

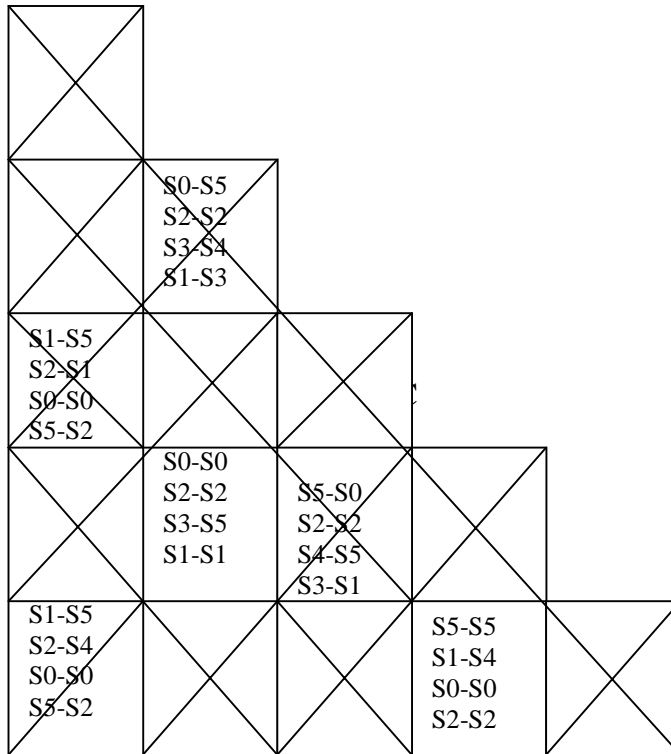
University of California at Berkeley  
 College of Engineering  
 Department of Electrical Engineering and Computer Science

EECS 150  
 Fall 2000

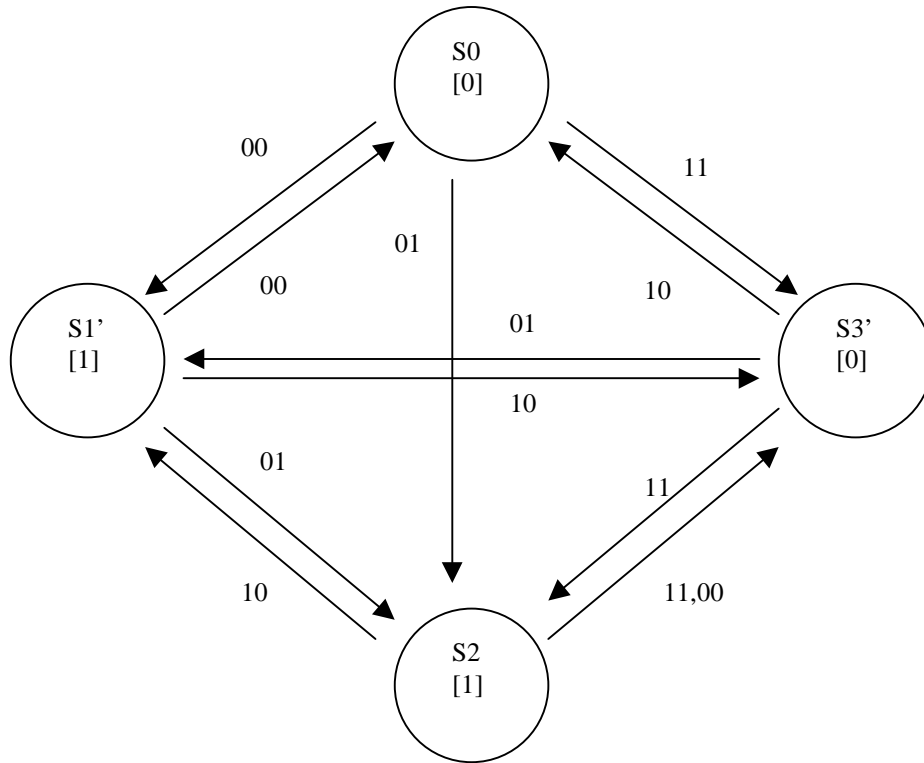
R. H. Katz

**Problem Set # 6 Solution**

3)



current state		next state		output	
CS	NS				OUT
0	1'	2	0	3	0
1'	0	2	3	1'	1
2	3'	2	1'	3'	1
3'	3'	1'	0	2	0



4a)

Current states		Inputs		Next states		Output
S1	S0	IN1	IN0	N1	N0	OUT
0	0	0	0	0	0	0
		0	1	0	1	1
		1	0	1	1	0
		1	1	1	0	1
0	1	0	0	0	1	0
		0	1	0	0	0
		1	0	0	1	0
		1	1	1	0	1
1	0	0	0	0	0	0
		0	1	1	1	0
		1	0	1	1	0
		1	1	1	0	1
1	1	0	0	0	0	0
		0	1	0	1	0
		1	0	0	1	0
		1	1	1	0	1

S1 S0		Output				
		IN1 IN0	00	01	11	10
00	00	00	0	0	0	0
		01	1	0	0	0
01	01	10	1	1	1	1
		11	0	0	0	0

S1 S0 IN1 IN0		N1			
		00	01	11	10
00		0	0	0	0
01		0	0	0	1
11		1	1	1	1
10		1	0	0	1

S1 S0 IN1 IN0		N2			
		00	01	11	10
00		0	1	0	0
01		1	0	1	1
11		0	0	0	0
10		1	1	1	1

$$N1 = In1In0 + S0'In1 + S1S0'In0$$

$$N2 = In1In0' + S1'S0In0' + S0'In1'In0 + S1 In1'In0$$

$$Out = In1In0 + S1'S0'In0$$

4b)

S3	S2	S1	S0	IN1	IN0	N3	N2	N1	N0	OUT
1	0	0	0	0	0	1	0	0	0	0
				0	1	0	1	0	0	1
				1	0	0	0	0	1	0
				1	1	0	0	1	0	1
0	1	0	0	0	0	0	1	0	0	0
				0	1	1	0	0	0	0
				1	0	0	1	0	0	0
				1	1	0	0	1	0	1
0	0	1	0	0	0	1	0	0	0	0
				0	1	0	0	0	1	0
				1	0	0	0	0	1	0
				1	1	0	0	1	0	1
0	0	0	1	0	0	1	0	0	0	0
				0	1	0	1	0	0	0
				1	0	0	1	0	0	0
				1	1	0	0	1	0	1

S3 S2 S1 S0		IN1 IN0			
		00	01	11	10
00		X	0	X	0
01		0	X	X	X
11		X	X	X	X
10		0	X	X	X

S3 S2 S1 S0		IN1' IN0			
		00	01	11	10
00		X	1	X	0
01		0	X	X	X
11		X	X	X	X
10		0	X	X	X

S3 S2		IN1 IN0'			
		00	01	11	10
S1 S0	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

		IN1' IN0'			
		00	01	11	10
	00	X	0	X	1
	01	1	X	X	X
	11	X	X	X	X
	10	1	X	X	X



$$N3 = In0In1'S2S3' + In0'In1'S2'$$

S3 S2		IN1 IN0			
		00	01	11	10
S1 S0	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

		IN1' IN0			
		00	01	11	10
	00	X	0	X	1
	01	1	X	X	X
	11	X	X	X	X
	10	0	X	X	X

S3 S2		IN1 IN0'			
		00	01	11	10
S1 S0	00	X	1	X	0
	01	1	X	X	X
	11	X	X	X	X
	10	0	X	X	X

		IN1' IN0'			
		00	01	11	10
	00	X	1	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X



$$N2 = In0'S2S3' + In1'In0S1'S2' + In0'In1S2$$

S3 S2		IN1 IN0			
		00	01	11	10
S1 S0	00	X	1	X	1
	01	1	X	X	X
	11	X	X	X	X
	10	1	X	X	X

		IN1' IN0			
		00	01	11	10
	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

S3 S2		IN1 IN0'			
		00	01	11	10
S1 S0	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

		IN1' IN0'			
		00	01	11	10
	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

↑  $N1 = In0In1$

S3 S2		IN1 IN0			
		00	01	11	10
S1 S0	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

		IN1' IN0			
		00	01	11	10
	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	1	X	X	X

S3 S2		IN1 IN0'			
		00	01	11	10
S1 S0	00	X	0	X	1
	01	0	X	X	X
	11	X	X	X	X
	10	1	X	X	X

		IN1' IN0'			
		00	01	11	10
	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

↑  $N0 = In0In1'S1 + In0'In1S0'S2'$

S3 S2		IN1 IN0			
		00	01	11	10
S1 S0	00	X	1	X	1
	01	1	X	X	X
	11	X	X	X	X
	10	1	X	X	X

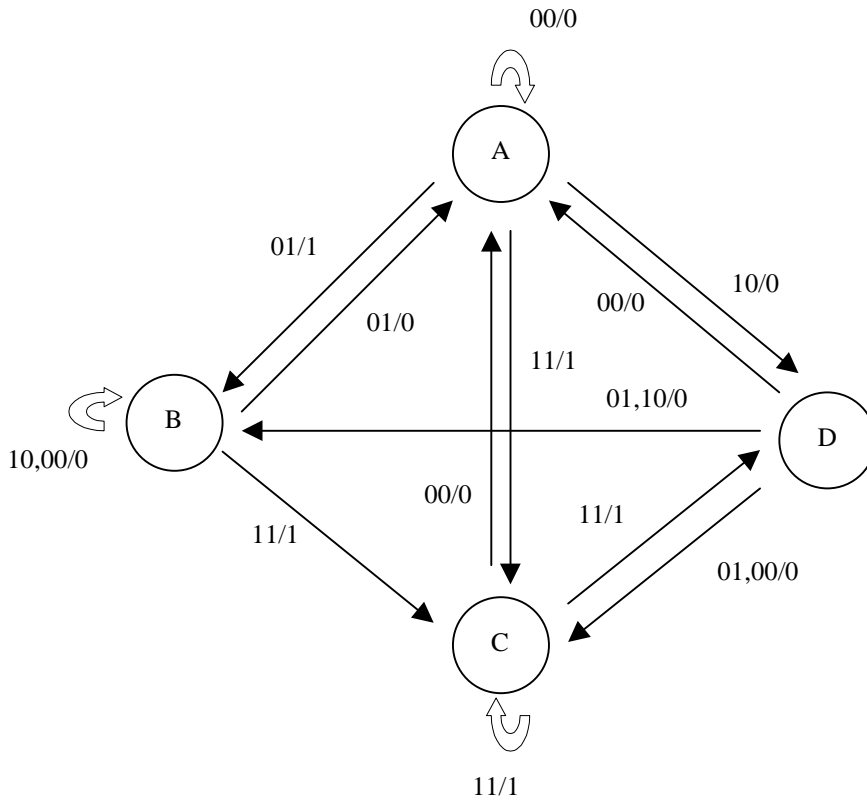
		IN1' IN0			
		00	01	11	10
	00	X	0	X	1
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

S3 S2		IN1 IN0'			
		00	01	11	10
S1 S0	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

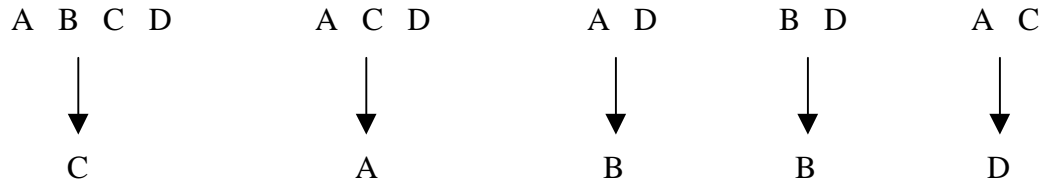
		IN1' IN0'			
		00	01	11	10
	00	X	0	X	0
	01	0	X	X	X
	11	X	X	X	X
	10	0	X	X	X

↑  $Out = In0In1 + In0S3$

4c)



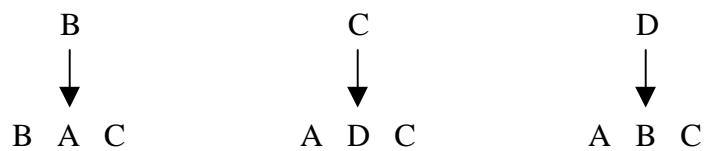
Same next states:



States with same ancestor state:



Same output:



From the above priority, A and C have the highest priority and should be placed next to each other in state assignment. Next, C and D should be placed adjacently. As follows:

A = 00		0	1
B = 10	0	A	C
C = 01			
D = 11	1	B	D

4d)

For this state assignment, it turns out it will give me the same complexity as the sequential implementation. For larger circuits, heuristic may get simpler implementation according to the priority approach.