Exercise 5

Foundations of Logic Programming

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Exercise 5.1

Write a predicate `most_frequent(List, Item)` in Prolog that finds the most frequently occurring item `Item` in a list `List`. If there are two or more items in the list that occur equally often (i.e., with the same frequency), return only the one whose first occurrence is closest to the beginning of the list.

Examples:
`?-most_frequent([1,2,3,1,2], Item).` returns `Item = 1`.
`?-most_frequent([1,2,3,1,2,3,2], Item).` returns `Item = 2`.

Exercise 5.2

Show with the help of the Prolog tree how the cut is used in the following program,

```
(r1)  r(a).
(r2)  r(b).
(r3)  q(a) :- r(X), !, p(a).
(r4)  q(f(X)) :- r(X).
(r5)  p(X) :- r(X).
(r6)  p(f(X)) :- q(X), !, r(X).
(r7)  p(g(X)) :- r(X).
```

and where the query `?- p(X).` is taken. What would happen without the cut?

Exercise 5.3

Consider the following Prolog program for the intersection of two sets:

```
inter([],_,[]).
inter([X|Xs],Ys,[X|Zs]) :- member(X,Ys), !, inter(Xs,Ys,Zs).
inter([X|Xs],Ys,Zs) :- inter(Xs,Ys,Zs).
```

Find three terms t_1, t_2, t_3 such that query `inter`(t_1, t_2, t_3) is successful although for its C.A.S. θ $t_3\theta$ is not an intersection of $t_1\theta$ and $t_2\theta$. How can this fault be fixed?

Hint: t_3 should not be a variable.

Exercise 5.4

Reconsider the program P from Exercise 4.3:

```
add(X,0,X).
add(X,s(Y),s(Z)) :- add(X,Y,Z).

mul(X,0,0).
mul(X,s(Y),Z) :- mul(X,Y,Z1), add(Z1,X,Z).
```

a) Give the Herbrand universe HU_F and the Herbrand base $HB_{\Pi,F}$ determined by P.

b) Give two Herbrand models of P.

c) Consider the interpretation I_6 from Slide IV/9 together with the additional definition $mul_{I_6} = \{(m,n,n) \mid m,n \in \{0,1\}\}$. Show either $I_6 \models P$ or $I_6 \not\models P$.

d) Show that $P \not\models mul(s(0), s(0), X)$.

e) Show that $P \models mul(0, s(0), 0)$.