Flip-flops & Race-around Problems

Farhan Tanvir
1805073
Shehabul Islam Sawraz
1805088

Department of Computer Science and Engineering
Bangladesh University of Engineering and Technology

August 29, 2022

Table of Contents

Checkpoint

Before We Start!!!

- Before we dive into the discussions of Flip-flops, let's go for a quick introduction of it!
- And for that, we will need to know about one important concept first!

Before We Start!!!

- Before we dive into the discussions of Flip-flops, let's go for a quick introduction of it!
- And for that, we will need to know about one important concept first!

Sequential Circuits

- We know, pretty much in everywhere, output depends on input.

Sequential Circuits

- We know, pretty much in everywhere, output depends on input.
- Putting it more formally in case of circuits... present output depends on present input.

Sequential Circuits

- We know, pretty much in everywhere, output depends on input.
- Putting it more formally in case of circuits... present output depends on present input.
- **But output of sequential circuits depend on past output too!!!**

Sequential Circuits (contd.)

- That brings an important point: we need to store the past output somewhere.

Sequential Circuits (contd.)

- That brings an important point: we need to store the past output somewhere.
- For that, we need storage devices.

Sequential Circuits (contd.)

- That brings an important point: we need to store the past output somewhere.
- For that, we need storage devices.
- And here is where **Flip-flop** comes in play.

Sequential Circuits (contd.)

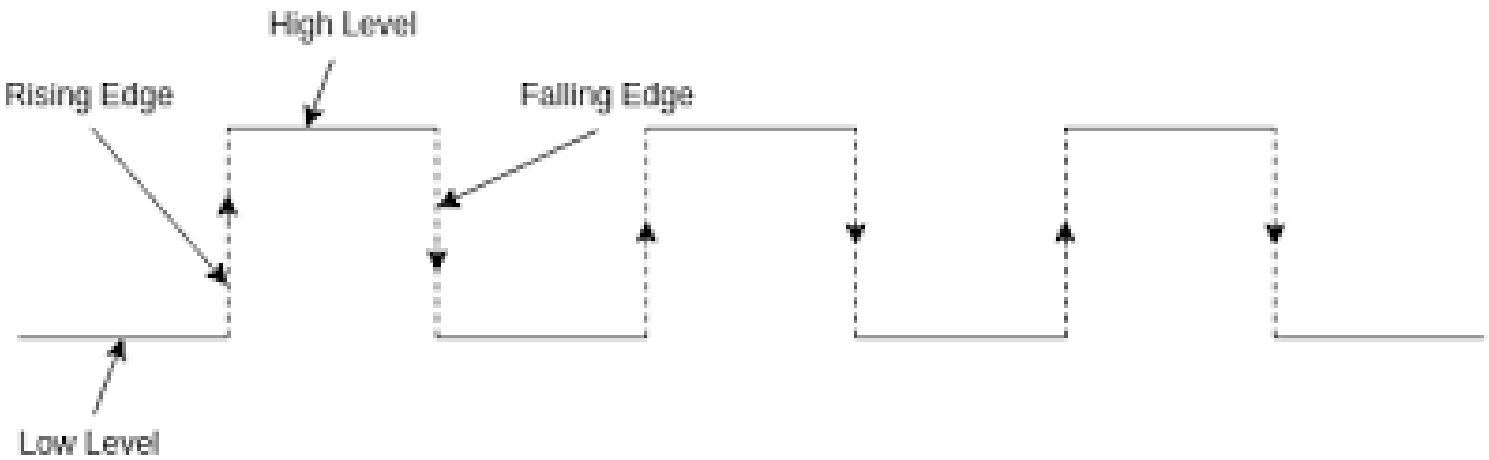
- That brings an important point: we need to store the past output somewhere.
- For that, we need storage devices.
- And here is where **Flip-flop** comes in play.
- This whole thing is also known as storing the state of our circuit.

Two Important Questions

1. What does Flip-flop do?
   - It stores and updates the state of our circuit

Two Important Questions

1. What does Flip-flop do?
   - It stores and updates the state of our circuit
2. How does it know when to update the state?
   - It updates upon receiving a signal, whom we refer to as clock



Checkpoint

Types of Flip-flops

- SR (Set-Reset FF)
- D (Delay FF)
- T (Toggle FF)

Types of Flip-flops

- SR (Set-Reset FF)
- D (Delay FF)
- T (Toggle FF)
- **JK (Jack Kilby FF)**

Checkpoint

Truth Table for JK Flip-flop

J	K	Q_{n-1}	Q_n	Mode
0	0	0	0	Hold/Store
0	0	1	1	
0	1	0	0	Reset
0	1	1	0	
1	0	0	1	Set
1	0	1	1	
1	1	0	1	Toggle
1	1	1	0	

Truth Table for JK Flip-flop

J	K	Q_{n-1}	Q_n	Mode
0	0	0	0	Hold/Store
0	0	1	1	
0	1	0	0	Reset
0	1	1	0	
1	0	0	1	Set
1	0	1	1	
1	1	0	1	Toggle
1	1	1	0	

Truth Table for JK Flip-flop

J	K	Q_{n-1}	Q_n	Mode
0	0	0	0	Hold/Store
0	0	1	1	
0	1	0	0	Reset
0	1	1	0	
1	0	0	1	Set
1	0	1	1	
1	1	0	1	Toggle
1	1	1	0	

Truth Table for JK Flip-flop

J	K	Q_{n-1}	Q_n	Mode
0	0	0	0	Hold/Store
0	0	1	1	
0	1	0	0	Reset
0	1	1	0	
1	0	0	1	Set
1	0	1	1	
1	1	0	1	Toggle
1	1	1	0	

Truth Table for JK Flip-flop

J	K	Q_{n-1}	Q_n	Mode
0	0	0	0	Hold/Store
0	0	1	1	
0	1	0	0	Reset
0	1	1	0	
1	0	0	1	Set
1	0	1	1	
1	1	0	1	Toggle
1	1	1	0	

Some Trouble Waiting?

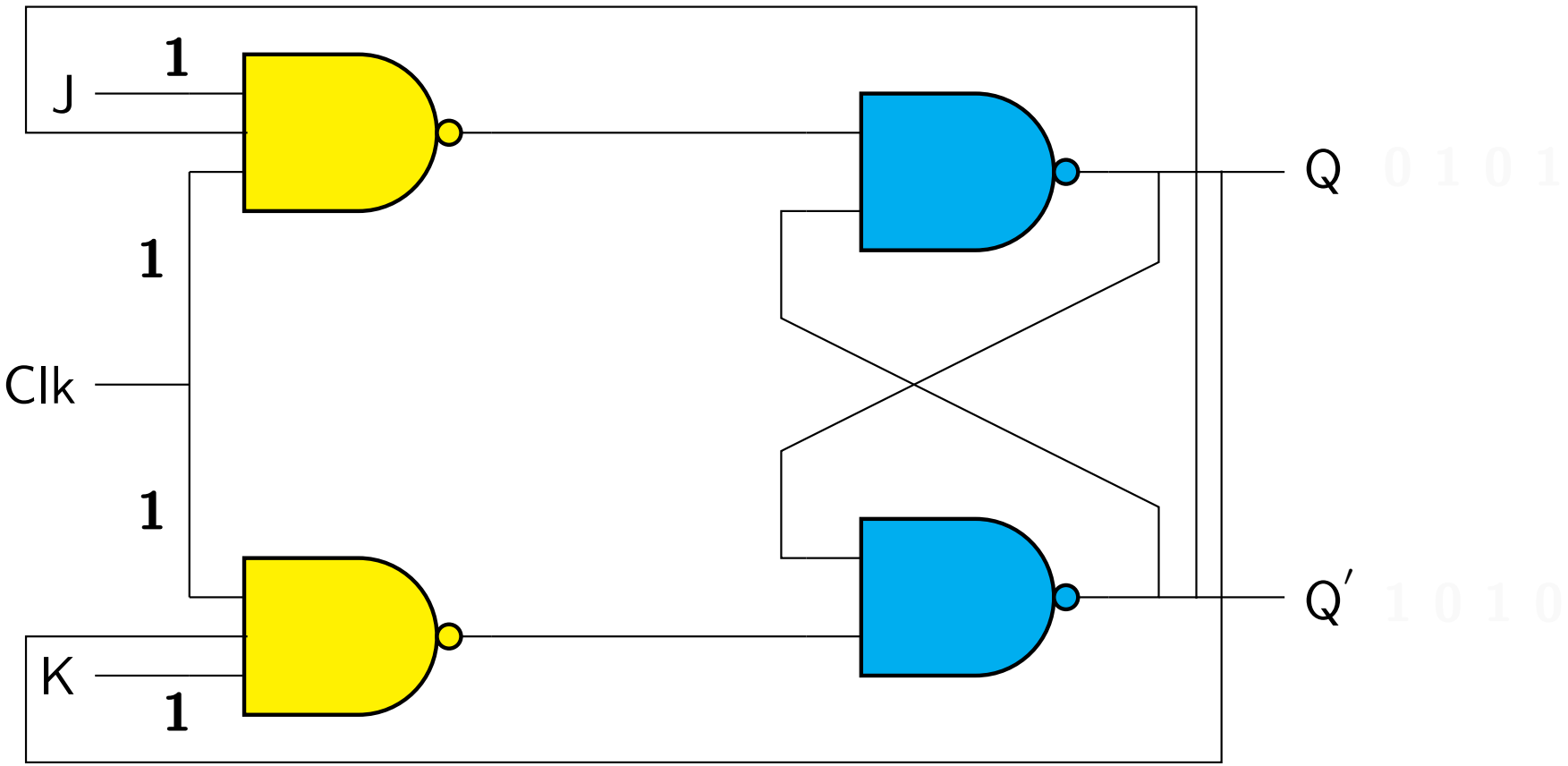
When $J = K = 1$, an interesting event may occur depending on the clock mechanism. This event is known as Race Around Condition

Some Trouble Waiting?

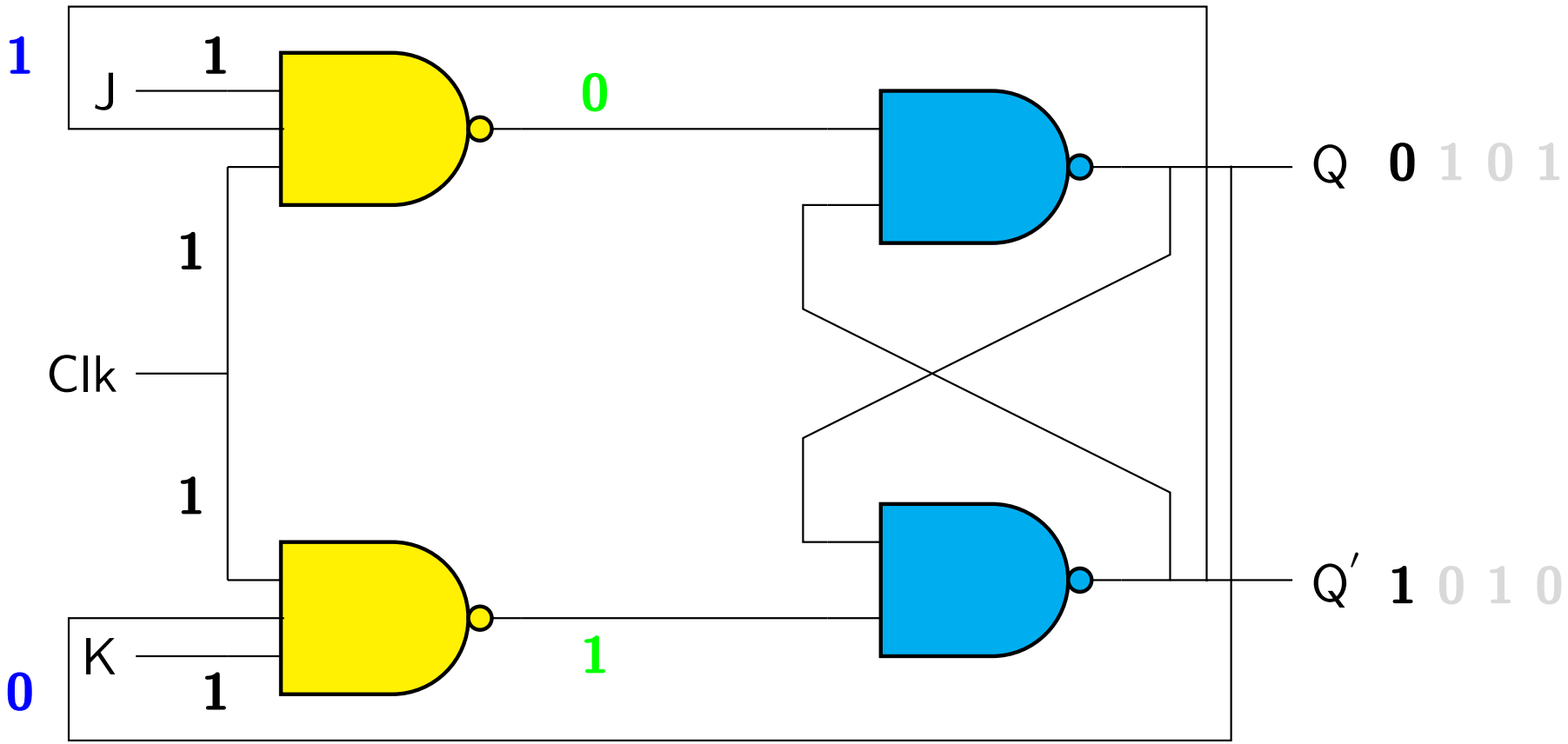
When $J = K = 1$, an interesting event may occur depending on the clock mechanism. This event is known as Race Around Condition

Checkpoint

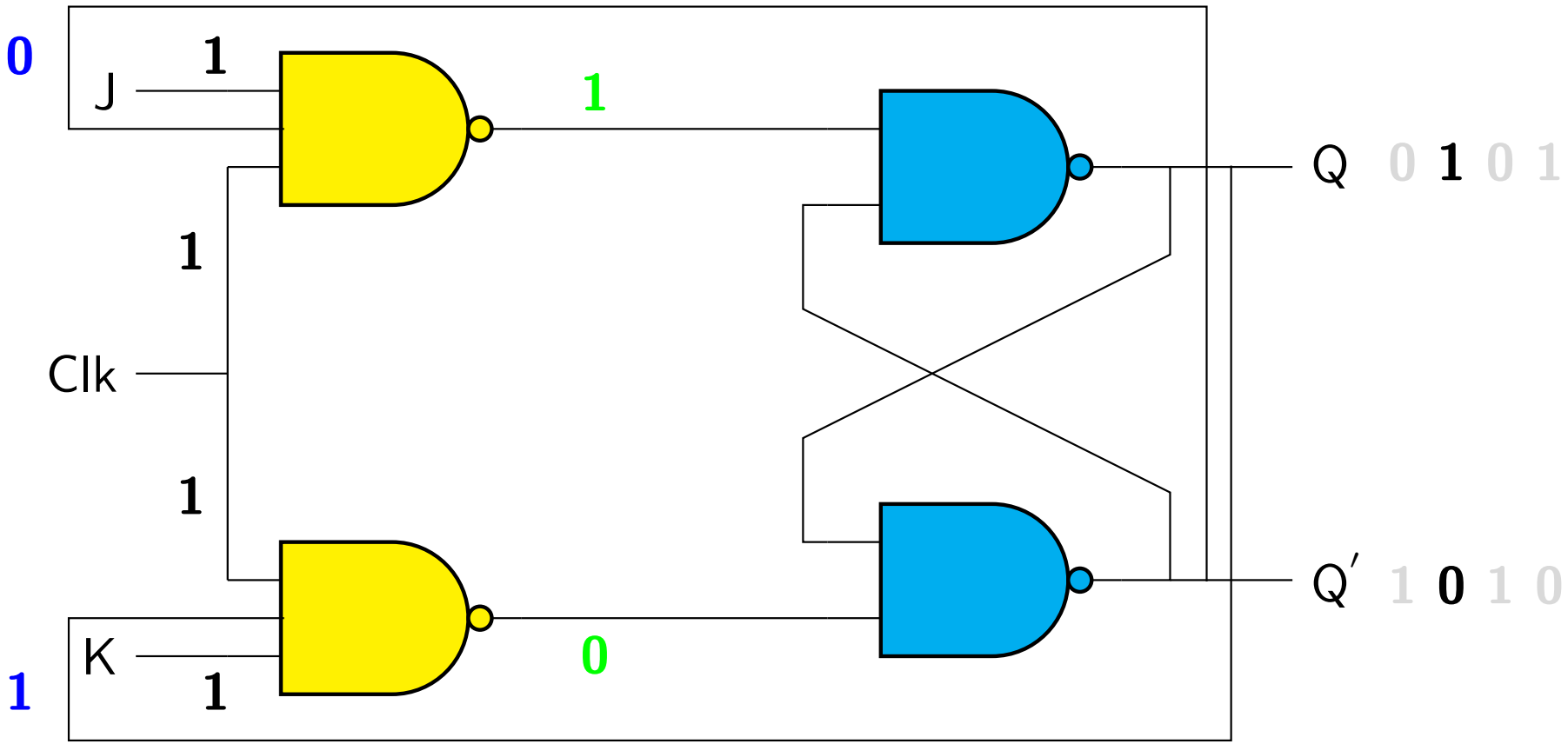
Circuit Diagram for $J = K = 1$



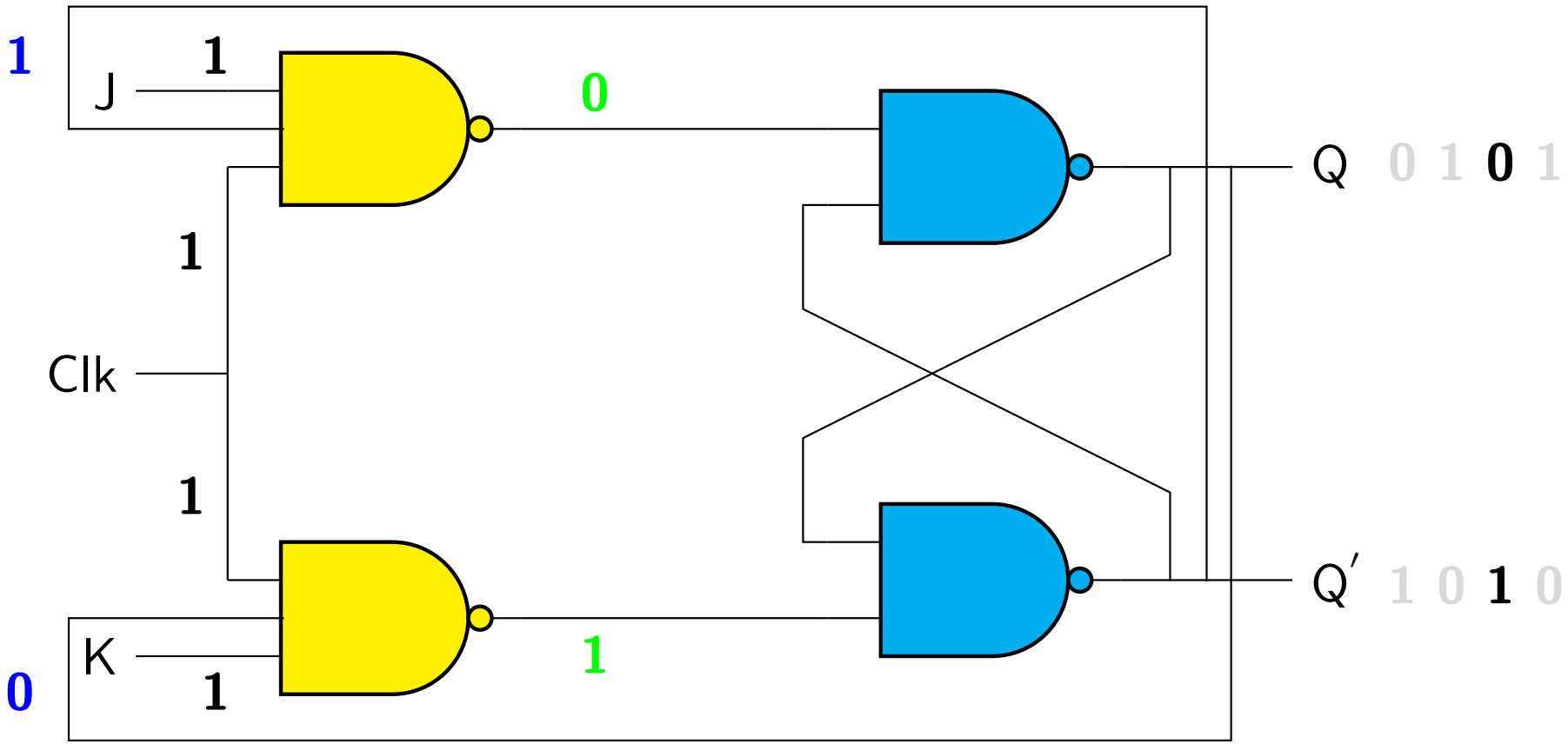
Circuit Diagram for $J = K = 1$



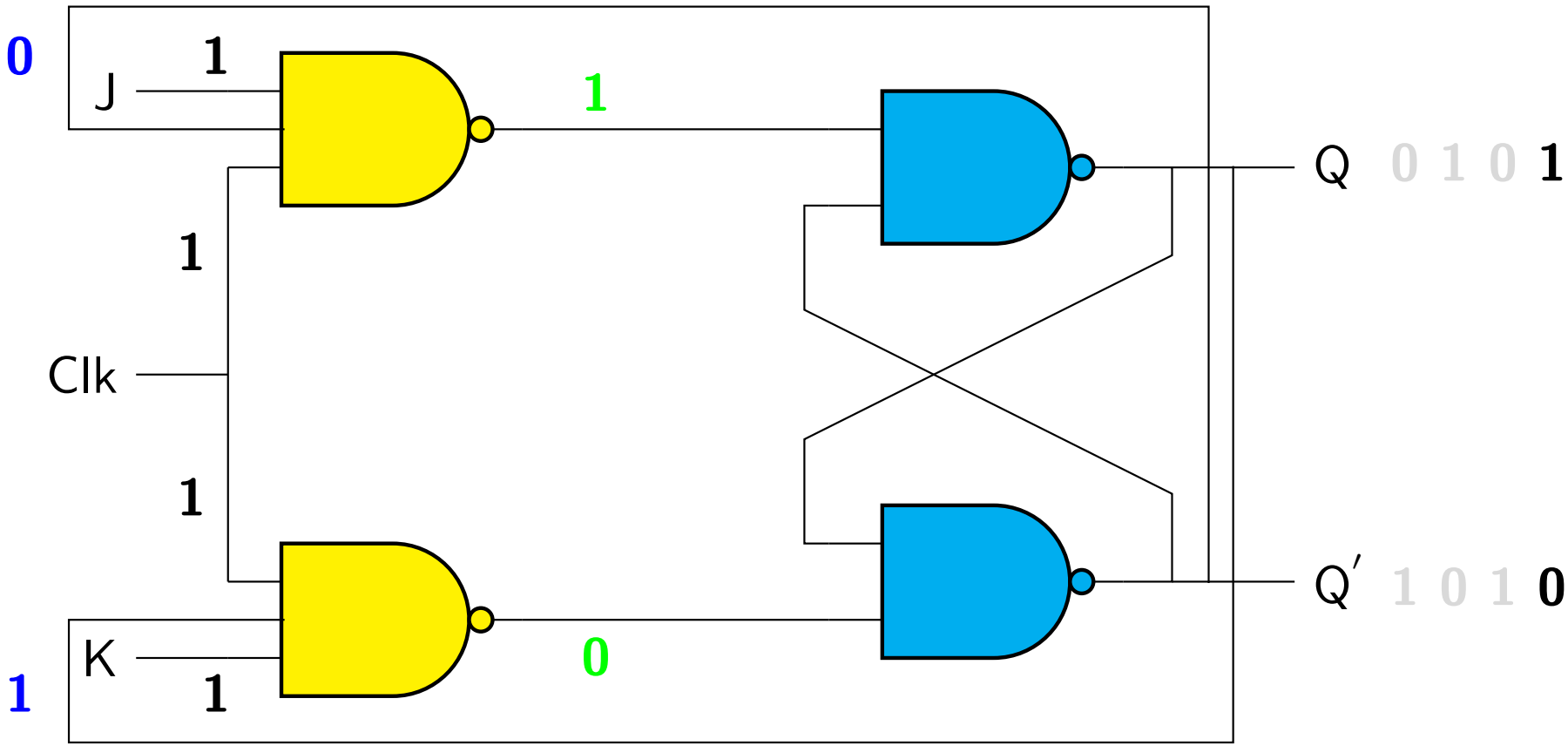
Circuit Diagram for $J = K = 1$



Circuit Diagram for $J = K = 1$



Circuit Diagram for $J = K = 1$



Checkpoint

Some Misconception!!

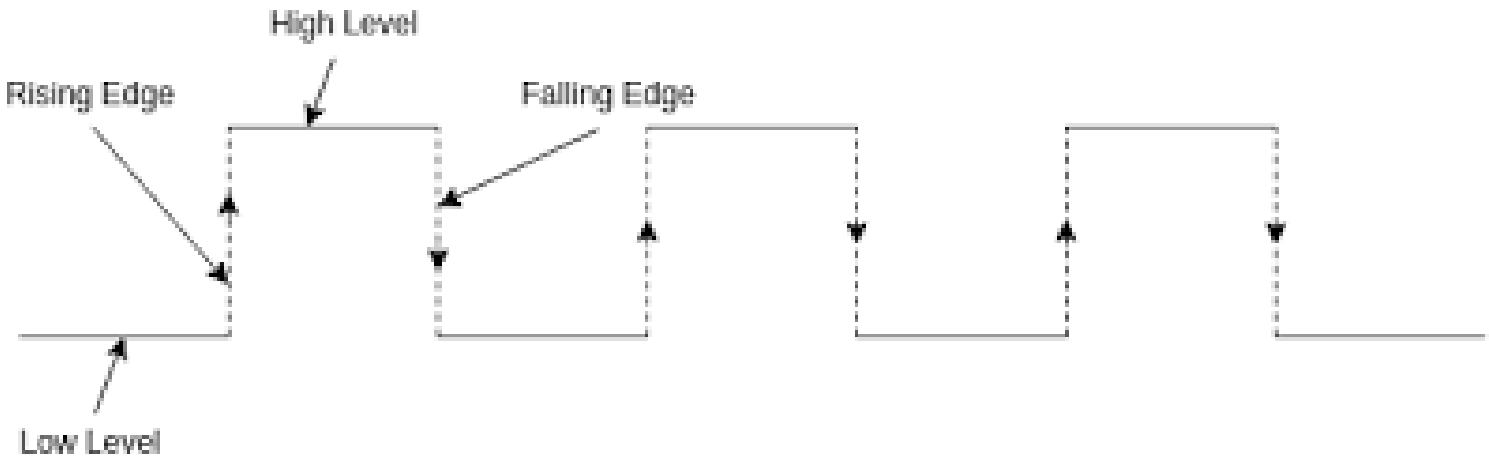
Fallacy

Toggling & Race Condition is same

Checkpoint

Solution

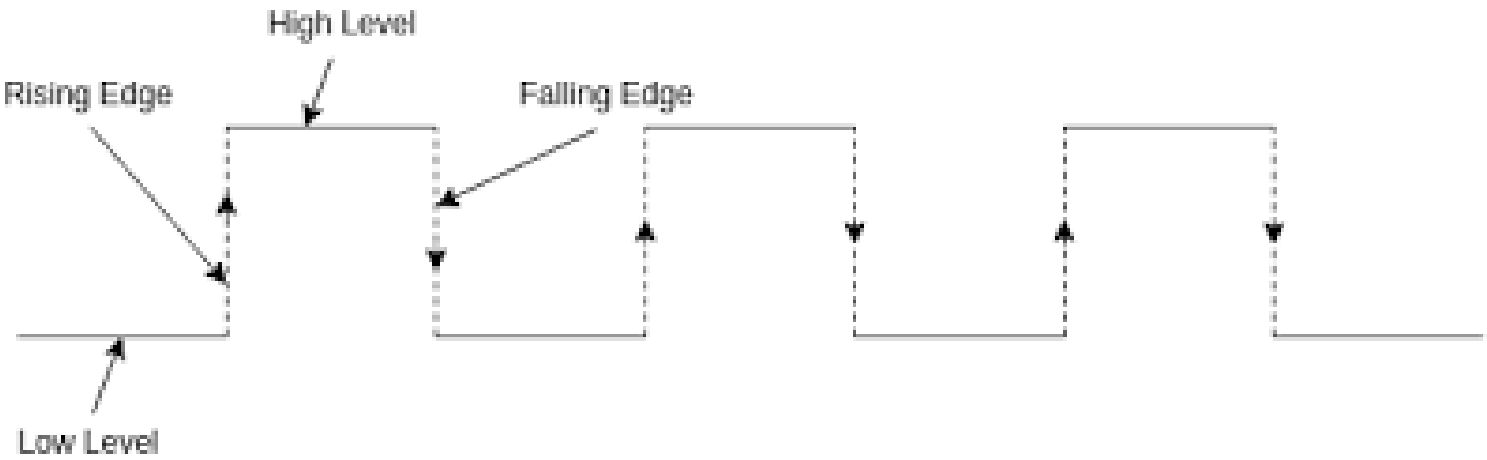
1. Use edge triggering instead of level triggering



2. Use Master-Slave JK Flip-Flop

Solution

1. Use edge triggering instead of level triggering



2. Use Master-Slave JK Flip-Flop