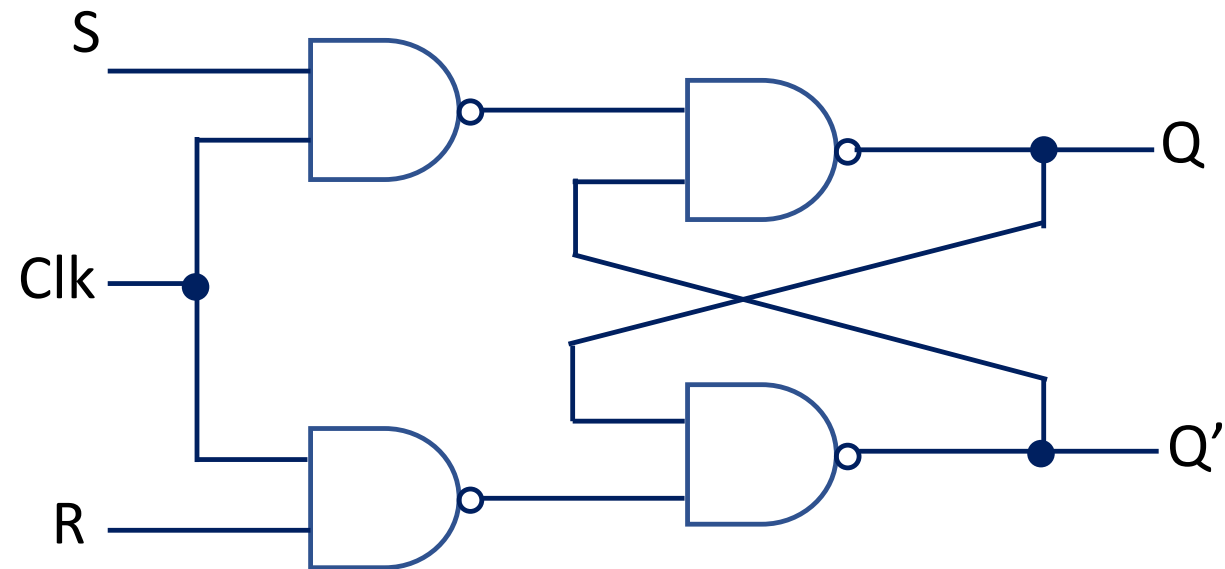
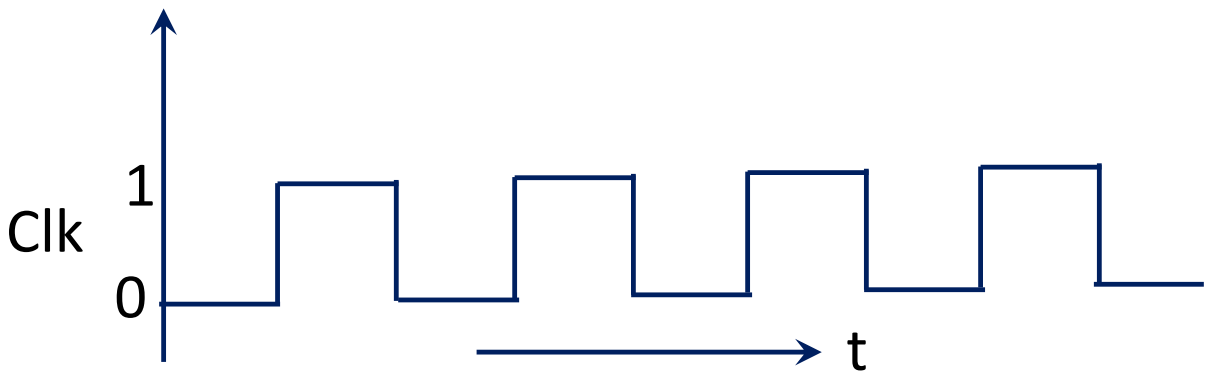
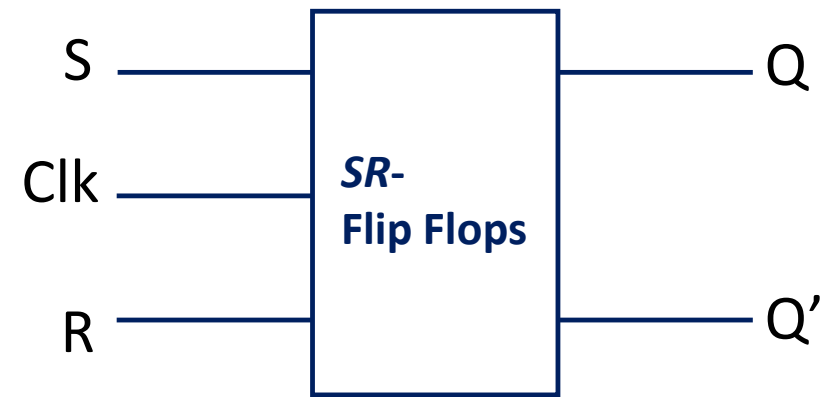


# SR-Flip Flops

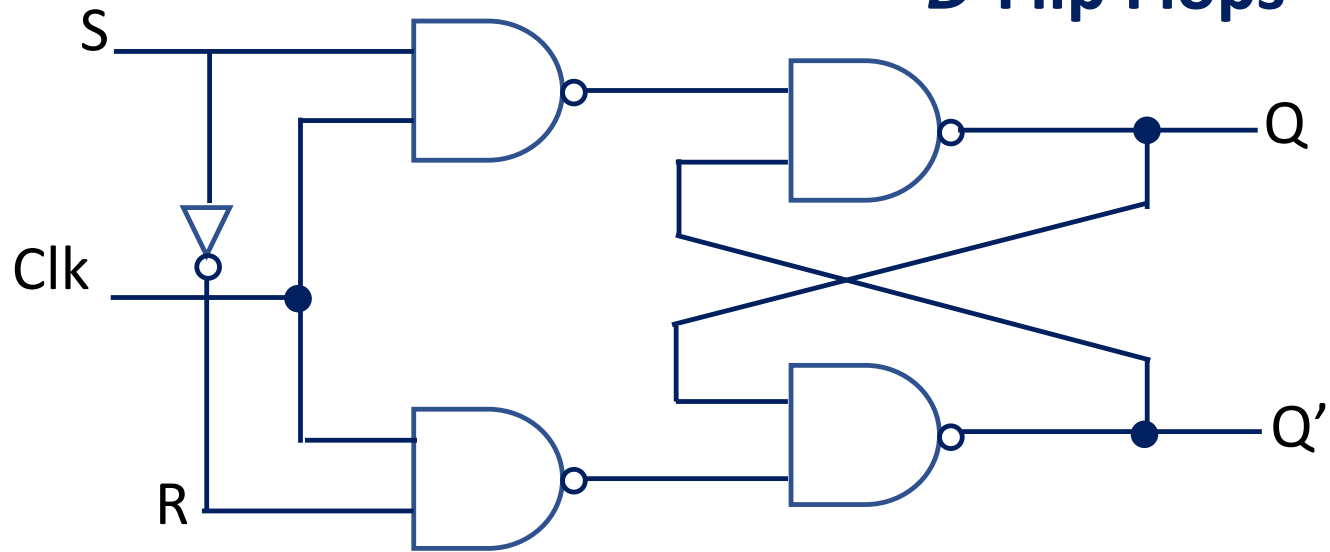


| Clk | S | R | Q        | Q' |
|-----|---|---|----------|----|
| 0   | X | X | Memory   |    |
| 1   | 0 | 0 | Memory   |    |
| 1   | 1 | 0 | 1        | 0  |
| 1   | 0 | 1 | 0        | 1  |
| 1   | 1 | 1 | Not used |    |

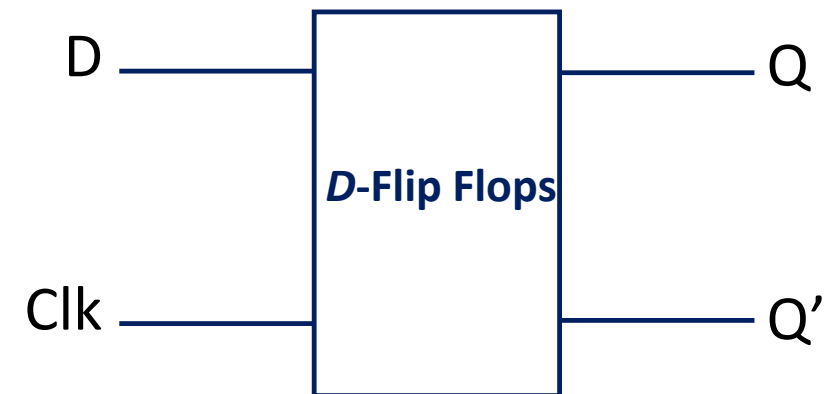
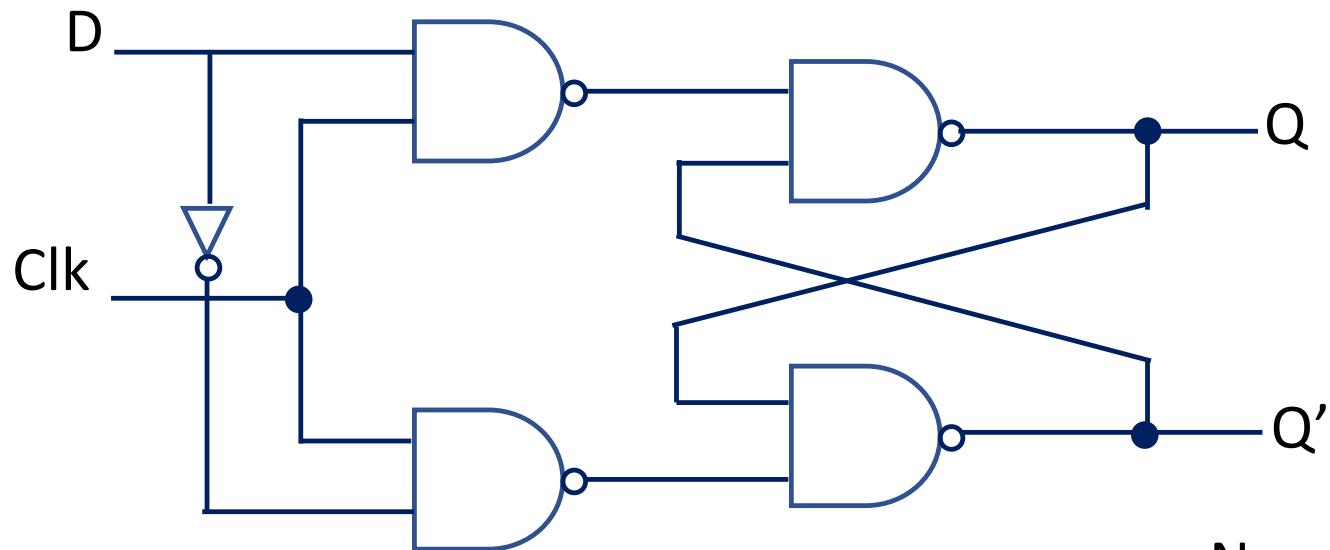


- Inputs are applied when clock is 0 and then enable the clock to transfer the inputs to output.

## D-Flip Flops

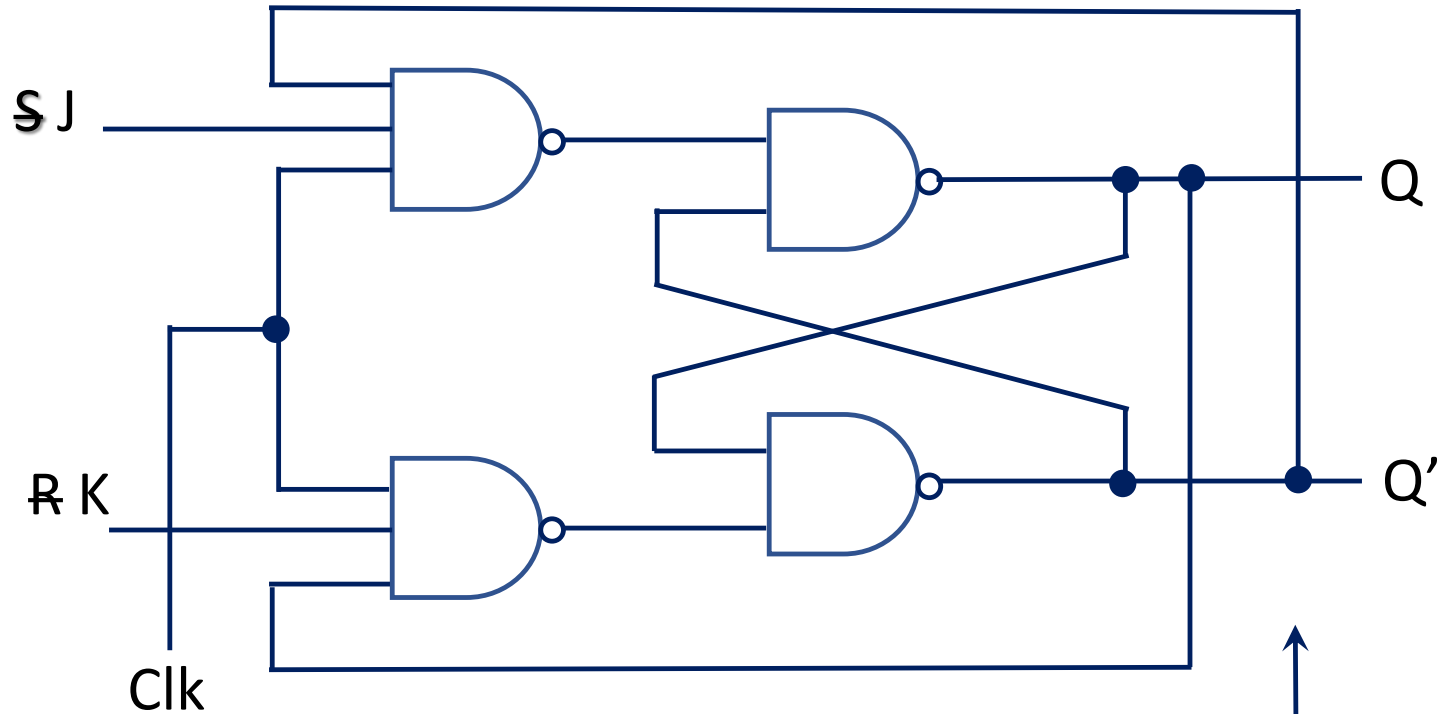


| Clk | D | Q      | Q' |
|-----|---|--------|----|
| 0   | X | Memory |    |
| 1   | 1 | 1      | 0  |
| 1   | 0 | 0      | 1  |

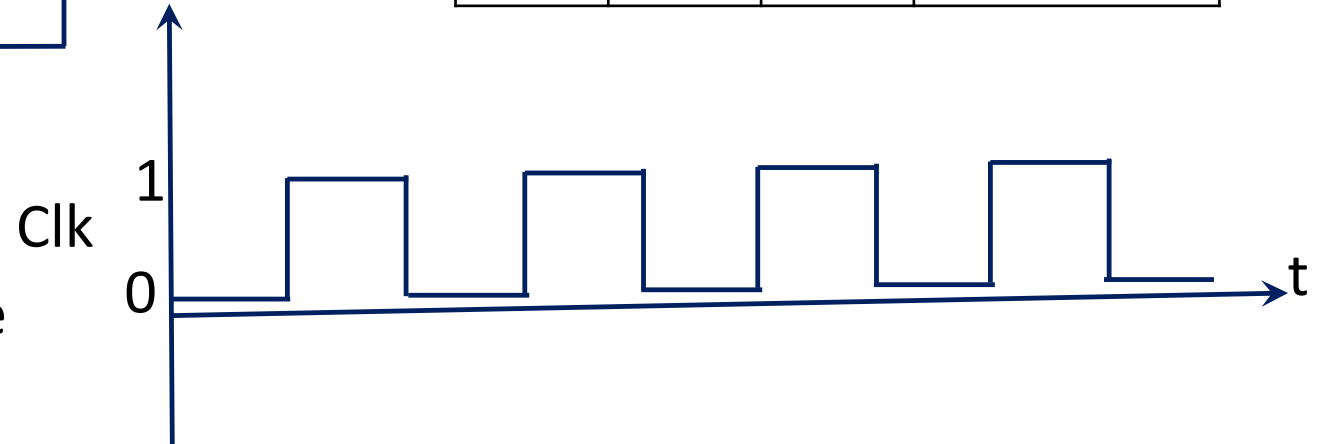


- No need to put  $S = 0$  and  $R = 0$  for memory.

# RACING

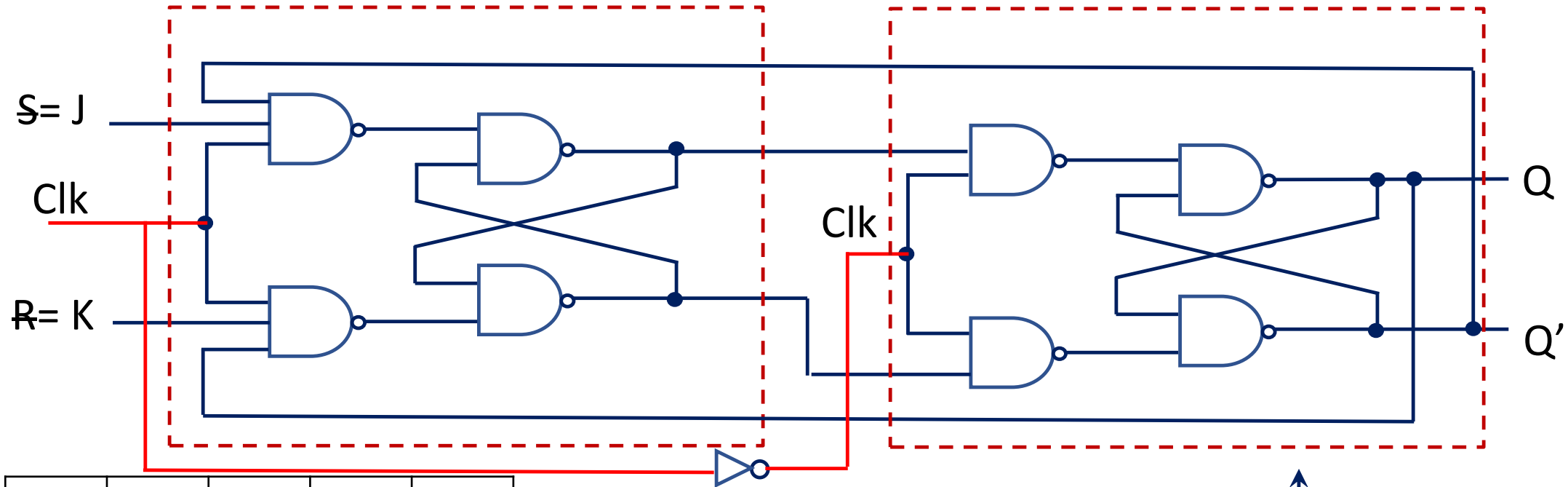


| Clk | S | R | Q      | Q' |
|-----|---|---|--------|----|
| 0   | X | X | Memory |    |
| 1   | 0 | 0 | Memory |    |
| 1   | 1 | 0 | 1      | 0  |
| 1   | 0 | 1 | 0      | 1  |
| 1   | 1 | 1 | Racing |    |

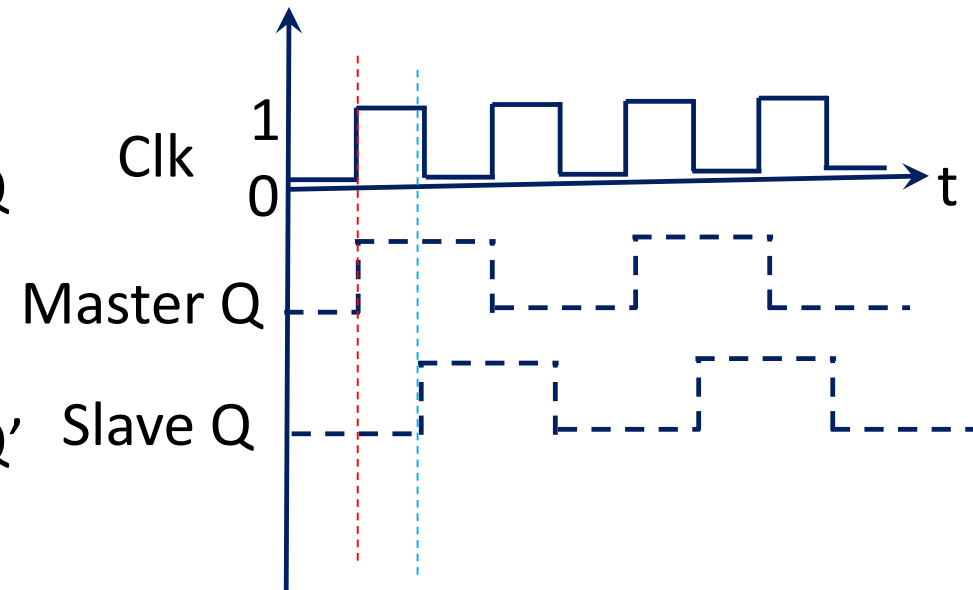
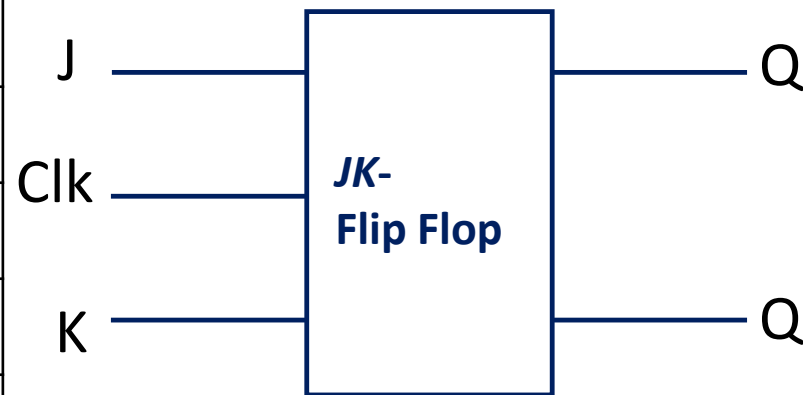


- Racing can be avoided if the clock time is less than propagation delay or
- Flip Flop is made to toggle only once in clock period.

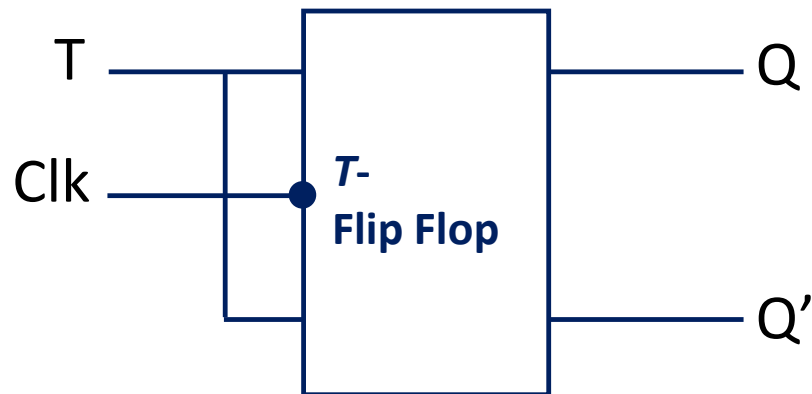
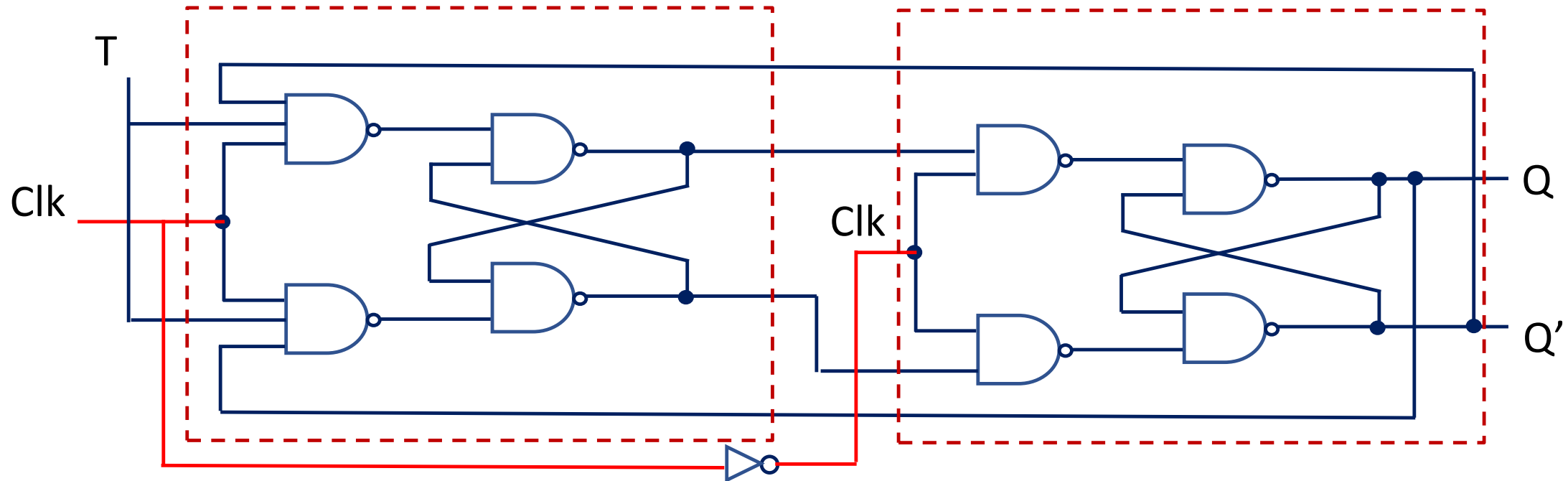
# Master-Slave Flip Flop (JK-Flip-Flop)



| Clk | J | K | Q      | Q' |
|-----|---|---|--------|----|
| 0   | X | X | Memory |    |
| 1   | 0 | 0 | Memory |    |
| 1   | 1 | 0 | 1      | 0  |
| 1   | 0 | 1 | 0      | 1  |
| 1   | 1 | 1 | Q'     | Q  |



# Master-Slave Flip Flop (T-Flip-Flop)



| Clk | T | $Q_{n+1}$ |
|-----|---|-----------|
| 0   | X | $Q_n$     |
| 1   | 0 | $Q_n$     |
| 1   | 1 | $Q_n'$    |