Problem 1 (20 points)

a) $(25)_{11} = (x)_y$

Find base y, such that the number of non-leading zeros in x is maximum.
Example:
The number of non- leading zeros in 10021 is 2.
The number of non-leading zeros in 204003 is 3.

b) $(A1965321)_{16} = (a)_8$
Find the value for a.

a) $(25)_{11} = (5)_{10} + (22)_{11} = (27)_{10}$

$(27)_{10} = (11011)_2 \Rightarrow 1$ 0's $\quad (1000)_3$

$(27)_{10} = (300)_3$ X $\Rightarrow 2$ 0's $\Rightarrow$ Most zero's

$(27)_{10} = (123)_4 \quad = 0$ 0's

$\boxed{\text{Base } y = 3}$

7

b) $(A1965321)_{16} = (a)_8$

$= (1010\ 0001\ 1001\ 0110\ 0101\ 0011\ 0010\ 0001)_2$

$\boxed{= (24145451441)_8}$

$= (a)_8$

10

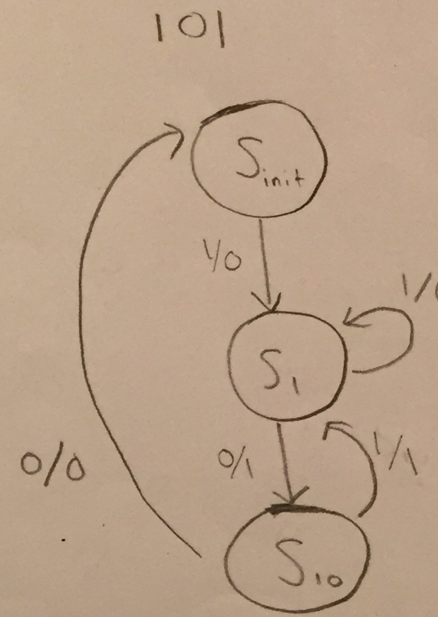
18

Problem 2 (20 points)

Create a state transition table that has 8 states, which satisfies the following conditions:

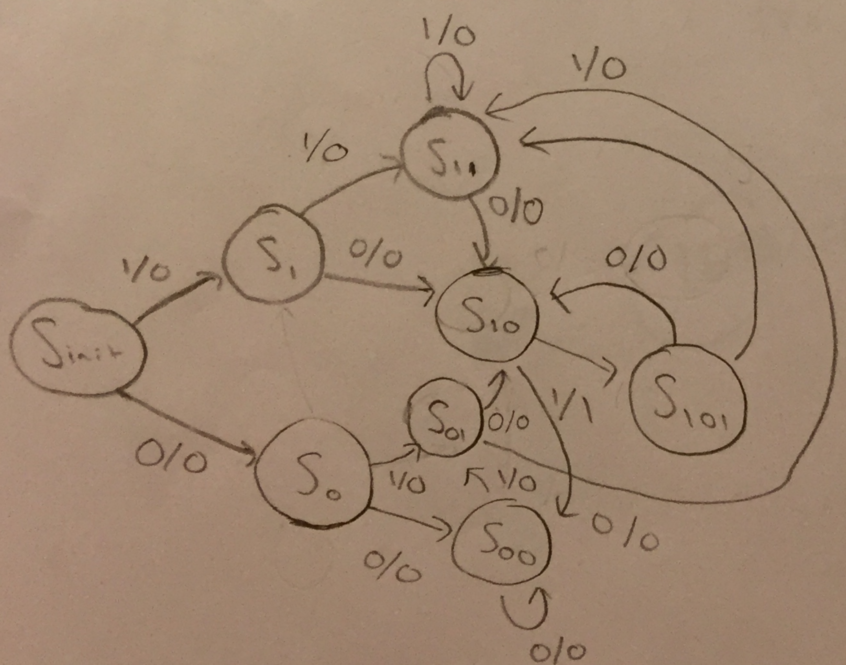
1) After minimization, it should have only 3 states.
2) Some states which are 2-equivalent are not 3- equivalent.

P.S.	0	1
S_{init}	$S_0/0$	$S_1/0$
S_0	$S_{00}/0$	$S_{01}/0$
S_1	$S_{10}/0$	$S_{11}/0$
S_{00}	$S_{00}/0$	$S_{01}/0$
S_{01}	$S_{10}/0$	$S_{11}/0$
S_{10}	$S_{00}/0$	$S_{101}/1$
S_{11}	$S_{10}/0$	$S_{11}/0$
S_{101}	$S_{10}/0$	$S_{11}/0$



in	0	1	00	01	11	101	S_{10}
1	1	2	1	2	2	2	
1	1	1	1	1	1	1	

← didn't show the minimized group -2



Problem 3 (20 points)

For a K-map, M denotes the number of prime implicants of the K-map, and N denotes the number of essential prime implicants of the K-map. Draw a 4×4 K-map that has the largest value of P=M-N among all the 4×4 K-maps. For example, in the following 4×4 K-map, M=3, N=2, P=M-N=1

x_0

0	0	0	0
1	1	0	0
1	1	1	0
0	0	1	0

x_2

x_3

x_1

x_3x_2 \ x_1x_0	00	01	11	10
00	1	1		1
01		1	1	1
11			1	
10		1	1	1

M=12
N=0

P=12-0
P=12

No grouping of PIs.

15+12 = 17

Problem 4 (20 points)

F(a,b,c,d,e,f) =((a+b'c)'(a'+de'+f))'+(a'b')

a	b	E(a,b)
0	0	1
0	1	0
1	0	1
1	1	1

$= (a+b'c) + (a'+de'+f)' + \underbrace{(a'b')}_{(a+b)'}$

$= a+b'c + (af'(d'+e)) + a'b'$

$= (a+b'c+a'b')f + (a+b'c+ad'+ae'+a'b')f'$

a) Use only the "E" gate defined above to implement Boolean function F. You can use constants 0 and 1.

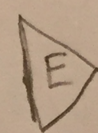
b) Implement the Boolean function F using only multiplexers.

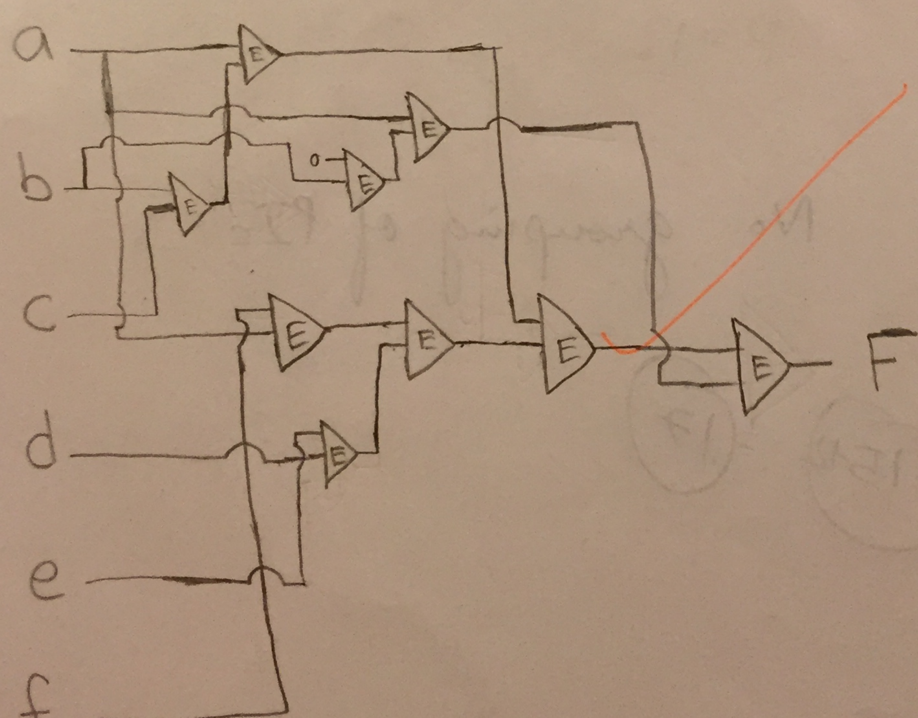
a) $E(a,b) = a'b' + ab' + ab \Rightarrow E(a,b) = a + a'b' \Rightarrow E(a,b) = a + b'$

NOT) $E(0,b) = b'$

$E(0, E(a,b)) = a'b$

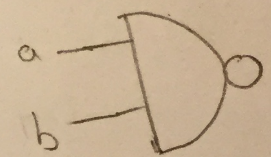
$E(a, E(0,b)) = a+b$

Let  = E(a,b) as a gate



Problem 5 (20 points)

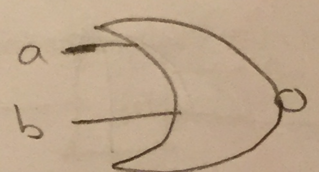
Find all the 2 input gates which form universal sets by itself (Universal set with only one gate). You can use constants 0 and 1.

1) NAND: 

$E(a,b) = (ab)'$

$= a' + b'$

+4

2) NOR: 

$E(a,b) = (a+b)'$

$= a'b'$

but missing proof.

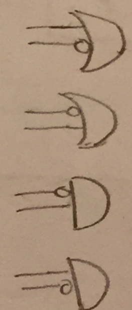
+3

3) $E(a,b) = a + b'$

4) $E(a,b) = a' + b$

5) $E(a,b) = a'b$

6) $E(a,b) = ab'$



+10