COMP 472/6721 **Assignment 1** **Fall 2012**

Due date: Monday Oct. 1, 2012
Late submission: 20% per day
Teams: You can do the project individually or in teams of 2.
Teams must submit only 1 copy of the assignment.
Purpose: The purpose of this assignment is to make you practice logics and automated reasoning.

Question 1 (10pts): Forward and Backward Chaining

Consider the following knowledge base:

```
L ∧ F => Z
Y ∧ D => Z
X ∧ B ∧ E => Y
A => X
C => L
A
B
C
D
E
```

A. Prove Z using forward chaining. Show all your work clearly.
B. Prove Z using backward chaining. Show all your work clearly.
C. In this case, which method is more efficient?

Question 2 (10pts): Predicate Logics

Formulate these sentences in first-order predicate logics:

A. All professors are smart.

B. All Computer Science professors are crazy.

C. If a student has a good GPA, then he/she is on the Dean's list.

D. There is a student who likes all courses that do not have assignments.

E. No person likes a professor unless the professor is smart.

Question 3 (40pts): Murder by Predicate Logics

Assume that you are an amateur crime-scene investigator, and you are investigating two very suspicious deaths. Obviously, you do not have access to the death scene yourself and cannot look at the dead bodies, but you have a contact at the police department who has been to the death scene and is willing to leak some information... The possible ways a death can take place are:

D1) Death from a stray bullet
D2) Murder by knife
D3) Murder by gun
D4) Murder by strangulation
D5) Murder by baseball bat
D6) Suicide by rope
D7) Suicide by knife
D8) Suicide by gun
D9) Suicide by jumping off the roof

Unfortunately, your contact at the police department is being watched, and only has time to answer a few of the following questions, and answer them with yes/no answers.

Q1. Were there any bullet wounds?
Q2. Were there any cuts on the body?
Q3. Were there any marks on the neck?
Q4. Were there any head injuries?
Q5. Was the victim holding the weapon used, or have it nearby?
Q6. Was the victim inside the house?

Assume that a killer always takes his weapon with him when he leaves the crime scene.

Based on your knowledge of the world, and the information above, write down a knowledge base using predicate logics. To represent the facts indicated by the 6 questions above, you can use the following predicates:

```
injuries(bullet), injuries(cuts), injuries(marks_neck),
injuries(head), holding(weapon), inside(house)
```

and use any other predicate you need to represent the 9 types of death above.

Then, use the facts given below and units-resolution to solve the following death cases. Show all your work.

A. Adam's case.
- for question Q1, your contact answered yes.
- for question Q5, your contact answered no.
- for question Q6, your contact answered yes.

Prove that Adam was murdered by a gun.

B. Babara's case:
- for question Q3, your contact answered yes.
- for question Q5, your contact answered no.

Prove that Babara was strangled to death.

Question 4 (40pts): Proof by Resolution-Refutation

Consider the following story:

Tony, Simon and Ellen belong to the Outdoor Club. Every member of the Outdoor Club is either a biker or a skier or both. No biker likes rain, and all skiers like snow. Ellen dislikes whatever Tony likes and likes whatever Tony dislikes. Tony likes rain and snow.

A- Let `skier(X)` means `X` is a skier, `biker(X)` means `X` is a biker, and `likes(X,Y)` means `X` likes `Y`, where the domain of the first variable is the Outdoor club members, and the domain of the second variable is snow and rain. Translate the above English sentences into predicate calculus.

B- Convert these sentences into CNF

C- Apply resolution-refutation with the unification to prove that: "Ellen is a biker but not a skier." show all your work, and all substitutions.

Submission:

The assignment can be handed-in on paper or electronically by midnight on the due date.

1. Make sure that you have signed the expectation of originality form (available on the Web page; or at: http://www.encs.concordia.ca/documents/expectations.pdf) and given it to me.

2. In addition, write one of the following statements on your assignment:
   - For individual work: *"I certify that this submission is my original work and meets the Faculty's Expectations of Originality***",** with your signature, I.D. #, and the date.
   - For group work*: "We certify that this submission is the original work of members of the group and meets the Faculty's Expectations of Originality"*, with the signatures and I.D. #s of all the team members and the date.

3. If you hand in your assignment on Paper:
   - Staple your hand-written answers together and give it in class.
   - If you cannot give the assignment in class:
     - Go to the Department of Computer Science and Software Engineering (EV 3. 139)
     - Ask the receptionist to stamp the date and time on your assignment.
     - Put the assignment in my mailbox (Kosseim) in room EV 3.251.

4. If you hand in your assignment Electronically:
   - Create one zip file, containing all files for your assignment.
   - Name your zip file this way:
     - For individual work: name the zip file: *a1_studentID*, where *studentID* is your ID number.
     - For group work*:* name the zip file: *a1_studentID1_studentID2*, where *studentID1* and *studentID2* are the ID numbers of each student.
   - Upload your zip file at: https://fis.encs.concordia.ca/eas/

Note: If you hand in both an electronic copy and a paper copy, then **both** must be on time.