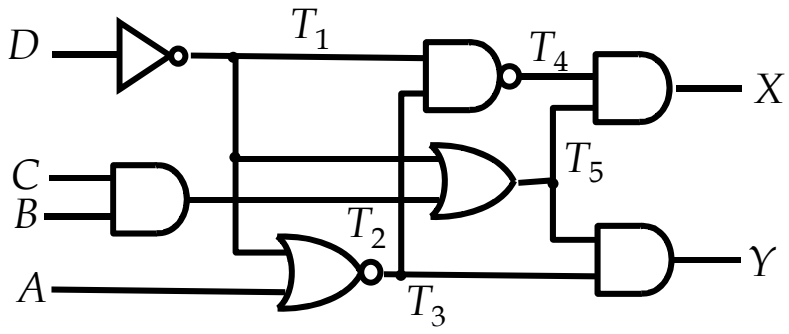
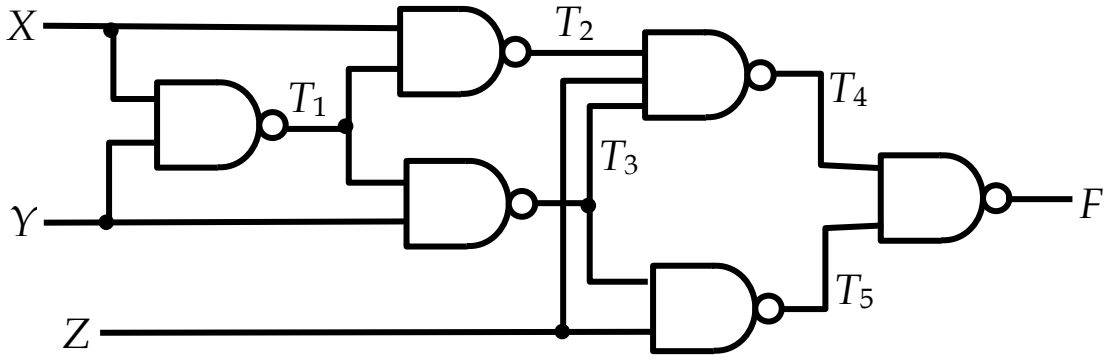
CSE 260M - Homework 5

Due October 4, 2006

1. Determine the Boolean functions for outputs *X* and *Y* as a function of the four inputs in the following circuit:



2. Obtain the truth table for the circuit shown below. Draw an equivalent circuit for *F* with fewer NAND gates.



3. A majority function is defined as a combinational circuit where the output is equal to 1 if the input variables have more 1s than 0s. The output is 0 otherwise. Design a 3-input majority function. What circuit that you are familiar with does this circuit correspond to?

4. A combinational circuit is defined by the following three Boolean functions.

$$F_1 = (X+Y)' + XYZ'$$
$$F_2 = (X+Y)' + X'YZ$$
$$F_3 = XYZ + (X+Y)'$$

Design the circuit with a decoder and external OR gates.

5. Construct a 10-to-1 line multiplexer with three 4-to-1 line multiplexers. The multiplexers should be interconnected and inputs labeled so that the selection codes 0000 through 1001 can be directly applied to the multiplexer selections inputs without added logic.

6. Implement a binary full adder with a dual 4-to-1 line multiplexer and a single inverter.

7. Design a combinational circuit that forms the 2-bit binary sum S_1S_0 of two 2-bit numbers A_1A_0 and B_1B_0 and has both input C_0 and a carry output C_2. Do not use half adders or full adders, but instead use a two-level circuit plus inverters for the input variables, as needed.

8. Design a "magnitude" reporting circuit for a 4-bit 2's complement number. That is, the output should be the magnitude ($M_3M_2M_1M_0 = |A_3A_2A_1A_0|$) of the input, $A_3A_2A_1A_0$.

9. Design a 1-bit full subtractor. It should have two inputs, A and B, as well as a borrow-in. The outputs are the difference (D) and a borrow-out.

   a. Write a truth-table for this subtractor.

   b. Determine a minimal circuit for each output. Also look carefully at D and see if you can use an XOR gate for it. If so, feel free to do so! Draw your minimal circuit.