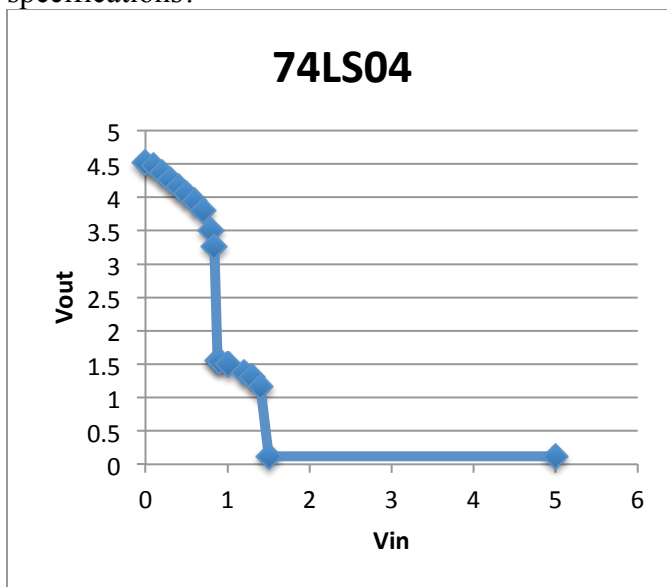# E85: Digital Design and Computer Architecture

Problem Set 2

1) The voltage transfer characteristics below are measured for a 74LS04 operating at 5V. Determine V_{IL}, V_{IH}, V_{OL}, V_{OH}, and the high and low noise margins. Compare your results to the 74LS specification in Table eA.2 of the textbook. Are they within the specifications?

74LS04

2) Referring to the logic level specifications in Tables eA.2 and eA.3 of the textbook:
   a) What could go wrong if a 74LS04 inverter drives a 74HC08 AND gate?
   b) In light of your answer to Part (a), why does the HCT family exist?
   c) i) Can a 3.3V 74LVC32 gate reliably drive a 5V 74HC00?
      ii) Can a 3.3V 74LVC32 gate reliably drive a 5V 74HCT00?
      iii) Can a 74HC00 reliably drive a 3.3V 74LVC32?

3) Sketch a transistor-level implementation of a 3-input NAND gate.

4) Give the Boolean equation performed by the following gate.
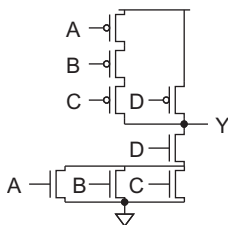
5) Give a minimal sum of products Boolean equation for the following function. Show how to implement the function with logic gates and in Verilog.

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

6) Give a minimal sum of products Boolean equation for the following function. Show how to implement the function with logic gates and in Verilog.

$$Y = \overline{\overline{AB}} + \overline{BCD}$$

7) Give the minimal sum-of-products equation for the following circuit.
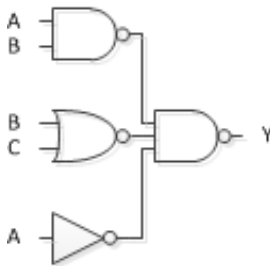
8) Impact on Society: Integrated circuits have been following Moore's Law since 1965, with cost per transistor reducing approximately 30% per year. This progress is slowing as nanometer lithography is becoming extremely expensive. Supposing cost reduction grinds to a halt by 2020, write a thoughtful paragraph predicting a significant impact on society caused by the end of Moore's Law.

9) How long did you spend on this problem set? This will not count toward your grade but will help calibrate the workload.