HOMEWORK 6

Propositional Logic (PL)

1. Transform the following formulas into conjunctive normal form (CNF)

   (a) $A \iff B$

   (b) $A \wedge B \iff A \vee B$

   (c) $A \wedge (A \implies B) \implies B$

2. Given a knowledge base as follows

$$KB = \{A \wedge B \implies C, D \wedge E \implies B, F \implies A, E \implies A, E, D\}$$

   Prove that the sentence C is entailed by KB by using

   (a) Forward chaining

   (b) Backward chaining

3. If the criminal had an accomplice, then he came in a car. The criminal had no accomplice and did not have the key, or he had the key and an accomplice. The criminal had the key.

   Using a resolution inference to answer the question "Did the criminal come in a car?"

First-Order Logic (FOL)

4. For each English sentence below, write the FOL sentence that best expresses its intended meaning using the following predicates $\textsc{Cat}(x)$ for "x is a cat," $\textsc{Mouse}(x)$ for "x is a mouse," and $\textsc{Chases}(x, y)$ for "x chases y."

   (a) Every cat chases every mouse.

   (b) For every cat, there is a mouse that the cat chases.

(c) There is a cat who chases every mouse.

(d) Some cat chases some mouse.

(e) There is a mouse that every cat chases.

(f) For every mouse, there is a cat who chases that mouse.

5. Given English sentences as follows

- Every child loves Santa.
- Everyone who loves Santa loves any reindeer.
- Rudolph is a reindeer, and Rudolph has a red nose.
- Anything which has a red nose is weird or is a clown.
- No reindeer is a clown.
- Scrooge does not love anything which is weird.

(a) Build a FOL knowledge base from the above sentences, using only the following predicates.

CHILD(x): "x is a child", LOVES(x, y): "x loves y"

REINDEER(x): "x is a reindeer", REDNOSE(x): "x has red nose"

WEIRD(x): "x is weird", CLOWN(x): "x is a clown"

(b) Convert each FOL sentece in the knowledge base into CNF

(c) Use resolution to prove that "Scrooge is not a child."