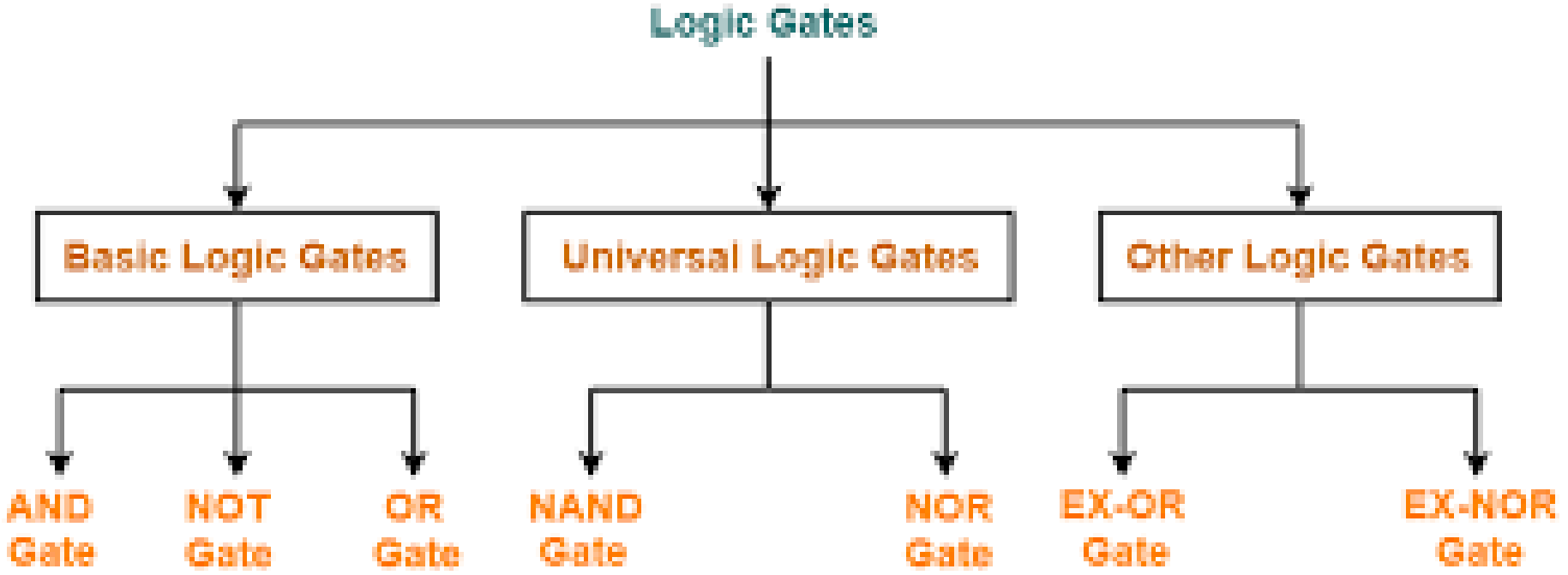
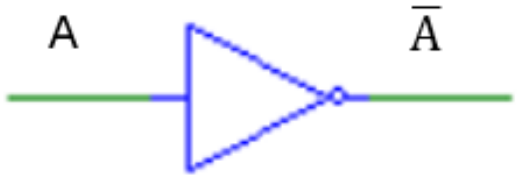
Basic & Universal Logic Gates



Types of Logic Gates

NAND Gate representation

- All the logic gates can be implemented using NAND gates only
- Let’s consider the basic logic gates
- Implementing **NOT** gate using **NAND** gate ONLY

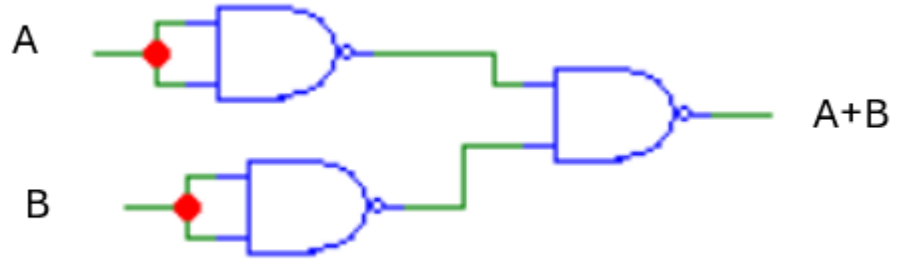


- **OR** Gate by using only **NAND** gates

By applying de morgan's rule to the equation of OR gate

$A + B$

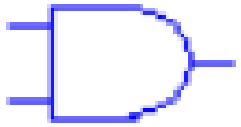
$$A + B = \overline{\overline{A + B}}$$
$$= \overline{\overline{A}.\overline{B}}$$



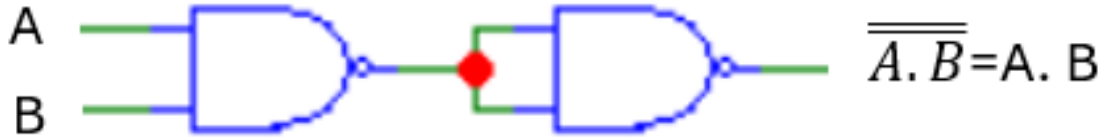
- AND Gate by using only NAND gates

By applying de morgan’s rule to the equation of OR gate

$A.B$



$A.B = \overline{\overline{A.B}}$



- Implement the XOR gate using NAND gate only

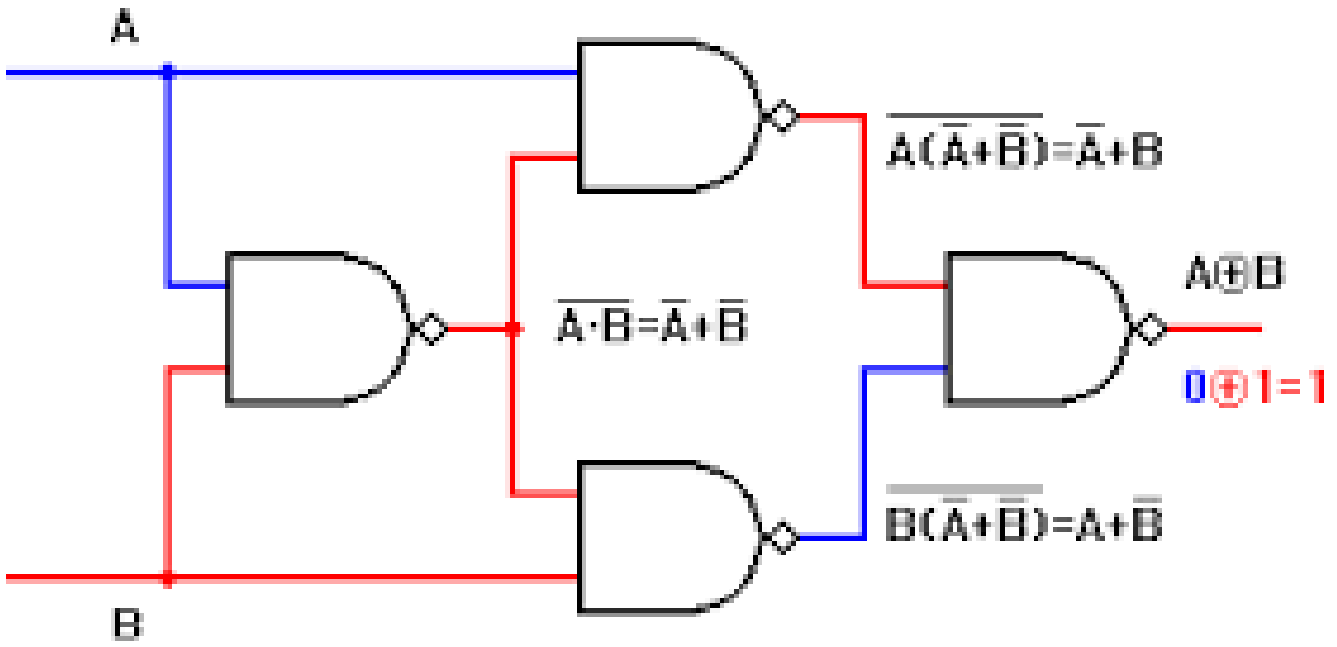
$$A'B + AB'$$

$$\overline{\overline{\bar{A}B + A\bar{B}}}$$

$$\overline{\overline{(\bar{A}B)}.\overline{(A\bar{B})}}$$

- Draw the NAND gate logic diagram

- Another method of implementing XOR gate using NAND gate only



Homework

Implement NOT, AND, OR operations using:

- NOR gates only

- Implement the circuit for the following expression using AND, OR, NOT gate

$$Z = \bar{A}B + X\bar{Y}$$

- Implement the expression using NAND gate only

- Implement the circuit for the following expression using Only NAND gates

1. $\overline{A + \overline{B}\ \ \overline{C}}$

2. $\overline{\overline{\overline{A + BC} + AB + \overline{CD}}}$

Sensor system of S0, S1, S2 and S3 are used to detect movement around a security compartment. These sensors are connected to an alarm system that would indicate outcomes depending on the following conditions.

- Only sensor S1 and S3 are triggered
- Only sensor S0 and S2 are triggered
- S0, S1, S3 are all triggered
- None of the sensors are triggered

i. Determine the truth table of the above system (4 Marks)

ii. Get the simplified:
    a. SOP expressions (4 Marks)
    b. POS expressions (4 Marks)

i. Implement the circuit using:
    a. NAND gates (4 Marks)