Assignment No: - 7

Name :- Isha Ghorpade

Enrollnment :- 22420020

Roll :- 381066

Problem Statement

Implement the Forward Chaining Algorithm for reasoning in a knowledge-based system.

Objectives

- To understand the concept of inference mechanisms in AI.
- To study the Forward Chaining algorithm as a reasoning strategy.
- To apply rules iteratively to derive new facts from a knowledge base.
- To demonstrate reasoning using production rules.

Theory

Introduction

In Artificial Intelligence, knowledge-based systems use inference engines to derive conclusions from stored knowledge.

- Forward Chaining is a data-driven reasoning approach.
- It starts with the known facts and applies inference rules to generate new facts until a goal or conclusion is reached.

It is widely used in expert systems, rule-based reasoning, and decision-making systems.

Forward Chaining Mechanism

- Works like IF–THEN rules.
- Starts with the initial facts.
- Applies rules whose premises match the known facts.
- Adds the conclusion to the fact base.
- Repeats the process until:
    1. The goal is found, or

2. No more rules can be applied.

Example

Knowledge Base:

1. IF it rains THEN the ground is wet.
2. IF the ground is wet THEN the game is cancelled.

Facts:

- It rains.

Reasoning with Forward Chaining:

- From fact (It rains) + rule (1) ⇒ The ground is wet.
- From fact (The ground is wet) + rule (2) ⇒ The game is cancelled.
- Goal achieved.

Algorithm (Forward Chaining)

1. Start with the initial set of facts.
2. Repeat until goal is found OR no new facts can be derived:
   a. For each rule in the knowledge base:
      i. If the rule's premises are satisfied by current facts:
         - Add the conclusion to the fact base.
         - Mark rule as applied.
3. If goal is in the fact base → SUCCESS.
4. Else → FAIL (goal cannot be derived).

Characteristics

- Type: Data-driven inference.
- Direction: From facts → conclusions.
- Control: Explores all possible inferences from known facts.

Advantages

- Simple and systematic reasoning process.
- Useful when many initial facts are available.
- Works well in expert systems and diagnosis applications.
- Guarantees completeness (will find all possible conclusions).

Limitations

- Can be computationally expensive if knowledge base is large.
- May generate many irrelevant facts before reaching goal.
- Not efficient when goal is clearly defined but facts are limited (Backward Chaining works better there).

Applications

- Expert systems (MYCIN, DENDRAL).
- Medical diagnosis (reasoning from symptoms to disease).
- Decision-making in business and management.
- Control systems in robotics and automation.

Conclusion

The Forward Chaining Algorithm is a data-driven inference technique widely used in AI for reasoning and expert systems. By repeatedly applying inference rules to known facts, it derives new facts until the goal is achieved. Although sometimes inefficient for large knowledge bases, it ensures completeness and is highly useful in domains where many facts are known in advance.