

# COM 6854: Verification and Testing

## Exercise Sheet 1

**Exercise 1:** Give truth tables for conjunction, implication and bi-implication.

**Exercise 2:** Use truth tables to show that the following formulae are valid.

- (a)  $p \rightarrow (q \rightarrow p)$
- (b)  $(p \rightarrow q) \rightarrow (\neg q \rightarrow \neg p)$
- (c)  $(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow (p \rightarrow r))$

**Exercise 3:** Use the PL calculus to prove the following formulae.

- (a)  $p \rightarrow (q \rightarrow p)$
- (b)  $(p \rightarrow q \wedge r) \rightarrow ((p \rightarrow q) \wedge (p \rightarrow r))$
- (c)  $(p \rightarrow q) \rightarrow (p \wedge r \rightarrow q \wedge r)$

**Exercise 4:** Use the FOL calculus to prove the following formulae.

- (a)  $s = t \rightarrow t = s$
- (b)  $r = s \wedge s = t \rightarrow r = t$
- (c)  $\forall x.\phi \wedge \forall x.\psi \rightarrow \forall x.(\phi \wedge \psi)$

**Exercise 5:** Formalise and prove Lewis Carroll's Kangaroo-Puzzle (see lecture notes, semi-formal argument suffices).