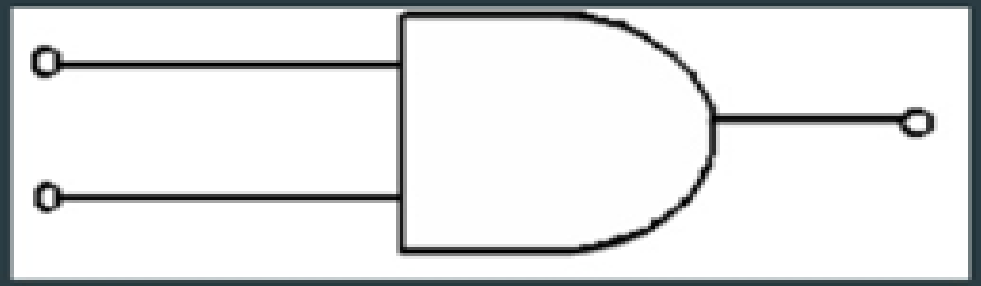
LOGIC GATES

Basic Gates : AND Gate

- An AND gate can have two or more inputs and performs what is know as multiplication.
- The output of AND gate is high when all inputs are high otherwise all outputs are low.

Logical Symbol



Truth Table

Inputs		Output
A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

- It's logical expression is, X=A.B

Basic Gates : OR Gate

- OR gate can have two or more inputs and performs what is known as logical addition.
- The output of OR gate is Low when all inputs are low, otherwise all outputs are high

Logical Symbol

Truth Table

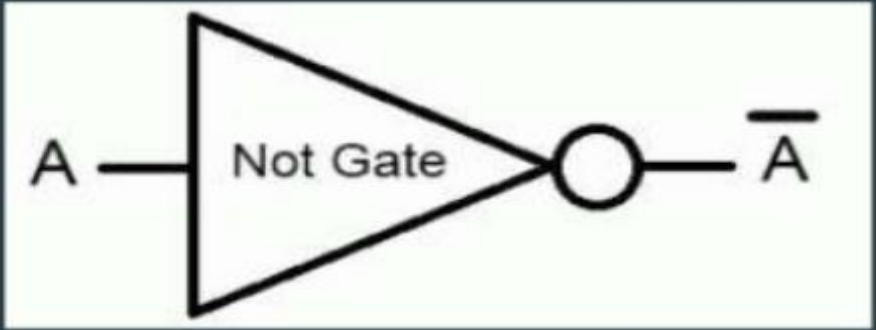
Inputs		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

- It's logical expression is, X=A+B

Basic Gates : NOT Gate

- The inverter (NOT circuit) performs the operation called inversion or complementation.
- The NOT operation changes one logic level to the opposite logical level. When the input is Low, the output is high. When the input is high, the output is low.

Logical Symbol



Truth Table

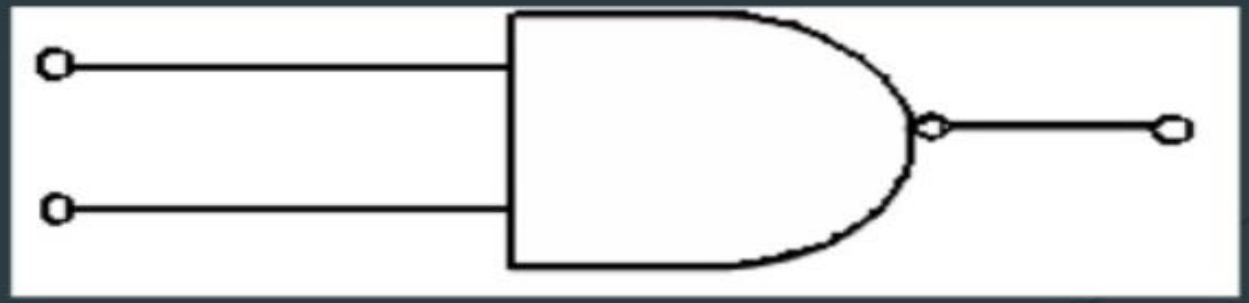
Input	Output
0	1
1	0

- It's logical expression is, A=A'

Universal Gate : NAND Gate

- The NAND gate is the one of the popular logic element because it can be used as a universal gate; that is NAND gate can be used in combination to perform the AND, OR, and inverter operations.
- NAND Gate is constructed by attaching NOT Gate at the output of AND Gate, hence NAND Gate is called NOT- AND Gate.
- The output of NAND gate is low when all inputs are high, otherwise all outputs are high.

Logical Symbol



Truth Table & Boolean Expression of NAND Gate

Inputs		Output
A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

- It's logical expression is, X= (AB)'

NAND gate as Universal gate

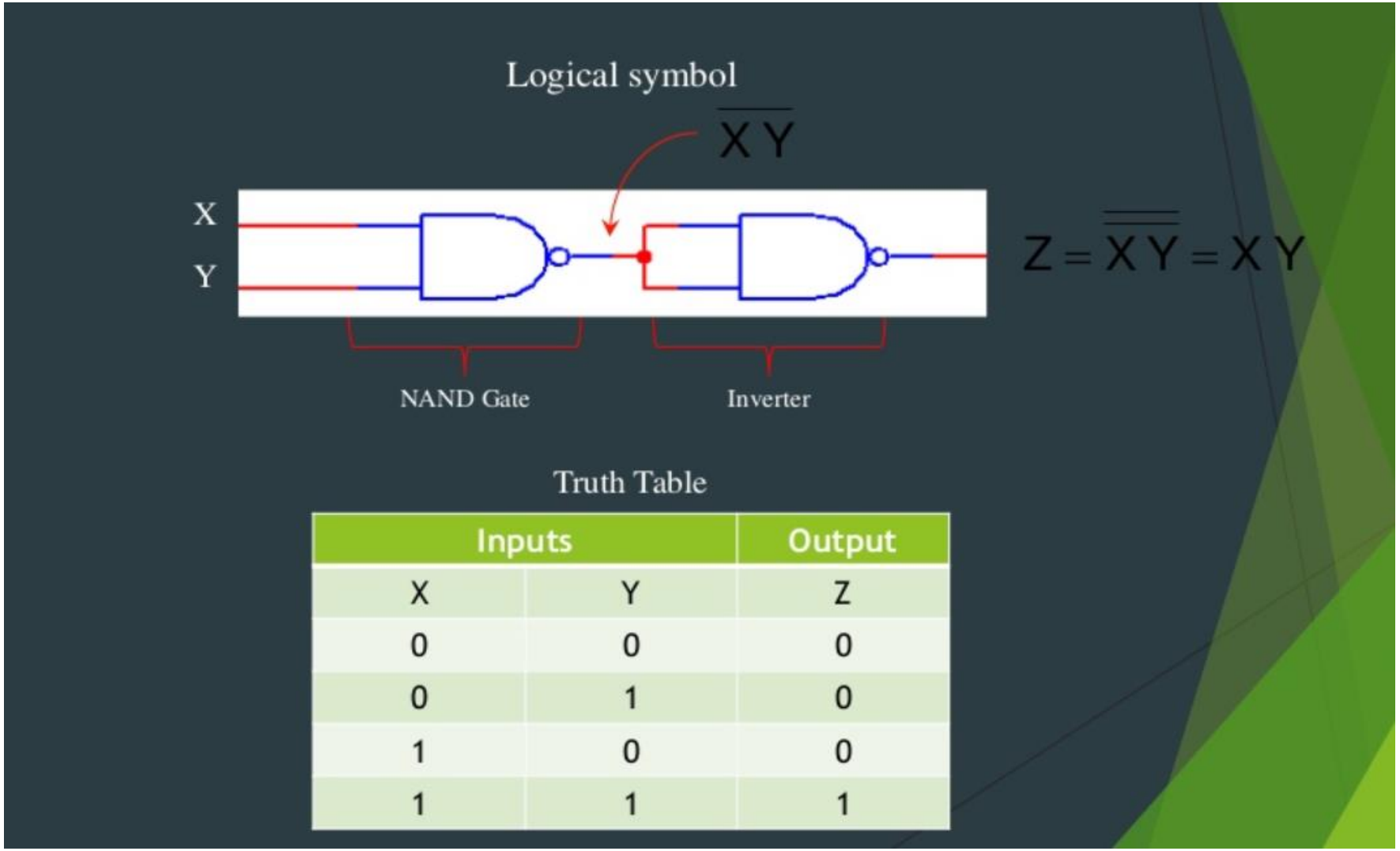
Implementing a NOT Gate using NAND Gate

Logical symbol

Truth Table

Input	Output
X	Z
0	1
1	0

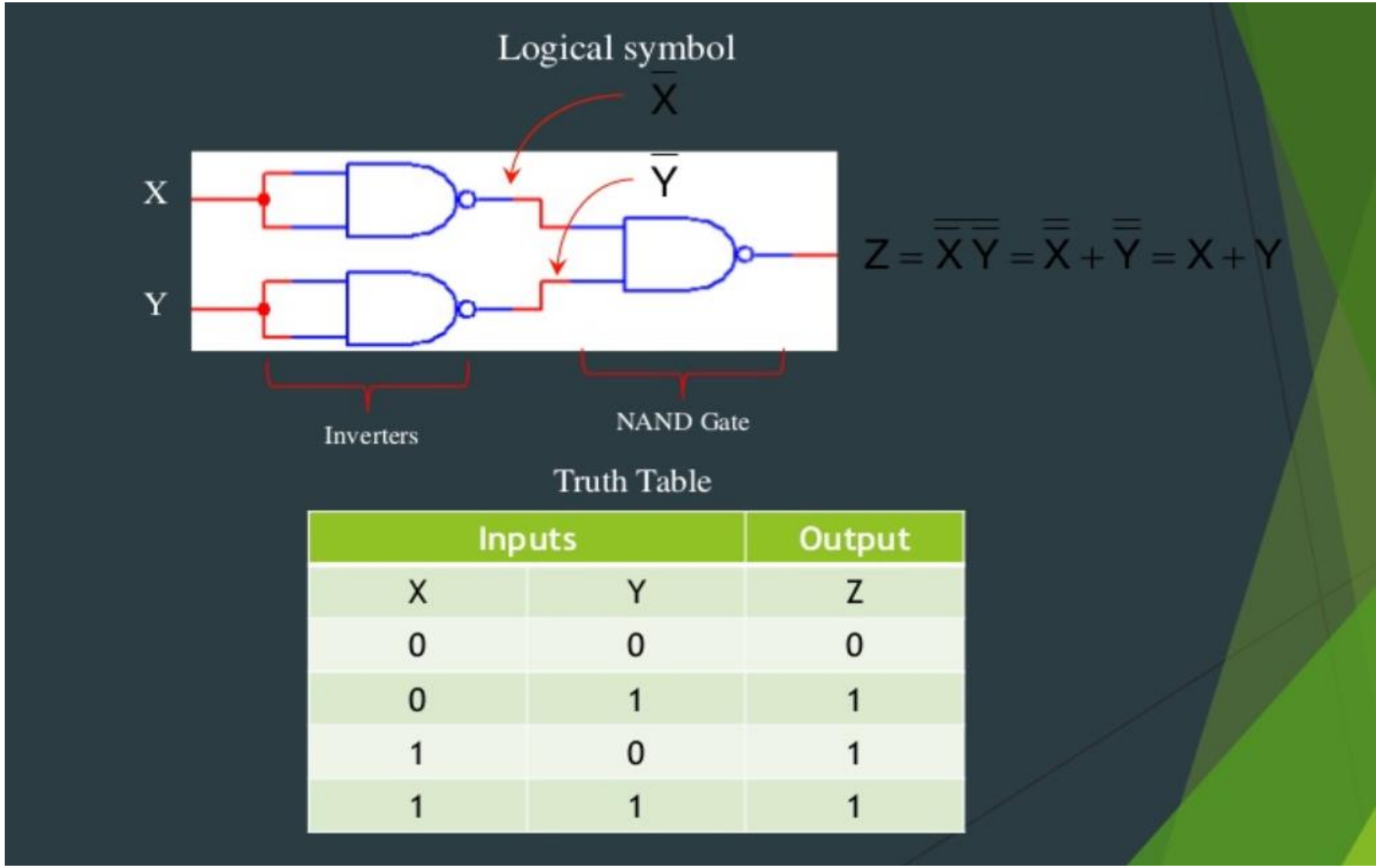
Implementing an AND Gate using NAND Gate



Truth Table

Inputs		Output
X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

Implementing an OR Gate using NAND Gates



Truth Table

Inputs		Output
X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

Universal Gate : NOR Gate

- The NOR gate, like the NAND gate, NOR gate is also useful logical element because it can also be used as a universal gate.
- NOR gate can be used in combination to perform the AND, OR and Inverter operations.
- NOR Gate is the combination of NOT gate at the output of OR gate, hence NOR gate is type of NOT-OR gate.
- The Output of NOR gate is high when all inputs are low otherwise the output is low.

Logical Symbol

Truth Table & Boolean Expression of NOR Gate

Inputs		Output
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

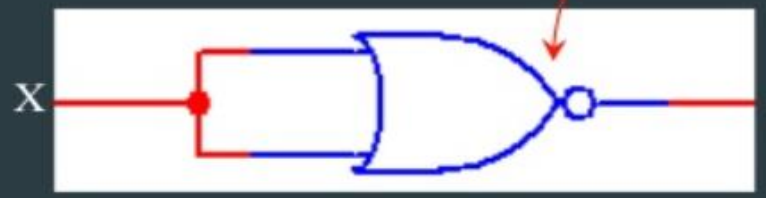
- It's expression is, X=(A+B)'

NOR gate as Universal gate

Implementing NOT Gate using NOR Gate

Logical symbol

$X + X = X$ (Before Bubble)

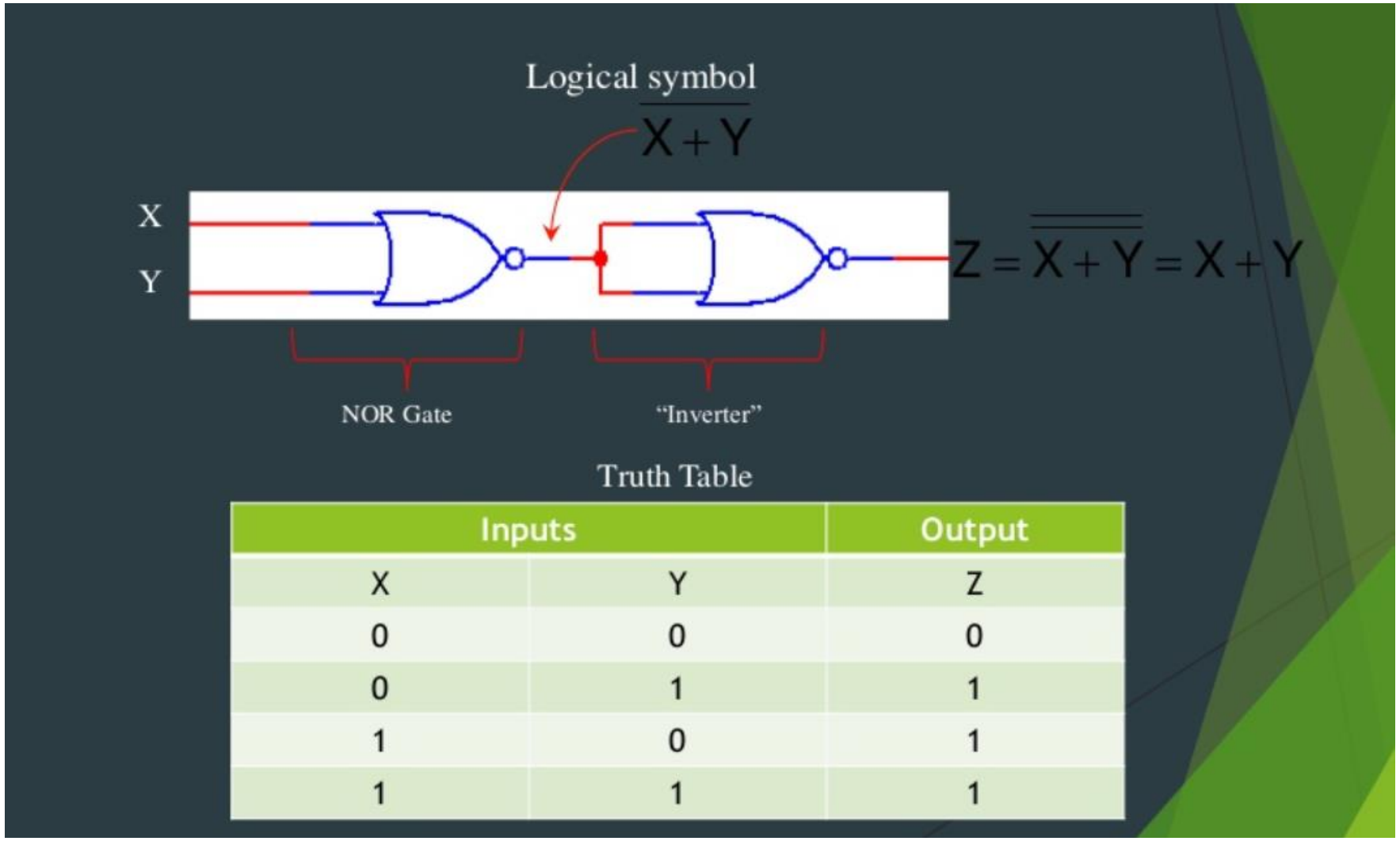


$Z = \overline{X}$

Truth Table

Inputs	Output
X	Z
0	1
1	0

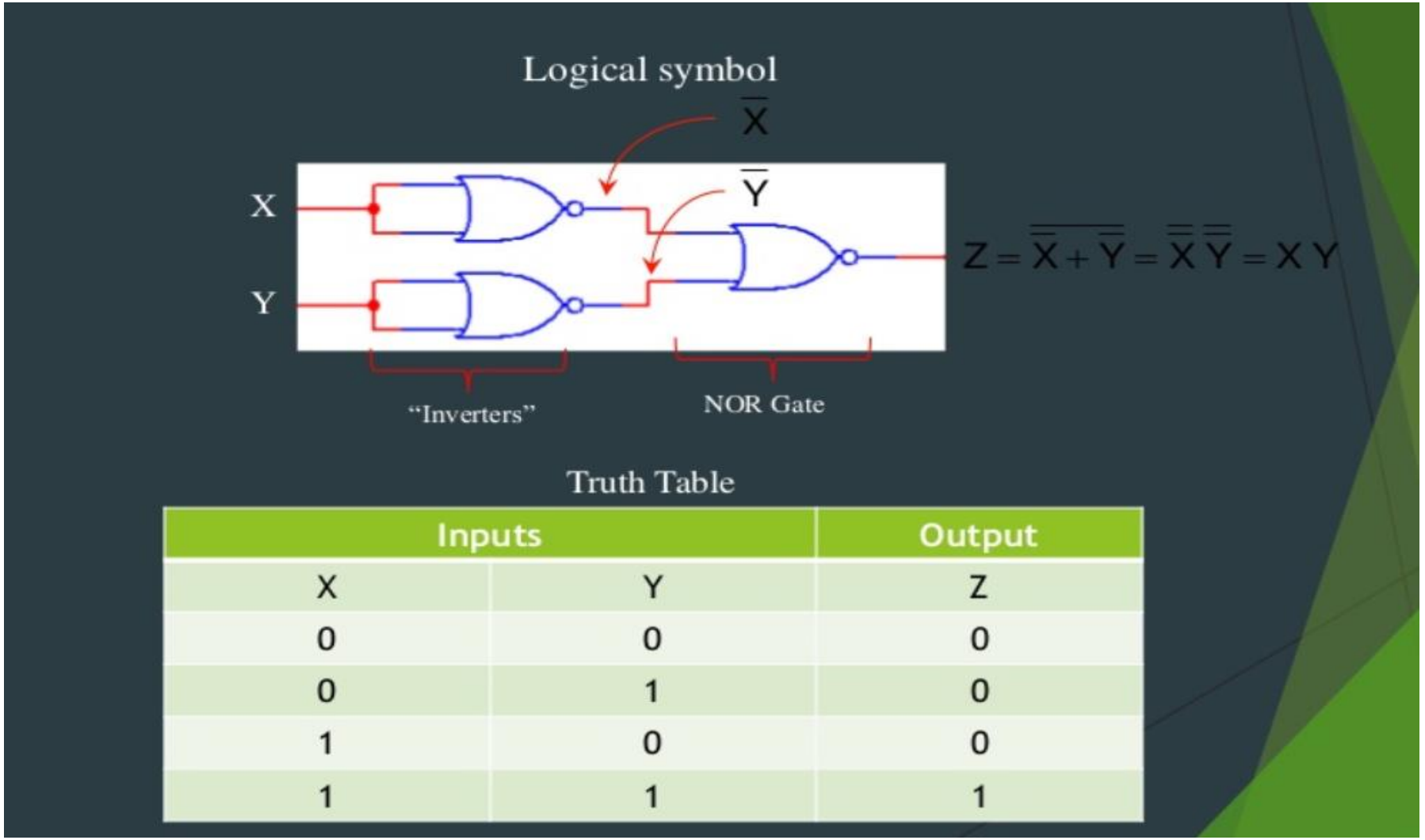
Implementing an OR Gate using NOR Gate



Truth Table

Inputs		Output
X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

Implementing an AND Gate using NOR Gate



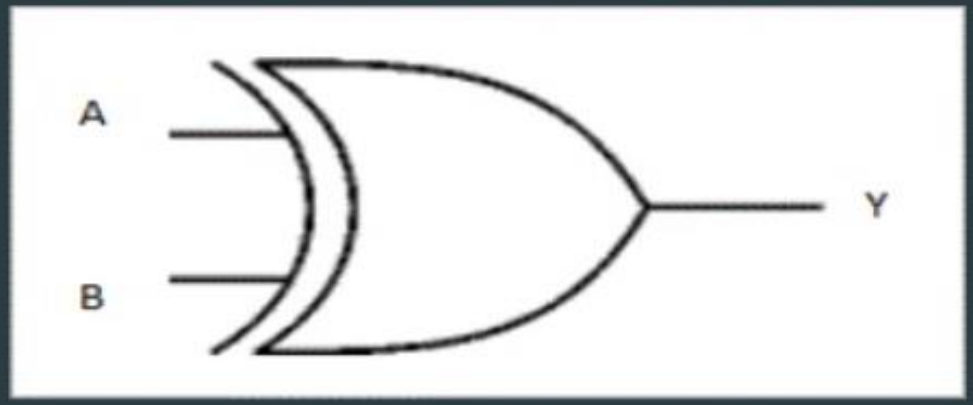
Truth Table

Inputs		Output
X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

Exclusive-OR (XOR) Gate

- The exclusive-OR gate has a graphical symbol similar to that of the OR gate, except for the additional curved line on the input side.
- If both inputs are Low or both are High then it produces the output Low or 0. otherwise it produce the High.

Logical Symbol



Truth Table & Boolean Expression of XOR Gate

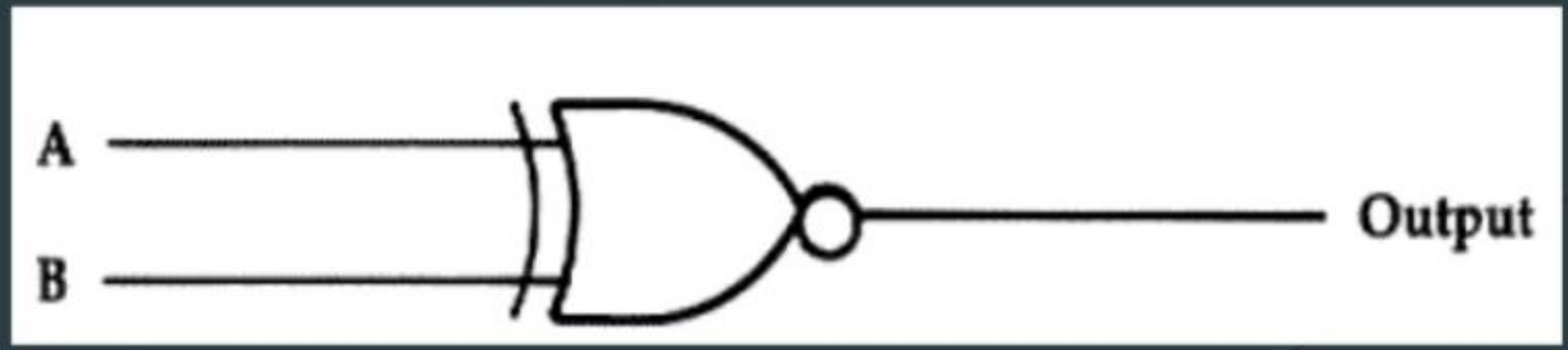
Inputs		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

- It's logical expression is X=AB'+A'B
- $X = A \oplus B$

Exclusive-NOR (XNOR) Gate

- The exclusive-NOR gate is the complement of the exclusive-OR gate, as indicated by small circle on the output side of the graphic symbol.
- If both inputs are Low or both are High then it produces the output High or 1. otherwise it produce the Low output.

Logical symbol



Truth Table & Boolean Expression of XNOR Gate

Inputs		Output
A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

- It's logical expression is $X = AB + A'B'$
- $X = A \odot B$