1. Introduction

Montag, 24. April 2017 08:30

Why different prog. languages? Slide 1+2

- Choose the right language for the right application
- Eases learning of new prog. languages

Main application area of logic programming:

- artificial intelligence
- expert systems
- robotics

Several Prolog implementations:

http://www.swi-prolog.org

Ex: Family Data Base as a Logic Program Slide 3

Prolog = Programming in Logic

Prolog-Prog. consists of facts and rules.

fact: predicate symbol(obj$_1$, ..., obj$_n$).

start with lower-case symbols

Comments in Prolog:

% .... end of line

or

/*
:
:
*/

Execution of logic prog: ask queries

```
?- male(gerd).
true

?- married(monika, werner).
false
```

↑ Prolog uses a closed-world-assumption:
If a statement is not implied by the formulas in the program, then it must be false.

To execute a program, one has to "load" it.
↑
Consult

Variables in Programs

Extend Prog. by the following fact:

```
human(X).
```

↑ variables start with capital letters

Variables in a program are universally quantified
(stand for all possible instantiations)

```
?- human(gerd).
true

?- human(5).
true
```

If a variable occurs several times in the same clause, then all of its occurrences have to be instantiated in the same way.

```
likes(X, Y).
```

everybody likes everybody

```
likes(X, X).
```

everybody just likes him/herself

Variables in Queries


```
?- motherOf(X, susanne).
```

Variables in queries are existentially quantified.
"Who is the mother of susanne?"

```
X = renate
```

```
?- motherOf(renate, Y).
```

"Who are the children of renate?"

```
Y = susanne ;
Y = peter
```

↑ stands for "or", can be used to let Prolog continue searching for solutions

In Prolog, the query determines what is input/output.

In Prolog, the query determines what is input / output.

Combination of Queries

Slide 5

comma stands for "and"

```
?- married(gerd, W), motherOf(W, susanne).
```

"Is gerd the father of susanne?"

Prolog first solves married(gerd, W)
↳ W = renate

Then it solves motherOf(renate, susanne).

- Prolog treats queries from left to right
- " " clauses in a prog. from top to bottom

```
?- mO(G, M), mO(M, aline)
```

G = monika, M = karin → mO(karin, aline) ✓

G = monika, M = klaus → mO(klaus, aline) ✓

G = renate, M = susanne → mO(susanne, aline) | □ ↑ "empty clause", means that the proof ended successfully

Prolog constructs a proof tree and backtracks in case of failure.

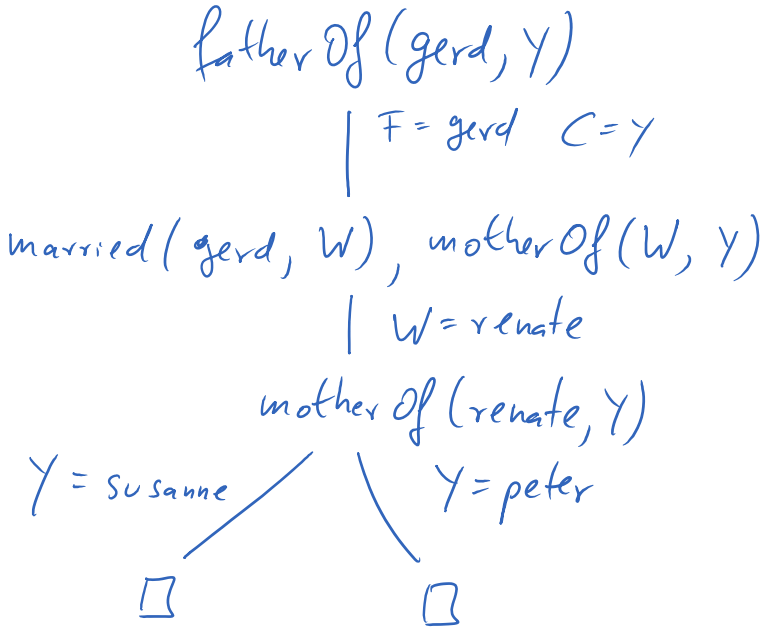
It stops as soon as □ is reached and returns the instantiation of the variables that corresponds to the path from the root to □.

Rules

Slide 6

Rules are needed to deduce new knowledge from existing knowledge.

```
fatherOf(F, C) :- married(F, W), motherOf(W, C).
   head        "if"        body
```



Several Rules for the same Predicate

Slide 7

```
parent(X, Y) :- motherOf(X, Y).
parent(X, Y) :- fatherOf(X, Y).
```

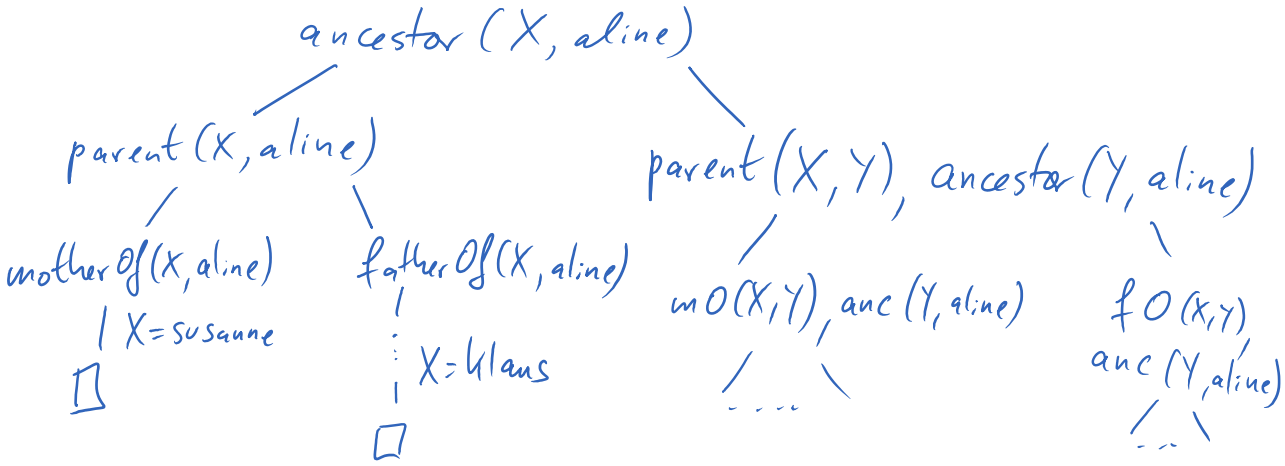
Alternative:

```
parent(X,Y) :- motherOf(X,Y) ; fatherOf(X,Y).
```

Recursive Rules

Slide 8

Recursion ~ can lead to non-termination



Characteristics of Logic Programming:

- Programs are just a collection of facts and rules, no control structures.
- LP resulted from automated theorem proving, program does not determine input/output, but this depends on the query
- LP particularly suitable for AI, deductive data bases, rapid prototyping

Contents of the Lecture:

1. Intro to LP
2. Basics of Predicate Logic
3. Resolution (Proof Principle used in LP)
4. Syntax + Semantics of Pure Logic Programs
5. The Programming Language Prolog
6. Constraint Logic Programming

Organization

- english
- german course notes (web)
- english handwritten course notes ← notes from the lecture, also on the web
- video (2013)
- web site: http://verify.rwth-aachen.de/lp17
- includes info on references, software, news, transparencies, exercise sheets, ...
- weekly exercise sheets
  - * Solve in groups of 3
  - * first ex. sheet this Friday (April 28)
  - * return ex. sheets next Friday
    - beginning of ex. course or
    - wooden box, E1, 2nd floor
  - * 50 % of the points needed to participate in the exam
  - * register to participate in the exercises until Friday (April 28)

ON OUR WEBSITE

(no L2P, no reg. for exercises on

Campus Office)