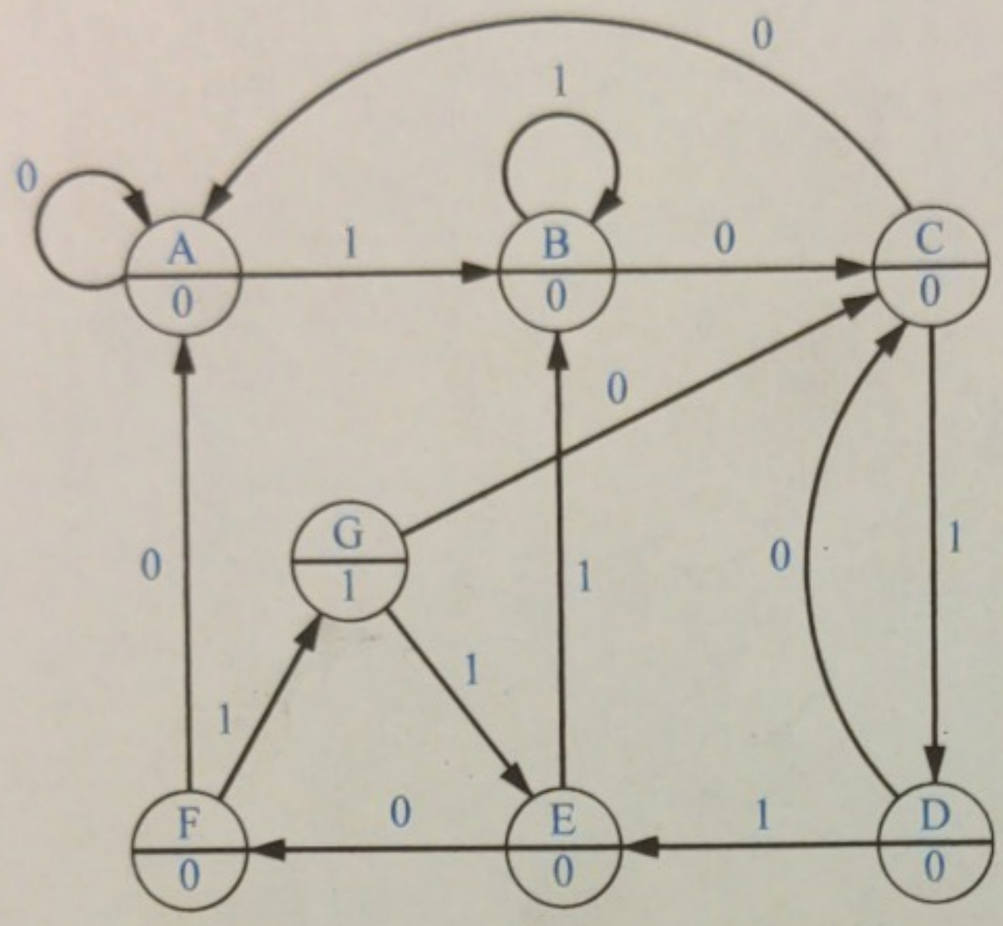
 NAME Chris Hunt

1.) You have been handed a state diagram that you have been asked to implement the design for. (Unused states: extra state encodings can be treated as "don't care" values and are used to simplify the combinational logic.)



Current State				Input	Next State				Outputs
State Name	Q2	Q1	Q0	X	State Name	Q2(t+1)	Q1(t+1)	Q0(t+1)	Z
A	0	0	0	0	A	0	0	0	0
A	0	0	0	1	B	0	0	1	0
B	0	0	1	0	C	0	1	0	0
B	0	0	1	1	B	0	0	1	0
C	0	1	0	0	A	0	0	0	0
C	0	1	0	1	D	0	1	1	0
D	0	1	1	0	C	0	1	0	0
D	0	1	1	1	E	1	0	0	0
E	1	0	0	0	F	1	0	1	0
E	1	0	0	1	B	0	0	1	0
F	1	0	1	0	A	0	0	0	0
F	1	0	1	1	G	1	1	0	0
G	1	1	0	0	C	0	1	0	1
G	1	1	0	1	E	1	0	0	1

a. Implement the design using T flip-flops, JK flip-flops, and SR flip-flops
b. Determine the Boolean expression for the inputs of the different types of flip-flops and the output.
c. Draw the circuit using only the JK flip-flops using the Deeds software and verify that it works. You do not need to draw the circuits using the T or SR flip-flops. Include a screen shot of your schematic and include the Deeds file with your homework submission.

Current State				Input	Next State				Outputs	Flip Flop Inputs		
State Name	Q2	Q1	Q0	X	State Name	Q2(t+1)	Q1(t+1)	Q0(t+1)	Z	T2	T1	T0
A	0	0	0	0	A	0	0	0	0	0	0	0
A	0	0	0	1	B	0	0	1	0	0	0	1
B	0	0	1	0	C	0	1	0	0	0	1	1
B	0	0	1	1	B	0	0	1	0	0	0	0
C	0	1	0	0	A	0	0	0	0	0	1	0
C	0	1	0	1	D	0	1	1	0	0	0	1
D	0	1	1	0	C	0	1	0	0	0	0	1
D	0	1	1	1	E	1	0	0	0	1	1	1
E	1	0	0	0	F	1	0	1	0	0	0	1
E	1	0	0	1	B	0	0	1	0	1	0	1
F	1	0	1	0	A	0	0	0	0	1	0	1
F	1	0	1	1	G	1	1	0	0	0	1	1
G	1	1	0	0	C	0	1	0	1	1	0	0
G	1	1	0	1	E	1	0	0	1	0	1	0

Q(t)	Q(t+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

T_1 (rows Q_0X, columns Q_2Q_1)

Q_0X \ Q_2Q_1	00	01	11	10
00	0	1	0	0
01	0	0	1	0
11	0	1	X	1
10	1	0	X	0

$$T_1 = Q_2Q_1X + Q_1Q_0X + Q_2Q_0X + \bar{Q}_2\bar{Q}_1Q_0\bar{X}$$

Z (rows Q_0X, columns Q_2Q_1)

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	X	0
10	0	0	X	0

$$Z = Q_2Q_1$$

T_2 (rows Q_0X, columns Q_2Q_1)

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	1	0
01	0	0	0	1
11	0	1	X	0
10	0	0	X	1

$$T_2 = Q_2Q_1\bar{X} + Q_1Q_0X + Q_2Q_0\bar{X} + Q_2\bar{Q}_1\bar{Q}_0X$$

T_0 (rows Q_0X, columns Q_2Q_1)

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	0	1
01	1	1	0	1
11	0	1	X	1
10	1	1	X	1

$$T_0 = Q_2\bar{Q}_1 + Q_1Q_0 + Q_0\bar{X} + \bar{Q}_2\bar{Q}_0X$$

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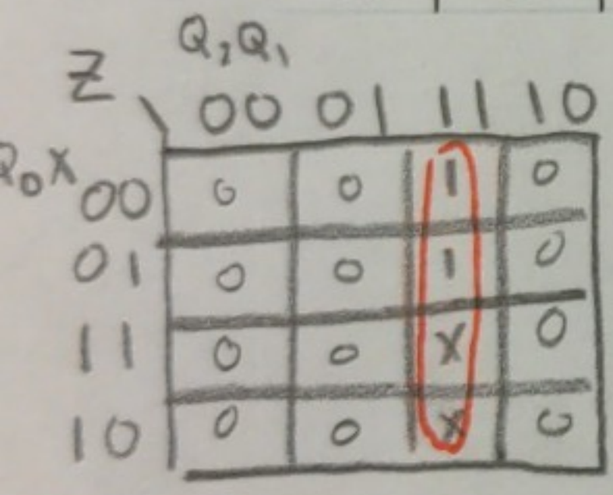
Current State				Input	Next State				Outputs	Flip Flop Inputs					
State Name	Q2	Q1	Q0	X	State Name	Q2(t+1)	Q1(t+1)	Q0(t+1)	Z	J2	K2	J1	K1	J0	K0
A	0	0	0	0	A	0	0	0	0	0	X	0	X	0	X
A	0	0	0	1	B	0	0	1	0	0	X	0	X	1	X
B	0	0	1	0	C	0	1	0	0	0	X	1	X	X	1
B	0	0	1	1	B	0	0	1	0	0	X	0	X	X	0
C	0	1	0	0	A	0	0	0	0	0	X	X	1	0	X
C	0	1	0	1	D	0	1	1	0	0	X	X	0	1	X
D	0	1	1	0	C	0	1	0	0	0	X	X	0	X	1
D	0	1	1	1	E	1	0	0	0	1	X	X	1	X	1
E	1	0	0	0	F	1	0	1	0	X	0	0	X	1	X
E	1	0	0	1	B	0	0	1	0	X	1	0	X	1	X
F	1	0	1	0	A	0	0	0	0	X	1	0	X	X	1
F	1	0	1	1	G	1	1	0	0	X	0	1	X	X	1
G	1	1	0	0	C	0	1	0	1	X	1	X	0	0	X
G	1	1	0	1	E	1	0	0	1	X	0	X	1	0	X

Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

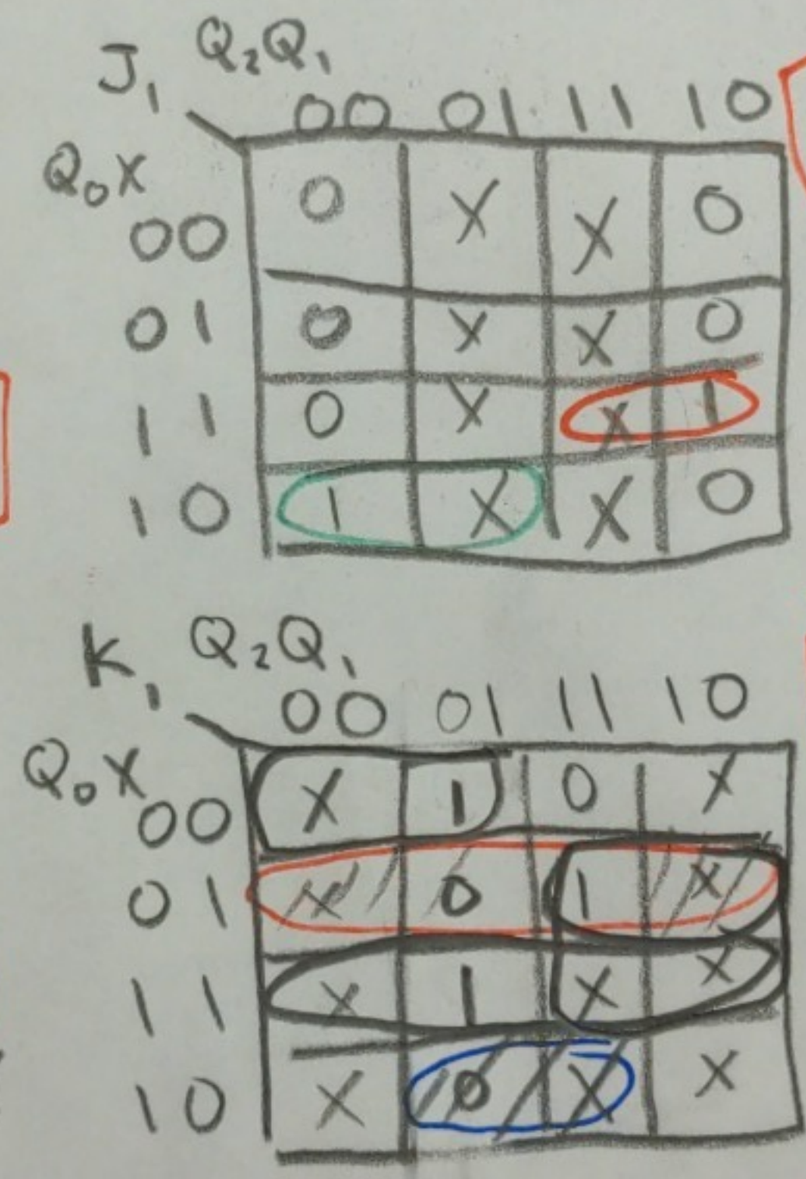
$Z = Q_2Q_1$



~~$J_2 = Q_1Q_0$~~

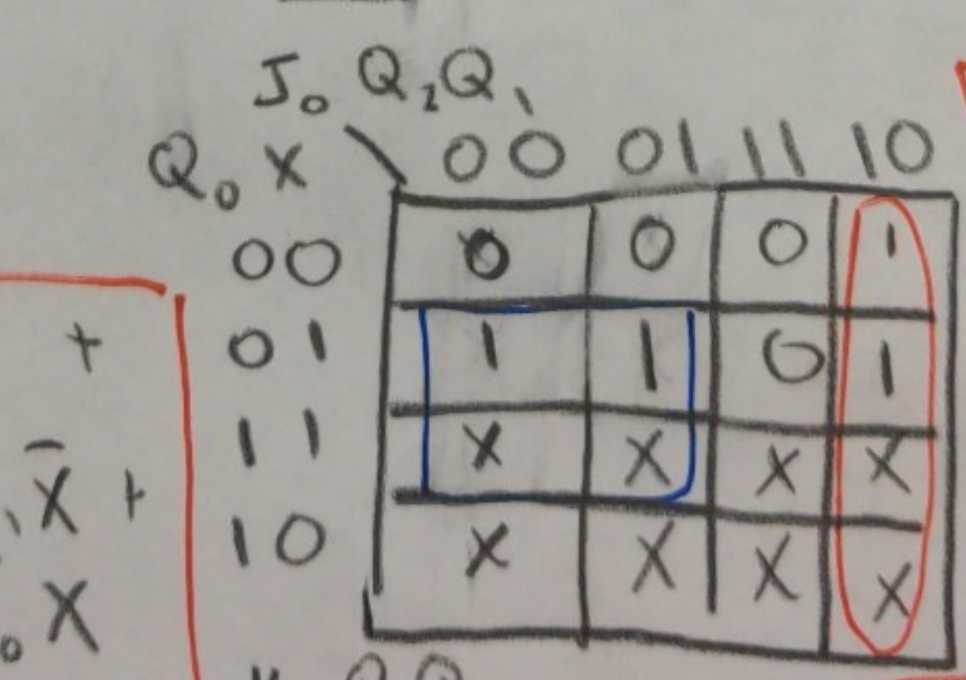
$J_2 = Q_1Q_0X$

$K_2 = Q_0\bar{X} + Q_2Q_1\bar{X} + \bar{Q}_1\bar{Q}_0X$

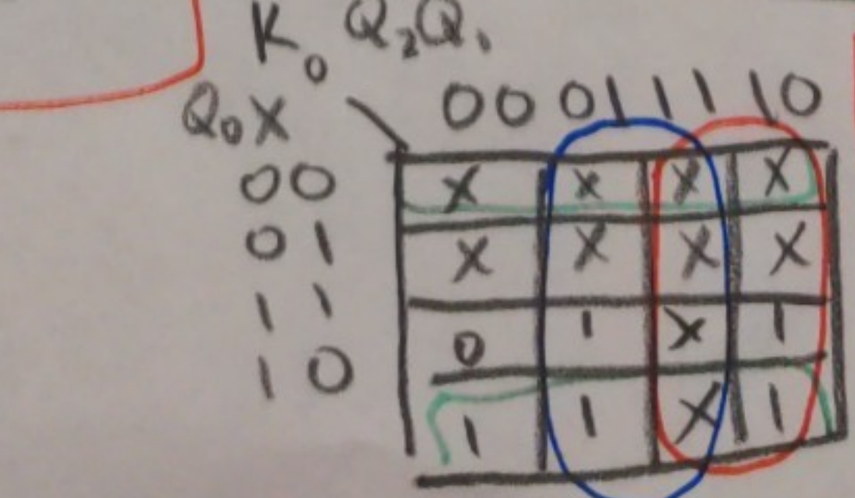


$J_1 = Q_2Q_0X + \bar{Q}_2Q_0\bar{X}$

$K_1 = Q_2X + Q_0X + \bar{Q}_2\bar{Q}_0\bar{X}$



$J_0 = Q_2\bar{Q}_1 + \bar{Q}_2X$



$K_0 = Q_2 + Q_1 + \bar{X}$

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Current State				Input	Next State				Outputs	Flip Flop Inputs					
State Name	Q2	Q1	Q0	X	State Name	Q2(t+1)	Q1(t+1)	Q0(t+1)	Z	S2	R2	S1	R1	S0	R0
A	0	0	0	0	A	0	0	0	0	0	X	0	X	0	X
A	0	0	0	1	B	0	0	1	0	0	X	0	X	1	0
B	0	0	1	0	C	0	1	0	0	0	X	1	0	0	1
B	0	0	1	1	B	0	0	1	0	0	X	0	X	X	0
C	0	1	0	0	A	0	0	0	0	0	X	0	1	0	X
C	0	1	0	1	D	0	1	1	0	0	X	X	0	1	0
D	0	1	1	0	C	0	1	0	0	0	X	X	0	0	1
D	0	1	1	1	E	1	0	0	0	1	0	0	1	0	1
E	1	0	0	0	F	1	0	1	0	X	0	0	X	1	0
E	1	0	0	1	B	0	0	1	0	0	1	0	X	1	0
F	1	0	1	0	A	0	0	0	0	0	1	0	X	0	1
F	1	0	1	1	G	1	1	0	0	X	0	1	0	0	1
G	1	1	0	0	C	0	1	0	1	0	1	X	0	0	X
G	1	1	0	1	E	1	0	0	1	X	0	0	1	0	X

Q(t)	Q(t+1)	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

S_1

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	X	0
01	0	X	0	0
11	0	0	X	1
10	1	X	X	0

$S_1 = \overline{Q}_2 Q_0 \overline{X} + Q_2 Q_0 X$

Z

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	1	0
01	0	0	1	0
11	0	0	X	0
10	0	0	X	0

$Z = Q_2 Q_1$

R_1

Q_0X \ Q_2Q_1	00	01	11	10
00	X	1	0	X
01	X	0	1	X
11	X	1	X	0
10	0	0	X	X

$R_1 = \overline{Q}_2 \overline{Q}_0 X + Q_2 Q_1 X + Q_1 Q_0 X$

S_2

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	0	X
01	0	0	X	0
11	0	1	X	X
10	0	0	X	0

$S_2 = Q_1 Q_0 X$

S_0

Q_0X \ Q_2Q_1	00	01	11	10
00	0	0	0	1
01	1	1	0	1
11	X	0	X	0
10	0	0	X	0

$S_0 = Q_2 \overline{Q}_1 Q_0 + \overline{Q}_2 \overline{Q}_0 X$

R_2

Q_0X \ Q_2Q_1	00	01	11	10
00	X	X	1	0
01	X	X	0	1
11	X	0	X	0
10	X	X	X	1

$R_2 = Q_0 X + Q_1 \overline{Q}_0 \overline{X} + \overline{Q}_1 \overline{Q}_0 X$

R_0

Q_0X \ Q_2Q_1	00	01	11	10
00	X	X	X	0
01	0	0	X	0
11	0	1	X	1
10	1	1	X	1

$R_0 = Q_0 \overline{X} + Q_2 Q_0 + Q_1 Q_0$