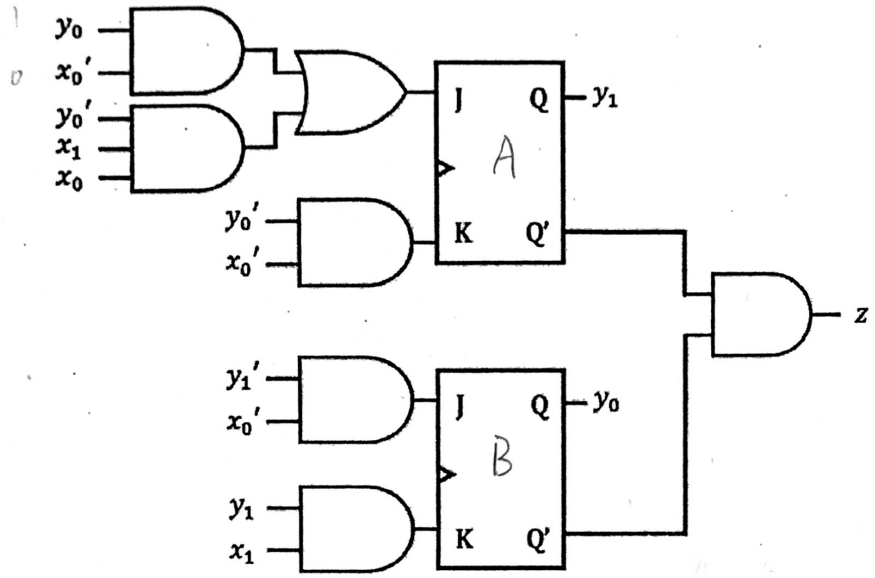
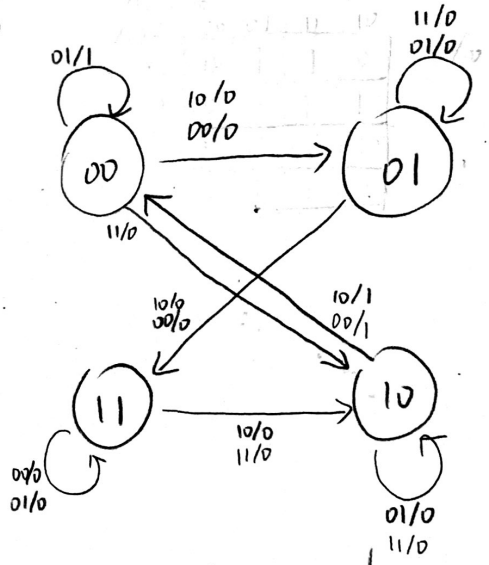
Problem 1 (20 points)

Obtain a high level description (state transition table) of the network shown in the figure below. The system has two input bits x1 and x0 with output bit z.



X_1	X_0	Y_1	Y_0	J_A K_A	$Q_A(Y_1)$	J_B K_B	$Q_B(Y_0)$	$Z = Q_A'Q_B'$
0	0	0	0	(0 1)	0	(1 0)	1	0
0	0	0	1	(1 0)	1	(1 0)	1	0
0	0	1	0	(0 1)	0	(0 0)	0	1
0	0	1	1	(1 0)	1	(0 0)	1	0
0	1	0	0	(0 0)	0	(0 0)	0	1
0	1	0	1	(0 0)	0	(0 0)	1	0
0	1	1	0	(0 0)	1	(0 0)	0	0
0	1	1	1	(0 0)	1	(0 0)	1	0
1	0	0	0	(0 1)	0	(1 0)	1	0
1	0	0	1	(1 0)	1	(1 0)	1	0
1	0	1	0	(0 1)	0	(0 1)	0	1
1	0	1	1	(1 0)	1	(0 1)	0	0
1	1	0	0	(1 0)	1	(0 0)	0	0
1	1	0	1	(0 0)	0	(0 0)	1	0
1	1	1	0	(1 0)	1	(0 1)	0	0
1	1	1	1	(0 0)	1	(0 1)	0	0



PS	input=00	input=01	input=10	input=11
(00) A	B,0	A,1	B,0	C,0
(01) B	D,0	B,0	D,0	B,0
(10) C	A,1	C,0	A,1	C,0
(11) D	D,0	D,0	C,0	C,0

Problem 2 (20 points) 20

Design a state transition table such that it initially has 8 states, and after minimization, reduces down to 3 states.

① ② ③

{A, B, C} {D, E} {F, G, H}

A 2D 3F
B 2E 3G
C 2D 3H

D 2D 1A
E 2E 1B

F 1A 3F
G 1B 3G
H 1C 3H

PS	input = 0	input = 1	
A	D, 0	F, 0	✓
B	E, 0	G, 0	
C	D, 0	H, 0	
D	D, 0	A, 1	✓
E	E, 0	B, 1	
F	A, 1	F, 0	✓
G	B, 1	G, 0	
H	C, 1	H, 0	

Problem 3 (20 points) 14

Given two 1-bit input streams A and B, output 1 if the difference between the number of times the pattern "001" appears in stream A and "101" appears in stream B is 3. If the difference between the number of their appearances is not 3, then the output is ~~1~~ 0. You may use any type of flip flops or logical units of your choosing.

For example:

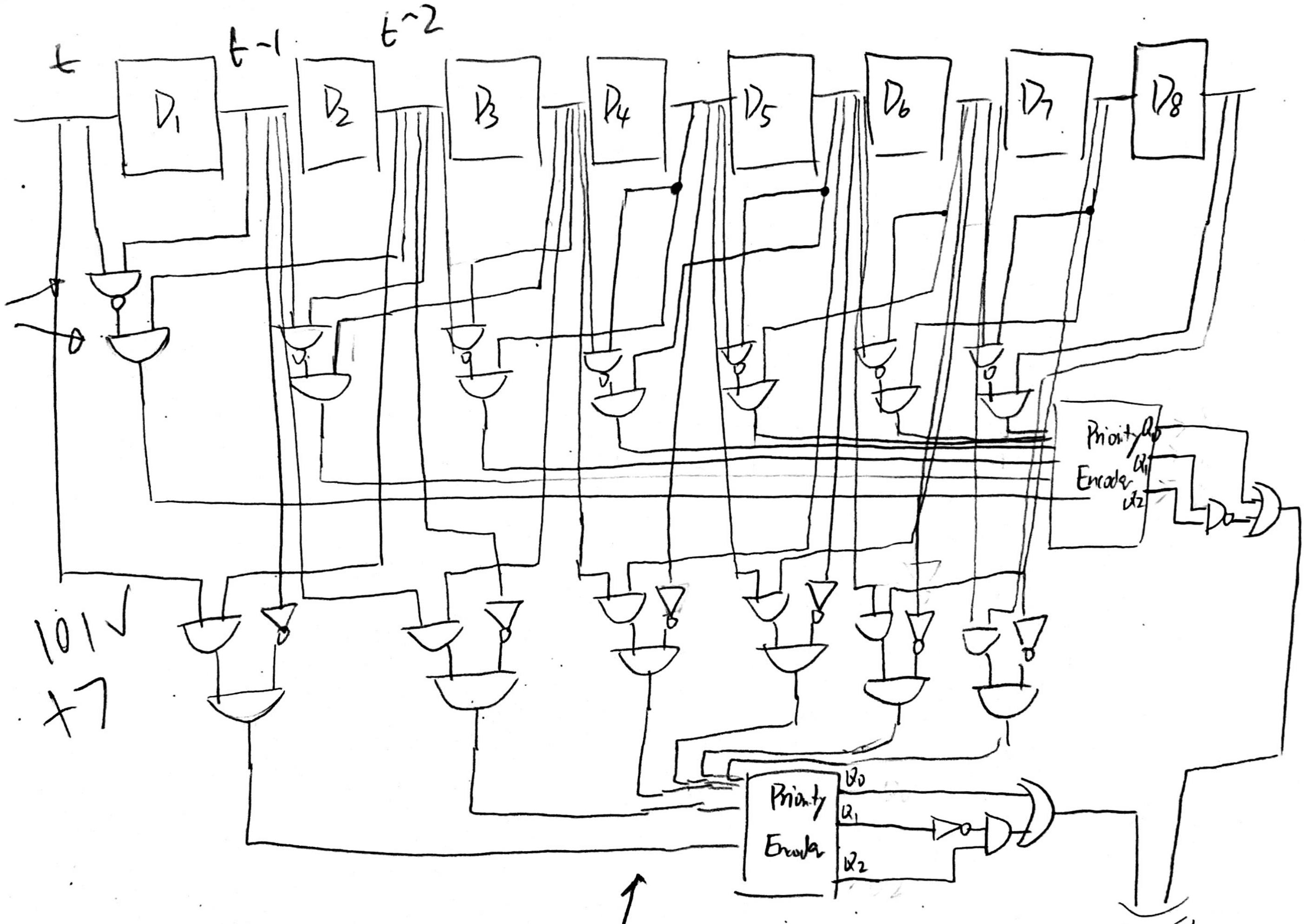
A: 001000000

B: 101010101

max 4. A - 0 or 1, B - 3 or 4.

Would output: 000000001. Notice that the B pattern overlaps.

x 100 +5



101 ✓ +7

Not quite correct +2

7
+7
14.

Problem 4 (20 points)

Using **OK flip-flops** as designed below and **multiplexers** for logic, design a **minimum** system which has the following behaviors:

Input set: {a, b, c} d

Output: 1 if x(t-n, t) = a[b|c]+d*a

0 otherwise

Notes: ababa

Overlaps can occur. For example adada would output 00101

| means OR

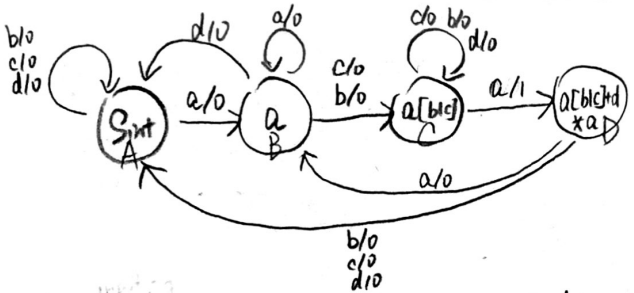
* means 0 or more of the previous character

+ means 1 or more of the previous character

0→0 : 10
0→1 : 0-
1→0 : 1-
1→1 01

you are using 4 states. however. you are recognising abcdbca as well.

Prev State Q(t)	OK			
	00	**01**	**10**	**11**
0	1	1	0	-
1	-	1	0	0
	Nxt State Q(t+1)			



	input=a	input=b	input=c	input=d
A	B,0	A,0	A,0	A,0
B	B,0	C,0	C,0	A,0
C	D,1	C,0	C,0	C,0
D	B,0	A,0	A,0	A,0

	input=a	b	c	d
00 A	B,0	A,0	A,0	A,0
01 B	B,0	C,0	C,0	A,0
10 C	A,1	C,0	C,0	C,0

reduction to 3 states

	00 a	01 b	10 c	11 d
00	01	00	00	00
01	01	10	10	00
10	00	10	10	10

Q_1K_1

	00	01	10	11
00	10	10	10	10
01	10	0-	0-	10
10	1-	01	01	01

Q_2K_2

	00	01	10	11
00	0-	10	10	10
01	01	1-	1-	1-
10	10	10	10	10

Q_1

Q_AQ_B \ X_1X_0	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	-	-	-	-
10	1	0	0	0

$Q_1 = Q_A'Q_B' + X_1'X_0' + Q_B X_1X_0$

K_1

Q_AQ_B \ X_1X_0	00	01	11	10
00	0	0	0	0
01	0	-	0	-
11	-	-	-	-
10	-	1	1	1

$K_1 = Q_A$

Q_2

Q_AQ_B \ X_1X_0	00	01	11	10
00	0	1	1	1
01	0	1	1	1
11	-	-	-	-
10	1	1	1	1

$Q_2 = Q_A + X_0 + X_1$

K_2

Q_AQ_B \ X_1X_0	00	01	11	10
00	-	0	0	0
01	1	-	-	-
11	-	-	-	-
10	0	0	0	0

you can make larger grp

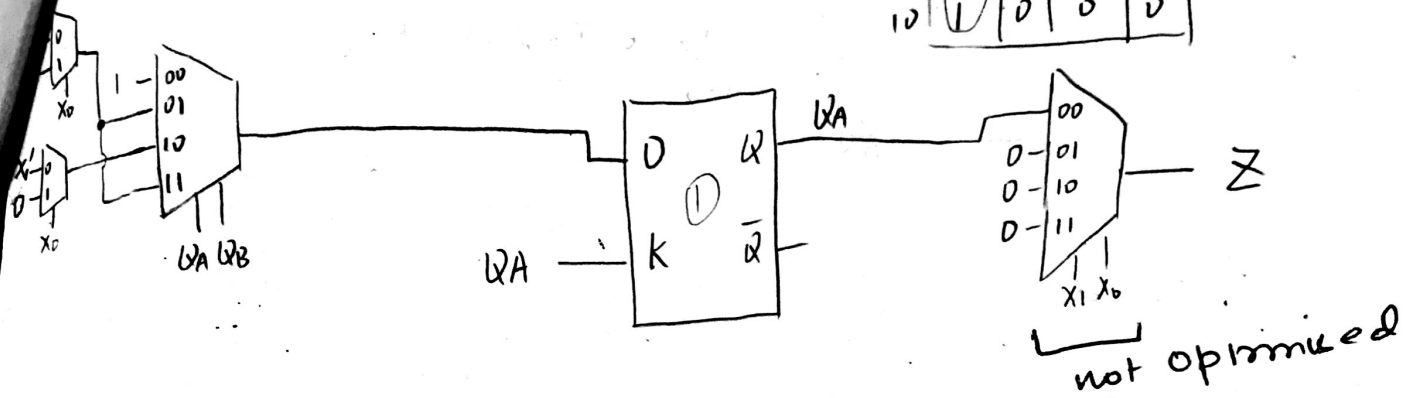
$K_2 = Q_B X_1' X_2'$

Extra Page

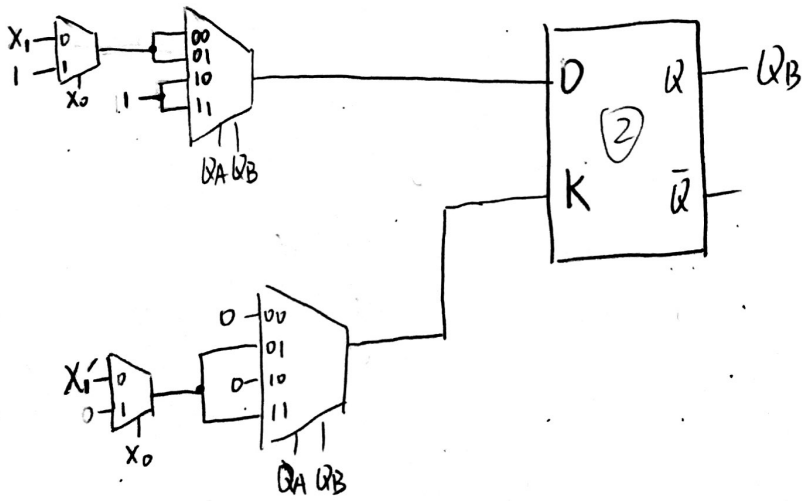
Output Z

Q_AQ_B \ X_1X_0	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	-	-	-	-
10	1	0	0	0

$Z = Q_A X_1' X_0'$



not optimized



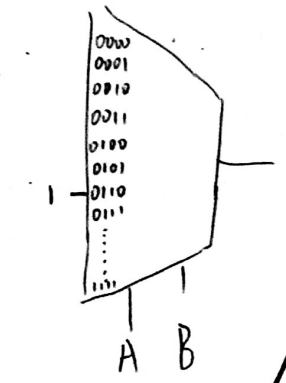
Problem 5 (20 points)

Given 6 2-bit numbers as input, {A, B, C, D, E, F}, design a system such that the system finds the maximum sum between any of the 2 inputs. You may only use multiplexers to implement this system.

min: 0 000
max: 6 110

For example, if all the inputs are 01, then the maximum sum output should be 010.

2+3



Time Allowed: 100 Minutes

Problem(Possible Points)	Points
1 (20)	18
2 (20)	20
3 (20)	14
4 (20)	14.
5 (20)	0
Total (100)	66