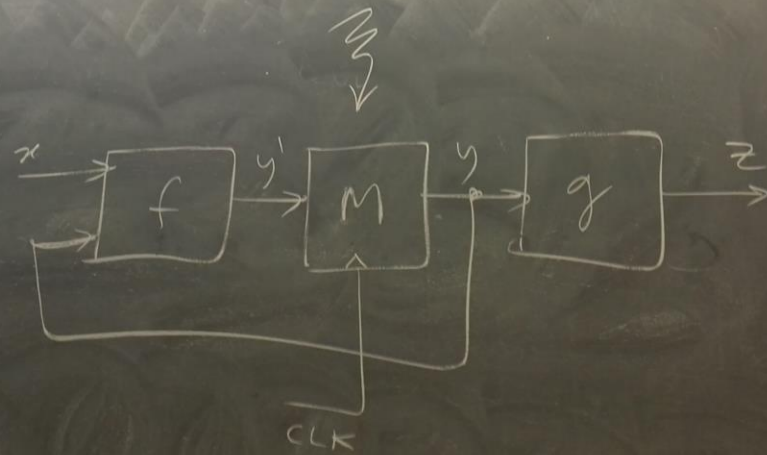


Flip-flop



x	y	z
0	0	0
0	1	0
1	0	1
1	1	1

1000

0011

R

Q

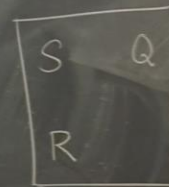
1100

S

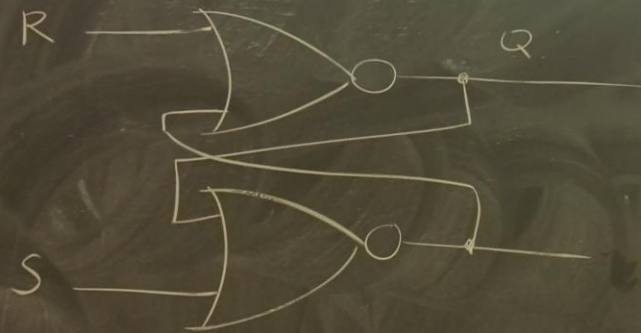
x	y	$\overline{x+y} = \overline{xy}$
0	0	1
0	1	0
1	0	0
1	1	0

0010

$\rightarrow t$



Gödel, Eschen, Bach



S	R	Q_{t+1}	
0	0	Q_t	"hold"
0	1	0	"reset"
1	0	1	"set"
1	1	X	"forbidden"



$\bar{z}$
→

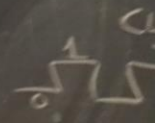
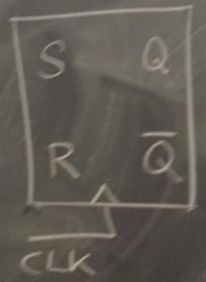
$f(x, y)$
 $g(y)$

	S	R	Q	Q'
hold	0	0	0	0
	0	0	1	1
reset	0	1	0	0
	0	1	1	0
set	1	0	0	1
	1	0	1	1
forb.	1	1	0	X
	1	1	1	X

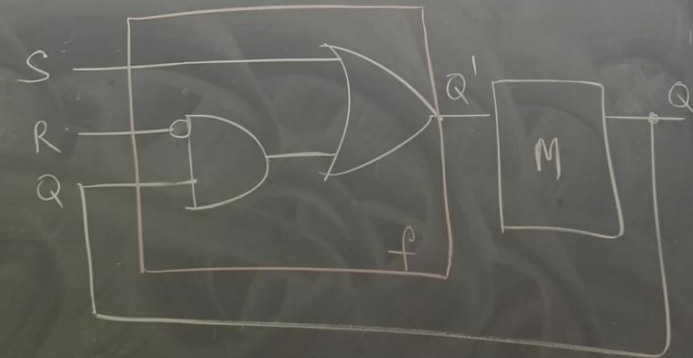
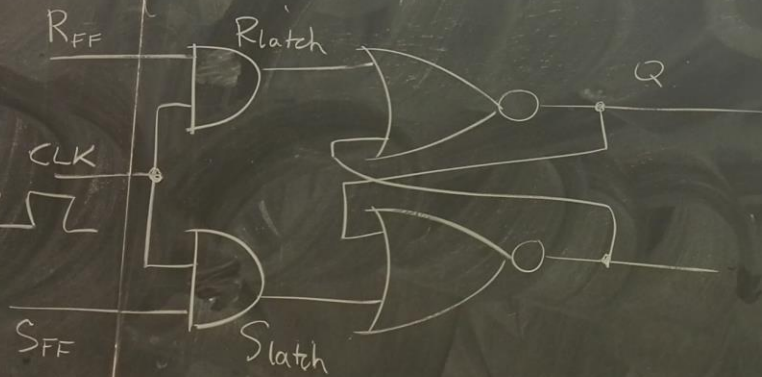
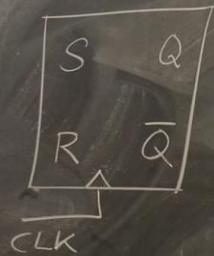
$$Q'_{FF} = Q'_{latch} \cdot CLK + Q \cdot \overline{CLK}$$

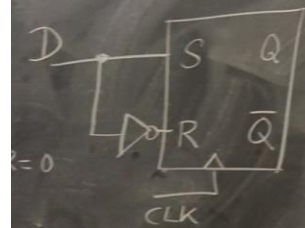
SR	Q			
	00	01	11	10
0	0	0	X	1
1	1	1	X	1

$$Q' = S + \bar{R}Q$$



+ $Q \overline{CLK}$





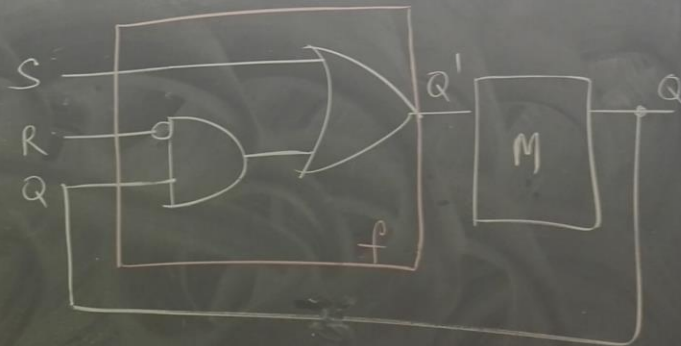
$\rightarrow$
 $D = S = \bar{R}$

$$Q' = D + DQ = D$$

$$Q' = D$$

ep. car.
 del FF D

NON FA
 HOLD =
 fa solo
 Set/reset



$$J\bar{Q} < Q \Rightarrow \bar{R} = \bar{K} + \bar{Q}$$

$$+ \bar{R}Q =$$

$$\bar{Q} + (\bar{K} + \bar{Q})Q =$$

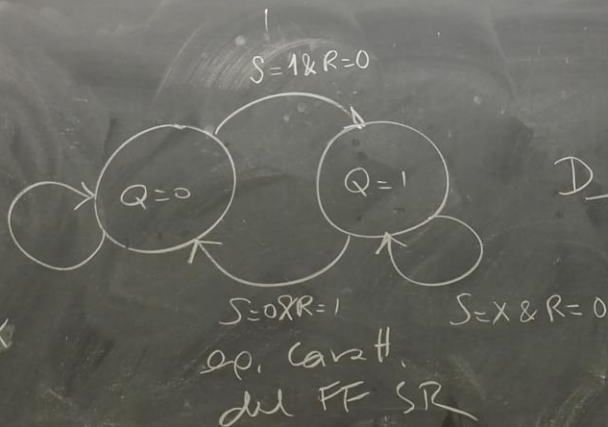
$$\bar{Q} + \bar{K}Q$$

$$\bar{Q} + \bar{T}Q = T \oplus Q$$

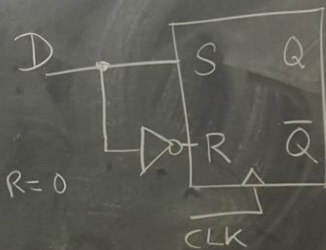
$$S=0 \& R=0$$

$$S=0 \& R=1$$

$$S=0 \& R=X$$



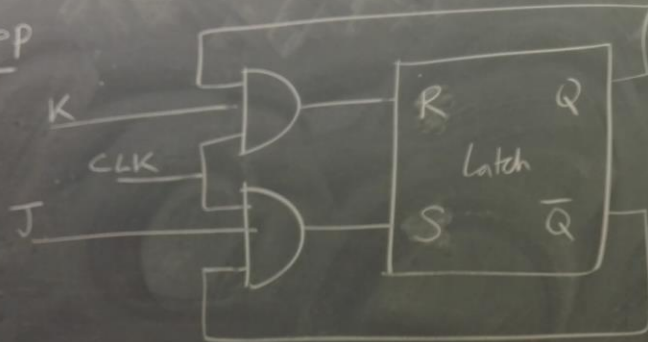
$$Q' = S + \bar{R}Q$$



$$D = S = \bar{R}$$

$$Q' = D + DQ = D$$

Flip-flop



FF
JK

(da Jack Kilby)

Se $D = \bar{K} = D$ Notteniamo il FF D

Se $J = K = T$ otteniamo il FF T

$$S = J\bar{Q}$$

$$R = KQ \Rightarrow \bar{R} = \bar{K} + \bar{Q}$$

$$Q' = S + \bar{R}Q =$$

$$= J\bar{Q} + (\bar{K} + \bar{Q})Q =$$

$$= J\bar{Q} + \bar{K}Q$$

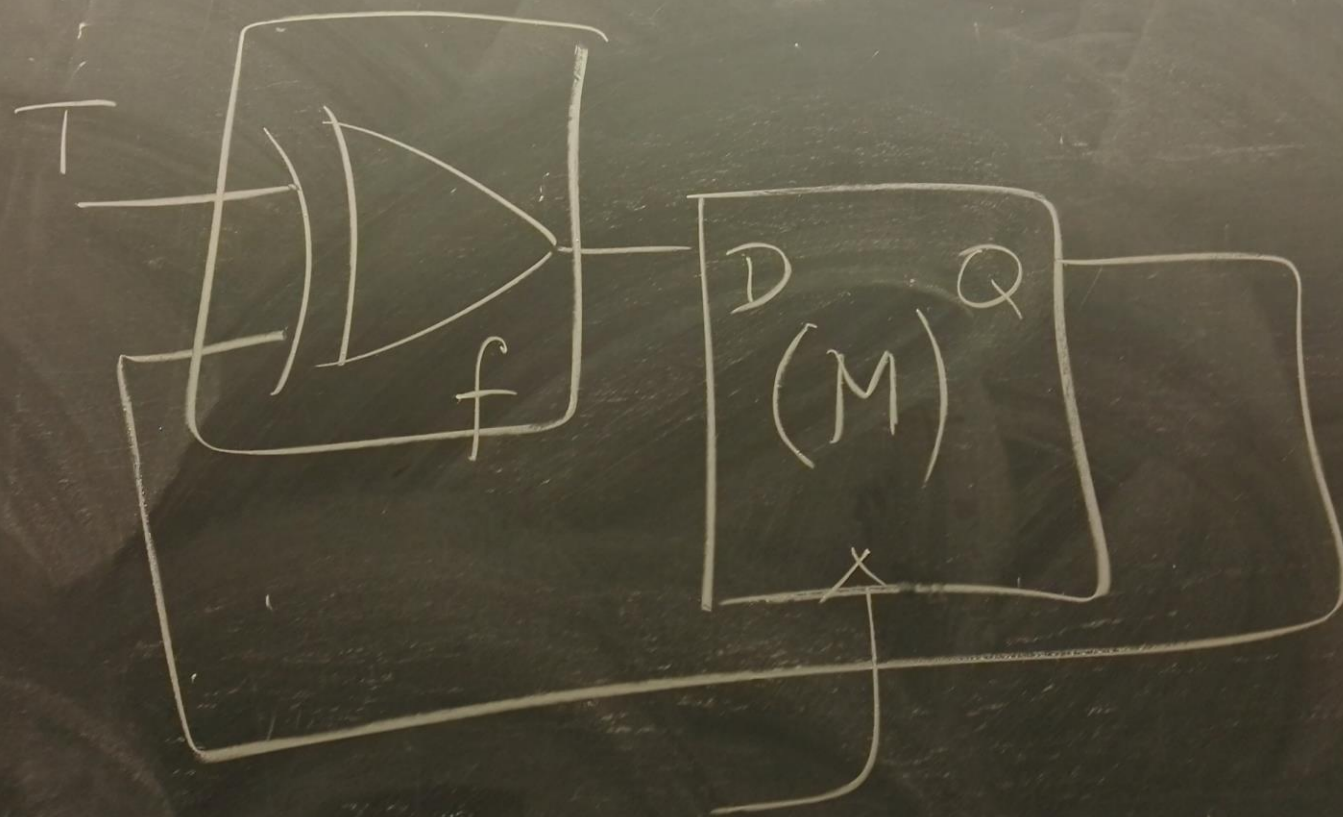
$$Q' = T\bar{Q} + TQ = T \oplus Q$$

$$S = 0 \& R = 1$$

$$S = 0 \& R = 0$$

$$S = 1 \& R = 0$$

J	K	Q'
0	0	Q
0	1	0
1	0	1
1	1	$\bar{Q}$



CLK

NON F
HOL