CSc 520 — Principles of Programming Languages

44 : Logic Programming — Executing Prolog

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1 Executing Prolog

- Now that we know about matching, we can take a closer look at how Prolog tries to satisfy goals.
- In general, to solve a goal
$$G = G_1, G_2, \cdots, G_m,$$
Prolog will first try to solve the sub-goal G_1.
- It solves a sub-goal G_1 it will look for a rule
$$H_i \text{ :- } B_1, \cdots, B_n$$
in the database, such that G_1 and H_i will match.
- Any variable substitutions resulting from the match will be stored in a variable θ.

2 Executing Prolog...

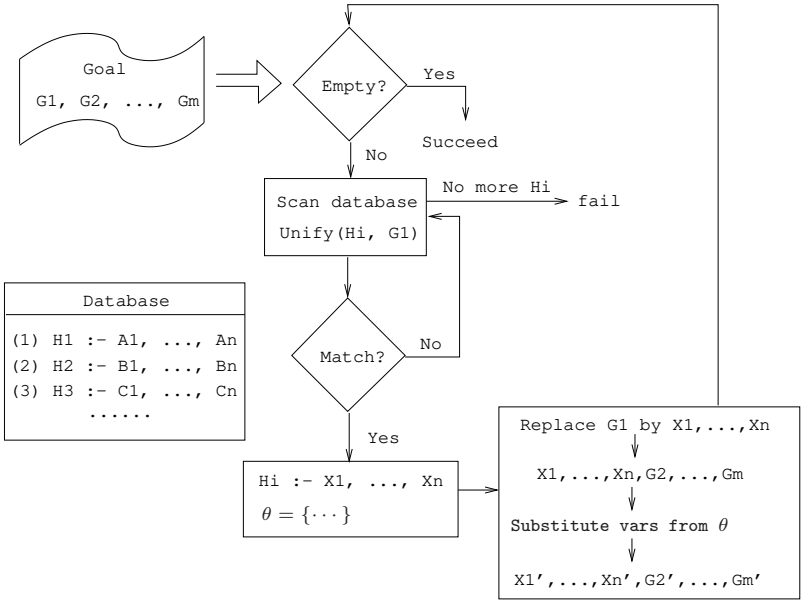
- A new goal will be constructed by replacing G_1 with $B_1, \cdots, B_n$, yielding
$$G' = B_1, \cdots, B_n, G_2, \cdots, G_m.$$
If $n = 0$ the new goal will be shorter and we'll be one step closer to a solution to G!
- Any new variable bindings from θ are applied to the new goal, yielding G''.
- We recursively try to find a solution to G''.

3 Executing Prolog...

FUNC `Execute` ($G = G_1, G_2, \cdots, G_m$; `Result`);
  IF `Is_Empty`(G) **THEN** `Result := Yes`
  ELSE
    `Result := No;`

```
    i := 1;
    WHILE Result=No & i ≤ NoOfClauses DO
       Clause := H_i :- B_1, ··· , B_n;
       IF Unify(G_1, Clause, θ) THEN
          G' := B_1, ··· , B_n, G_2, ··· , G_m;
          G'' := substitute(G', θ);
          Execute(G'', Result);
       ENDIF;
       i := i + 1;
    ENDDO
 ENDIF
```

4 Executing Prolog



5 Northern Exposure Example

```
% From the Northern Exposure FAQ
% friend(of, kind(name, regular)).
friend(maggie, person(eve, yes)).
friend(maggie, moose(morty, yes)).
friend(maggie, person(harry, no)).
friend(maggie, person(bruce, no)).
friend(maggie, person(glenn, no)).
friend(maggie, person(dave, no)).
friend(maggie, person(rick, no)).
friend(maggie, person(mike, yes)).
friend(maggie, person(joel, yes)).
```

6 Maggie (Janine Turner)

7 Northern Exposure Example...

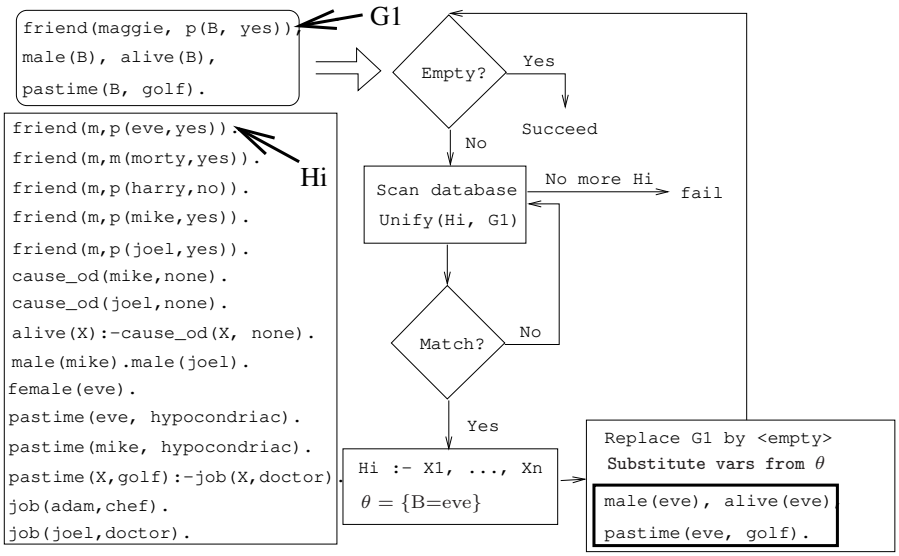
```
cause_of_death(morty, copper_deficiency).
cause_of_death(harry, potato_salad).
cause_of_death(bruce, fishing_accident).
cause_of_death(glenn, missile).
cause_of_death(dave, hypothermia).
cause_of_death(rick, hit_by_satellite).
cause_of_death(mike, none_yet).
cause_of_death(joel, none_yet).

male(morty).  male(harry).  male(bruce).
male(glenn).  male(dave).  male(rick).
male(mike).  male(joel).  female(eve).
```

8 Northern Exposure Example...

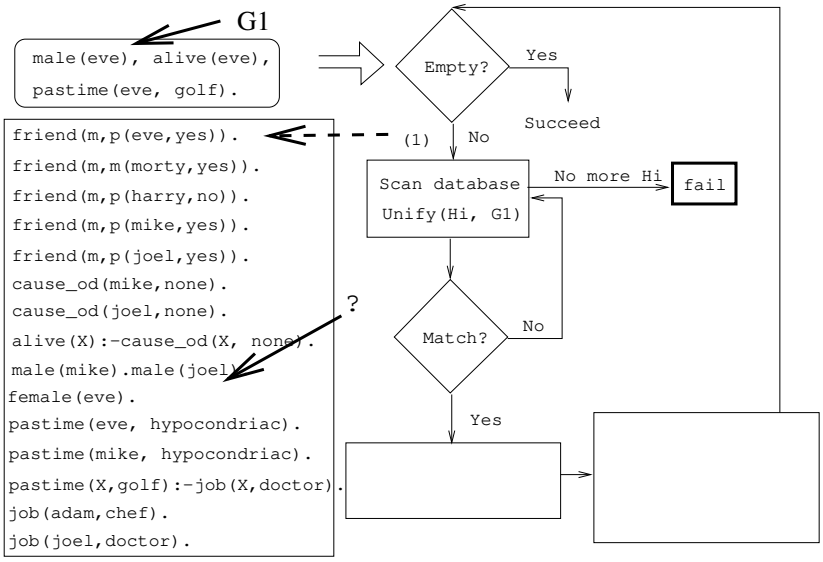
```
alive(X) :- cause_of_death(X, none_yet).

pastime(eve, hypochondria).
pastime(mike, hypochondria).
pastime(X, golf) :- job(X,doctor).

job(mike, lawyer).  job(adam, chef).
job(maggie, pilot).  job(joel, doctor).
```

?- friend(maggie, person(B, yes)),
male(B),
alive(B),
pastime(B, golf).

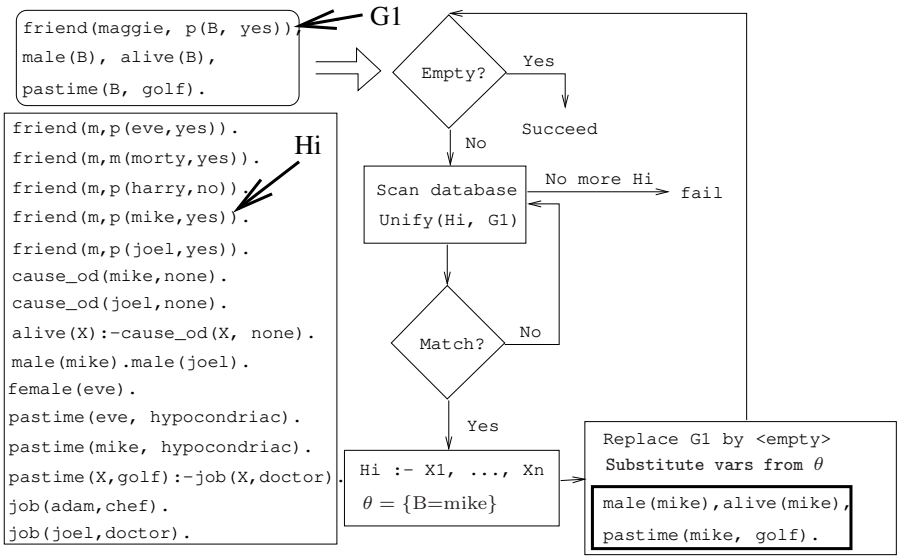
9 Northern Exposure Example...



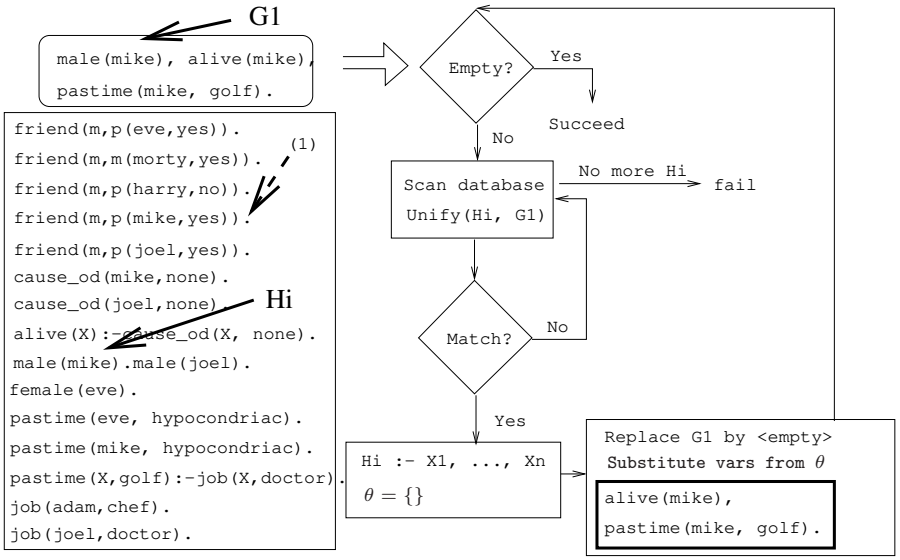
10 Northern Exposure Example...



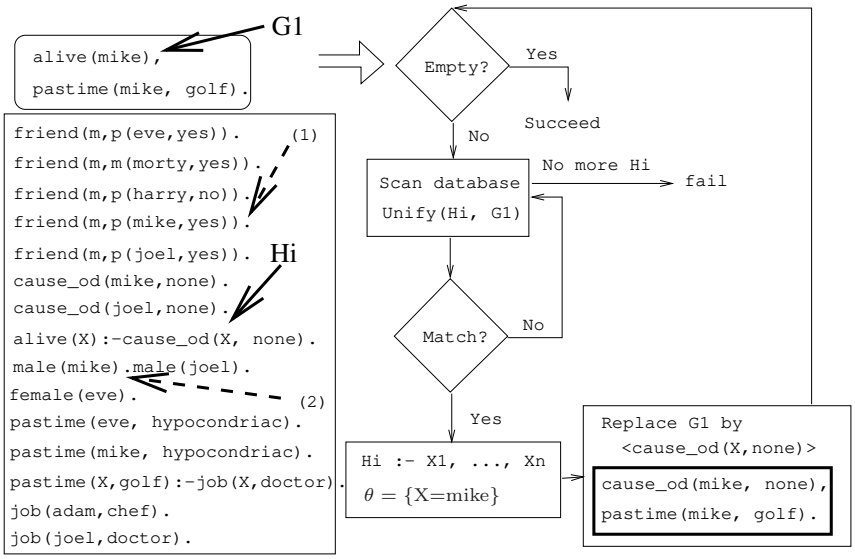
11 Northern Exposure Example...



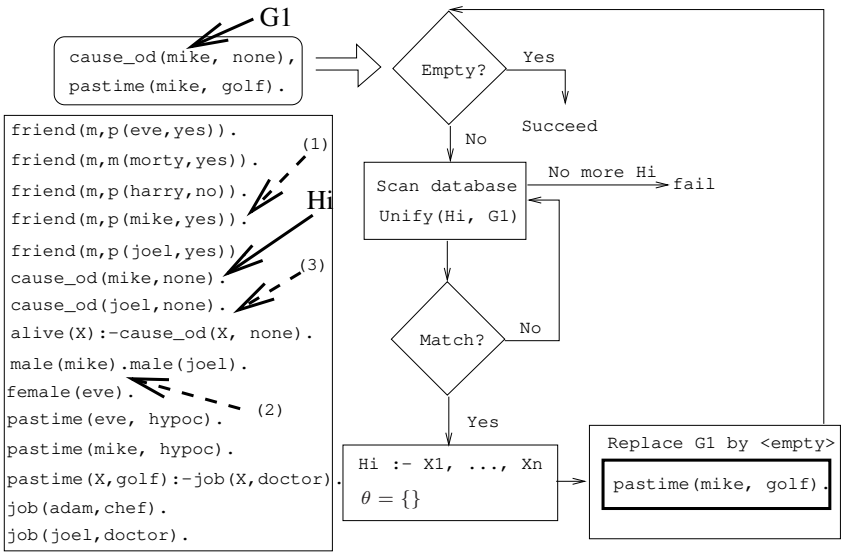
12 Northern Exposure Example...



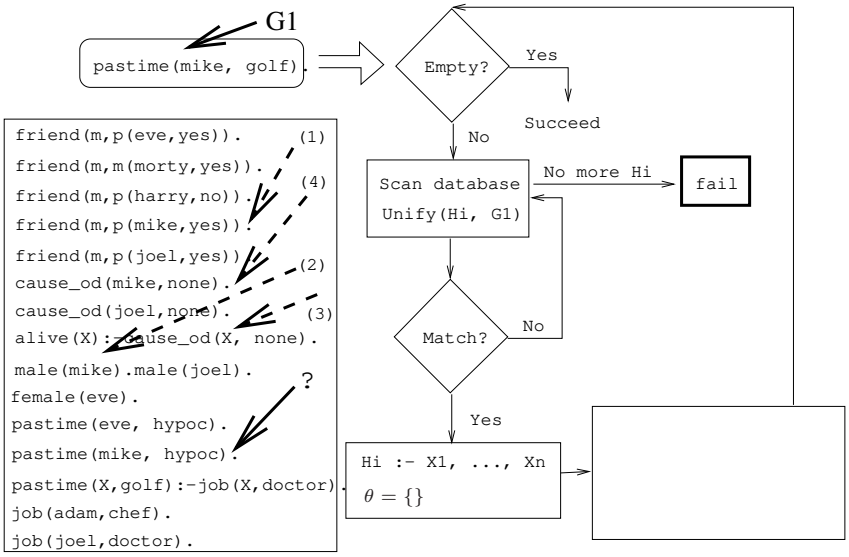
13 Northern Exposure Example...



14 Northern Exposure Example...



15 Northern Exposure Example...



16 Northern Exposure Example...

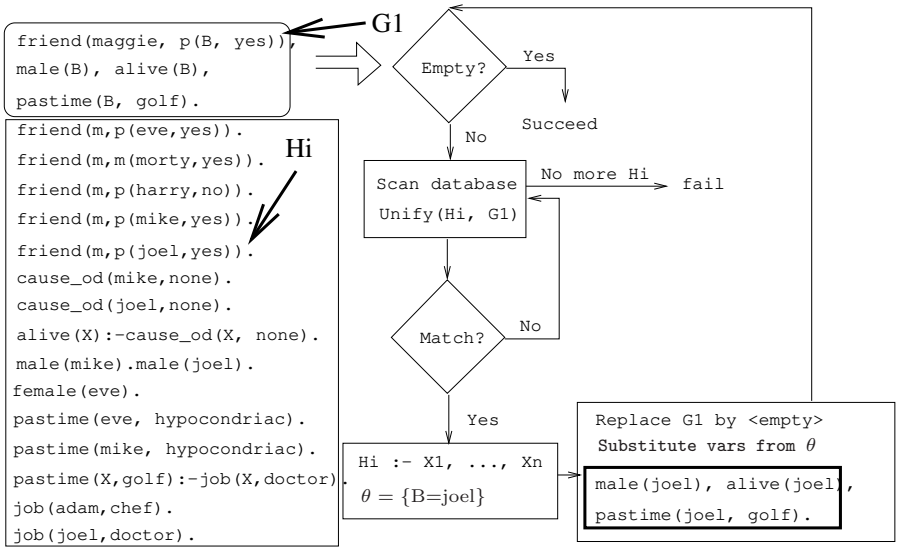
- We skip a step here.
- `pastime(mike, golf)` unifies with

```
pastime(X, golf) :- job(X, doctor).
```

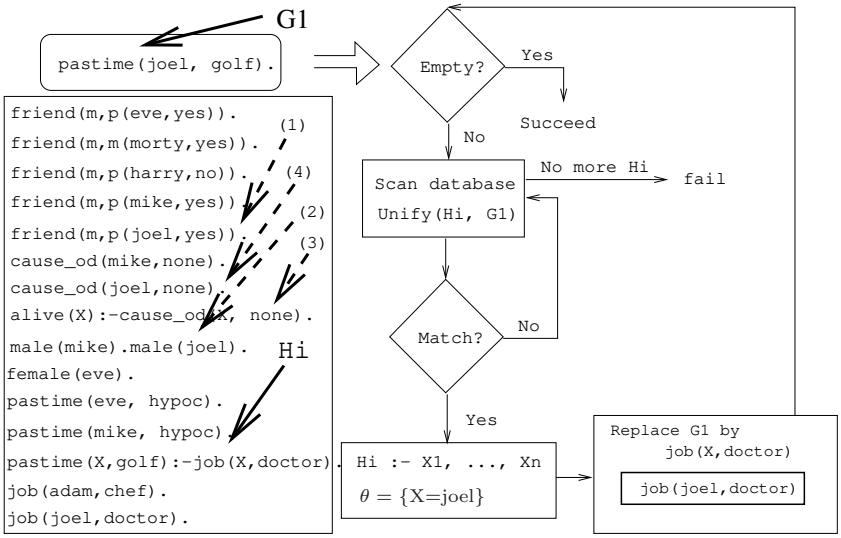
.

- However, `job(mike, doctor)` fails, and we backtrack all the way up to the original query.

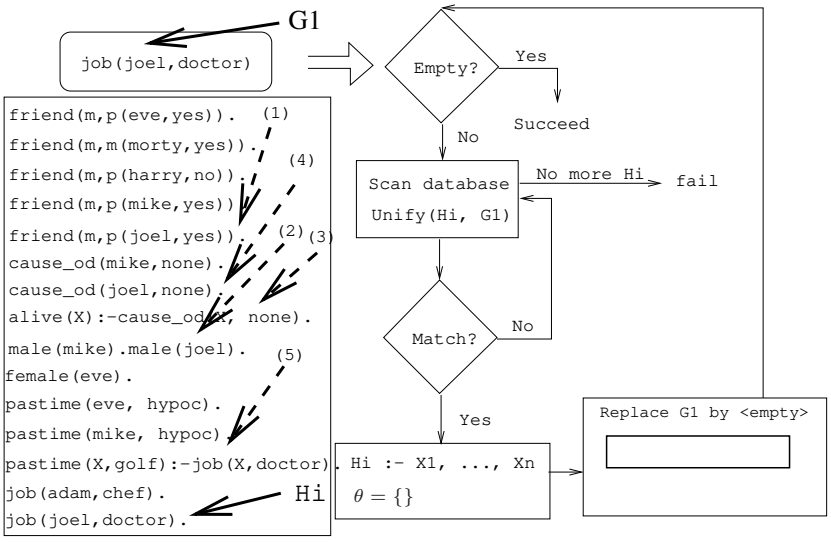
17 Northern Exposure Example...



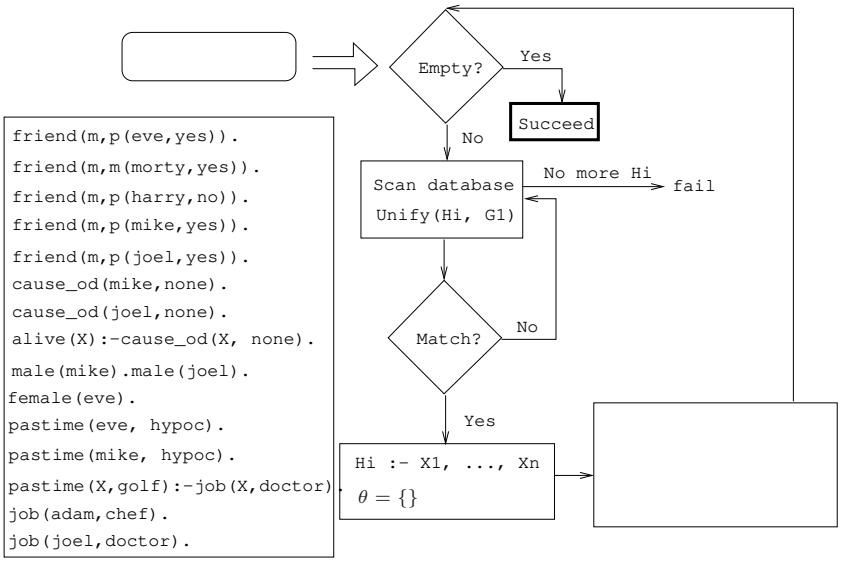
18 Northern Exposure Example...



19 Northern Exposure Example...



20 Northern Exposure Example...



21 Readings and References

- Read **Clocksin-Mellish, Section 4.1**.
- See `http://www.moosefest.org` for information about the annual Moosefest.
- See `http://members.lycos.co.uk/janineturner/engl/index.html` for pictures of Janine Turner, who plays Maggie.
- See `http://home.comcast.net/~mcnotes/mcnotes.html` for show transcripts.

22 Prolog So Far...

- A term is either a
  - a constant (an atom or integer)
  - a variable
  - a structure
- Two terms *match* if
  - there exists a variable substitution θ which makes the terms identical.
- Once a variable becomes instantiated, it stays instantiated.
- Backtracking *undoes* variable instantiations.
- Prolog searches the database sequentially (from top to bottom) until a matching clause is found.