CS2136: Paradigms of Computation

Class 06: Satisfying Multiple Subgoals

Cut!

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But First...

z Schedule

y ...

z A little about not().

y Does not work with uninstantiated variables.

y See programs ‘fun’ and ‘likes4’.
OR

- Prolog really does have an “OR” operator.
- Use the semicolon: “;”.
- Usually clearer to use separate rules.
Satisfying Multiple Subgoals
Satisfying Multiple Subgoals

- Prolog tries to satisfy subgoals left-to-right.
- If a subgoal fails, Prolog backtracks and tries to resatisfy the goal to the left of the one that failed.
- Works the same way for subgoals which themselves have subgoals.
Try these queries with trace activated:

sister(mary,sid).
sister(X,sid).
Find the age status of john, paul, george, and ringo.

Note how each rule is self-contained.

You cannot query:

status(john).
Cut
Cut

- Indicated by “!”
  - i.e. exclamation point a.k.a. “bang”.
- Used to control backtracking.
- Use of cut is controversial and tricky.
  - Clocksin & Mellish refer to it as extralogical.
Cut: Success and Control of Backtracking

z Counts as a goal which succeeds, but...
  y All choices made up to that point are frozen.
  y If backtracking occurs, the cut prevents attempts to re-satisfy the goal.

z “an attempt to re-satisfy any goal between the parent goal and the cut goal will fail.” – Clocksin & Mellish, p. 84.
Consider:

foo :- a, b, c, !, d, e, f.

To start, can backtrack among a, b, and c.

Once Prolog reaches d, cannot backtrack back to c.

Can backtrack between d, e, and f.
Once someone is classified as a senior, do not bother checking if the person is a medium.
Once you have found that a person can only access basic facilities, do not bother checking for advanced facilities.
Combining Cut With Success

Tell Prolog it has found the right rule, so it can succeed and stop.

Sum up numbers from 1 to N:

\[
\text{sum}_\text{to}(1,1) :- !. /* Base case */
\]

\[
\text{sum}_\text{to}(N,\text{Res}) :- N1 \text{ is } N - 1, \\
\text{sum}_\text{to}(N1,\text{Res1}), \text{ Res is } \text{Res1} + N.
\]
Combining Cut With Failure

z Tells Prolog to stop trying, and indicate failure.

z Test for average taxpayer:

  y average_taxpayer(X) :- foreigner(X), !, fail.
  y average_taxpayer(X) :- spouse(X,Y),
                   gross_income(Y,Inc), Inc > 3000, !, fail.
  y average_taxpayer(X) :- gross_income(X,Inc),
                   2000 < Inc, 20000 > Inc.
Problems With Cut

Consider this program:

```prolog
number_of_parents(adam,0) :- !.
number_of_parents(eve,0) :- !.
number_of_parents(X,2).
```

The Result

z Using Cut is tricky!
Next Time

z Creating & Altering the Database
z First-Order Predicate Calculus
  y The theoretical basis for Prolog!