

Boolean Algebra

Making Sense of it All

Digital Electronics

Unit 4 – Boolean Algebra

$$A + (B + C) = (A + B) + C$$

$$A(BC) = (AB)C$$

$$A + \bar{A} = 1$$

$$A * \bar{A} = 0$$

$$A + 0 = A$$

$$A + 1 = 1$$

$$A(B + C) = AB + AC$$

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

$$A + A = A$$

$$A * 1 = A$$

$$A * 0 = 0$$

$$A + B = B + A$$

$$AB = BA$$

$$A * A = A$$

$$\bar{\bar{A}} = A$$

$$A + B = B + A$$

$$AB = BA$$

$$A + (B + C) = (A + B) + C$$

$$A(BC) = (AB)C$$

$$A(B + C) = AB + AC$$

$$A + 0 = A$$

$$A + 1 = 1$$

$$A * 0 = 0$$

$$A * 1 = A$$

$$A * A = A$$

$$A * \bar{A} = 0$$

$$A + A = A$$

$$\bar{\bar{A}} = A$$

$$A + \bar{A} = 1$$

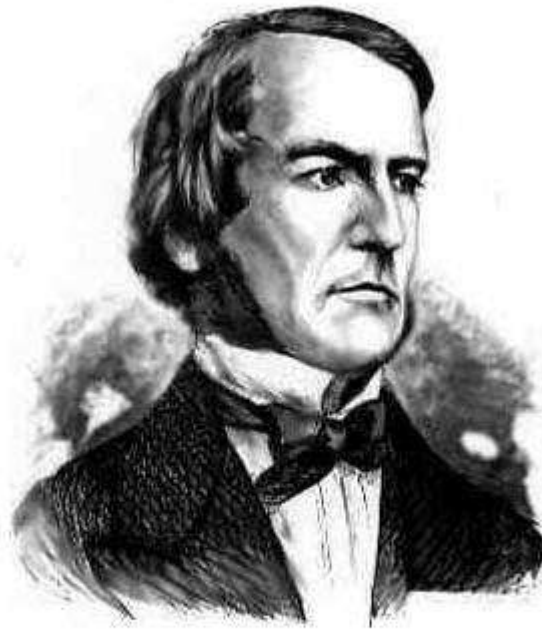
$$A + \bar{A}B = A + B$$

In this lesson:

The Man Responsible

The Laws and Rules

The Inventor:



George Boole

1815-1864

Boole's Most Important Work

1854 – An Investigation into the Laws of Thought, on Which founded the Mathematical Theories of Logic and Probability

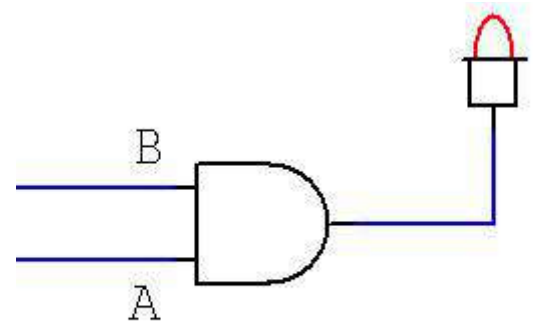
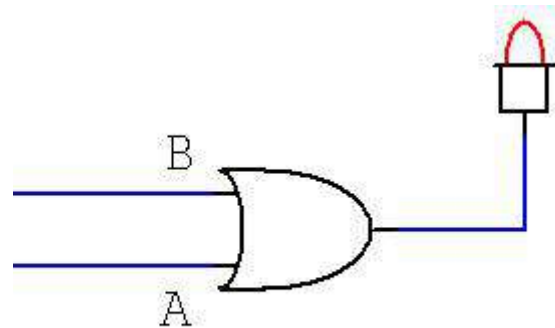
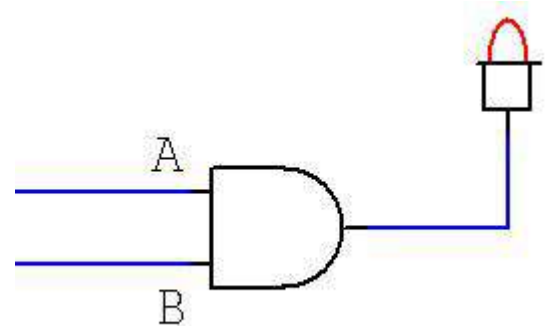
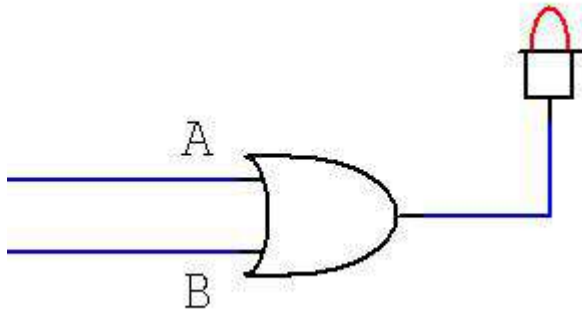
Incorporated Logic into Mathematics

Pointed out the alignment between Algebraic Symbols and those symbols used to represent logic

Commutative Law:

$$A + B = B + A$$

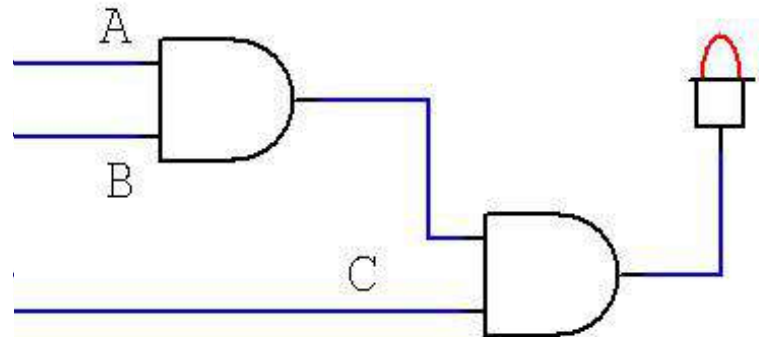
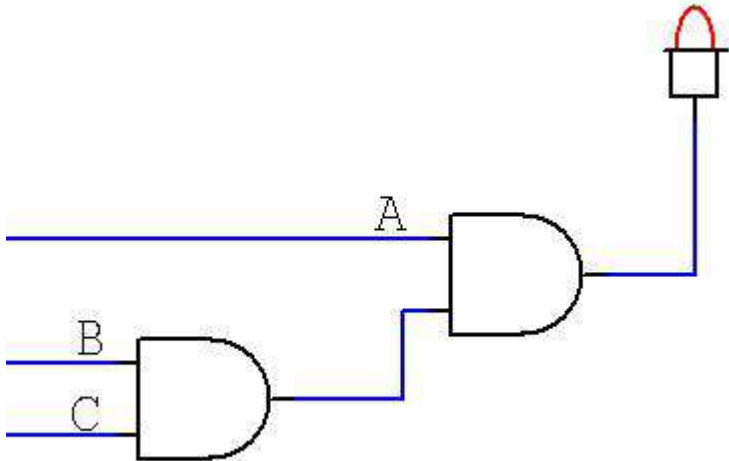
$$AB = BA$$



Associative Law:

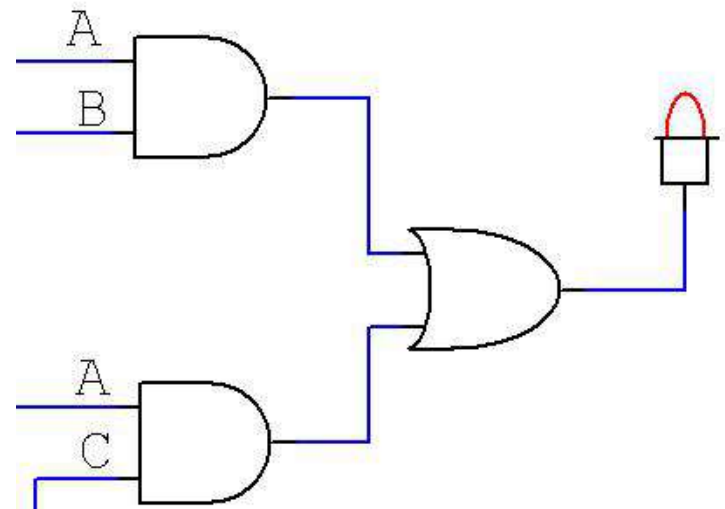
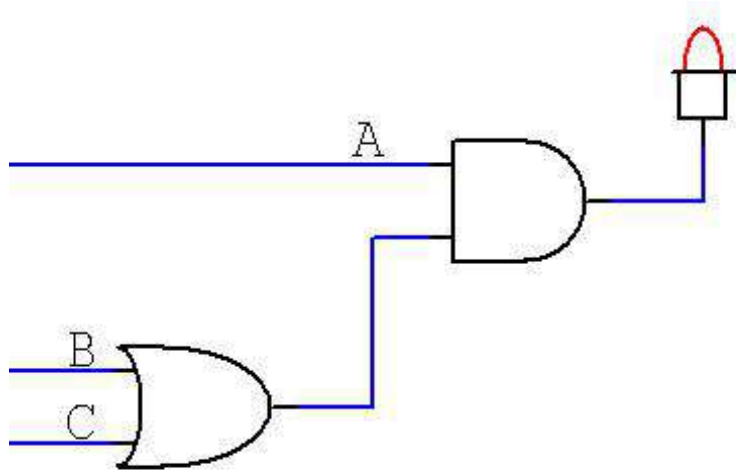
$$A + (B + C) = (A + B) + C$$

$$A(BC) = (AB)C$$

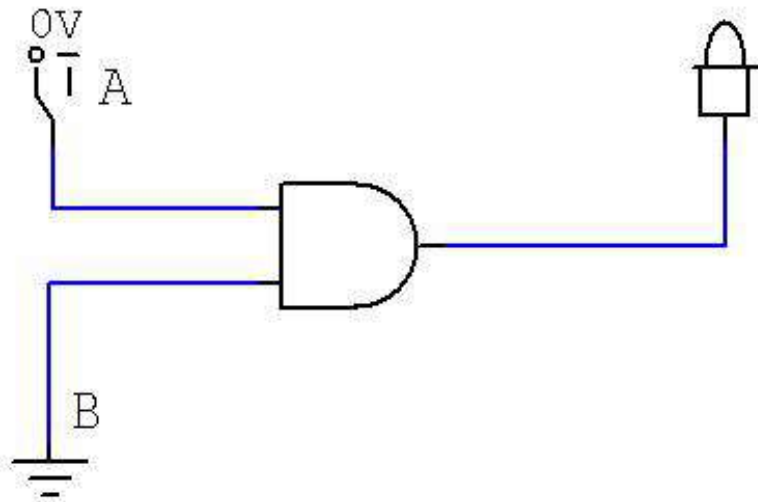


Distributive Law:

$$A(B + C) = AB + AC$$



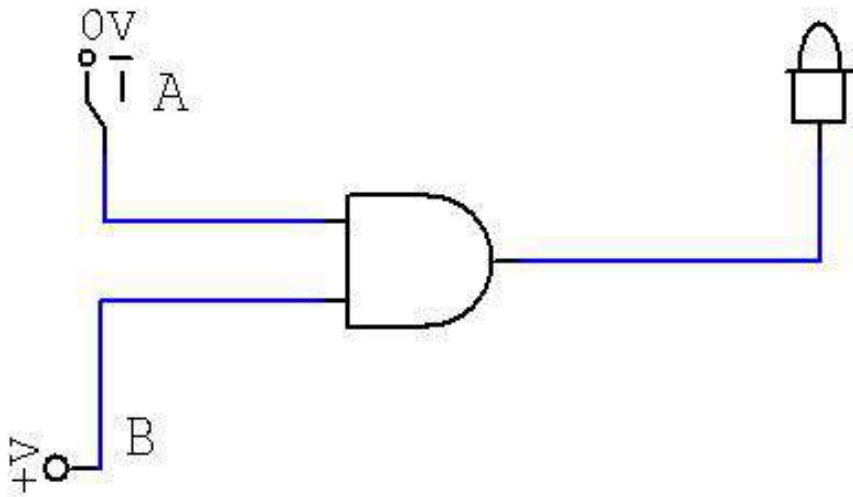
Rule 1: $A * 0 = 0$



A	B	X
0	0	0
1	0	0

Mathematically – Anything times 0 equals 0!

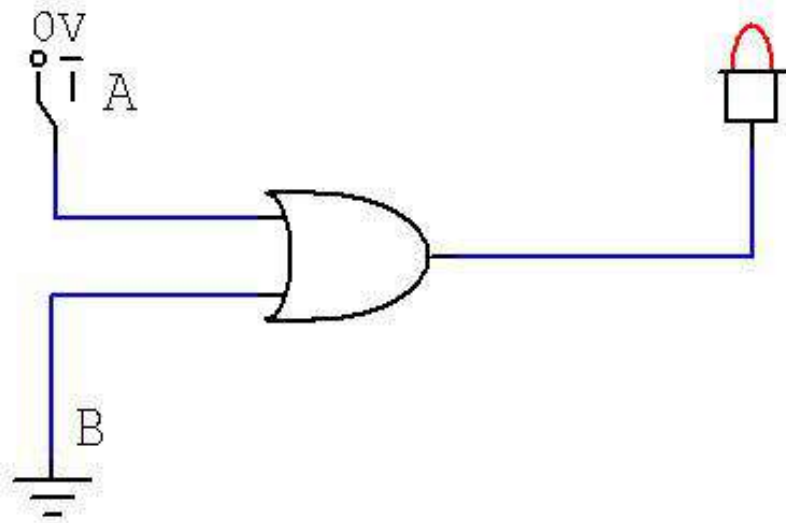
Rule 2: $A * 1 = A$



A	B	X
0	1	0
1	1	1

Mathematically – Anything times 1 equals itself!

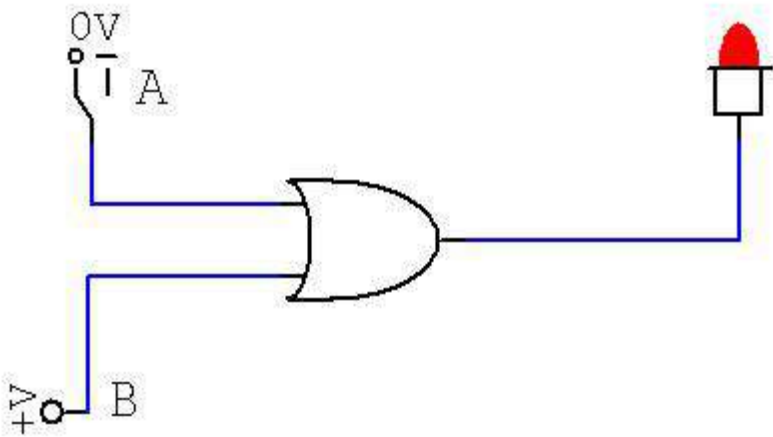
Rule 3: $A + 0 = A$



A	B	X
0	0	0
1	0	1

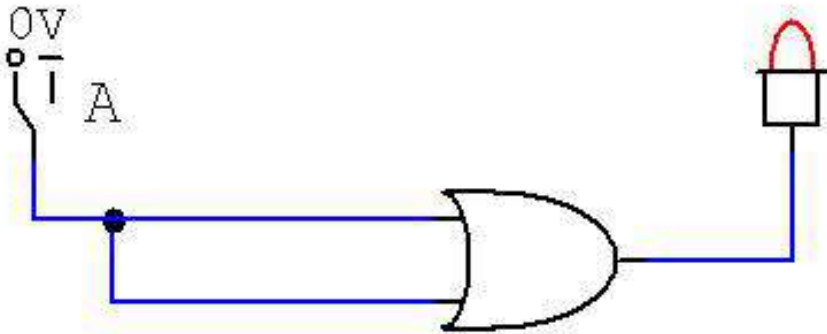
Mathematically – Anything added to 0 equals itself!

Rule 4: $A + 1 = 1$



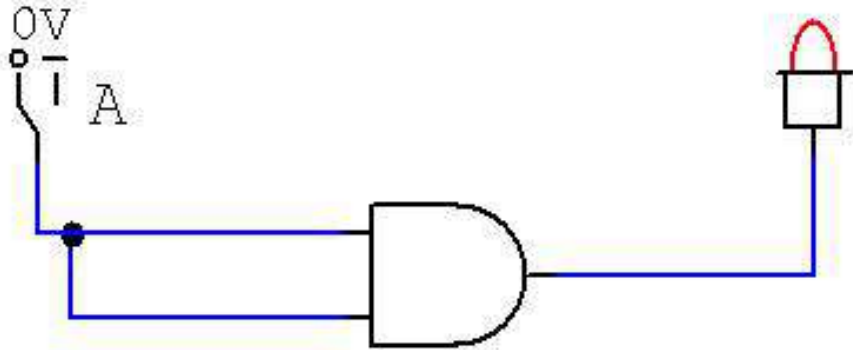
A	B	X
0	1	1
1	1	1

Rule 5: $A + A = A$



A	A	X
0	0	0
1	1	1

Rule 6: $A * A = A$



A	A	X
0	0	0
1	1	1

Pop Quiz!

$$ABC + 0 = ABC$$

$$D + 1 = 1$$

$$C + C = C$$

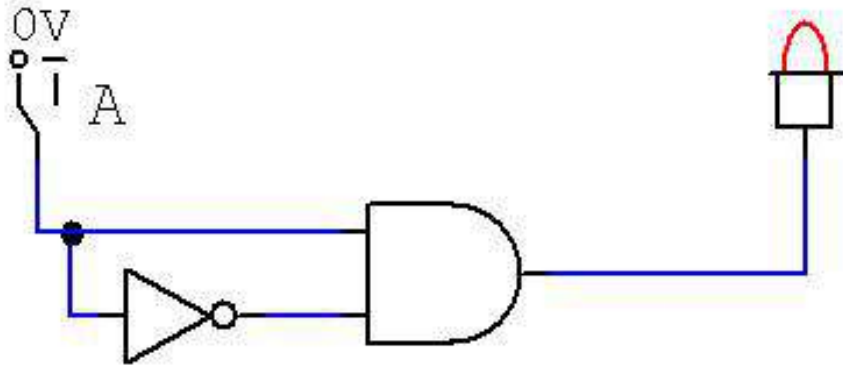
$$\bar{A} * \bar{A} = \bar{A}$$

$$ABC + ABC = ABC$$

$$B * 0 = 0$$

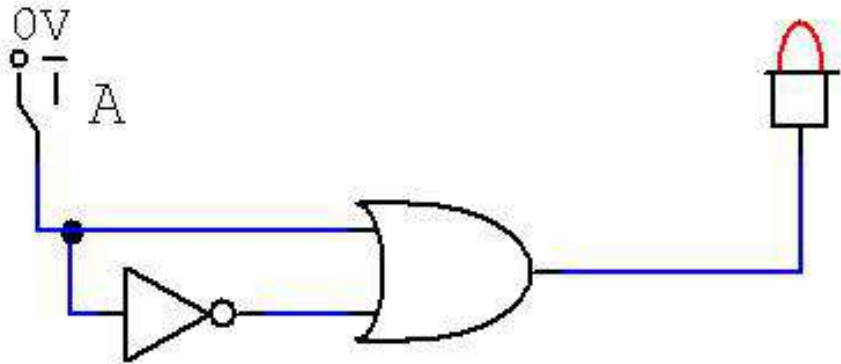
$$B * 1 = B$$

Rule 7: $A * \bar{A} = 0$



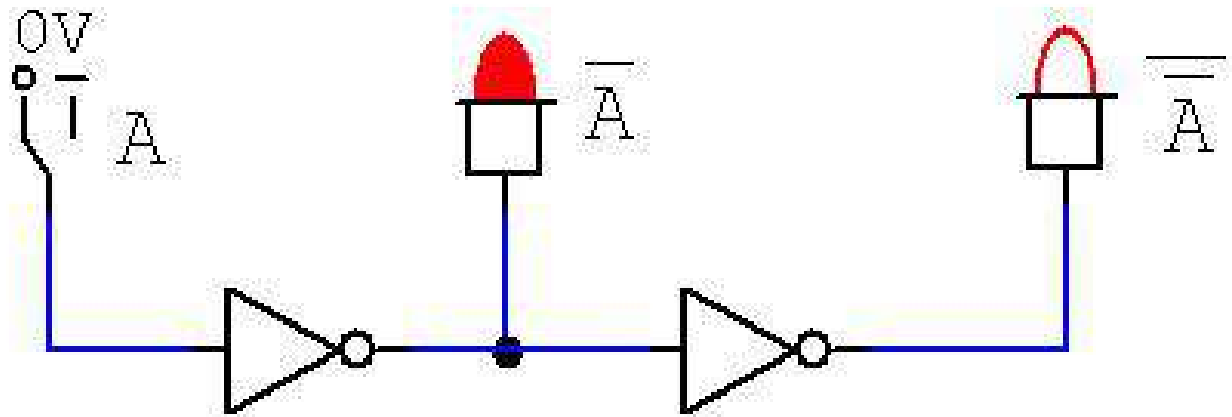
A	$\bar{A}$	X
0	1	0
1	0	0

Rule 8: $A + \bar{A} = 1$



A	$\bar{A}$	X
0	1	1
1	0	1

Rule 9: $\overline{\overline{A}} = A$



Rule 10: $A + \bar{A}B = A + B$

A	B	$A + \bar{A}B$	$A + B$
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	1

Pop Quiz!

$$AB + AC = A(B + C)$$

$$C + \bar{C}D = C + D$$

$$A + \bar{A} = A$$

$$\overline{\overline{ABC}} = ABC$$

$$B * \bar{B} = 0$$

$$\bar{B} + BE = \bar{B} + E$$

Curriculum Alignment:

Unit 4 – Boolean Algebra

Lesson 4.2 – Logic Simplification

Act. 4.2A – Logic Simplification

References:

Kleitz, W. (2002). Digital Electronics: A practical Approach. Upper Saddle River, NJ: Prentice Hall.

O'Connor, JJ & Robertson, EF. George Boole. Retrieved June 16, 2004, from Web site: <http://www.-gap.dcs.st-and.ac.uk/~history/Mathematics/Boole.html>

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