Assignment 1

Due: Tuesday, October 7, in the class

Some rules and conditions:

1. This assignment is to be done in singles.
2. Late submission penalty: 25% off the grade for every 24 hours or part of thereof.
3. Cheating will not be tolerated. Remember, its *very* easy to see when an assignment has been copied.
4. Please write clearly – if I can't understand what you write, I can't evaluate your work.
5. If anything is unclear, email me. Frequently asked questions will be posted on the website.

Question 1 (20 points - 10 points each part)**.** Which of the following sets of clauses are inconsistent ? Justify your answers by either giving a resolution refutation tree of by defining a suitable interpretation.

(a) $S_1 = \{$

$$
\begin{aligned}
&:- p, s, q \\
q &:- \\
q, s &:- \\
p, q &:- \\
p, s &:- \\
p &:- s \\
s &:- p
\end{aligned}
$$

$\}$

(b) $S_2 = \{$

$$
\begin{aligned}
&:- p, q, s \\
p &:- t \\
q, t &:- r \\
&:- t \\
s &:- p, t
\end{aligned}
$$

$\}$

Question 2 (20 points)**.** Show that every logic program P is consistent. (*Hint:* if you cannot understand the question, review the definitions of *logic program* and *consistent*).

Question 3 (30 points - 10 points each part)**.** Execute Robinson's unification algorithm on each of the following three sets of terms. Show every step of the algorithm, the way we did this in the class (you can omit the first column, but if you do, make sure to write out the unifier explicitly by composing the appropriate substitutions).

(a) $U_1 = \{p(a, X, f(g(Y))),\ \ p(T, h(T, Z), f(Z))\}$

(b) $U_2 = \{p(X, X, V),\ \ p(f(Y), W, g(Z))\}$

(c) $U_3 = \{q(g(b, T), h(c), h(T)),\ \ q(X, h(Z), h(X))\}$

Question 4 (30 points - 10 points part (a), 20 points part (b))**.** In this question we will consider a simplified model of the "People you may know" application in Facebook. The basic idea is that if two people have a common friend, then they may know each other. We will also take into account the fact in Facebook the relation "friend" is symmetric, that is, if X is a friend of Y, then Y is a friend of X.
Thus, as a problem description P, we have the following two predicate logic sentences:

$$\forall X \forall Y [(\exists Z (friend(X, Z) \wedge friend(Z, Y))) \leftrightarrow may\_know(X, Y)]$$
$$\forall X \forall Y [friend(X, Y) \rightarrow friend(Y, X)]$$

Our goal is to show, using resolution refutation, that the following sentence g is implied by P:

$$\forall X \forall Y [may\_know(X, Y) \rightarrow may\_know(Y, X)].$$

In other words, in Facebook, the relation "may know" is also symmetric.

(a) Represent the problem description and the goal in the form suitable for resolution refutation, that is, as a set of logic programming clauses which is inconsistent if and only if $P \rightarrow g$.

(b) Find the resolution refutation of the set of logic programming clauses you have constructed in part (a). *Hint:* linear refutation is likely to be long and confusing; think first how would you prove what you need to prove, and then construct the refutation that mimics your proof.