CSSE2010/CSSE7201 – Introduction to Computer Systems
Semester two, 2021

Lab 4 Preparation Task

You should complete three circuit schematic diagrams as listed below before your week 3 Lab 4 session. Refer to the week by week teaching outline on Blackboard to see when is your lab 4 session. You should consult the device pinout information on Blackboard (under learning resources>>lab resources digital logic). Internal (IN) mode students will be constructing these circuits during the prac session if you have a kit otherwise simulate in Logisim. External (EX) mode students will be simulating these circuits using Logisim. Either way, you should verify the functionality of these circuits.

Circuit 1

Draw a circuit schematic diagram for a 2-to-1 multiplexer that uses only 2-input NAND gates. The data inputs should be connected to push buttons. The select input should be connected to a switch. The output should be connected to an LED.
Hint: Do the truth table (or a function table) for a 2-to-1 multiplexer, obtain the logic expression, then draw a logic circuit and convert it to the NAND equivalent circuit by replacing each gate with its NAND version. If you use Logisim, do not use the MUX module.

Circuit 2

Draw a circuit schematic diagram for a 2-to-4 decoder - using whichever logic gates you prefer (from those available in the CSSE2010/CSSE7201 lab). The two inputs should be connected to switches. The outputs should be connected to LEDs.

A 2-to-4 decoder has the following truth table (inputs A1, A0 and outputs X0, X1, X2, X3):

A1	A0	X0	X1	X2	X3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Circuit 3

Using a 74HCT04, 74HCT157 and a 74HCT283, draw a circuit schematic diagram for a circuit which can act as a 4-bit two's complement adder or subtractor. The output (4-bits from the 74HCT283, which should be shown on LEDs) will have the value A+B or A-B (where A and B are the 4-bit inputs which are taken from switches). A push button input (M, mode) will determine whether the circuit performs addition or subtraction - if the value is 0, addition will be performed; if the value is 1, subtraction will be performed by calculating A+(-B). The circuit is similar to that shown in lecture 4 slide 7 except the selection of the "B" input bits as B or not(B) is to be performed using multiplexers instead of XOR gates. (The 74HCT157 is a quad 2-to-1 multiplexer with a shared select input.) The carry output should be shown on a LED also.

For EX students: You should still draw the circuit schematic diagram on paper indicating how you would use the above ICs to construct the required circuit. You can then simulate it on Logisim during the prac. Logisim has 2-to-1 multiplexers and adders (which you can configure to be 4-bits) and NOT gates, which are the building blocks required to test the circuit 3. Logisim also has an inbuilt subtractor module, which should not be used for this task.