COMP4418: Knowledge Representation and Reasoning—Exercise Set 1
Propositional Logic

1. Translate the following sentences into propositional logic.

   (i) If Jane and John are not in town we will play tennis

   (ii) It will either rain today or it will be dry today

   (iii) You will not pass this course unless you study

   To do the translation you will need to

   (a) Identify a scheme of abbreviation

   (b) Identify logical connectives

2. Convert the following formulae into Conjunctive Normal Form (CNF)

   (i) $P \rightarrow Q$

   (ii) $(P \rightarrow \neg Q) \rightarrow R$

   (iii) $\neg(P \wedge \neg Q) \rightarrow (\neg R \vee \neg Q)$

3. Show using the truth table method that the following inferences are valid

   (i) $P \rightarrow Q, \neg Q \models \neg P$

   (ii) $P \rightarrow Q \models \neg Q \rightarrow \neg P$

   (iii) $P \rightarrow Q, Q \rightarrow R \models P \rightarrow R$

4. Repeat Question 3 using resolution. In this case we want to show:

   (i) $P \rightarrow Q, \neg Q \vdash \neg P$

   (ii) $P \rightarrow Q \vdash \neg Q \rightarrow \neg P$

   (iii) $P \rightarrow Q, Q \rightarrow R \vdash P \rightarrow R$

5. Determine whether the following sentences valid (i.e., tautologies) using truth tables

   (i) $((P \vee Q) \wedge \neg P) \rightarrow Q$

   (ii) $((P \rightarrow Q) \wedge \neg(P \rightarrow R)) \rightarrow (P \rightarrow Q)$

   (iii) $\neg(\neg P \wedge P) \wedge P$

   (iv) $(P \vee Q) \rightarrow \neg(\neg P \wedge \neg Q)$

6. Repeat Question 5 using resolution. In this case we want to show:

   (i) $\vdash ((P \vee Q) \wedge \neg P) \rightarrow Q$

   (ii) $\vdash ((P \rightarrow Q) \wedge \neg(P \rightarrow R)) \rightarrow (P \rightarrow Q)$

   (iii) $\vdash \neg(\neg P \wedge P) \wedge P$

   (iv) $\vdash (P \vee Q) \rightarrow \neg(\neg P \wedge \neg Q)$