*Lab 2*

*First Stage*

*Cyber Security Science Department*


# Computer Organization and Logic Design

## Lab 2: Basic Logic Gates (AND & OR Gates)

**By**

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# Basic Logic Gates (AND & OR Gates)

## 1. The AND Gate

The AND gate can have two or more inputs with one output and performs what is known as logical multiplication.

Figure below shows the AND gate logic symbol with **two**, **three**, and **four** input variables and the output variables indicated

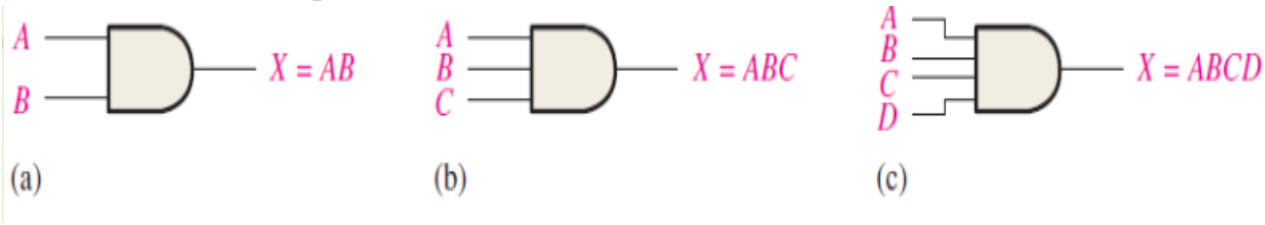
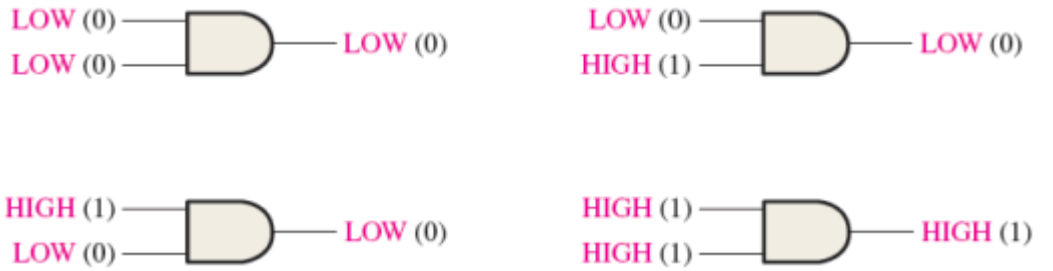



Figure below illustrates a **2-input AND** gate with all four possibilities of input combinations and the resulting output for each.

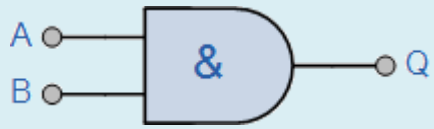


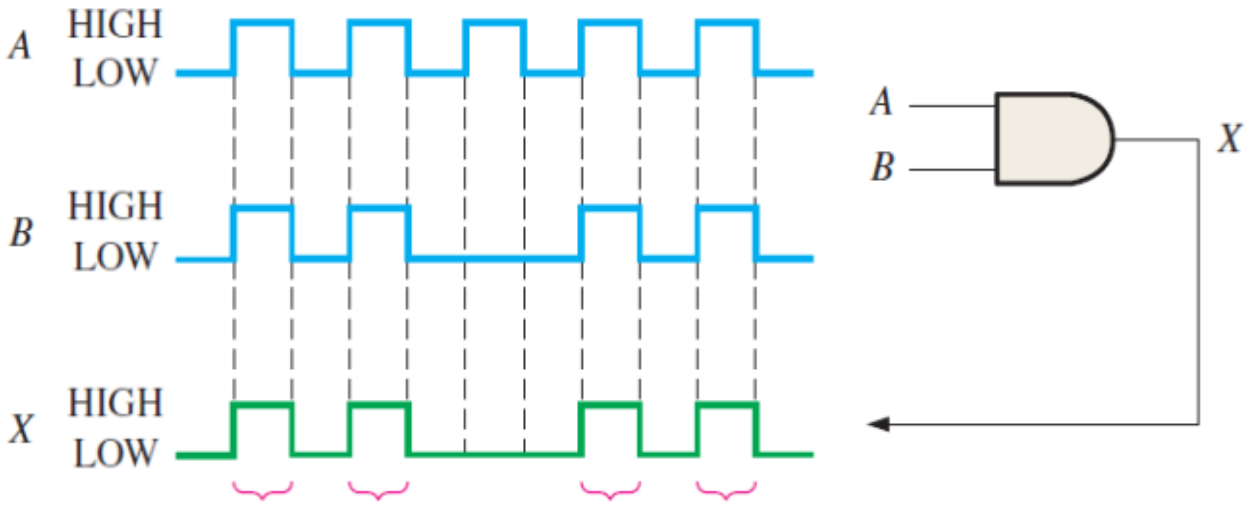

### ❖ Operation and Truth table for a 2-input AND gate

For two input variables: N = $2^2$ = 4 combinations

**Boolean Expression: Q = A*B**

**The 2-input Logic AND Gate**

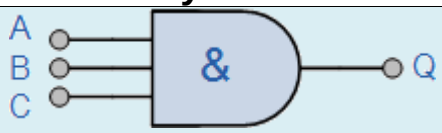
| **Symbol** | **Truth Table** | | |
|---|---|---|---|
|   **2-input AND Gate** | A | B | Q |
| | 0 | 0 | 0 |
| | 0 | 1 | 0 |
| | 1 | 0 | 0 |
| | 1 | 1 | 1 |
| **Boolean Expression Q = A.B** | Read as A **AND** B gives Q | | |




*A* and *B* are both HIGH during these four time intervals; therefore, *X* is HIGH.

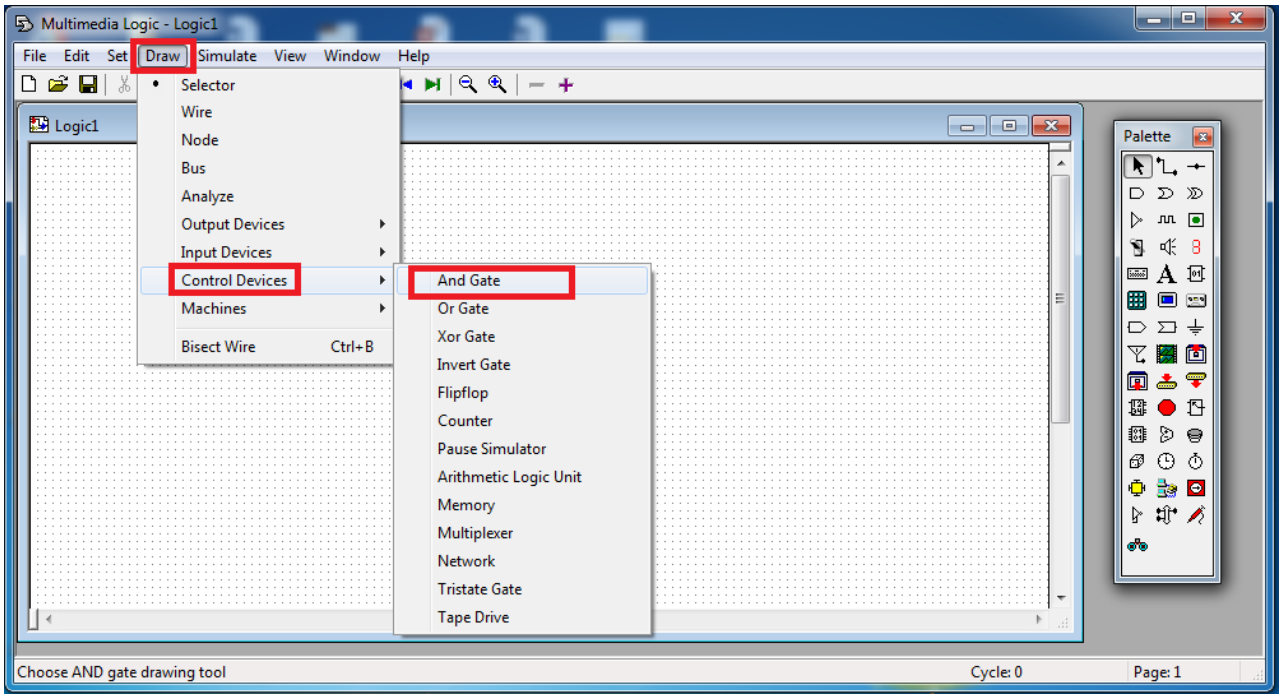
**For three input variables: N = $2^3$ = 8 combinations**

**The 3-input Logic AND Gate**

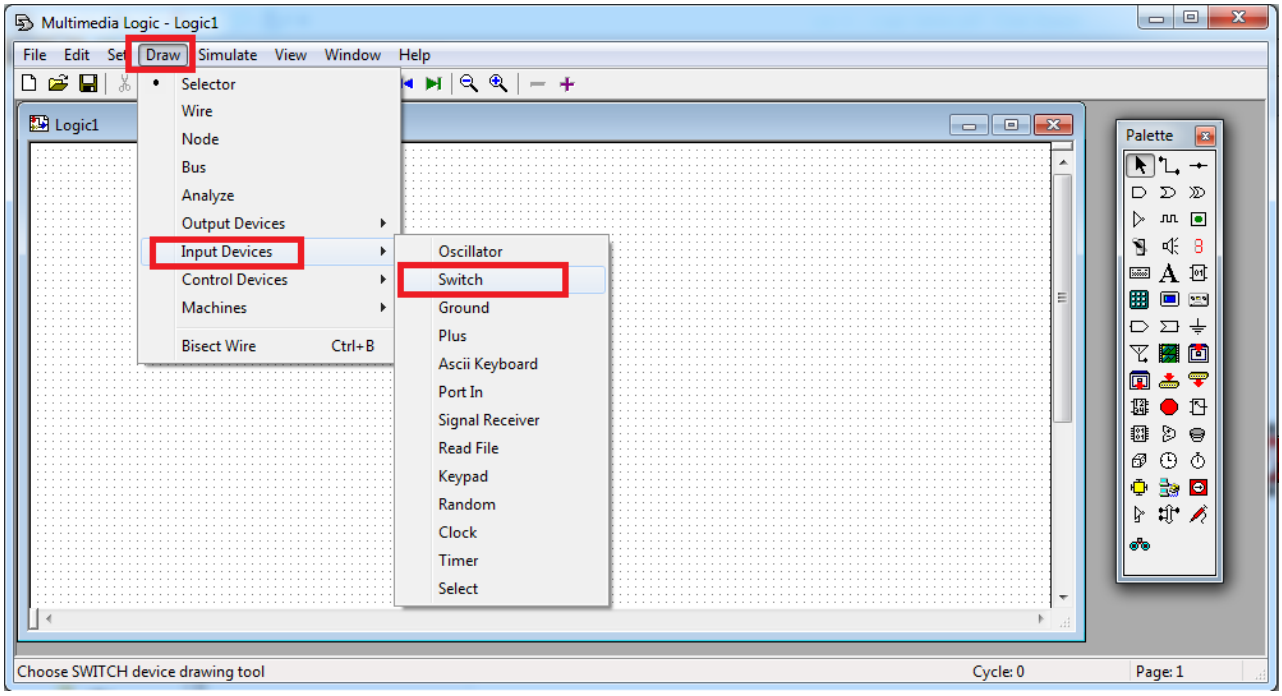
| Symbol | Truth Table | | | |
|---|---|---|---|---|
|   **3-input AND Gate** | A | B | C | Q |
| | 0 | 0 | 0 | 0 |
| | 0 | 0 | 1 | 0 |
| | 0 | 1 | 0 | 0 |
| | 0 | 1 | 1 | 0 |
| | 1 | 0 | 0 | 0 |
| | 1 | 0 | 1 | 0 |
| | 1 | 1 | 0 | 0 |
| | 1 | 1 | 1 | 1 |
| **Boolean Expression Q = A.B.C** | Read as A **AND** B **AND** C gives Q | | | |

## 1.2 Practical Application of AND gate

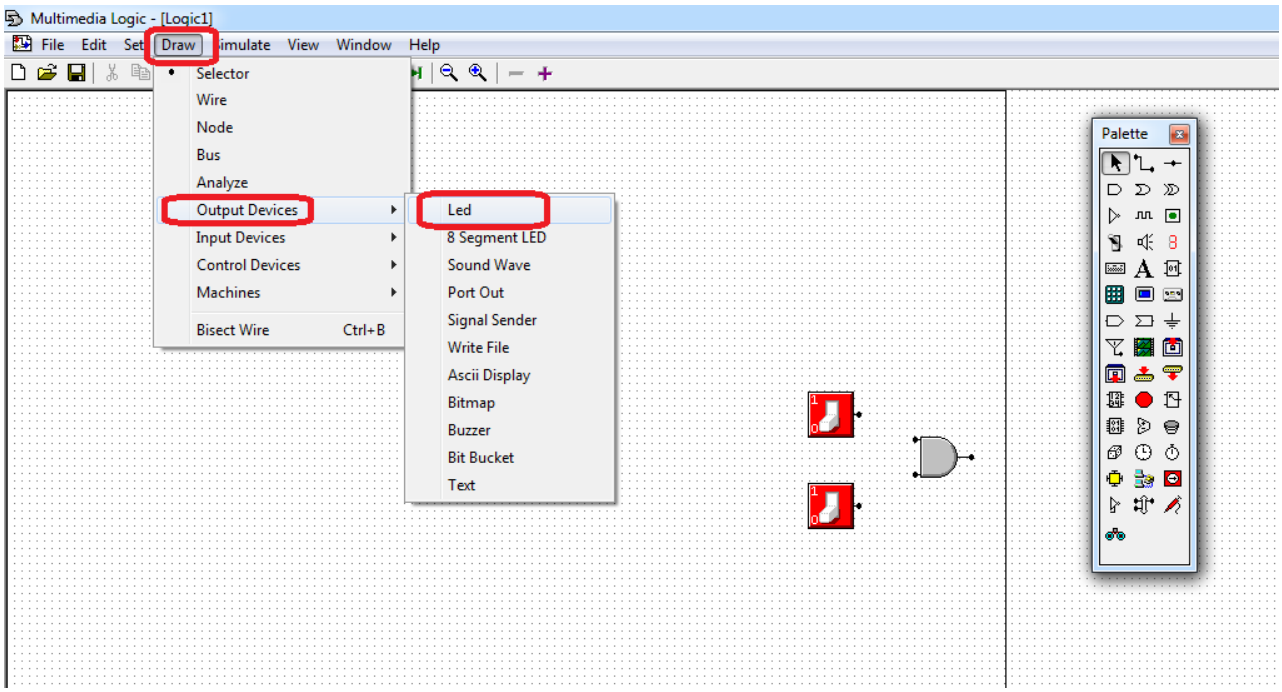
### Step 1




### Step 2

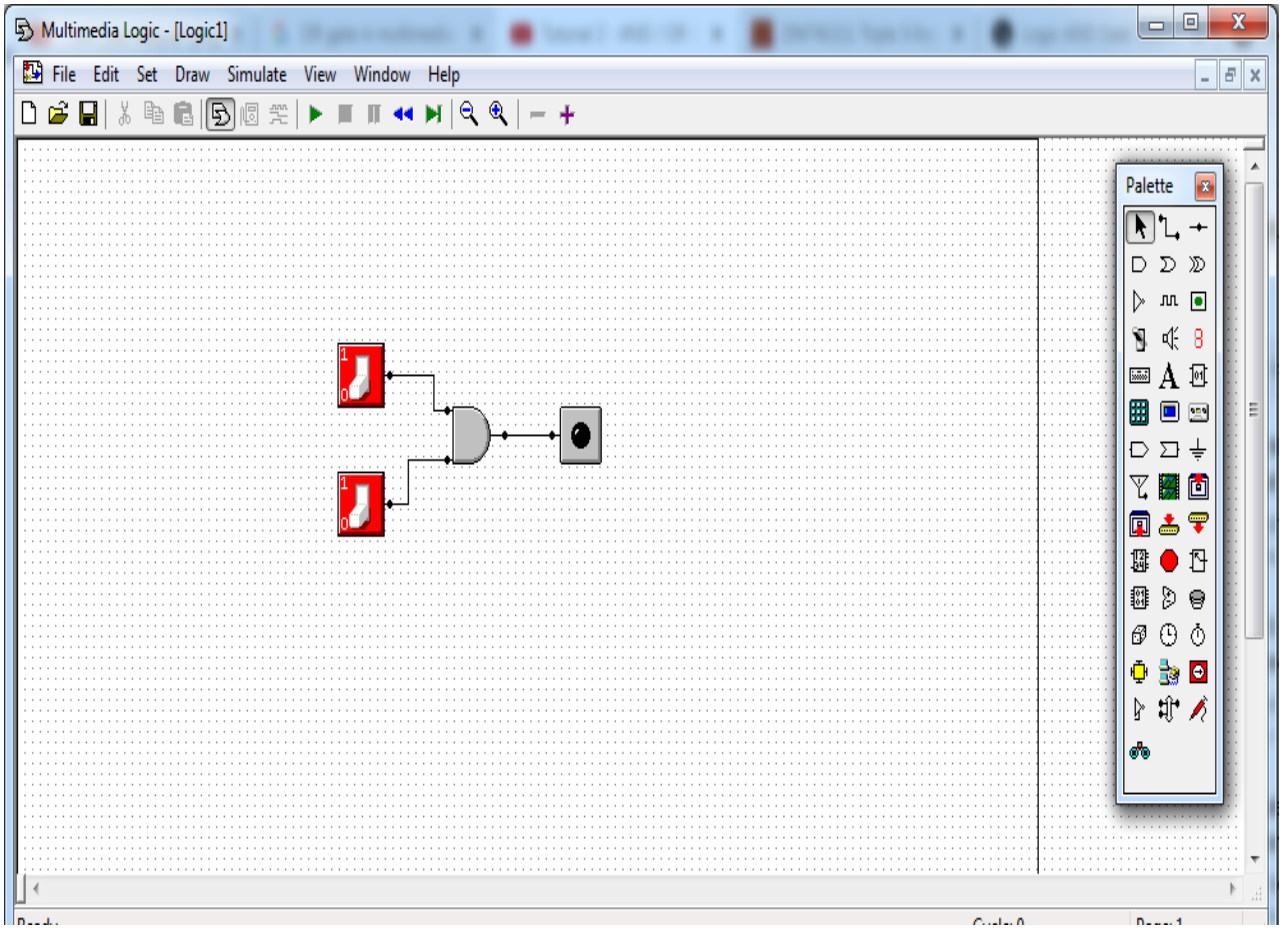


## Step 3



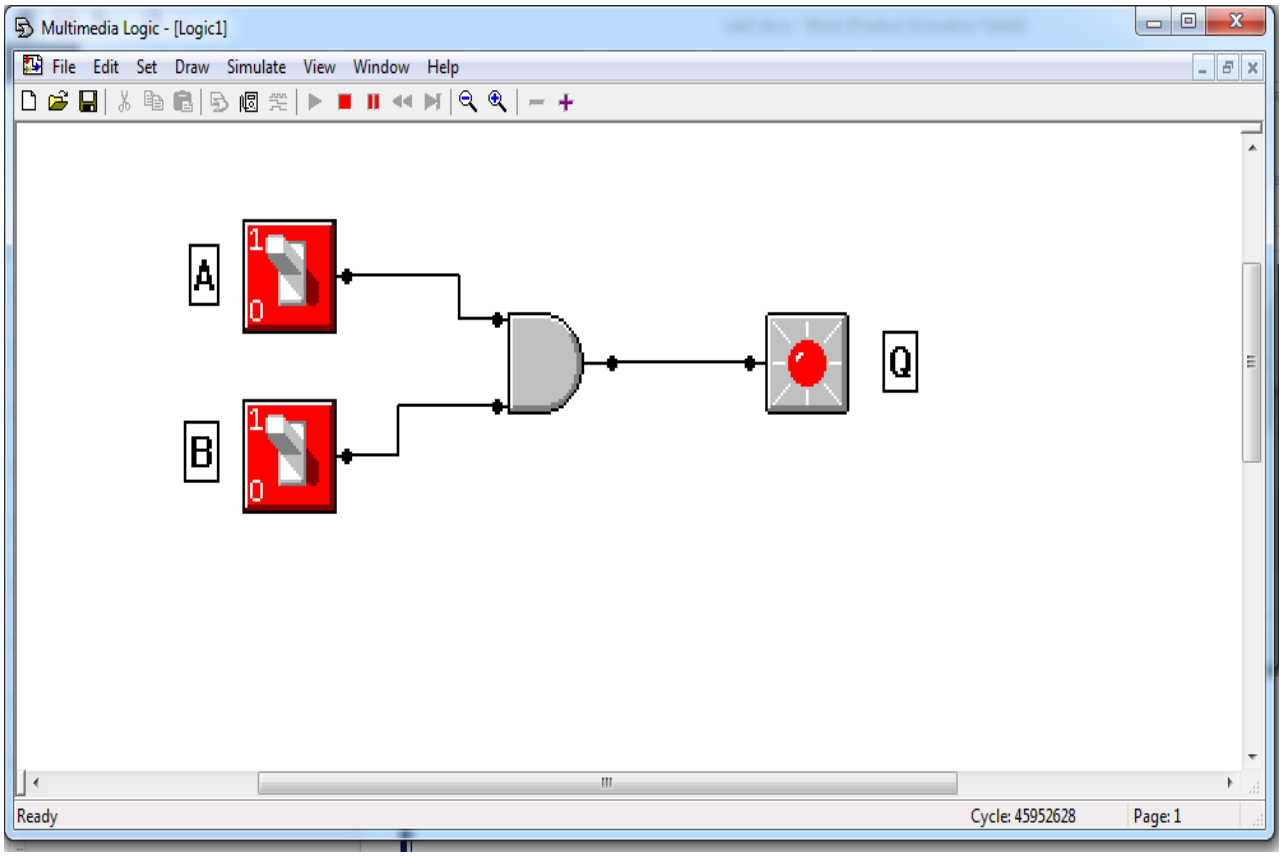

## Step 4

Wire connected gate and switches



**Step 5**

**Run simulate when set both switches to 1 , the Led is on otherwise off**




## 2. The OR Gate

The OR gate can have two or more inputs with one output and performs what is known as logical addition.

Figure below shows the OR gate logic symbol with **two**, **three**, and **four** input variables and the output variables labeled.

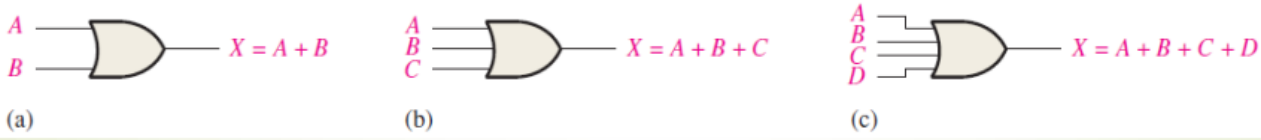
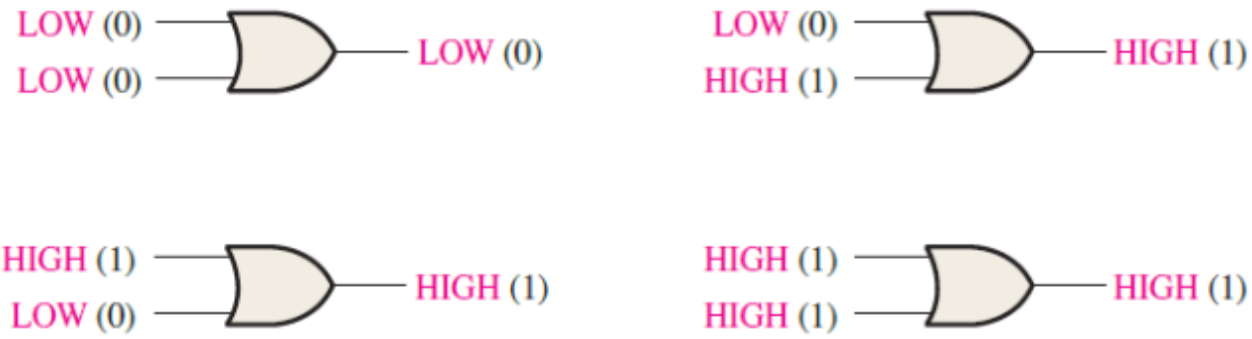



Figure below illustrates a **2-input OR** gate for all four possibilities of input combinations.

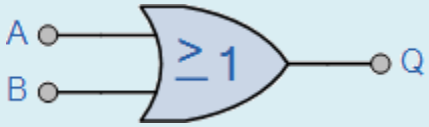



❖ **Operation and Truth table for a 2-input AND gate**

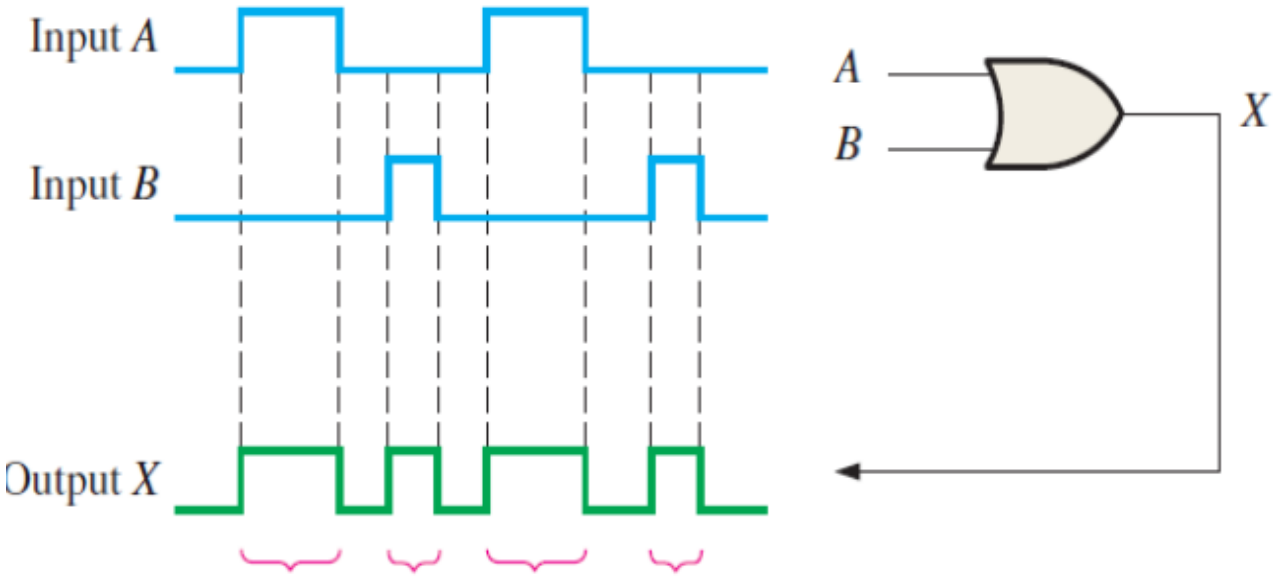
For two input variables: N = $2^2$ = 4 combinations

Boolean Expression : **Q= A + B**

**The 2-input Logic OR Gate**

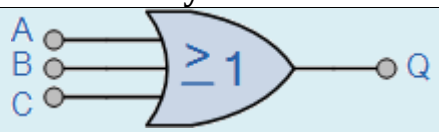
| | | | |
|---|---|---|---|
|  **2-input OR Gate** | B | A | Q |
| | 0 | 0 | 0 |
| | 0 | 1 | 1 |
| | 1 | 0 | 1 |
| | 1 | 1 | 1 |
| Boolean Expression Q = A+B | Read as A **OR** B gives Q | | |






When either input or both inputs are HIGH, the output is HIGH.

## The 3-input Logic OR Gate

| Symbol | Truth Table | | | |
|---|---|---|---|---|
|  **3-input OR Gate** | C | B | A | Q |
| | 0 | 0 | 0 | 0 |
| | 0 | 0 | 1 | 1 |
| | 0 | 1 | 0 | 1 |
| | 0 | 1 | 1 | 1 |
| | 1 | 0 | 0 | 1 |
| | 1 | 0 | 1 | 1 |
| | 1 | 1 | 0 | 1 |
| | 1 | 1 | 1 | 1 |
| **Boolean Expression** Q = A+B+C | Read as A **OR** B **OR** C gives Q | | | |

## 2.1 Practical Application of OR Gate