

University of New Brunswick  
Computer Science  
Computer Architecture and Organization  
Instructor: Joanna Nanjehye, jnanjehye@unb.ca  
**Due Date: July 26, 2024 – 11:59 PM**

**LAB 2 EXTENDED**

**Pre-lab instructions:**

- Complete and test the setup required for the remote access to the FCS labs: <https://www.cs.unb.ca/help/>
  - Set up UNB VPN: <https://unbcloud.sharepoint.com/sites/ITServices/SitePages/VPN.aspx>
  - Set up SSH for the command line mode access: <https://www.cs.unb.ca/help/ssh-help.shtml>
  - Set up VNC for the remote desktop access: <https://www.cs.unb.ca/help/remote-lab-gui-access.shtml>
- Start a VNC session before the lab session.

**Reference materials**

- LogicWorks 5, by Capilano Computing Systems, Benjamin-Cummings. Chapter 4, pages 21 to 33, provides a tutorial with advanced features.
- Sample LogicWorks tutorial online: <https://www.cs.uregina.ca/Links/class-info/201/LW5/lecture.htm>

**General instructions:**

- Log in to Windows in the FCS lab.
- Using remote access to the FCS labs is recommended.
- Complete lab exercises and prepare a lab report.
- Group work is allowed, however, individual D2L submissions are required from each student.
- You may finish the lab on your own time.

**Submission instructions:**

- Submit the pdf files to the Desire2Learn dropbox

**Task 1.** Use NAND gates to implement the AND, OR, and NOT functions as discussed in lecture 5. You should use two switches as input, and an LED as output.

**Task 2.** Build a logic circuit to verify the DeMorgan's laws, see lecture 5 for the basic boolean identities. Design both parts of the equation separately and have the outputs of each go to a separate LED.

**Task 3.** Build a BCD adder circuit. In BCD arithmetic, you use 4 bits to represent the digits 0 through 9. If the sum exceeds 9, you generate a carry and subtract 10 from the sum to get the correct digit.

- Prepare a truth table for the circuit
- take the screenshot of addition of addition  $4 + 6$  performed in the simulator