JOINT INSTITUTE
交大密西根学院

Ve270 Introduction to Logic Design

Homework 3

Assigned: May 28, 2020

Due: June 4, 2020, 2:00pm.

A pop quiz will be given on the due date.

1. Problem 2.57 (15 points)

2.57 A network router connects multiple computers together and allows them to send messages to each other. If two or more computers send messages simultaneously, the messages "collide" and the messages must be resent. Using the combinational design process of Table 2.5, create a collision detection circuit for a router that connects 4 computers. The circuit has 4 inputs labeled `M0` through `M3` that are `1` when the corresponding computer is sending a message and `0` otherwise. The circuit has one output labeled `C` that is `1` when a collision is detected and `0` otherwise.

(Please refer to your Lecture Notes and find "The combinational design process of Table 2.5")

2. Problem 2.58 (15 points)

2.58 Using the combinational design process of Table 2.5, create a 4-bit prime number detector. The circuit has four inputs, `N3`, `N2`, `N1`, and `N0` that correspond to a 4-bit number (`N3` is the most significant bit) and one output `P` that is `1` when the input is a prime number and that is `0` otherwise.

3. Problem 2.60 (15 points)

2.60 A car has a low-tire-pressure sensor that outputs the current tire pressure as a 5-bit binary number. Create a circuit that illuminates a "low tire pressure" indicator light (by setting an output `T` to `1`) when the tire pressure drops below 16. Hint: you might find it easier to create a circuit that detects the inverse function. You can then just append an inverter to the output of that circuit.

4. Problem 2.74 (15 points)

2.74 A house has four external doors each with a sensor that outputs 1 if its door is open. Inside the house is a single LED that a homeowner wishes to use to indicate whether a door is open or closed. Because the LED can only show the status of one sensor, the homeowner buys a switch that can be set to 0, 1, 2, or 3 and that has a 2-bit output representing the switch position in binary. Create a circuit to connect the four sensors, the switch, and the LED. Use at least one mux (a single mux or an N-bit mux) or decoder. Use block symbols with a clearly defined function, such as "2x1 mux," "8-bit 2x1 mux," or "3x8 decoder"; do not show the internal design of a mux or decoder..

5. Show how two 4-to-1 and one 2-to-1 MUXs could be connected to form an 8-to-1 MUX. Make sure the control signals are clearly connected and labeled. (5 points)

6. Show how to make a 5-to-1 MUX using an 8-to-1 MUX. (5 points)

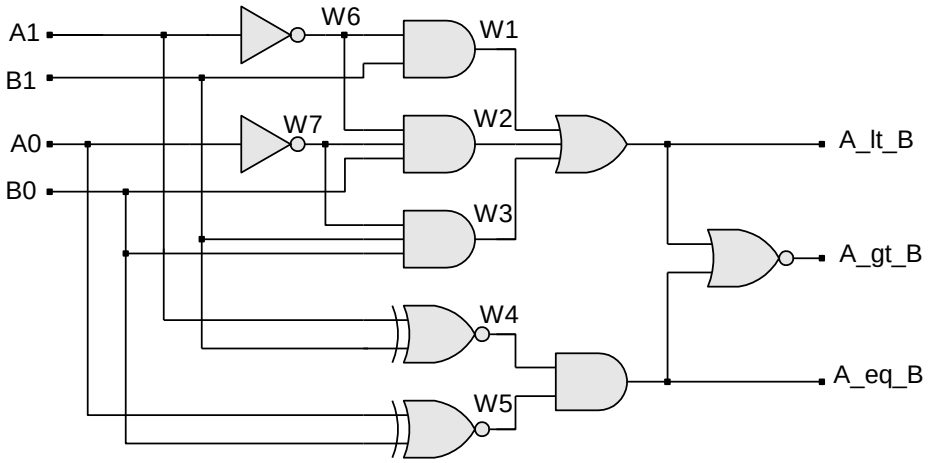
7. Use one 4-to-1 MUX and one inverter to implement a digital circuit for following truth table. (5 points)

a	b	c	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

8. Use one 3-by-8 decoder and other components to implement a digital circuit for above truth table. (10 points)

9. An incrementor is a combinational circuit that always adds "1" to the input. Design a 4-bit incrementor with half-adder building blocks. (10 points)

10. Highlight the critical paths of the following circuit. Assume that each gate (including the individual inverters, NOR, and XNOR gates) has a delay of 2 ns and each wire has a delay of 1 ns. (5 points)


A1
B1
A0
B0
W6
W7
W1
W2
W3
W4
W5
A_lt_B
A_gt_B
A_eq_B