



CSSE1000/CSSE7035 - Prac 1

Basic Logic Gates

Goal

The goal of this prac is to gain familiarity with some of the equipment to be used in the course and some experience wiring up basic digital circuits on a breadboard. Specifically, for each of the circuits, you will need to prepare a circuit schematic diagram, wire up the circuit and test it systematically. You are not expected to know anything about the equipment before this prac.

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Preparation - Answer the following questions in your Prac workbook.

For this first prac, it is not required that you complete the preparation before you attend the prac. You should however read through the prac instructions below and the linked pages:

1. [Breadboards](#) - we will be using these throughout the semester
2. [Circuit schematic diagrams](#) - We will be requiring you to do these for many of the pracs and your prac exam

You should also read through the week 1 lecture readings.

Your tutor will give you a verbal introduction to the equipment in the lab. Remember, **you must obtain and use a prac workbook**. It must be a bound A4 notebook - loose-leaf pages may not be used and will not be assessed. Your prac workbook will be the only thing you can bring into prac exam.

For pracs in future weeks, it is compulsory that you complete the preparation before you come to the prac. This will allow you to complete all prac exercises in the given time,

1. Prepare a [circuit schematic diagram](#) of the 2-input AND gate shown in [Figure 1a](#). The two inputs, *A* and *B* will connect to toggle switches and the output *F* will connect to an LED on the logic workstation. Complete the truth table in [Figure 1b](#) with the expected outputs.



(a) Logic diagram

A	B	F
0	0	
0	1	
1	0	
1	1	

(b) Truth table

Figure 1. 2-input AND gate.

2. Prepare a circuit schematic diagram of a **3-input OR** gate using two 2-input OR gates as shown

in the logic diagram below (Figure 2).

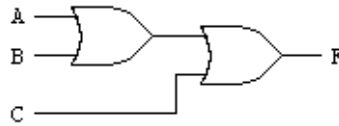
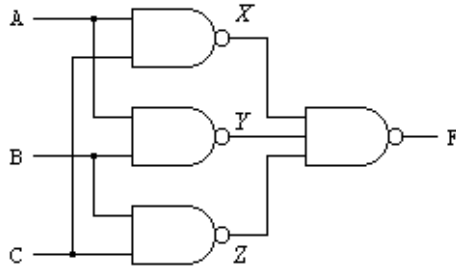


Figure 2. Cascading 2-input OR gates to form 3 inputs.

3. A *majority* gate is a digital circuit whose output is equal to 1 if the majority of inputs are 1's. The output is 0 otherwise. Prepare a circuit schematic diagram of the 3-input majority gate circuit shown in Figure 3a. The three inputs, *A*, *B* and *C* will connect to toggle switches and the output *F* will connect to an LED on the logic workstation. Complete the truth table in Figure 3b.



(a) Logic diagram

A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

(b) Truth table

Figure 3. 3-input majority gate circuit.

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Procedure

Familiarisation with equipment. The tutor will give a verbal introduction to the equipment. Make sure you ask questions if you do not understand.

1. Connect the power and switch on the logic workstation. Take a look at the various resources - toggle switches, buttons, LEDs (light emitting diodes), etc.
2. Familiarise yourself with the logic workstation, e.g. connect the output of a switch to the input of a LED and see what happens when you toggle the switch. Familiarise yourself with the use of the logic probe.
3. Experiment using the [breadboard](#) - work out how the horizontal rails are connected, and how the vertical ones are separated. Refer to the breadboard resource page if necessary.

Standard Tasks - extensive help will be provided by the tutor - don't hesitate to ask any questions. Ask the tutor to give you feedback on your circuit schematic diagrams and your wiring. This is important as you will have to draw circuit schematic diagram in future weeks and neat wiring will also be required.

4. Wire up and test the 2-input AND gate shown in Figure 1a from the circuit schematic diagram that have prepared. Connect the two inputs, *A* and *B* to toggle switches and the output *F* to an LED on the logic workstation. Compare the results with the truth table that you completed in Figure 1b.
 - ◊ Make sure you switch everything off while you are constructing the circuit and changing any connections.
 - ◊ If you apply the power connections incorrectly, you may destroy the IC. Before you switch the power on, always check the power and ground connections. Ask the tutor to check your connections if you are unsure.
5. Leaving your circuit for part 1 wired up, wire up and test the 3-input OR gate from the circuit schematic diagram that you have prepared. Connect the three inputs to toggle switches and the output to an LED on the logic workstation. Generate a truth table for the circuit.
6. Leaving both your circuits for part 1 and 2 wired up, wire up and test the 3-input majority gate circuit shown in Figure 3a from the circuit schematic diagram that have prepared. Connect the three inputs, *A*, *B* and *C* to toggle switches and the output *F* to an LED on the logic workstation. Compare the results with the truth table that you completed in Figure 3b. Extend your truth table to include the signals *X*, *Y* and *Z* as outputs as well. Use the logic probe to test the values of *X*, *Y* and *Z* in your wired up circuit, and complete the truth table accordingly.
7. Demonstrate your design for Part 3 to the tutor and show your completed truth tables for all

parts.

Tutor Task:

8. Complete the additional task given to you by the tutor. You will be required to draw a circuit schematic, wire up and test a simple circuit using AND, NAND and OR gates.

Important: *If you need to remove a chip from the breadboard, do NOT use your fingers - it may come out suddenly and you may end up with metal pins in your fingers, or you may bend the pins. Use two pens as levers on both sides to "pop" it out.*

Challenge Task (not assessed, complete this after you have been signed off for a mark by the tutor)

- Design a 2-input XOR gate using only 2-input NAND gates. Draw a circuit schematic diagram and fill in the truth table. Wire up and test your design.

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Assessment





This prac is marked out of 3 marks and is worth 2% of your final grade for CSSE1000/CSSE7035.

- Functionality - Part 3 circuit wired up and working (partial marks given if part 1 or 2 is demonstrated instead). Circuit functionally correct - **1 mark**
- Workbooks - Experimental process documented. Truth tables for all part completed. Any differences between expected and measured values noted and discussed. Corrections made as necessary - **1 Mark**
- Tutor Task - Tutor task completed and results correct. Circuits demonstrated and process documented in workbooks - **1 Mark**

Note that in future weeks preparation will be assessed, and must be completed before the session in order to get marks for preparation.

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Equipment

- Computer
- Logic Workstation
- Breadboard
- Hook up Wire
- Wire Strippers
- Components:
 - 1 x **74HCT00** - Quad 2-input NAND Gate  [Datasheet](#)
 - 1 x **74HCT10** - Triple 3-input NAND Gate  [Datasheet](#)
 - 1 x **74HCT08** - Quad 2-input AND Gate  [Datasheet](#)
 - 1 x **74HCT32** - Quad 2-input OR Gate  [Datasheet](#)

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References

- Tanenbaum, Andrew S., *Structured Computer Organization*, 5th Ed., Prentice/Hall, 2006. ISBN: 0-13-148521-0
- Mano, M., *Digital Design*, Prentice/Hall, 1984. ISBN: 0-13-212325-8

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