The University of British Columbia
Department of Computer Science
Midterm Examination 2 — Fall 2016

Computer Science 312
Functional and Logic Programming

Question 1 [12 marks]

(a) [4 marks] In the semantic web, a URI is a "Uniform Resource Identifier". What is a URI? Why are URIs useful?

(b) [4 marks] Explain what "Triples are universal representations of relations" means, and why it is true.

(c) [4 marks] Suppose you are told the triples using *prop*(*Subject*, *Verb*, *Object*):

```
prop(bread,'rdfs:domain','http://schema.org/Person').
prop(bread,'rdfs:range','http://schema.org/Book').
prop(p123,bread,b764).
```

This entails that:

i) p123 is a _____

ii) b764 is a _____

Question 2 [10 marks]

(a) [3 marks] Give Clark's completion (using explicit quantification) of

```
del1(E, [E|R], R).
del1(E, [H|T], [H|R]) :-
   del1(E,T,R).
```

(b) [5 marks] Given the logic program:

```
del1(E, [E|R], R).
del1(E, [H|T], [H|R]) :-
   del1(E,T,R).
```

Give a proof for the first answer that Prolog finds for the query:

```
?- del1(a(X),[b(c),e(f),a(d),a(c)],Y).
```

You need to show the answer clause and an appropriately renamed cause to resolve against, but you do not need to show substitutions.

Answer clause	Clause resolved

(c) [2 marks] What is the first answer that Prolog gives for this query?

Question 3 [10 marks]

(a) [6 marks] Define the relation *shuffle*$(L1, L2, L3)$ that is true if $L3$ is an interleaving of the elements of $S1$ and $S2$ (i.e., some elements of one, followed by some elements of the other, followed by some elements of the first, etc. The orders of elements in $S1$ and $S2$ should be preserved). For example, it should work as follows:

```
?- shuffle([a,b],[1,2],S).
S = [a, b, 1, 2] ;
S = [a, 1, b, 2] ;
S = [a, 1, 2, b] ;
S = [1, a, b, 2] ;
S = [1, a, 2, b] ;
S = [1, 2, a, b] ;
false.
?- shuffle([a,b,c],[],S).
S = [a, b, c] ;
false.
```

(b) [4 marks] What are all of the answers to the following query? (You should be able to answer this even if you cannot answer part (a)).

```
? shuffle([a,e],L,[a,v,e,r,a,g,e]).
```

Question 4 [10 marks]

(a) [6 marks]

For each the following pairs of terms, either give their most general unifier or say why no most general unifier exists.

i) [3 marks] $p(f(h(X,d)), h(X,Y), Y)$ and $p(f(Z), Z, c)$.

ii) [3 marks] $k([u,n,f,u,n], R)$ and $k([u,n|Z], [n,o|Z])$.

(b) [4 marks] Consider the code:

```
noun_phrase(T1,T3,Obj,C1,C3) :-
    adjectives(T1,T2,Obj,C1,C2),
    noun(T2,T3,Obj,C2,C3).
adjectives(T,T,_,C,C).
adjectives(T0,T2,Obj,C0,C2) :-
    adj(T0,T1,Obj,C0,C1),
    adjectives(T1,T2,Obj,C1,C2).
adj([Lang,speaking | T],T,Obj,C,[language(Obj,Lang)|C]).
noun([country | T],T,Obj,C,[country(Obj)|C]).
```

What is the answer to the query:

```
?- noun_phrase([french,speaking,country,borders,a, spanish, speaking,
                  country],L,Ind,[large(Ind)],R).
```