Forward Chaining Analogy — Detective Gathering Clues

AIM

To implement a simple **forward chaining** inference system where the detective starts from known evidence (facts) and applies rules step-by-step to infer new conclusions automatically until no more can be derived.

PROCEDURE

1. **Start with initial evidence** (facts known).
2. **Apply rules** whose premises are satisfied by current facts.
3. Add the rule's conclusion to the facts.
4. Repeat applying rules as long as new facts can be inferred.
5. Stop when no new facts can be added.
6. Check if the goal/conclusion is among the derived facts.

CODE :

```
class ForwardChaining:
    def __init__(self, rules, facts):
        """
        rules: dict {conclusion: [premises]}
        facts: set of known facts
```

```
        """
        self.rules = rules
        self.facts = set(facts)

    def infer(self):
        added = True
        while added:
            added = False
            for conclusion, premises in self.rules.items():
                if conclusion not in self.facts and all(p in self.facts for p in premises):
                    self.facts.add(conclusion)
                    added = True

    def query(self, goal):
        self.infer()
        return goal in self.facts


# Example knowledge base: Detective case
rules = {
    'Suspect is guilty': ['Motive', 'Opportunity'],
    'Motive': ['Financial trouble'],
    'Opportunity': ['At crime scene']
}

facts = ['Financial trouble', 'At crime scene']

fc = ForwardChaining(rules, facts)

goal = 'Suspect is guilty'
result = fc.query(goal)

print(f"Can the detective conclude '{goal}'? {result}")
print(f"Facts known after inference: {fc.facts}")
```

OUTPUT :

```
Can the detective conclude 'Suspect is guilty'? True
Facts known after inference: {'Opportunity', 'Financial trouble', 'Suspect is guilty', 'At crime scene', 'Motive'}
```

EXPLANATION

- Starting from facts: "Financial trouble" and "At crime scene"
- Forward chaining applies rules:
    - "Motive" inferred from "Financial trouble"
    - "Opportunity" inferred from "At crime scene"
    - "Suspect is guilty" inferred since both "Motive" and "Opportunity" are known
- The system adds new facts stepwise until no more new facts appear.
- Finally, the detective concludes "Suspect is guilty."

CONCLUSION

- Forward chaining is data-driven reasoning.
- It starts from facts and iteratively applies inference rules.
- It’s useful when all facts are known and the goal is unknown or multiple conclusions are possible.
- It mimics how a detective gathers clues and builds the case progressively.