

COMP9414: Artificial Intelligence - Exercise Set Week 5

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 are 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 aim 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) $\vdash (P \vee Q) \rightarrow \neg(\neg P \wedge \neg Q)$