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 (*Programming in logic*, 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,
  \[ \forall (L_1 \lor L_2 \lor ... \lor L_n) \]

- A logic program clause is a clause with exactly one positive literal
  \[ \forall (A \lor \lnot A_1 \lor \lnot A_2 ... \lor \lnot A_n) \equiv \]
  \[ \forall (A \leftarrow A_1 \land A_2 ... \land A_n) \]

- A goal clause: no positive literal
  \[ \forall (\lnot A_1 \lor \lnot A_2 ... \lor \lnot A_n) \]

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