CS-UY 2214 — Homework 1

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Complete the following exercises. Put you answers in a plain text file named `hw1.txt`. Number your solution to each question. When you finish, submit your file on Gradescope.

Please note that your solutions must be in a *plain text file*. Other formats, such as PDF, RTF, and Microsoft Word, will not be accepted. Here are some recommended editors that produce plain text files:

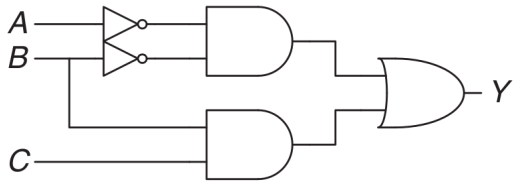
- Notepad (comes with Windows)
- TextEdit (comes with Mac OS); note that if you are using TextEdit, you need to select "Make Plain Text" from the Format menu before saving the file
- gedit (available on most Linux distributions)
- nano (available on most Linux distributions)
- Sublime Text
- VSCode
- Atom
- Vim
- Emacs

For questions that require a solution expressed as an image (specifically, question 3), submit the image as a separate file. The image file should be named `hw`n`q`m, where n is the homework number and m is the question number; use an appropriate suffix (either `jpg` or `png`).

Please note that all homework must represent *solely your own work*. Any form of collaboration is strictly prohibited. Please see the syllabus for more details.

Problems

1. Consider the following circuit:



   Complete the truth table for the circuit:

A	B	C	Y

2. Give an algebraic expression for the circuit in the previous question.

3. Draw a circuit diagram corresponding to the following expression:

```
Q = (A & B) | ((B | C) & (B & C))
```

   Do not simplify the equation. Submit your answer as an image, in accordance with the instructions at the beginning of this document. Your image may be a diagram created in a drawing program, or it may be a photograph of a hand-drawn diagram on paper.

4. Consider the following C++ program. Do not run it.

```
#include <iostream>
using namespace std;
int main() {
    unsigned int x = 79;
    while (x <= 79)
        x--;
    cout << "x=" << x << endl;
    return 0;
}
```

   Your friend Rufus argues that this program has an infinite loop, and will therefore never end. Is he right or wrong? Justify your opinion with a persuasive explanation, but do not type in or run the program. Predict the output of the program.

5. Write the following decimal numbers in 8-bit 2's-complement binary. Write all eight bits, including leading zeros.

   (a) 53
   (b) -53
   (c) -77
   (d) -12

6. Write the following 8-bit 2's-complement binary numbers in decimal.

   (a) 01111111
   (b) 10111111
   (c) 11011111
   (d) 01010101

7. Assume that the following operations are calculated using 8-bit 2's complement numbers. Give the resulting sum in decimal. Take into account the effects of possible overflow.

(a) $34 + 55$

(b) $99 + 30$

(c) $30 + -40$

(d) $-100 + -100$

8. Assume that the following operations are calculated using 8-bit unsigned numbers. Give the resulting sum in decimal. Take into account the effects of possible overflow.

   (a) $34 + 55$

   (b) $99 + 30$

   (c) $100 + 200$