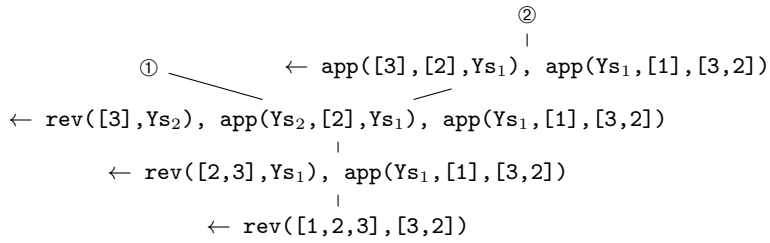
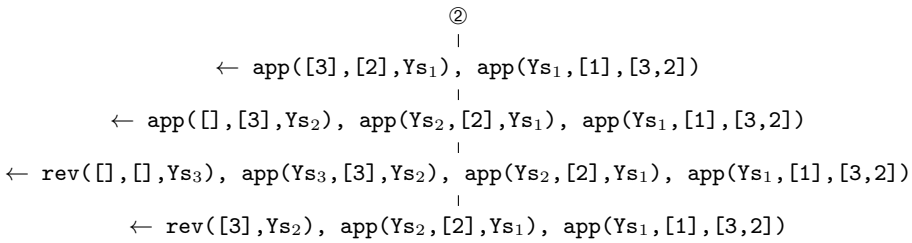
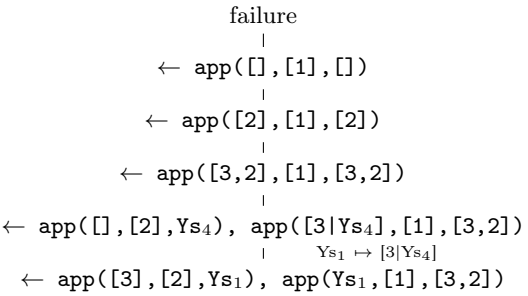
1. a) We write *rev* (*app*) instead of *reverse* (*append*) and obtain the following SLD tree, where answer substitutions have usually be performed directy, exception: $\mathrm{Ys}_1 \mapsto [3|\mathrm{Ys}_4]$.



Here ① is the following subtree:



and ② is:



b) The program is not deterministic and the cardiality of the answer set is two. This is due to nondeterminancy introduced between the 2nd and 3rd rule.

c)
```
reverse(Xs,Ys) :-
    reverse(Xs,[],Ys).

reverse([],Acc,Acc).
reverse([X|Xs],Acc,Ys) :-
    reverse(Xs,[X|Acc],Ys).
```

d) The proof proceed by induction on the length of Xs.

2. a)
```
constant(C) :-
    integer(C) ; atom(C).

occurrences(Sub,Term,1) :-
    ground(Term),
    Sub = Term.
occurrences(Sub,Term,0) :-
    constant(Term),
    Sub \= Term.
occurrences(Sub,Term,N) :-
    compound(Term),
    Term =.. [_F|Args],
    occurrences_args(Args,Sub,N).

occurrences_args([],_Sub,0).
occurrences_args([Term|Ts],Sub,N) :-
    occurrences(Sub,Term,N0),
    occurrences_args(Ts,Sub,N1),
    N is N0 + N1.
```

b)
```
occurrences(Sub,Term,N) :-
    findall(Sub,sub_term(Sub,Term),Subs),
    length(Subs,N).
```

3. a) foo(X,Y) holds if Y is reachable from X in a graph represented by the predicate *edge*/2. The graph is traversed breadth-first.

b) setof1(Template,Goal,Set) succeeds with the empty list, if no instance of *Template* can meet *Goal*. This is in contrast to the system predicate *setof*/3, which simply fails in this case. If *setof1*/3 is replaced by *setof*/3 in the considered program, then the breadth-first search fails. Let us call the new programm new_foo. For example, if we define the following facts:

```
edge(a,b).
edge(a,c).
```

we have that foo(a,c) holds (as it should), but new_foo(a,c) fails. Thus the meaning of the program changes if *setof1*/3 is replaced by the system predicate *setof*/3.

4.

statement	yes	no
(Prolog) terms are build from logical variables, constants, and functions.	☐	✓
A type is an infinite set of terms.	☐	✓
A rule is a universally quantified logical formula of the form $A \leftarrow B_1, B_2, \ldots, B_n$, where A is a goal and for all $i = 1, \ldots, n$: B_i is a goal.	✓	☐
An SLD refutation is a finite SLD derivation ending in $\square$.	✓	☐
A proof tree is the same as an SLD tree	☐	✓
A logic program's meaning is the Herbrand model of the program.	☐	✓
The operators `#=`, `#\=`, and `#>` are standard arithmetic comparison operators.	☐	✓
Answer Set Programming (ASP) is a novel programming language that extends CLP, that is, all constraint logic programs can be formulated as ASPs.	☐	✓
Prolog programs are executed using SLD resolution, where leftmost and topdown selection is used.	✓	☐
A cut fixes all choices between the moment of matching a rule's head with the goal of the parent clause and the cut.	✓	☐
The predicate *setof(Template,Goal,Bag)* is similar to *bagof*. However it removes duplicates in the obtained multiset, which is also sorted.	✓	☐