CSE-AI TY A div

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Assignment 7

Implement Forward Chaining Algorithm (Medical Diagnosis)

Problem Statement:

To implement a **Forward Chaining Algorithm** for **medical diagnosis**, inferring whether a patient has the **Flu** based on observed symptoms such as Fever, Cough, and Body Ache, using a set of predefined rules.

Objective:

To understand **rule-based reasoning** and **knowledge-based inference** in AI by applying the forward chaining technique to derive conclusions from initial facts.

Requirements:

- Input: Initial facts provided by the doctor (Fever, Cough, Body Ache).
- Output: Step-by-step inference showing which rules are applied and the final conclusion (Flu).
- Approach: **Forward Chaining** — derive new facts from existing facts until the goal is reached.

Operating System:

Windows / Linux / macOS

Libraries and Packages Used:

- **C++ iostream**, **string**, and **map** for representing facts and rules.
- No external libraries required.

Theory:

Definition:

Forward Chaining is a **data-driven reasoning** technique used in **expert systems**, where inference starts from known facts and applies rules to deduce new facts until the goal is reached.

Structure:

- **Facts:** Initial observations (e.g., Fever, Cough, Body Ache).
- **Rules:** Knowledge base representing conditional statements.
    1. Fever $\wedge$ Cough $\Rightarrow$ ViralInfection
    2. ViralInfection $\wedge$ BodyAche $\Rightarrow$ FluSymptoms
    3. FluSymptoms $\Rightarrow$ Flu
- **Inference Engine:** Applies rules iteratively to deduce new facts.

Methodology:

1. Represent **initial facts** in a set or list.
2. Store **rules** as conditional statements linking symptoms to diagnoses.
3. Iteratively check if the **conditions of any rule** are satisfied by current facts.
4. If a rule's conditions are satisfied, **add the new fact** to the knowledge base.
5. Repeat until the **goal (Flu)** is inferred.
6. Display the **step-by-step application** of rules and inferred facts.

Advantages:

- Simple and intuitive for **rule-based reasoning**.
- Works well for **forward reasoning in expert systems**.
- Easy to implement and extend with new rules or facts.

Limitations:

- Can be **inefficient** for large knowledge bases.
- May generate unnecessary facts if rules are not optimized.
- Only works with **deterministic, fully known rules**.

Working / Algorithm:

Algorithm Steps:

1. Initialize **facts**: Fever, Cough, Body Ache.
2. For each rule in the knowledge base:
    - Check if all **antecedents** (conditions) are present in the current facts.
    - If yes, **infer the consequent** (new fact) and add it to the facts.
    - Display which rule was applied and the inferred fact.
3. Repeat until **no more rules can be applied** or goal is reached.
4. Output the final conclusion: Flu.

Example Step-by-Step Inference:

```
Initial Facts: Fever, Cough, BodyAche

Step 1: Apply Rule 1 → Fever ∧ Cough ⇒ ViralInfection
Current Facts: Fever, Cough, BodyAche, ViralInfection

Step 2: Apply Rule 2 → ViralInfection ∧ BodyAche ⇒ FluSymptoms
Current Facts: Fever, Cough, BodyAche, ViralInfection, FluSymptoms
```

```
Step 3: Apply Rule 3 → FluSymptoms ⇒ Flu
Current Facts: Fever, Cough, BodyAche, ViralInfection, FluSymptoms,
Flu

Conclusion: Patient has Flu
```

Conclusion:

The **Forward Chaining Algorithm** demonstrates **data-driven reasoning** in expert systems. By iteratively applying rules to initial facts, it effectively infers a diagnosis. This method is widely used in **medical expert systems**, **troubleshooting systems**, and other AI applications that rely on **knowledge-based inference**.