~~Lecture~~ (1)

April 3, 2017

Learning
Problem solving
Using Sequential circuit Design:

HW#4 is posted
We'll ~~return~~ return exams, graded hwks on Friday

Synthesis: Design and Implement of Sequential circuit.

Problem statement: Build a counter that counts {0, 1, 2, 3}

Step 1: How many states? 4 states

How many FF (min?): $\lceil \log_2 (\#\text{states}) \rceil$

~~Steps~~ what type of FF?

D-FF (T-FF, JK-FF) $= \lceil \log_2 4 \rceil$

$= \lceil \log_2 2^2 \rceil$

$= \lceil 2 \log_2 2 \rceil$

$= 2 * 1 = 2$

Step 2: Draw the finite state machine (FSM) or the state diagram

one of the UML (Unified Modeling Language) design tools

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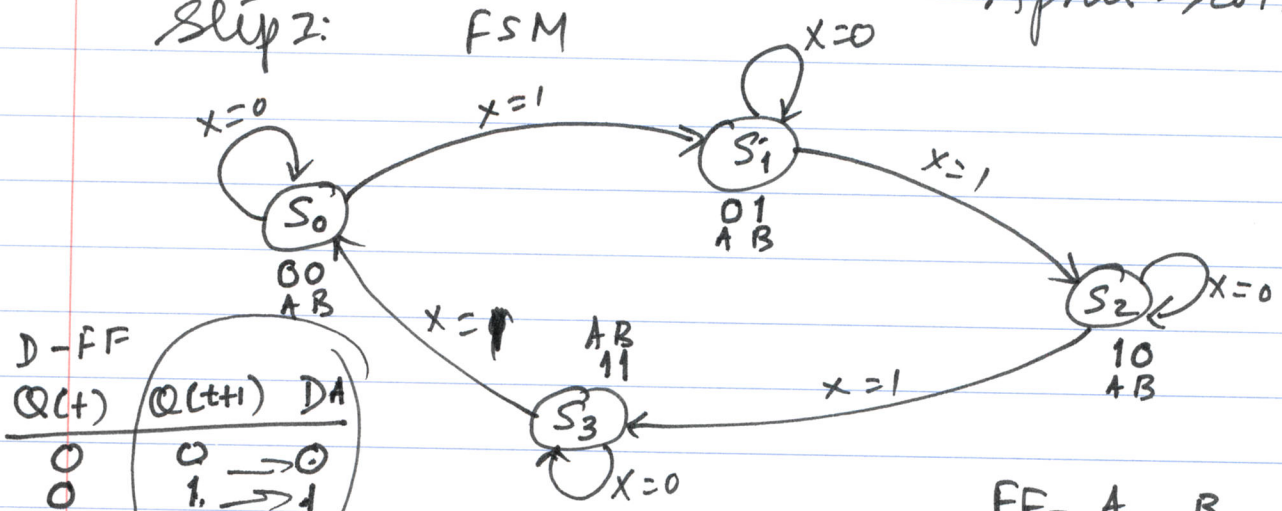
Slip 2: FSM



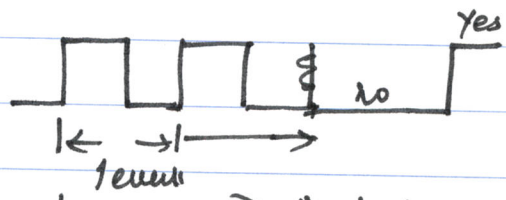
D-FF

Q(t)	Q(t+1)	DA
0	0	0
0	1	1
1	0	0
1	1	1

"coding the states"

FF = A , B

x visualizing? event;



Slip 3: state table

current input next FF inputs output

A(t) B(t) ~~A(t+1)~~ x

current state A(t)	B(t)	input x	next A(t+1)	B(t+1)	FF inputs DA	DB
S_0	0	0	0	0	0	0
	0	1	0	1	0	1
S_1	0	1	0	1	0	1
	0	1	1	0	1	0
S_2	1	0	0	1	1	0
	1	0	1	1	1	1
S_3	1	1	0	1	1	1
	1	1	1	0	0	0

for D-FF

DA = ?

DB = ?

DA(A,B,x) = ?

DB(A,B,x) = ?

FF-input circuit is a combinational circuit and it drives the FF

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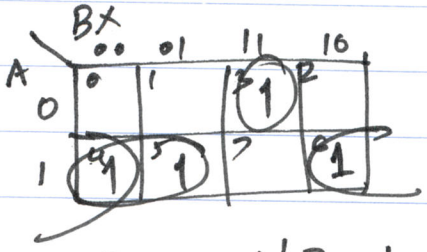
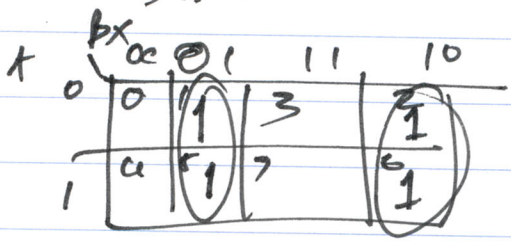
$DA(A, B, x) = ? = \Sigma(3, 4, 5, 6)$

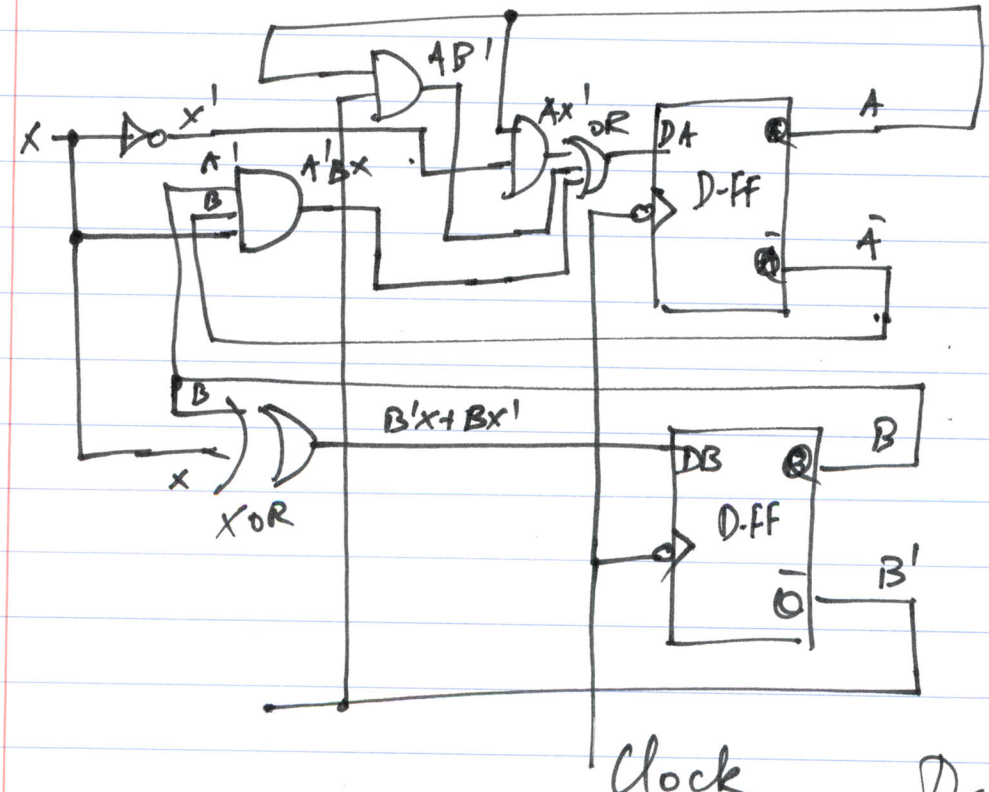
$DB(A, B, x) = ? = \Sigma(1, 2, 5, 6)$



$DA = A'Bx + AB' + Ax'$



$DB = B'x + Bx'$



Done

Problem #2: April 3, 2017

Repeat combi design {0, 1, 2, 3} with JK-FF.

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

2 FF — 2 JK FF

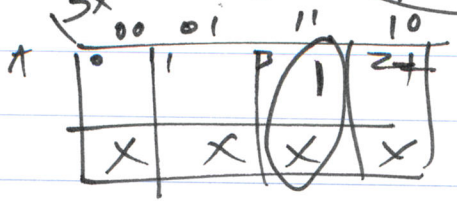
State diagram is same

State table.

Q(t)	Q(t+1)	J K
0	0	0 x
0	0	0 1
0	1	1 x
0 →	1	1 1
1	0	x 1
1 →	0	1 1
1	1	x 0
		1 0

Current state input next state. FF inputs

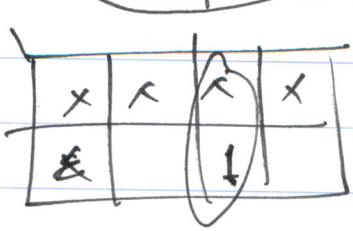
	A(t)	B(t)	x	A(t+1)	B(t+1)	JA	KA	JB	KB
S0	0	0	0	0	0	0	x	0	x
	0	0	1	0	1	0	x	1	x
S1	0	1	0	0	1	0	x	x	0
	0	1	1	1	0	1	x	x	1
S2	1	0	0	1	0	x	0	0	x
	1	0	1	1	1	x	0	1	x
S3	1	1	0	1	1	x	0	x	0
	1	1	1	0	0	x	1	x	1



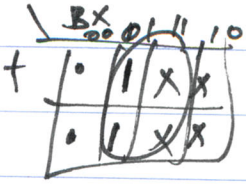
$JA = \Sigma(3)$

$d = \Sigma(4,5,6,7)$

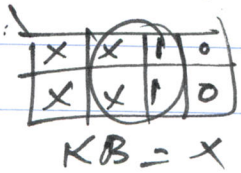
$JA = Bx$



$KA = Bx$



$JB = x$



$KB = x$

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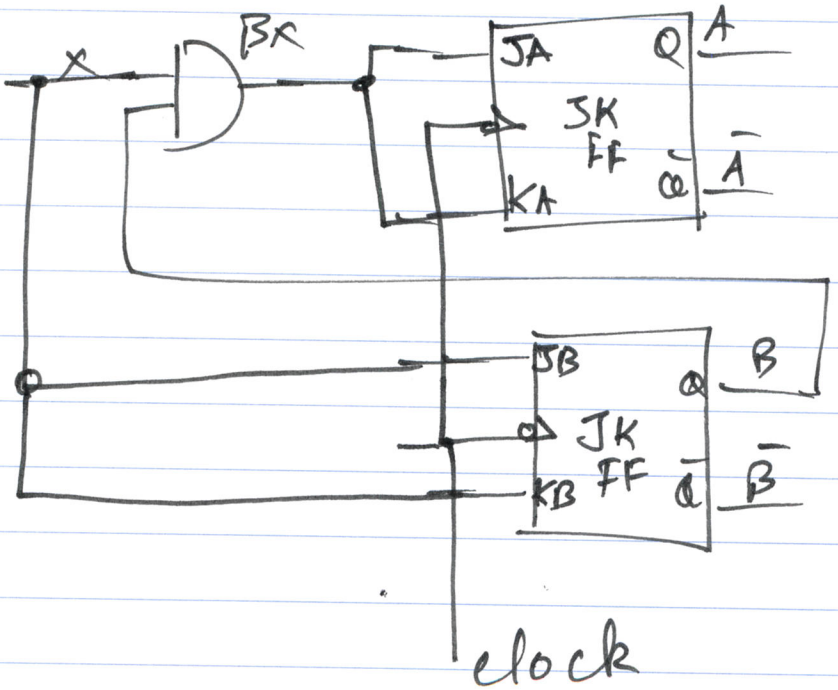
final answer for counter design: {0, 1, 2, 3}



Problem: Analyze This!