

Homework 1

Due: 6 Feb 2009

All homeworks are due at 1:00pm in the CS22 bin on the CIT second floor, opposite the elevators.

Write your *full name* and the problem number on each piece of paper you hand in and then staple.

As was done in class, please use the “0” and “1” convention for truth values, and use the standard truth table row ordering.

Reading: Textbook sections 1.1, 1.2, 1.3 (required), 1.4 (recommended).

Problem 1.1

Using a **truth table**, decide if each of the following expressions is a contradiction, a tautology, or neither.

- a. $[(p \rightarrow r) \vee (r \rightarrow q)] \wedge (p \wedge \sim q)$
- b. $[(r \wedge p) \vee \sim r] \vee [p \rightarrow (p \wedge \sim q)]$
- c. $[(p \wedge q) \vee (\sim q \wedge r)] \wedge (\sim q \wedge \sim r)$

Problem 1.2

Given the following definitions:

- a:* “Vampires don’t get along with werewolves.”
- b:* “Willy the Werewolf is missing.”
- c:* “Vinny the Vampire is pleased.”
- d:* “Willy’s mother is sad.”

Translate the given English sentences into the logical notation we’ve been using in class:

1. Willy the Werewolf is missing and Vinny the Vampire is pleased.
2. If Willy the Werewolf is missing, then Willy's mother is sad.
3. If vampires get along with werewolves and Willy the Werewolf is missing, then Vinny the Vampire is not pleased.

Translate the following formal statements into English sentences:

4. $\sim d \rightarrow \sim b$
5. $(a \wedge \sim c) \rightarrow (\sim b \wedge \sim d)$
6. $b \rightarrow ((a \wedge c) \vee (\sim a \wedge \sim c))$

Problem 1.3

Simplify the following expressions using logical equivalences (indicate at each step which equivalence is being used).

- a. $((p \vee \sim q) \wedge (\sim p \vee q)) \vee \sim (\sim (p \vee \sim r) \wedge q)$
- b. $\sim ((p \vee q) \wedge r) \vee q$

Problem 1.4

Show the correctness or falsehood of the following equivalences, without using a truth table (indicate at each step which equivalence is being used).

- a. $\sim (p \rightarrow ((q \vee \sim (p \vee q)) \wedge (q \rightarrow p))) \equiv p \wedge \sim q$
- b. $(p \wedge ((\sim (\sim p \vee q)) \vee (p \wedge r))) \equiv p$

Problem 1.5

Give the contrapositive, converse, and inverse of each of the following statements.

- a. If Catherine is going to the Providence Place Mall, then she is accompanied by Thea and Chris.

- b. If Alex does not sit down in the SciLi before 10 PM, then he will not complete his homework on time.
- c. If Ben plans on cleaning his dorm room, then he plans on asking Greg for garbage bags and does not plan to invite Tom over to watch soccer.

Problem 1.6

Identify the form of the following arguments. If there is an error, identify the **type of error**.

- a. Nothing intelligible ever puzzles me. Logic puzzles me. Therefore, logic is unintelligible.
- b. If the car doesn't start, it is broken. The car is broken. Therefore, the car doesn't start.