***KWANTLEN* POLYTECHNIC UNIVERSITY**

INFO 1214 – Spring 2024

ASSIGNMENT 3

Textbook: Epp, S., **Discrete Mathematics with Applications**, 4th Edition
From sections 2.4, 2.5, and 3.1

OBJECTIVES

Upon successful completion of this assignment, the student will be able to:

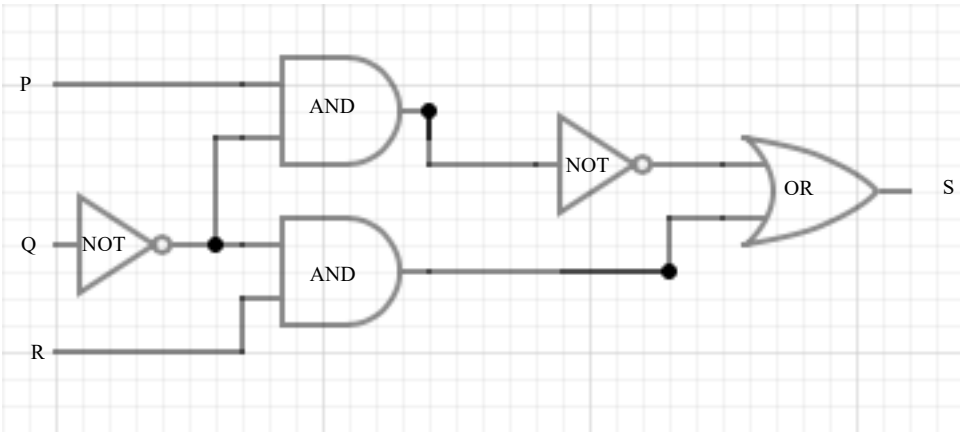
- Create logic circuits using gates and construct Boolean expressions
- Demonstrate an understanding of simple binary numbers, two's complement, addition, and subtraction
- Demonstrate an understanding of the Universal and Existential qualifiers, formal versus informal language, and universal conditional statements.

ASSIGNMENT

Answer the following questions, using the course notes, books and/or reliable sources from the Web. Do not merely copy solutions you may find; all answers should be in your own wording. After each answer, **include a reference to your source** for the answer **if and only if** you used a source other than the textbook to help you solve the problem. Please double-check your answers before submitting them.

Note that copying and pasting an answer from a reference or handing in the same answer as another student is considered plagiarism and/or cheating and will result in a zero for the entire assignment. Answers must be your own work and in your own words!

1. Consider the following logic circuit (Lesson #4: Slides 42-49) (3 pts):



a. Find the Boolean expression that corresponds to this circuit.

b. Write a complete input/output table for the circuit.

2. Construct a circuit for the following Boolean expression (Lesson #4: Slides 51-59) (2 pts):

$(\sim A \vee \sim B) \wedge (\sim A \wedge C) \wedge (B \vee \sim C)$

3. **For the following input/output table, where A, B, C are inputs, and D is the output (Lesson #4: Slides 64-66) (4 pts):**

A	B	C	D
1	1	1	0
1	1	0	1
1	0	1	1
1	0	0	0
0	1	1	1
0	1	0	1
0	0	1	0
0	0	0	0

   a. Construct a Boolean expression having the given table as its input/output table

   b. Construct a circuit having the given table as its input/output table

4. **Write the following decimal integers in binary notation (<u>not</u> in 8-bit two's complement form unless specified). <u>Please</u> use the technique shown in class (do not simply ask Google) and <u>show</u> your calculation as a sum of powers of two as shown in class to get full marks (Lesson #5: Slide 30-34 for positive integers and Lesson #5: Slide 53-54 for negative integers) (3 pts):**

   a. 37
   b. 2002
   c. -33 (write in 8-bit two's complement of 33)

5. **Write the binary integers in decimal notation (NOTE: they are <u>not</u> in 8-bit two's complement form unless specified). <u>Please</u> use the technique shown in class (do not simply ask Google) and <u>show</u> your calculation as a sum of powers of two as shown in class to get full marks (Lesson #5: Slide 28 for positive integers and Lesson #5: Slides 56-59 for negative integers) (3 pts):**

   a. 10101_2
   b. 1011101_2
   c. 11011101_2 (assume this is in 8-bit two's complement form, your answer should be a negative number)

6. **Perform the arithmetic in binary notation. <u>Please</u> use the technique shown in class (do not simply ask Google) and <u>show</u> your calculation as shown in class to get full marks (Lesson #5: Slides 36-37 for addition and Slides 38-43 for subtraction) (4 pts):**

   a. 110111011_2
   $+\ 1011011011_2$

   b. 11010010_2
   $-\ 101101_2$

7. **Perform the arithmetic in binary notation <u>using two's compliment</u>. <u>Please</u> use the technique shown in class (do not simply ask Google) and <u>show</u> your calculation <u>and</u> check your answer by converting final answer to decimal as shown in class to get full marks (Lesson #5: Slides 61-68) (6 pts):**
   a. 109 + (-12)
   b. 27 + (-42)

8. **Let Q(n) be the predicate "$n^2 - 2n + 2 \leq 30$" (Lesson #5: Slide 74) (2 pts)**

   a. Write Q(4), Q(-4), Q(6), and Q(-6), and indicate which of these statements are ***true*** and which are ***false***.

   b. Find the truth set of Q(n) if the domain of ***n*** is $\mathbf{Z}^+$, the set of all positive integers.

9. **Find the truth set of each predicate (Lesson #5: Slide 74) (2 pts):**

   a. Predicate: "18/d is an integer", domain: $\mathbf{Z}^-$ (note the domain is all negative integers)

   b. Predicate: "$1 < x^2 < 16$", domain: **Z**

10. **Find *counterexamples* to show that the following statements are false (Lesson #5: Slide 81) (2 pts):**

    a. $\forall y \in Z, \frac{y-4}{y}$ *is* ***not*** *an integer*

    b. $\forall$ *real numbers a and b,* $\sqrt{a+b} = \sqrt{a} + \sqrt{b}$

11. **Rewrite the following statement "Some assignments are hard." into the following formal forms (Lesson #5: Slides 88-91) (2 pts):**

    a. "∃ _____ ***a*** such that _____"

    b. "∃***a*** such that _____ and _____"

Before handing in this assignment, make sure you have provided references for your answers to each question <u>ONLY if</u> you used another source other than the textbook as your source of inspiration to answer your question.

WHAT TO HAND IN

You should hand in:

- a **cover page** showing your name and student number, the course number (INFO 1214), your section number (S12 or S13), the assignment number (Assignment #3) and the date the assignment is actually submitted, all centered horizontally on the page;
- the answers to the questions, in the order given above

DUE DATE

S12: Wed Feb 7, 2024 at 1 pm
S13: Fri Feb 9, 2024 at 1 pm