AI1001: Introduction to Modern AI
Homework Assignment 1
Due Date: 07 August 2019

1. Show that the set of clauses

$$\phi_1 = X_1 \vee X_2 \vee \neg X_4, \phi_2 = \neg X_1 \vee X_2 \vee \neg X_4, \phi_3 = X_2 \vee X_4, \phi_4 = \neg X_2$$

   is not satisfiable. **Caution:** If you simply enumerate all possibilities, you won't get full credit. You have to be more efficient.

2.
   - Show that if X is a Boolean variable and ϕ_1, ϕ_2 are clauses that do not involve X, then the pair of clauses
$$X \vee \phi_1, \neg X \vee \phi_2$$
     are satisfiable if and only if the single clause $\phi_1 \vee \phi_2$ is satisfiable.
   - Using this fact, enumerate *all* solutions of
$$X_1 \vee \neg X_2 \vee X_3 \vee X_4, \neg X_1 \vee \neg X_2 \vee \neg X_3.$$

3. Suppose A, B, C are Boolean variables, and that the following are given:
   - A is true with probability 0.8.
   - B is true with probability 0.7.
   - The statement $(A \vee B) \implies C$ is true with probability 0.9.

   Using the linear programming formulation, compute the minimum and maximum probabilities that C is true.

4. Prove that the linear programming formulation of probabilistic reasoning *never* leads to absurd conclusions such as a probability being less than zero or more than one. To address this problem, you first state what precisely you are trying to prove, and then prove it.

5. (This question will not be marked and is for your benefit only.) Search the literature to find at least one practical example each of forward chaining, backward chaining, and Bayesian networks.