# Circuit Simulation Project

https://esim.fossee.in/circuit-simulation-project

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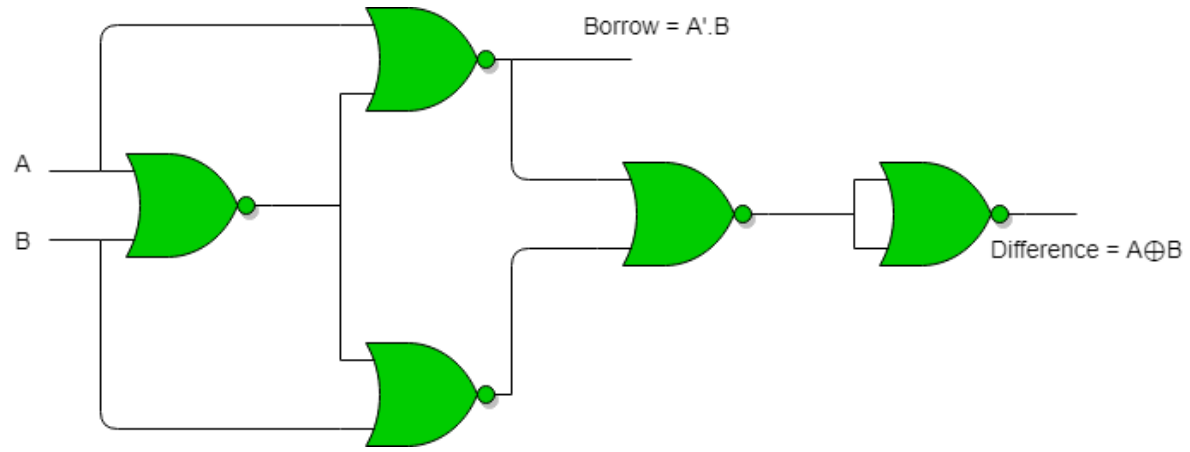
**Project Guide:** Dr R. Maheshwari
**Title of the Circuit:** Half Subtractor using NOR gates

**Description:**

The **Half Subtractor** is a digital circuit which processes the subtraction of two 1-bit numbers. In this, the two numbers involved are termed as **subtrahend** and **minuend.** In the subtraction procedure, the subtrahend will be subtracted from minuend. The circuit of Half subtractor consists of two inputs and two outputs. The inputs of the half subtractor circuit will be subtrahend and minuend. On the other hand, the output will be the difference and the borrow. The NOR gate is a universal gate and can be used to design the half subtractor. A minimum of five NOR gates are required to build a half subtractor. Half subtractor has two inputs A and B. There are two outputs Difference and Borrow. The difference is equal to (A⊕B) and the borrow is equal to (A'.B).

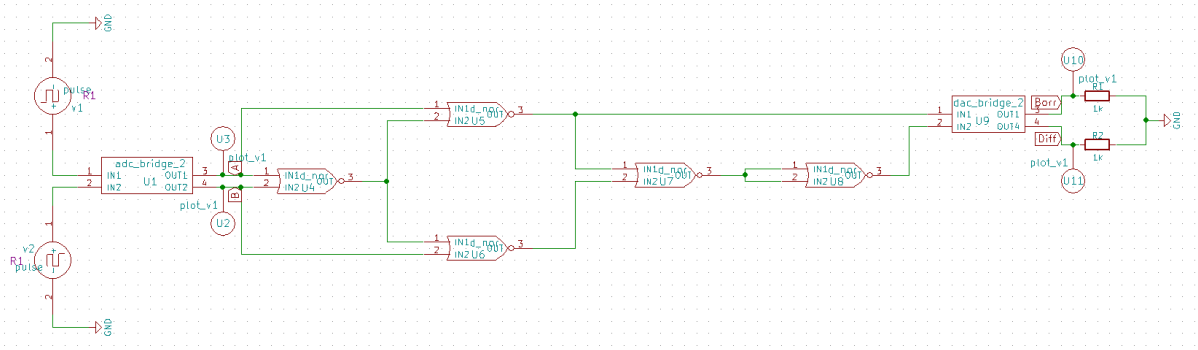
**Circuit :**




**Truth table :**

| A | B | Difference | Borrow |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |

## e-Sim Schematic :




## Source details :

Add parameters for pulse source v1

| | |
|---|---|
| Enter initial value(Volts/Amps): | 0 |
| Enter pulsed value(Volts/Amps): | 5 |
| Enter delay time (seconds): | 10 |
| Enter rise time (seconds): | 0 |
| Enter fall time (seconds): | 0 |
| Enter pulse width (seconds): | 10 |
| Enter period (seconds): | 20 |

Add parameters for pulse source v2

| | |
|---|---|
| Enter initial value(Volts/Amps): | 0 |
| Enter pulsed value(Volts/Amps): | 5 |
| Enter delay time (seconds): | 5 |
| Enter rise time (seconds): | 0 |
| Enter fall time (seconds): | 0 |
| Enter pulse width (seconds): | 5 |
| Enter period (seconds): | 10 |

## Transient details :

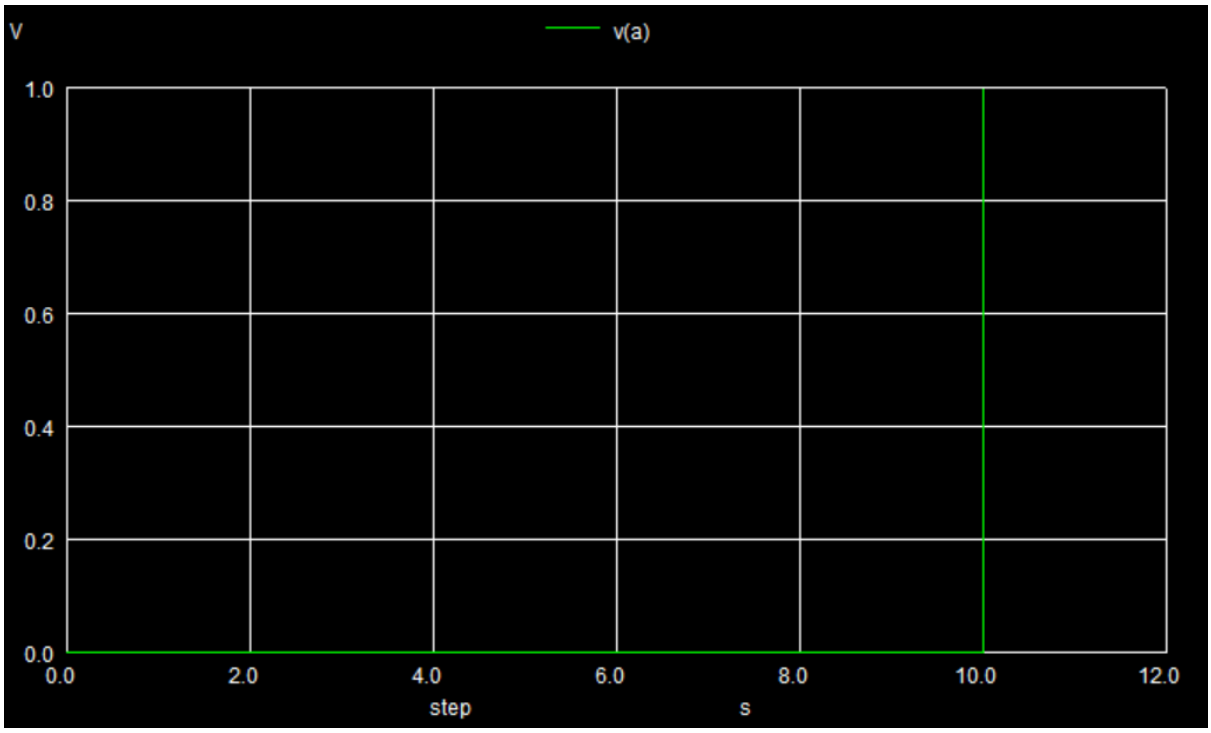
Transient Analysis

| | | |
|---|---|---|
| Start Time | 0 | Sec |
| Step Time | 10 | ms |
| Stop Time | 20 | Sec |

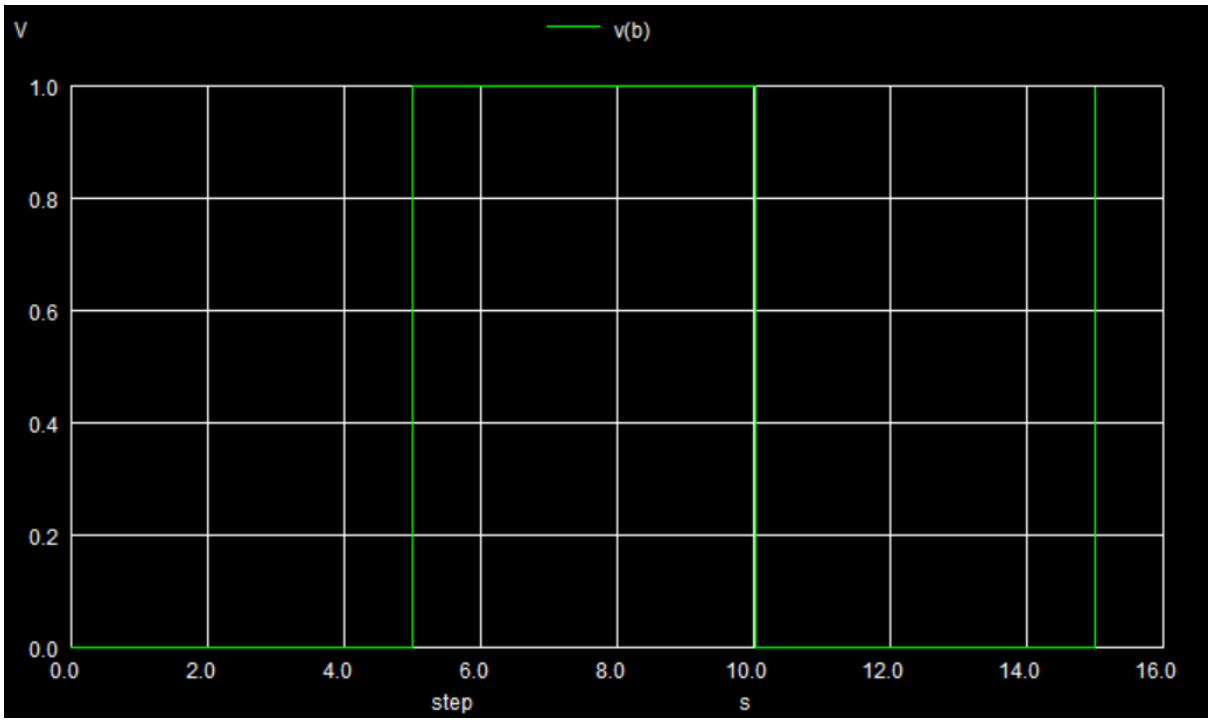
**Simulation results :**

**1.NgSpice Waveforms**

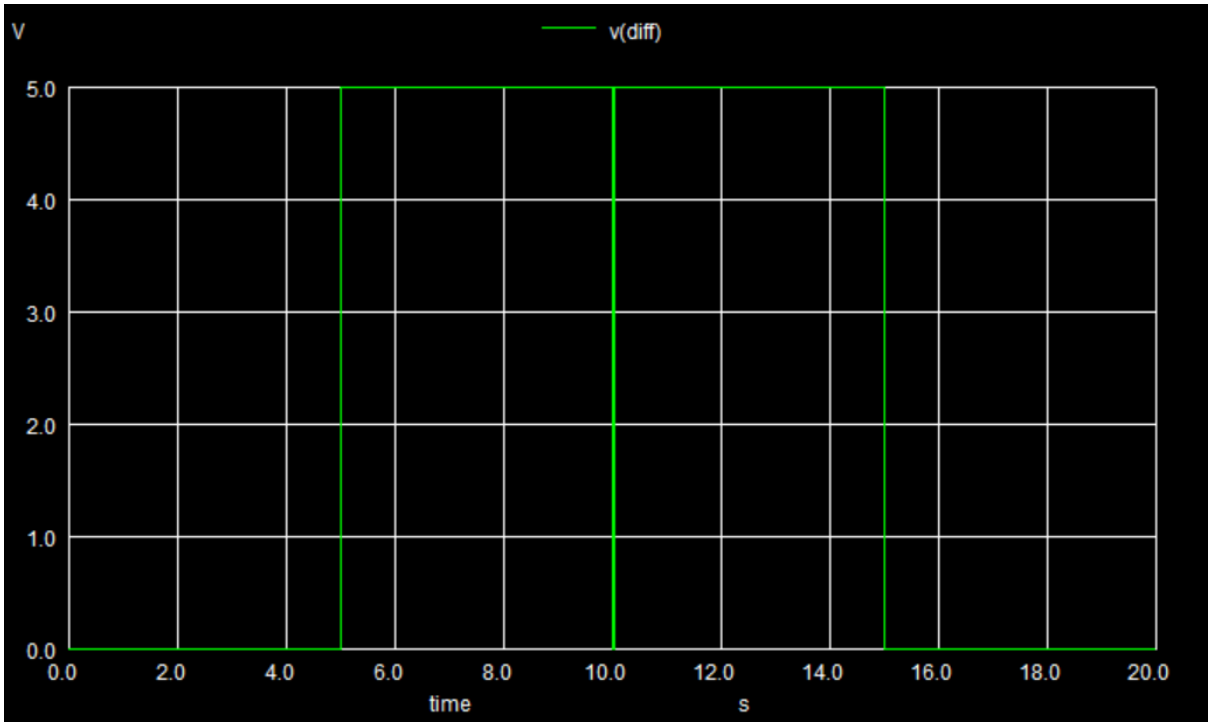
A



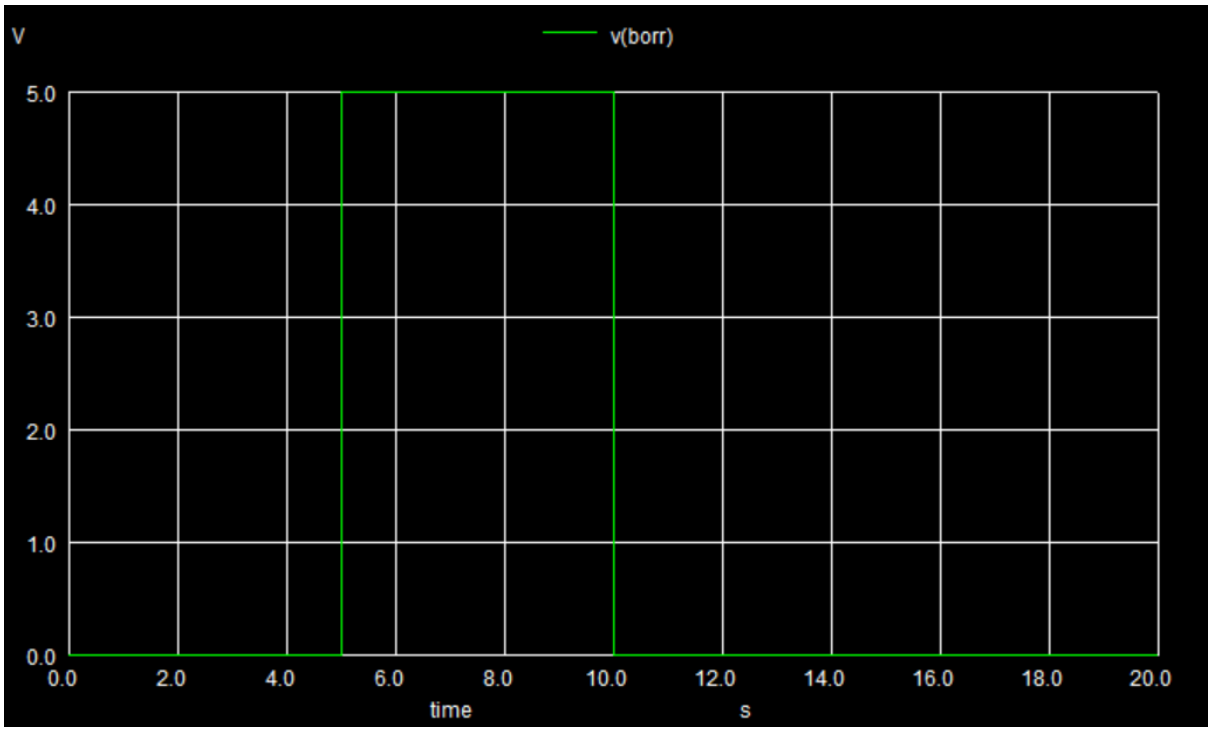

B



Difference

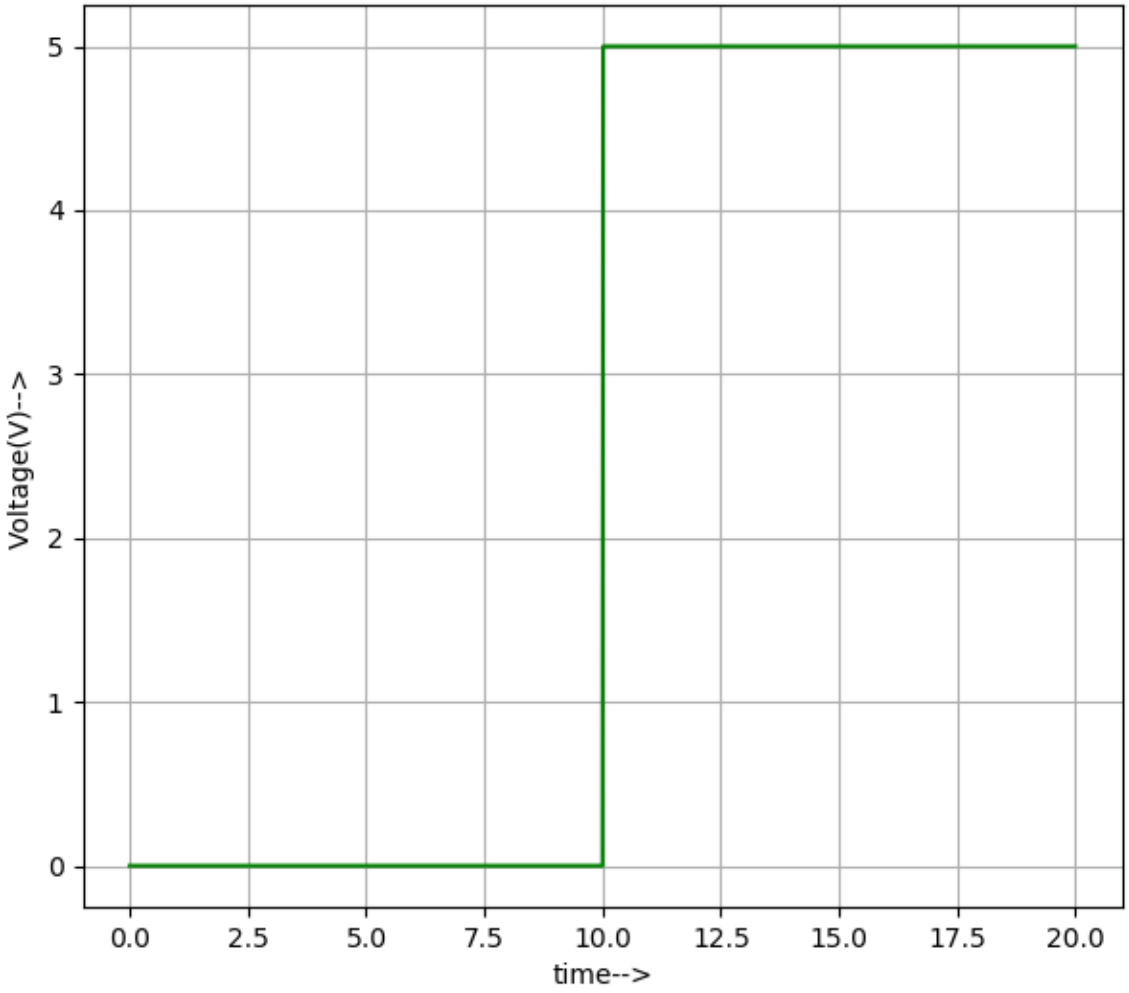



Borrow

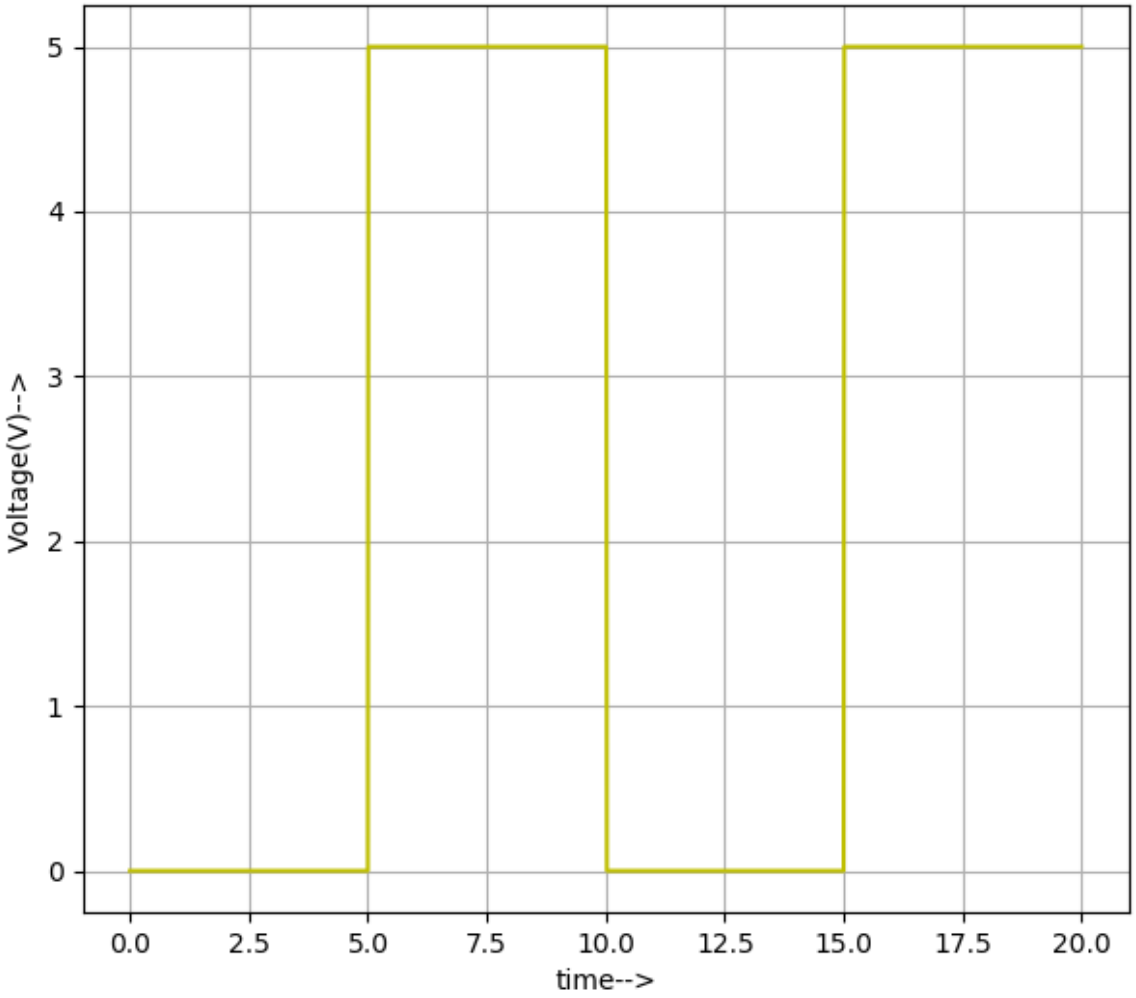


**2.Python Waveform**

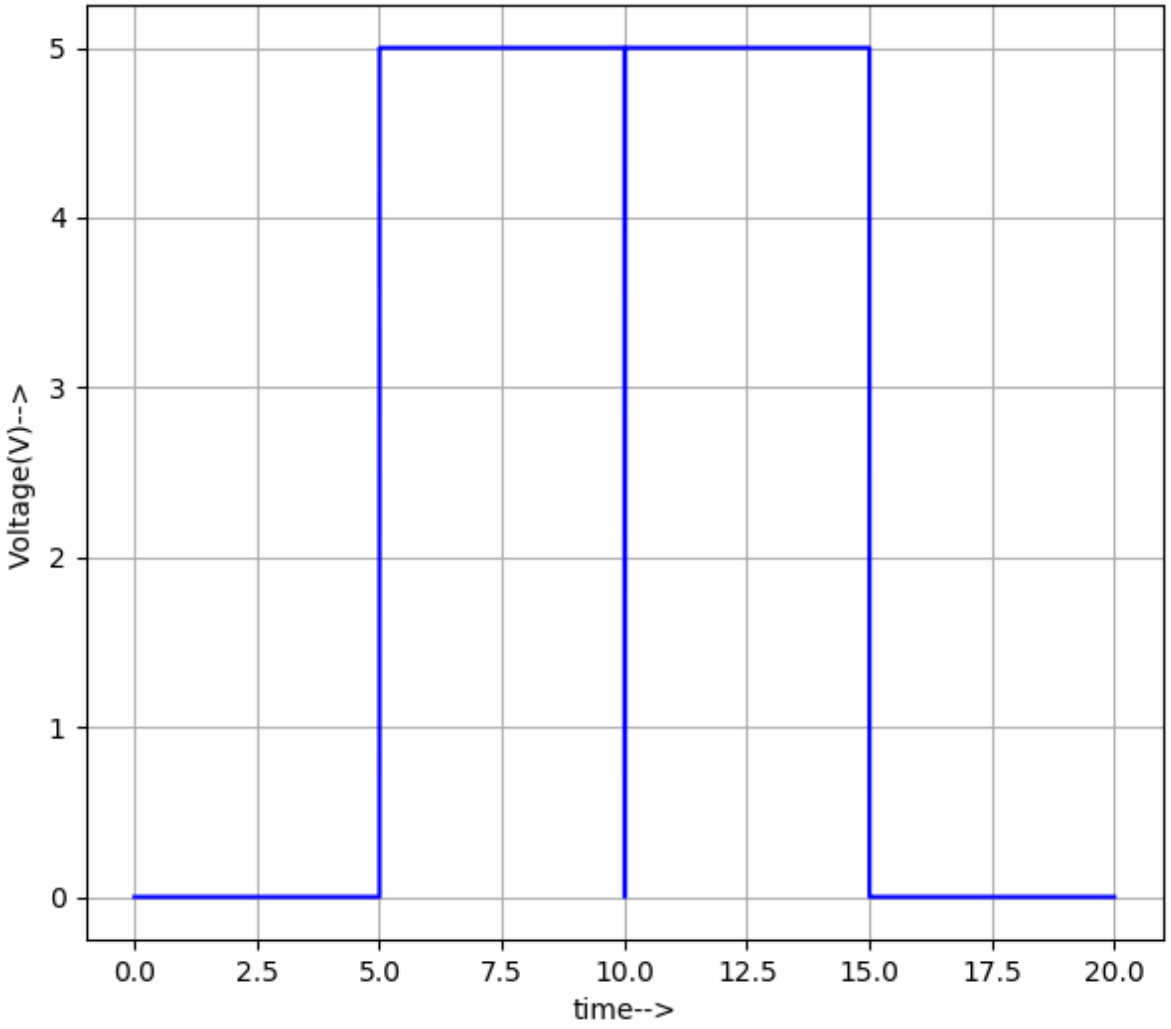
A



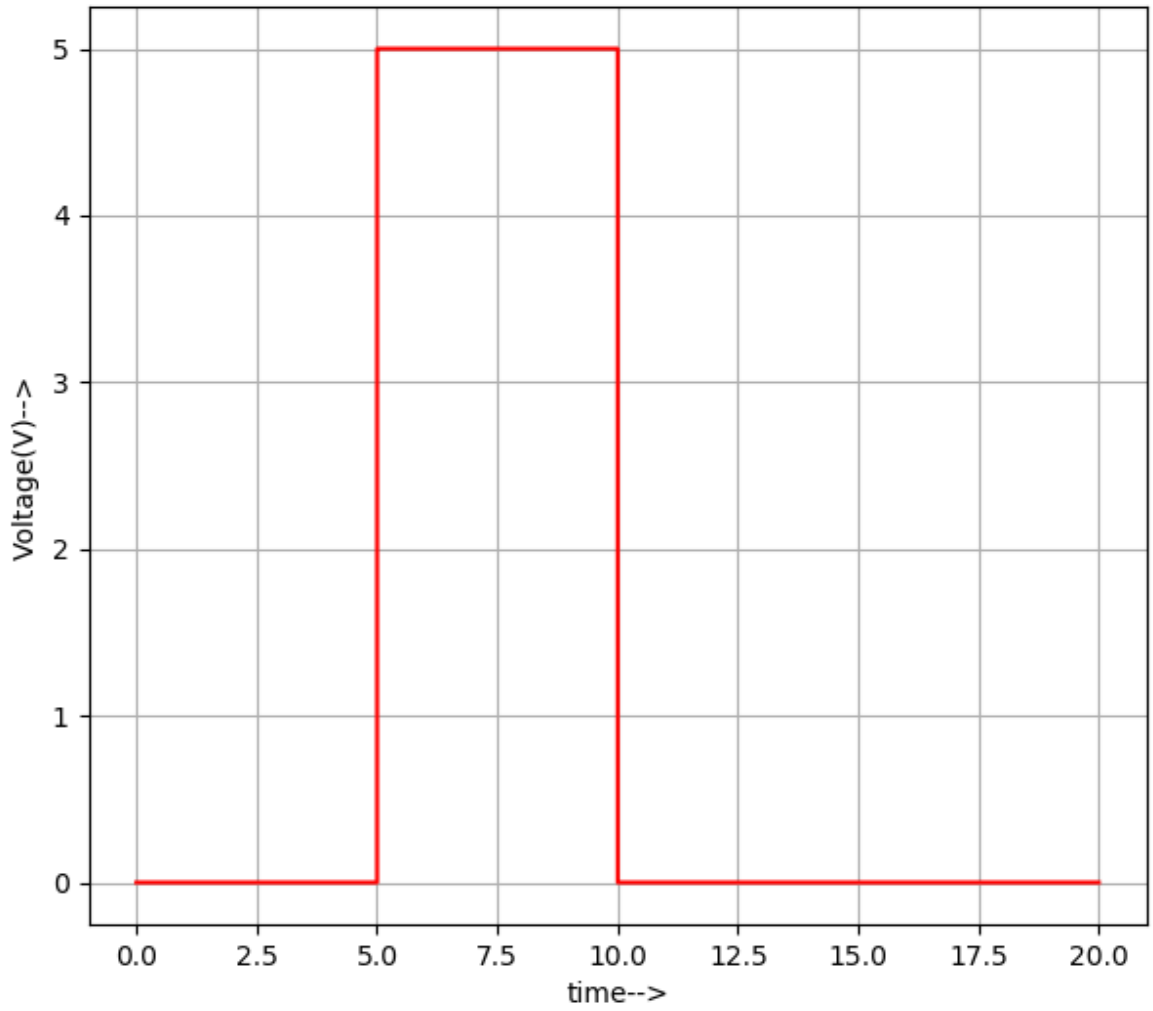
B



Difference



Borrow




**Reference:**

https://www.geeksforgeeks.org/half-adder-half-subtractor-using-nand-nor-gates/

https://electronicscoach.com/half-subtractor.html