Formal Model and Verification
Exercise 2: Semantics of propositional logics

1. Truth table:

We have the following two formulas:

(1a) $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$

(1b) $((p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)) \rightarrow r$

Please construct truth tables to show that (1a) and (1b) are both tautologies.

2. Equivalence laws: Please use equivalence laws to show that (1a) and (1b) are tautologies.

3. Natural Deduction: Please use Natural Deduction to show that (1a) and (1b) are tautologies.

4. Tableau method: Please use the tableau proof method to prove that both (1a) and (1b) are tautologies.

5. Resolution principle: Please construct resolution trees to show that (1a) and (1b) are tautologies.

6. DPLL: Please use the DPLL algorithm to show that (1a) and (1b) are tautologies.

7. DPLL: Please use the DPLL algorithm to show that $((p \rightarrow q) \land (q \rightarrow r)) \lor (p \rightarrow r)$ is satisfiable.