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## CSI2120 Programming Paradigms

### MIDTERM EXAM

**Length of Examination: 75 minutes**

**February 11, 2014, 13:00**

**Professor: Jochen Lang**

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Family Name: \_\_\_\_\_

Other Names: \_\_\_\_\_

Student Number: \_\_\_\_\_

Signature \_\_\_\_\_

You are allowed one single-sided letter-sized sheet of notes.

At the end of the exam, when time is up: Stop working and close your exam booklet. Remain silent.

Question	Marks	Out of
1		2
2		3
3		2
4		4
5		5
6		2
7		6
Total		24

**Question 1** [2 marks]

Given the following program:

```
postIt([]).  
postIt([c|R]):- postIt(R), !, nl.  
postIt([X|R]):- postIt(R), write(X).
```

What will be printed as response to the following query?

```
?- postIt([a,b,c,d,e]).
```

**Question 2 [3 marks]**

Complete the predicate `negCount` below such that it counts the negative numbers in a list, e.g.,

```
?- negCount ([0,4,-3,-1,6,-7], N) .  
N = 3
```

*Note: You are not allowed to change the order of the following rules.*

```
negCount ([], 0) .
```

```
negCount ([X|L], N) :- _____
```

```
negCount ([X|L], N) :- X>=0, negCount (L, N) .
```

**Question 3 [2 marks]**

The following predicate q3 below is designed to operate on binary trees:

```
q3(t(V, nul, nul), 0).  
q3(t(V, Q, nul), 1).  
q3(t(V, nul, Q), 1).  
q3(t(V, Q1, Q2), T) :- q3(Q1, T1), q3(Q2, T2), T is 1+T1+T2.
```

What value for T is obtained with the following query?

```
?- q3(t(4,  
        t(2,  
            nul,  
            t(3, t(1,nul,nul), t(9,nul,nul))),  
        t(7, t(5, nul, t(6, nul, nul)),  
            t(9, t(1,nul,nul), t(9,nul,nul)))), T).
```

T=

**Question 4 [4 marks]**

The following facts describe which license or permit is held by whom. The list includes driving licenses, fishing permits and licensed weapons.

```
permitted(robert,fishing).  
permitted(jochen,driving).  
permitted(paul,fishing).  
permitted(jean,weapons).  
permitted(jean,driving).  
permitted(sam,weapons).  
permitted(sam,fishing).
```

a) Give a query which finds a person who is **not** permitted to drive.

b) List in order **all solutions** found by the following query.

```
?- permitted(X,Y),permitted(X,Z),Y\==Z.
```

**Question 5 [5 marks]**

a) Given the following Prolog program

```
p(X) :- b(X), c(Y).  
p(X) :- a(X).  
c(X) :- d(X).  
a(1).  
a(2).  
a(3).  
b(4).  
b(5).  
d(6).  
d(7).
```

Draw the complete Prolog search tree for the following query (clearly mark the solutions found and the **order** in which they are found).

```
?- p(X).
```

**Question 5** (continued)

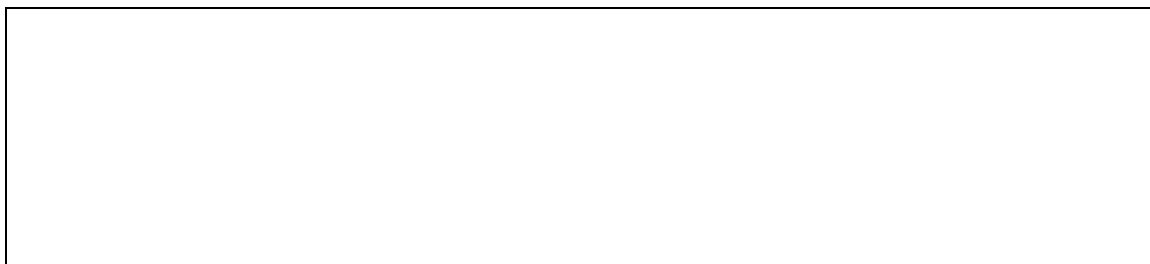
b) List the solutions which are found by the same query when a Cut is added as below:

```
p(X) :- b(X), !, c(Y).  
p(X) :- a(X).  
c(X) :- d(X).  
a(1).  
a(2).  
a(3).  
b(4).  
b(5).  
d(6).  
d(7).
```



c) List the solutions which are found by the same query when a Cut is added as below:

```
p(X) :- b(X), c(Y).  
p(X) :- a(X).  
c(X) :- d(X).  
a(1).  
a(2) :- !.  
a(3).  
b(4).  
b(5).  
d(6).  
d(7).
```



**Question 6 [2 marks]**

Which of the predicates below works correctly? The predicate is to substitute all elements of the list equal the first argument with the second argument. For example:

```
?- subElement(apple, orange, [apple, celery, pear, pear, apple, raisin],L).
    L = [orange, celery, pear, pear, orange, raisin]
```

<p><b>a)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [X R], [Y R]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R).</p> <p>subElement(X, Y, [Z R], [Z R]) :- X==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R).</p>	<p><b>b)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [X R], [Y R1]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p> <p>subElement(X, Y, [Z R], [Z R1]) :- X==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p>
<p><b>c)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [Z R], [Z R1]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p> <p>subElement(X, Y, [X R], [Y R1]) :- X==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p>	<p><b>d)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [X R], [Y R1]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p> <p>subElement(X, Y, [Z R], [Z R1]) :- X\==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p>
<p><b>e)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [Z R], [Z R1]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p> <p>subElement(X, Y, [X R], [Y R1]) :- X\==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p>	<p><b>f)</b></p> <p>subElement(____, [], []).</p> <p>subElement(X, Y, [X R], [X R1]) :-</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p> <p>subElement(X, Y, [Z R], [Z R1]) :- X\==Z,</p> <p style="padding-left: 40px;">subElement(X, Y, R, R1).</p>



**Question 7 [6 marks]**

Given the following database:

```
prerequisite(csi2520,csi2510).  
prerequisite(csi2520,csi2610).  
prerequisite(csi2510,iti1521).  
prerequisite(csi2510,mat1748).  
prerequisite(csi2510,csi2772).
```

What is the value of L obtained by each of the following queries (if multiple solutions are possible, list only the first solution that will be found)?

```
?- bagof(X,Y^prerequisite(X,Y),L).
```

L=

```
?- setof(X,Y^prerequisite(X,Y),L).
```

L=

```
?- setof(Y,prerequisite(X,Y),L)
```

L=