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35
DISC

AIDS

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Assignment 1

Q1) What is AI? Considering the Covid-19 pandemic solution. how AI helped to survive & renovated our way of life with different applications?

→ Artifical Intelligence (AI) enables machines to think, learn & make decision like humans. It includes techologies like machine learning, NLP & robotics.

Application:

1) Healthcare: AI helped in early diagnosis, vaccine development, & chatbot-based health assitance.
2) Contact Tracing: AI powered apps traced covid-19 exposure ensuring public safety
3) Remote work & Education: AI enhanced virtual meeting, online learning & productivity tools.
4) Supply chain & delivery: AI optimized logistic & enhanced autonomus delivery
5) Mental health support: AI driven app provided emotional & fitness assistance

Q2) What AI agents terminology, explain with eg.

→ 1) Agent: An entity that interact with env & makes decision based on inputs.
eg: A self driving car perceives traffic signal & adjust speed accordingly.
2) Performance measure: Defines how successful an agent is achieving its goal
ex: Self driving car perfomance measure could be minning accident fuel efficiency & travel time

3) Behaviour / Action of Agent: The action an agent takes based on its properties.
Ex: An robotic vaccum cleaner moves around obstacles after deleting them.
4) Percept: The data an agent recieves at a specific moment from Sensors.
Ex: A spam filter recieves an email & detects Keywords Senor info, & attactments.
5) Percepts sequence: The entire history of percepts recieved by an agent.
6) Agent function: A mapping from percepts sequence to an action.
ex: A smart thermostat analyze past temprature changes & adjusts heating accordingly.

Q3) How AI technique is used to Solve an 8 puzzle problem?

→ It consist of a 3 x 3 grid with 8 numerical tiles. & one empty space, where objective is to move the tile around to match a predefined goal configuration
Inital State:

1 2 3
4 6
7 5 8

This is the random starting configuration of 8 puzzel. with the tile placed in a non goal configuration

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

Goal State

1 2 3
4 5 6
7 8

* Solving the 8 Puzzle problem.

• AI Search algorithm, such as breadth first search (BFS), Depth first search (DFS) & A* are commonly used

▷ Breadth first Search (BFS):

·BFS is an uniform search algorithm that expands all possible state level by level, starting from the initial state.

·BFS guarantees that solution found in shortest in terms of number of moves, but it can be very slow.

Advantage:

Guarantee: to find optimal solution

Disadvantage:

BFS has a high memory managment as it must store all states at each level of exploration.

2) Depth first search:

·DFS doesn't has a high memory requirement.

· It is another algo uniform Search algo that explore one branch of state space tree as deep as possible before backtracking.

Adv: Memory efficient

Dis adv: DFS can get stuck in loop, non optimal paths, & may not find short solution.

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Steps using A*
- Compute Manhattan distance for each possible move.
- choose the best move (lowest f(n)).
- Repeat until reaching goal state.

Q4) What is PEAS descriptor? Give PEAS descriptor for following.

→ 1) Taxi driver:
P: Minimize time travel efficiency, passanger safety, obey traffic rules
E: ROADS, traffic, passengers, weather, obstacles
A: steering, accelerator, brakes, turn signal, horn.
S: Camera, GPS, Speedometer, radar, LiDAR, microphone.

2) Medical Diagnosis Support:
P: Accuracy of dignosis, treatment success rate, etc.
E: Patient records, Symptoms, medical treatment.
A: Display screen, printed prescription, notification.
S: Patient input, lab report, electronic health care.

3) Music Composer:
P: Quality of music, adherescence, to genre, audience engame
E: Digital workspace, music production, real time composition
A: Audio output, digital instrument selection, file saving
S: user inputs, style preference, tempo, feedback form listners.

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4) An aircraft Autolander:
P: Smooth landing, accuracy in reaching runway, passenger Safety
E: Airspace runway, weather, wind speed, visibility
A: flight control, landing gears, brake.
S: optical character recognition, NLP, grammer & spell checker.

5) Essay Evaluator:
P: Accuracy of grading, consistency fairness, grammer.
E: Keck Digital text input, student essay, predefined grading.
A: feedback generation, score assignment.
S: Optical Chidracter recognisation, NLP grammar.

6) A Robotic sentry gun for Keck lab.
P: Target accuracy threat detection efficiency response speed
E: Keck lab premises, intruders-lighting condition, obstacle.
A: Gun climbing system, camera planning alert system.
S: Motion detectors, intrared sensor, cameras, LIDAR, radar.

(Q5) Categorize a Shopping bot for an offline bookstore to each of six dimension (Fully/Partially) deterministic, discrete/ Stoctastic / episodic / Sequential static / dynamic, discrete / Continous, Single, multi agent).

→ 1) Partial observable: The bot may not have complete visibility.
2) Stochastic: Environment is unpredictable
3) Sequential: Each decision bot makers affect

4) Dynamic: The bookstore environment changes overtime.
5) Discrete: Bot choose discrete choices
6) Multi agent: bot interacts with multiple entities.

Q6) Differentiate Model based & utility based agent

Model based Agent	Utility Based Agent
1) Maintains an internal model of the environment to make decision	1) Uses a utility based fermance & make option choices
2) Relies on Stored Knowledge & updates the model	2) Choose action based on maximizing expected utility.
3) Can adapt to changing environment by updating the internal model	3) More flexible & goal-oriented Changes dynamically
4) Moderate complexity due to model maintance	4) Higher complexity due to need to compute utilities for diff action.
5) Ex: Self-driving car that predicts pedestrain movement	5) ex: Self driving cars that discrete select best path.

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

→ 1) Knowledge-Based Agent Architecture.

- A knowledge-based agent is an intelligent that makes decision using knowledge base (KB) & measuring mechanism.

Architecture component:

1) Knowledge base: Stores, fact, rules & hurestic about the world.
2) Inference Engine: Use logical reasoning (FOL) to derive new knowledge from KB.
3) Preception Module: Collects data from sensor & updates KB.
4) Action Selection Module: Choose appropriate actions based on reasoning outcomes.

Q8) What is AI? Considering COVID-19 pandemic Situation, AI helped to survive & renovate our way of life with diffirent applications?

→ Artifical Intelligence (AI) is simulation of human intelligence in machines that can learn, reason & make decision AI system process large dataset recognize pattern & automate tasks, enancing efficiency accross institutes.

AI's role in COVID 19 pandamic.

1) Health care & Diagnosis: AI analyzed CT scans & detected COVID-19 faster.

2) Chatbots & vertual assistants : Provided instant medical drive.

Q9) Convert the following to predicates:

1) Anita travels by car if avaliable otherwise travel by bus.

→ • Avaliable (Car) → Travels (Anita, Car)
• ¬Avaliable (Car) → Travels (Anita, Car)

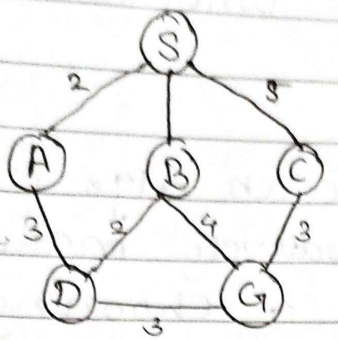
2) Bus goes via Andheri & goregaon.

→ • Route (Bus, Andheri).
• Route (Bus, Goregaon).

3) Car has a puncture, so it is not avaliable.
• Puncture (Car) → ¬Avaliable (car)
• Given: Puncture (car).
• Therefor ¬Avaliable (car)

Forward Reasoning:
1) From 3, ¬Avaliable (Car) \neg Avaliable (Car) ¬Avaliable(car)
2) From 1, ¬Avaliable (car) → Travels (Anita, BUS) \neg Avaliable(car)
→ Travels (Anita, BUS) ¬Avaliable (car)
→ Travels (Anita, Bus), So Anita must travel by bus
3) From 2, Route (BUS, Goregaon) Route (BUS, Goregoan)
Route (BUS, Goregaon), meaning the BUS travds via goregaon

10) Find route from S to G using BFS



Ans:

Current node	Queue	Visited Node
S	A | B | C	S
A	B | C | D | G	S → A
B	C | D | G	S → A → B → C
C	D | G	S → A → B → C → D
D	G	S → A → B → C → D → G

Paths: S → A → B → C → D → G

11) What do you mean by Depth limited Search? Explain iterative Deepining Search with ex.

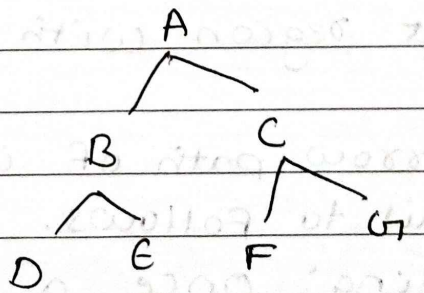
→ Depth-Limited Search (DLS)

- Depth limited search is a variant of DFS where the search is restricted to a specific depth limit LLL. if a goal is not found within this limit, search terminates. It prevents infinite loops in deep or infinite state but risks falling to find solution if LL is too low.

Eg: If L = 2, DFS explores node only upto depth 2.

Iterator deppening Search: It combines DLS with BFS by increasing the depth limit.

Example:



(2) Explain hill climbing & its drawback in detail with example also state limitation of stack asset Climbing

→ Hill climbing is a local search algo used to find an optimal sol^n by iteratively making small changes to current state & choosing best improvment.

Algo Steps:
1) Start with an initial sol^n.
2) Evaluate neighbouring states.
3) Move to do neighbour with highest value
4) Repeat until no better neighbour exists.

Ex. Hill climbing is path optimization. A robust trying to reach highest hilltop (goal) uses hill climbing It moves upwards step by step choosing strongest assent until no higher step is available.

Drawback of hill Climbing:
1) Local Maxima - May get stuck at a peak i.e not global maxima.
2) Plateau: A flat region with no implementation stagnation
3) Ridges: A narrow path of improvements that algo may fail to follows.
4) No Backtracking: once a move is made, previous state are not reconsidered.

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Q13) Explain simulated annealing & write its algo

→ A probabilistic search method inspired by cooling proccess of metas.
Allow occastional downfall moves or escape local option

i) Start with an initial sol° temprature T.
2) Generate a neighbouring solution
3) If its letter, accept it, otherwise accept it with probabilistic $e^{(-\Delta E / T)}$
4) Decrease T gradually & repeat until T is very small.

Use case: Travelling Salesman problem (optimized Problem).

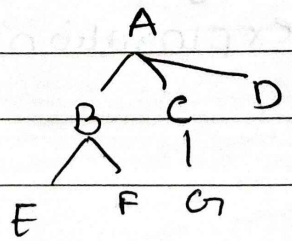
Q14) Explain A* Algorithm with an example.

→ A* is like best first search algorithm used in path finding & graphs traversed It used the following trends:

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

$g(n)$ → use to reach n from start.
$h(n)$ → heuristic estimate of cost to reach from goal to n.
$f(n)$ → total estimated cost

eg: Goal G



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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 neighbour 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 neighbour of C f(G)

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

5) Goal reached at G with total cost G.

Advantages →

efficient for finding shortest path in weighte graph balances exploration by considering both g(n) & h(n).

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Q15) Explain min-max algo & draw game tree for tic-tac-toe game.

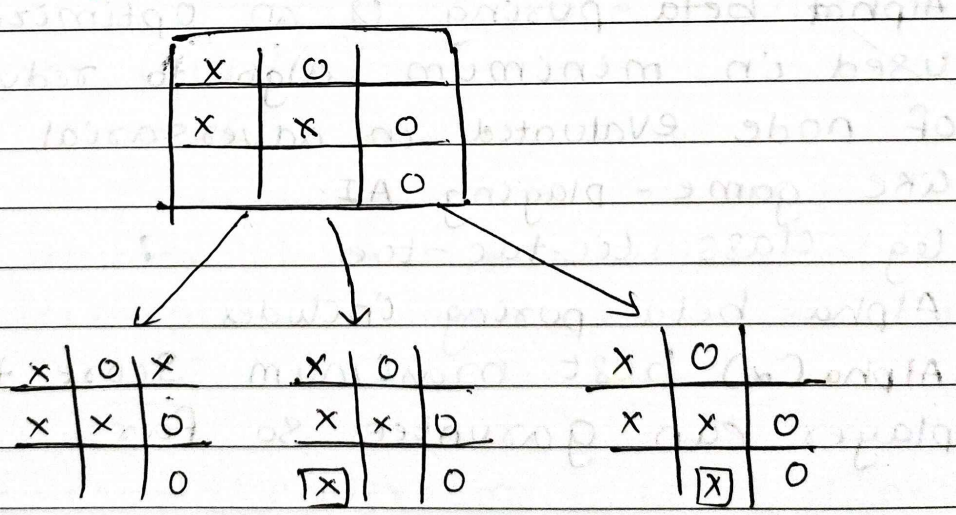
→ The min max algo is a decision making algo used in 2 player games it answers one player (max) tries to maximize the score answers one player tries to minimize the score.

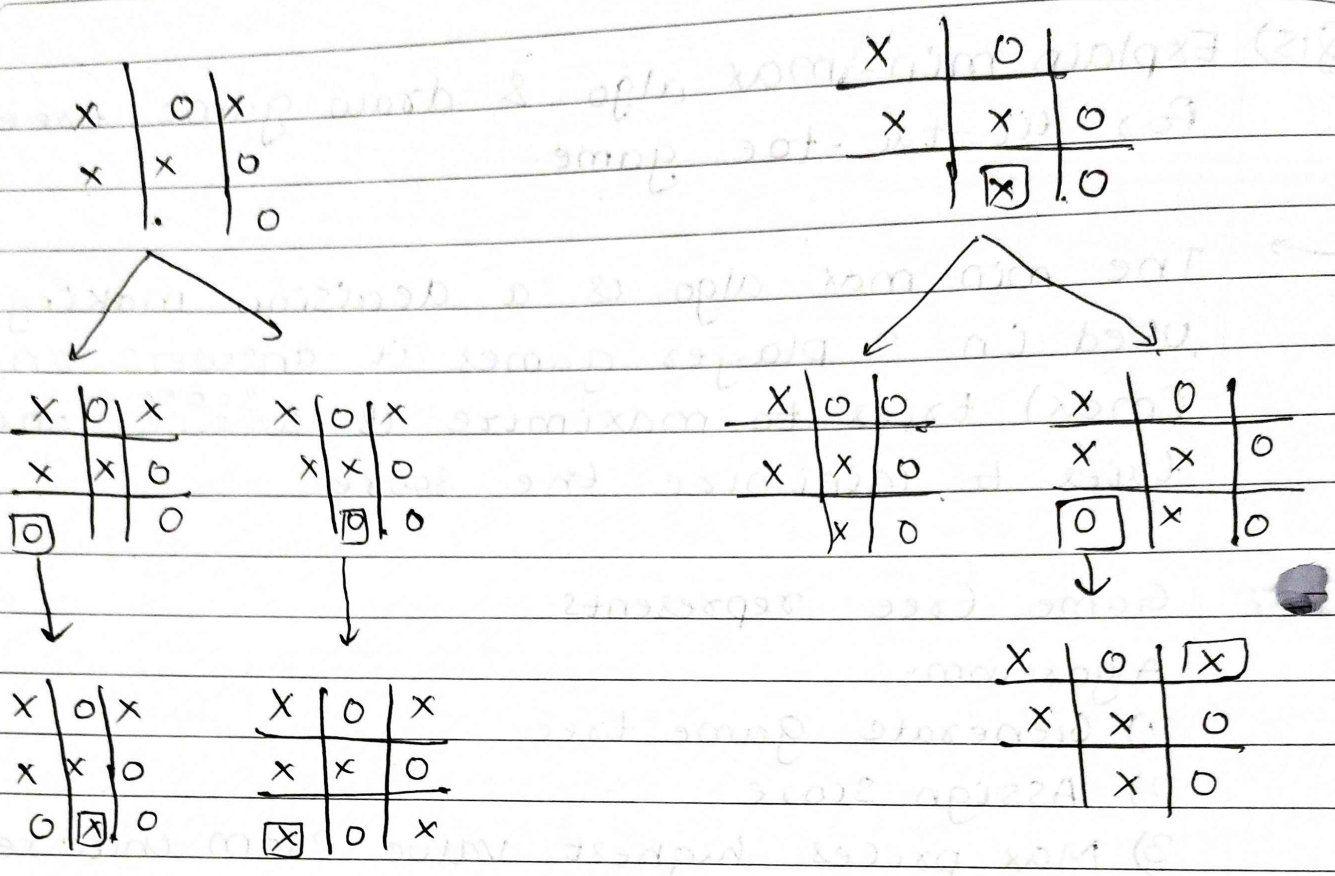
Game tree represents

Algorithm:

1) Generate game tree.
2) Assign score
3) Max prices highest value from children.
4) Repeat until root node is evaluated a bottom-up approach.

Game tree for the tic-tac-toe game.





Q16 Explain alpha beta pruning algo for adversial Search with example.

→ Alphat beta pruning is an optimized technique used in minimum algo to reduce no. of node evaluated in adversarial Search problem like game-playing AI.
Eg class tic-tac-toe
Alpha beta pruning includes
Alpha (α) best maximum score that maximising player can garuntee so far.

Beta (β): ~~Maximum~~ minimum score that the minimizing player can gaurentee. So far.
the algo. prunes branches that will not influence final decision.

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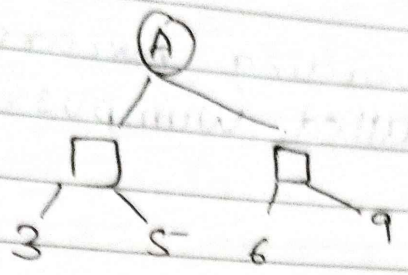
eg:



1. Start at root node A.
   $\alpha = -\infty$, $\beta = \infty$
2) Check left min node (Child of A)
   Check first child value = 3 → update $\beta = 3$.
   check second child value = 5 → update $\beta = 3$
   Min node return 3 to Max.
3) Right Min node (Child of A)
   - Check first child value = 6 → $\beta = 6$.
   - Here $\alpha = 3$ at max node but $\beta (6) > \alpha (3)$ so no pruning.
4) - Explores 2nd child (4) → Here pruning will occur
   - Min node a & so use prune node with value a.
4. Max value = 6.

Q17) Explain Wumpus World environment giving its PEAS description. Explain how percept seq. is generated.

→ Wumpus world environment is a simple grid based environment used in AI to study intelligent agent behaviour
In certain env. it is a turn based environment where an agent must navigate a care to find

gold while avoiding hazards like pits & a monster called Wumpus.

PEAS:

P: Agent is rewarded for grabbing gold & exiting safely- penalty is imposed for falling into pits & getting eaten by wumpus.

E: 4x4 grid world containing agent, wumpus, pits, gold.

A: Agent can move forward, left, right, shoot climb.

S: Agent previous search, breeze, gutter, wumpus scream.

Percept Sequence generation.

It is history of all perception achieved by agent AI each time step, agent AI each time step the agent percieves information based on its current location & surroundings.

Eg percepts Seq:

1) Agent start: at (1,1)
   - No I breeze, no stretch, no gutter → Safe squares
2) Agent moves to (2,1):
   - Breeze detect → A pit is nearby but not in current square.

3) Agent moves to (1,2)
Stench detected → wumpus is in adjacent cell.
4) Agent moves to (2,2)
Glitter detected → gold is here
5) Agent moves back to (1,1) & climbs out.

Q(8) Solve the Crypt Arithmetic SEND + MORE = MONEY

→ STEP 1 : M must be 1.
Sum of 2 '4' digital no. comes to be greater than equal to 20000.

$$\begin{array}{r} SEND \\ +\ MORE \\ \hline MONEY \end{array} \qquad \begin{array}{r} S\ E\ N\ D \\ +\ M\ O\ R\ E \\ \hline 1\ O\ N\ E\ Y \end{array}$$

Step 2: Assume E + O = 10 + N
then E + O generate Carry : S has to be 8 otherwise if S is 9 & Carry is 1 then 9 + 1 = 11 but 'O' cannot be 1 ∴ M = 1

Step 3 : but then E + O cannot generate Carry so inital assumption of carry is wrong & so S ≤ 9

$$\begin{array}{r} 9END \\ 10RE \\ \hline 1ONEY \end{array}$$

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Step 4: Now $E + 0 = N$

$\Rightarrow E = N$

but then is a contr So $N+R$ must generate Carry 1 & $E + 1 + 0 = N$

$N = 1 + E$

$N + R + K1 = 10 + E$

$R\ 4, K1 = 10 - 1 = 9$

K cannot be 0 otherwise $R = 9$

$R + 1 = 9$

$R = 8$

```
  S E N D                    9 E N D
  M O R E        ⟶           1 D 8 E
M O N E Y                  1 0 N E Y
```

$D + E = 10 + Y$

but $N = E + 1$ Let assume $E = 5$ then $N = 6$

```
  9 5 6 D
  1 0 8 5
1 0 6 5 7
```

So only requirement is D should be a no. such that when added to 5 generate a query available space d 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

2, 3, 4, cannot be as Cannot generate Carry

$D = 7$

```
  9 5 6 7
+ 1 0 8 5
1 0 6 5 2
```

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Q(9) Consider the following question

All people who are graduating are happy.

→ ① Represent it predicate logic

G(x) → x is graduating

H(x) is a happy.

1. Collect Clauses.

(1) ∝ 7 {¬G(x), H(x)}

(2) ∝ 7 {¬H(x), S(x)}

(3) {G(x)}

2. Apply resolution

Resolve (1) {¬G(x), H(x)} with (3) & G(x)

Substituting x=a

{¬G(a), H(a)}

∴ We have H(a) resolving gives H(a)

Resolves (2) {¬H(a), S(a)}

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

3) Prove 'is Someone graduating using resolution.

(1) Collect clauses:

(1) {¬ → G(x), H(x)}

(2) {¬ → H(x), S(x)}

(3) { Gr(a) }

(4) Assume contradiction { ¬ S(a) }

2) Apply resolution

Resolve (1) { ¬ Gr(H), H(x) } with (3) { Gr(x) }

Substitute x = a → { Gr(a) }

{ ¬ Gr(a), H(a) }

We have Gr(a) resolving gives { H(a) }

Resolve (2) { ¬ H(x), S(x) } with { H(a) }

Substitute x = a

{ ¬ H(a), S(a) } & { H(a) }

Now left with { S(a) }

we can resolve it with { ¬ S(a) }

we are left with

our assumption of contradiction is wrong

Q20) Explain Modus ponen with suitable example.

→ Modus ponen is a fondamental rule of inference is propotional logic that allows us to deduce a conclusion from a conditional statement & its ~~accident~~ antecedint.

It follows form

1) P → Q (if P then Q)

2) P (P is true)

∴ Q (Q must be there)

Example : 1) If ground will be wet P → Q

2) If is rainning P ∴ Ground is wet → Ss.

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Q21) Explain forward & backward chainning algo

→ Forward chainning - starts with given facts & applies inference chaning - It rule to derive new facts until goal is reached It is a data drive approach because it begins with known data & works to reach a conclusion.

Example Diagnosing a deseas

Rules

1) It a person has a fever & cough they might have fly.
2) It is a person has a throat & fever they might have cold.

Facts:

- The patient has a fever.
- The patient has cough.

Inference: 1) Fever Eough → Fly (rule 1 applies)
2) Conclusion. the patient might have fly

Backward It starts with goal & work backword by checking what facts are needed to support it. It is a goal drove approach

Eg: Diagnosing a desiase.

goal: Determine if patient has flu.

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Rules:
1) (Fever ∩ Cough) → Flu.
2) (Sore throat ∩ Fever) → Cold.

Process using backward chainning.
1) We want to prove Flu
2) Looking at rule 1 (Fever ∩ Cough) → Flu.
   We need to check if patient has Fever & Cough.
3) We check our known facts.
   · Patient has Fever
   · Patient has cough.
4) Since both conflicts are met, we confirm Flu is true.

So...