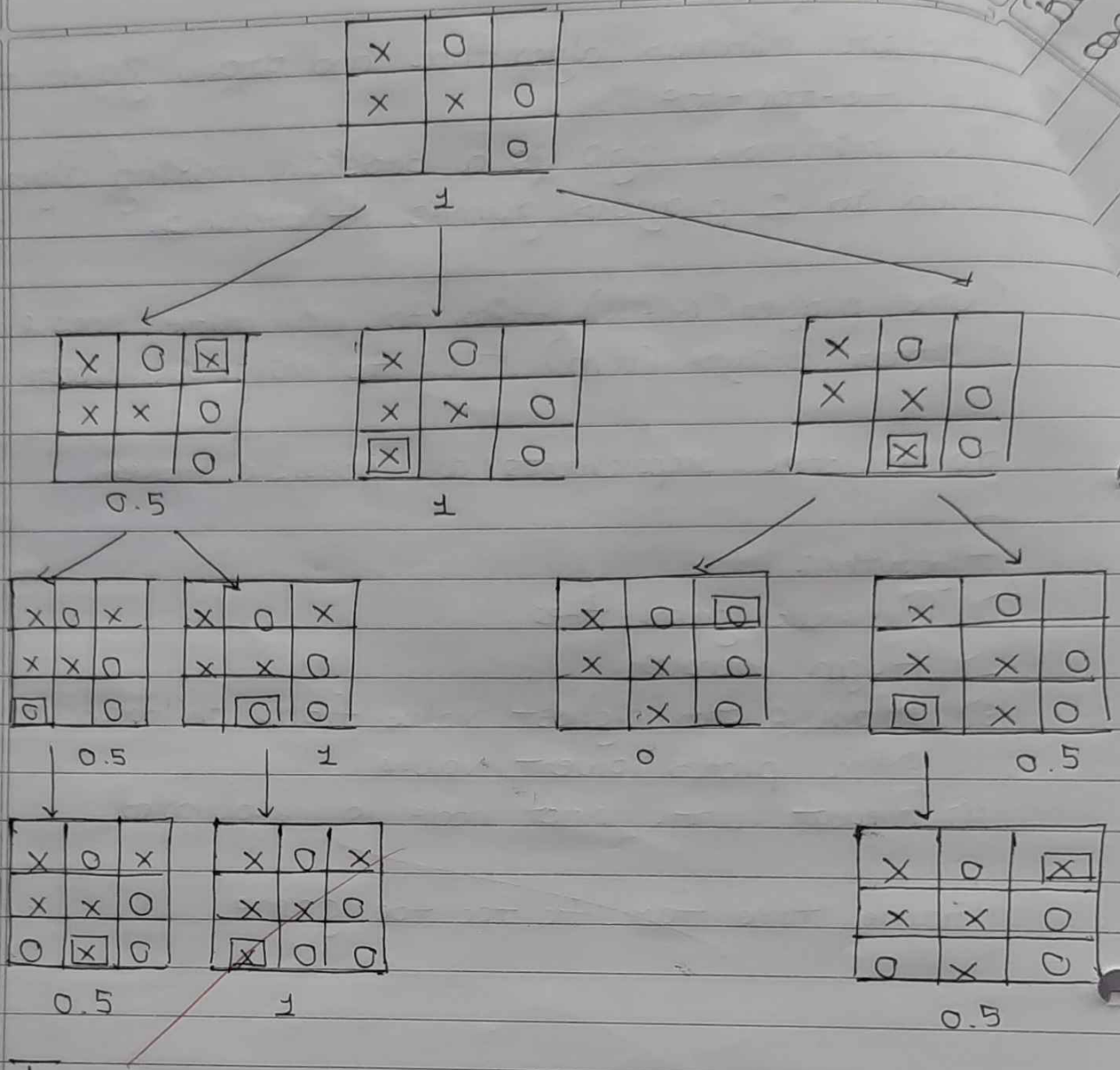
game tree represents all possible moves.

Algorithm

1) Generate game tree.
2) Align scores.
3) Max picks highest value from children
   Min picks lowest value.
4) Repeat until root node is evaluated.

Game tree for tic tac toe game.

P.T.O →



16) Explain alpha beta pruning algorithm for adversarial search with example.

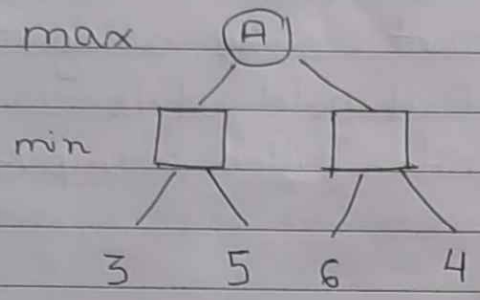
→ Alpha beta pruning is an optimization technique used in minimum algorithm to reduce the no. of nodes evaluated in adversarial search problems like game-playing AI (eg chess, tic tac toe).

Alpha beta pruning includes:

Alpha (α): Best max score that max player can guarantee so far.

Beta (β): The best min score that MIN player can guarantee.

ex:



1) Start at root node A.
$\alpha = -\infty$, $\beta = +\infty$

2) Check left min node (child of A)
check first child value → update $\beta = 3$
check second value = 5 → β remains 3
min node returns 3 to max.

3) right min node (child of A)
check first child value = 6 → $\beta = 6$
pruning ~~of~~
here $\alpha = 3$ at max but $\beta(6) > \alpha(3)$ so, no pruning.
explore 2nd child (9) → here pruning will occur
min node already has value ≤ 6, it will never choose 9 and so, we prune node with value 9.

4) Max value = 6

17) Explain wumpus world environment, giving its PEAS description. explain how percept seq. is generated.

→ The WUMPUS world environment is a simple based environment used in AI to study intelli agents behavior in uncertain environments. It is turn based environment where an agent must navigate a cave to find gold while avoiding hazard like pits and a monster called wumpus.

PEAS:

P: the agent is rewarded for grabbing gold and exiting safely. Penalty is imposed for falling into pits and getting eaten by wumpus.

E: 4 × 4 grid world containing agent, wumpus, pits, gold.

A: agent can move forward, left, right, shoot, climb

S: agent perceives stench, breeze, glitter, bump and scream.

example percept sequence:

1) Agent starts at (1, 1)
no breeze, no stench, no glitter → safe square.

2) agent moves to (2, 1)
breeze detected → A pit is nearby but not in current square.

3) moves to (1, 2)
Stench detected → wumpus in adjacent cell.

4) moves to (2, 2)
glitter detected → gold is here.

5] agent moves back to (1,1), climbs out.

18] Solve the foll. crypto-arithmetic problem.
SEND + MORE = MONEY.

→ Step 1:
M must be 1. The sum of 2 4-digit nos cannot be more than 10,000.

```
 SEND
+MORE
-----
10NEY
```

2] S must be 8, as 1 is carry over from EON.
O must be 0 and there is a 1 carried or S=9 and there is no 1 carry. But 1 is already taken, so O must be 0.

```
  SEND
+ 10RE
-------
10NEY
```

3] There cannot be carry from EON because any digit + 0 < 10, unless there is carry from column NRE and E=9. But this cannot be the case because then N would be 0 and 0 is already taken. So, E<9 and there is no carry from this column. Therefore S=9 because 9+1=10

Step 4:
case 1:

No carry : $N+R = 10+(N-1) = N+9$

$R = 9$

but 9 is already taken so will not work

case 2:

carry : $N+R+1 = 9$

$R = 9-1 = 8$. This must be solution of R.

Step 5:

lets consider $E = 5$ or 6

$E = 5$

then $D = 7$ and $Y = 3$, so this part will work but look at column N8E, There is carry from DEY, $N+8+1 = 16$ but then $N = 7$ and 7 is taken by D, therefore $E = 5$

```
 9 5 N D
+1 0 8 5
-------
1 0 N 5 Y
```

Now, $N+8+1 = 15$, $N = 6$

```
 9 5 6 D
+1 0 8 5
-------
1 0 6 5 Y
```

Step 6:

The digits left are 7, 4, 3 and 2. We know there is carry from column D5Y, so only pair that works is $D = 7$ and $Y = 2$

$$\begin{array}{r} 9\ 5\ 6\ 7 \\ +\ 1\ 0\ 8\ 5 \\ \hline 1\ 0\ 6\ 5\ 2 \end{array}$$

19] Consider the foll. axioms:
All people who are graduating are happy.
All people happy people are smiling.
Someone is graduating.

→ ① Represent there axioms in first order predicate logic.

In clause form: $\{G(a)\}$

② Prove "is Someone smiling?" using resolution.
collect of clauses
(1) $\{\neg G(x), H(x)\}$
(2) $\{\neg H(x), S(x)\}$
(3) $\{G(a)\}$

Apply resolution
resolve (1) $\{\neg G(x), H(x)\}$ with (3) $\{G(a)\}$
Substituting $x = a$.
$\{\neg G(a), H(a)\}$
∵ we have $G(a)$, resolving gives
$\{H(a)\}$
Resolve (2) $\{\neg H(x), S(x)\}$ with $\{H(a)\}$
Subs. $x = a$
$\{\neg H(a), S(a)\}$
Since, we have $H(a)$, resolving given $\{S(a)\}$.

Since we have derived S(a), we conclude th someone(a) is smiling.

20) Explain modus ponen with suitable ex.

→ Modus ponen is a fundamental rule of inferen in propopositional logic that allows us to deduc a conclusion from a conditional statement and th antecedent.

It follows the form
1) $P \rightarrow Q$ (if P, then Q)
2) P (P is true)
   Q (Q must be true)

ex. If it rains, ground will be wet.
→ $P \rightarrow Q$

It is raining → P, ground is wet → Q

21) Explain forward chaining and backward chaining algo with the help of an example.

→

Forward chaining: It starts with given facts and applies inference rules to derive new facts until goal is reached. It is a data driven approach because it begins with known data and works forward to reach a concln.

ex: diagnosing a disease
Rules:
1) If a person has fever & cough, they might have flu.
2) If a person has sore throat and fever, they might have cold.

Facts:
The patient has a fever.
The patient has cough

1) Fever + cough → flu (rule 1 applies)
2) conclusion: patient might have flu.

Backward chaining: It starts with goal and works backwards by checking what facts are needed to support it. It is a goal driven approach.

ex: diagnosing a disease.
goal: determine if patient has flu

Rules:
1) (Fever ∧ cough) → flu
2) (sore throat ∧ Fever) → cold.

Process using backward chaining:
1) We want to prove flu.
2) Looking at rule 1 (Fever ∧ cough) → Flu, we need to check if patient has fever and cough.

3) We check our known facts.
- patient has fever
- patient has cough

4) Since, both conditions are met, we confirm flu is true.