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05/05

Q1 What is AI? Considering the COVID-19 pandemic situation, how AI helped to survive and renovate over way of life with different application.

→ ① Artificial Intelligence is made up of 2 words.

Artificial → Refers to something which is made by human

Intelligence → Refers to ability to acquire and apply knowledge and skills.

② AI can be defined as the ability of computer system i.e hardware and software, to do tasks that normally required human beings to use intelligence.

③ Term can also be applied to any machine that exhibits traits associated with a human mind areas learning and problem-solving.

AI applications during Covid 19 Pandemic
① ~~AI~~ AI driven vaccine distribution
② Educating people with AI chatbots regarding COVID
③ Leveraging AI for person contact tracing.

Q2 What are AI Agents terminology. Explain with examples.

-> ① Agent

An ~~ab~~ entity that perceives its environment through sensors and acts upon it through actuators to acheieve specific goals.

Eg - A robot vacuume cleaner perceives dust and abstacles through sensor and navigates around cleaning floors.

② Environment

The external surroundings in which an agent operates.

Eg - For a self driving car, the environment includes roads traffic signals.

③ Percept

Information recived by agent from environment through sensor.

Eg - AI receives current board state in games like chess.

④ Percept sequences.

The complete history of percepts an agent has recived.

Eg - The history of all board positions a chess AI has observed.

⑤ Agent function.
A mapping from percept sequences to actions
Eg - A functions that maps a sequences of observed chess positions to the next best moves.

⑥ Performance measure.
A criteria used to evaluate the success of agents behaviours.
Eg - Recomendation system, the percentage of suggested items.

⑦ Rationality
The ability of an agent do select actions that maximes its ~~pet~~ performance based on percept sequence and in build knowledge.
Eg - Navigation system that choses the shortest ro

⑧ Autonomy
Ability of agent to work without human intervention.
Eg - A mars rover ~~pro~~ performing navigation. terrain.

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Q3 How AI techique is used to solve and puzzle

→ The puzzle is a sliding puzzle that consist of eight numbered tites (1-8) played randomly on 3x3 grid along with one empty slot. The player can move adjacent tiles to the blank space and the objective is to arrange the tiles in a specific goal state by sliding

Initial state
This is the random starting ~~a~~ configuration of the 8 puzzles with the tiles placed in a non-goal configuration.

1	2	3
4		6
7	5	8

Goal state
In the 8 puzzle, only tiles adjacent ~~at~~ to the blank space can be moved.

① Move the blank space up.
② move the blank space down
③ Move the blank space left
④ Move the blank space right

1	2	3
4	5	6
7	8	

Solving the 8 puzzle requires systemically searching through possible states (configuration) to find sequence of moves that lead to the goal state. AI search algorithm such as Breadth ~~first~~ first search, Depth first search A* are used.

Q4 What is PEAS discriptor? Gives PEAS descripter for following.

→ The PEAS stands for ~~PE~~ Performance measure, Environment, Actuators, Sensors.

PEAS describes an intelligent agent characteristics and performance and is used to evaluate it.

PEAS descriptors:

① Taxi drivers

ⓐ P: Safety, speed, satistaction ⓑ E: Roads, traffic, weather
ⓒ A: Steering, brakes, accelerator ⓓ S: GPS, cameras, odometer.

② Medical Diagnosis System

ⓐ P: Accuracy, treatement rate ⓑ E: Patients, symptoms
ⓒ A: Display diagnosis, treatment ⓓ S: Patient input, lab, test

③ Music Composser AI

ⓐ P: Creativity, harmony, satisfaction ⓑ E: Music styles, preferences
ⓒ A: Generate melodies, harmonies ⓓ S: User feedback, existing music

④ Aircraft Autolander

ⓐ P: Safe landing, precision ⓑ E: Runaway, weather, altitue
ⓒ A: Control flaps, throttle ⓓ S: Altimeter, GPS, radar

⑤ Essay Evaluator AI

ⓐ P: Grammar accuracy, coherence ⓑ E: Essays, language rules
ⓒ A: Grade, suggest improvement ⓓ S: Text input, linguistic analys

⑥ Robotic Sentry Gun

ⓐ P: Accuracy, threat detection ⓑ E: Security zone, intruders
ⓒ A: Rotate, aim, fire ⓓ S: Motion sensors, cameras, sensors.

Q5 Categorization of a Shopping Bot for an Online Bookstore.

→ ① Observability
Partially observable (limited info on customer preferences)

② Determinism
Stochastic (customer behavior is unpredictable, making outcomes uncertain

③ Episodic vs Sequential
The environment changes ~~with~~ depends on prior exchanges with the user.

④ Static vs Dynamic
The environment changes with new books, shifting demand, and customer arrivals (Dynamic)

⑤ Discrete vs continuous:
The bot processes distinct books selections and step wise interactions (Discrete).

⑥ Single vs multi~~ple~~ Agent
It collaborates with multiple entities like customers, bookstore, etc. (Multi agent)

Q6 Differentiate Model based and Utility based Agent
→

Model Based Agent	Utility Based Agent
① Uses an internal model of the environment to make decisions	① Evaluates actions based on utility function to maximize performance.
② Uses past and current precepts to update its models and predict future state.	② Selects actions that leads to the highest expected ~~utt~~ utility.
③ Handles partially observable environments	③ Handles uncertainity by assigning utility.
④ Self-driving cars using road maps and sensor data	④ AI recommending personalised content based user preferences
⑤ Works based on a goal or known environment uses	⑤ AI recommending personalised content based on user preferences.

FOR EDUCATIONAL USE

27 Explain the architecture of a knowledge based agent and learning Agent.

→ Knowledge-Based Agent

Uses a knowledge ~~E~~ Base (KB) and Inference Engine for decision-making by applying logical rules

Components

Knowledge Base: Stores facts and rules

Inference Engine: Derives conclusions based on topic

Perception Module: Collects environment data.

Action Execution Module: Acts based on meeting resoning.

Eg-Medical diagnosis AI analysing symptoms to suggest treatm

Learning Agent

Adapts and improves performance over time through feedback and expriments

Components

Learning: Updates knowledge based on experience

Performance: Choses actions based on learned data.

Critic: Evaluates actions and provides feedback.

Problem: Suggets new strategies for improvement.

Eg- Ches AI refining strategies by analysing past games.

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

→ What is AI:
Artificial Intelligence (AI) is the simulation of human intelligence in machines, enabling them to learn, reason, and make decisions.

AI's Role in the COVID-19 Pandemic
AI played ~~is~~ a crucial role in managing and adapting to the crisis through various applications.

① Healthcare and diagnosis.
AI-powered CT scan analysis, symptom tracking apps, and early COVID-19 detection.

② Drug discovery and vaccine development
AI accelerated vaccine research by analysing protein structures (eg DeepMind's AlphaFold)

③ Contact Tracing and Monitoring
AI driven contact tracing apps helped track infections.

Impact on Daily life
AI reshapes lifestyles by promoting remote healthcare, digital learning, e-commerce automatic, and smart surveillance.

Teacher's Sign.:

Q9 Convert the following to predicates
ⓐ Anita travels by Car if available otherwise travels by bus.
ⓑ Bus goes via Andheri and Goregaon.
ⓒ Car has puncture so is not available.
Will Anita travels via Goregaon? Use forward reasoning

→ Predicates Representation

① Anita Travel Preferences
ⓐ Travels (Anita, Car) if Available (Car)
ⓑ Travels (Anita, Bus) if ~~P~~ ¬ Available (Bus)

② Bus Route
ⓐ GoesVia (Bus, Andheri)
ⓑ Goes Via (Bus, Goregaon)

③ Car Availability
ⓐ Puncture (Car) → ¬ Available (Car)

Forward Reasoning
① Given: Puncture (Car), so ¬ Available (Car)
② Since ¬ Available (~~C~~ Car), Anita travels by Bus: Travels (Anita, Bus)
③ Bus goes via Goregaon: ~~GoestoG~~. GoesVia (Bus, Goregaon)
⑤ Since Anita is on the Bus and the Bus goes via Goregaon, Anita will travel via Goregaon.

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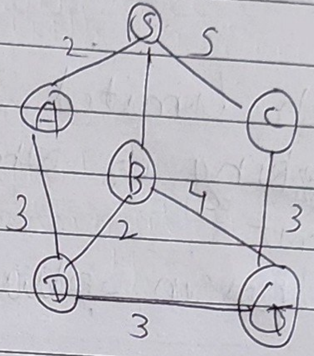
Q10 Find the route from S to G using BFS

-> Step for BFS

① Start at node S, Mark it visited enque S

S



② Dequeue S and explain it's neighbour (A, B, C)

	Queue (Q)
	Processed (P)

①

S		Q
		P

②

A	B	C	Q
S			P

③

B	C	D	Q
S	A		P

IV

C	D	G	
S	A	B	

V

D	G			Q
S	A	B	C	P

VI

G					Q
S	A	B	C	D	P

VII

						Q
S	A	B	C	D	G	P

Ajacency list $S \to \{A, B, C\}$
$D \to \{D\}$
$B \to \{D, G\}$
$C \to \{G\}$
$D \to \{G\}$

From BFS and adjacency list
Shortest path is $S \to B \to G$
Other path are $S \to C \to G$ and $S \to B \to G \to G$

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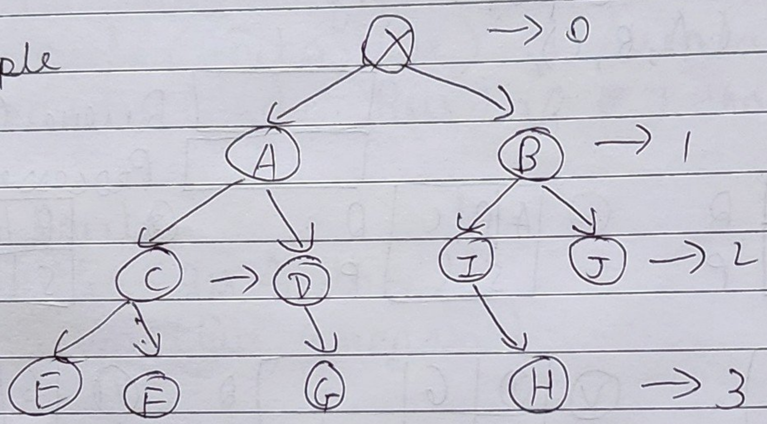
Q11 What do you mean by depth limited search ?
Explain Iterative Depening search with example

->

Depth Limited Search Algorithm
① Working is similar to DFS but with a predetermined limit
② Helps in solving the problem of DFS : Infinite Path

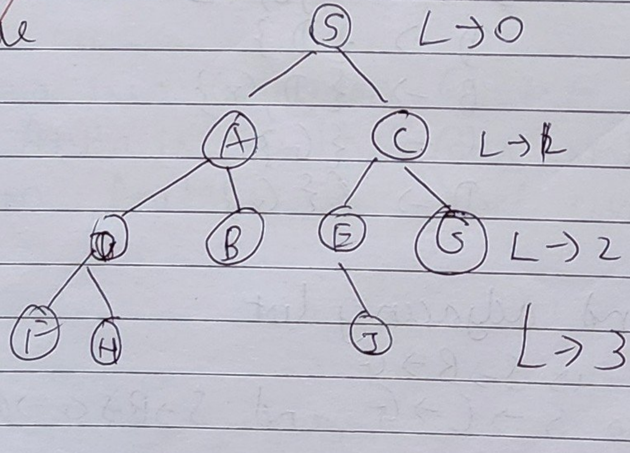
Example



Path : X→A → C → D→B
→ I → J

Iterative Deepening Depth First Search
① Combination of both DFS and BFS
② Best Depth limit is found out by gradually increasing limit

Example



d = 0

d = 0 + 1 = 1

d = 1 + 1 = 2

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Q12 Explain Hill climbing and its drawbacks in detail with example. Also state limitation of steepest-ascent hill climbing.

→

Hill climbing

An optimisation algorithm that moves towards the highest-valued neighbouring state untill no better move exists.

Eg - Maximising $f(x) = -(x-3)^2 + 9$

Start at $x=0$, move to $x=1,2,3$ (global max)

Drawbacks:

① Local Maxima - May stop at suboptimal peaks.

② Plateau - No gradient leads to stagnation.

③ Ridges - Cant move downward to reach higher peaks.

④ Needs Random Restarts - To escape local maxima.

Steepest-Ascent Hill Climbing Limitation

① Computationally Expensive
Evaluates all neighbours

② Struck at local maxima
Still a major issue.

③ Inefficient in large spaces
Slow for high-dimentional promblems.

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Q13 Explain simulated annealing and write its algorithm

→ Simulated Annealing (SA)

Simulated Annealing is an optimisation algorithm inspired by the annealing process in metallurgy. It allows occasional bad moves to escape local optima, gradually reducing these moves over time.

Concept

① Start with an initial solution and temperature (T)

② Generate a neighbouring solution.

③ If better accept if worse accept with probability $e^{-\Delta E/T}$ (helps escape local maxima)

④ Gradually reduce T (cooling)

⑤ Stop when T is low or no better solution is found.

Algorithm

① Initialise current solution S and temp T

② While $T > T_{min}$

a. Generate a neighboring solution S

b. Compute change $\Delta E = f(S') - f(S)$

c. If $\Delta E > 0$, accept S' with probability $e^{\wedge}(-\Delta E/T)$

d. Else accept S

e. Reduce T using probability ~~$e^{\wedge}(\Delta E/T)$~~ cooling schedule

3. Return the best solution found.

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Q14 Explain A* Algorithm with an example.

→ A* is a pathfinding and graph traversal algorithm that finds the shortest path using

(a) g(n): Cost from the start node to n

(b) h(n): Estimated cost from n to the goal (heuristic)

(c) f(n) = g(n) + h(n) Total estimated cost

Steps

1. Initialise an open list (nodes to explore) and a closed list (visited nodes)
2. Start from the initial node, add it to the open list.
3. Pick the node with the lowest f(n)
4. Expand the node, update costs and add them to the open list.
5. Repeat until the goal is reached.

Eg-

Node	g(n)	h(n)	f(n) = g(n) + h(n)
A→B	1	4	5
A→C	2	2	4
C→D	3	0	3

Start at A, Choose C, → Move to D → Path A→C→D

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Q15 Explain Min Max. Explain Minimax Algorithm and draw game tree for Tic Tac Toe game.

→

Minimax Algorithm

The Minimax Algorithm is a decision making algorithm used in ~~to~~ turn-based games like Tac - Toe. ~~It~~ It aims to minimize the possible loss for a worst-case scenario while maximising the potential gain.

Steps of Minimax in Tic-Tac-Toe

① Generate Game Tree

Create all possible moves up to the terminal states

② Assign Scores

ⓐ +1 for a win

ⓑ -1 for a loss

ⓒ 0 for a draw

③ Backpropagate Values

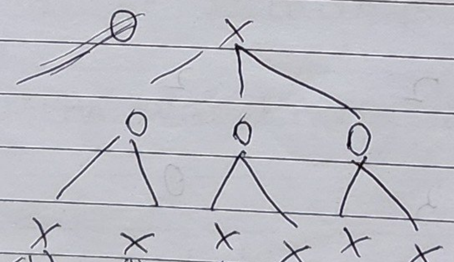
ⓐ Maximizer (X) chooses the maximum value

ⓑ Minimizer (O) chooses the ~~max~~ ~~max~~ minimum value.

④ Best Move Selection

Pick the move leading to the best score.

Tic Tac Toe Game Tree



Q16 Explain Alpha beta pruning algorithms for adversial search with example.

->

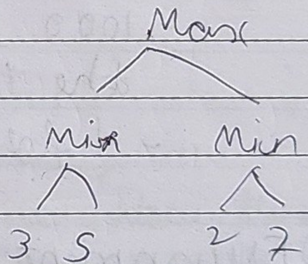
Alpha Beta pruning in an optimization technique for the Minimax algorithm in adversarial search. It eliminates branches that won't affect the final decision reducing the number of nodes evaluated.

Alpha (α) : Best value that the Max player can guarantee
Beta (β) : Best value that the Min player can guarantee
If $\alpha \geq \beta$; further exploration of that branch is unnecessary

Eg - ① Left subtree evaluation

a - Min node evaluates 3 and 5, chooses 3.

b - $\alpha = -\infty$, $\beta = 3$ (prune branches if $\alpha \geq \beta$)



② Right subtree evaluation (pruning possibility)

a - The first value is 2. Min node must return ≤ 2

b - Since Max already has a better option (3), there's no need to evaluate the second child.

Key Benefits

Faster than Minmax

Works best with good move ordering.

Used in chess, checkers and AI games.

Q17 Explain WUMPUS world environment giving its [illegible] description. Explain how percept sequence is generated.

-> The Wumpus world is a simple, grid-based partially observable environment used in AI to ~~des~~ demonstrate intelligent agent behaviour.

PEAS (Performance Measure, Environment, Actuators, Sensors)

① Performance Measure
ⓐ Goal: Find gold and exit safety.
ⓑ Rewards:
+1000 for grabbing gold
-1000 for falling into a pit or encountering the Wumpus
-1 for each move (to encourage efficiency)

② Environment
ⓐ 4×4 grid world
ⓑ Contains
Agents (starts at (1,1))
Wumpus (dangerous creature)
Pits (deadly)
Gold (~~got~~ goal)
ⓒ Walls form boundaries.

③ Actuators
Move: Left, Right, UP, Down
Grab: Pick up gold
Climb: Exit if at (1,1)

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④ Sensors
Breese (If adjacent to a pit)
Stench (If adjacent to Wumpus)
Glitter (If gold is present)
Bump (If hitting a wall)

Percept Sequence Generation
A Percept sequence is the history of all percepts the agent has received

At each step, the agent receives a 5-tuple percept (Breeze, Stench, Glitter, Bump, Scream).

Exp sequence

At (1,1): (None, None, None, None, None)
Move to (2,1): (Breeze, None, None, None, None) (Near pit)
Move to (2,2): (Breeze, Stench, None, None, None) (Near pit and Wumpus)
Move to (3,2): (None, Stench, Glitter, None, None) (Gold nearby)

The agent uses these percepts to build a knowledge base and make intelligent decisions.

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Q18 Solve the following Crypto-arithematic problems
SEND + MORE = MONEY

→ Step 1: Assign Letters to Digits
Each letter repents a unique ~~to~~ digits, and
leading digits cannot be zero

Let's assign S, M ≠ 0 (Since they are the first digits of numbers)

Step 2: Identify the structure of the Sum

Step 3: Solve digit to Digit
① M = 1 (Since MONEY has one more digit)
② Column 4: D + E = Y (or D + E + carry = Y)
③ Column 3: N + R = E (or N + R + carry = E)
④ Column 2: E + O = N (or E + O + carry = N)
⑤ Column 1: S + M = O (or S + M + carry = O)

Step 4: Assign values

M = 1	N = 6
O = 0	D = 7
S = 9	R = 8
E = 5	Y = 2

Step 5: Verify Calculation

$$\begin{array}{r} 9567 \\ +\ 1085 \\ \hline 10652 \end{array}$$

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Q19 Consider the following axioms
All people who are graduating are happy
All happy people are ~~willing~~ smiling Someone is gradually
→

Step 1: Define predicates
$G(x)$ is graduating
$H(x)$ is happy
$S(x)$ is smilling.

Step 2: Translate Axioms into logic
(a) All people who are graduating are happy
$$\forall x (G(x) \rightarrow H(x))$$
(b) All happy people are smilling
$$\forall x (H(x) \rightarrow S(x))$$
(c) Someone is graduating
$$\exists x\, G(x)$$

Step 3: Logical deduction.
From $\exists x\, G(x)$, let's say there exists some person a such that $G(a)$ is true.
Using Modus Ponens on the first axiom.
$$G(a) \rightarrow H(a)$$
Sine $G(a)$ is true, we conclude
$H(a)$ is true.
Now applying Modus Ponens on the second axiom
$$H(a) \rightarrow S(a)$$
Sine $H(a)$ is true we can conclude
$S(a)$ is true.

Sine $S(a)$ is ~~smiling~~ true for some a, someone is smiling

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① Represent these axioms in first order predicate logic

Lets define predicates

G(x): x is graduating

H(x): x is happy

S(x): x is smiling

Given axioms

① All people who are graduating are happy

$\forall x (G(x) \rightarrow H(x))$

② All happy people are smiling

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

③ Someone is graduating

$\exists x (G(x))$

② Convert to clause form

ⓐ Eliminate implications

$A \rightarrow B$ is equivalent to $\neg A \vee B$

$\forall x (\neg G(x) \vee H(x))$

$\forall x (\neg H(x) \vee S(x))$

$\exists x (G(x))$

ⓑ Convert extensial quantifier to skolem constant

Since $\exists x (G(x))$, introduce a constant a such that $G(a)$

ⓒ Convert to clause form (Conjunctive Normal Form - CNF)

Convert each formula into disjunction of literals.

Clauses → ① $\neg G(x) \vee H(x)$

② $\neg H(x) \vee S(x)$

③ $G(a)$ (from Skolemisation)

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3) Prove "Is someone smiling" using resolution.

a) Negate the goal

Assume the negation $\neg S(x)$

Convert to clause form $\neg S(y)$ (introducing a new variable)

b) Resolution steps

From $G(a)$ and $\neg G(x) \vee H(x)$, substitute $x = a$:

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

Since $G(a)$ is given, resolve $H(a)$

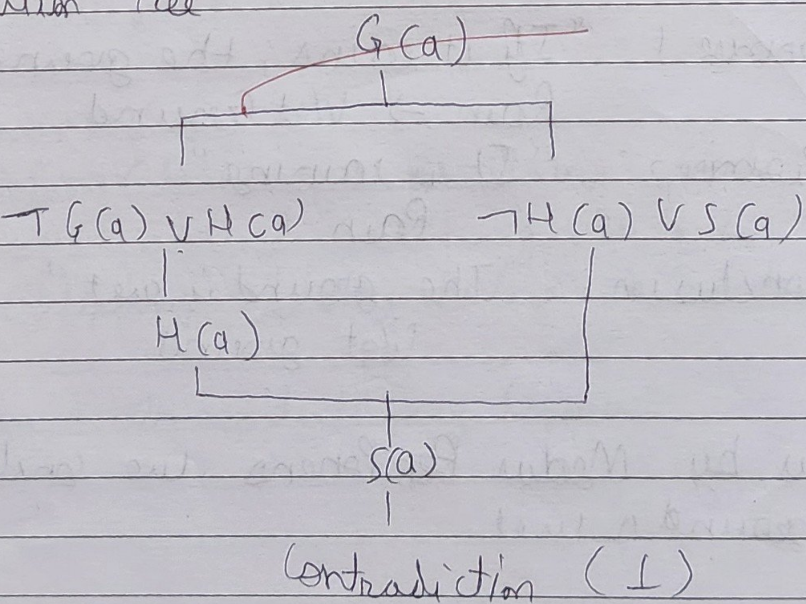
From $H(a)$ and $\neg H(x) \vee S(x)$, substitute $x = a$:

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

Since $H(a)$ is known, resolve $S(a)$

Contradiction with $\neg S(y)$ since substituting $y = a$ gives $S(a)$ and $\neg S(a)$

c) Resolution Tree



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Q20 Explain Modus ponen with suitable example

→ Modus Ponens explaination

Modus Ponens (Latin for "mode that affirms") is a fundamental rule of inheritance in logic.

It follows the structure

① Premise 1: $P \to Q$ (if P, then Q)
② Premise 2: P (P is true)
③ Conclusion: Q (Thus Q is true)

This rule states that if a conditional statement ($P \to Q$) is true and its antecedant (P) is true, then the consequent (Q) must be true.

Ex of Modus Ponens.

Senario:

① Premise 1: "If it rains, the ground will be wet
Rain → Wet Ground.
② Premise 2: "It is raining"
Rain
③ Conclusion: "The ground is wet"
Wet ground.

Thus, by Modus ~~Per~~ Ponens, we conclude that the ground is wet.

Teacher's Sign.:

Q21 Explain forward chaining and backward chaining algorithm with the help of example

→

① Forward Chaining (Data-driven Reasoning)

ⓐ Starts with known facts and applies rules to infer new facts until the goal is reached.

ⓑ Works like a bottom-up approach.

Example of forward chaining.

Knowledge Base (Rules)

ⓐ If it rains, the ground is wet. → Rain → Wet Ground

ⓑ If the ground is wet, it is slippery → Wet Ground → Slippery

ⓒ If it is slippery accidents may happen → Slippery → Accident

Given Fact

It is raining → Rain

Inference Process

① Rain (Given) → Using Rule 1 → Wet Ground

② Wet Ground → Using Rule 2 → Slippery

③ Slippery → Using Rule 3 → Accident

Conclusion → An accident may happen.

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Q21 F

② Backward Cha
~~Go~~ Starts with a goal and works backward to check if known facts support it

Works like a top-down approach

Eg of Backward chaining

Goal:
Will an accident happen? -> Need to prove accident

Inference process
① To prove Accident, check Rule 3: Slippery -> Accident
Need to prove Slippery.

② To prove Slippery, check Rule 2: Wet Ground -> Slippery
Need to prove Wet Ground.

③ To prove Wet Ground, check Rule 1: Rain -> Wet Ground
Need to prove Rain

④ Fact: Rain is already known, so we confirm

Rain -> Wet Ground
Wet Ground -> Slippery
Slippery -> Accident

Conclusion -> An accident may happen

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