EEL 3701 — Digital Logic & Computer Systems
Revision 1
Lab 2 Report: **MSI Circuits**

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Class #: 12478
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PRE-LAB QUESTIONS OR EXERCISES

N/A

PROBLEMS ENCOUNTERED

N/A

REQUIREMENTS NOT MET

N/A

FUTURE WORK/APPLICATIONS

This lab gave me a better understanding of how somewhat more complex circuit and logic designs can be made and implemented. In this lad we created a decoder that converted a binary number into HEX of an LED display. This is valuable because it gives insight as to how basic conversion works, even if this is at a really low level.

PRE-LAB REQUIREMENTS (Design, Schematic, ASM Chart, VHDL, etc.)

Part A

S_0	S_1	D_3(L)	D_2(H)	D_1(L)	D_0(H)	Y(L)	S_0	S_1	D_3(L)	D_2(H)	D_1(L)	D_0(H)	Y(L)
0	0	-	-	-	0	0	L	L	-	-	-	L	H
0	0	-	-	-	1	1	L	L	-	-	-	H	L
0	1	-	-	0	-	0	L	H	-	-	L	-	L
0	1	-	-	1	-	1	L	H	-	-	H	-	H
1	0	-	0	-	-	0	H	L	-	L	-	-	H
1	0	-	1	-	-	1	H	L	-	H	-	-	L
1	1	0	-	-	-	0	H	H	L	-	-	-	L
1	1	1	-	-	-	1	H	H	H	-	-	-	H

Figure 1: Truth and voltage table for MUX

$$SOP = \bar{S}_0\bar{S}_1D_0 + \bar{S}_0S_1D_1 + S_0\bar{S}_1D_2 + S_0S_1D_3$$

$$POS = (S_0+S_1+D_0)(S_0+\bar{S}_1+D_1)(\bar{S}_0+S_1+D_2)(\bar{S}_0+\bar{S}_1+D_3)$$

Figure 2: Logic equations for MUX

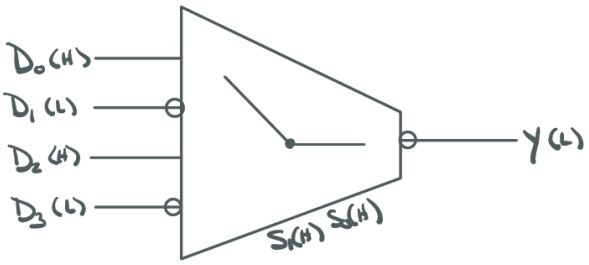


Figure 3: Functional Block Diagram for MUX

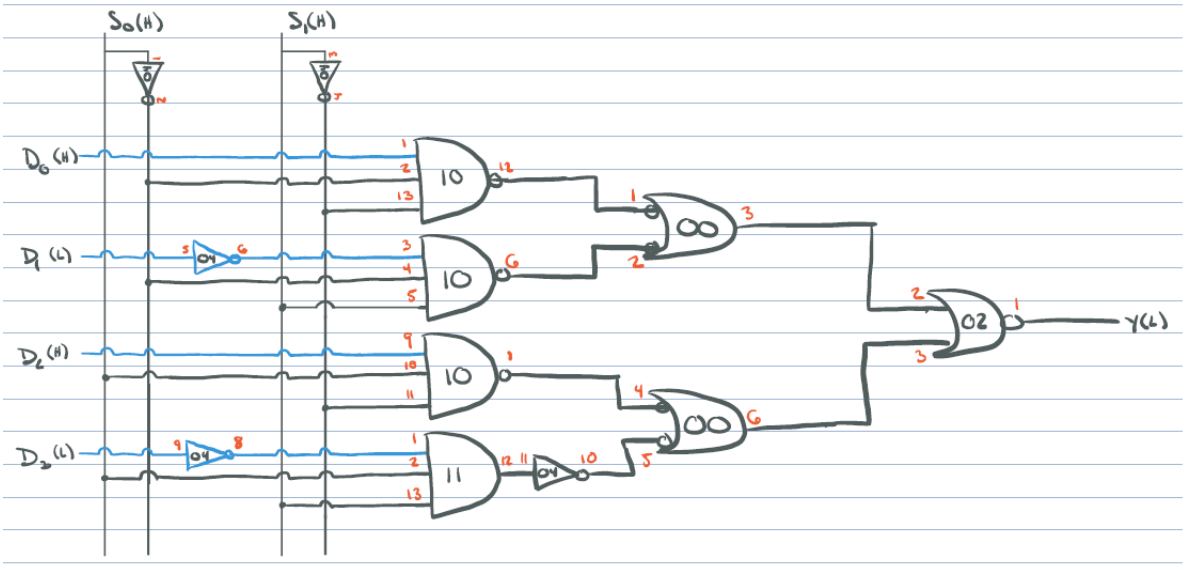


Figure 4: Circuit design for MUX

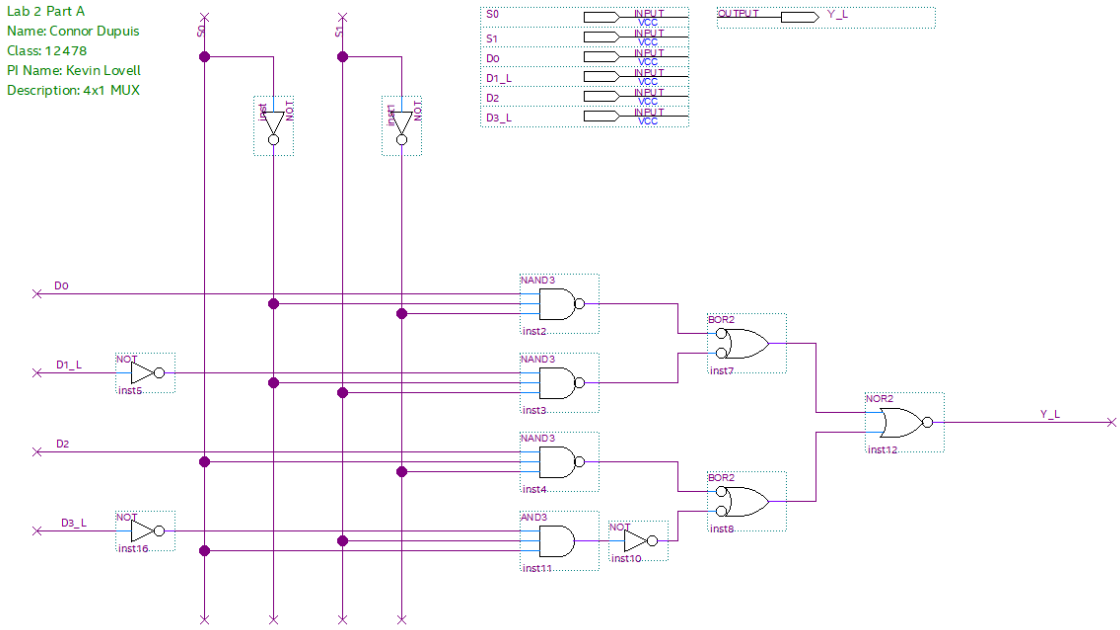
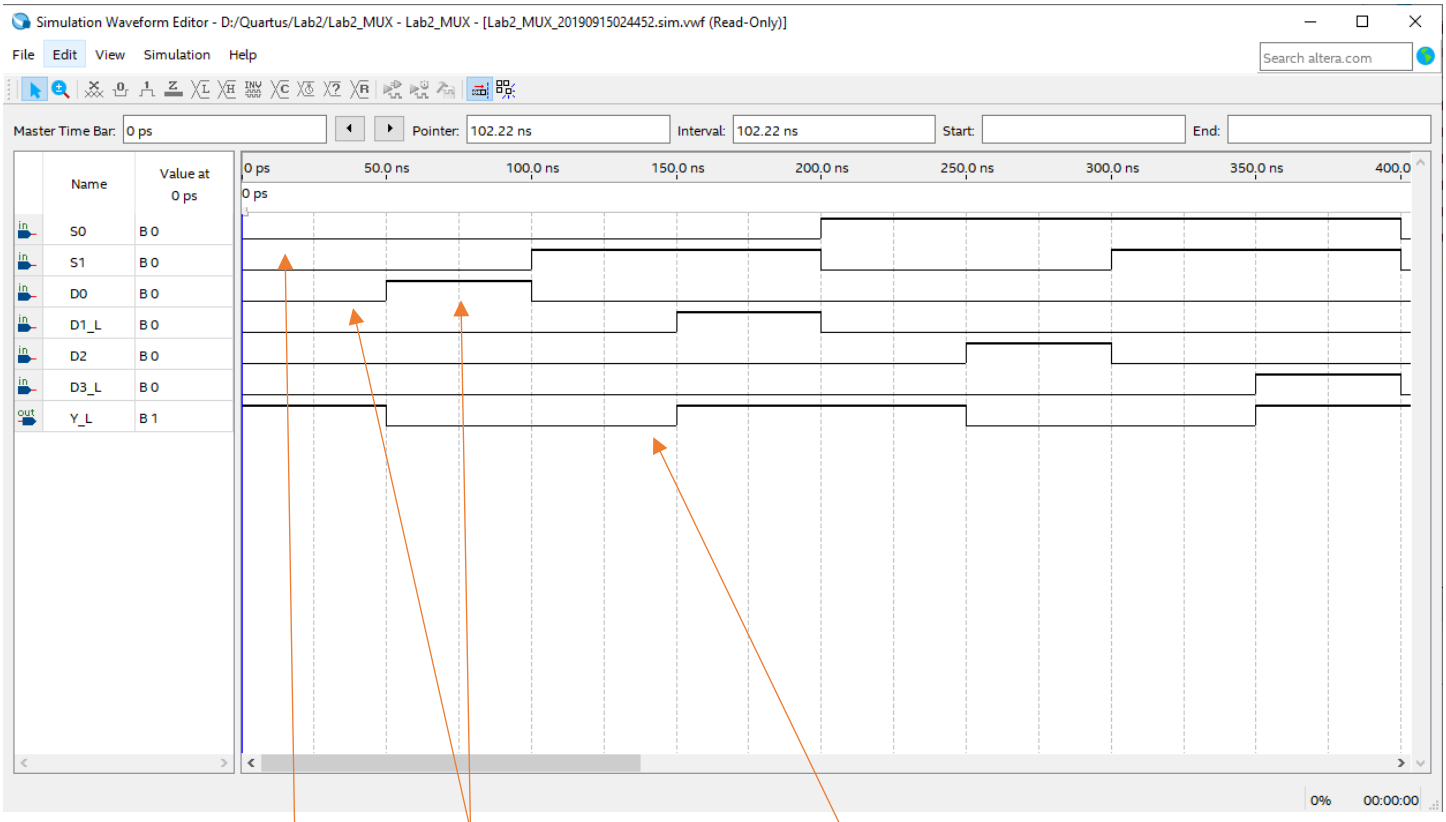


Figure 5: Quartus circuit design for MUX



S0 and S1 corresponds to which input it is directing to. 00 goes to D0, 01 goes to D1_L, 10 goes to D2, and 11 goes to D3_L.

When being directed to, all the inputs have a 0 and a 1. The arrow is pointing to when S0 and S1 are 00, then D0 is 0 then 1.

The final output of the MUX.

Part B

T(L)	X_3	X_2	X_1	X_0	A	B	C	D	E	F	G	
1	0	0	0	0	1	1	1	1	1	1	0	
1	0	0	0	1	0	1	1	0	0	0	0	
1	0	0	1	0	1	1	0	1	1	0	1	
1	0	0	1	1	1	1	1	1	0	0	1	
1	0	1	0	0	0	1	1	0	0	1	1	
1	0	1	0	1	1	0	1	1	0	1	1	
1	0	1	1	0	1	0	1	1	1	1	1	
1	0	1	1	1	1	1	1	0	0	0	0	
1	1	0	0	0	1	1	1	1	1	1	1	
1	1	0	0	1	1	1	1	1	0	1	1	
1	1	0	1	0	1	1	1	0	1	1	1	
1	1	0	1	1	0	0	1	1	1	1	1	
1	1	1	0	0	1	0	0	1	1	1	0	
1	1	1	0	1	0	1	1	1	1	0	1	
1	1	1	1	0	1	0	0	1	1	1	1	
1	1	1	1	1	1	0	0	0	1	1	1	
0	-	-	-	-	1	1	1	1	1	1	1	

Figure 6: Truth table for 7-segment LED

A POS: $(X_3+X_2+X_1+\bar{X}_0)(X_3+\bar{X}_2+X_1+X_0)(\bar{X}_2+X_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+\bar{X}_2+X_1+\bar{X}_0)$

B POS: $(X_3+\bar{X}_2+X_1+\bar{X}_0)(\bar{X}_3+X_2+X_1+\bar{X}_0)(\bar{X}_3+X_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+\bar{X}_2+X_1+X_0)(\bar{X}_3+\bar{X}_2+\bar{X}_1+X_0)(\bar{X}_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)$

C POS: $(X_3+X_2+\bar{X}_1+X_0)(\bar{X}_3+\bar{X}_2+X_1+\bar{X}_0)(\bar{X}_3+\bar{X}_2+\bar{X}_1+X_0)(\bar{X}_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)$

D POS: $(X_3+X_2+X_1+\bar{X}_0)(X_3+\bar{X}_2+X_1+X_0)(X_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+X_2+\bar{X}_1+X_0)(\bar{X}_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)$

E POS: $(X_3+X_2+X_1+\bar{X}_0)(X_3+X_2+\bar{X}_1+\bar{X}_0)(X_3+\bar{X}_2+X_1+X_0)(X_3+\bar{X}_2+X_1+\bar{X}_0)(X_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+\bar{X}_2+X_1+\bar{X}_0)$

F POS: $(X_3+X_2+X_1+\bar{X}_0)(X_3+\bar{X}_2+X_1+X_0)(X_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+X_2+X_1+\bar{X}_0)$

G POS: $(X_3+X_2+X_1+X_0)(X_3+X_2+X_1+\bar{X}_0)(X_3+\bar{X}_2+\bar{X}_1+\bar{X}_0)(\bar{X}_3+\bar{X}_2+X_1+X_0)$

Figure 7: Logic equations for 7-segment LED

T(L)	X_3	X_2	X_1	X_0	A	B	C	D	E	F	G	
H	L	L	L	L	H	H	H	H	H	H	L	
H	L	L	L	H	L	H	H	L	L	L	L	
H	L	L	H	L	H	H	L	H	H	L	H	
H	L	L	H	H	H	H	H	H	L	L	H	
H	L	H	L	L	L	H	H	L	L	H	H	
H	L	H	L	H	H	L	H	H	L	H	H	
H	L	H	H	L	H	L	H	H	H	H	H	
H	L	H	H	H	H	H	H	L	L	L	L	
H	H	L	L	L	H	H	H	H	H	H	H	
H	H	L	L	H	H	H	H	H	L	H	H	
H	H	L	H	L	H	H	H	L	H	H	H	
H	H	L	H	H	L	L	H	H	H	H	H	
H	H	H	L	L	H	L	L	H	H	H	L	
H	H	H	L	H	L	H	H	H	H	L	H	
H	H	H	H	L	H	L	L	H	H	H	H	
H	H	H	H	H	H	L	L	L	H	H	H	
L	-	-	-	-	H	H	H	H	H	H	H	

Figure 8: Voltage table for 7-segment LED

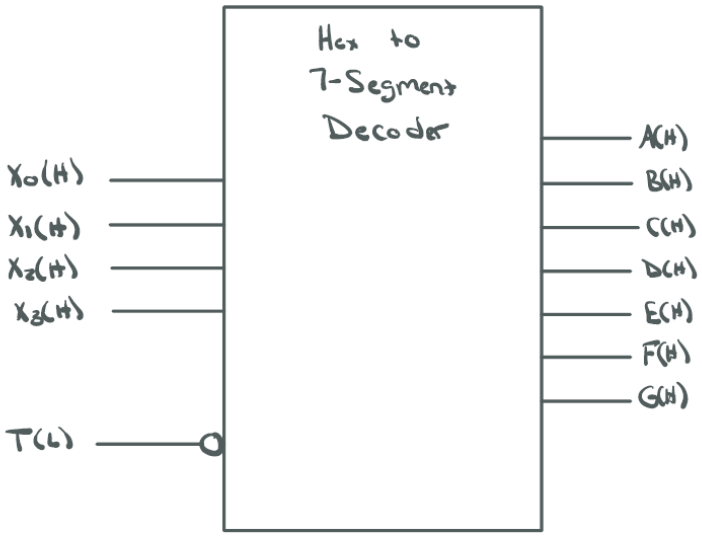


Figure 9: Functional block diagram for 7-segment LED

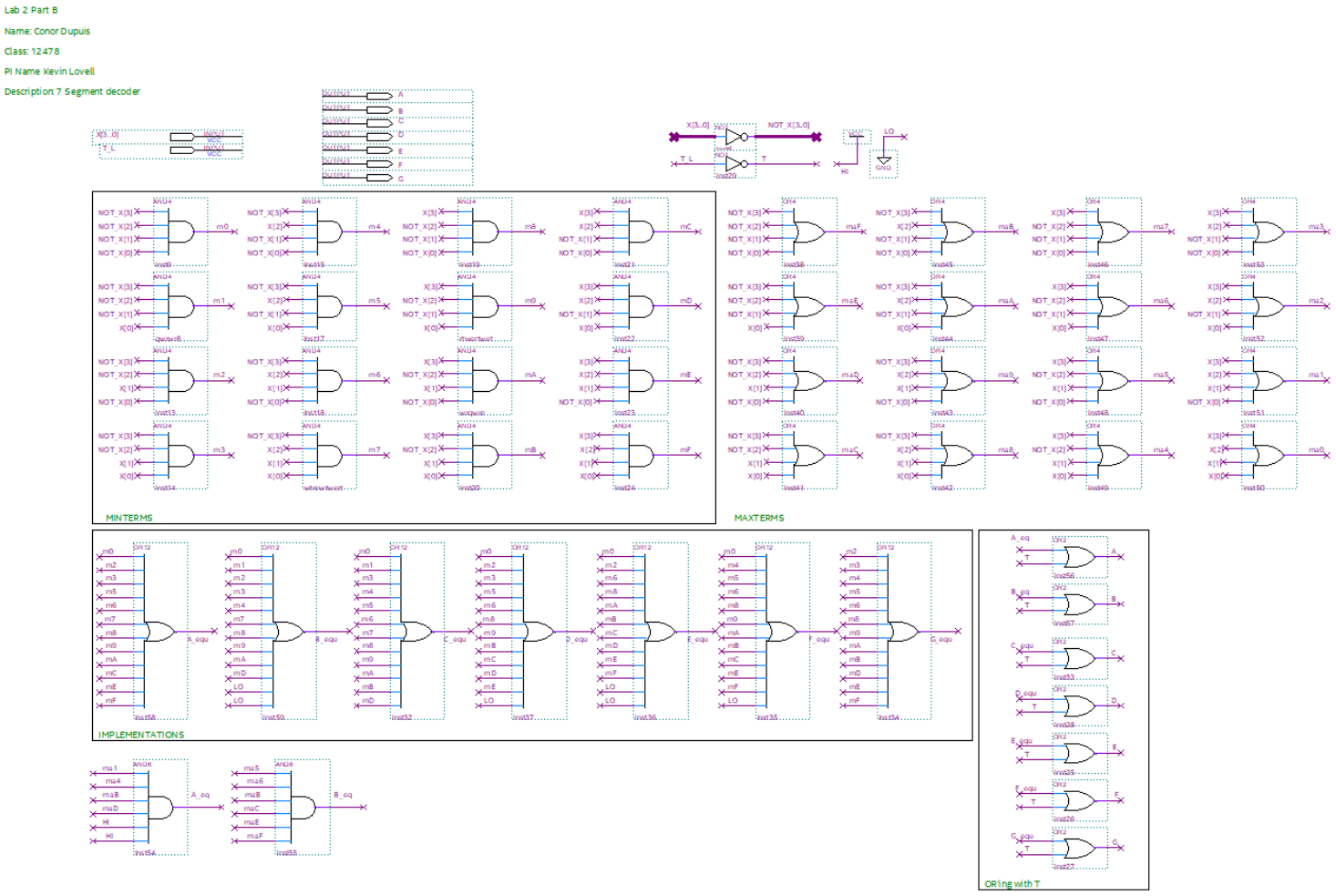


Figure 10: Quartus circuit design for 7-segment LED

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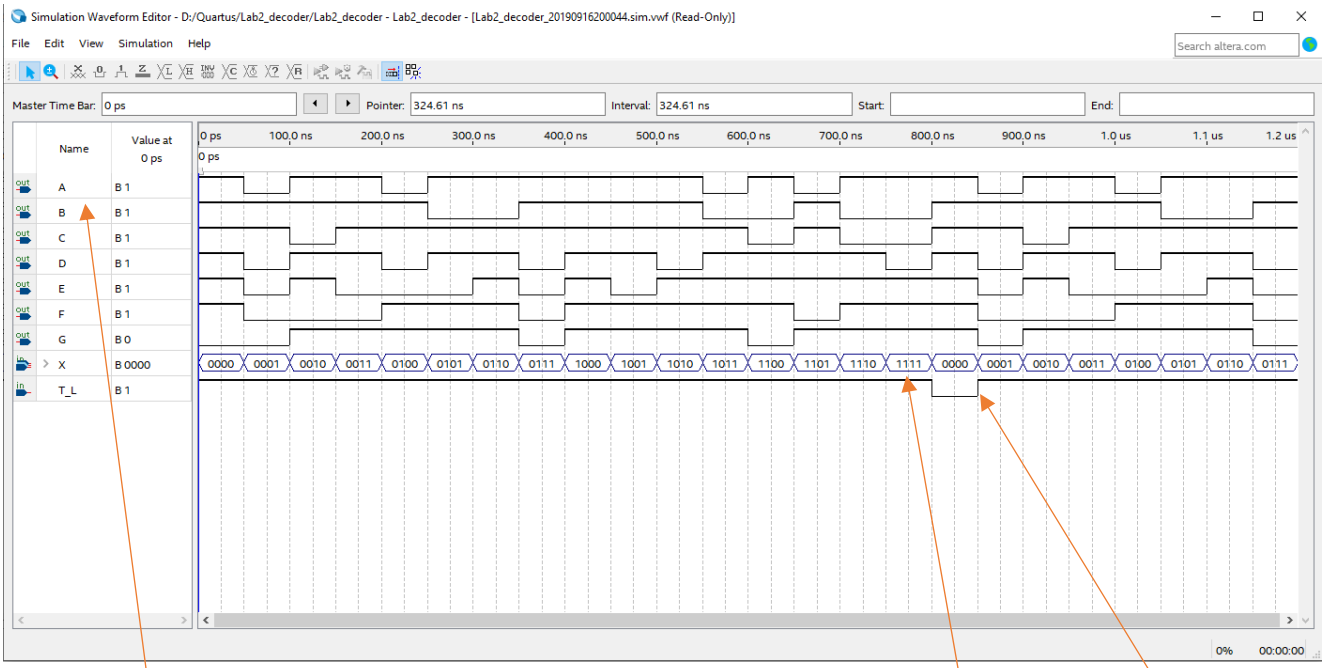

The letter determines whether not that respective LED segment is on. High is on and Low is off

The inputs represent a binary number which is then translated into the hex via the LED segments previously described. IE. 1111= 15 = F

T is a test input which if it is Low, then all the LED segments should turn on.