Programming Language Concepts

Logic Prog. Paradigm

Onur Tolga Şehitoğlu

Bilgisayar Mühendisliği

Outline

Logic Programming Paradigm

- Based on logic and declarative programming
- 60's and early 70's
- Prolog (**Pro**gramming in **log**ic, 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, λProlog, datalog, and CLP languages

Constraint Logic Programming

- Clause: disjunction of universally quantified literals,

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

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

$$\forall(A \vee \neg A_1 \vee \neg A_2 \ldots \vee \neg A_n) \equiv$$
$$\forall(A \Leftarrow A_1 \wedge A_2 \ldots \wedge A_n)$$

- A goal clause: no positive literal

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

- 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 encolsed in paranthesis, separated by comma
  - structure head cannot be a variable or anything other than atom.