

**CSc 4330 Programming Language Concepts**  
**Practice for Exam 3, Spring 2018**

1. Consider the following substitutions:

$$\sigma = \{X \leftarrow g(U), Y \leftarrow f(Z), V \leftarrow W, Z \leftarrow c\}$$

$$\theta = \{Z \leftarrow f(U), W \leftarrow V, U \leftarrow b\}$$

Compute  $\sigma\theta$  and  $\theta\sigma$

2. Find the mgu, if any, for the following sets:

$$\{ p(X, f(X)), p(Y, f(a)) \}$$

$$\{ p(a, X), p(X, f(X)) \}$$

$$\{ p(a, X, f(g(Y))), p(Z, f(Z), f(W)) \}$$

$$\{ p(f(g(X, a)), X), p(Z, b) \}$$

$$\{ [[the, Y]|Z], [[A,hare],[is,here]] \}$$

$$\{ [X,Y|Z], [mary, likes, wine] \}$$

$$\{ \text{append}([b],[c,d],L), \text{append}([X|Xs],Ys,[X|Zs]) \}$$

3. Consider the following program:

$p(Y) :- q(X,Y), r(Y).$

$p(X) :- q(X,X).$

$q(X,X) :- s(X).$

$r(b).$

$s(a).$

$s(b).$

Draw the complete SLD-refutation tree for the goal:

?-  $p(A).$

4. Write a Prolog program to pack consecutive elements in a list into lists. For example,

```
?- pack([a,a,a,a,b,c,c,a,a,d,e,e,e,e],X).  
X = [[a,a,a,a],[b],[c,c],[a,a],[d],[e,e,e,e]]
```

and then use this program to find the run-lengths as follows:

```
?- encode([a,a,a,a,b,c,c,a,a,d,e,e,e,e],X).  
X = [[4,a],[1,b],[2,c],[2,a],[1,d],[4,e]]
```

5. Write a Prolog program to split a list into two lists of positive and negative numbers. For example:

```
?- split([20,-10,30,22,45,0,-15,0,12], L1, L2).  
L1 = [20,30,22,45,12]  
L2 = [-10,-15]
```