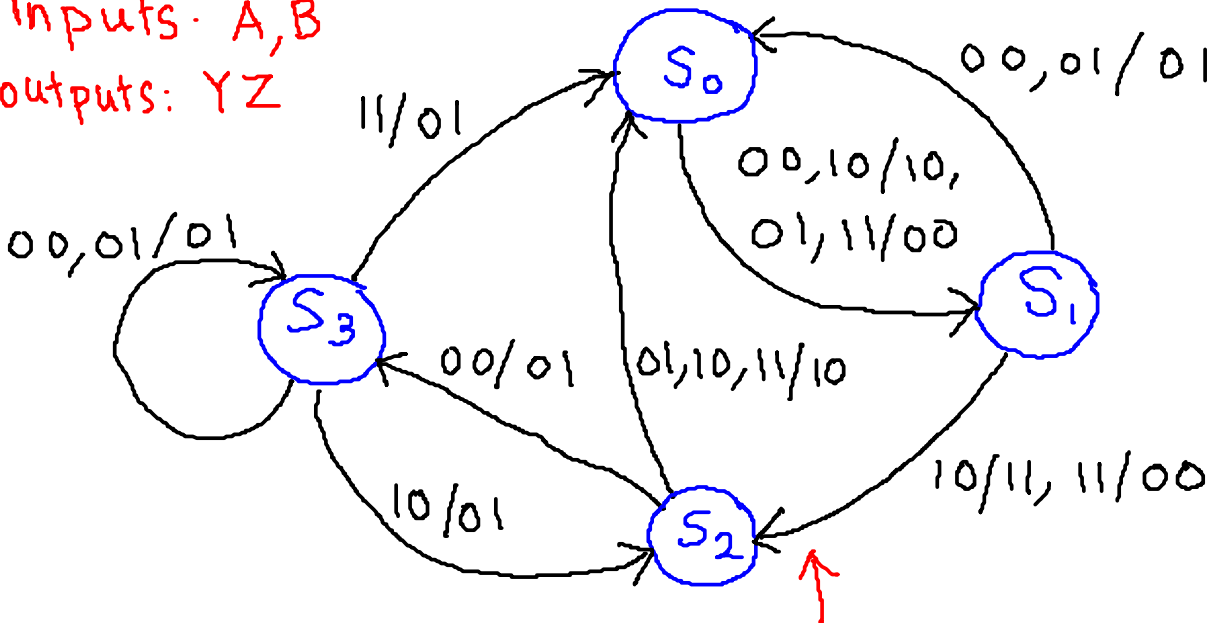


# 5-7 State-Machine Diagrams

Inputs: A, B  
 outputs: YZ

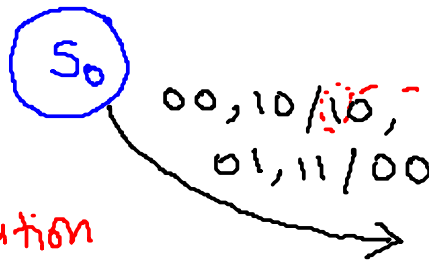


State Diagram

Convert to State Machine Diagram

Defaults: Y=0, Z=0

S<sub>0</sub>:



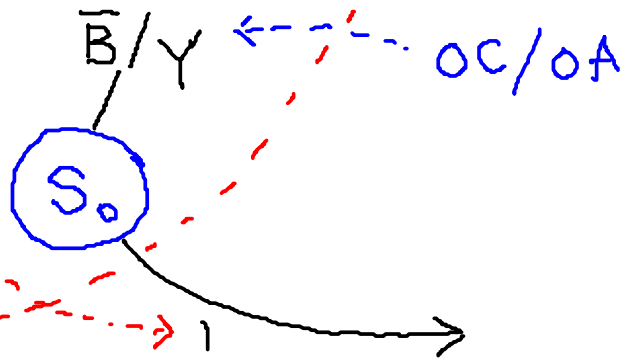
TC: Transition Condition

$$00, 10, 01, 11$$

$$\bar{A}\bar{B} + A\bar{B} + \bar{A}B + AB$$

$$= 1$$

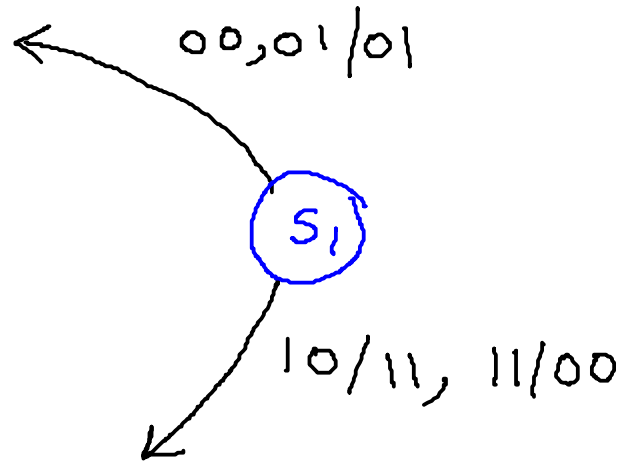
OC: Output condition



$$\rightarrow Y=1 \quad 00, 10 \rightarrow \bar{A}\bar{B} + A\bar{B} = (\bar{A}+A)\bar{B} = \bar{B}$$

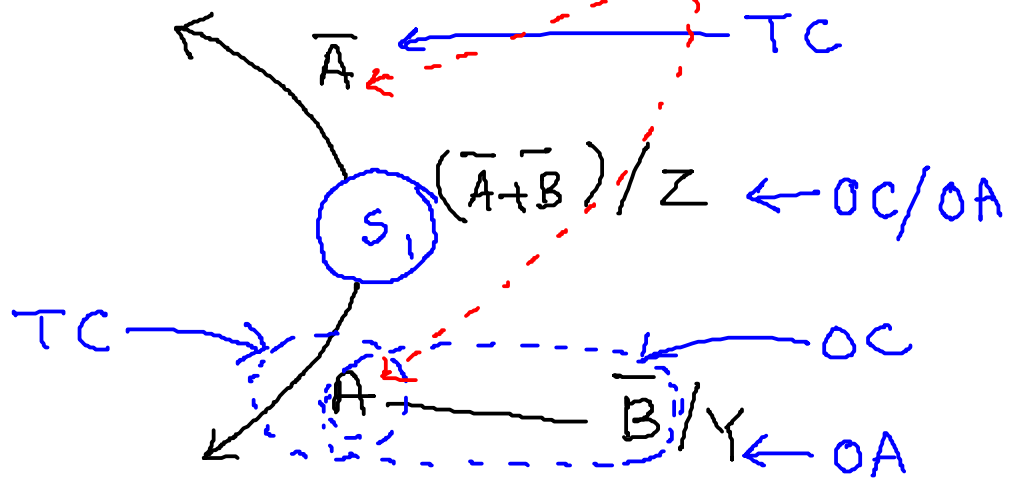
OA: output action Y

S1.



TC:  $00, 01 \rightarrow \bar{A}\bar{B} + \bar{A}B = \bar{A}(\bar{B} + B) = \bar{A}$

$10, 11 \rightarrow A\bar{B} + AB = A(\bar{B} + B) = A$



OC:  $Z=1 \quad 00, 01, 10 \rightarrow \bar{A}\bar{B} + \bar{A}B + A\bar{B}$

$= \bar{A}(\bar{B} + B) + A\bar{B} = \bar{A} + A\bar{B}$

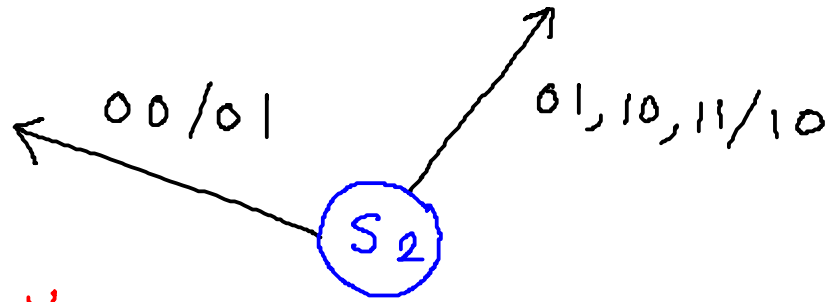
$= (\bar{A} + A)(\bar{A} + \bar{B}) = \bar{A} + \bar{B}$

OA:  $Z$

OC:  $Y=1 \quad 10 \rightarrow A\bar{B}$

OA:  $Y$

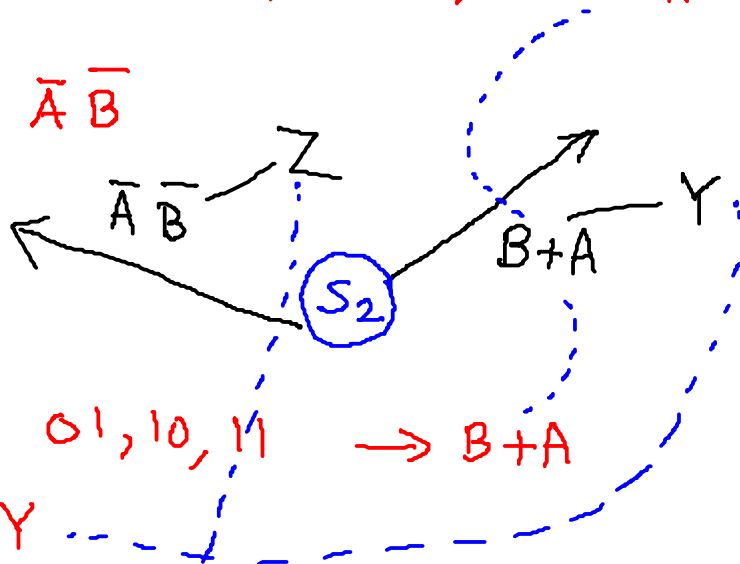
$S_2$



TC: 01, 10, 11

$$\begin{aligned} \bar{A}B + A\bar{B} + AB &= \bar{A}B + A(\bar{B} + B) \\ &= \bar{A}B + A = (\bar{A} + A)(B + A) = B + A \end{aligned}$$

00  $\rightarrow$   $\bar{A}\bar{B}$



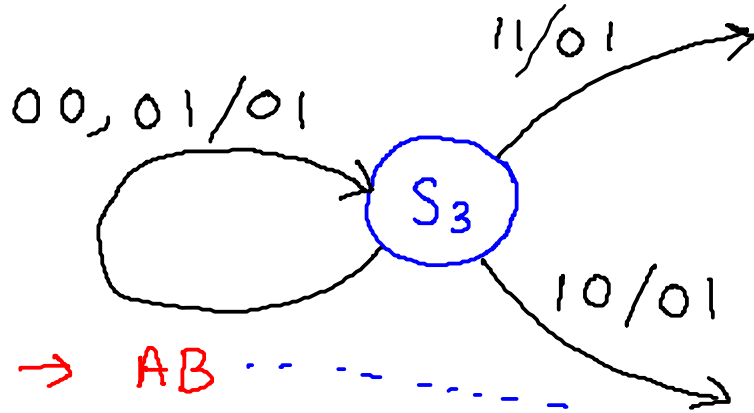
$Y=1$  OC: 01, 10, 11  $\rightarrow$   $B+A$

OA: Y

$Z=1$  OC: 00  $\rightarrow$   $\bar{A}\bar{B}$

OA = Z

$S_3$



TC:  $11 \rightarrow AB$

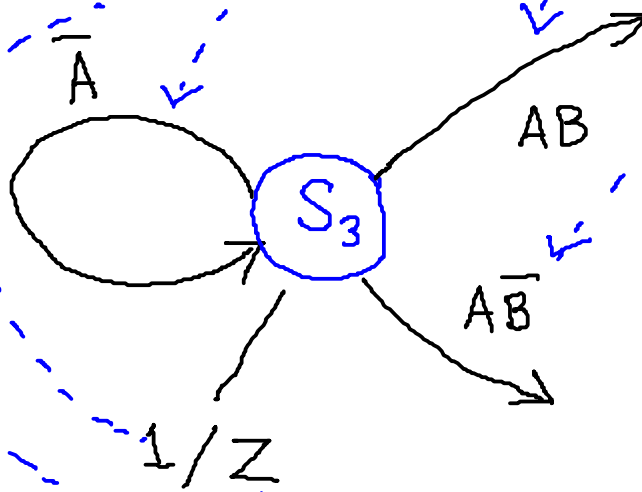
$00, 01 \rightarrow \bar{A}\bar{B} + \bar{A}B = \bar{A}$

$10 \rightarrow A\bar{B}$

OC:  $Z=1 \quad 00, 01, 10, 11$

$\rightarrow \bar{A}\bar{B} + \bar{A}B + A\bar{B} + AB = 1$

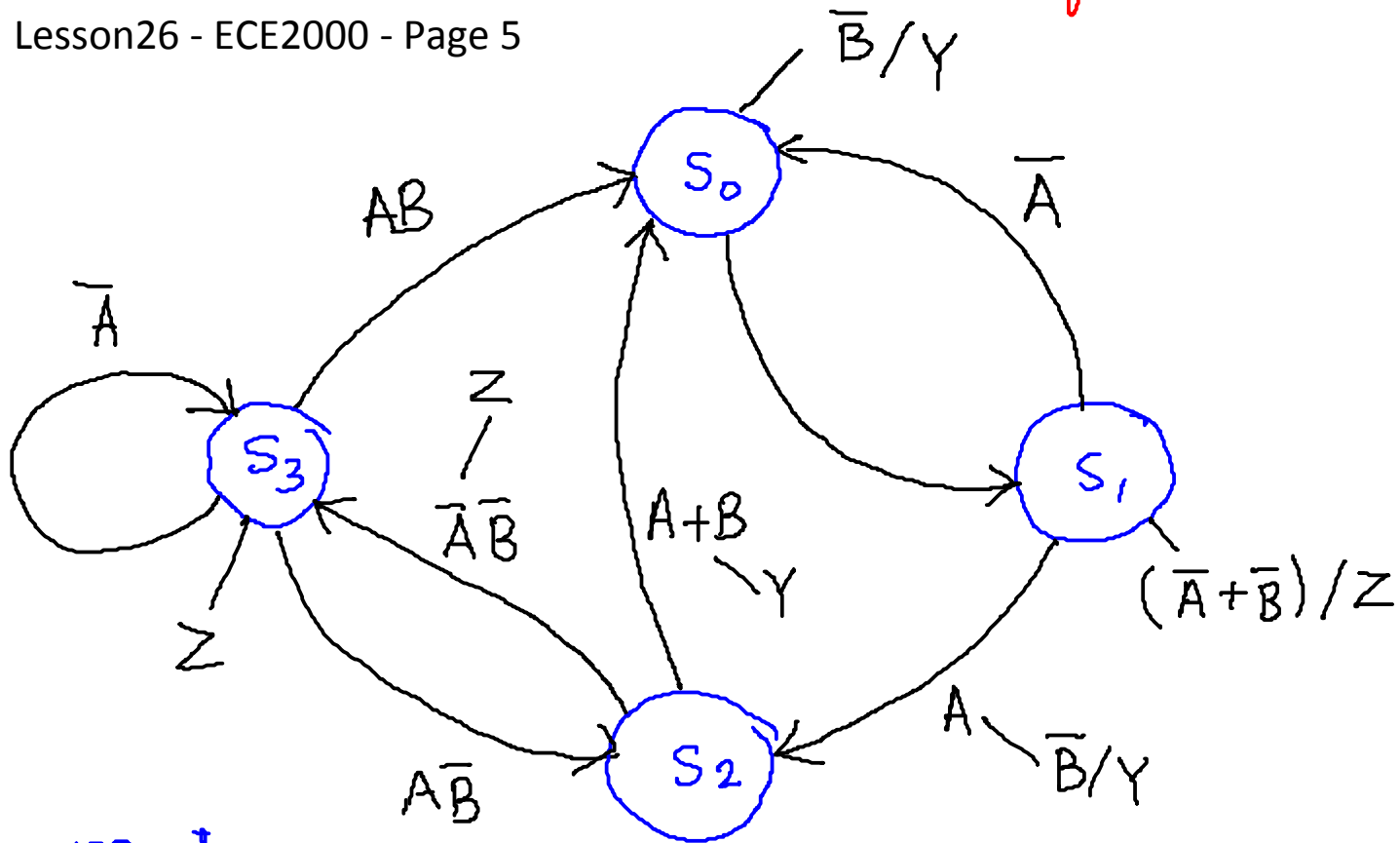
OA Z



note.  $1/Z \rightarrow Z$

# State-Machine Diagram

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current state	A	B	next state	Y	Z
S <sub>0</sub>	0	0	S <sub>1</sub>	1	0
S <sub>0</sub>	0	1	S <sub>1</sub>	0	0
S <sub>0</sub>	1	0	S <sub>1</sub>	1	0
S <sub>0</sub>	1	1	S <sub>1</sub>	0	0
S <sub>1</sub>	0	0	S <sub>0</sub>	0	1
S <sub>1</sub>	0	1	S <sub>0</sub>	0	1
S <sub>1</sub>	1	0	S <sub>2</sub>	1	1
S <sub>1</sub>	1	1	S <sub>2</sub>	0	0
S <sub>2</sub>	0	0	S <sub>3</sub>	0	1
S <sub>2</sub>	0	1	S <sub>0</sub>	1	0
S <sub>2</sub>	1	0	S <sub>0</sub>	1	0
S <sub>2</sub>	1	1	S <sub>0</sub>	1	0
S <sub>3</sub>	0	0	S <sub>3</sub>	0	1
S <sub>3</sub>	0	1	S <sub>3</sub>	0	1
S <sub>3</sub>	1	0	S <sub>3</sub>	0	1

$S_3$   
 $S_3$   
 $S_3$

0  
1  
1

1  
0  
1

$S_3$   
 $S_2$   
 $S_0$

0  
0  
0

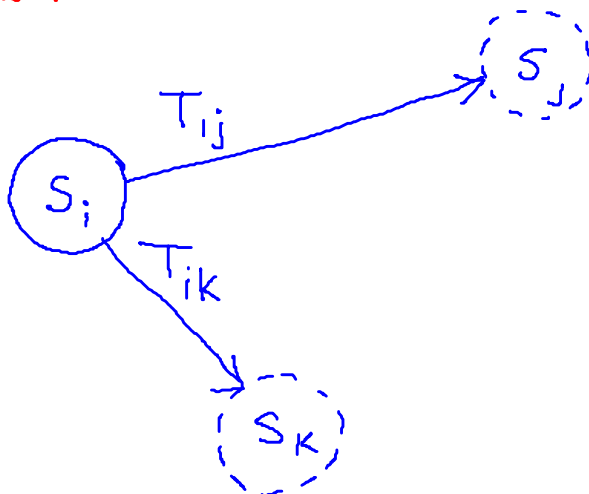
—  
—  
—

### Constraints on input conditions

Transition conditions:

Visit each state

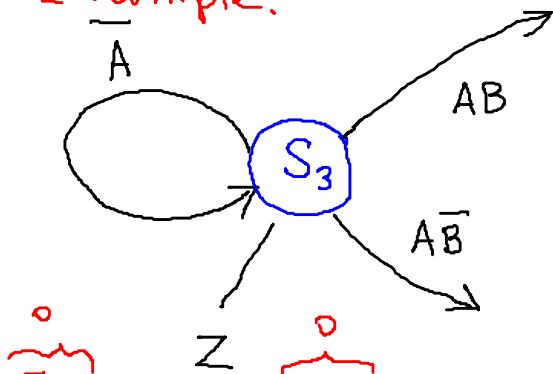
visiting state  $S_i$



show  $T_{ij} T_{ik} = 0$  for all pairs of transitions for the state  $S_i$

no two transition conditions should simultaneously evaluate to 1

Example:



A	B	$\bar{B}$	AB	$\bar{A}\bar{B}$	$\bar{A}$
0	0	1	0	0	1
0	1	0	0	0	1
1	0	1	0	1	0
1	1	0	1	0	0

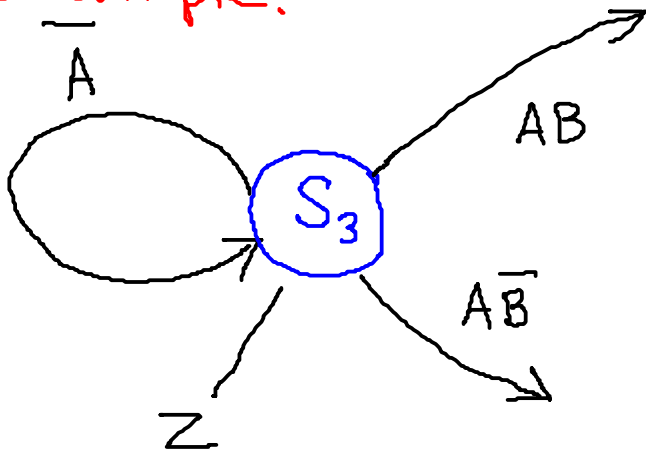
$\bar{A}AB = 0$      $\bar{A}A\bar{B} = 0$      $ABA\bar{B} = 0$      $ABB\bar{B} = 0$

For the state you are visiting

$$\sum_{\substack{i,j \\ \text{fixed}}} T_{ij} = 1$$

If this condition is not satisfied then there are some input combinations for which the state-machine diagram does not indicate any state transition

Example:



$$\bar{A} + AB + A\bar{B} = \bar{A} + A(B + \bar{B}) = \bar{A} + A = 1$$