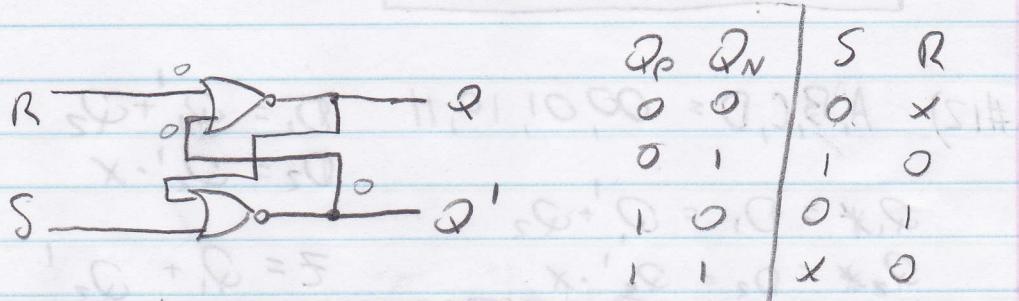
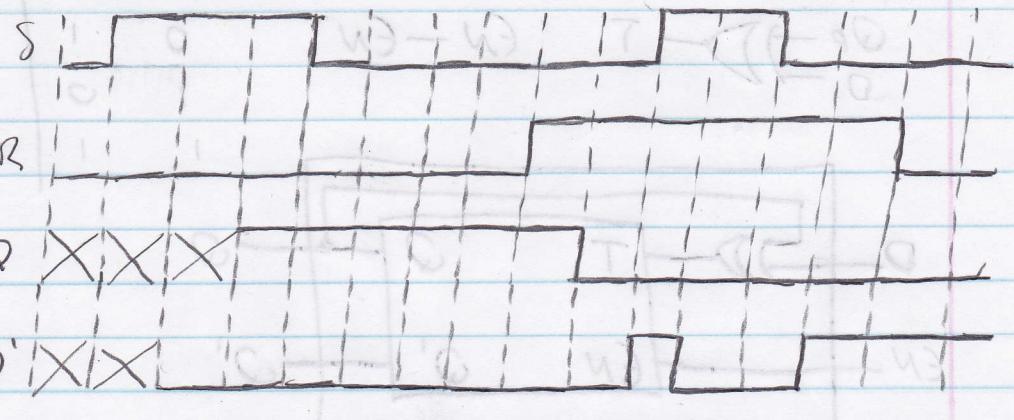


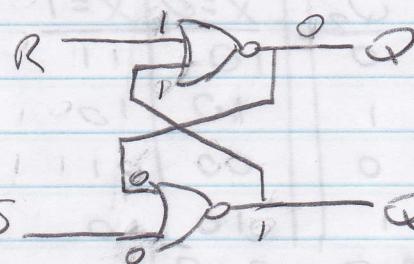
Brian Fawcett DLD Hw#9 RUID: 150003563

#4)



NOR Delay = 10ns

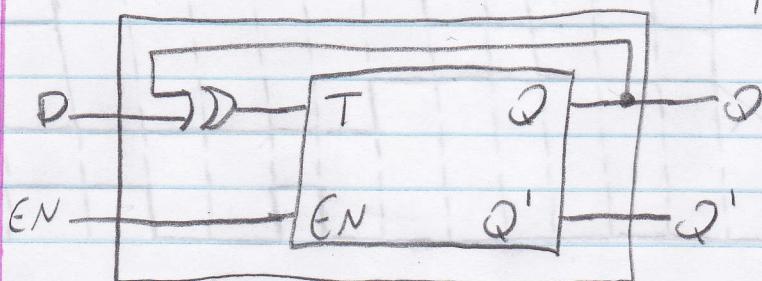
NOR	
0	0
0	1
1	0
1	1



#6) D flip-flop using T flip-flop

$$Q_P \rightarrow D \rightarrow T \quad EN - EN$$

Q_P	0	0	Q_N	T
	0	0	0	0
	0	1	1	1
	1	0	0	1
	1	1	1	0



$$\#12) \quad A, B, C, D = 00, 01, 10, 11 \quad D_1 = Q_1 + Q_2$$

$$D_2 = Q_2' \cdot X$$

$$Q_1 \neq D_1 = Q_1' + Q_2$$

$$Q_2 \neq D_2 = Q_2' \cdot X$$

[* Q_1, Q_2]

$$Z = Q_1 + Q_2'$$

Q_1	Q_2	$X=0$	$X=1$
0	0	10	11
0	1	10	10
1	0	00	01
1	1	10	10

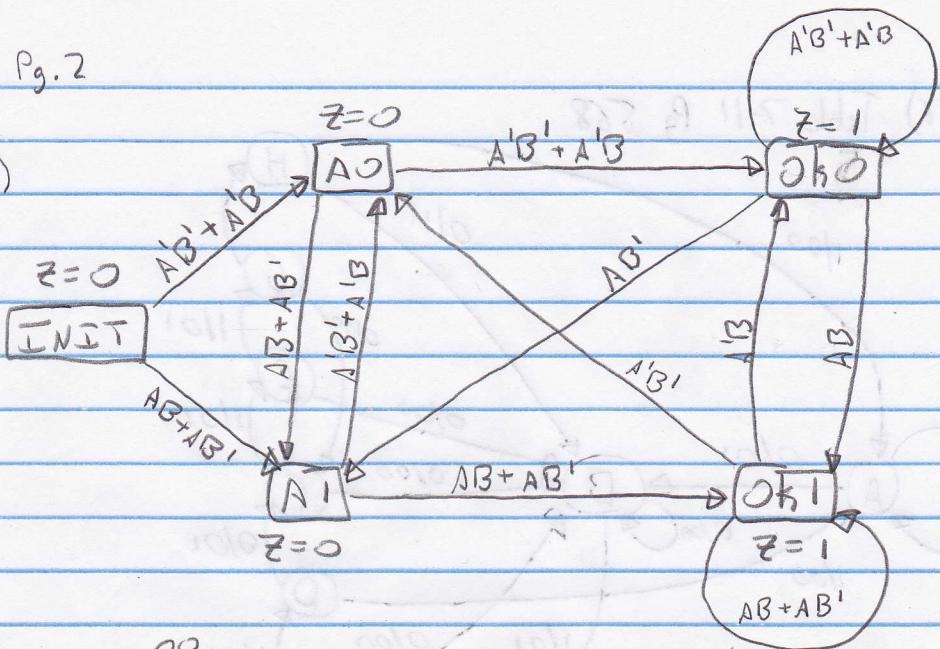
	$X=0$	$X=1$
A	C	D
B	C	C
C	A	B
D	C	C

$$Z = A + C + D = Q_1 + Q_2'$$

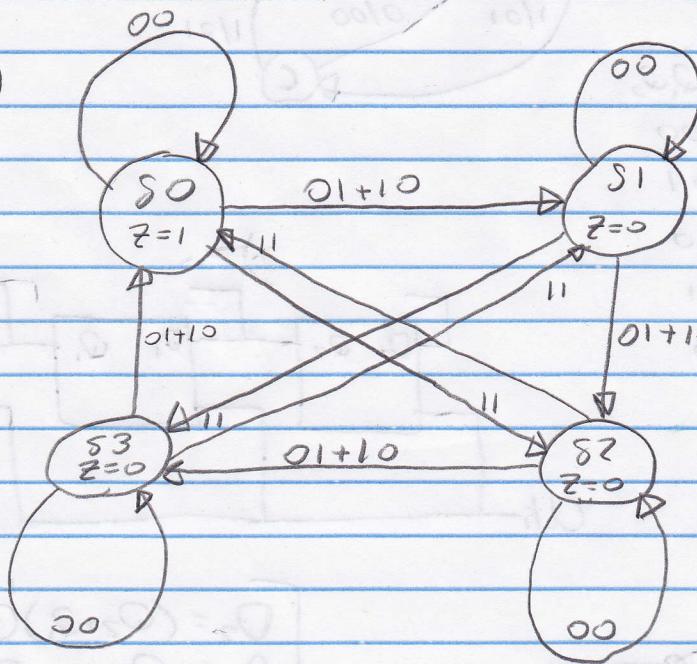
STATE, Z		
	$X=0$	$X=1$
A	C, 1	D, 1
B	C, 1	C, 1
C	A, 1	B, 0
D	C, 1	C, 1

Pg. 2

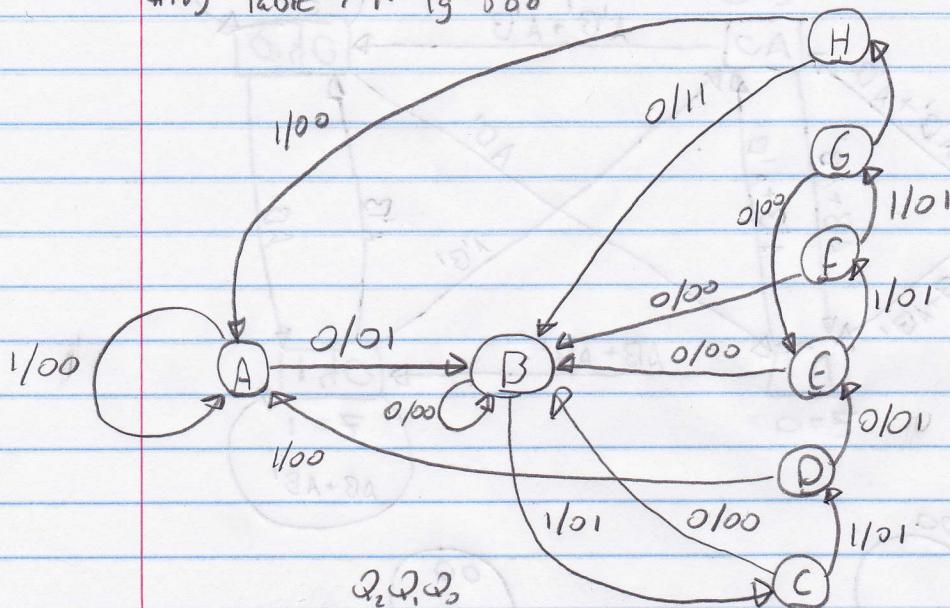
#14)



#15)



#16) Table 7-11 Pg 568



#18) A 000

B 001

C 010

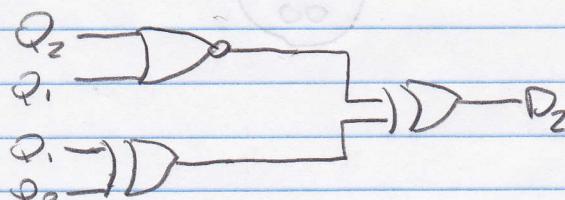
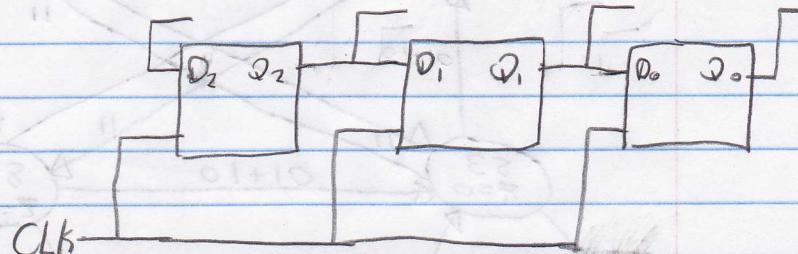
D 011

E 100

F 101

G 110

H 111



$$\begin{aligned} D_2 &= (Q_2 + Q_1) \oplus (Q_1 \oplus Q_0) \\ D_1 &= Q_2 \quad D_0 = Q_1 \end{aligned}$$

$$*Q_2 = D_2 \quad *Q_1 = D_1 \quad *Q_0 = D_0$$

$$\begin{aligned} *Q_2 &= (Q_2 + Q_1) \oplus (Q_1 \oplus Q_0) \\ *Q_1 &= Q_2 \\ *Q_0 &= Q_1 \end{aligned} = (Q_2' Q_1') \oplus (Q_1 \oplus Q_0)$$

Pg 3

	<u>$Q_2 Q_1 Q_0$</u>	<u>$*Q_2 *Q_1 *Q_0$</u>	
A	0 0 0	1 0 0	$1 \oplus 0 = 1$
B	0 0 1	0 0 0	$1 \oplus 1 = 0$
C	0 1 0	1 0 1	$0 \oplus 1 = 1$
D	0 1 1	0 0 1	$0 \oplus 0 = 0$
E	1 0 0	0 1 0	$0 \oplus 0 = 0$
F	1 0 1	1 1 0	$0 \oplus 1 = 1$
G	1 1 0	1 1 1	$0 \oplus 1 = 1$
H	1 1 1	0 1 1	$0 \oplus 0 = 0$

Present Next

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

 $Q_1 Q_0$

- #20) $*Q_1 = EN_1 Q_1' + EN_1' Q_1$ $EN_1 = Y$
- B 0 1 $*Q_1 = Y Q_1' + Y' Q_1$
- C 1 0
- D 1 1 $*Q_2 = EN_2 Q_2' + EN_2' Q_2$ $EN_2 = Q_1 Y X'$
- $Z = (X' Q_2')$
- $*Q_2 = Q_1 Y X' Q_2' + (Q_1 Y X')' Q_2$

		XY				Q ₁ Q ₂	
		00	01	10	11	A=00	
A	00	00	10	00	10	B=01	
B	01	01	10	01	11	C=10	
C	10	10	01	10	00	D=11	
D	11	11	00	11	01		

$$* Q_1 = YQ_1 + Y'Q_1$$

$$* Q_2 = (X'YQ_1)(Q_1') + (X'YQ_1')(Q_2)$$

		XY				XY			
A	00	01	10	11	A	00	01	10	11
A	A	C	A	C	A	A, 1	C, 1	A, 0	C, 0
B	B	C	B	D	B	B, 0	C, 1	B, 0	D, 0
C	C	B	C	A	C	C, 1	B, 0	C, 0	A, 0
D	D	A	D	B	D	D, 0	A, 1	D, 0	B, 0

$$Z = (X'Q_2')$$

#52) ORIGINAL NEW

$$S_0 = 00$$

$$S_0 = 00$$

$$S_1 = 01$$

$$S_1 = 01 \quad Z = S_0$$

$$S_2 = 11$$

$$S_2 = 10$$

$$S_3 = 10$$

$$S_3 = 11$$

		XY			
D ₁ D ₂	00	01	11	10	
S ₀	S ₀	S ₁	S ₂	S ₁	
S ₁	S ₁	S ₂	S ₃	S ₂	
S ₃	S ₃	S ₀	S ₁	S ₀	
S ₂	S ₂	S ₃	S ₀	S ₃	

A₃⁴

	XY				
	00	01	11	10	Q ₁
S0	00	01	10	01	
S1	01	10	11	10	Q ₁ , Q ₂ XY
S3	11	00	01	00	
S2	10	11	00	11	

$$\begin{aligned}
 D_1 = & XY Q_1 + Q_1 Q_2 Y + Q_1' Q_2 X \\
 & + XY' Q_1 + Q_1 Q_2' X' + \\
 & Q_1' Q_2' Y'
 \end{aligned}$$

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

D₂

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

$$\begin{aligned}
 D_2 = & XY' Q_2 + XY Q_2 + X' Y Q_2' \\
 & + X Y' Q_2'
 \end{aligned}$$

$$Z = Q_1' Q_2'$$

-Compared to the equations derived in the text, my Z & D₂ equations are very similar but my equation for D₁ is much longer, making mine more expensive

#46) w/ DFF's A=00 B=01 C=11 D=10

	$Q_1 Q_2$	0	1	X
A	0 0	01	10	
B	0 1	11	01	
C	1 1	01	00	
D	1 0	01	11	

$Z = Q_1 Q_2$

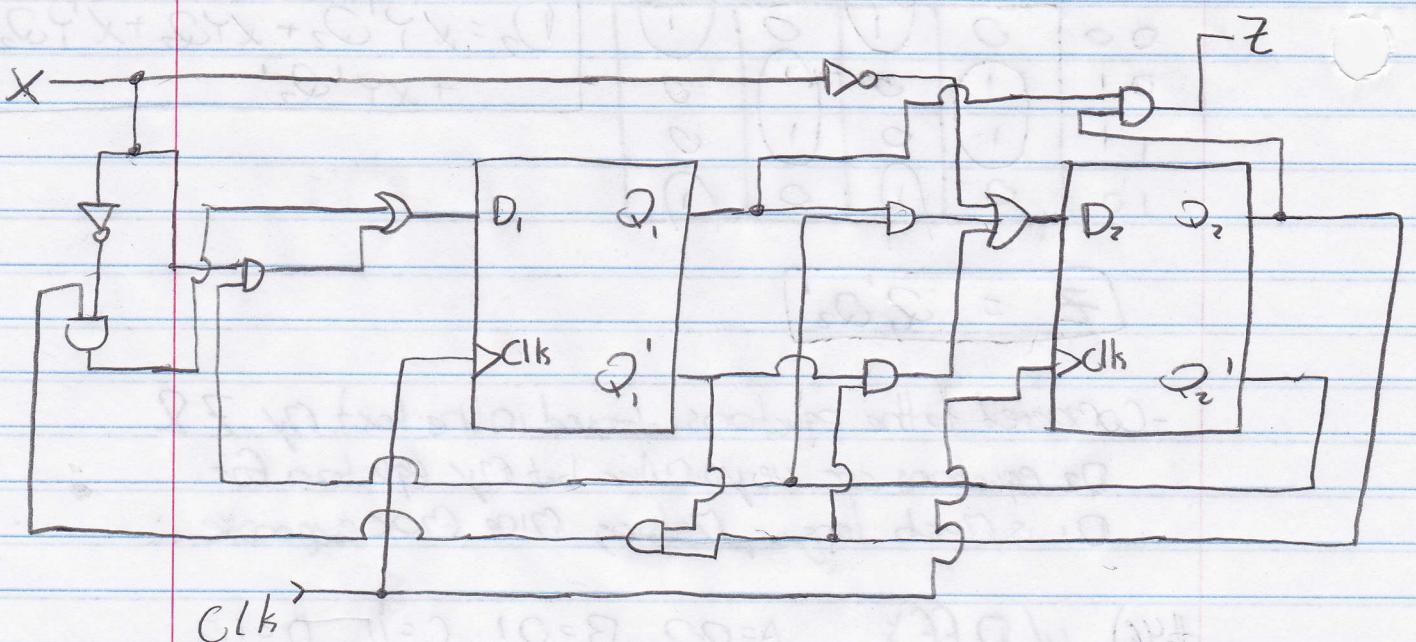
	$Q_1 Q_2$	A	B
A	0 0	00	00
B	0 1	10	01
C	1 1	01	11
D	1 0	11	01

	D_1	D_2
X	$Q_1 Q_2$	$Q_1 Q_2$

$D_1 = Q_1' Q_2 X' + X Q_2'$

$D_2 = X' + Q_1' Q_2 + Q_1 Q_2'$

$Z = Q_1 Q_2$



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w/ SR flip flops

	Q_1	Q_2	\parallel	0	1	X
A	0	0	\parallel	01	10	
B	0	1	\parallel	11	01	
C	1	1	\parallel	01	00	
D	1	0	\parallel	01	11	

SET

	Q_1	Q_2	\parallel	00	01	11	10
0	0	0	\parallel	0	0	1	0
1	1	0	\parallel	1	0	0	1
0	0	1	\parallel	0	1	0	0
1	1	1	\parallel	1	1	1	0

RESET

$$\begin{aligned} \text{SET 1} &= X'Q_1Q_2 + XQ_2' \\ \text{RESET 1} &= Q_1Q_2 + XQ_2 + X'Q_1 \\ &\quad + X'Q_2' \end{aligned}$$

	Q_1	Q_2	\parallel	00	01	11	10
0	0	0	\parallel	0	0	1	1
1	0	1	\parallel	1	0	0	0
0	1	0	\parallel	0	1	0	0
1	1	1	\parallel	1	1	1	0

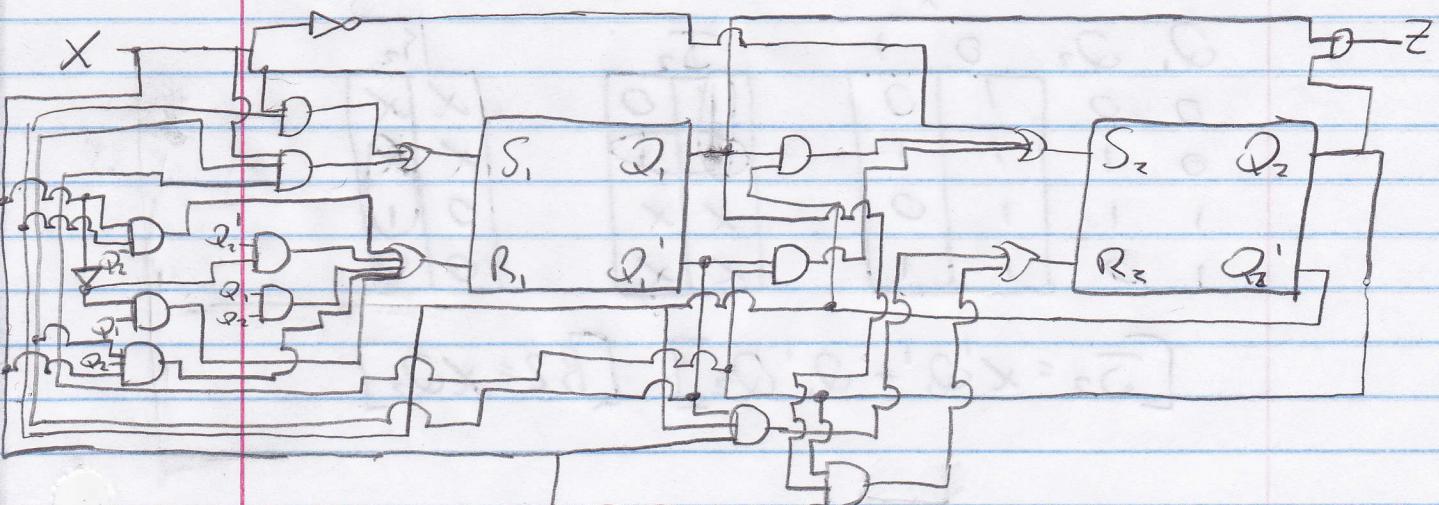
SET 2

	Q_1	Q_2	\parallel	00	01	11	10
0	0	0	\parallel	1	1	1	1
1	0	1	\parallel	0	1	0	0
0	1	0	\parallel	0	0	1	0
1	1	1	\parallel	1	0	1	0

RESET 2

	Q_1	Q_2	\parallel	00	01	11	10
0	0	0	\parallel	0	0	0	0
1	0	1	\parallel	1	0	0	1
0	1	0	\parallel	0	1	0	0
1	1	1	\parallel	1	0	1	0

$$[\text{SET 2} = X' + Q_1'Q_2 + Q_1Q_2'] \quad [\text{RESET 2} = Q_1'Q_2'X + Q_1Q_2X]$$



W/SK flip flops

		P	N	S	K	J	K	<u>Q_{next}</u>
		x	00	0x	00	00	00	Q _{last}
Q, Q ₂	0 1		01	1x	01	01	0	
A	00	01	10	10	x1	10	1	
B	01	11	01	11	x0	11	Q _{last}	
C	11	01	00					
D	10	01	11					

* Q₁

Q, Q ₂	0 1	J ₁	K ₁
0 0	0 1	0 1	x x
0 1	1 0	1 0	x x
1 1	0 0	x x	1 1
1 0	0 1	x x	1 0

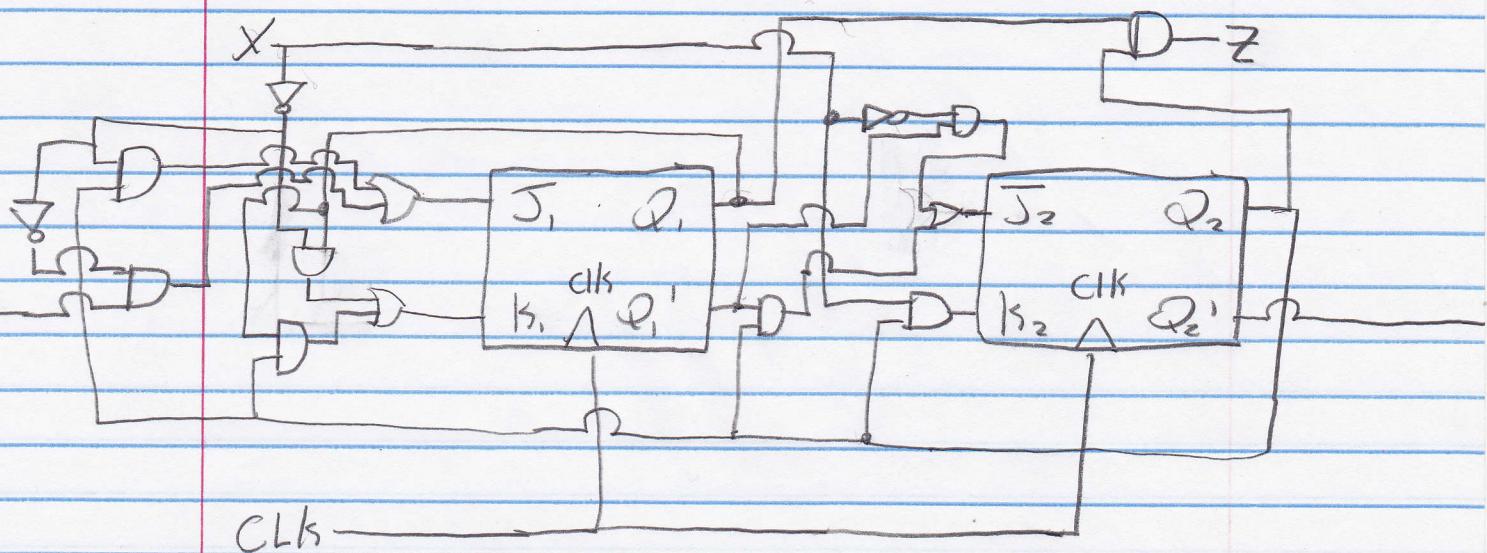
$$[J_1 = Q_2 x' + Q_1 x] \quad [K_1 = Q_1 Q_2 + Q_1 x']$$

* Q₂

Q, Q ₂	0 1	J ₂	K ₂
0 0	1 0	0 0	x x
0 1	1 1	1 1	x x
1 1	1 0	x x	0 1
1 0	1 1	x x	0 0

$$[J_2 = x' Q_1 + Q_1 Q_2] \quad [K_2 = x Q_2]$$

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W/T ff's

* Q_1

Q_1, Q_2	0	1
0 0	0	1
0 1	1	0
1 1	0	0
1 0	0	1

EN_1
0 1
1 0
1 1
1 0

$$EN_1 = XQ'_1Q'_2 + X'Q_2 + X'Q_1 + Q_1Q_2$$

Present	Next	T	EN
0 0	0 0	1	0
0 1	0 1	1	1
1 0	1 0	1	1
1 1	1 1	1	0

* Q_2

Q_1, Q_2	0	1
0 0	1	0
0 1	1	1
1 1	1	0
1 0	1	1

EN_2
1 0
0 1
0 0
0 0

$$EN_2 = X'Q_1 + Q'_1Q_2 + XQ_2$$

