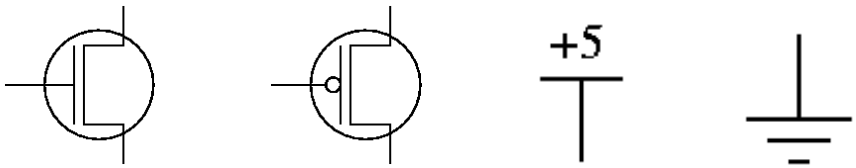
COSC 065 - Hardware Systems
Homework #1 - Digital Logic
Due: 2006 September 13th, beginning of class
These questions are to be completed individually, but answers from the laboratory exercise should be based upon circuits built by your lab group.

1. Give a transistor-level schematic diagram for a three-input OR gate and for a three-input NAND gate. For each diagram, clearly label the inputs ("x", "y", and "z"), the output ("*out*"), as well as power and ground.

   Use the schematic symbols presented in class:



   n-type *p-type* *power* *ground*

2. A 7400 chip (as shown in figure 2.10 of your textbook) contains four NAND gates.

   (a) Show how you could use two such chips (for a total of eight two-input NAND gates,) to implement each of the main two-input Boolean logic functions: AND, NAND, OR, NOR, XOR, and XNOR. Your circuit should consist only of NAND gates and connections. Clearly label your inputs and outputs. You do **not** need to include resistors, LED's, or other items from lab – just the logic gates.

   (b) If you could trade one of your two 7400 chips for a different chip with different gates on it, which gates would be the most help with the task above? Why?

3. In class, we examined several logic functions over two variables (logic gates with two inputs).

   (a) How many possible logic functions over two variables are there? (Hint: How many possible truth tables are there?)

   (b) Give a boolean formula (using variables "x" and "y" as the inputs) for each possible two-variable function.

   (c) Draw a logic circuit (at the gate level) for each function.

4. Lab question 1: Draw a complete schematic diagram for your circuit under the heading, "Logic Gates At Work," from laboratory handout #1. Include power, ground, switches, LEDs, and pin numbers for the logic gates.

5. Lab question 2: Give complete schematic diagrams and truth tables for the two gate combinations under the heading "Combinational Logic," from laboratory handout #1. Include power, ground, switches, LEDs, and pin numbers for the logic gates. Identify these logic functions.