IT307B : Artificial Intelligence and Machine Learning

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Aim: Implement Resolution Inference Rule Using Prolog

Theory:

Inference is the act or method of deriving logical conclusions from premises known or assumed to be true. The conclusion drawn is additionally known as an idiomatic.

The laws of valid inference are studied within the field of logic.
Human inference (i.e. how humans draw conclusions) is historically studied inside the sphere of cognitive psychology; artificial intelligence researchers develop machine-driven inference systems to emulate human inference. statistical inference permits for inference from quantitative data.

The process by which a conclusion is inferred from multiple observations is named inductive reasoning. The conclusion is also correct or incorrect, or correct to within a certain degree of accuracy, or correct in certain situations. Conclusions inferred from multiple observations are also tested by additional observations.

A conclusion reached on the basis of proof and reasoning.
The process of reaching such a conclusion: "order, health, and by inference cleanliness".

The validity of an inference depends on the shape of the inference. That is, the word "valid" does not refer to the reality of the premises or the conclusion, but rather to the form of the inference. an inference may be valid though the elements are false, and may be invalid though the elements are true. However, a valid form with true premises can always have a real conclusion.

Humans are best at understanding, reasoning, and interpreting knowledge. Humans know things, which is knowledge and as per their knowledge they perform various actions in the real world. **But how machines do all these things comes under knowledge representation and reasoning**. Hence we can describe Knowledge representation as following:

- Knowledge representation and reasoning (KR, KRR) is the part of Artificial intelligence which is concerned with AI agents thinking and how thinking contributes to intelligent behavior of agents.

- It is responsible for representing information about the real world so that a computer can understand and can utilize this knowledge to solve complex real world problems such as diagnosing a medical condition or communicating with humans in natural language.
- It is also a way which describes how we can represent knowledge in artificial intelligence. Knowledge representation is not just storing data into some database, but it also enables an intelligent machine to learn from that knowledge and experiences so that it can behave intelligently like a human.

Following are the kind of knowledge which needs to be represented in AI systems:

- **Object:** All the facts about objects in our world domain. E.g., Guitars contains strings, trumpets are brass instruments.
- **Events:** Events are the actions which occur in our world.
- **Performance:** It describes behavior which involves knowledge about how to do things.
- **Meta-knowledge:** It is knowledge about what we know.
- **Facts:** Facts are the truths about the real world and what we represent.
- **Knowledge-Base:** The Knowledgebase is a group of the Sentences (Here, sentences are used as a technical term and not identical with the English language).

For example, consider the syllogistic form

All Cretans are islanders.
All islanders are liars.
Therefore, all Cretans are liars.
Or more generally,

$\forall X\ P(X) \rightarrow Q(X)$

$\forall X\ Q(X) \rightarrow R(X)$

Therefore, $\forall X\ P(X) \rightarrow R(X)$

In CNF, the antecedents become:

$\neg P(X) \vee Q(X)$

$\neg Q(Y) \vee R(Y)$

(Note that the variable in the second clause was renamed to make it clear that variables in different clauses are distinct.)

Now, unifying Q(X) in the first clause with ¬Q(Y) in the second clause means that X and Y become the same variable anyway. Substituting this into the remaining clauses and combining them gives the conclusion:

$\neg P(X) \vee R(X)$

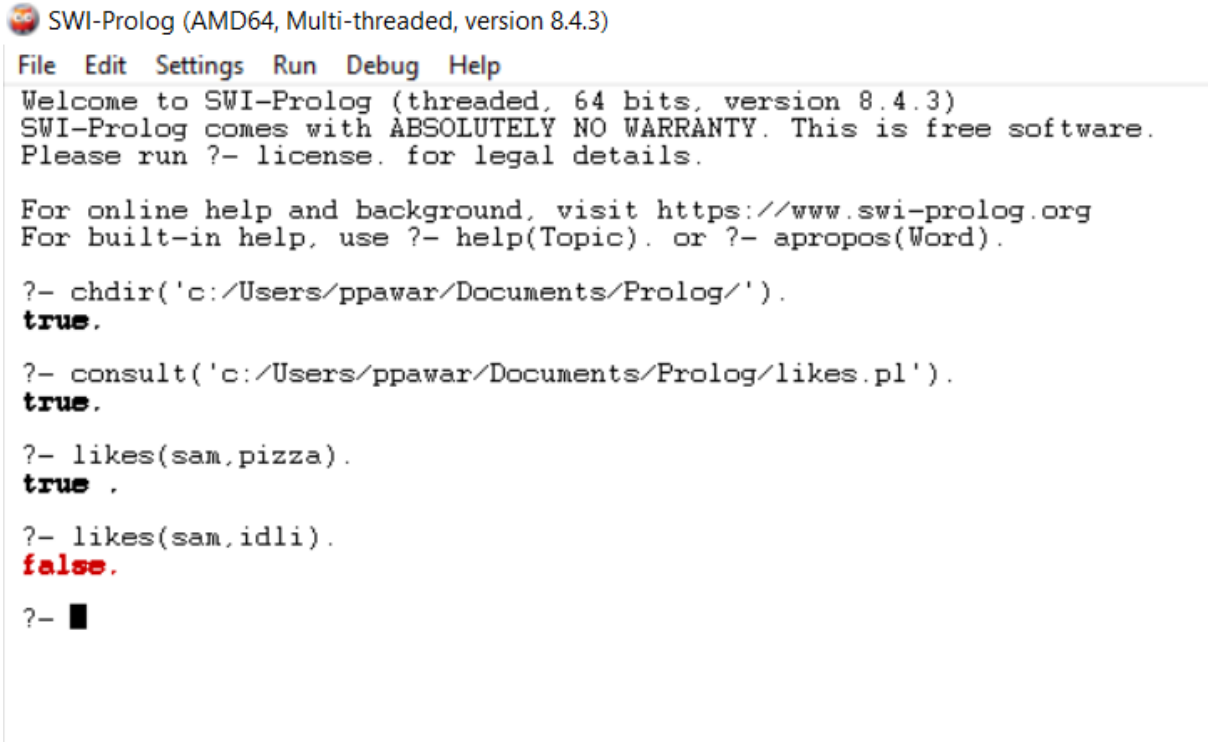
The resolution rule, as defined by Robinson, also incorporated factoring, which unifies two literals in the same clause, before or during the application of resolution as defined above. The resulting inference rule is refutation complete, in that a set of clauses is unsatisfiable if and only if there exists a derivation of the empty clause using resolution alone


Knowledge
Declare active Knowledge
Object facts
Heuristic Knowledge
Rule of thumb
Meta Knowledge
Knowledge about knowledge
Procedural Knowledge
Rules Procedure
Structural Knowledge
Relationship between object, concept

Code 1:

```
likes(sam,Food) :-
indian(Food),
mild(Food).
likes(sam,Food) :-
chinese(Food).
likes(sam,Food) :-
italian(Food).
likes(sam,chips).
indian(curry).
indian(dahl).
indian(tandoori).
indian(kurma).
mild(dahl).
mild(tandoori).
mild(kurma).
chinese(chow_mein).
chinese(chop_suey).
chinese(sweet_and_sour).
italian(pizza).
italian(spaghetti).
```

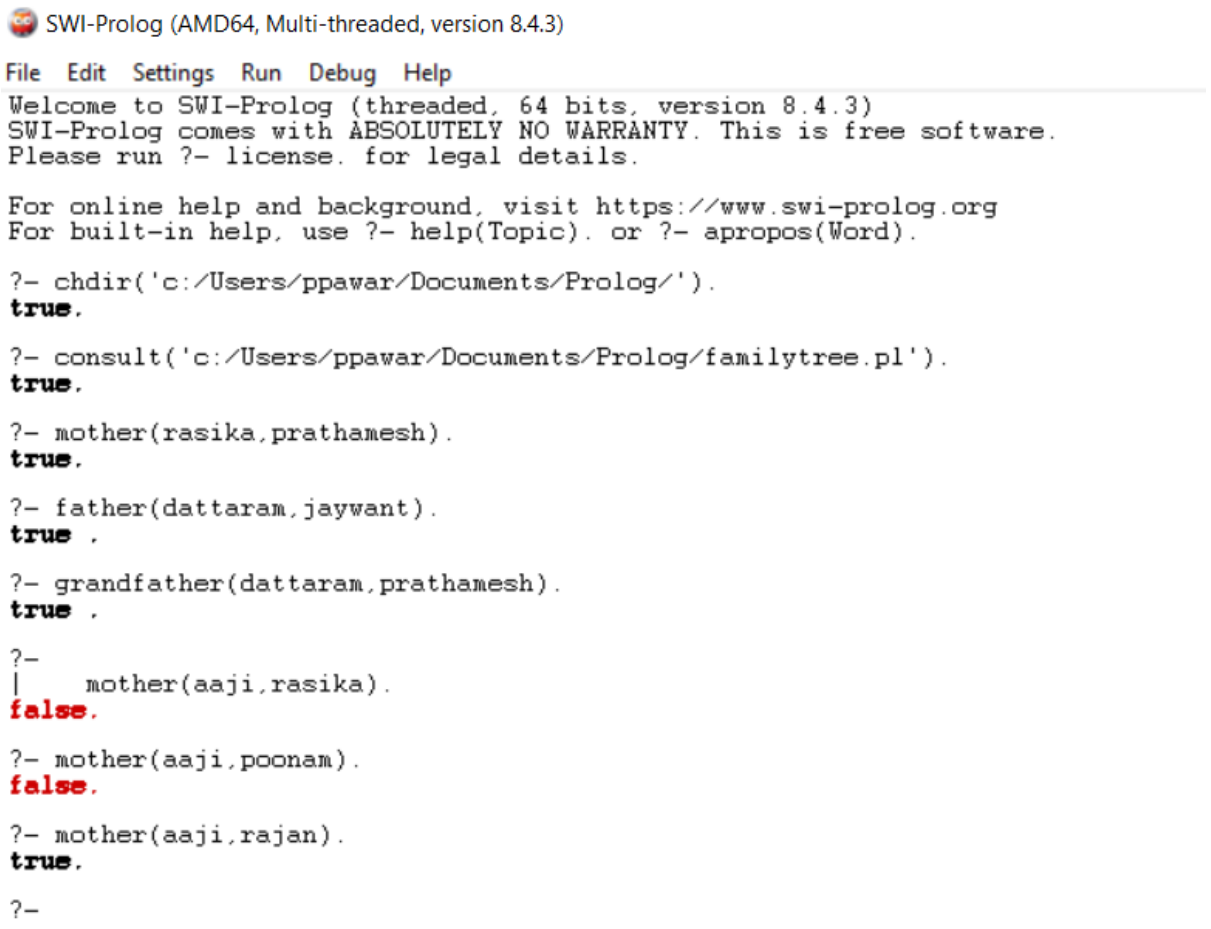
Output 1:



Code for Family Tree:

```
female(rasika).
female(poonam).
female(jayanti).
female(aatya).
female(aaji).

male(dattaram).
male(jaywant).
male(rajan).
male(prathamesh).

parent(dattaram,rajan).
parent(dattaram,jaywant).
parent(dattaram,aatya).
parent(aaji,rajan).
parent(aaji,jaywant).
parent(aaji,aatya).
parent(rajan,prathamesh).
parent(rajan,poonam).
parent(rasika,prathamesh).
parent(rasika,poonam).

partner(rajan,rasika).
partner(rasika,rajan).
partner(dattaram,aaji).
partner(aaji,dattaram).

husband(X,Y):- partner(X,Y),male(X).
wife(X,Y):- partner(X,Y),female(X).

mother(X,Y):- parent(X,Y),female(X).
father(X,Y):- parent(X,Y),male(X).

sister(X,Y):- parent(Z,X),parent(Z,Y),female(X),X\==Y.
brother(X,Y):-parent(Z,X),parent(Z,Y),male(X),X\==Y.

grandfather(X,Y):-parent(Z,Y),father(X,Z).
grandmother(X,Y):-parent(Z,Y),mother(X,Z).
```

Output for Family tree:



Assignment Question:

Suppose we know that

“if Richa is thin, then Akshay is not blonde or Sarika is not tall”

“if Sarika is tall then Janhvi is lovely”

“if Janhvi is lovely and Akshay is blonde then Richa is thin”

“Akshay is blonde”

Can we deduce that “Sarika is not tall” ?

Answer:

We cannot use SWI-prolog to solve the above question.

Conclusion:

In this experiment, I Studied about **knowledge representation and reasoning** and applied it in SWI-Prolog for implementation of family trees.