

# CPE 301 – Embedded Systems Design Lab **Lab # 02**

## Decoding and D-Latches

Fall 2020

### Objectives:

1. To become familiar with the logic required to decode a number of input signals using a decoder and latch circuit, such as in a memory address decoding circuit problem.
2. To understand how ICs work and the various control signals necessary to operate them.
3. To learn how to read a data sheet and build a circuit from the information found.

### Required Equipment:

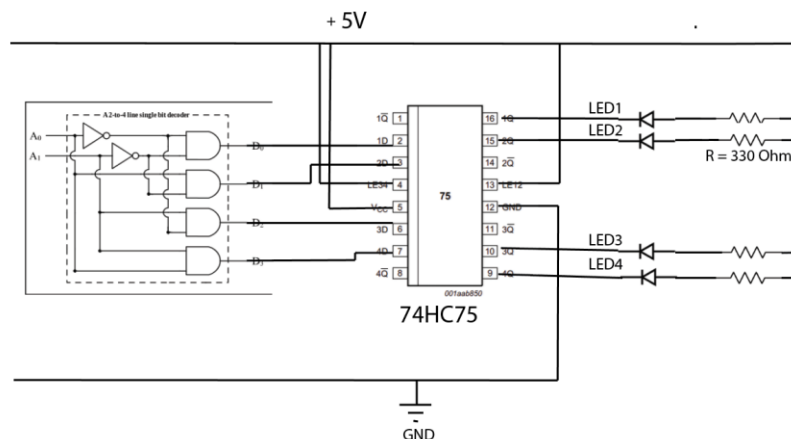
1. Tinkercad Oscilloscope
2. Tinkercad Power Supply
3. Tinkercad Function Generator
4. LED
5. switch array
6. 330Ω Resistor

### Procedure:

**BEFORE THE LAB:** Find the datasheets for the 74HC75, 74HC00, and 74HC04. Read their functional descriptions on the first few pages. Then review how a decoder functions.

Complete each part of the lab, answer the questions and include them in your lab report. Be sure to label your answers with respect to their relevant lab part and question number (ex. Part 1 #4c). Any handwritten drawings should be connected and included alongside the text of your lab report. Add links of your tinkercad circuits to your lab report.

Part 1 – Construct a circuit as depicted below. Construct the 2 to 4 decoder using 74HC00 and 74HC04. Connect the switches to the input of the 74HC75 using the pull up resistor configuration you learned in Lab #1.



1. Briefly explain how the circuit works / what function does it perform in terms of its input and outputs?
2. What are the control signals on the 74HC75?
3. Include a picture of the circuit you built while its input is 0b01.

**Note:**

Because the 2-4 decoder is not available in Tinkercad, we will implement 2 to 4 decoder from scratch using NAND gates and inverters.

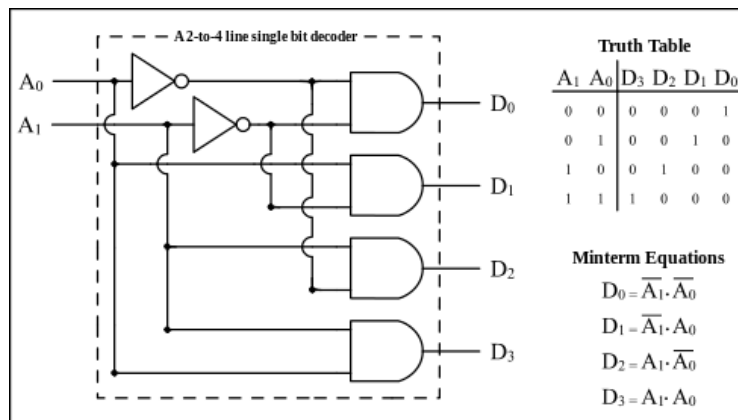
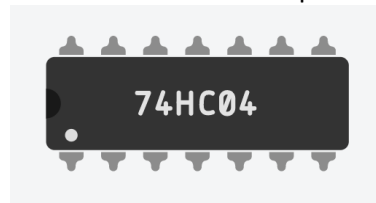


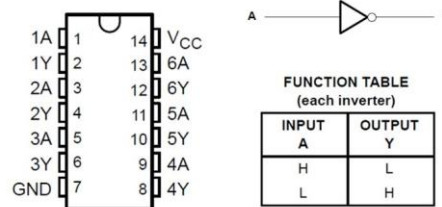
Figure 1. 2 to 4 decoder implementation using NAND gate and inverter.

To use inverter in Tinkercad, you can search for 74HC04 chip.

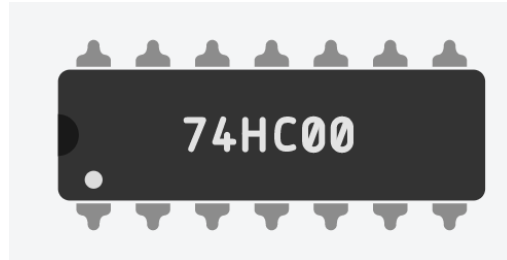


This HEX inverter has 6 negation gates and the pins layout are as follows:

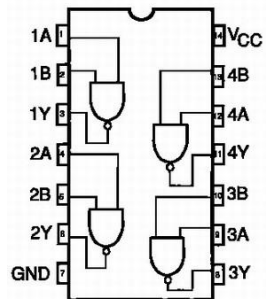
74HC04



To use the NAND gate, you can search for the 74HC00 chip in Tinkercad. The chip will look like this:



The 74HC00 has 4 NAND gates with the pins layout as follow:



we can use 4-bit D latch 74HC75 chip available in tinkercad. The chip will look like this figure below:

