

Introduction to Logic

Assignment 5 (Part A)

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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 not 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:

$$\begin{aligned} & r \vee \neg s \vee t \\ & p \vee \neg r \vee \neg s \\ & \neg t \\ & \neg p \vee \neg q \vee t \\ & s \vee t \\ & \neg p \vee q \end{aligned}$$

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:

$$\begin{aligned}\neg p \vee t \\ p \vee s \vee r \\ \neg s \vee t \\ p \vee \neg q \\ q \vee \neg r\end{aligned}$$

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.