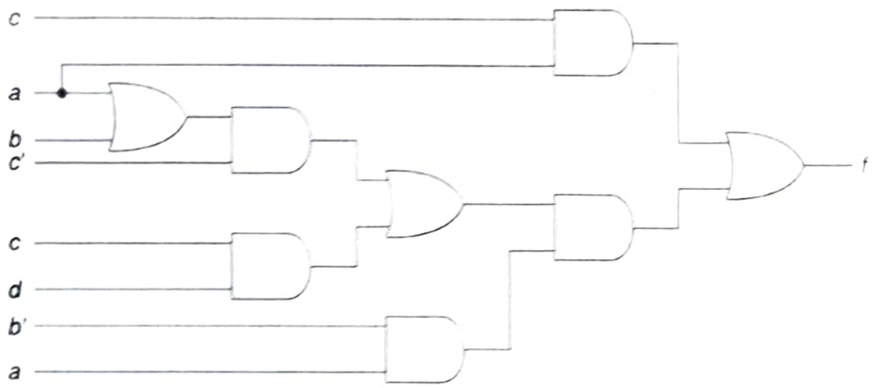
You must show **all** your work! Answers without supporting work will not be given credit.

All problems are inspired by our *Introduction to Logic Design* **3rd** *Edition* text. Any submissions which are not clear and use a respectable amount of space will **NOT** be considered.

This assignment is worth 10.0 points.

Name: Sebastian Garcia

1. Consider the following circuit and provide analysis as indicated. (1.25 Points)



Give your answers in terms of Δ.

(a) How long until the circuit is stable if complemented variables are available?

Answer: 5Δ

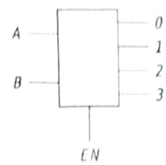
(b) Which variable(s) is(are) on the longest path to f, if only **uncomplemented variables** are available?

Answer: a, b

(c) How long until the circuit is stable after input a changes (there is only one answer)?

Answer: 2Δ

2. Using three (3) of the following 2-to-4 active-high enabled, active-high output binary decoders, build a 3-to-8 active-high output binary decoder. (1.25 Points)



A 2-to-4 active-high enabled, active-high output binary decoder.

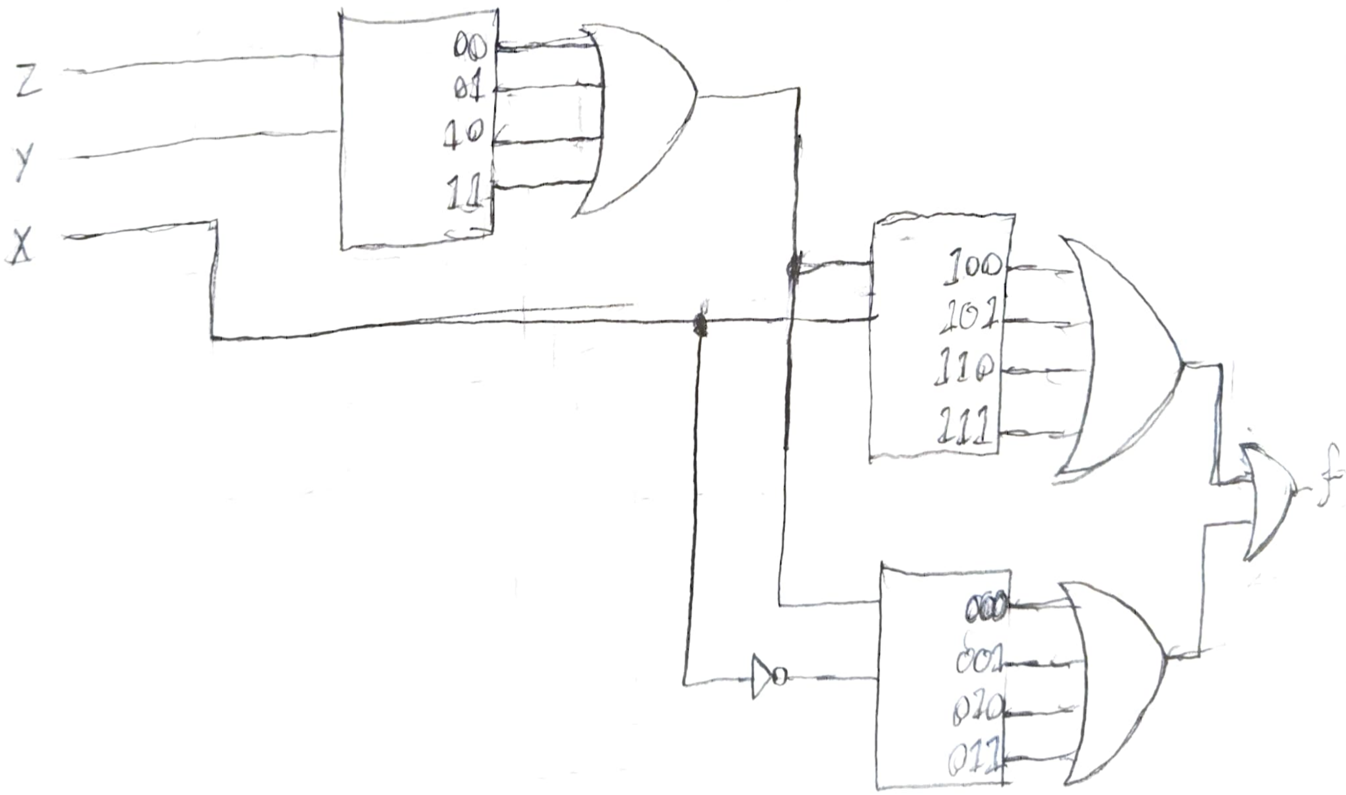
Your decoder should have inputs x, y, z and output lines $0, 1, 2, 3, 4, 5, 6, 7$:

x, y, z inputs are select lines for output,

Your decoder's eight output should be ascending, top-to-bottom,

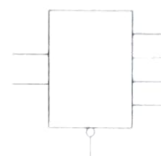
Your decoder does not require an enable, and

You may assume you can access a low or high signal (0 or 1) as needed.



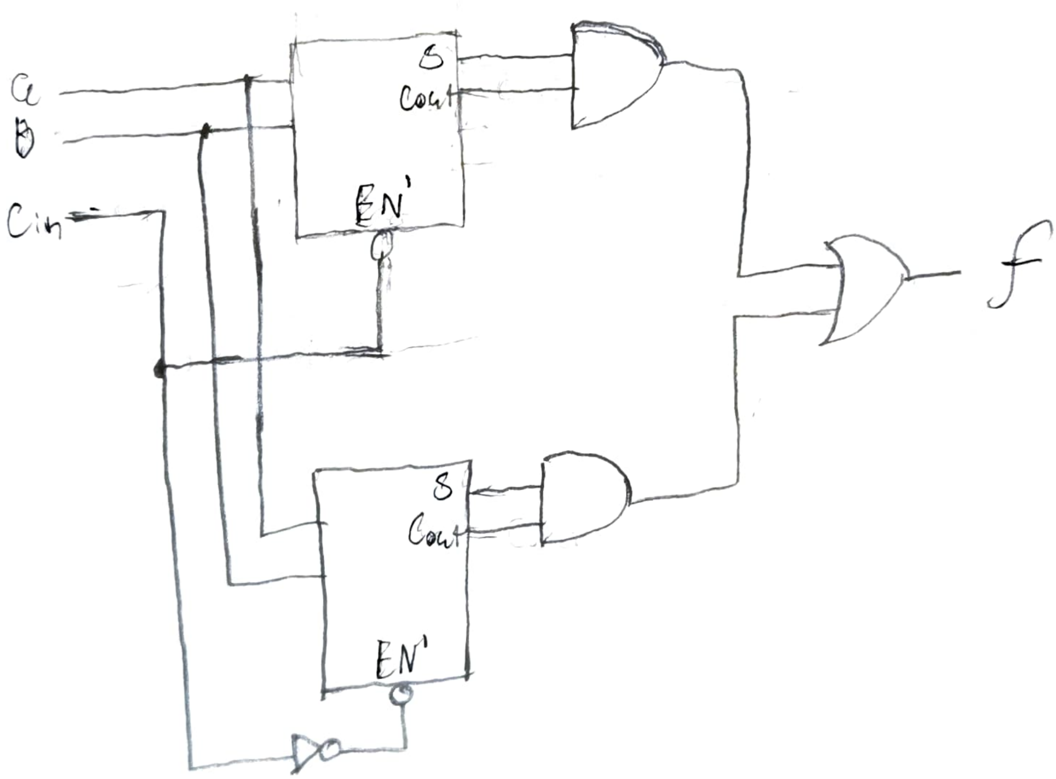
Cont.

3. Using two (2) of the following decoders and any number of OR and NOT gates, implement a **one-bit full binary adder**. (1.25 Points)



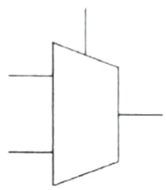
A 2-to-4 active-low enabled, active-high output binary decoder.

Your adder should have the standard inputs a, b, c_{in} and the standard outputs s, c_{out}. See Figure 1.2 for reminder and Table 1.5 for an explanation of behavior (page 10 from our text).

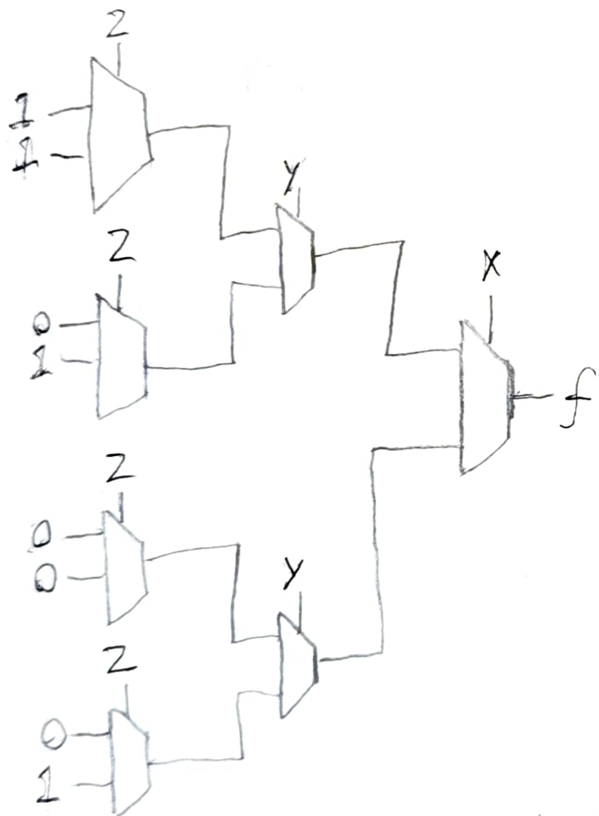


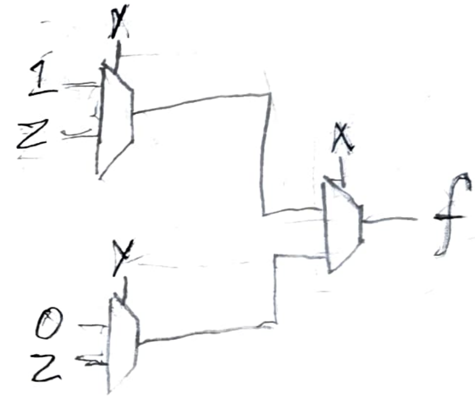
4. Using exactly seven (7) two-way MUX, implement the following function. You should also attempt to use **row-pairing** and exactly three (3) two-way MUX. (1.25 Points)

$$f(x, y, z) = \Sigma m(0, 1, 3, 7)$$



A two-way MUX.





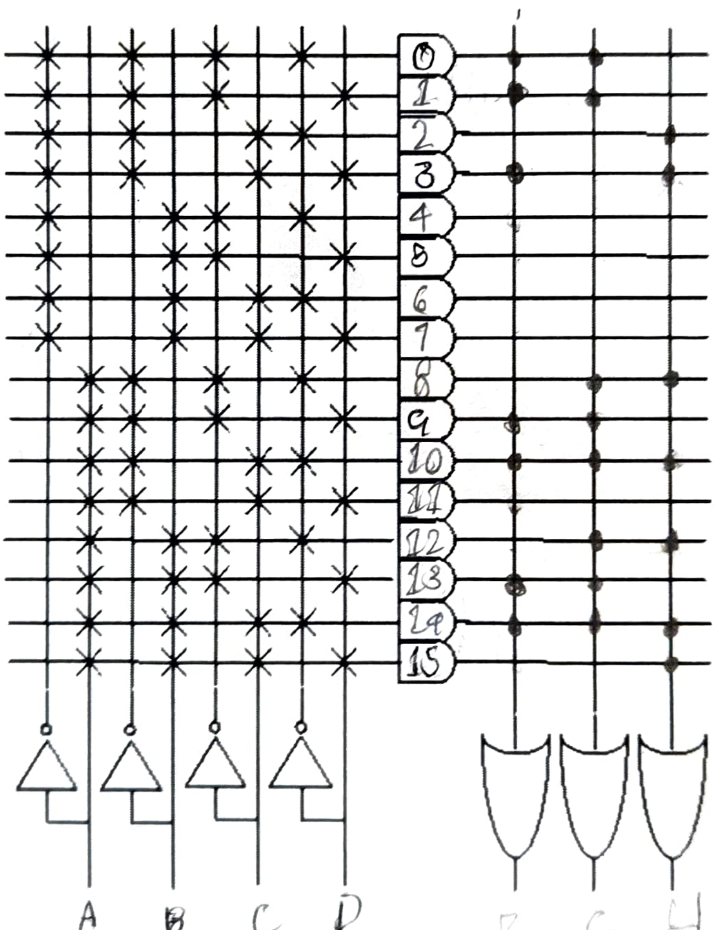
X	Y	Z	f	
0	0	0	1	f = 1
0	0	1	1	
0	1	0	0	f = z
0	1	1	1	
1	0	0	0	f = 0
1	0	1	0	
1	1	0	0	f = z
1	1	1	1	

Cont.

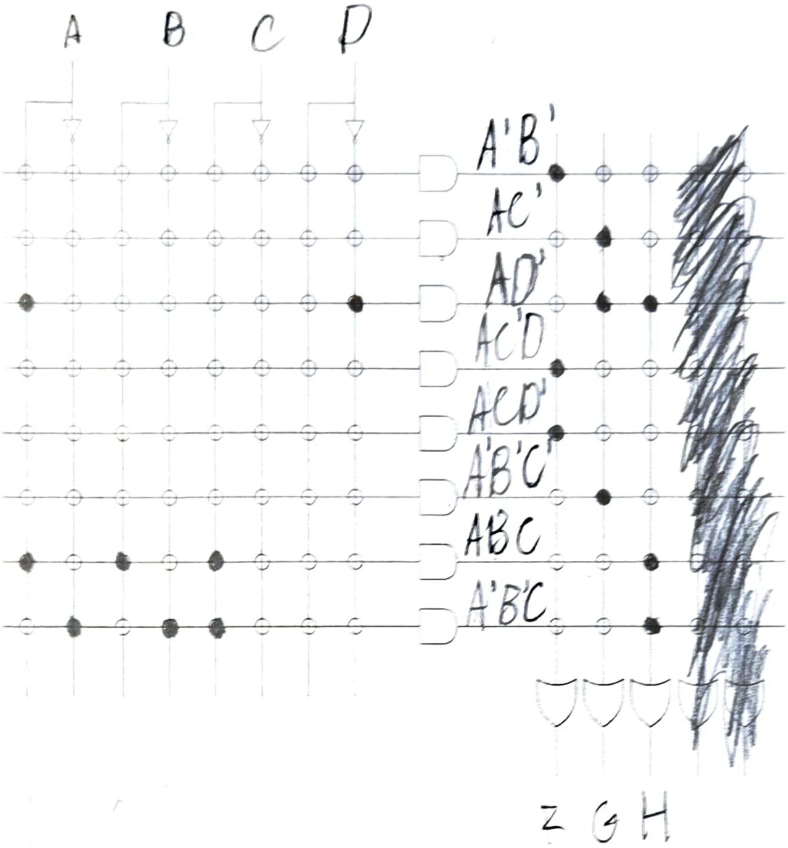
5. For the following functions, program a ROM and PLA; a separate function will be provided for a PAL. (3.75 points)

$$F(A,B,C,D) = \Sigma m(0,1,2,3,9,10,13,14)$$
$$G(A,B,C,D) = \Sigma m(0,1,8,9,10,12,13,14)$$
$$H = AD' + A'B'C + ABC$$

(a) Label the AND gates corresponding to minterms (0–15) and "program" functions F, G, H. (1.25 points)



(b) Using the functions from the previous section, encode F, G, and H using the following PLA. You will need to share terms between functions. Label each line with its product term. (1.25 points)

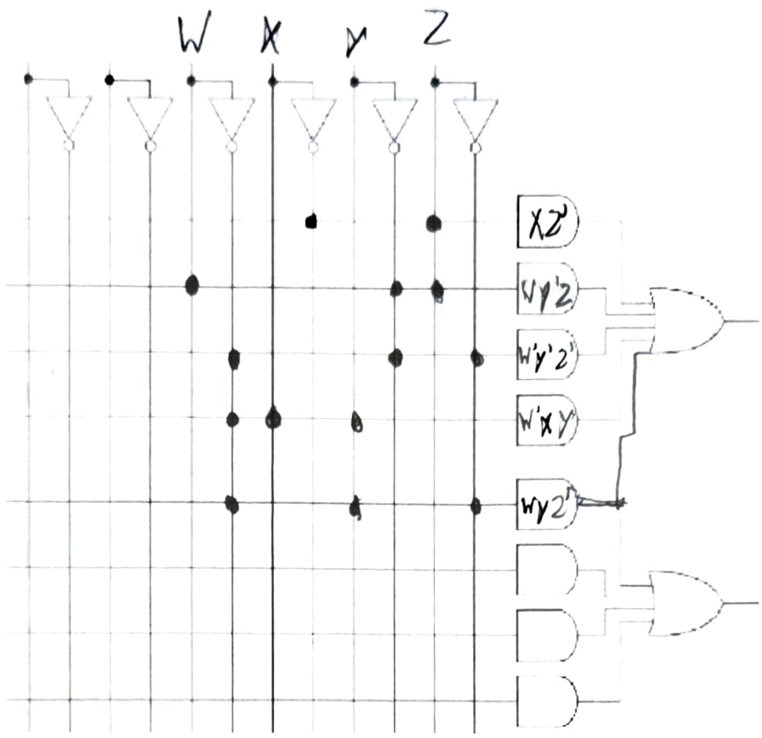


$F = A'B' + AC'D + ACD'$

$G = AD' + AC' + A'B'C'$

$H = AD' + A'B'C + ABC$

(c) Encode the function $f(w, x, y, z) = \Sigma m(0, 1, 3, 4, 7, 6, 9, 11, 10, 13, 14)$. You must label your product terms and use the left-most and top-most input/output lines for any required feedback for credit. (1.25 points)

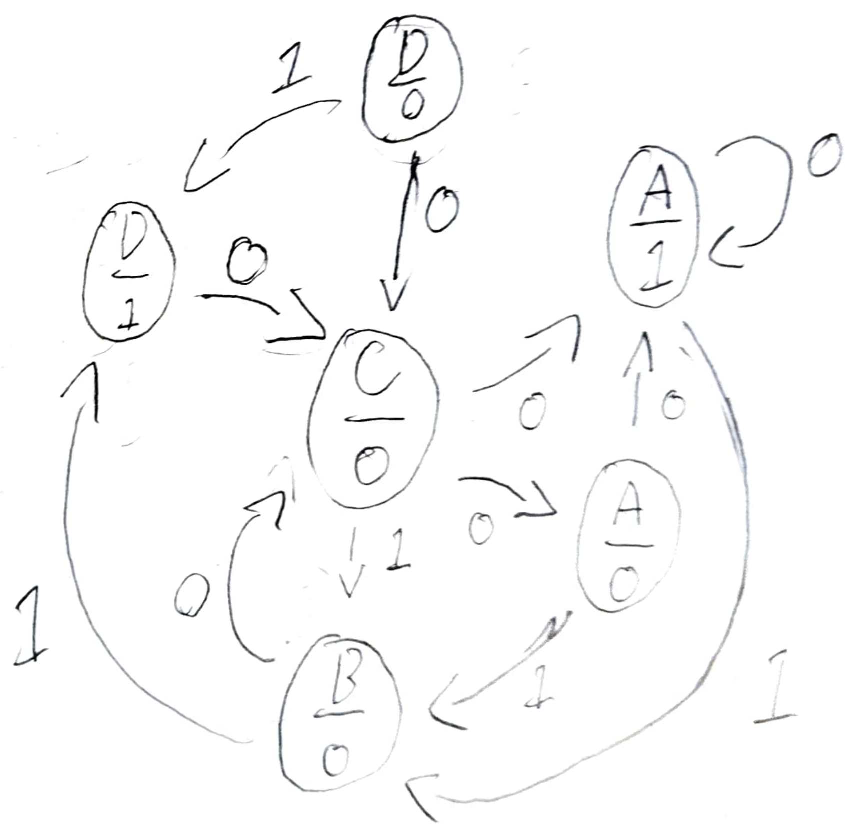


$f = XZ' + Wy'Z + W'y'Z' + W'Xy'$
$+ WyZ'$

Cont.

6. Draw both the state diagram and complete the timing sequence as x changes until you have no distinct state information remaining. (1.25 points)

q	q^+ $x=0$	$x=1$	z $x=0$	$x=1$
A	A	B	1	0
B	C	D	0	0
C	A	B	0	0
D	C	D	1	0



x	1	0	1	1	1	0	
q	?	B	C	B	D	D	C
z	0	0	0	0	0	1	0

The End.