Fall 2025 / EC311
Pre-Lab-A: Digital Logic Gates

Acknowledgement

This lab was adapted from Digital Design, Fifth Edition, Mano and Ciletti, Pearson.

1. Goals

- Familiarize yourself with standard digital logic gates.
- Learn the Logisim tool.
- Design simple combinational circuits.

2. Overview

In this lab, you will investigate the logic behavior of the following gates:
NOT, AND, OR, NAND, NOR and XOR.

3. Tasks

1. **Familiarize yourself with Logisim**
   Complete the Logisim Beginner's tutorial at
   (http://www.cburch.com/logisim/docs/2.3.0/guide/tutorial/index.html)

2. **Schematic Capture and Simulation**
   Pick AND, NOR, and XOR gates from the list. For each gate, write its truth table on a sheet of paper. On Logisim canvas add the gate symbol, connect I/O markers to inputs and output of the gate, and simulate it. Test all input combinations in the truth table.

3. **Universal NAND Gate**
   On paper, design a circuit that, using up to four 2-input NAND gates, produces:

   (a) a two-input AND,
   (b) a two-input OR.

   Use Logisim to draw your circuits and then verify your circuits by checking their functionality against their truth table.

4. **Combinational Logic Circuit** In the Logisim canvas, construct a circuit with only NAND gates that implements the following Boolean function

$$F = AB + CD \tag{1}$$

   (a) Draw the circuit diagram.
   (b) On a sheet of paper, write the truth table for F as a function of the A,B,C,D.
   (c) Simulate the circuit and verify the truth table.

5. **Deliverables**
   Show your designs for Task 3 and 4 to your lab TA.