Forward and Backward Chaining in AI

Inference Techniques in Rule-Based Systems

Overview

- What is Forward Chaining?
- What is Backward Chaining?
- Practical Examples
- Uses in AI
- Comparison

What is Forward Chaining?

- Data-driven inference
- Starts with known facts
- Applies rules to infer new facts until goal is reached

What is Backward Chaining?

- Goal-driven inference
- Starts from goal
- Works backward to check if it can be supported by facts

Example 1: Medical Diagnosis – Rules

1. IF fever AND cough THEN flu
2. IF headache AND fatigue THEN flu
3. IF flu THEN recommend rest and hydration

Example 1: Medical Diagnosis – Forward Chaining

- Facts: Patient has fever and cough

→ Rule 1 fires → flu inferred

→ Rule 3 fires → recommend rest and hydration

Example 1: Medical Diagnosis – Backward Chaining

- Goal: Recommend rest and hydration

→ Requires: flu

→ Rule 1 OR Rule 2 can infer flu

→ Check Rule 1: Fever and Cough? Yes

→ Flu confirmed → Recommend rest

Example 2: Animal Identification – Rules

1. IF has hair THEN mammal
2. IF mammal AND pointed teeth AND claws AND forward-facing eyes THEN carnivore
3. IF carnivore AND tawny color AND black stripes THEN tiger

Example 2: Animal Identification – Facts

- Has hair
- Pointed teeth
- Claws
- Forward-facing eyes
- Tawny color
- Black stripes

Example 2: Animal Identification – Forward Chaining

→ Hair → Mammal

→ Mammal + teeth + claws + eyes → Carnivore

→ Carnivore + color + stripes → Tiger

Example 2: Animal Identification – Backward Chaining

- Goal: Is the animal a Tiger?

→ Requires: Carnivore + Tawny + Black stripes

→ Check carnivore:

  → Requires: Mammal + teeth + claws + eyes

  → Check mammal: Has hair → Yes

→ All conditions satisfied → Tiger confirmed

Uses of Forward Chaining

- Expert systems (e.g., medical diagnosis)
- Real-time monitoring systems
- Event-based automation (e.g., smart homes)
- Business rules engines
- Game AI

Uses of Backward Chaining

- Diagnostic assistants and help desks
- Theorem proving and logic programming (e.g., Prolog)
- Planning in AI and robotics
- Expert systems with focused goals

Forward vs Backward Chaining – Comparison

	Forward Chaining	Backward Chaining
Starts From	Facts	Goal
Reasoning	Data-driven	Goal-driven
Best When	Lots of data	Specific goal
Speed	Slower	Faster
Examples	Monitoring	Diagnosis

Summary

- Forward: From facts to conclusions
- Backward: From goals to validating facts
- Both essential in rule-based AI applications