Note Title 4/22/2009

CSCE 211, Homework Assignment #6

due Monday, April 27

Exercises 1 and 3 only!

Instructions

- Show all your steps--answers alone are not sufficient.
- Homework must be done neatly.
- Use straight-edged paper (no notebook tear-outs with ragged edges).
- Please STAPLE papers to a signed cover sheet.

Homework Problems: Please use a straight edge to make your diagrams neat. For all timing diagrams, show important edges (falling or rising depending on the flip-flip).

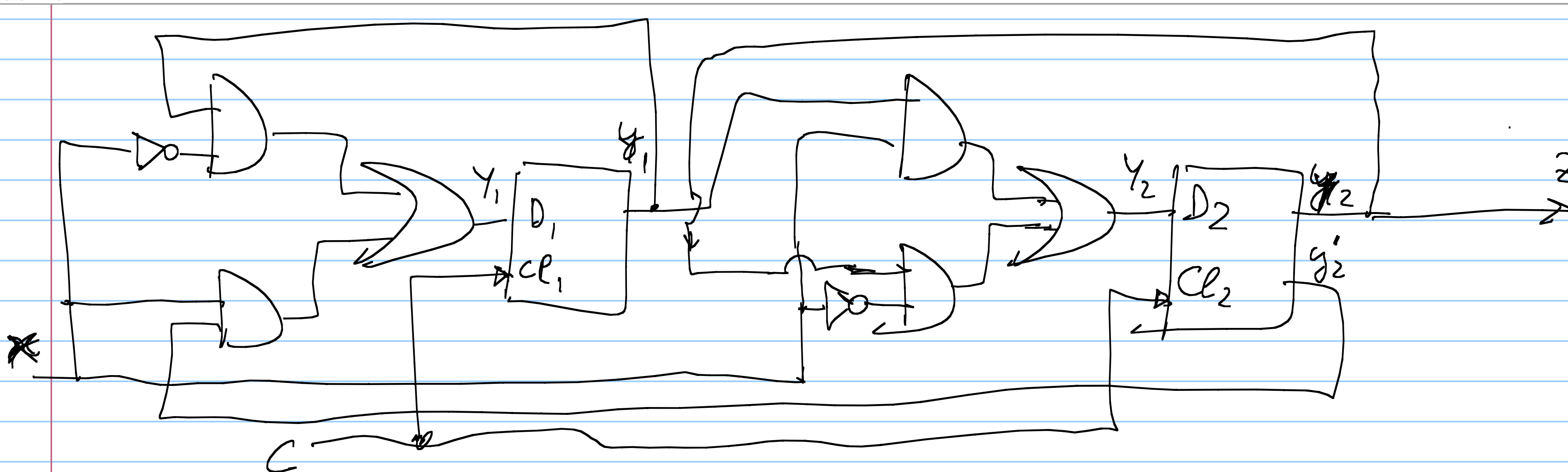
1. Problem 11.7, which is a rising-edge J-K flip-flop. Use Q = 0 initially. An easy way is to draw a vertical line at each rising edge and read the values for J and K. These values tell what to do: HOLD, RESET, SET, or TOGGLE. (25points)

2. Problem 11.12 (a). Start in the Set state (Q=1) and S=R=0. Keep S = 0 and change R from 0 to 1. Show the changes in the circuit. Use a separate diagram to show the changes as R is returned "0." Use two separate diagrams to keep your work neat. Omit showing the symmetric changes for the S signal. (25 points)

3. Programmed exercise 13.1, parts (a) – (i). For part (a), confirm the algebraic equations. For part (b), use the author's K-maps for A+, B+, and Z; then and fill in each map for X=0 substituted in the equation for the left columns and X=1 for the right columns. For part (i), simply identify the false outputs on the timing diagram of part (h). (25 points)

4. For the Moore machine example of Page 397 ("101" detector), convert State Table 14-4 to a "pseudo truth table" with K-map numbering order. (Use S2=11 and S3=10). Then design the circuit using a T flip-flip for state variable A, and a J-K flip-flop for state variable B. Draw the circuit after K-map simplifications for the flip-flop inputs. (25 points)

Note Title 4/21/2009



1. Determine (a) flip-flop input equations and (b) circuit output equation(s)

$D_1 = x'y_1 + xy_2'$

$D_2 = xy_1 + x'y_2$

$z = y_2$ ——— output equation for the whole sequential circuit

2. Determine the next-state equations for each flip-flop, using the characteristic equation of the flip-flops used. In this case, we use a D flip-flop, for which $Q^+ = D$ (13-1).

3. The next-state equations are the same as the input equations:

$$y_1^+ = x' y_1 + x y_2'$$

$$y_2^+ = x y_1 + x' y_2$$

(In more complicated cases, this may require using K-maps)

4. Derive transition table and output table

$y_1 y_2 \backslash x$	0	1
00	00, 0	10, 0
01	01, 1	00, 1
11	11, 1	01, 1
10	10, 0	11, 0

y_1^+, y_2^+, z

, or, in a different form

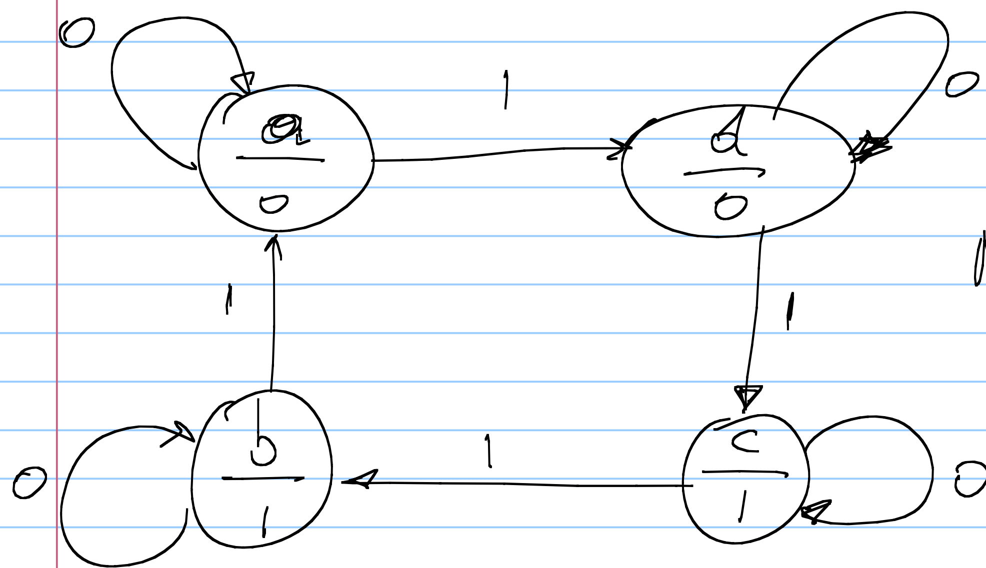
$y_1 y_2$	$y_1^+ y_2^+$ $x=0$	$x=1$	Z
00	00	10	0
01	01	00	1
11	11	01	1
10	10	11	0

In this case, Z depends on the current state only:
we have a Moore machine

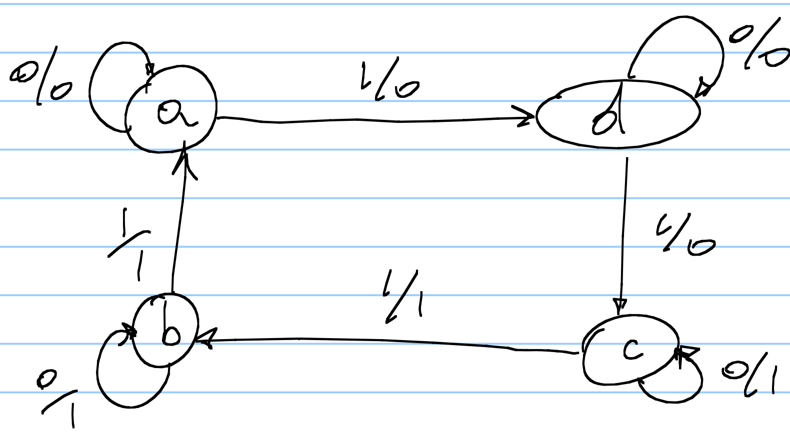
We can abstract the state of the flip-flops into a single variable:

Present state	Next State $x=0$	$x=1$	Present Output
a	a	d	0
b	b	a	1
c	c	b	1
d	d	c	0

The last table can be represented as a graph, the state graph

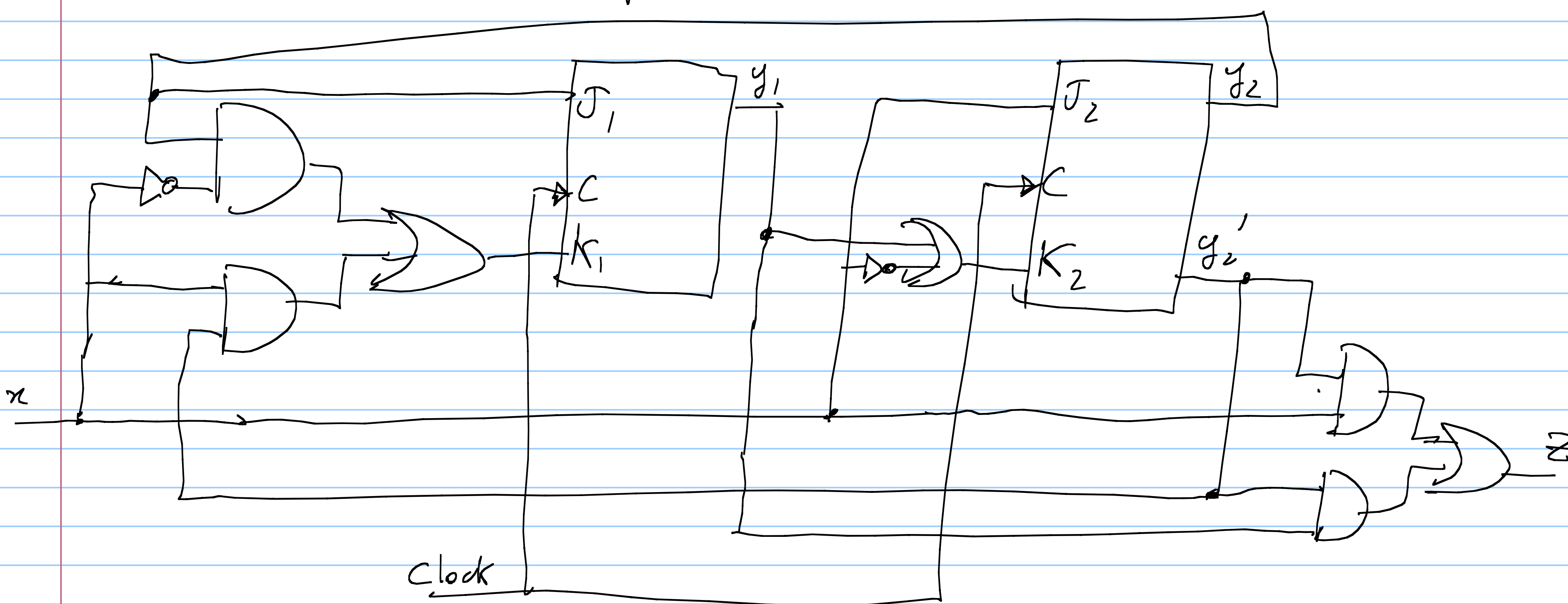


Moore state graph



Mealy state graph

A Mealy machine example



Flip-flop input equations:

$J_1 = y_2$ $\qquad$ $J_2 = x$

$K_1 = x'y_2 + xy_2'$ $\qquad$ $K_2 = y_1 + x'$

Output equation:

$z = xy_2' + y_1y_2'$

In tabular form,

$y_1 y_2$ \ x	0	1
00	00, 01	01, 10
01	11, 01	10, 10
11	11, 01	10, 11
10	00, 01	01, 11

$J_1 K_1, J_2 K_2$

Together with the next-state (characteristic) equation for the J-K flip-flop, $Q^+ = JQ' + K'Q$ (13-5), one obtains the following transition table and output table

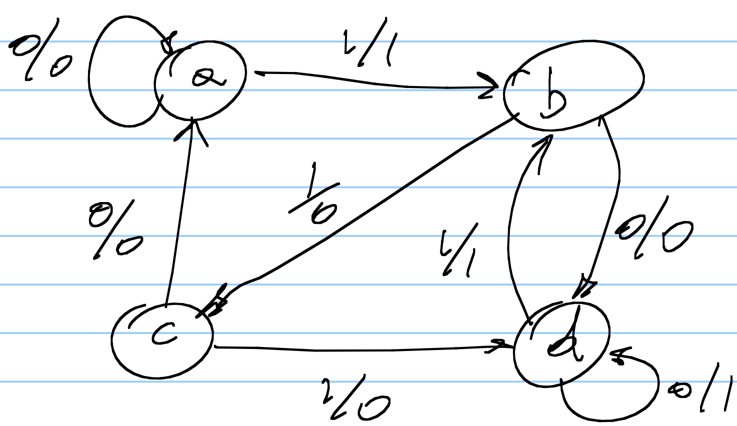
$Y_1 Y_2, Z$

$y_1 y_2$	$x=0$	$x=1$
0 0	00, 0	01, 1
0 1	10, 0	11, 0
1 1	00, 0	10, 0
1 0	10, 1	01, 1

The transition table can be abstracted to a state table:

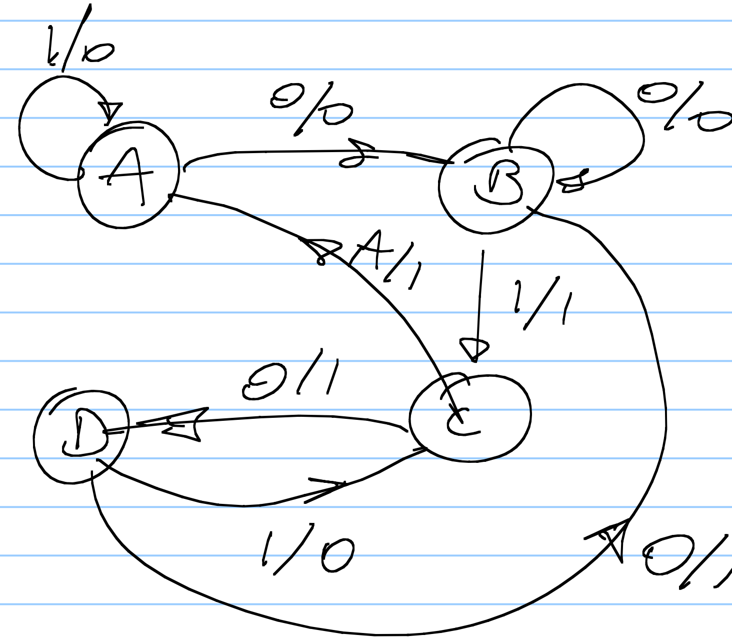
Present state	Next state, Next Output $x=0$	$x=1$
a	a, 0	b, 1
b	d, 0	c, 0
c	a, 0	d, 0
d	d, 0	b, 1

The state table can be represented as a Mealy state graph:

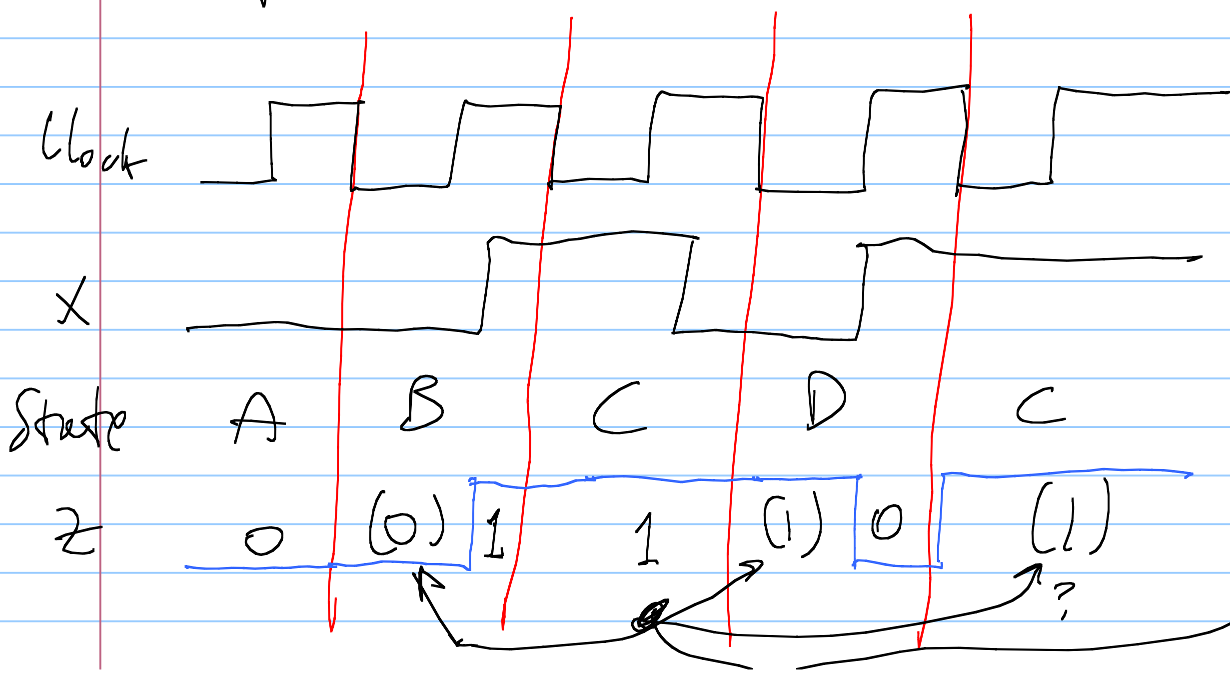


Q 10

S	X=0	X=1
	Next State (S+) / Present Output (Z)	
A	B/0	A/0
B	B/0	C/1
C	D/1	A/1
D	B/1	C/0



Mealy state graph



The outputs are read just before the active edge of the clock

false outputs (glitches and spikes) are typical of Mealy machines