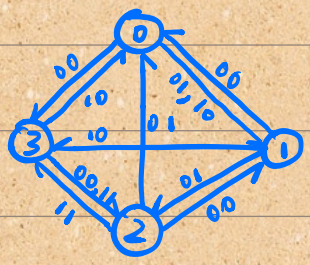
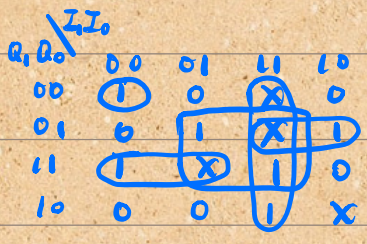
112 Intro to Computer System. 2018 Exam.

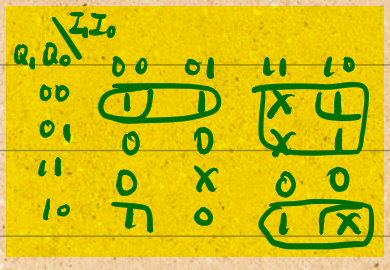
1a. i) State Transition diagram: ii) State Transition Table:



I_1	I_0	State	Q_1	Q_0	Next-state	D_1	D_0
0	0	0	0	0	3	1	1
0	1	0	0	0	1	0	1
1	0	0	0	0	1	0	1
1	1	0	0	0	X	X	X
0	0	1	0	1	0	0	0
0	1	1	0	1	2	1	0
1	0	1	0	1	3	1	1
1	1	1	0	1	X	X	X
0	0	2	1	0	1	0	1
0	1	2	1	0	0	0	0
1	0	2	1	0	X	X	X
1	1	2	1	0	3	1	1
0	0	3	1	1	2	1	0
0	1	3	1	1	X	X	X
1	0	3	1	1	0	0	0
1	1	3	1	1	2	1	0

1b. K-map for D_1: K-map for D_0:





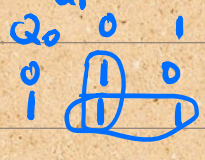
$$D_1 = Q_0 \cdot I_0 + I_1 \cdot I_0 + Q \cdot Q_0 \cdot I_1' + Q_1' \cdot Q_0 \cdot I_1 + Q_1' \cdot Q_0' \cdot I_1' \cdot I_0'$$

$$D_0 = Q_0' \cdot I_0' + Q_1' \cdot I_1 + Q' \cdot Q_0' \cdot I_1' + Q_1 \cdot Q_0' \cdot I_1$$

1c. For the lower right vertical segment, the logic is as follows:

State	Segment Signal
0	1
1	1
2	0
3	1

K-map:



Minterm:

$$Sig = Q_1' + Q_0$$

1d. It will work correctly since for the four don't-cares first don't-care falls to 3 which is in sequence 3,2,3,2. Second falls to 3 which in 3,2,3,2 as well. Third falls to 1 which is in sequence 1,3,0,1,3,0. Fourth one falls under 2 which is in sequence 1,2,0,1,2,0. All four don't-cares will fall to somewhere in the sequence after changing the input.

2a. K-map for D:

P \ AB	00	01	11	10
0	0	1	0	1
1	1	0	1	0

K-map for B:

P \ AB	00	01	11	10
0	0	1	0	0
1	1	1	1	0

D Minterm: $D = P \cdot A' \cdot B' + P' \cdot A' \cdot B + P \cdot A \cdot B + P' \cdot A \cdot B'$

$= P \cdot (A' \cdot B' + A \cdot B) + P' \cdot (A' \cdot B + A \cdot B')$

$= P \cdot (A \cdot B' + B \cdot A')' + P' \cdot (A' \cdot B + A \cdot B')$

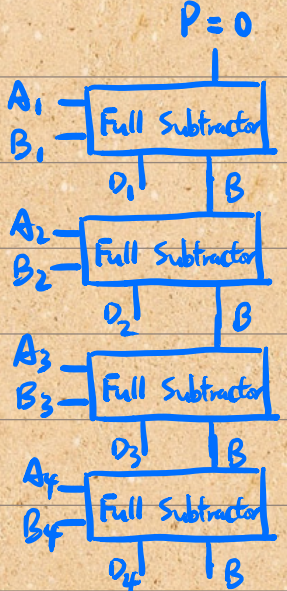
$= P \cdot (A \oplus B)' + P' \cdot (A \oplus B)$

$= P \oplus (A \oplus B)$

B Minterm: $B = P \cdot A' + A' \cdot B + P \cdot B$

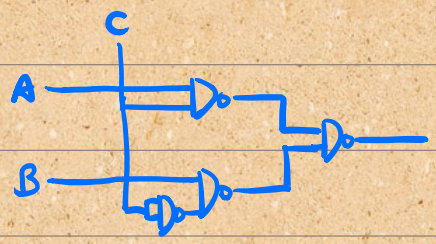
$= A' \cdot (P + B) + P \cdot B$

2b.

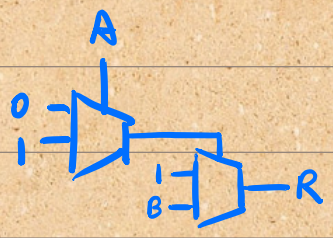


Pay back in is required when borrow is 1 from the previous digit. This will pay back the 1 borrowed by the last digit.

2c.



2d.



2e. The second one will respond faster since the first one has a bigger fan-out than second one, resulting in more load capacitance and more time.