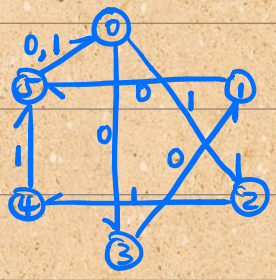
112 Intro to Computer System. 2015 Exam.

1a.



1b.

Input	This State	Q2	Q1	Q0	Next State	D2	D1	D0
0	0	0	0	0	3	0	1	1
0	1	0	0	1	5	1	0	1
0	2	0	1	0	X	X	X	X
0	3	0	1	1	1	0	0	1
0	4	1	0	0	X	X	X	X
0	5	1	0	1	0	0	0	0
0	X	1	1	0	X	X	X	X
0	X	1	1	1	X	X	X	X
1	0	0	0	0	2	0	1	0
1	1	0	0	1	X	X	X	X
1	2	0	1	0	4	1	0	0
1	3	0	1	1	X	X	X	X
1	4	1	0	0	5	1	0	1
1	5	1	0	1	0	0	0	0
1	X	1	1	0	X	X	X	X
1	X	1	1	1	X	X	X	X

1c. K-map for D_2:

IQ_2 \ Q_1Q_0	00	01	11	10
00	0	1	0	X
01	X	0	X	X
11	1	0	X	X
10	0	X	X	1

$D_2 = Q_2 \cdot Q_1' \cdot Q_0' + Q_2' \cdot Q_1' \cdot Q_0 + I \cdot Q_1$

K-map for D_1:

IQ_2 \ Q_1Q_0	00	01	11	10
00	1	0	0	X
01	X	0	X	X
11	0	0	X	X
10	1	X	X	0

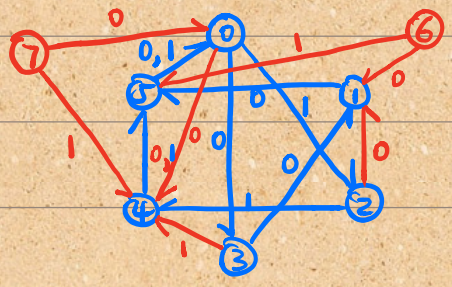
$D_1 = Q_2' \cdot Q' \cdot Q_0'$

K-map for D_0:

IQ_2 \ Q_1Q_0	00	01	11	10
00	1	1	1	X
01	X	0	X	X
11	1	0	X	X
10	0	X	X	0

$D_0 = I' \cdot Q_2' + Q_2 \cdot Q_0'$

1d.



For all possible unexpected state, it will finally be back on the right track.

1e. K-map for O_1:

Q_2 \ Q_1Q_0	00	01	11	10
0	0	1	1	0
1	0	1	1	0

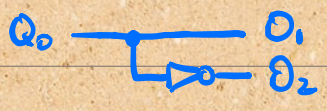
$O_1 = Q_0$

K-map for O_2:

Q_2 \ Q_1Q_0	00	01	11	10
0	1	0	0	1
1	1	0	0	1

$O_2 = Q_0'$

Circuit (Not part of the question):

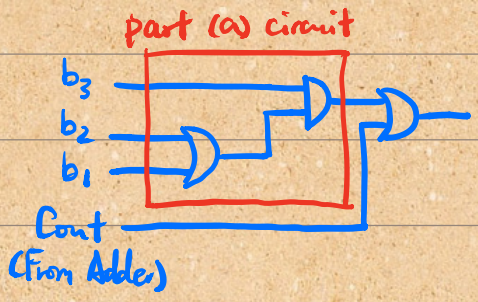


2a. K-map for output

b_3b_2 \ b_1b_0	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	1	1	1	1
10	0	0	1	1

Output = $b_3 \cdot b_2 + b_3 \cdot b_1 = b_3 \cdot (b_2 + b_1)$

b. Any sum bigger than 9 should be considered here: if the sum becomes an invalid combination, there should be a carry-out:

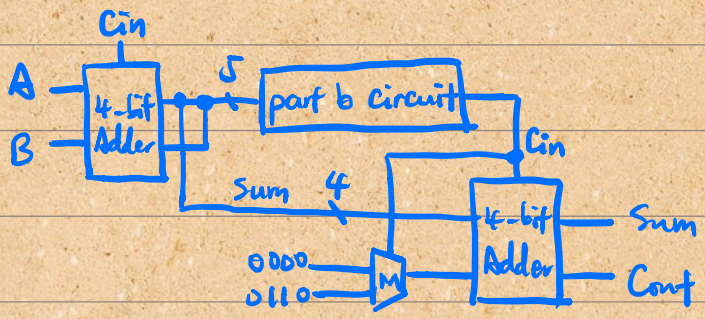


c. Decimal 10 11 12 The 4-bit number should be 0110_{binary}

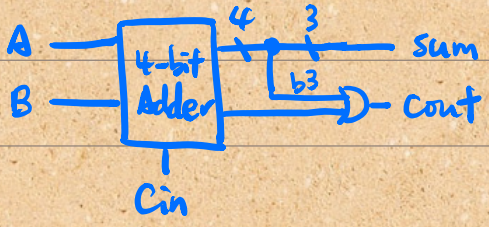
Binary 1010 1011 1100

BCD 0000 0001 0010

d.



e. Any bigger than 7 should incur a carry to the next digit



(Assuming A and B are both within the range 0~7)