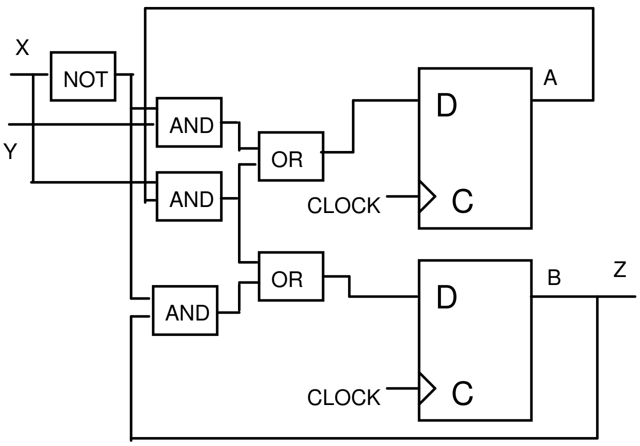
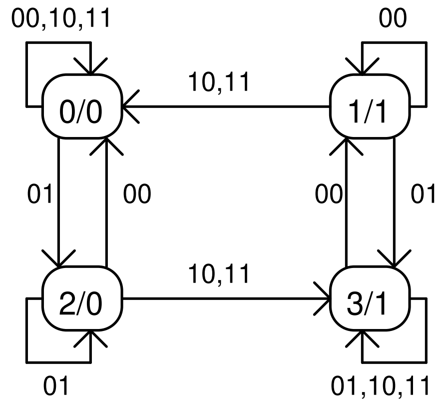
Solution IV

4-12



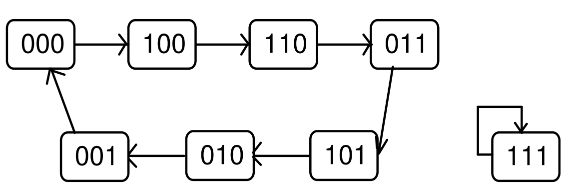


State diagram

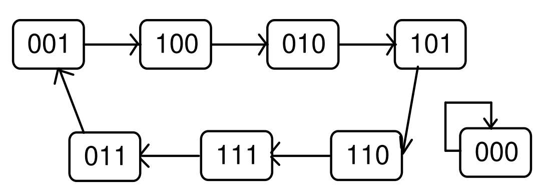
Present state		Inputs		Next State		Output
A	*B*	*X*	*Y*	*A*	*B*	*Z*
0	0	0	0	0	0	0
0	0	0	1	1	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	1	1
0	1	0	1	1	1	1
0	1	1	0	0	0	0
0	1	1	1	0	0	0
1	0	0	0	0	0	0
1	0	0	1	1	0	0
1	0	1	0	1	1	1
1	0	1	1	1	1	1
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

4-13

X = 0



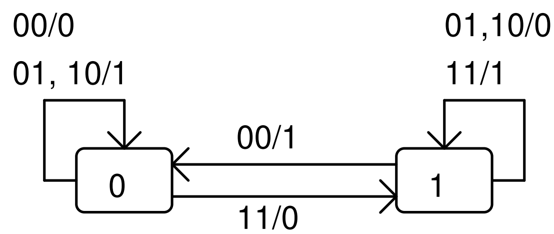
X = 1



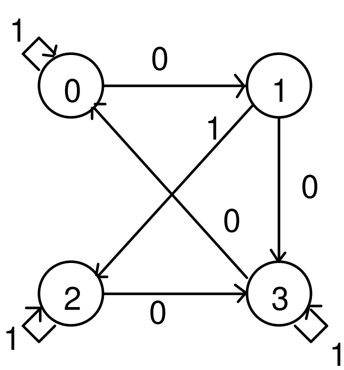
Present state			Input	Next State		
A	*B*	*C*	*X*	*A*	*B*	*C*
0	0	0	0	1	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	1	0	1
0	1	1	0	1	0	1
0	1	1	1	0	0	1
1	0	0	0	1	1	0
1	0	0	1	0	1	0
1	0	1	0	0	1	0
1	0	1	1	1	1	0
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	0	1	1

4-14

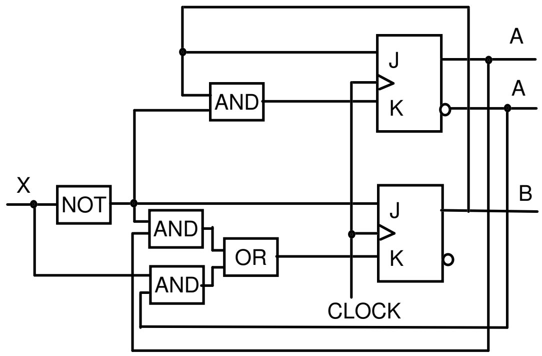
Present state	inputs		Next state	Output
Q	*X*	*Y*	*A*	*A*
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



4-16

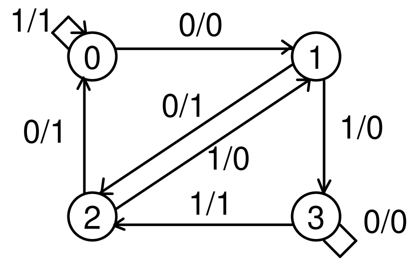


4-17

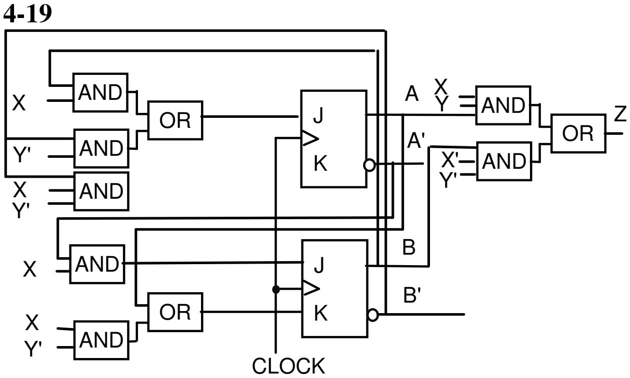


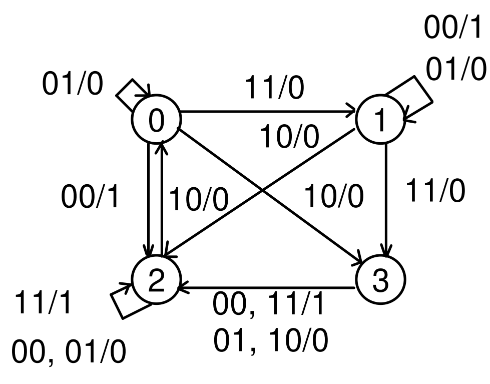
4-18

Present state		Input	Next state		Output
A	*B*	*X*	*A*	*B*	*Y*
0	0	0	0	1	0
0	0	1	0	0	1
0	1	0	1	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	0	1	0	1	0
1	1	0	1	1	0
1	1	1	1	0	1



4-19





Present state		Inputs		Next state		Output
A	*B*	*X*	*Y*	*A*	*B*	*Z*
0	0	0	0	1	0	0
0	0	0	1	0	0	0
0	0	1	0	1	1	0
0	0	1	1	0	1	0
0	1	0	0	0	1	1
0	1	0	1	0	1	0
0	1	1	0	1	0	0
0	1	1	1	1	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	0
1	0	1	1	1	0	1
1	1	0	0	1	0	1
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	1	0	1

4-20

Present state		Input	Next State	
A	*B*	*X*	*A*	*B*
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	1
1	0	0	1	0
1	0	1	0	0
1	1	0	1	1
1	1	1	1	0

$D_A = AX' + BX$

$D_B = BX' + A' X$

4-21

$D_A = AX' + BX$
$D_B = BX + A' X'$
$Y = A' B'$

4-22

$D_A = A' J + AK'$

4-27

$J_A = BX$
$K_A = B'$
$J_B = A' X'$
$K_B = A X'$

4-30

$J_A = E (BX + B' X')$
$K_A = E (BX + B' X')$
$J_B = E$
$K_B = E$

4-31

a) $A = C'$ $B = A$ $C = B$

b) Clear A = RESET Clear B = RESET Clear C = RESET

c) d) e) f)

The circuit is suitable for both a child’s toy and life critical applications. In the case of the child’s toy, it is the cheapest implementation. If an error occurs the child just needs to reset it. In life critical applications the immediate detection of errors is critical. The circuit above produces an invalid code word i.e. an invalid state when an error occurs, thus fault detection is an inherent property of the circuit. Depending on the implementation, however, additional circuitry could be added to detect when the circuit enters one of the invalid stated (Error = A’ BC’ + AB’ C).