

CSE 2321: Homework 1

Due Wednesday, May 16. You may turn in the homework during class or before class in the envelope outside my office (Caldwell 411).

Before completing the homework, carefully read the homework directions posted on Piazza in Resources > Homework.

1. Use a truth table to determine if the exclusive-or operator \oplus is associative. That is, does $(p \oplus q) \oplus r = p \oplus (q \oplus r)$ for all values of p , q , and r ? Be sure to justify your answer with a complete sentence or two. (8 pts)
2. For each of the following formulas, determine, by means of a truth table whether it is a *tautology*, a *contradiction*, or a *contingency*. Justify each answer with a complete sentence or two. (7 pts each)
 - (a) $(\neg p \vee q) \leftrightarrow (\neg p \wedge \neg q)$
 - (b) $(p \wedge (p \rightarrow q)) \rightarrow q$
 - (c) $((\neg p \vee \neg q) \vee r) \leftrightarrow ((p \wedge q) \rightarrow r)$
3. If the truth table for a proposition function with n variables has 1024 rows, then what is the value of n ? Briefly justify your answer. (3 pts)
4. State the converse and contrapositive of each of the following. Label both the converse and contrapositive. (6 pts each; 3 for converse and 3 for contrapositive)
 - (a) If it not Sunday, then I have class.
 - (b) If you have a straight, then you beat two pairs.

(c) You can't win if you don't play.

(d) All people from Columbus root for the Buckeyes. (Hint your answers should not use the word "All".)

5. Let P be the proposition "The semi-finals are on Sunday".
Let Q be the proposition "Walter doesn't bowl in the semi-finals".
Let R be the proposition "Walter's team wins the quarter-finals".

Using logical connectives, write a boolean expression that symbolizes each of the following.
(4 pts each)

(a) If the semi-finals are on Sunday and and Walter bowls in the semi-finals, then Walter's team wins the quarter-finals.

(b) Walter's team wins the quarter-finals only if Walter doesn't bowl in the semi-finals.

(c) The semi-finals are not on Sunday if and only if Walter bowls in them.

(d) The semi-finals are on Sunday but Walter doesn't bowl in them.

(e) Either Walter's team wins the quarter-finals, or the semi-finals are on Sunday and Walter doesn't bowl in them (but not both; that is, the "or" is exclusive).

Translate the following boolean expressions into English, using the sentences for each variable given above. For example, the translation of $P \wedge R$ is "The semi-finals are on Sunday and Walter's team wins the quarter-finals".

(f) $P \vee Q$

(g) $(\neg P \wedge R) \rightarrow \neg Q$

(h) $Q \rightarrow P$

(i) $\neg P \wedge \neg Q$

6. Consider the truth table for NAND (denoted “ $|$ ”), which is defined below:

p	q	$p q$
T	T	F
T	F	T
F	T	T
F	F	T

- (a) Create the truth table for $p | p$. What boolean operator has the same truth table? (Hint: your truth table should have two rows.) (4 pts)
- (b) Create the truth table for $(p | q) | (p | q)$. What boolean operator has the same truth table? (4 pts)