

CS 311H: Discrete Math (Fall 2026)

Problem Set #1

Due: September 4, 2026

Problem 1: Equivalence using Truth Tables

Use truth tables to show that the following statements are logically equivalent.

(a) $(p \rightarrow q) \vee (p \rightarrow r)$ and $p \rightarrow (q \vee r)$

(b) $\neg((p \vee q) \rightarrow \neg q)$ and q

Problem 2: Equivalence-style Proof

Using the basic equivalences, prove that $((p \vee q) \wedge (\neg p \vee r)) \rightarrow (q \vee r)$ is a tautology.

Note: Please show all steps (including associativity and commutativity). Please use parenthesis, do not rely on order of operations.

Problem 3: System specification consistent or not?

Given a system, its specifications must be **consistent**, that is they should not contain conflicting requirements that could be used to derive a contradiction. When a system specification is inconsistent, there would be no way to develop a system that satisfies all the specifications.

Another way to think about system specification consistency, the conjunction of all the specifications must be satisfiable.

Are these system specification consistent? Justify your answer.

1. The system is in multiuser state if and only if it is operating normally.
2. If the system is operating normally, the kernel is functioning.
3. The kernel is not functioning or the system is in interrupt mode.
4. If the system is not in multiuser state, then it is in interrupt mode.
5. The system is not in interrupt mode.

Problem 4: Prove using the Rules of Inference

$$\begin{array}{l} R \rightarrow W \\ W \rightarrow S \\ S \rightarrow C \\ R \\ C \rightarrow I \\ \hline \therefore I \end{array}$$

Problem 5: Prove using the Rules of Inference

$$\begin{array}{l} C \vee P \\ C \rightarrow W \\ W \rightarrow X \\ \neg X \\ \hline \therefore P \end{array}$$

Problem 6: Prove using the Rules of Inference

$$\begin{array}{l} (a \wedge q) \rightarrow m \\ f \rightarrow q \\ \neg p \rightarrow a \\ \hline \therefore \neg m \rightarrow (\neg f \vee p) \end{array}$$