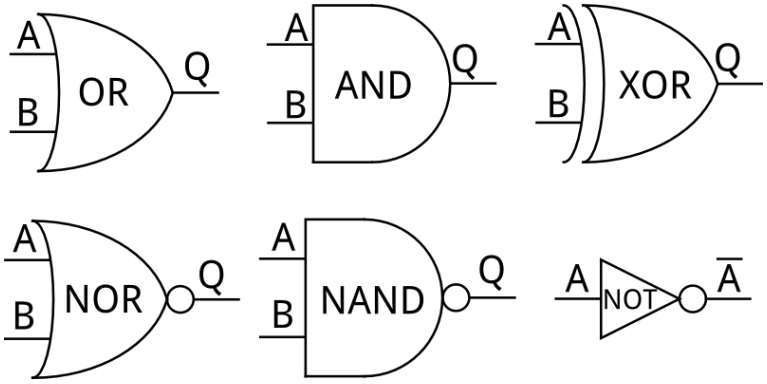
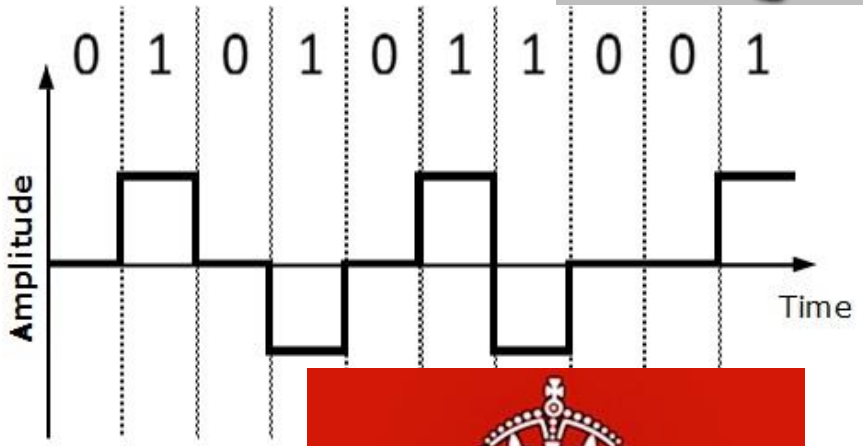
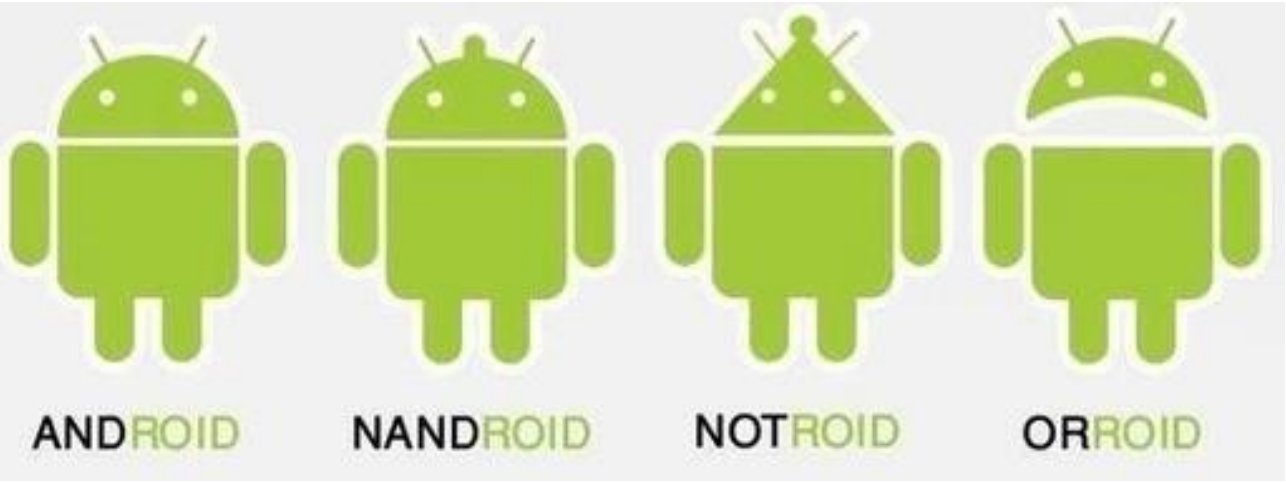
Proiectare Logica

Digital Logic Design

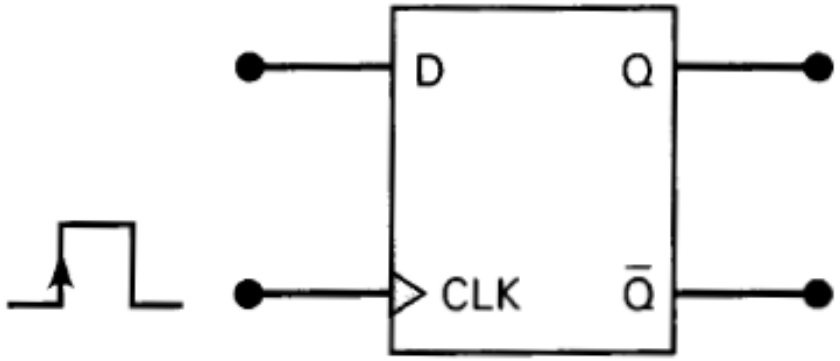
Curs 10





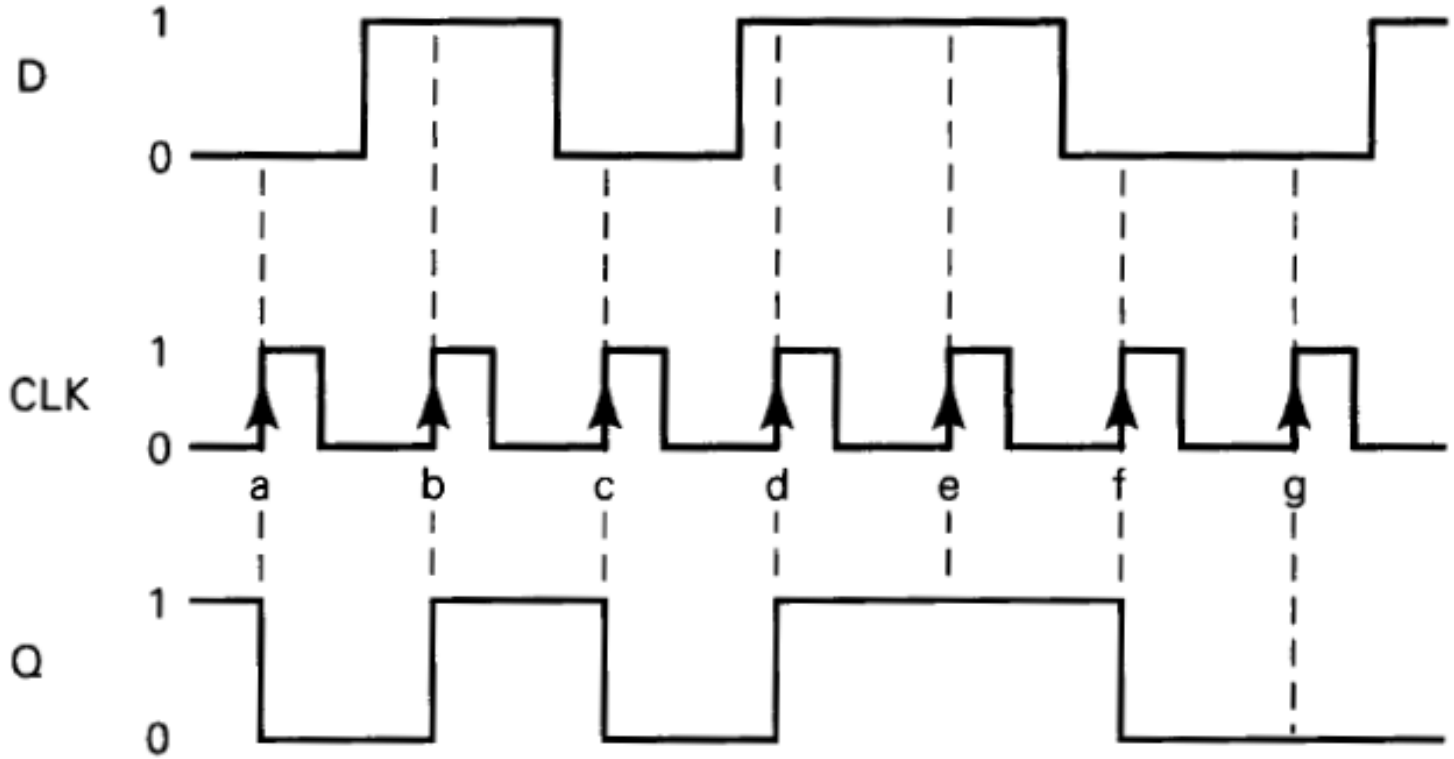


Bistabilul de tip D: *Clocked D Flip-Flop*

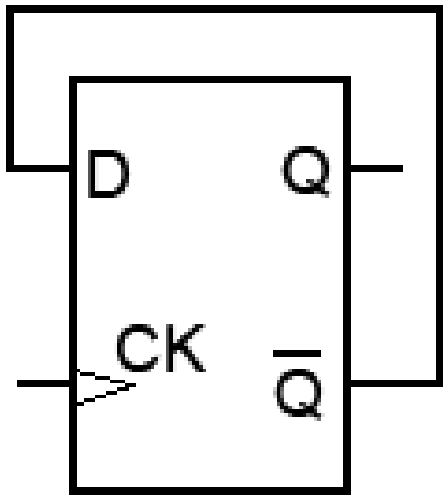


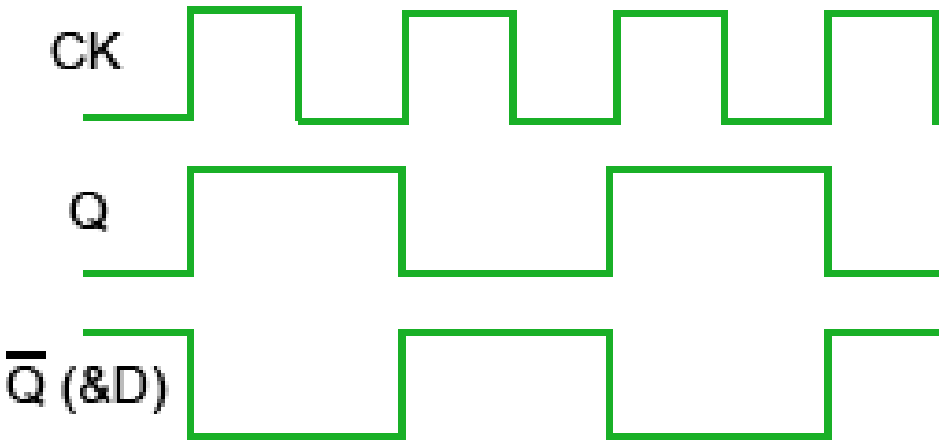
D	CLK	Q
0	↑	0
1	↑	1

(a)

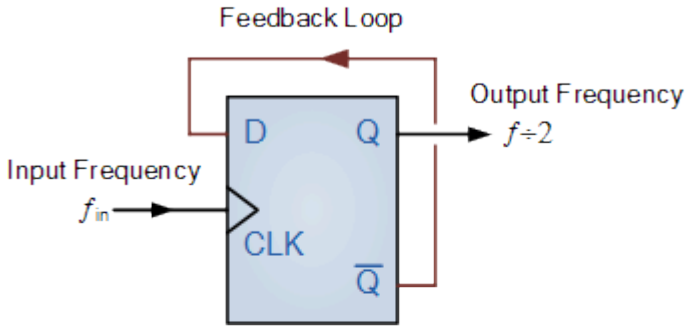


Bistabilul de tip D: *Toggle*

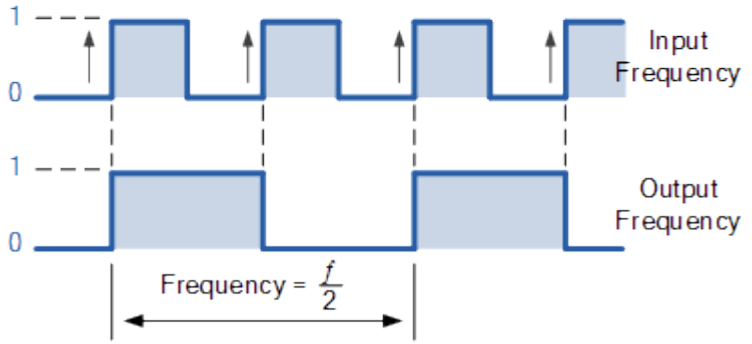




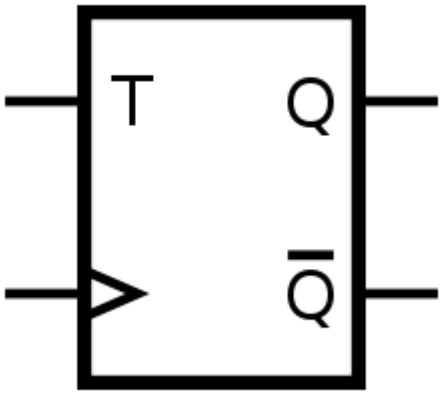
$$D = \overline{Q}$$



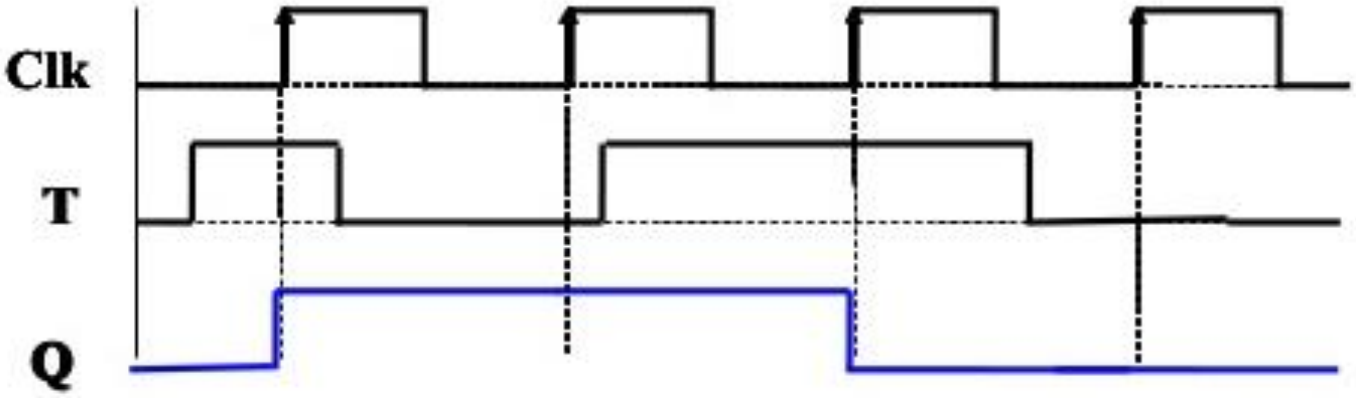
D	CLK	Q
0	↑	0
1	↑	1



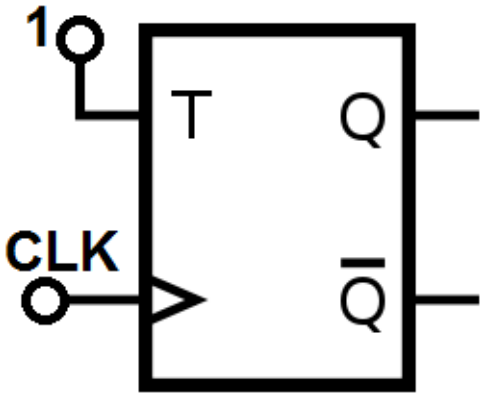
Bistabilul de tip T: *Clocked T Flip-Flop*



Inputs		Outputs		State
CLK	T	$Q_{(n+1)}$	not($Q_{(n+1)}$)	
↓	x	Q_n	not(Q_n)	No Change
0	x	Q_n	not(Q_n)	No Change
1	x	Q_n	not(Q_n)	No Change
↑	0	Q_n	not(Q_n)	No Change
↑	1	not(Q_n)	Q_n	Toggle



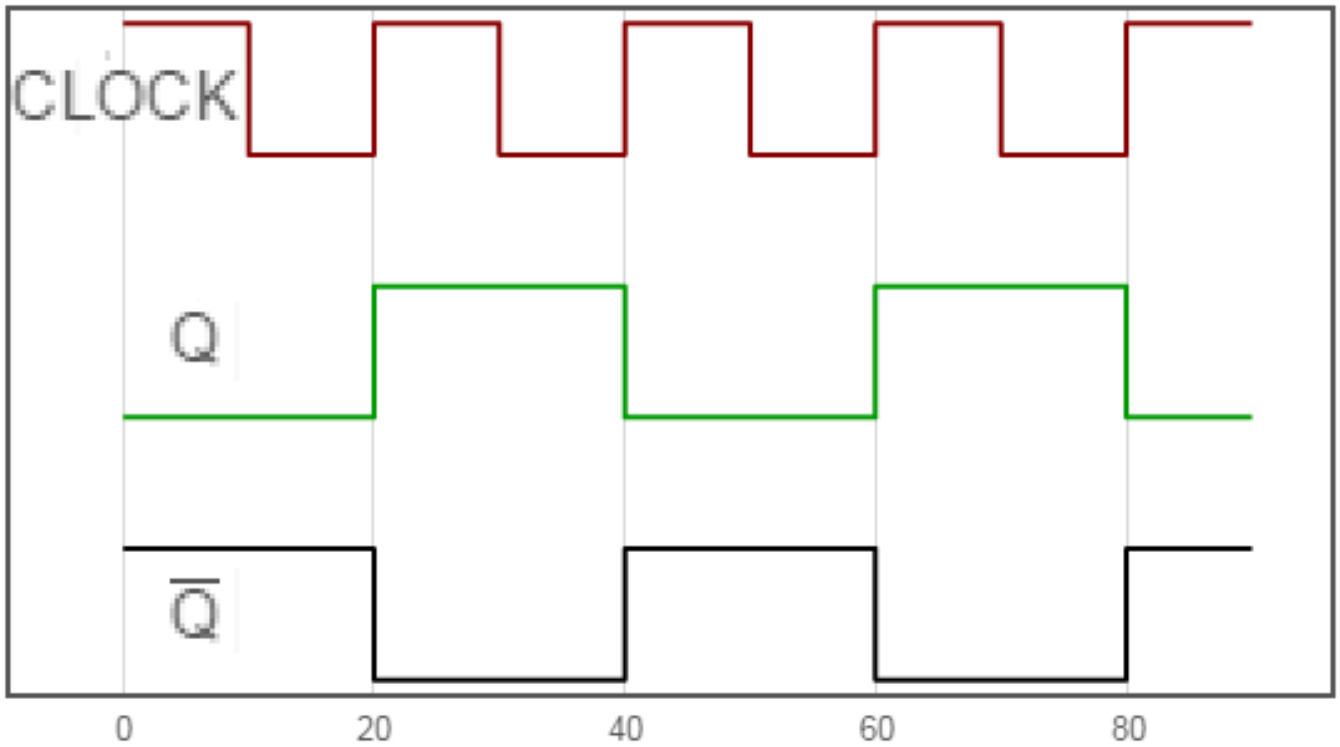
Bistabilul de tip T: *Toggle*



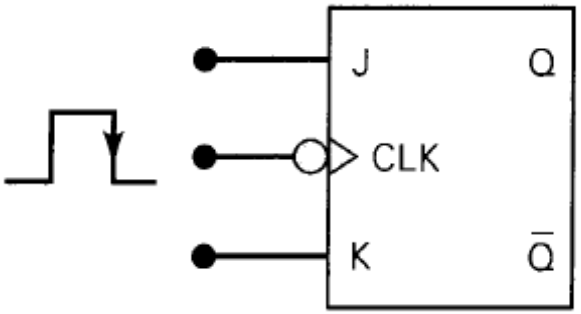
Inputs		Output	State
CLK	T	$Q_{(n+1)}$	
↑	0	Q_n	No Change
↑	1	not(Q_n)	Toggle

Mem

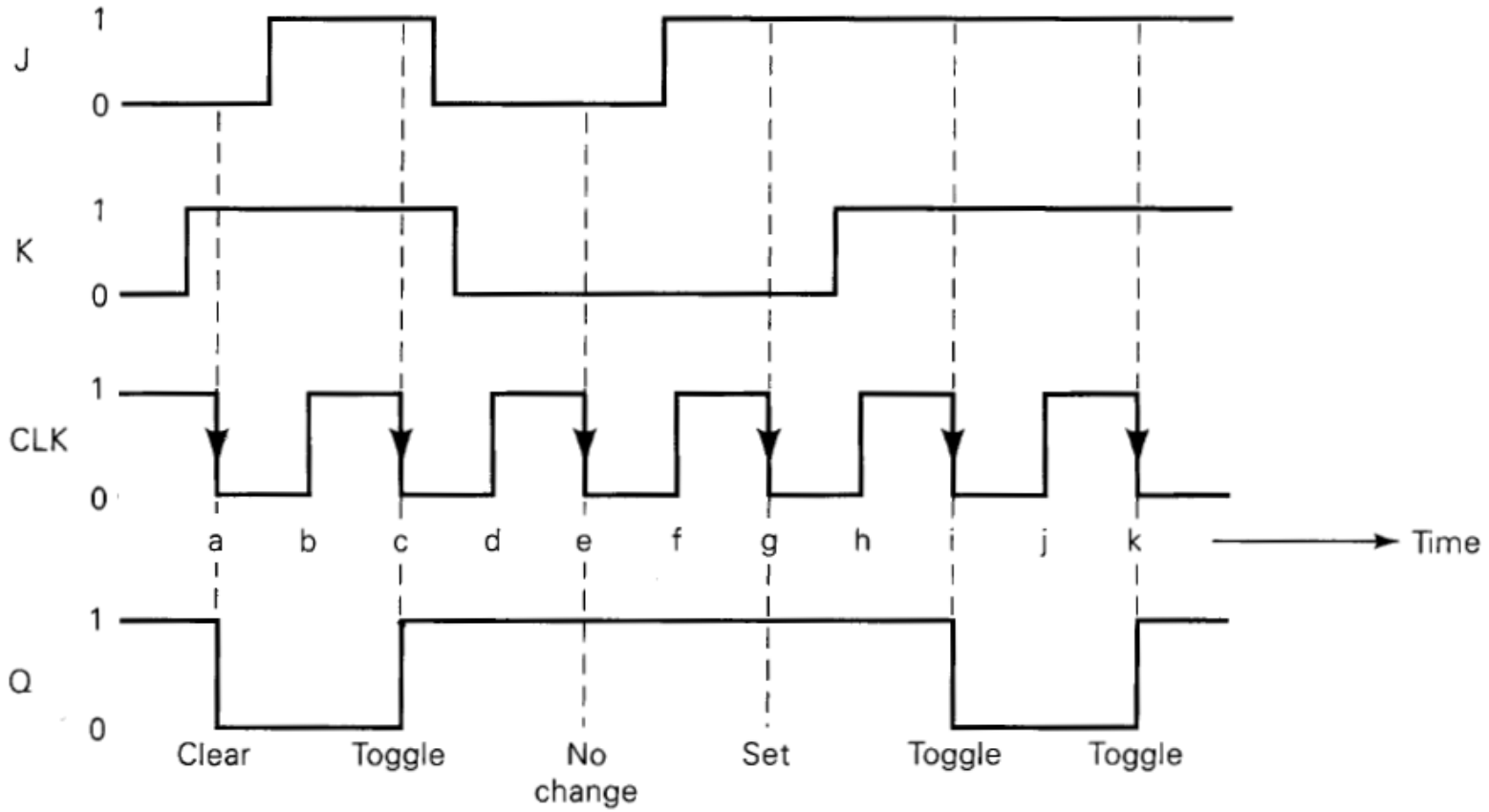
$$T = 1$$



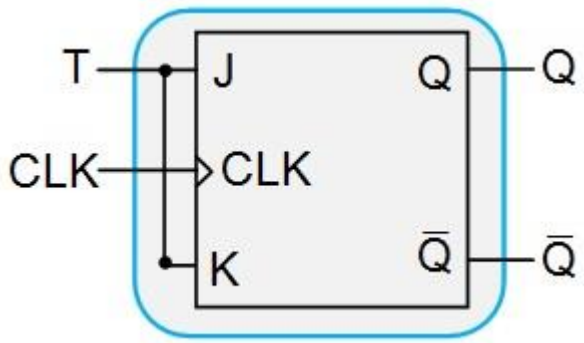
Bistabilul JK: tranzitie pe frontul negativ*



J	K	CLK	Q
0	0	↓	Q_0 (no change)
1	0	↓	1
0	1	↓	0
1	1	↓	$\overline{Q_0}$ (toggles)



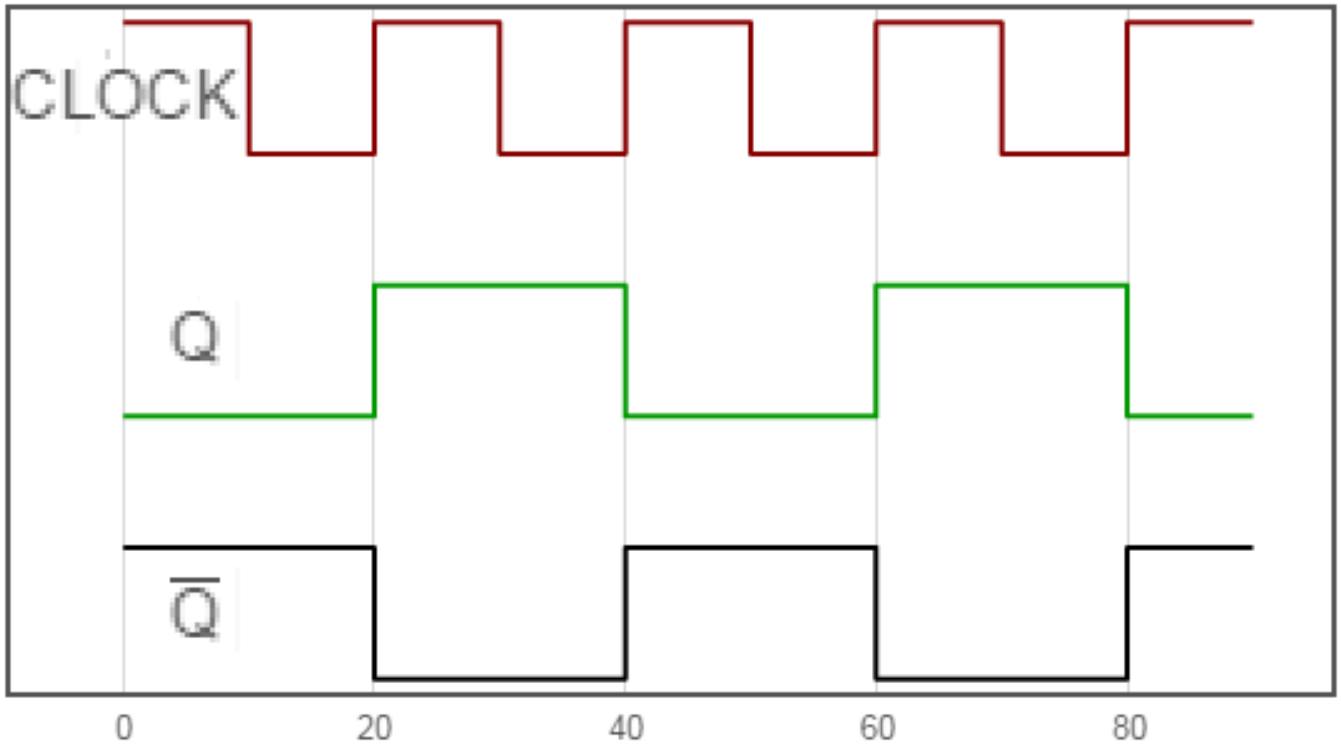
Bistabilul JK -> BB T: Toggle



J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	$\bar{Q}_0$ (toggles)

$$JK = 11$$

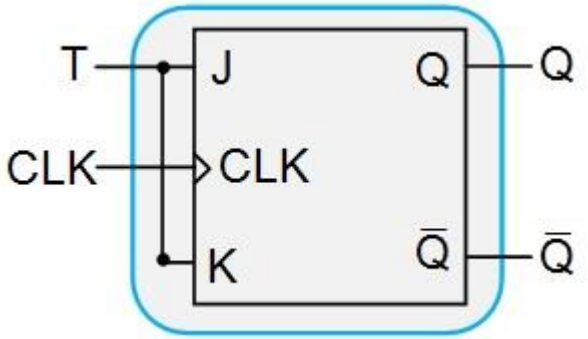
➔ **Toggle**



Cum facem Bistabil de tip T?

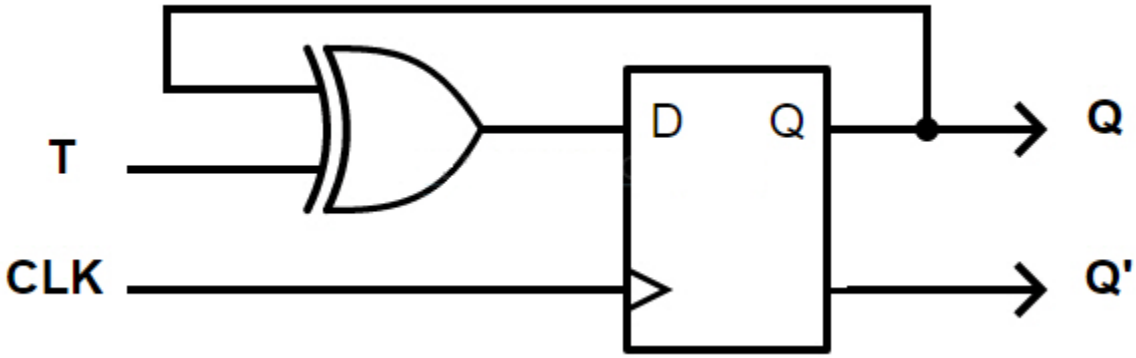
- Din BB de tip JK asa:

JK→T



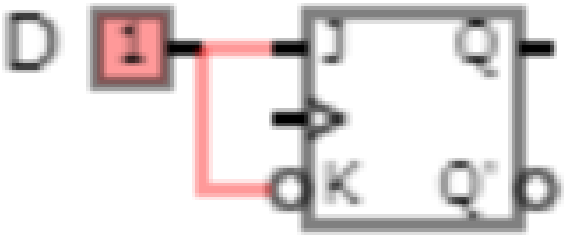
- Dar din BB de tip D ?

D→T



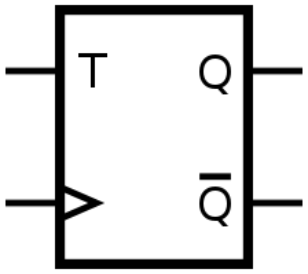
- Cum facem un BB de tip D dintr-un BB de tip JK ?

JK→D?



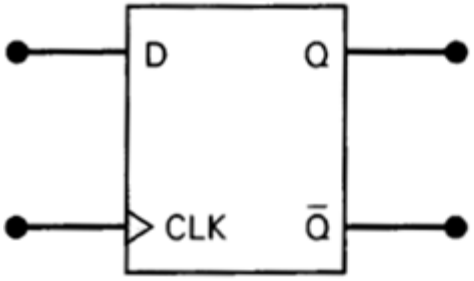
Intrebari suplimentare

Cum facem un BB de tip JK dintr-un BB de tip T?

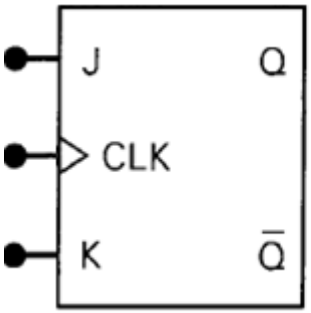


Inputs		Output	State
CLK	T	$Q_{(n+1)}$	
↑	0	Q_n	No Change
↑	1	not(Q_n)	Toggle

Dar dintr-un BB de tip D?



D	CLK	Q
0	↑	0
1	↑	1



J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	$\bar{Q}_0$ (toggles)

Indicatie: Folositi circuite logice suplimentare pentru a obtine aceeasi functionalitate ca a BB JK!

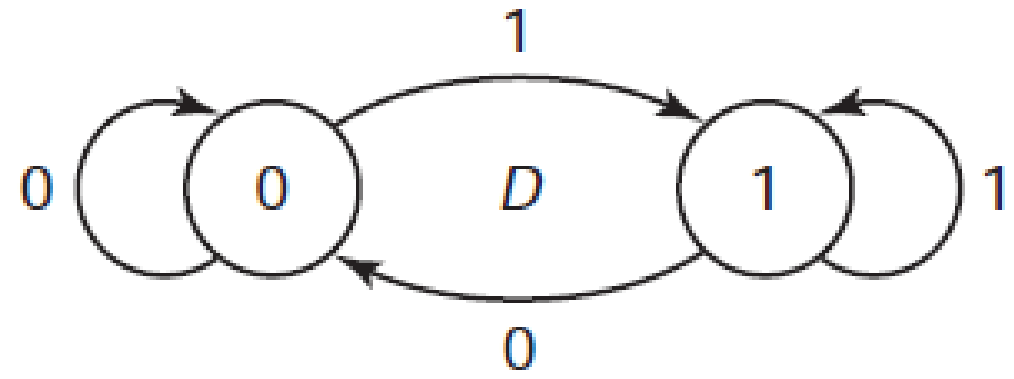
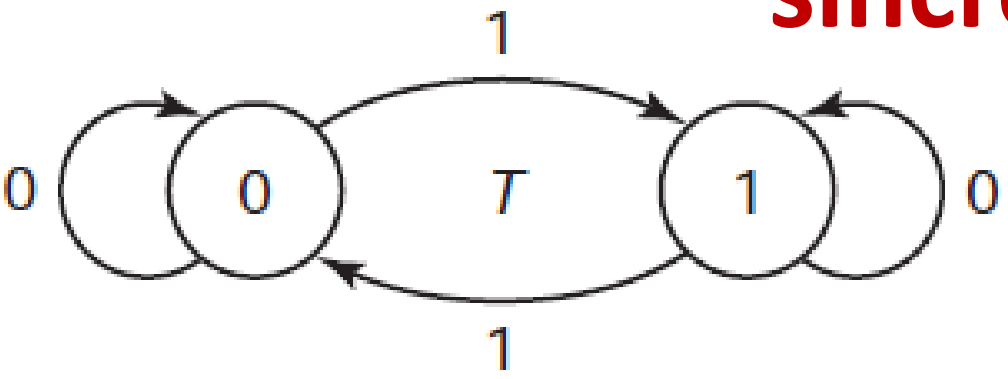
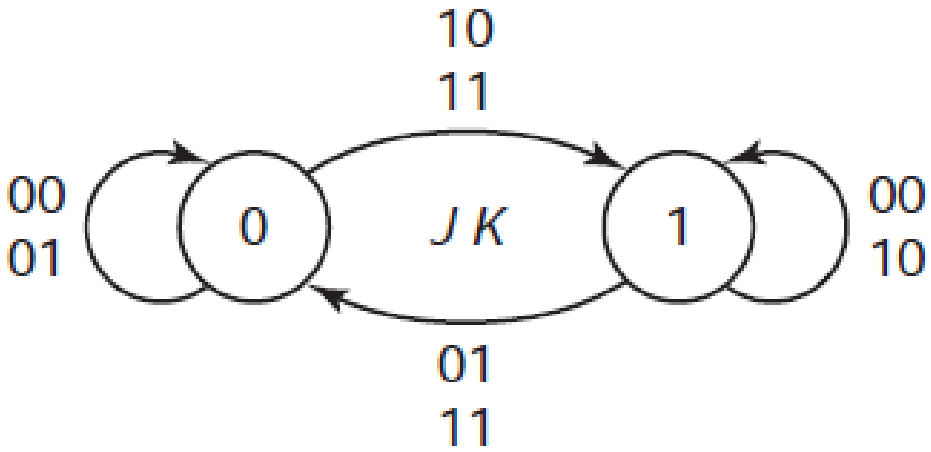


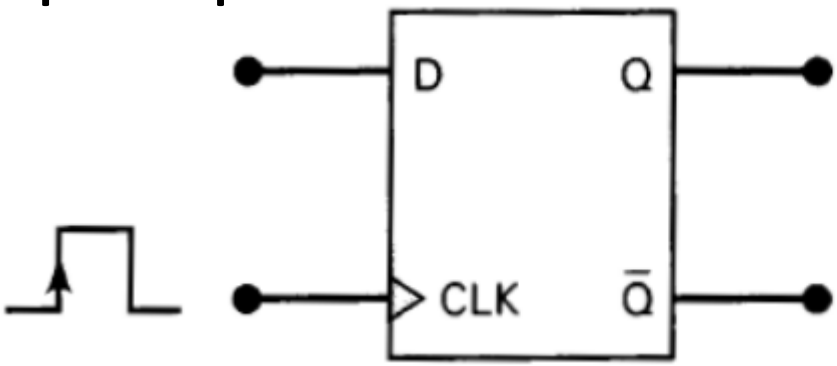
Diagrama starilor la Bistabilii sincroni





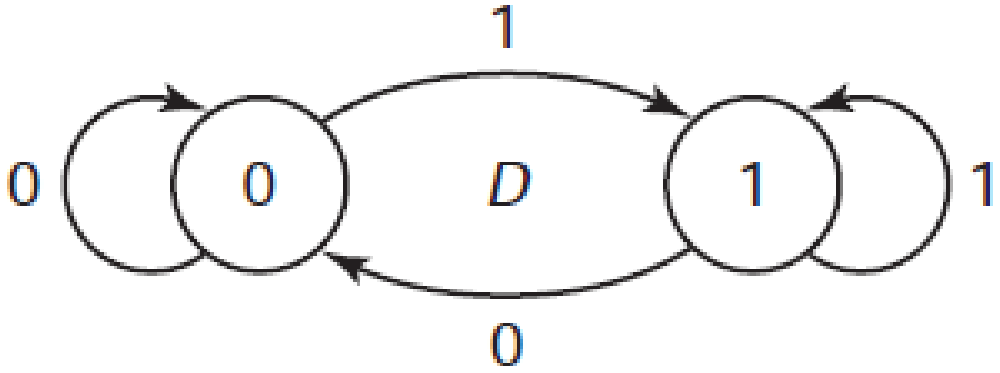
Bistabilul de tip D

- Clocked D Flip-Flop



D	CLK	Q
0	↑	0
1	↑	1

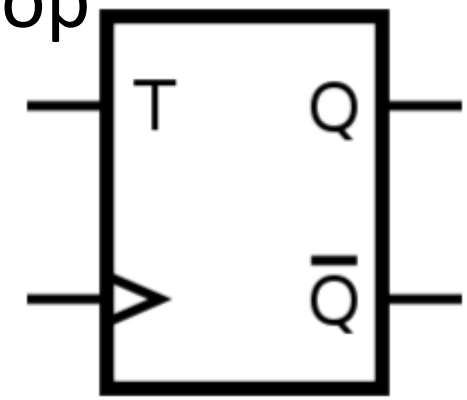
- Diagrama starilor asociata cu acest bistabil



- Nodurile (cerculetele) → starile BB
- Laturile orientate descriu tranzitiile intre stari ce depind de valoarea semnalului de control D

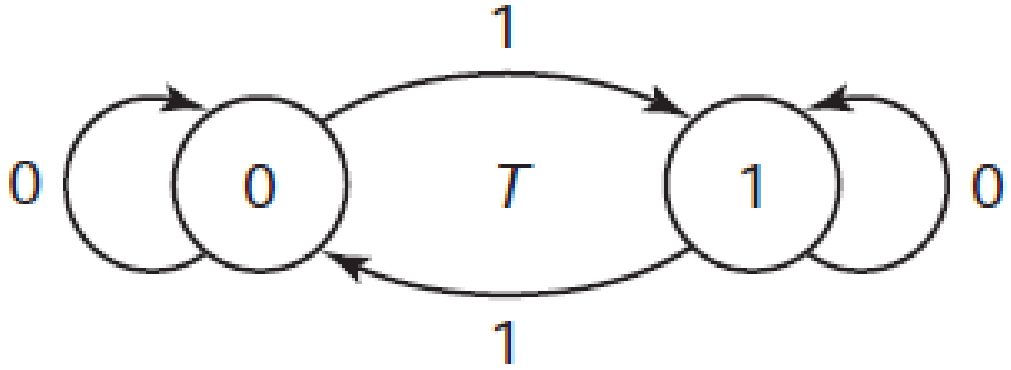
Bistabilul de tip T

- Clocked T Flip-Flop



Inputs		Output	State
CLK	T	$Q_{(n+1)}$	
↑	0	Q_n	No Change
↑	1	not(Q_n)	Toggle

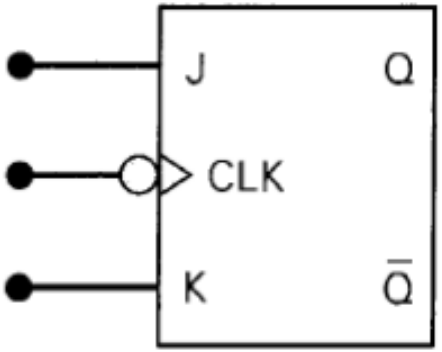
- Diagrama starilor asociata cu acest bistabil



- Nodurile (cerculetele) → starile BB
- Laturile orientate descriu tranzitiile intre stari ce depind de valoarea semnalului de control T

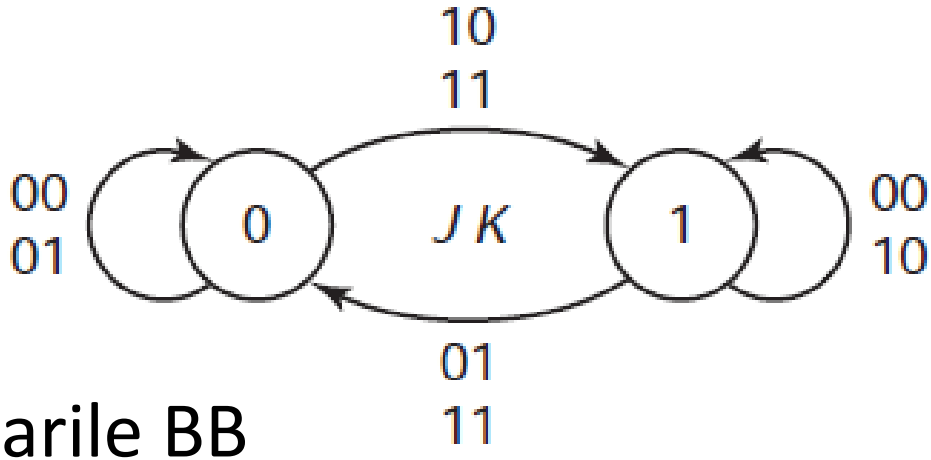
Bistabilul de tip JK

- Clocked JK Flip-Flop



J	K	CLK	Q
0	0	↓	Q_0 (no change)
1	0	↓	1
0	1	↓	0
1	1	↓	$\overline{Q_0}$ (toggles)

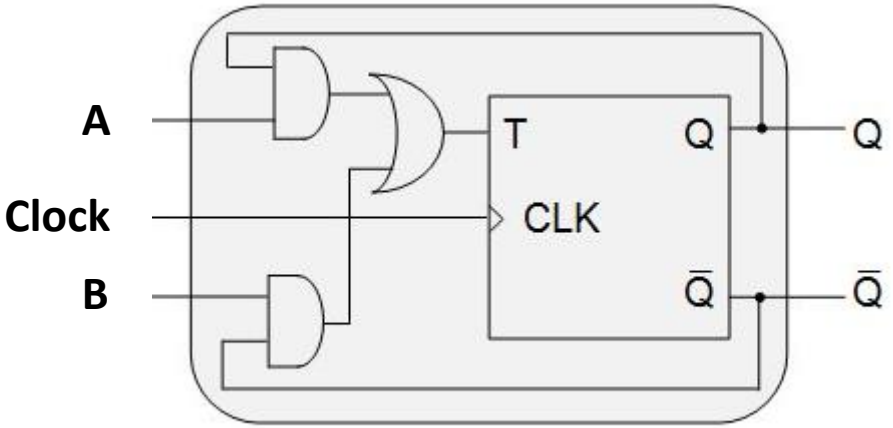
- Diagrama starilor asociata cu acest bistabil

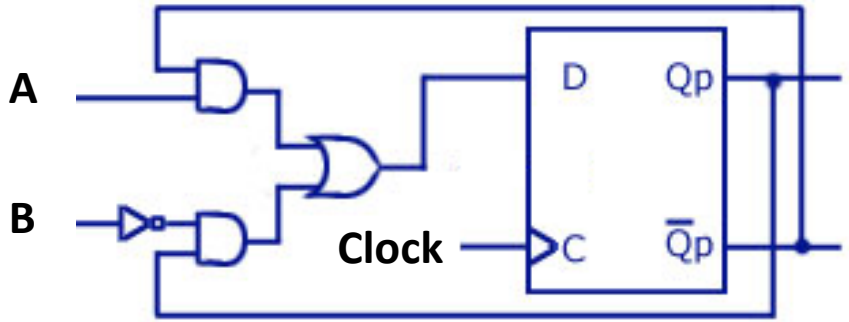


- Nodurile (cerculetele) → starile BB
- Laturile orientate descriu tranzitiile intre stari ce depind de valoarea semnalelor de control JK

Tema

Faceti diagrama starilor pentru sistemele urmatoare!



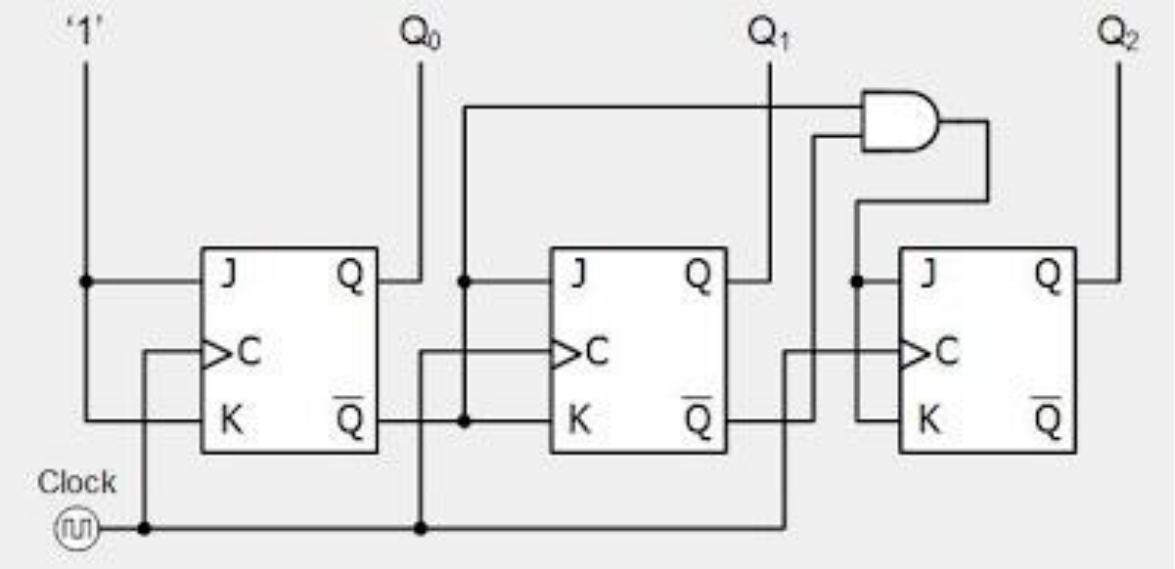


Analiza sistemelor secventiale

Avem schema unui sistem ce contine bistabili si circuite de reactie.

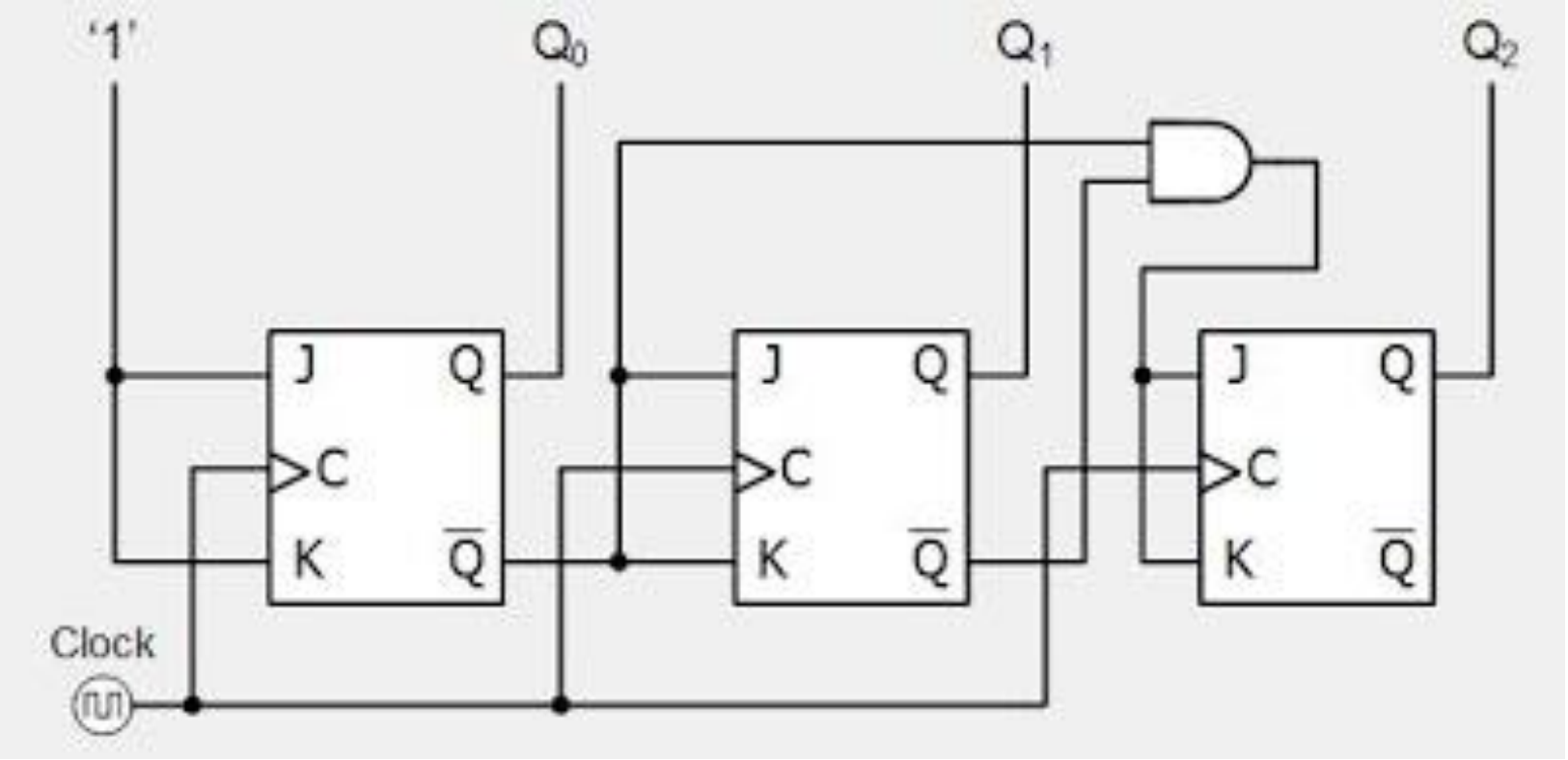
Analiza raspunde la intrebarea:

Ce face aceasta schema?



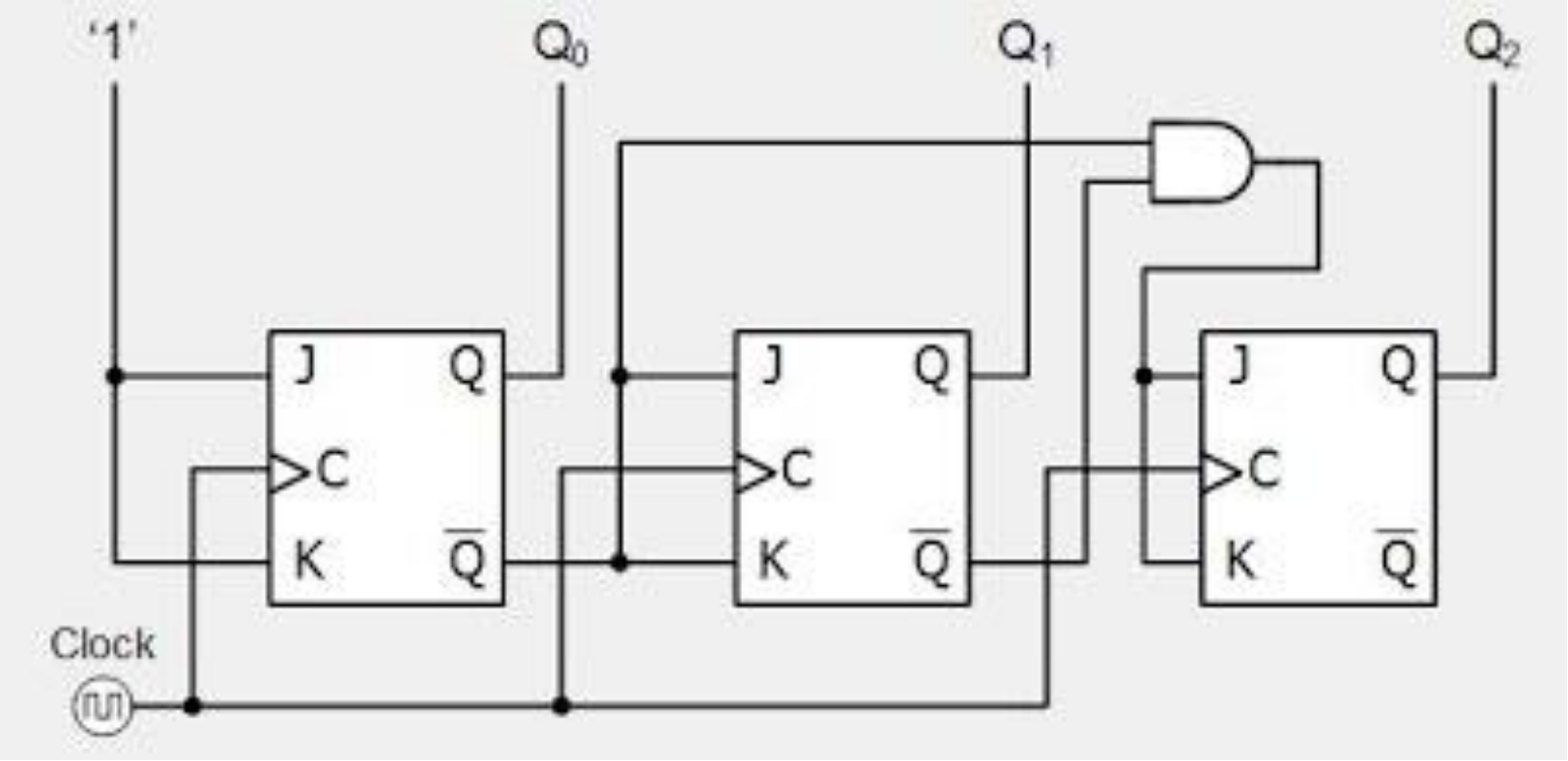
Ce face aceasta schema?

- Cum raspundem la aceasta intrebare?



1. Scriind functiile de reactie!
2. Desenand diagrama temporala asociata acestei scheme!

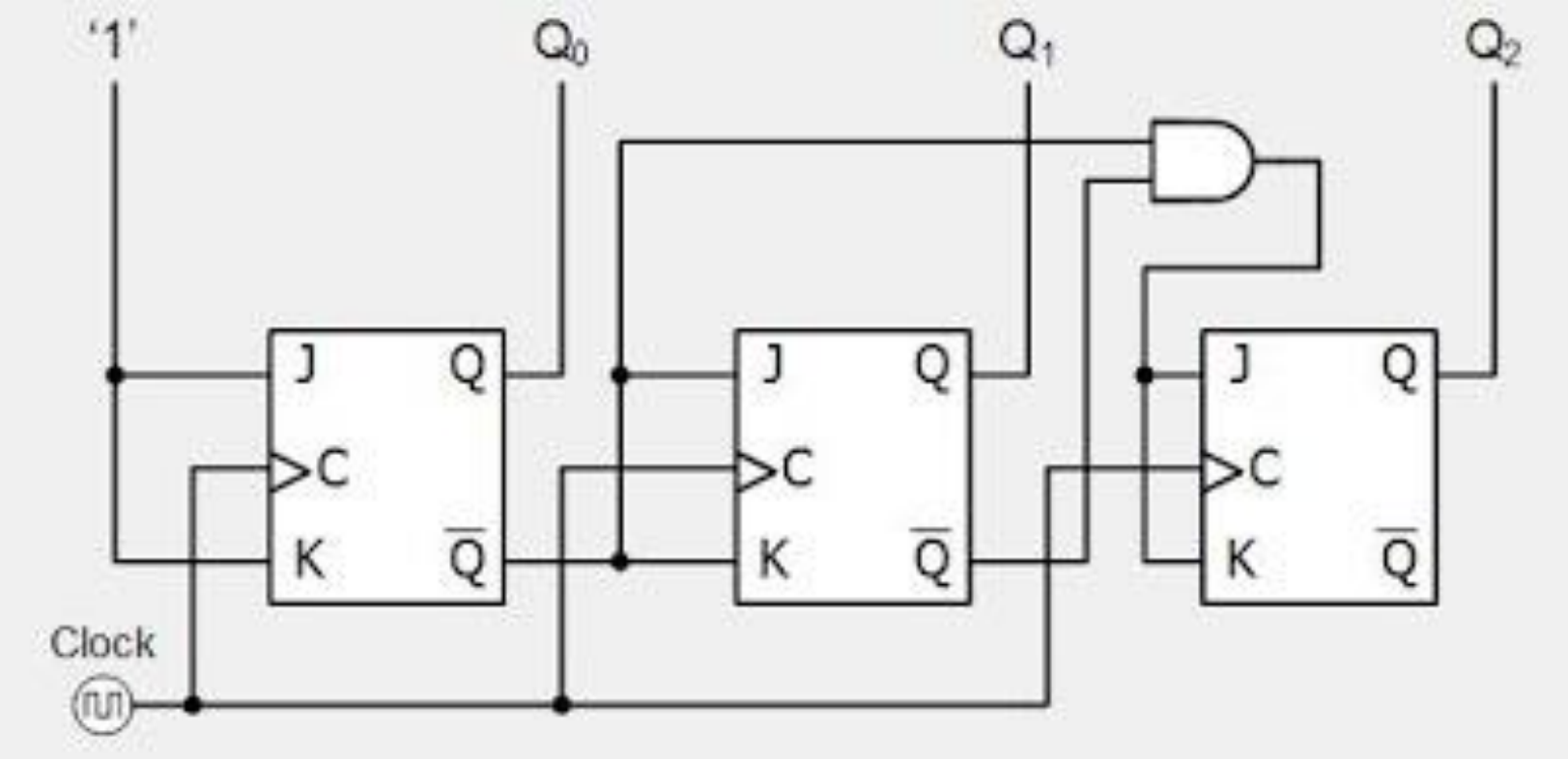
Ce face aceasta schema?



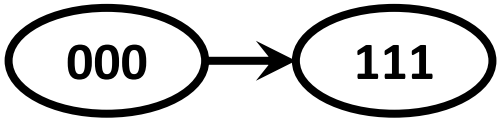
Functiile de reactie:

J0=1; K0=1; J1=!Q0; K1=!Q0; J2=!Q0.!Q1; K2=!Q0.!Q1;

Ce face aceasta schema?

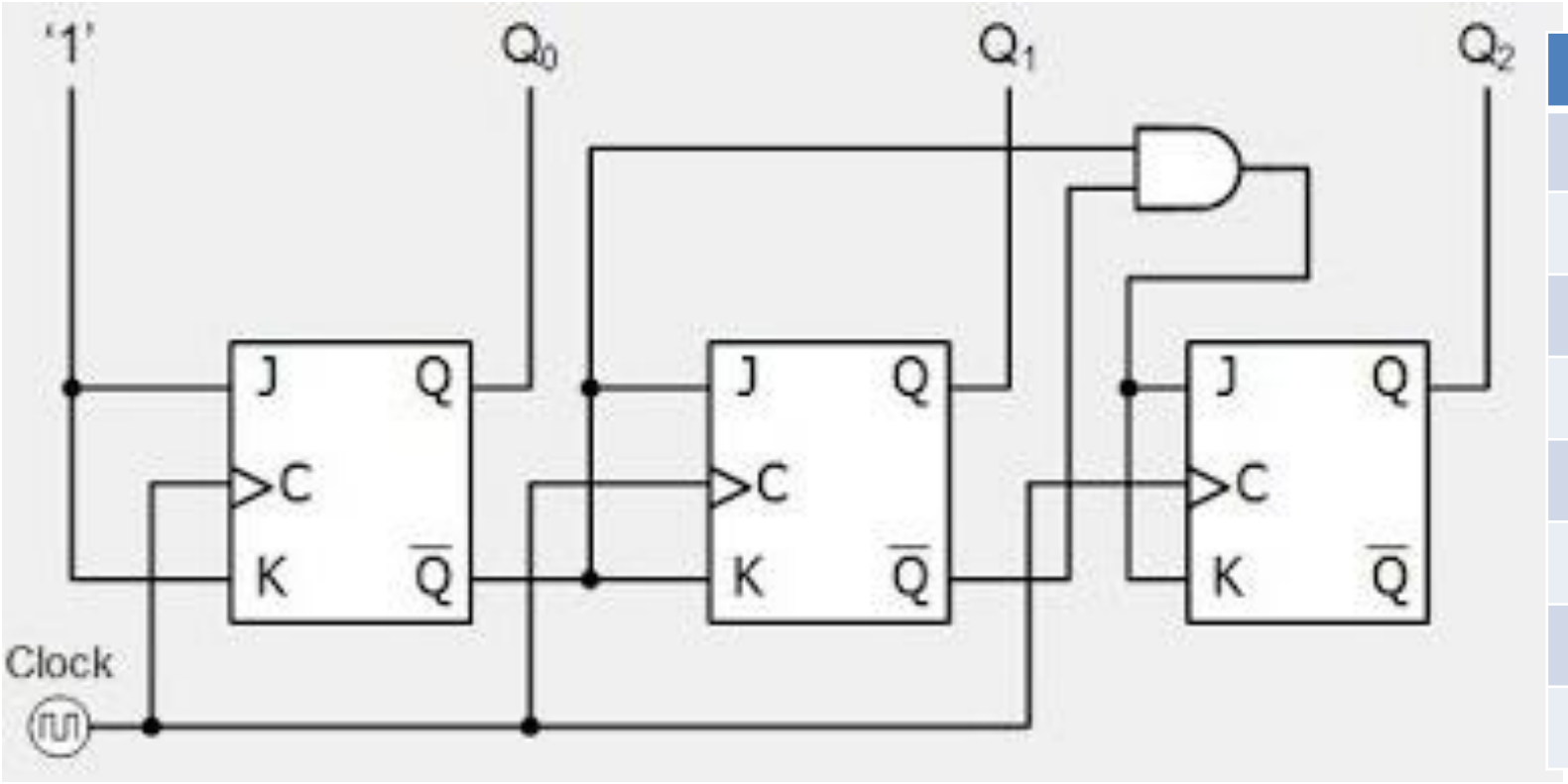


Stare initiala B2B2B0=000. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



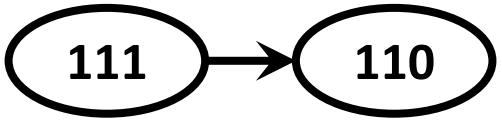
1. BB0: Q0=0; Toggle ↑ Q0*=!Q0➔ Q0*=1
1. BB1: Q1=0; J1=K1=!Q0=1 - Toggle ↑ Q1*=!Q1=1
1. BB2: Q2=0; J2=K2=!Q0.!Q1=1 – Toggle ↑ Q2*=!Q2=1

Ce face aceasta schema?



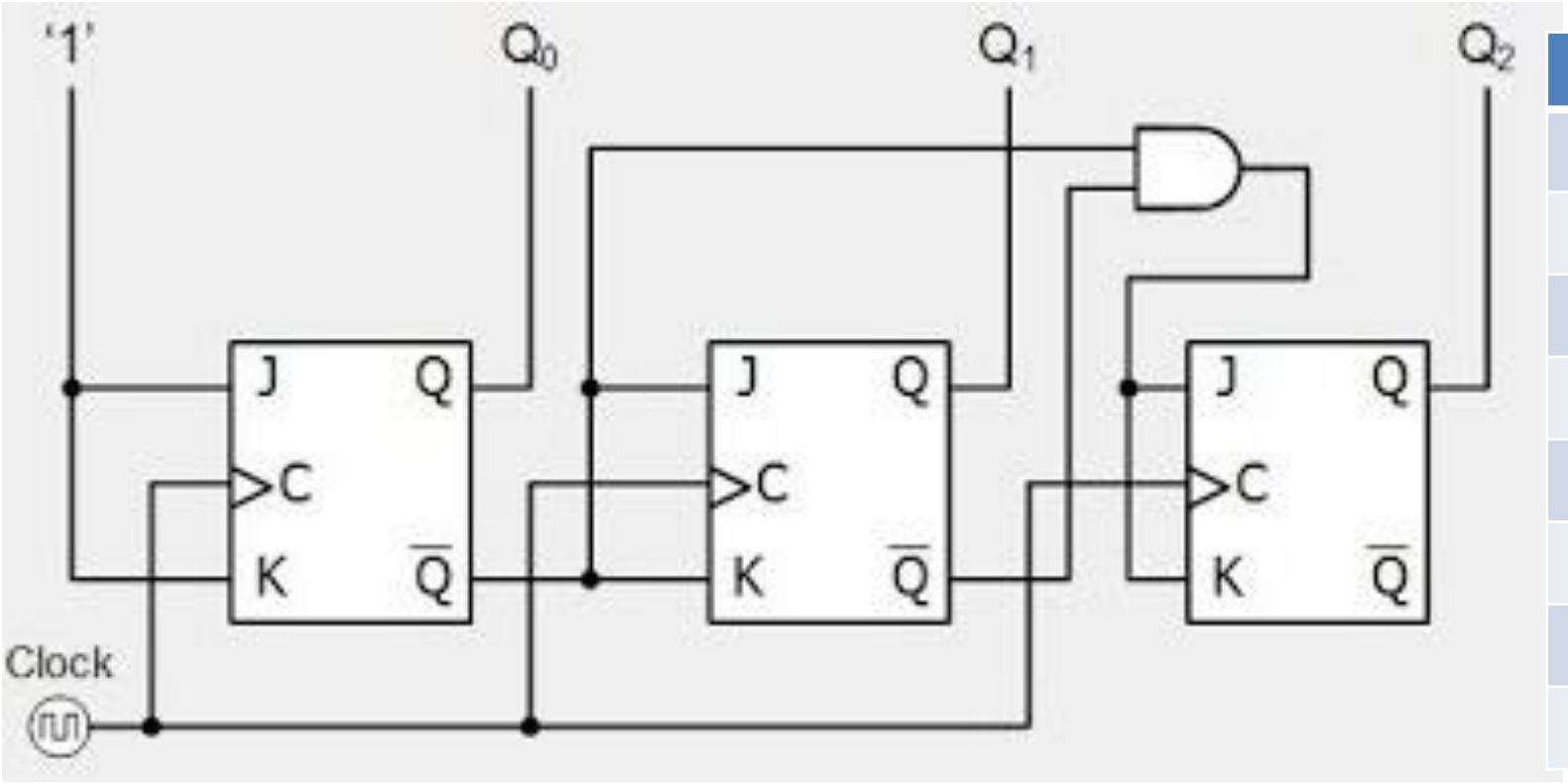
B2	B1	B0
0	0	0
1	1	1
1	1	0

Stare initiala B2B2B0=111. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



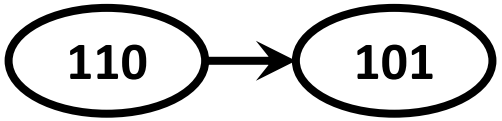
2. BB0: Q0=1; Toggle ↑ Q0*=!Q0➔ Q0*=0
2. BB1: Q1=1; J1=K1=!Q0=0 - Mem ↑ Q1*=Q1=1
2. BB2: Q2=1; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=1

Ce face aceasta schema?



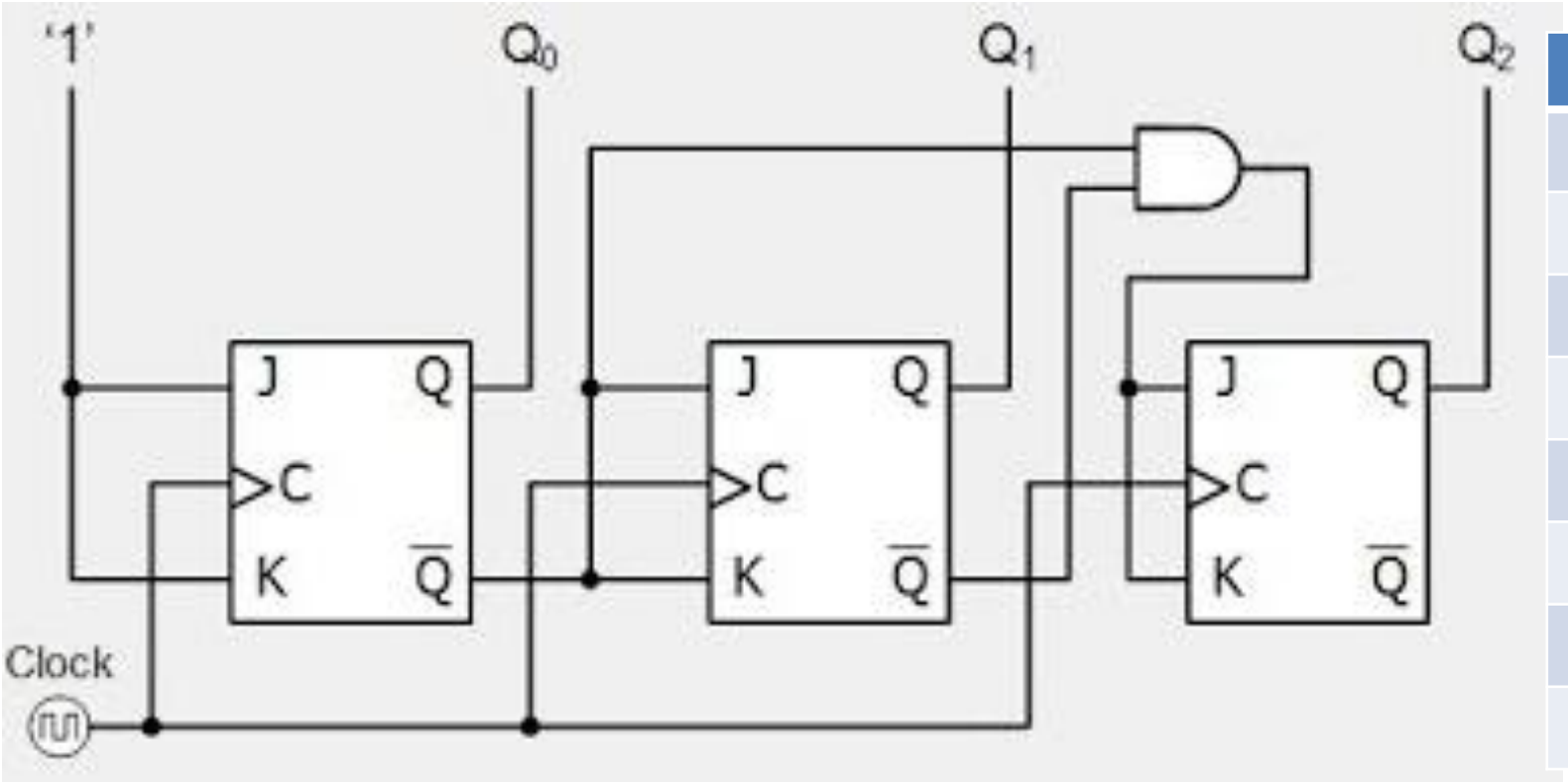
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1

Stare initiala B2B2B0=110. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



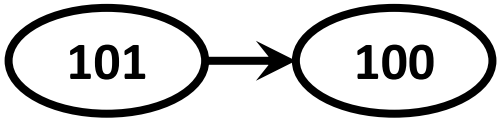
3. BB0: Q0=0; Toggle ↑ Q0*=!Q0➔ Q0*=1
3. BB1: Q1=1; J1=K1=!Q0=1 - Toggle ↑ Q1*=!Q1=0
3. BB2: Q2=1; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=1

Ce face aceasta schema?



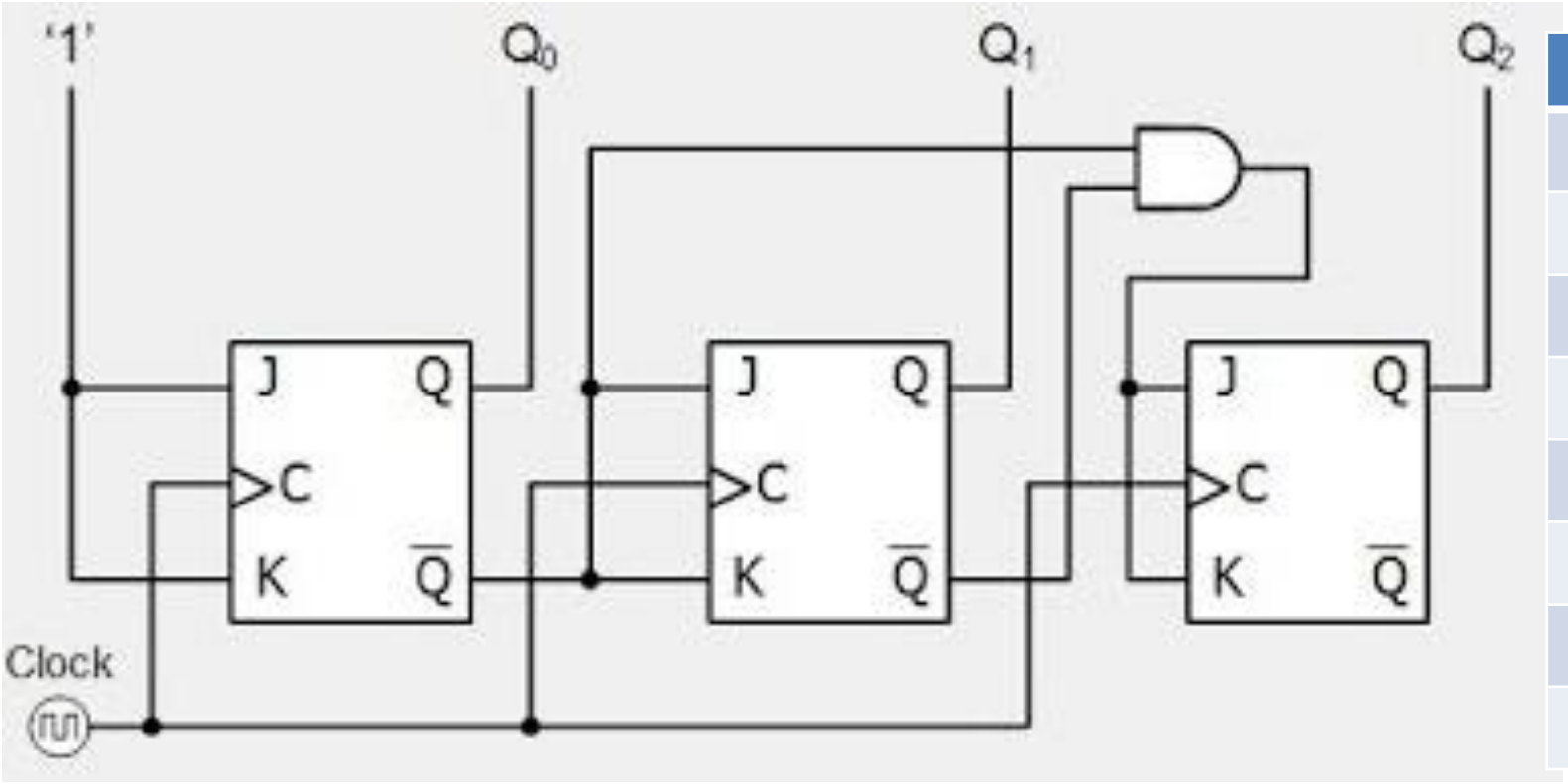
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0

Stare initiala B2B2B0=101. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



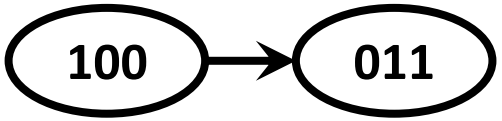
4. BB0: Q0=1; Toggle ↑ Q0*=!Q0➔ Q0*=0
4. BB1: Q1=0; J1=K1=!Q0=0 - Mem ↑ Q1*=Q1=0
4. BB2: Q2=1; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=1

Ce face aceasta schema?



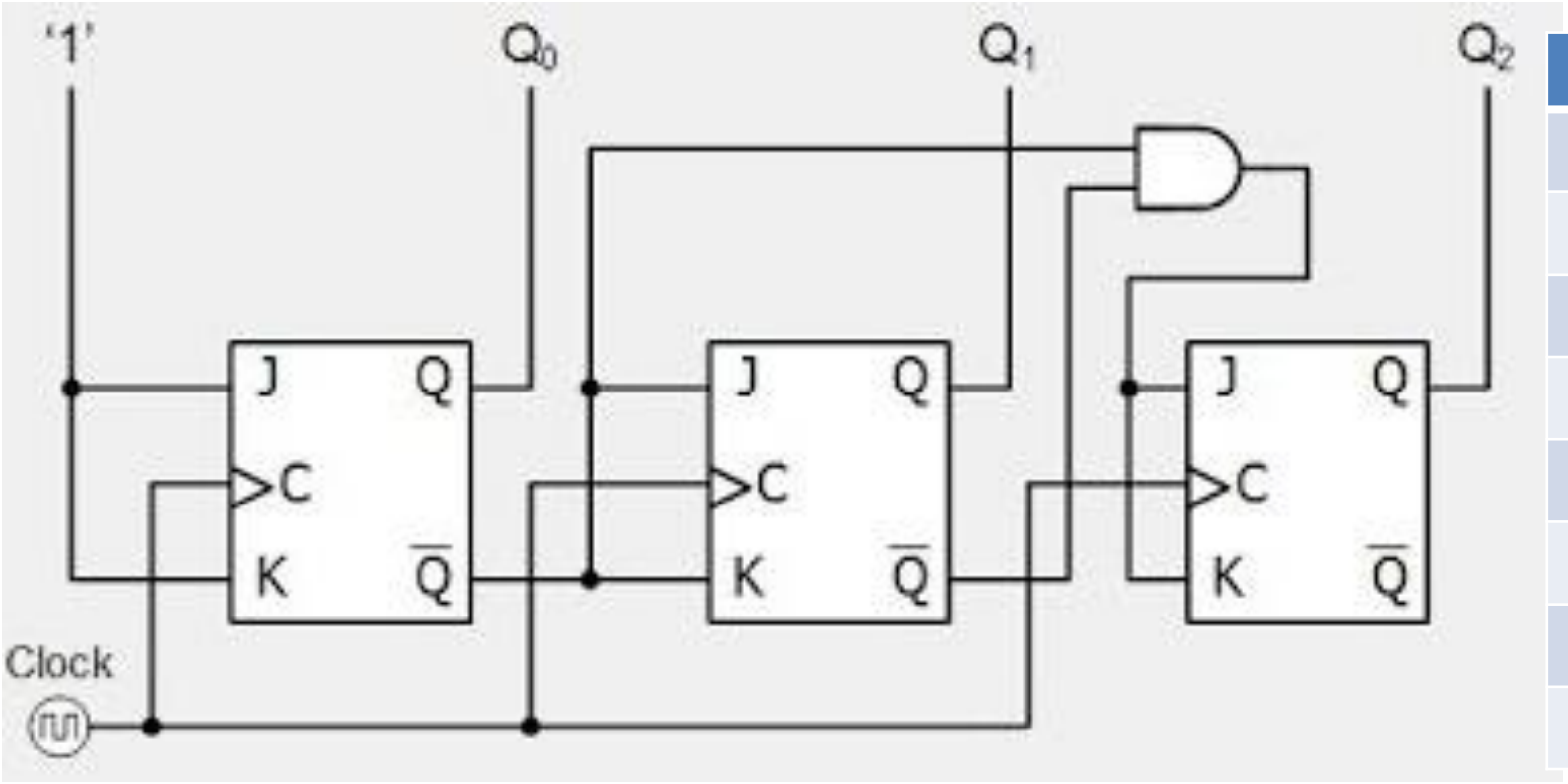
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0
0	1	1

Stare initiala B2B2B0=100. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



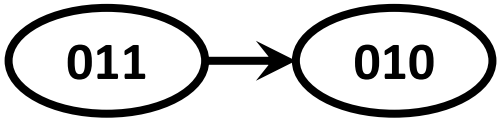
5. BB0: Q0=0; Toggle ↑ Q0*=!Q0➔ Q0*=1
5. BB1: Q1=0; J1=K1=!Q0=1 - Toggle ↑ Q1*=!Q1=1
5. BB2: Q2=1; J2=K2=!Q0.!Q1=1 - Toggle ↑ Q2*=!Q2=0

Ce face aceasta schema?



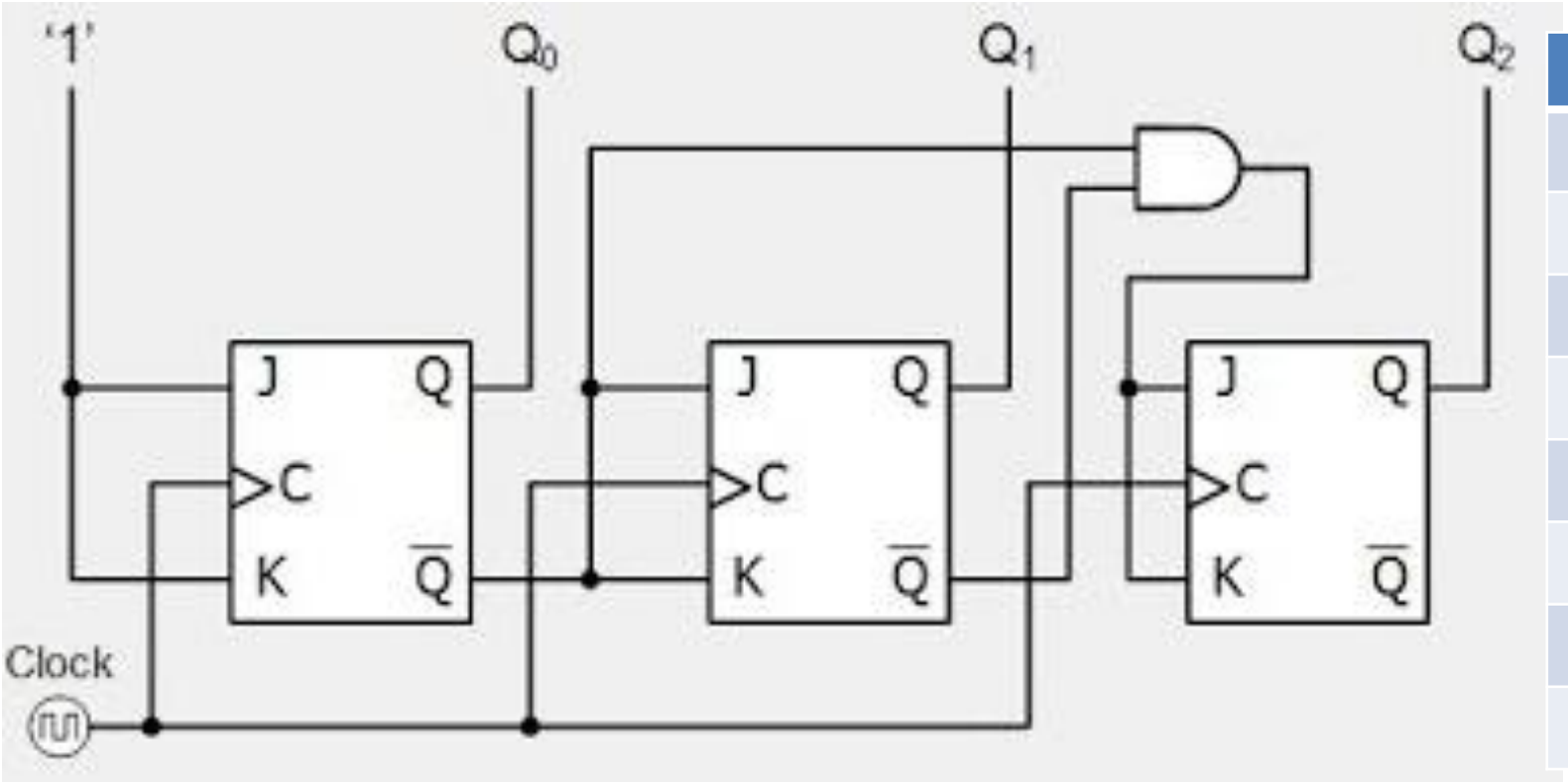
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0
0	1	1
0	1	0

Stare initiala B2B2B0=011. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



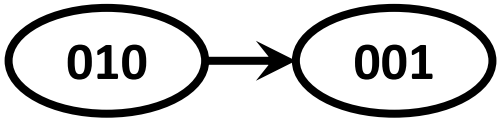
6. BB0: Q0=1; Toggle ↑ Q0*=!Q0➔ Q0*=0
6. BB1: Q1=1; J1=K1=!Q0=0 - Mem ↑ Q1*=Q1=1
6. BB2: Q2=0; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=0

Ce face aceasta schema?



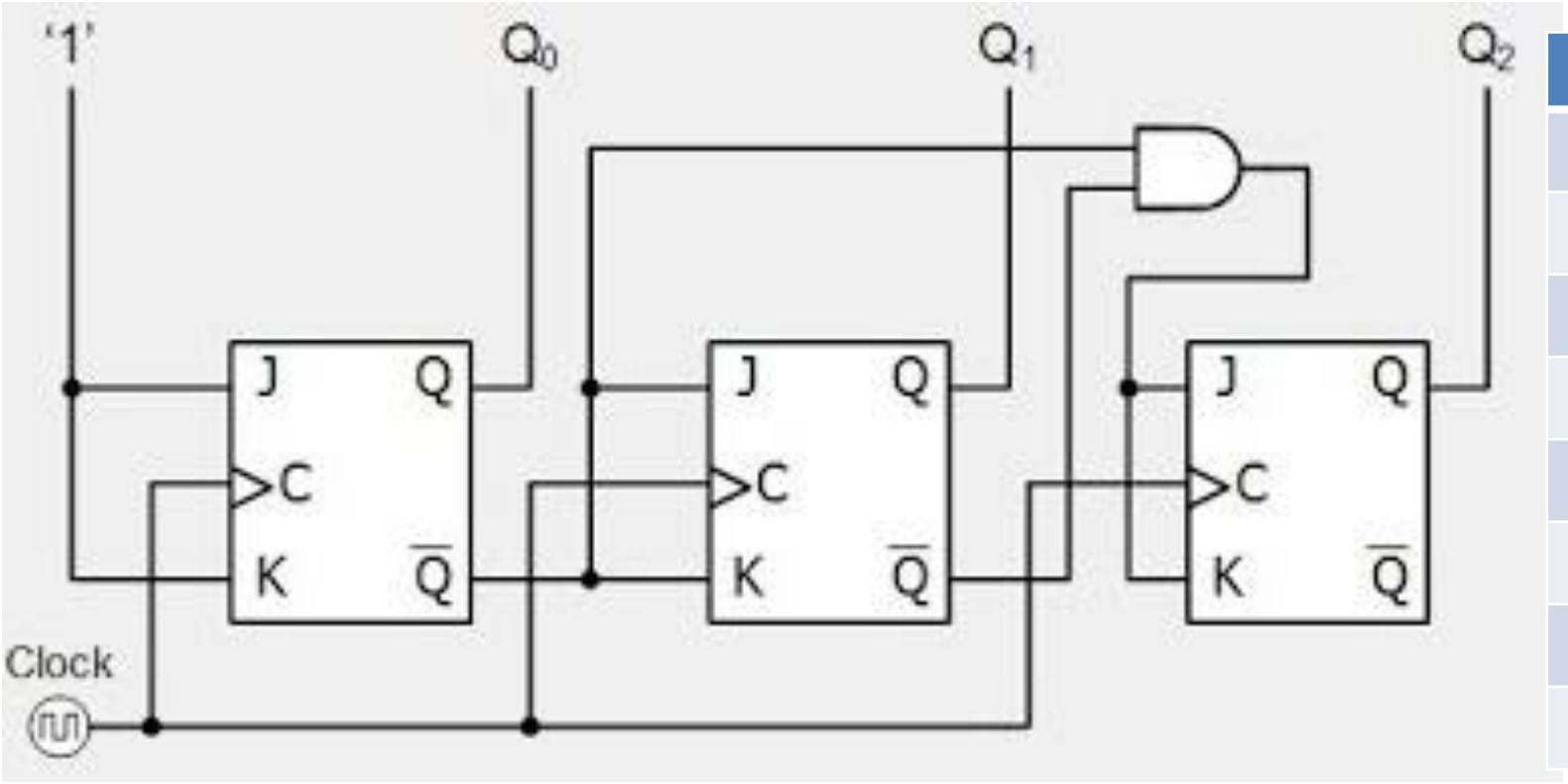
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0
0	1	1
0	1	0
0	0	1

Stare initiala B2B2B0=010. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



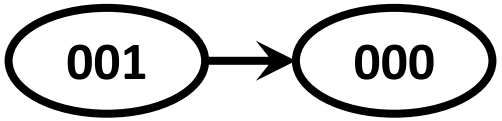
7. BB0: Q0=0; Toggle ↑ Q0*=!Q0➔ Q0*=1
7. BB1: Q1=1; J1=K1=!Q0=1 - Toggle ↑ Q1*=!Q1=0
7. BB2: Q2=0; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=0

Ce face aceasta schema?



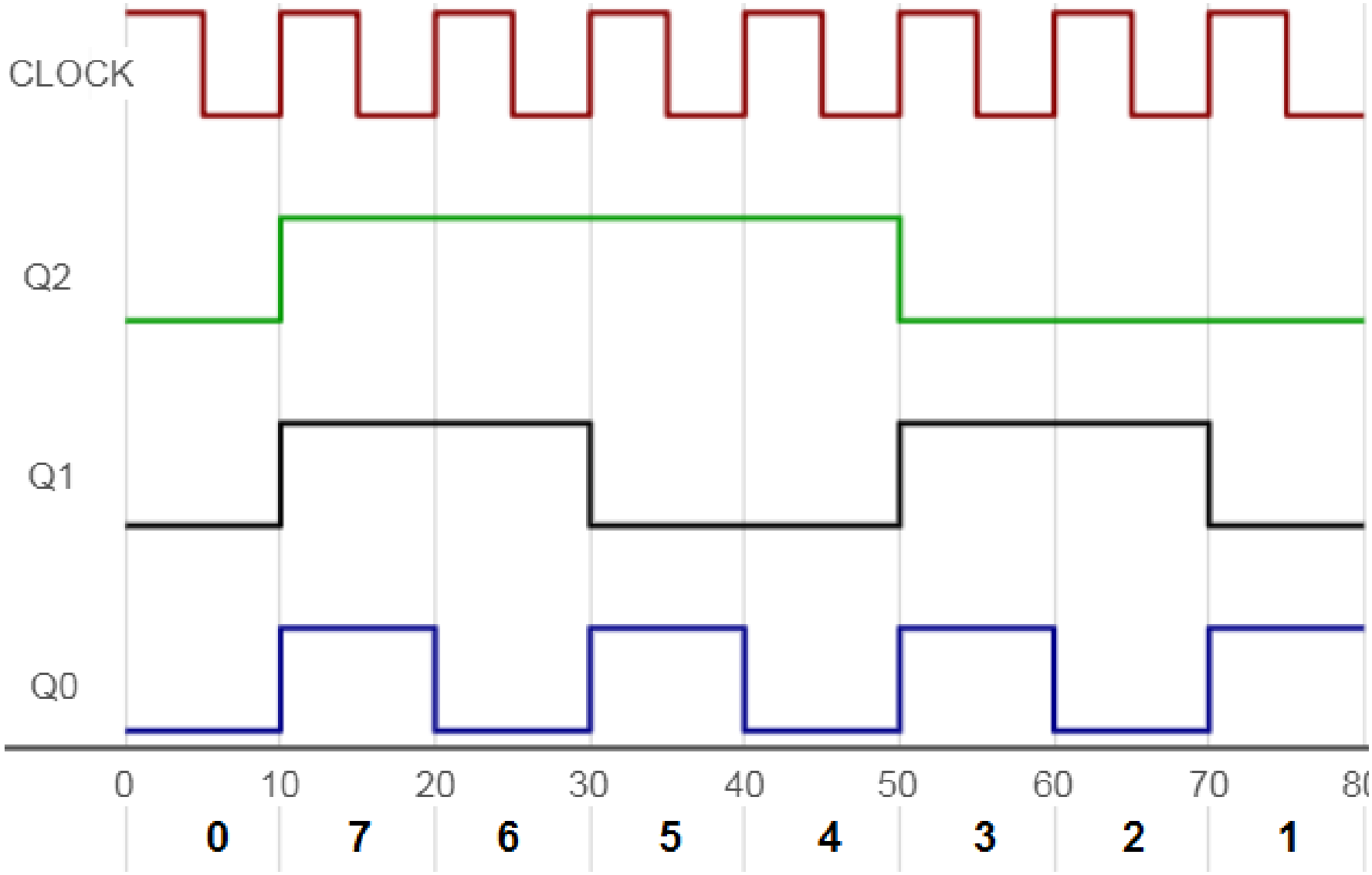
B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0
0	1	1
0	1	0
0	0	1

Stare initiala B2B2B0=001. Toti bistabilii reactioneaza la tranzitia Up a semnalului de Clock



8. BB0: Q0=1; Toggle ↑ Q0*=!Q0➔ Q0*=0
8. BB1: Q1=0; J1=K1=!Q0=0 - Mem ↑ Q1*=Q1=0
8. BB2: Q2=0; J2=K2=!Q0.!Q1=0 - Mem ↑ Q2*=Q2=0

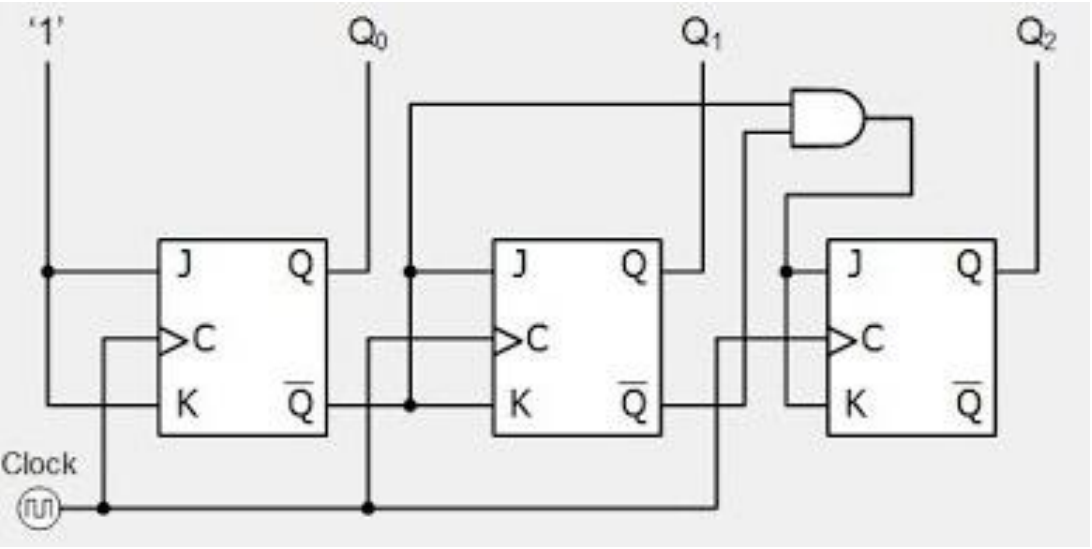
Diagrama temporala



Analiza este acum terminata!

Cum putem face un NR down cu 4 BB

folosind ideea din aceasta schema?



B2	B1	B0
0	0	0
1	1	1
1	1	0
1	0	1
1	0	0
0	1	1
0	1	0
0	0	1

Analiza trebuie sa continue!

Cand comuta (toggle) BB1? Atunci cand B0=0

Cand comuta (toggle) BB2? Atunci cand B1B0=00

Cand trebuie sa comute BB3? Atunci cand B2B1B0=000

Cum putem face un NR down cu 4 BB

folosind ideea din aceasta schema?

Cand trebuie sa comute BB3?

Atunci cand B2B1B0=000!

Cand trebuie sa comuta BB4?

B3	B2	B1	B0
0	0	0	0
0	1	1	1
0	1	1	0
0	1	0	1
0	1	0	0
0	0	1	1
0	0	1	0
0	0	0	1
0	0	0	0
1	1	1	1
1	1	1	0

Ce stari am folosit la BB JK?

- Numai starile Toggle si Mem!
- Dar exista un BB care are doar aceste 2 stari!
- Bistabilul de tip T!

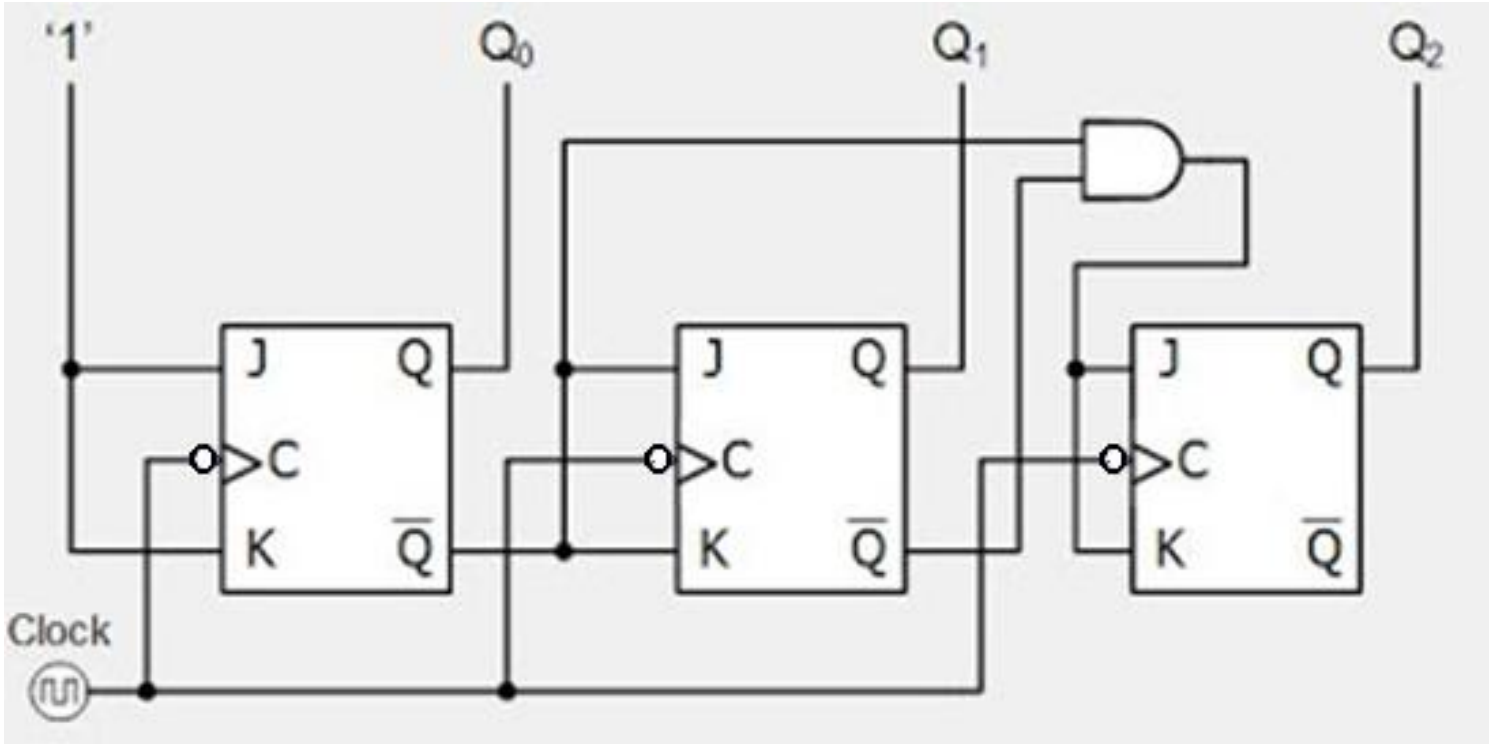
Tema:

Proiectati un NR cu 8 BB T folosind ideile din aceasta analiza!

Incapsulati-l si utilizati 2 afisoare cu 7 segmente pentru a verifica functionarea corecta!

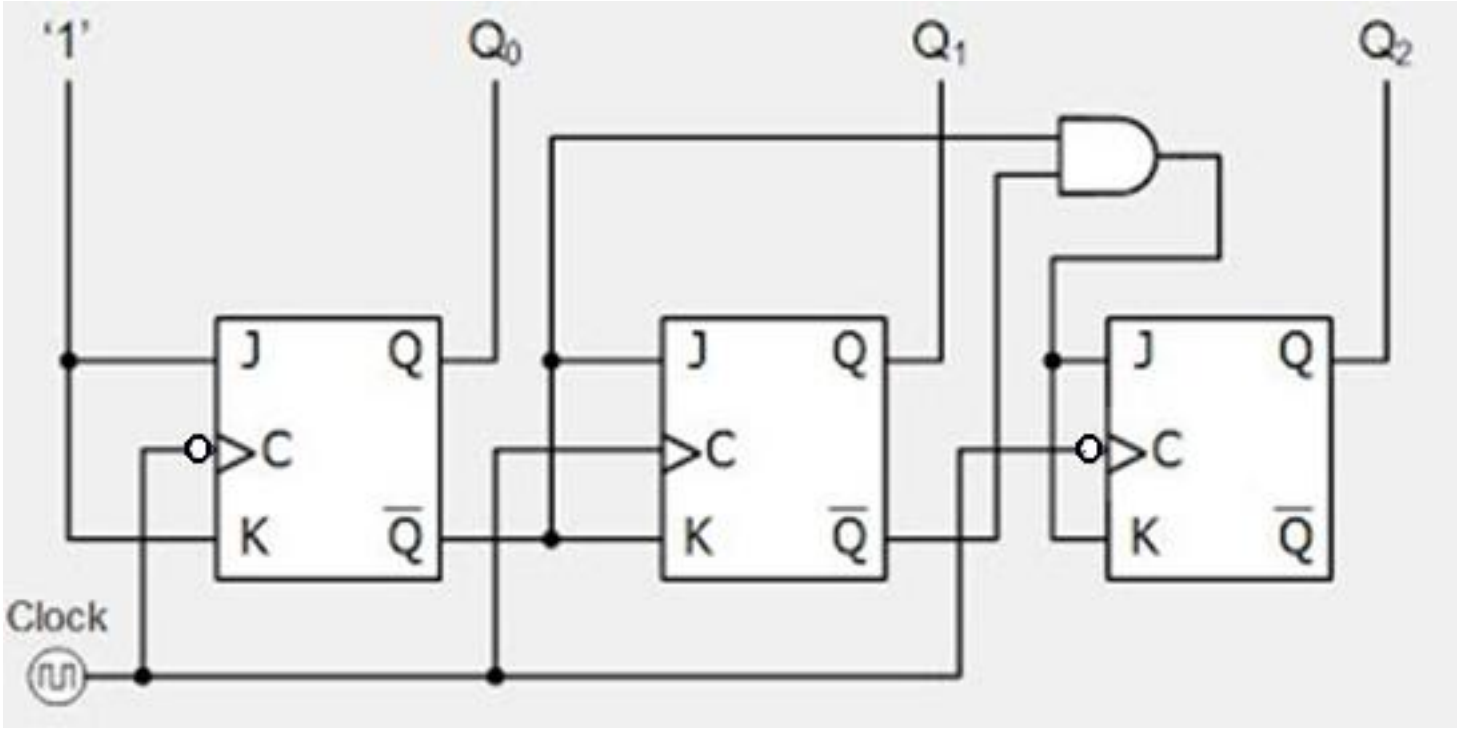
Intrebari suplimentare

- Cum se schimba functionarea acestui sistem daca toti bistabilii sunt sensibili la tranzitia Down a semnalului de Clock?



Intrebari suplimentare

- Cum se schimba functionarea acestui sistem daca facem ca bistabilii 0-3 sa fie sensibili la tranzitiile -+- ale semnalului de clock?



Tema: Sinteza

Proiectati (si verificati in wronex) toate numaratoarele date in pagina urmatoare!!

Numaratoare sicrone cu BB tip D si cu BB de tip JK

Proiectati si verificati in wronex numaratoarele ce functioneaza conform diagramelor de stari:

1. 5-2-0-4-5; 6-1-7-3-0;
2. 5-7-2-5; 3-6-4-0-1-6;
3. 6-0-2-1-4-6; 7-5-0; 3-1;
4. 1-3-5-7-1; 0-1; 2-3; 4-5; 6-7;
5. 12-5-3-9-13-2-10-8-7-12; 15-14-6-5; 4-11-1-0-2;

Q	Q_{next}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

NR 5-2-0-4-5; 6-1-7-3-0; cu BB D

•

Z	Q2	Q1	Q0	D2	D1	D0	Z*
0	0	0	0	1	0	0	4
1	0	0	1	1	1	1	7
2	0	1	0	0	0	0	0
3	0	1	1	0	0	0	0
4	1	0	0	1	0	1	5
5	1	0	1	0	1	0	2
6	1	1	0	0	0	1	1
7	1	1	1	0	1	1	3

D2=Q1'.(Q0'+Q2')

D1=...

D0=...

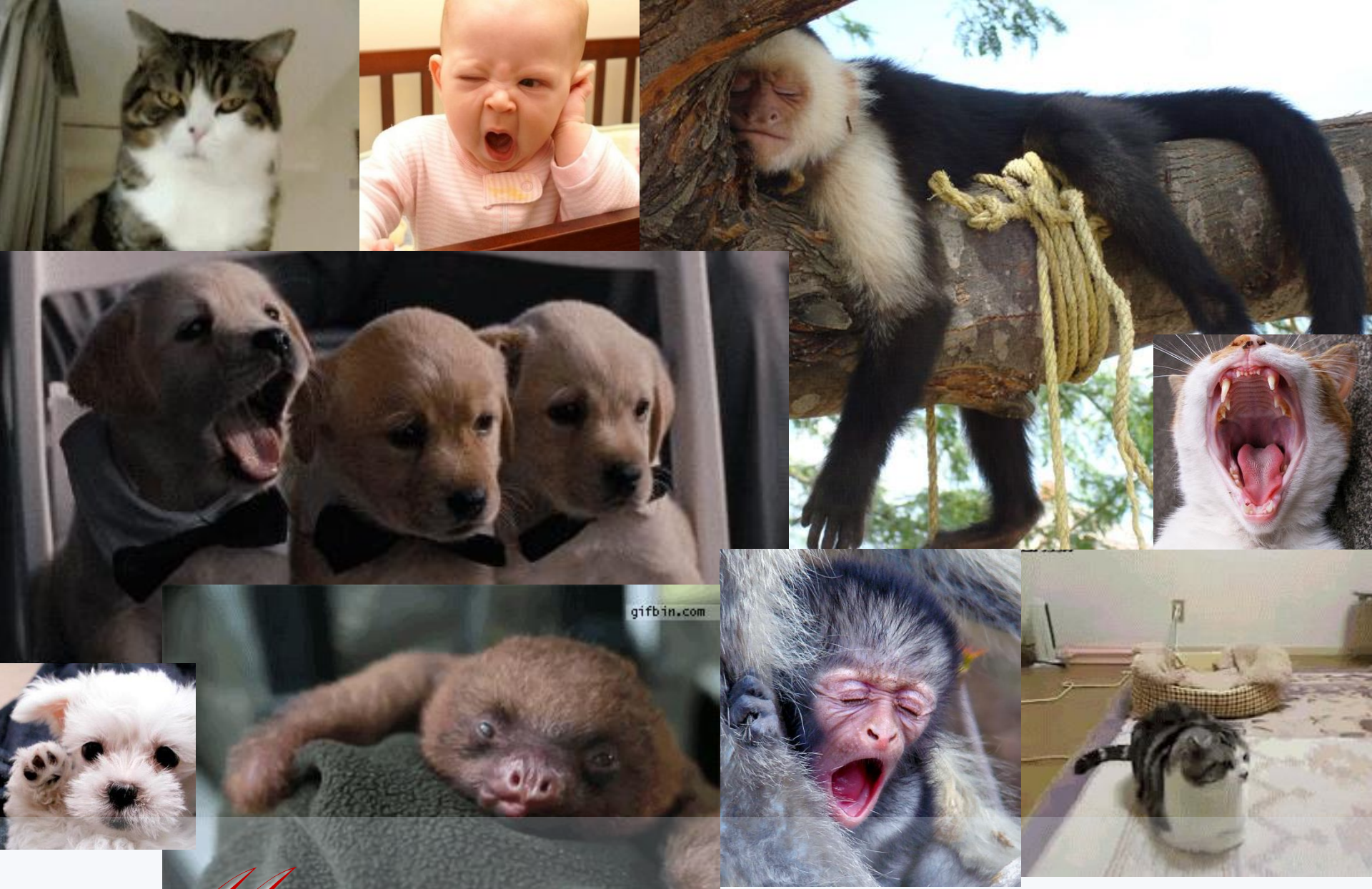
NR 5-2-0-4-5; 6-1-7-3-0; cu BB JK

Z	Q2	Q1	Q0	Q2*	Q1*	Q0*	J2	K2	J1	K1	J0	K0
0	0	0	0	1	0	0	1	X	0	X	0	X
1	0	0	1	1	1	1	1	X	1	X	X	0
2	0	1	0	0	0	0	0	X				
3	0	1	1	0	0	0	0	X				
4	1	0	0	1	0	1	X	0				
5	1	0	1	0	1	0	X	1				
6	1	1	0	0	0	1	X	1				
7	1	1	1	0	1	1	X	1				

J2=!Q1;

K2=Q1+Q0;

Q	Q_{next}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0



Multumesc pentru atentie