**Assignment 7**

**Problem Statement**: Implement Forward Chaining Algorithm.

**Library**

For implementing the Forward Chaining Algorithm, you may consider using the following libraries:

* **Python Standard Library**: The provided code utilizes basic data structures (lists, sets) and control flow without external dependencies.
* **NumPy or Pandas**: If you need to handle larger sets of facts or rules in a more structured format.

**Theory**

The Forward Chaining method is based on the following theoretical principles:

* **Rule-Based Reasoning**: It operates on a set of conditional rules (if-then statements). Each rule consists of conditions that must be satisfied (antecedents) and a conclusion (consequent).
* **Inference Process**: The algorithm iteratively checks the facts against the rules. When the conditions of a rule are met, the conclusion is added to the known facts, which may trigger additional conclusions from other rules.
* **Data-Driven Approach**: Unlike backward chaining, which starts with a goal and works backward, forward chaining starts with available facts and uses them to draw new conclusions.

**Methodology**

1. **Initialization**:
   * Define the initial set of facts.
   * Create a list of rules where each rule consists of conditions and a conclusion.
2. **Inference Process**:
   * Initialize a set to keep track of inferred facts.
   * Use a loop to continuously apply the rules until no new facts can be inferred:
     + For each rule, check if all conditions are satisfied by the current set of inferred facts.
     + If a rule's conditions are met and its conclusion is not already inferred, add the conclusion to the set of inferred facts and mark that a new fact has been added.
3. **Termination**:
   * The process continues until a full pass through the rules yields no new conclusions.

**Advantages**

* **Simplicity**: The Forward Chaining method is straightforward to implement and understand, making it suitable for educational purposes.
* **Completeness**: It guarantees that all possible conclusions will be derived from the initial facts, as long as the rules are well-defined.
* **Immediate Feedback**: New facts can be inferred as soon as conditions are met, allowing for real-time updates to knowledge bases.

**Disadvantages**

* **Scalability Issues**: The performance may degrade with a large number of facts and rules, as each fact needs to be checked against all rules repeatedly.
* **Redundancy**: The same fact may be inferred multiple times if multiple rules lead to the same conclusion.
* **No Goal-Oriented Reasoning**: It does not work backward from goals, which can be less efficient in certain applications compared to backward chaining.

**Conclusion**

The Forward Chaining Algorithm is an effective method for drawing inferences in rule-based systems. It allows for the systematic derivation of conclusions from known facts and rules, making it a valuable tool in AI applications such as expert systems and decision-making processes. While it has limitations in terms of scalability and efficiency, its simplicity and completeness make it an important foundational technique in knowledge representation and reasoning.