

Madhuri Pyreddy

10/24/19

CSCI 117 Lab 9

```
% mode (+,+,-)
% ?- cons(snoc(snoc(nil,3),4),5,O)
% Are there any more modes?
cons(nil,E,snoc(nil,E)).
cons(snoc(BL,N),E,snoc(BLN,N)):-cons(BL,E,BLN).
```

```
% mode (+,+,-)
% ?- snoc([1,2,3],5,O).
% Are there any more modes?
snoc([], E, [E]).
snoc([Y|YS],X,[Y|Out]) :- snoc(YS,X,Out).
```

```
% mode (+,-)
% ?-fromBList(snoc(snoc(snoc(nil,1),2),3),Out)
% Are there any more modes?
snoc([], E, [E]).
snoc([Y|YS],X,[Y|Out]) :- snoc(YS,X,Out).
fromBList(nil,[]).
fromBList(snoc(L,N),Out) :- fromBList(L,Y),snoc(Y,N,Out).
```

```
% mode (+,-)
% ?- toBList([1,2],Out).
% Are there any more modes?
cons(nil,E,snoc(nil,E)).
cons(snoc(BL,N),E,snoc(BLN,N)):-cons(BL,E,BLN).
toBList([],nil).
toBList([X|Xs],Out) :- toBList(Xs,Y),cons(Y,X,Out).
```

```
% mode (+,+,-)
% ?-num_emptyies(node(1,empty,empty),E)
num_emptyies(empty,1).
num_emptyies(node(A,T1,T2),Z) :- num_emptyies(T1,X),num_emptyies(T2,Y),Z is X+Y.
```

```
% mode (+,+,-)
% ?-num_nodes(node(1,empty,empty),E)
num_nodes(empty,0).
num_nodes(node(A,T1,T2),Z) :- num_nodes(T1,X),num_nodes(T2,Y),Z is 1+X+Y.
```

```
% mode (+,+,-)
% ?-insert_left(1,node(2,empty,empty),E)
```

```

insert_left(X,empty,node(X,empty,empty)).
insert_left(X,node(A,T1,T2),node(A,TT1,TT2)) :- insert_left(X,T1,TT1).

```

```

% mode (+,+,-)
% ?- insert_right(1,node(2,empty,empty),E)
insert_right(X,empty,node(X,empty,empty)).
insert_right(X,node(A,T1,T2),node(A,TT1,TT2)) :- insert_right(X,T2,TT2).

```

```

% mode (+,+,-)
% ?- sum_nodes(node(node(empty,empty,3),empty,5),O)
sum_nodes(Empty,0).
sum_nodes((node(A,T1,T2),Z) :- sum_nodes(T1,X),sum_nodes(T2,Y),Z is A+X+Y.

```

```

% mode (+,+,-)
% ?- inorder(node(3,empty,empty),O)
append([],Y,Y).
append([H|T],Y,[H|Z]) :- append(T,Y,Z).
inorder(empty,[]).
inorder(node(A,T1,T2),Out2) :-
inorder(T1,TT1),inorder(T2,TT2),append(TT1,[A],Out1),append(Out1,TT2,Out2).

```

```

% mode (+,-)
% ?- num_elts(node(1,leaf(1),leaf(3)),O)
num_elts(leaf(A),1).
num_elts(node(A,L,R),Z) :- num_elts(L,X),num_elts(R,Y),Z is 1+X+Y.

```

```

% mode (+,-)
% ?- sum_nodes2(node(1,leaf(1),leaf(3)),O)
sum_nodes2(leaf(A),1).
sum_nodes2(node(A,L,R),Z) :- sum_nodes2(L,X),sum_nodes2(R,Y),Z is A+X+Y.

```

```

% mode (+,-)
% ?- inorder2(node(1,leaf(4),leaf(1)),O)
append([],Y,Y).
append([H|T],Y,[H|Z]) :- append(T,Y,Z).
inorder2(leaf(A),[A]).
inorder2(node(A,T1,T2),Out2) :-
inorder2(T1,TT1),inorder2(T2,TT2),append(TT1,[A],Out1),append(Out1,TT2,Out2).

```

```

% mode (+,-)
% ?- conv21((node2(3,leaf(5),leaf(6))),Out)
conv21(leaf(A),node(A,empty,empty)).

```

```
conv21(node2(X,T1,T2),node(X,TT1,TT2)):- conv21(T1,TT1),conv21(T2,TT2).
```

```
% mode (+,-)
% ?- toBList_it([1,2],O)
toBList_it(List,O):- toBList_it(List,nil,O).
toBList_it([],A,A).
toBList_it([X|Xs],A,AN):-
    AP = snoc(A,X),
    toBList_it(Xs,AP,AN).
```

```
% mode (+,-)
% ?- fromBlist(snoc(snoc(snoc(nil,4),5),6),O)
fromBlist(snoc(L,N),O):- fromBlist_it(snoc(L,N),[],O).
fromBlist_it(nil,A,A).
fromBlist_it(snoc(L,N),A,AN):-
    AP = [N|A],
    fromBlist_it(L,AP,AN).
```

```
% mode (+,-)
% ?- num_emptyies_it((node(2,empty,empty)),Out)
num_emptyies_it(T,Out1) :- num_emptyies_it_H([T],0,Out1).
num_emptyies_it_H([],A,A).
num_emptyies_it_H([empty|Ts],A,Out1):- AP is A+1,num_emptyies_it_H(Ts,AP,Out1).
num_emptyies_it_H([node(X,T1,T2)|Ts],A,Out1):-num_emptyies_it_H([T1,T2|Ts],A,Out1).
```

```
% mode (+,-)
% ?- num_nodes((node(2,empty,empty)),Out)
num_nodes(T,Out1) :- num_nodes_it([T],0,Out1).
num_nodes_it([],A,A).
num_nodes_it([empty|Ts],A,Out1):- num_nodes_it(Ts,A,Out1).
num_nodes_it([node(X,T1,T2)|Ts],A,Out1):-AP is A+1,num_nodes_it(Ts,AP,Out1).
```

```
% mode (+,-)
% ?- sum_nodes2(leaf(2),Out)
sum_nodes2(T,N) :- sum_nodes2_it([T],0,N).
sum_nodes2_it([],A,A).
sum_nodes2_it([leaf(E)|Ts],A,N) :- AP is E+A, sum_nodes2_it(Ts,AP,N).
sum_nodes2_it([node2(X,T1,T2)|Ts],A,N) :- AP is A+X, sum_nodes2_it([T1,T2|Ts],AP,N).
```

```
% mode (+,-)
% ?-inorder2_it_H(node(X,L,R)|Ts],A,Out)
inorder2_it(T,Out1) :- inorder2_it_H([T],[],Out1).
inorder2_it_H([],A,A).
```

```
inorder2_it_H([leaf(F)|Ts],A, Out1) :- inorder2_it_H(Ts,[F|A],Out1).
inorder2_it_H([node2(X,T1,T2)|Ts],A,Out1):- inorder2_it_H([T2,leaf(X),T1|Ts],A,Out1).
```

```
% mode(+,-)
% ?-bst node(10,node(8,empty,node(9,empty,empty)),
node(11,empty,node(12,empty,empty)),O)
bst(empty,true).
bst(T):-bst_it(T,neginf,posinf).
bst_it(empty,_,_).
bst_it(node(X,L,R),low,high):-lt(low,fin(X)),lt(fin(X),high),bst_it(L,low,fin(X)),bst_it(R,fin(X),high).
```

```
% mode(+,-)
% ?-bst2 node(10,node(8,empty,node(9,empty,empty)),
node(11,empty,node(12,empty,empty)),O)
bst2(leaf(X),true).
bst2(T):-bst2_it(T,neginf,posinf).
bst2_it(leaf(X),low,high):-lt(low,fin(X)),lt(fin(X),high).
bst2_it(node(X,L,R),low,high):-
    lt(low,fin(X)),lt(fin(X),high),bst2_it(L,low,fin(X)),bst2_it(R,fin(X),high).
```

```
snoc:
% mode (+,+, -)
?-snoc(X,Y,[1,5])
% mode (-,+, +)
?- snoc(X,5,[1,5])
% mode (-,-, +)
?- snoc(X,Y,[1,3,5])
% mode (+,-, +)
?- snoc([1,2],X, [1,5])
```

```
fromBList:
% mode (+,-)
?-fromBList(snoc(snoc(snoc(nil,1),2),3),X)
```

```
toBList:
% mode (+,-)
toBList([1,2],X).
```

```
num_emptyies:
% mode (+,-)
?-num_emptyies(node(1,empty,empty),X)
```

```
num_nodes:
% mode (+,-)
?-num_nodes(node(1,empty,empty),X)
```

```
insert_left:
% mode (+,+,-)
?- insert_left(3,(node(2,empty,empty)),Out)
% mode (-,+,-)
?- insert_left(X,(node(2,empty,empty)), node(2, node(3, empty, empty), empty))
% mode (+,-,-)
?- insert_left(3,Y, node(2, node(3, empty, empty), empty))
% mode (-,+,-)
?- insert_left(X,node(2, empty, empty), Z)
% mode (-,-,+)
```

```
insert_right:
% mode (+,+,-)
?- insert_right(3,(node(2,empty,empty)),Out)
% mode (-,+,-)
?- insert_right(X,(node(2,empty,empty)), node(2, node(3, empty, empty), empty))
% mode (+,-,-)
?- insert_right(3,Y, node(2, node(3, empty, empty), empty))
% mode (-,+,-)
?- insert_right(X,node(2, empty, empty), Z)
% mode (-,-,+)
```

```
sum_nodes:
% mode (+,-)
?- sum_nodes2(node(1,leaf(1),leaf(3)),X)
```

```
inorder:
% mode (+,-)
?-inorder2(node(1,leaf(4),leaf(1)),O)
```

```
num_elts:
% mode (+,-)
num_elts(node(1,leaf(1),leaf(3)),X)
```

```
sum_nodes2:
% mode (+,-)
?-sum_nodes2(node(1,leaf(1),leaf(3)),X)
```

```
inorder2:
```

```
% mode (+,-)
?-inorder2(node(1,leaf(4),leaf(1)),X)
```

```
conv21:
% mode (+,-)
?- conv21((node2(3,leaf(5),leaf(6))),X)
```

```
toBList_it:
% mode (+,-)
% ?- toBList_it([1,2],O)
```

```
fromBList_it:
% mode (+,-)
?-fromBList(snoc(snoc(snoc(nil,1),2),3),X)
```

```
num_emptyies_it:
% mode (+,-)
?-num_emptyies_it((node(2,empty,empty)),X)
```

```
num_nodes_it:
% mode (+,-)
?-num_nodes((node(2,empty,empty)),X)
```

```
sum_nodes2_it:
% mode (+,-)
?-sum_nodes2(leaf(2),X)
```

```
inorder2_it:
% mode (+,-)
?-inorder2_it_H(node(X,L,R)|Ts],A,X)
```

```
bst:
% mode(+,-)
?-bst node(10,node(8,empty,node(9,empty,empty)), node(11,empty,node(12,empty,empty)),X)
```

```
bst2:
% mode(+,-)
?-bst node(10,node(8,empty,node(9,empty,empty)), node(11,empty,node(12,empty,empty)),X)
```