Prolog III

Lists

- Prolog represents a list using the ./2 relation but has a convenient bracket notation.
- [ ] is the empty list.
- [x, 2+2, [a, b, c]] is a list of three elements.
- The first element in the list is its "head".
- The list with the head removed is the "tail".

Lists

- Unification can be performed on lists:
  - [a, b, c] = [X, Y, Z] results in
    - results in X = a, Y = b, Z = c
  - [a, b, c] = [Head | Tail]
    - results in Head = a, Tail = [b, c]
- Nonempty lists can be matched against [Head|Tail].
- Empty lists will not match [Head|Tail].

Matching Heads and Tails

- If [a, b, c] = [Head | Tail], then
  a = Head and [b, c] = Tail
- If [a, b, c] = [X, Y | Tail], then
  a = X, b = Y, and [c] = Tail
- If [a, b, c] = [X, Y, Z | Tail], then
  a = X, b = Y, c = Z, and [ ] = Tail
- The tail of a list is always itself a list.
- [X | Y, Z] isn't legal.

Making Use of Unification

- Prolog has no functions. But you can use a parameter as an "output variable."
  - first([Head | Tail], X) :- X = Head.
- You can use unification in parameter lists to do much of the needed work
  - first([X | _], X).
  - second([_, X | _], X).
  - third([_, _, X | _], X).

Structures and Lists

- The "univ" operator, =.. , can be used to convert between structures and lists:
  - loves(chuck, X) =.. [loves, chuck, X]
- Double quotes indicate a list of ASCII values:
  - "abc" = [97, 98, 99]
  - This isn't usually very useful

Recursion

- Recursion is fully supported
- element(1, [X | _], X).
- element(N, [_ | X], Y) :-

```
        M is N - 1,
        element(M, X, Y).
```

- This is the typical way to process lists: do something with the head, recur with the tail.

member

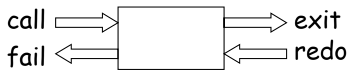
- member(X, [X | _]).
- member(X, [_ | Y]) :- member(X, Y).
- As usual, base cases go first, then recursive cases.
- There is in general no need for a "fail" case, because that's automatic.
  - member(_, [ ]) :- fail.

Accumulated Information

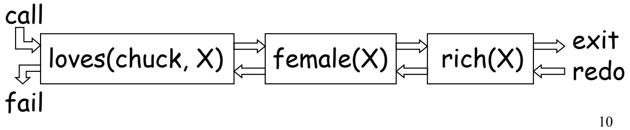
- If you reach a clause, you can assume that the earlier clauses of the same predicate have failed.
- member(X, [X | _]).
- If you fail this clause, the first element is not the one you want, so member(X, [_ | Y] :- member(X, Y).

Backtracking and Beads

- Each Prolog call is like a "bead" in a string of beads:



loves(chuck, X) :- female(X), rich(X).



Fail Loops

- It is possible to build a "fail loop" in Prolog

```
print_elements(List) :-
        member(X, List), write(X), nl,
        fail.
```

- But recursion is almost always better:

```
print_elements([Head|Tail]) :-
        write(Head), nl,
        print_elements(Tail).
```

Forcing a predicate to succeed

```
notice_objects_at(Place) :-
      at(X, Place),
      write('There is a '), write(X),
      write(' here.'), nl,
      fail.

notice_objects_at(_).
```

Forcing a predicate to fail

```
loves(chuck, X) :-
      really_ugly(X), !, fail.
loves(chuck, X) :-
      female(X), rich(X).
```

"Wrapping" another predicate

- The `buzz_off/0` predicate might succeed or fail. This is usually what we want.
- But sometimes we want to ignore failure.

```
optional_buzz_off :-
      buzz_off.

optional_buzz_off.
```

Asserting Clauses

- assert(*new_clause*).
  - assert(path(garden, n, toolshed)).
  - assert((loves(chuck,X) :- female(X) ,
            rich(X))).
- asserta(*new_clause*).
- assertz(*new_clause*).

Removing clauses

- retract(*clause*).
  - retract(path(garden, n, toolshed)).
  - retract(path(X, Y, X)).
  - retract((loves(chuck,X) :- female(X) ,
            rich(X))).
- abolish(path, 3).

Marking Clauses as “Dynamic”

- Standard Prolog allows you to assert and retract clauses without any restrictions.
- Sicstus and some others require you to mark variable clauses as “dynamic.”

  `:- dynamic i_am_at/1, at/2, alive/0.`
- The “`:-`” at the beginning says “do it now.”

Solving problems with *dynamic*

- If Prolog already knows a clause, and it's static, it's *too late* to mark it dynamic
- Prolog must see `:- dynamic functor/arity` *before* it sees any clauses of functor/arity.
  - This includes clauses loaded in from an earlier `consult`
- You can restart Sicstus Prolog, or…
- …you can use `abolish(`*functor, arity*`)`

Arithmetic

- The equals sign, `=`, means “unify.”
- `2+2` does not unify with `4`.
- To force arithmetic to be performed, use “`is`”: `X is 2 + 2, X = 4.`
- Comparisons `=:=` `=/=` `>` `>=` `<` `<=` also force their operands to be evaluated.
- `+ - * / mod`, *when evaluated*, have their usual meanings.

The End