

Programming Languages: Logic Paradigm

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Outline

1 Logic Programming Paradigm

2 Prolog basics

3 Prolog Terms

Logic Programming Paradigm

- Based on logic and declarative programming
- 60's and early 70's
- Prolog (**P**rogramming in **l**ogic, 1972) is the most well known representative of the paradigm.
- Prolog is based on Horn clauses and SLD resolution
- Mostly developed in fifth generation computer systems project
- Specially designed for theorem proof and artificial intelligence but allows general purpose computation.
- Some other languages in paradigm: ALF, Frill, Gödel, Mercury, Oz, Ciao, λ Prolog, datalog, and CLP languages

Constraint Logic Programming

- Clause: disjunction of universally quantified literals,

$$\forall (L_1 \vee L_2 \vee \dots \vee L_n)$$

- A logic program clause is a clause with exactly one positive literal

$$\begin{aligned} \forall (A \vee \neg A_1 \vee \neg A_2 \dots \vee \neg A_n) &\equiv \\ \forall (A \Leftarrow A_1 \wedge A_2 \dots \wedge A_n) & \end{aligned}$$

- A goal clause: no positive literal

$$\forall (\neg A_1 \vee \neg A_2 \dots \vee \neg A_n)$$

- Proof by refutation, try to unsatisfy the clauses with a goal clause G . Find $\exists(G)$.
- Linear resolution for definite programs with constraints and selected atom.

What does Prolog look like?

```
father(ahmet, ayse).  
father(hasan, ahmet).  
mother(fatma, ayse).  
mother(hatice, fatma).  
parent(X,Y) :- father(X,Y).  
parent(X,Y) :- mother(X,Y).  
grandparent(X,Y) :- parent(X,Z), parent(Z,Y).
```

- CLP on first order terms. (Horn clauses).
- **Unification**. Bidirectional.
- **Backtracking**. Proof search based on trial of all matching clauses.

Prolog Terms

■ Atoms:

- 1 Strings with starting with a small letter and consist of `[a-zA-Z_0-9]*`
- 2 Strings consisting of only punctuation
- 3 Any string enclosed in back quotes

■ Numbers

■ Variables:

- 1 Strings with starting with a capital letter or `_` and consist of `[a-zA-Z_0-9]*`
- 2 `_` is the universal match symbol. Not variable

■ Structures:

- starts with an atom head
- has one or more arguments enclosed in paranthesis, separated by comma
- structure head cannot be a variable or anything other than atom.