Laboratory assignment one
Introduction to combinational circuit implementation
EECS 203

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Lab checks will be conducted during your chosen times.
The lab report is due during your lab check slot on 9 April.

Please keep track of how long you spend doing this laboratory assignment. Specifically, how much time is needed to do the problems after studying enough to understand the concepts?

Please carefully review the lab kit lecture before starting this assignment. If you make catastrophic wiring mistakes, this could result in be exploding integrated circuits sending chunks of plastic into your forehead.

In this laboratory assignment, you will be implementing a few simple combinational circuits using logic gates in discrete TTL (transistor to transistor logic) packages. Following the material in lecture four, you should already have a decent understanding of the equipment in your lab kit.

Please show your work in your lab report. For example, if you do algebraic simplification, show your steps.

1. Implement the circuit shown in Figure 1. You will require the following equipment:

   - Three green LEDs
   - One red LED
   - One SPST (single-pole single-throw) switch 12-pack DIP
   - Four $330\,\Omega$ resistors
   - Three $510\,\Omega$ resistors
   - One 74LS00 quad two-input NAND IC

2. Before you begin wiring, you are encouraged to do a circuit floorplan diagram, in which you show the locations of each circuit component on your breadboard. You need not show every wire connection in this floorplan. However, you should keep connected components close together but provide enough space so that routing wires over components is not necessary.

3. Verify that your circuit functions correctly. If there is a problem, try the following debugging technique:

   (a) Disconnect the power supply.

   (b) Make sure none of the ICs are hot to the touch (be careful, you might burn yourself). If an IC is hot, check carefully for wiring errors. If you find a catastrophic wiring error, e.g., reversing V_{DD} and V_{SS}, fix the error and note that the IC may have been damaged.
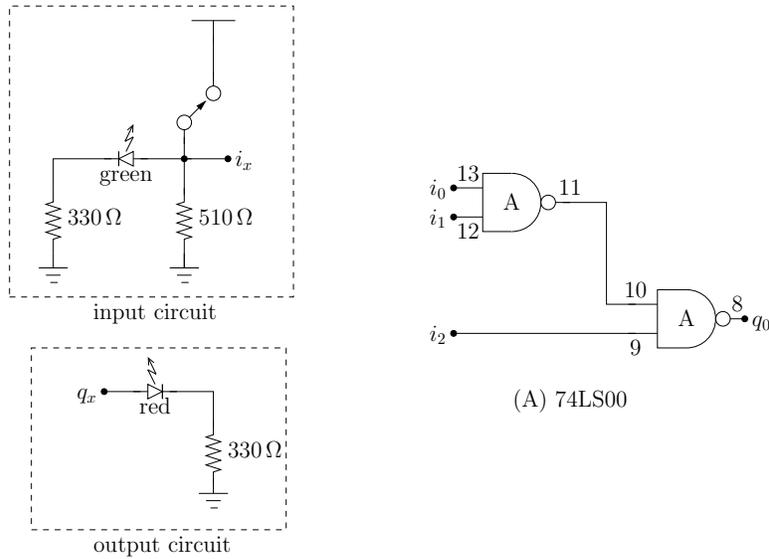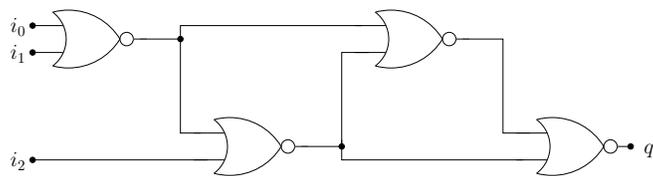
Figure 1: NAND circuit

Figure 2: NOR circuit

- (c) Check your wiring for errors.
- (d) If everything looks correct, reseat your components and re-connect the power supply.
- (e) Use your logic probe to work forward from the circuit inputs and determine where the circuit fails.

4. Using NOR gates in the 74LS02 IC, implement something functionally equivalent to the circuit shown in Figure 2. You have a choice – you may wire up the device shown here (plus the three input sub-circuits and the one output sub-circuit) or you may derive a truth table or formula and use it to simplify the circuit before implementation. Would you rather spend a bit more time on simplification or a bit more time wiring up hardware? If you decide to use algebraic minimization, you may use the variable names a, b, and c, instead of i_0, i_1, and i_2 to reduce the amount of writing necessary. You need to attach LEDs and switches to the inputs and outputs of your circuit as shown in Figure 1.

5. Prepare a laboratory report. This report should contain the following information.

- A problem statement or objective for the laboratory assignment
- Anything you used in achieving this objective, e.g., truth tables or algebraic simplification, etc.
- A list of the parts required for the circuits you implemented (you need not give parts for first circuit, as it appears in this handout)
- Schematic diagrams of the circuits you implemented (you need not give a schematic for the first circuit, as it appears in this handout).

- Comments and observations
- A circuit floorplan (optional)

6. The lab will be graded as follows:

Component	Weight
Circuit quality	5
Report clarity	2
Derivation and schematic	1
Layout style and neatness	1
Correct LED and switch use (resistors, etc.)	1

Note that, for this lab only, it is not necessary to color-code your wiring. However, you should use color-coding to facilitate debugging for all future laboratory assignments so please remember to take some wire from the spools in the teaching lab at the end of your lab check session.