

Princeton University

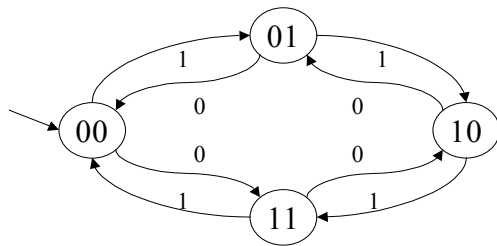
COS 217: Introduction to Programming Systems

A Two-Bit Counter Circuit

Description

The circuit should have one input and two flip flops. If the input is 1, then increment the two-digit binary number represented by the flip flops. If the input is 0, then decrement that binary number.

State Machine



Truth Table

A	B	x	next A	next B
0	0	0	1	1
0	1	0	0	0
1	0	0	0	1
1	1	0	1	0
0	0	1	0	1
0	1	1	1	0
1	0	1	1	1
1	1	1	0	0

Boolean Expressions:

$$\text{next A} = (\sim A \ \& \ \sim B \ \& \ \sim x) \ | \ (\sim A \ \& \ B \ \& \ x) \ | \ (A \ \& \ \sim B \ \& \ x) \ | \ (A \ \& \ B \ \& \ \sim x)$$

$$\text{next B} = (\sim A \ \& \ \sim B \ \& \ \sim x) \ | \ (\sim A \ \& \ \sim B \ \& \ x) \ | \ (A \ \& \ \sim B \ \& \ \sim x) \ | \ (A \ \& \ \sim B \ \& \ x)$$

Circuit Description:

```

INPUT x ;
FLIPFLOP A B ;
NEXT A = (\sim A \ \& \ \sim B \ \& \ \sim x) \ | \ (\sim A \ \& \ B \ \& \ x) \ | \ (A \ \& \ \sim B \ \& \ x) \ | \ (A \ \& \ B \ \& \ \sim x) ;
NEXT B = (\sim A \ \& \ \sim B \ \& \ \sim x) \ | \ (\sim A \ \& \ \sim B \ \& \ x) \ | \ (A \ \& \ \sim B \ \& \ \sim x) \ | \ (A \ \& \ \sim B \ \& \ x) ;
  
```

Circuit

(See reverse)