

# COMP9414: Artificial Intelligence

## Tutorial 4: Propositional Logic

1. Translate the following sentences into Propositional Logic.

- (i) If Jane and John are not in town we will play tennis [do both of them have to be away?]
- (ii) It will either rain today or it will be dry today [is “dry” the same as “not raining”?]
- (iii) You will not pass this course unless you study [this means “if you do not study”]

To do the translation

- (a) Identify a scheme of abbreviation for basic sentences
- (b) Identify logical connectives between variables

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 corresponding inferences are valid.

- (i)  $P \rightarrow Q, \neg Q \models \neg P$
- (ii)  $P \rightarrow Q \models \neg Q \rightarrow \neg P$
- (iii)  $P \rightarrow Q, Q \rightarrow R \models P \rightarrow R$

Check your answers using the Python program `tableau_prover.py`.

4. Repeat Question 3 using resolution. In this case, 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)  $(P \vee Q) \rightarrow \neg(\neg P \wedge \neg Q)$

Check your answers using the Python program `tableau_prover.py`.

6. Repeat Question 5 using resolution. In this case, try 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)  $\vdash (P \vee Q) \rightarrow \neg(\neg P \wedge \neg Q)$