National University of Singapore
School of Computing
IT5005 Artificial Intelligence

Propositional Logic 1

1. Verify the following logical equivalences. You may refer Table 7.11 of AIMA4e.

   (a) $\neg(P \vee \neg Q) \vee (\neg P \wedge \neg Q) \equiv \neg P$

   (b) $(P \wedge \neg(\neg P \vee Q)) \vee (P \wedge Q) \equiv P$

2. State whether the following statements are satisfiable (SAT), valid (tautology), or contradiction (UNSAT)

   (a) $(P \Rightarrow Q) \wedge (P \Rightarrow \neg Q)$

   (b) $P \wedge (P \Rightarrow \neg Q) \wedge Q$

   (c) $(P \Rightarrow (Q \Rightarrow R)) \Rightarrow ((P \wedge Q) \Rightarrow R)$

3. Prove or disprove that the following sentence is a tautology via truth table method.

$$(P \vee Q) \wedge (R \vee \neg P) \Rightarrow (R \vee Q)$$

4. Prove that the following sentence is a tautology without truth table enumeration.

$$(\neg P \vee \neg Q \vee R) \wedge (\neg R \vee S \vee T) \Rightarrow (\neg P \vee \neg Q \vee S \vee T)$$

5. Convert the following sentences to CNF

   (a) $\neg((P \Rightarrow Q) \wedge \neg R)$

   (b) $(X_1 \wedge Y_1) \vee (X_2 \wedge Y_2))$

6. Which of the following statements are $True$?

   (a) $False \models True$

   (b) $(A \wedge B) \models (A \Leftrightarrow B)$