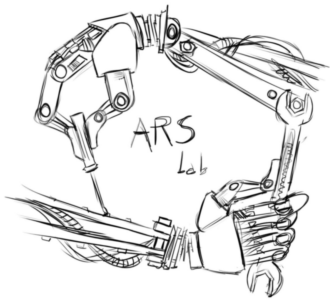
Tipologie di Flip Flop

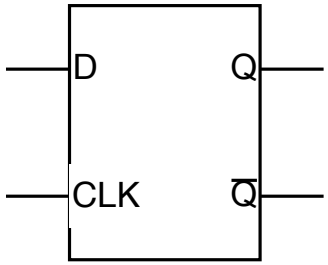
Corrado Santoro

Dipartimento di Matematica e Informatica
santoro@dmi.unict.it

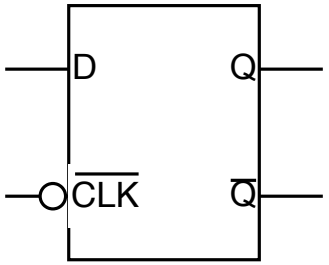


Corso di Architettura degli Elaboratori

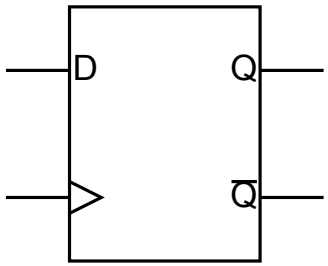
Simboli dei vari FF D-Type



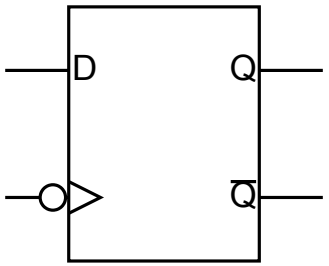
Level-Trigger, on CLK = 1



Level-Trigger, on CLK = 0

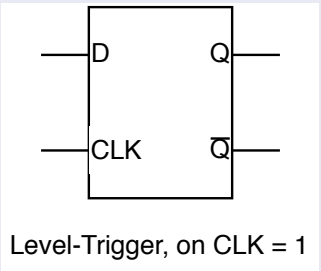


Edge-Trigger, on rising edge



Edge-Trigger, on falling edge

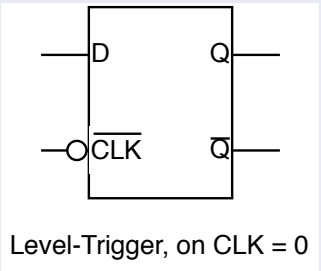
D-Type Positive-Level triggered



Level-Trigger, on CLK = 1

D	CLK	$Q(t)$	$\overline{Q}(t)$	
0	1	0	1	D copied to output
1	1	1	0	D copied to output
X	0	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

D-Type Negative-Level triggered

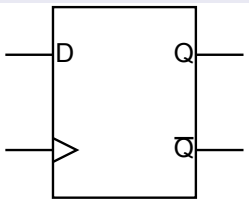


Level-Trigger, on CLK = 0

D	CLK	$Q(t)$	$\overline{Q}(t)$	
0	0	0	1	D copied to output
1	0	1	0	D copied to output
X	1	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

D-Type Edge Triggered

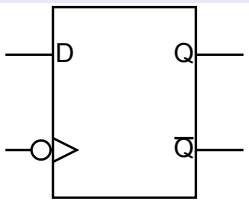
D-Type Rising-edge triggered



Edge-Trigger, on rising edge

D	CLK	$Q(t)$	$\overline{Q}(t)$	
0	$\uparrow$	0	1	D copied to output
1	$\uparrow$	1	0	D copied to output
X	X	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

D-Type Falling-edge triggered

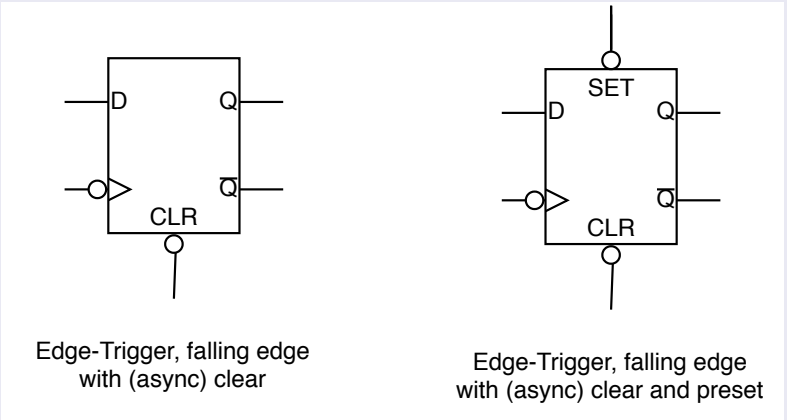


Edge-Trigger, on falling edge

D	CLK	$Q(t)$	$\overline{Q}(t)$	
0	$\downarrow$	0	1	D copied to output
1	$\downarrow$	1	0	D copied to output
X	X	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

D-Type Flip-Flop with Clear and Preset

Varianti dei FF D-Type



Edge-Trigger, falling edge with (async) clear

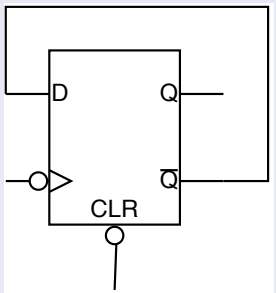
Edge-Trigger, falling edge with (async) clear and preset

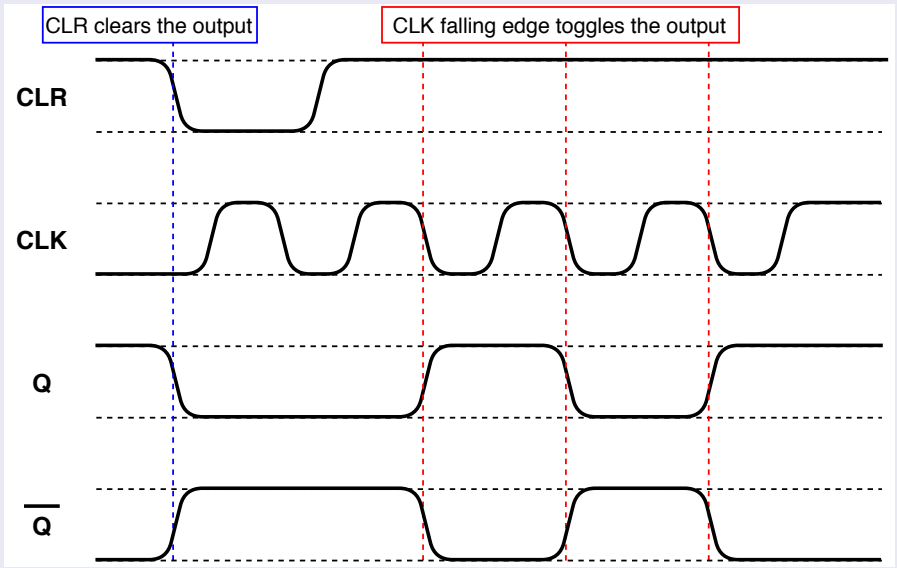
A volte i FF possono presentare degli ingressi di *CLEAR* o di *PRESET* che permettono di forzare le uscite indipendentemente dagli ingressi di *D* e *CLOCK*

D	CLK	CLR	SET	$Q(t)$	$\overline{Q}(t)$	
X	X	0	1	0	1	output clear
X	X	1	0	1	0	output set
0	$\downarrow$	1	1	0	1	D copied to output
1	$\downarrow$	1	1	1	0	D copied to output
X	X	1	1	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

Altri Flip-Flop costruiti sui D-Type

FF T-Type

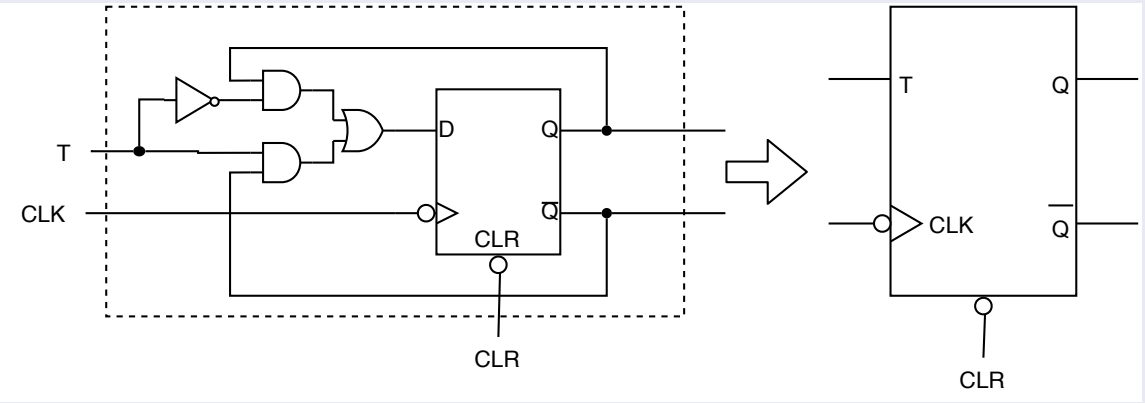




- Se, in un D-type, colleghiamo l'ingresso D all'uscita $\overline{Q}$ otteniamo un flip-flop denominato **T-type (toggle)**
- Ad ogni "colpo di clock", l'uscita $\overline{Q}$ viene "copiata" su Q
- Otteniamo cioè che (ad ogni colpo di clock) $Q(t) = \overline{Q}(t-1)$
- In altri terimini, ad ogni colpo di clock le uscite **cambiano stato (toggle)**

Altri Flip-Flop costruiti sui D-Type

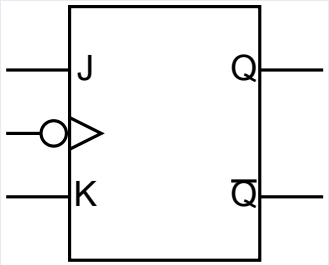
FF T-Type



- I FF T-type hanno il clock controllato da un ingresso **T**
- Se $T = 1$, il FF cambia stato al colpo di clock
- Se $T = 0$, il FF lo stato non cambia in nessun caso

T	CLK	CLR	$Q(t)$	$\overline{Q}(t)$	
X	X	0	0	1	output clear
1	$\downarrow$	1	$\overline{Q}(t-1)$	$Q(t-1)$	output toggle
0	X	1	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged

FF JK-Type



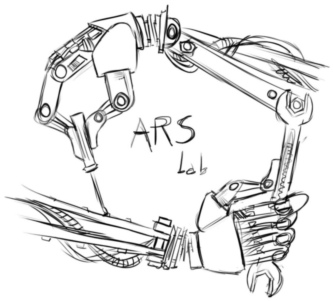
- I FF JK-type, a seconda dello stato degli input J e K, possono funzionare in modalità
  - **Toggle**
  - **Set-Reset**

J	K	CLK	$Q(t)$	$\overline{Q}(t)$	
0	0	$\downarrow$	$Q(t-1)$	$\overline{Q}(t-1)$	unchanged
0	1	$\downarrow$	0	1	output clear
1	0	$\downarrow$	1	0	output set
1	1	$\downarrow$	$\overline{Q}(t-1)$	$Q(t-1)$	output toggle

Tipologie di Flip Flop

Corrado Santoro

Dipartimento di Matematica e Informatica
santoro@dmi.unict.it



Corso di Architettura degli Elaboratori