School of Computing and Informatics Technology
Semester 2 Assignment1 2016/2017
CS 1209: Logic Programing
Date: 2^{nd}/06/2017

- This assignment is to be done on individual basis.
- All your programming and answer should be based on the Prolog programming environment.
- You are to submit a well commented listing of your Prolog program, along with the queries you posed, and the reponses that you received to them.
- Hand (upload your solutions on muele using the dropbox provided)in your solution on 2^{nd}

Question 1: Fact and rule

A crime wave has hit the city. Your mission is to enlist the help of the Prolog system to solve the crimes. Given below is a series of facts that you are to translate into Prolog, using predicates and constants as specified. The facts and rules you formulate, taken together, will form a Prolog program that you will then query to narrow down the list of crime suspects

1. Using a predicate *possible_suspect*, and constants for the names of people, formulate the following facts:
   Fred, Mary, Jane and George are all possible suspects.
2. Using a predicate *crime* and appropriate constants, record the following facts from the police log:
   (a) Robbery1 was committed against John on Tuesday in the park.
   (b) Assault1 was committed against Mary on Wednesday in the park.
   (c) Robbery2 was committed against Jim on Wednesday in the pub.
   (d) Assault2 was committed against Robin on Thursday in the park.
3. Using a predicate *was_ at* record the following facts (twelve facts all together).
   (a) Fred was at the park on Tuesday, and at the pub on Wednesday and Thursday.
   (b) George was at the pub on Tuesday and Wednesday, and at home on Thursday.
   (c) Jane was at home on Tuesday, and at the park on Wednesday and Thursday.

(d) Mary was at the pub on Tuesday, at the park on Wednesday, and at home on Thursday.

4. Using predicates *jealous_ of* and *owes_money_to* write the following facts:
   (a) Fred is jealous of John.
   (b) Jane is jealous of Mary.
   (c) George owes money to Jim.
   (d) Mary owes money to Robin.

5. Finally, you are to formulate the following rules in Prolog (using appropriate predicates):

   (a) A suspect had a motive against a victim if either the suspect is jealous of the victim, or the suspect owes money to the victim.

   (b) A person is a prime suspect for a crime if the person is a possible suspect and the person was at the time and place of the crime and the person had a motive against the victim of the crime.

6. Now that your program is complete, you are to formulate queries to the program corresponding to the following questions.

   (a) Is Fred a prime suspect in Robbery1?

   (b) Is George a prime suspect in Assault2?

   (c) Who is (or are) the prime suspect(s) in Robbery1?

   (d) Who is (or are) the prime suspect(s) in Robbery2?

   (e) Who is (or are) the prime suspect(s) in Assault1?

   (f) Who is (or are) the prime suspect(s) in Assault2?

   (g) In what crimes is Fred a prime suspect?

   (h) In what crimes is George a prime suspect

Question two: Working with lists

1. Define a predicate *last* computing the last member of a nonempty list.

2. Define a predicate *reverse* such that *reverse(K,L)* holds if and only if list L is the reverse of list K. For example, *?- reverse([a,b,c,a],L).* should produce the answer L = [a,c,b,a].

3. Define a predicate *select* such that *select(X,K,L)* means that X is a member of list K and L is the result of removing one occurrence of X from K. For example, ?- select(a,[a,b,c,a],L). should produce the answers

```
L = [b, c, a];
L = [a, b, c];
No
```

4. Define a predicate *different* such that for a list L without repetitions *different(X, Y,L)* means that X and Y are different members of L.

5. Define a predicate *samelength* such that *samelength(K,L)* means that K and L are lists of same length. For example, the query ?- samelength([a,b,a],[d,e,f]). should produce the answer Yes, where ?-samelength([a,b,a],[d,e]). should produce the answer No.
   What are the answers to ?- samelength([a,b,c],L). and ?- samelength(L,[a,b,c]).? Does your program loop if your press ";"? (Find a solution which does not loop.)

6. Define a predicate *similar* such that *similar(K,L)* means that K and L are lists of same length containing the same elements (including their multiplicity).For example, ?- similar([a,b,a],L). (and also ?- similar(L,[a,b,a]).) should produce the answers (possably in a different order)'

```
L = [a, b, a] ;
L = [a, a, b] ;
L = [b, a, a] ;
L = [a, a, b] ;
L = [b, a, a] ;
L = [a, b, a] ;
No
```

   The answer to ?- similar([a,b,b],[a,b,a]). should be No.

Question 3: Database Construction

Create a Prolog database for a university. The database consists of ground atomic formulas made from the following predicates:

```
student[name,gpa,dept].
professor[name,salary,dept].
course[course#,year,prof_name].
enrolment[course#,year,student_name].
```

These predicates are interpreted as follows. Each student has a name, grade point average, and department. Each professor has a name, salary and department. Each course has a course number, year and a professor who teaches it. Finally, the enrolment predicate describes which students take which courses in each year. A course may have many students, a student may take many courses, a professor may teach many courses, but each course may be offered only once a year.
Here are typical atomic formulas for each of the four predicates:

```
student(maria, 3.9, cs).
professor(jane, 85000, cs).
course(csc1209, 2009 jane).
enrolment(csc1209, 2009, maria).
```

Your database should contain at least 40 atomic formulas using the four predicates above.

1. Without adding any rules to your Prolog database, pose queries to Prolog that retrieve the information below (and no more). You may use inequality predicates;e.g., $x < y$ is true iff x is less than y

   (a) The name and gpa of all students in CS.

   (b) The course numbers of all courses taught by Rose.

   (c) The course number and year of all courses taken by John that were taught by Joseph.

   (d) The names of all students who took cs2100 from fred and the years in which they took it.

   (e) The name and gpa of all students who took csc3212 from Rose and the years in which they took it.

2. Add rules to your Prolog database that define the predicates below.

   (a) hotshot(s): True if student s has a gpa greater than 3.8.

   (b) taught(p,s): True if professor p has ever taught a course taken by student s.

   (c) offered(c,y,d): True if course c was taught in year y by a professor in department d.

   (d) taken(d1,d2): True if a student in department d1 has ever taken a course offered by department d2.

   (e) neverTaken(d1,d2): True if no student in department d1 has ever taken a course offered by department d2. Use this predicate to retrieve all those departments that have a student who has never taken a course offered by the IT department. Likewise, retrieve all those departments that have never offered a course taken by a student in the IS department.

   Test your rules by posing queries to the database you constructed. Of course, your rules should work for any reasonable set of data, not just the particular data in your database. For example, if a new student enrolls in a course, or if a department hires a new professor, then your rules should still work without modification. This property of a rulebase is called data independence. You should also use the Prolog setof predicate to eliminate duplicate answers.

Question four: Bicycle Factory

A factory in charge of assembling and selling bicycles wishes to know all parts that makeup a bicycles so that it can identify possible suppliers for these parts. Information available indicate that some of these parts are basic parts while others can be assembled from other parts. Below a list of basic parts and assembled parts.

Basic parts

rim, spoke,rearframe, handles,gear), bolt,, nut and fork

Assembled parts

- A bike is an assembly of wheel,wheel and frame.
- A wheel is an assembly of spoke,rim and hub.
- A frame is an assembly of rearframe and frontframe.
- A frontframe is an assembly of fork and handles.
- A hub is made of gears and axle.
- An axle is made of bolt and nut

Write a program that, given a part, will list all the basic parts required to construct it.

Good Luck!