CS 520: Introduction to Artificial Intelligence

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Lecture 13:

Prolog

Logic Programing

- **Goal:**
  - Tell computer the facts
  - Ask a question
  - Computer uses facts as needed to answer the question.
  - "logic + control = algorithm"
- **Reality:**
  - This is very hard
    - Sorted (x, y)<= permutation(x, y) ^ inorder(y)

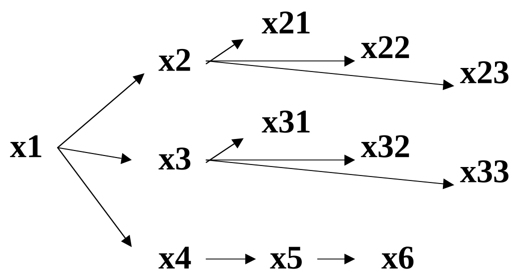
Prolog

- Fallback goal
  - Separate logic from control
    - Control implicit in way logic formulated
      - Order of clauses
      - Order of subgoals in clause
      - Overall formulation
    - Additional explicit notation for control
      - We'll see an example later this lecture

Order of clauses

```
path0(A, B):- path0(A, C), arc(C, B).
path0(A, B):- arc(A, B).
 versus
path1(A, B):- arc(A, B).
path1(A, B):- path1(A, C), arc(C, B).
```

```
path0(x1, x6).
```



Order of Subgoals

```
path1(A, B):- arc(A, B).
path1(A, B):- path1(A, C), arc(C, B).
 versus
path2(A, B):- arc(A, B).
path2(A, B):- arc(C, B), path2(A, C).

Path1(X, x6).
```


Overall formulation

```
path2(A, B):- arc(A, B).
path2(A, B):-  arc(C, B), path2(A, C).

versus

path3(A, B):- arc(A, B).
path3(A, B):- arc(A, C), path3(C, B)
```

Additional explicit control

- **Cut can be used to suppress redundant solutions**

```
a(X):- b(X), !, c(X).
```

! Always succeeds, but if you fail back to it, then goal that matched head of clause fails

- – **Ignore other ways for b(X) to succeed**
- – **Ignore other clauses for a(X).**

Cut

```
foo:-a.
foo:-b.
a:-c1,!,c3.
a:-d.
b:-write('b'),nl.
c1:-write('c1 first'),nl.
c1:-
   write('c1 second'),nl.
c3:-write('c2
  fail'),nl,fail.
d:- write('d'),nl.
```

```
foon:-an.
foon:-b.

an:-c1,c3.
an:-d.

fie:-a.
fie:-b,a.
```

Pruning redundant solutions

```
isa-mother(X) :- female(X),parent(X,_),!.
isa-father(X) :- male(X),parent(X,_),!.
parent(fred,sue).
parent(janet,sue).
parent(fred,tim).
parent(janet,tim).
male(fred).female(janet).
?- isa-mother(X).X = janet ;
no
```


Negation by failure

- The goal \+(G) succeeds whenever the goal G fails.
- | ?- member(b,[a,b,c]).
- yes
- | ?- \+(member(b,[a,b,c])).
- no

Disjoint sets

```
overlap(S1,S2) :- member(X,S1),member(X,S2).
disjoint(S1,S2) :- \+(overlap(S1,S2)).
| ?- overlap([a,b,c],[c,d,e]).
yes
| ?- overlap([a,b,c],[d,e,f]).
no
| ?- disjoint([a,b,c],[c,d,e]).
no
| ?- disjoint([a,b,c],[d,e,f]).
yes
| ?- disjoint([a,b,c],X).
no %<---------Not what we wanted??????
```


Negation by failure

- **Negation by failure \+(G) works properly only in the following cases:**
  - **When G is fully instantiated at the timePROLOG processes the goal \+(G).**
    - **In this case, we interpret \+(G) to mean "goal G does not succeed".**
  - **When all variables in G are unique to G, i.e., they don't appear elsewhere in the same clause.**
    - **In this case, we interpret \+(G(X)) to mean "There is no value of X that will make G(X) succeed".**

Iterative deepening

```
idpath(A, B, Bound):- pathb(A, B, Bound).
idpath(A, B, Bound):-
   Higher is Bound + 1,
   print('trying bound '),
   print(Higher),
  nl,
   idpath(A, B, Higher).

idpath(A, B):- idpath(A, B, 0).
```