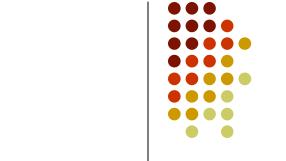
Introduction to Prolog Accumulators, Debugging

CS181: Programming Languages



Topics:

- More list processing
- Accumulators
- Prolog in action: Towers of Hanoi
- Debugging



The goal nextto(X,Y,L) succeeds if elements
 X and Y are consecutive elements of list L:

```
nextto(X, Y, [X,Y|_]).
nextto(X, Y, [_|Z]) :- nextto(X, Y, Z).
```



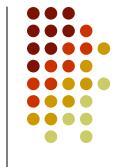
 Delete all occurrences of element X from list L1 and create the resulting list L2:

```
delete(_, [], []).
delete(X, [X|L], M) :- !, delete(X,L,M).
delete(X, [Y|L1], [Y|L2]) :- delete(X, L1, L2).
```



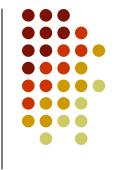
 The rule subst(X,L,A,M) constructs a new list M made up from elements of list L, except that any occurrence of X is replaced by A:

```
subst(_, [], _, []).
subst(X, [X|L], A, [A|M]) :- !, subst(X, L, A, M).
subst(X, [Y|L], A, [Y|M]) :- subst(X, L, A, M).
```



 The rule sublist(X,Y) succeeds if X is a sublist of Y, that is, if every element of X appears in Y, consecutively, in the same order:

```
sublist([X|L], [X|M]) :- prefix(L, M), !. sublist(L, [_|M]) :- sublist(L, M).
```



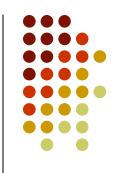
Accumulators

 An accumulator is an argument of the predicate used to represent the "answer so far".

```
len(L, N):- lenacc(L, 0, N).
```

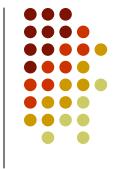
```
lenacc([], A, A).
lenacc([H|T], A, N) :- A1 is A + 1,
lenacc(T, A1,N).
```

Accumulators



[a, b, c, d, e]

```
lenacc([a, b, c, d, e], 0, N)
lenacc([b, c, d, e], 1, N)
lenacc([c, d, e], 2, N)
lenacc([d, e], 3, N)
lenacc([e], 4, N)
lenacc([], 5, N)
```



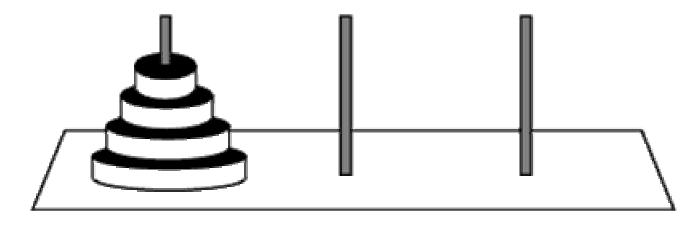
Accumulators

 The rule remdup(L,M) succeeds if M is a list with same elements as L, but the duplicate elements are removed:

Towers of Hanoi

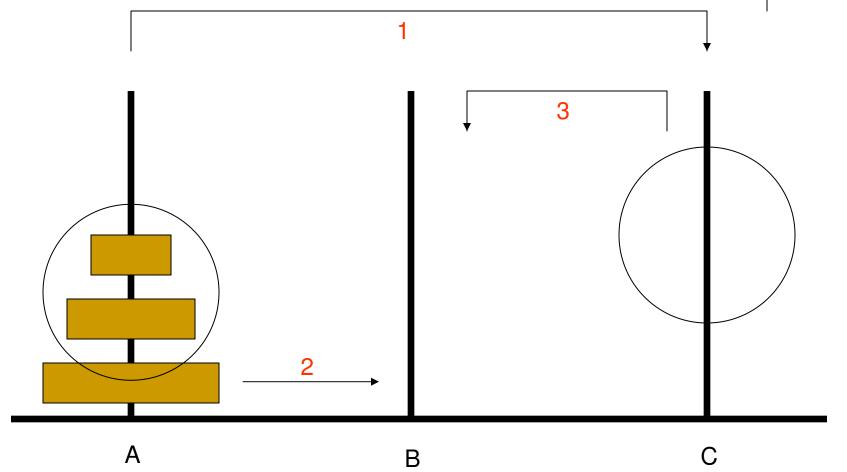


- Stack of n disks arranged from largest on the bottom to smallest on top placed on a rod
- Two empty rods: goal and an auxiliary rod
- Minimum number of moves to move the stack from one rod



Towers of Hanoi







Towers of Hanoi

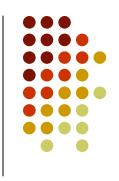
```
hanoi(N):- move(N, left, centre, right).
move(0, _, _, _) :- !.
move(N, A, B, C) :- M is N-1,
   move(M, A, C, B),
                                % 1
   inform(A, B),
                                % 2
   move(M, C, B, A).
                                % 3
inform(X,Y) :=
   write([move, disk, from, X, to, Y]), nl.
```

Debugging



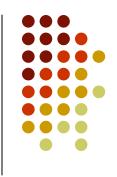
- Don't forget to write the dot.
- Add at least one "white space" after the dot
- Some characters belong in pairs: (), [], /**/
- Do not misspell names of facts, rules, built-in predicates
- Use parentheses to define explicitly the associativity of operators.

Debugging (lists)



- How do [a,b,c] and [X|Y] match?
- Do [a] and [X|Y] match?
- Do [] and [X|Y] match?
- Is [X, Y | Z] meaningful?
- Is [X | Y, Z] meaningful?
- Is [X | [Y | Z]] meaningful?
- Is there more than one way to match to lists?

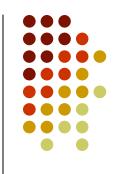




 The trace predicate prints out information about the sequence of goals in order to show where the program has reached in its execution

Example (see trace_example.pl)

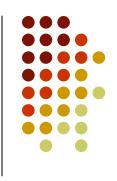




Some of the events which may happen during a trace:

- CALL: A CALL event occurs when Prolog tries to satisfy a goal
- EXIT: An EXIT event occurs when some goal has just been satisfied
- REDO: A REDO event occurs when the system comes back to a goal, trying o re-satisfy it
- FAIL: A FAIL event occurs when a goal fails

References



- Clocksin, W.F., and Mellish C.S.
 Programming in Prolog. 4th edition. New York: Springer-Verlag. 1994.
- Van Le, T. Techniques of Prolog Programming. John Wiley & Sons, Inc. 1993.