# ECT 213 – Lecture 3

Chapter 3

Logic Gates
Truth Tables

Chapter 5

Boolean Equations

**Logic Gates:**
Building blocks for basic digital electronic circuits.

Output will be High (1) or Low(0)

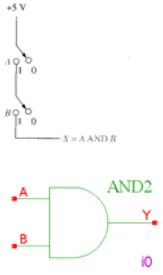
**Truth Table:**
Graphically displays output in table form.

## 2-Input AND Gate

Truth Table

| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

Boolean Equation:



## Example – 2 Input And Gate Timing Diagram

| | $t_0$ | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| A | | | | | | | | | | |
| | | | | | | | | | | |
| B | | | | | | | | | | |
| | | | | | | | | | | |
| Y | | | | | | | | | | |

## 3-Input AND

| Input | | | Output |
|---|---|---|---|
| A | B | C | Y |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |


Boolean Equation

## Example – Burglar Alarm

Create a circuit that will sound an alarm when the alarm is armed and the door is opened.

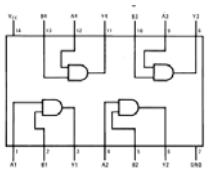
Inputs

Output

# Example Circuit

Given the following Boolean equation,
Wire it using the 74LS08 IC

X = A * B * C

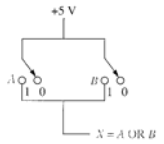


# 2-Input OR Gate

Truth Table

| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

Boolean Equation:



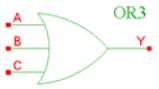


# Example – 2 Input OR Gate Timing Diagram

| | $t_0$ | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| A | | | | | | | | | | |
| | | | | | | | | | | |
| B | | | | | | | | | | |
| | | | | | | | | | | |
| Y | | | | | | | | | | |

## 3-Input OR

| Input | | | Output |
|---|---|---|---|
| A | B | C | Y |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |




Boolean Equation

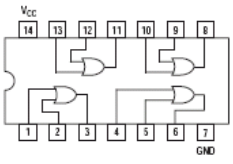
## Example – 3 Input OR Gate Timing Diagram

| | $t_0$ | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| A | | | | | | | | | | |
| | | | | | | | | | | |
| B | | | | | | | | | | |
| | | | | | | | | | | |
| C | | | | | | | | | | |
| | | | | | | | | | | |
| Y | | | | | | | | | | |

## Example Circuit

Given the following Boolean equation,
Wire it using the 74LS32 IC

X = A + B + C



# Inverter (aka NOT Gate)


Boolean Equation:

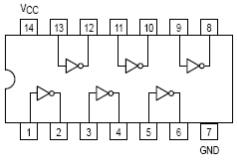
| Input | Output |
|---|---|
| A | Y |
| | |
| | |

| | $t_0$ | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ | $t_{10}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| A | | | | | | | | | | | |
| | | | | | | | | | | | |
| Y | | | | | | | | | | | |

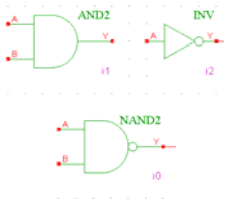
# Example Circuit

Given the following Boolean equation,
Wire it using the 74LS04 IC

$$Y = \overline{X}$$




# 2 Input NAND Gate




Boolean Equation

| Input | | Output |
|---|---|---|
| A | B | Y |
| | | |
| | | |
| | | |
| | | |

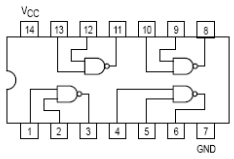
## Example – 2 Input NAND Gate Timing Diagram

| | $t_0$ | $t_1$ | $t_2$ | $t_3$ | $t_4$ | $t_5$ | $t_6$ | $t_7$ | $t_8$ | $t_9$ | $t_{10}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| A | | | | | | | | | | | |
| | | | | | | | | | | | |
| B | | | | | | | | | | | |
| | | | | | | | | | | | |
| Y | | | | | | | | | | | |

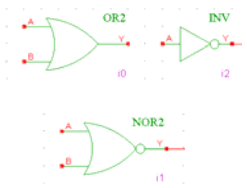
## Example Circuit

Given the following Boolean equation,
Wire it using the 74LS00 IC

$$Z = \overline{\overline{X \bullet Y} \bullet D}$$




## 2 Input Nor Gate



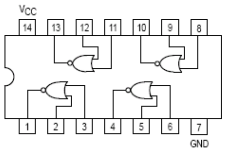

| Input | | Output |
|---|---|---|
| A | B | Y |
| | | |
| | | |
| | | |
| | | |

Boolean Equation

## Example Circuit

Given the following Boolean equation,
Wire it using the 74LS02 IC

$$N = \overline{H + \overline{I + J}}$$




## Combinational Logic

Uses one or more basic logic gates to form a function. The Inputs determine the output.

## Examples

Logic for automobile warning buzzer using combinational logic

- Buzzer activates if headlights are on and the driver's door is opened.
- Key is in the ignition and the driver's door is opened
- Motor is running, car in drive and the driver is NOT wearing a seatbelt.

## Example

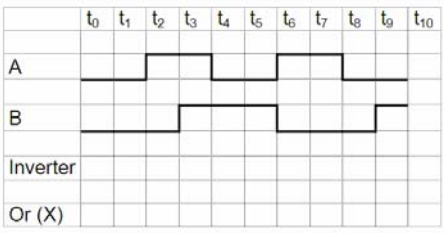
Draw the circuit and fill in the truth table for the following boolean equation.

$$X = \overline{A} + B$$

| | A | B | X |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

## Example Continued

- Complete the timing diagram for the last example




## Example Continued

- Connect the circuit from the previous example using a 74LS04 (inverter) and 74LS32 (OR) IC's.