LAB 8 // Hardware

VOTING MACHINES

INSTRUCTIONS and RUBRIC

CSE 2301 – Fall 2024

INTRODUCTION

Prerequisites

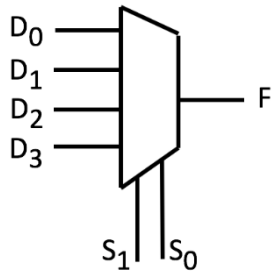
At this point you should have reviewed module 10. This lab deals with implementing logic functions using a multiplexer or MUX.

Objectives

The purpose of this assignment is to realize the implementation of a simple majority-detection circuit using multiplexers. This will reinforce our previous lessons on multiplexer design.

Background

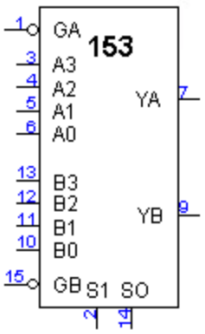
Multiplexers are a class of logic chip that allow selection between a set of inputs. Referencing the image below for a 4-1 MUX, S1 and S0 are select bits that choose between inputs D0-D3. If s1 is 0 and s0 is 1, D1 is output at F. If S1 is set to 1 and S0 is set to 0 (a binary 2) then D2 is output at F. This general scheme can be followed for all multiplexers used in this course.

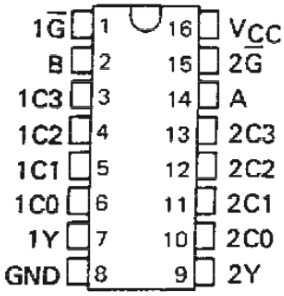


PART 1:

4-1 MUX Voting Machine

YOUR TASK – Create a circuit in LogicWorks using a 74153 4-1 MUX chip that will perform the function described by the table below. Then, build this circuit on your breadboard. Each input (W, X, and Y) is a voter and your output F will go high if a majority of voters choose "1". Using the values below, decide what value to connect to each D input. Each D input can be connected to either 1, 0, Y, or Y'. W will be connected to S1 and X will be connected to S0. Also included are two pinouts for the 74153 4-1 MUX IC.



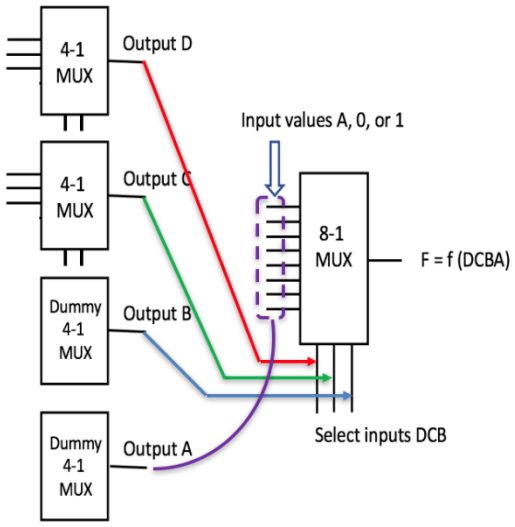


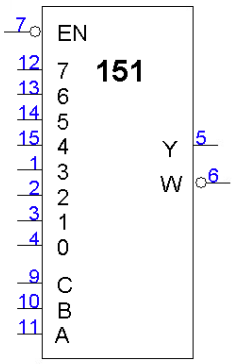
W (S1)	X (So)	Y	F	D (in)
0	0	0	0	D0
0	0	1	0	
0	1	0	0	D1
0	1	1	1	
1	0	0	0	D2
1	0	1	1	
1	1	0	1	D3
1	1	1	1	

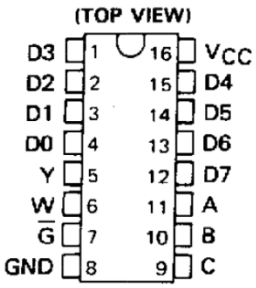
PART 2:

12-Person Voting Machine

YOUR TASK – Now, expand your 3-person voting machine into a 12-person voting machine. This can be accomplished by building 4 3-Person voting machines and using an 8-1 MUX to detect when a majority of these subcircuits are outputting 1. Since we only have two 74153 chips, two of our 3-person voting machines will be represented by "dummy MUXes" or wires that can be connected to 0 or 1. Complete the table below to determine the inputs of the 8-1 74151 MUX and use the picture below for guidance. Also included are pinout diagrams for the 74151 MUX.







D (S_2)	C (S_1)	B (S_0)	A	F	"D" (in)
0	0	0	0	0	D_0
0	0	0	1	0	
0	0	1	0	0	D_1
0	0	1	1	0	
0	1	0	0	0	D_2
0	1	0	1	0	
0	1	1	0	0	D_3
0	1	1	1	1	
1	0	0	0	0	D_4
1	0	0	1	0	
1	0	1	0	0	D_5
1	0	1	1	1	
1	1	0	0	0	D_6
1	1	0	1	1	
1	1	1	0	1	D_7
1	1	1	1	1	

SCORING

Demo Requirements [5 pts]:

- ✓ Present your working 12-person voting machine to a TA. Make sure you understand the workings of the circuit well enough to demonstrate.

Report Requirements [2 pts]:

- ✓ [0.8] Theory:
  - [0.8] What is a multiplexer? Each 74153 chip contains 2 MUXs, what prevents us from utilizing both MUXs on each chip for this lab?
- ✓ [0.8] Deliverables:
  - [0.4] Include the implementation table for your 4-1 multiplexors and explain how both **f** and the **D_0-D_3** inputs were determined (see page 2 of instructions).
  - [0.4] Include the table for your 8-1 MUX and explain how both **f** and the **D_0-D_7** inputs were determined.
- ✓ [0.4] Discussion section. Should conform to standard lab report guidelines.

Practice Questions [3 pts]:

- ✓ [1] Question 1:
  What is the difference between a Mealy machine and a Moore machine?

- ✓ [1] Question 2:
  How can you implement a J-K flipflop using a D flipflop? Please give the diagram.

- ✓ [1] Question 3:
  What is the difference between a latch and a flipflop?