**CS150, Spring 2010**

**1st Discussion Section Worksheet**

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1. The below plot is a DC Transfer Characteristic for a hypothetical inverter. 

a) Sketch the DC Transfer Characteristic for two inverters in series (on a separate set of axes).



b) Draw the truth table for the new component.

c) Draw a schematic for the new component. Give a name to the component.

d) Are the two inverters in series a useful component? Why or why not?

2. How can you implement a 3-input Boolean function on an FPGA, if you only have 2-input LUTs? Explain why your solution works.

3. What does the below circuit do? 

4. Our toolbox contains an lots of AND, OR, and NOT gates, and basic D flip-flops. Sadly, our D flip-flops have only D and Clock inputs and of course a Q output.

a) Basic gates are annoying to work with! Add a 2:1 Mux to our toolbox using what we have.

b) It would be nice if our D flip-flop had an enable signal. Add this using what’s in our toolbox.

c) Add a Reset signal to our D flip-flop. Does your design have asynchronous or synchronous reset?

5. It turns out that you can build any Boolean function out of NOT and 2-input AND and OR gates.

a) are there any 2-input gates (functions) that by themselves can build any Boolean function?

b) prove your claim in (a).

c) Build an XOR out of AND, OR, NOT gates. If your answer to (a) was yes, then build an XOR also out of just that special gate.