385L / 5585 – Laboratory 6 – Logic Gates / 10 APR 2017 (Due 17 APR 2017)

After the Op Amp lab, this one's easy! Just a quick one week lab, then one more and you're done.

Objectives:

1. Determine the logic levels available from modern gates
2. Construct logic tables from multi-input gates

Equipment and Parts:

1. Oscilloscope
2. Function generator
3. Logic Gate ICs
4. DC voltage source

Gate Types

Gates come in CMOS or TTL. CMOS is "complimentary metal-oxide semiconductor" and TTL is transistor-transistor logic. CMOS represents the basis for most modern semiconductor components (i.e. RAM), as they exhibit low noise and low power consumption relative to TTL. The "complimentary" part refers to a symmetry incurred with a pair of metal-oxide semiconductor field effect transistors (MOSFET) one based on n-type and the other p-type; while TTL is based on the bipolar junction transistor (BJT).

6-1 Logic Levels

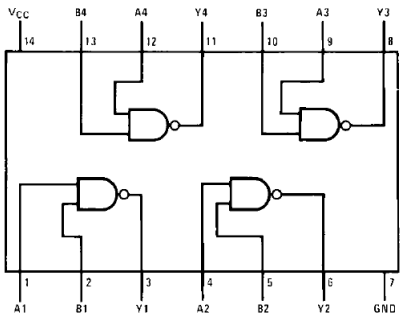
Obtain the 7400 NAND gate (the pinouts are given below). Pin 7 is ground, while pin 14 is the supply voltage at 5 V. For the inputs to the gate, use the variable +voltage source, only applying 0 to 5 V. Any values outside this range will damage the chip - please check before applying. While monitoring the input and output voltages on the scope, adjust the voltage input from 0 to 5-. From here, determine the voltage at which the logic changes state, for both the HIGH and LO inputs.

Now, using the function generator, apply a 5-V sawtooth wave (check that the p-p voltage is not +/- 10-V with the scope before proceeding). Determine the frequency at which the output becomes unstable. Try the same with square and sine waves. How are these three input types different in the output and why are the frequencies at which they become unstable different?

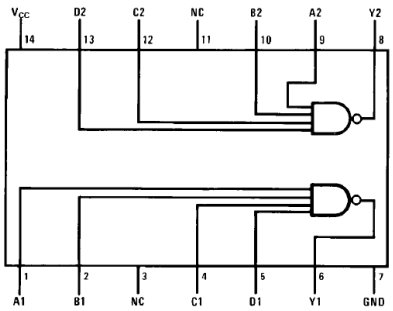
6-2 NAND gates

Using again the 7400 (two input), but with LED's on the output (for quick determination of the output), generate the truth table. Now, locate the 7420. This is a four input NAND gate. Connect four logic sources and again, generate this truth table. Finally, locate the 7402 (two input) NOR gate. Again, generate the truth table.

7400



7420



7402