Introduction to Logic
Assignment 4 (Part A)

King Mongkut's Institute of Technology Ladkrabang

September 6, 2022

Problem 1

Suppose ϕ is the formula $p \leftrightarrow (q \wedge \neg r)$.

(a) Find a formula in disjunctive normal form which is logically equivalent to ϕ.

(b) Find a formula in conjunctive normal form which is logically equivalent to ϕ.

Problem 2

Determine whether each of the following formula is **valid** or not. If it is <u>not</u> valid, describe a truth assignment which makes the formula false.

(a) $(r \vee \neg r \vee q) \wedge (s \vee q \vee \neg s) \wedge (p \vee r \vee \neg q) \wedge (s \vee p \vee \neg p)$

(b) $(p \vee q \vee \neg p) \wedge (s \vee \neg s \vee q) \wedge (r \vee p \vee s \vee \neg r)$

Problem 3

(a) Suppose ϕ is the conjunction of the following clauses:

$$r \vee \neg s \vee t$$
$$p \vee \neg r \vee \neg s$$
$$\neg t$$
$$\neg p \vee \neg q \vee t$$
$$s \vee t$$
$$\neg p \vee q$$

Demonstrate the application of the Davis-Putnam algorithm to check whether ϕ is satisfiable or not. If ϕ is satisfiable, describe a truth assignment which makes the formula true.

(b) Suppose ϕ is the conjunction of the following clauses:

$$\neg p \vee t$$
$$p \vee s \vee r$$
$$\neg s \vee t$$
$$p \vee \neg q$$
$$q \vee \neg r$$

Demonstrate the application of the Davis-Putnam algorithm to check whether ϕ is satisfiable or not. If ϕ is satisfiable, describe a truth assignment which makes the formula true.