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 \( \text{prop}(Subject, Verb, Object) \):

\[
\text{prop(bread, ’rdfs:domain’, ’http://schema.org/Person’).} \\
\text{prop(bread, ’rdfs:range’, ’http://schema.org/Book’).} \\
\text{prop(p123, bread, b764).}
\]

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

\[
dell(E, [E|R], R). \\
dell(E, [H|T], [H|R]) :- \\
\] \\
\[
dell(E, T, R).
\]

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

\[
dell(E, [E|R], R). \\
dell(E, [H|T], [H|R]) :- \\
\] \\
\[
dell(E, T, R).
\]

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

\[
?- \text{dell(a(X), [b(c), e(f), a(d), a(c)], Y).}
\]

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

<table>
<thead>
<tr>
<th>Answer clause</th>
<th>Clause resolved</th>
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(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).