

Artificial Intelligence

Lecture 17

- Prolog Programming for AI



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Outlines

- **What is Prolog?**
- **The Structure of Prolog Programs**
 - Facts
 - Rules
 - Query
- **Clause and Programs**
- **Some simple Prolog programs**
- ...



What is Prolog?

- Prolog, which stands for PROgramming in LOGic, is the most widely available language in the logic programming paradigm. Logic and therefore Prolog is based the mathematical notions of relations and logical inference.
- Prolog is a programming language for symbolic, non-numeric computation. It is specially well suited for solving problems that involve objects and relations between objects.
- The program consists of a data base of facts and logical relationships (rules) which describe the relationships which hold for the given application.
- Prolog is used in artificial intelligence applications such as natural language interfaces, automated reasoning systems and expert systems.

The Structure of Prolog Programs

- A Prolog program consists of a database of facts and rules, and queries (questions).
 - Fact:
 - Rule: ... :-
 - Query: ?-

Facts

- A fact in everyday language is often a proposition like ``It is sunny." or ``It is summer." In Prolog such facts could be represented as follows:
 - 'It is sunny'.
 - 'It is summer'.
- The following clause 'parent' represents the fact that Tom is a parent of Bob can be written as:
 - Parent(tom,bob).
- In Prolog, a fact is a predicate followed by a dot.
- The intuitive meaning of a fact is that we define a certain instance of a relation as being true.

Rules

- Rules extend the capabilities of a logic program.
- They are what give Prolog the ability to pursue its decision-making process.
- The following program contains two rules for temperature.
 - The first rule is read as follows: ``It is hot if it is summer and it is sunny."''
 - The second rule is read as follows: ``It is cold if it is winter and it is snowing."''
 - 'It is sunny'.
 - 'It is summer'.
 - 'It is hot' :- 'It is summer', 'It is sunny'.
 - 'It is cold' :- 'It is winter', 'It is snowing'.

Rules

- The specification of the mother relation can be based on the following logical statement:
 - For all X and Y, X is the mother of Y if X is a parent of Y and X is a female.
- In Prolog, a rule consists of a head (a predicate) and a body. (a sequence of predicates separated by commas).
 - Head and body are separated by the sign :- and a rule has to be terminated by a dot.
- The above example can be written in Prolog as the following rule:
 - `mother(X,Y) :- parent(X,Y), female(X).`

Program with Rules

- The following program contains a number of predicates that describe a family's genealogical relationships:

Prolog Program-1:

% Facts

```
female(amy).
female(johnette).
male(anthony).
male(bruce).
male(ogden).
parentof(amy,johnette).
parentof(amy,anthony).
parentof(amy,bruce).
parentof(ogden,johnette).
parentof(ogden,anthony).
parentof(ogden,bruce).
```

% Rules

```
siblingof(X,Y):-
    parentof(Z,X), parentof(Z,Y).
siblingof(X,Y):-
    parentof(Z,X), parentof(Z,Y).
brotherof(X,Y):-
    parentof(Z,X), male(X), parentof(Z,Y).
```


Clauses, Programs and Queries

- Facts and rules are also called **clauses**.
- A Prolog **program** is a sequence of clauses.
- After compilation a Prolog program is run by submitting queries to the interpreter.
- A **query** in Prolog is the action of asking the program about information contained within its data base.

Query

- A query in Prolog is the action of asking the program about information contained within its data base.
- Thus, queries usually occur in the interactive mode. After a program is loaded, you will receive the query prompt,

?-

at which time you can ask the run time system about information in the data base.

?- 'It is sunny'.

and it will respond with the answer

Yes

?-

- A **YES** means that the information in the data base is consistent with the subject of the query.

Query

- If the data base does not contain sufficient information to answer a query, then it answers the query with a no.

?- 'It is cold'.

no

?-

Prolog Environment

- **SWI Prolog download :**
 - <https://www.swi-prolog.org/>
- **LIVE Prolog program editor and execution:**
 - <https://swish.swi-prolog.org/>

Simple Prolog Programs

- **Sample Program-2:**

```
% Print a list of items.
item(tshirt).
item(pants).
item(caps).
products :-
    item(X), write(X), nl, fail.

?- products.
tshirt
pants
caps
false
```

- **Sample Program-3:**

```
% Print the GPA of a given student.
gpa(ashik, 3.5).
gpa(fahim, 3.2).
gpa(rukon, 3.0).
gpa(isha, 3.3).
gpa(akhi, 3.4).
result :-
    write("Enter student name:"),
    read(X), gpa(X,Y),nl,
    write("GPA is "),
    write(Y).

?- result.
Enter student name: isha.
GPA is 3.3
```

Simple Prolog Programs

- **Sample Program-4:**

```
% Nth Fibonacci number.  
fib(1,1).  
fib(2,1).  
fib(N, F) :- N > 2,  
             N1 is N-1, N2 is N-2,  
             fib(N1, F1),  
             fib(N2, F2),  
             F is F1 + F2.  
  
?- fib(7, F).  
F = 13.
```

- **Sample Program-5:**

```
% Factorial of a number.  
fact(0, 1).  
fact(N, F) :-  
             N > 0,  
             N1 is N-1,  
             fact(N1, F1),  
             F is N*F1.  
  
?- fact(5, F).  
F = 120.
```

Prolog Programming for AI
TO BE CONTINUED...