Boolean Algebra

Making Sense of it All

Digital Electronics

Unit 4 – Boolean Algebra

project lead the way

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

$A(BC) = (AB)C$

$A + \bar{A} = 1$

$A * \bar{A} = 0$

$A + 0 = A$

$A + 1 = 1$

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

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

$A + A = A$

$A * 1 = A$

$A * 0 = 0$

$A + B = B + A$

$AB = BA$

$A * A = A$

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

project lead the way

$A + B = B + A$ $AB = BA$

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

$A(BC) = (AB)C$

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$A * 0 = 0$

$A * A = A$

$A + A = A$

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

$A + 1 = 1$

$A * 1 = A$

$A * \bar{A} = 0$

$A + \bar{A} = 1$

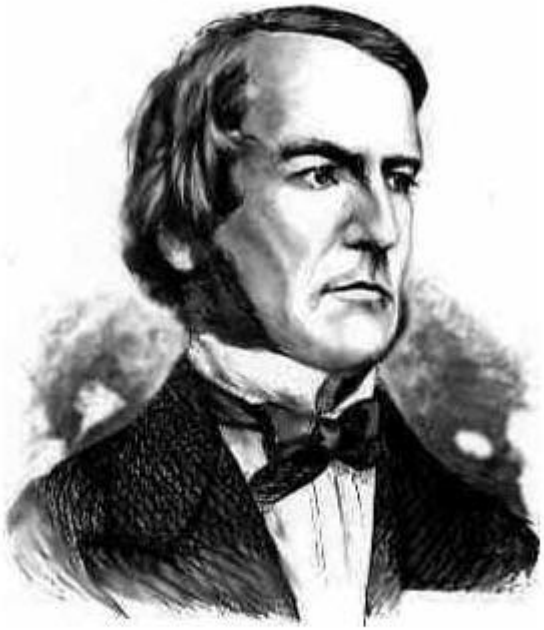
$A + \bar{A}B = A + B$

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*

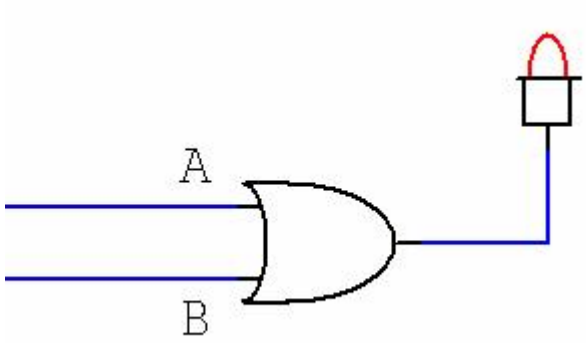
Incorporated Logic into Mathematics

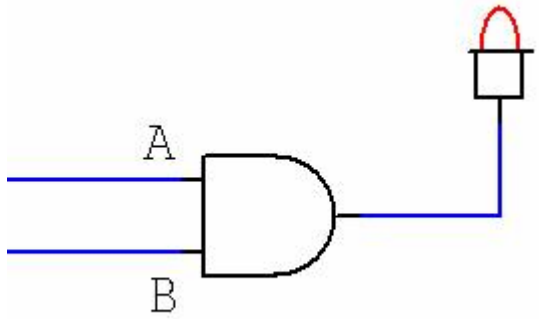
Pointed out the alignment between Algebraic Symbols and those symbols used to represent logic

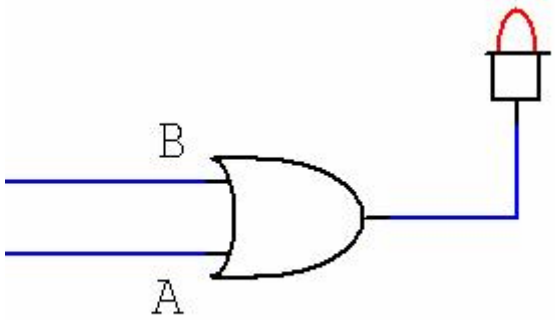
Commutative Law:

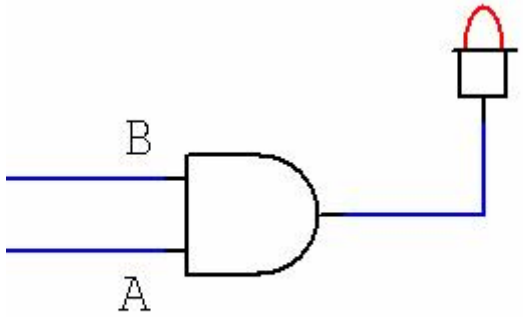
A + B = B + A

AB = BA





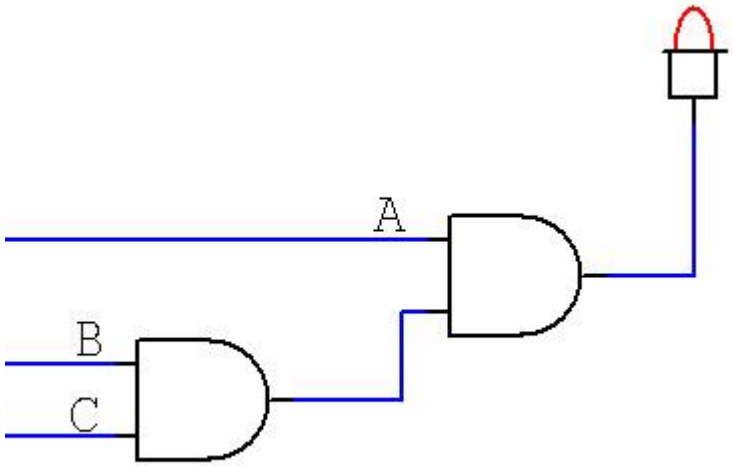


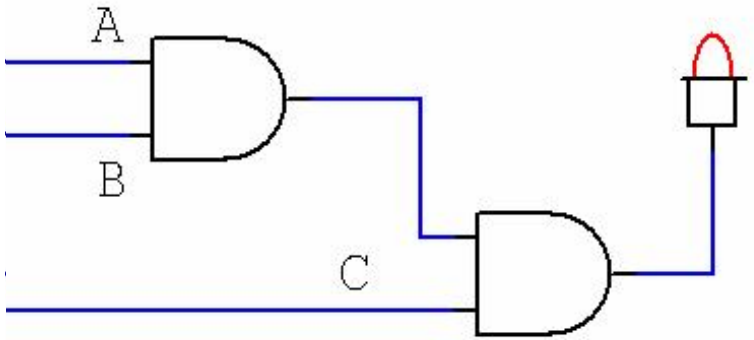


Associative Law:

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

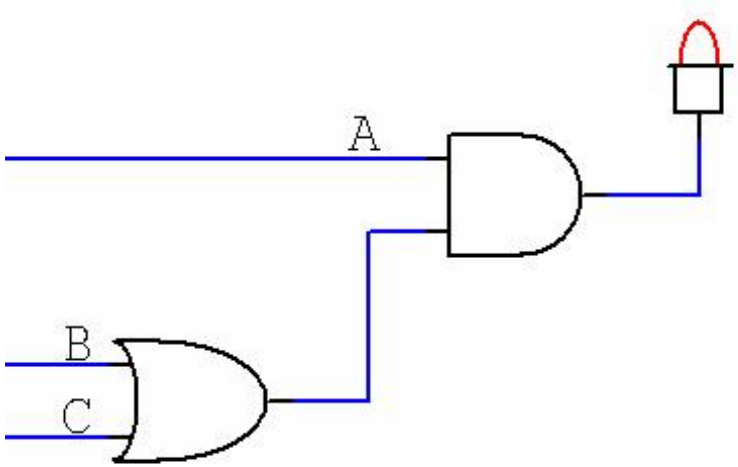
$$A(BC) = (AB)C$$

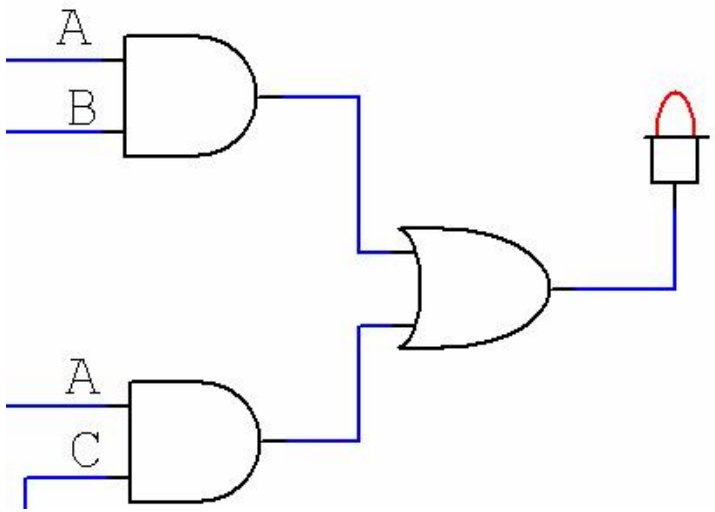




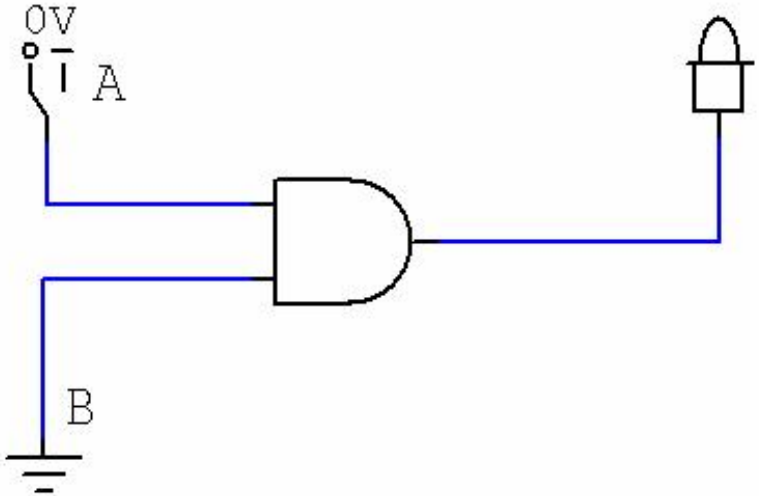
Distributive Law:

A(B + C) = AB + AC





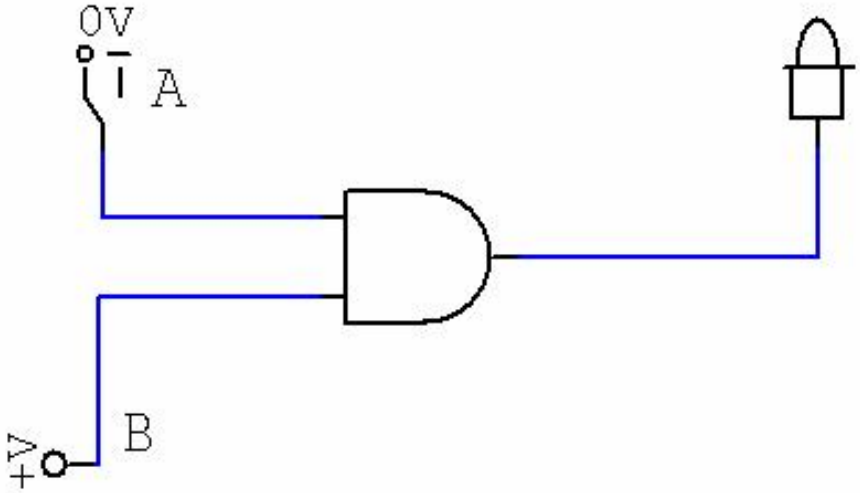
Rule 1: A * 0 = 0



A	B	X
0	0	0
1	0	0

Mathematically – Anything times 0 equals 0!

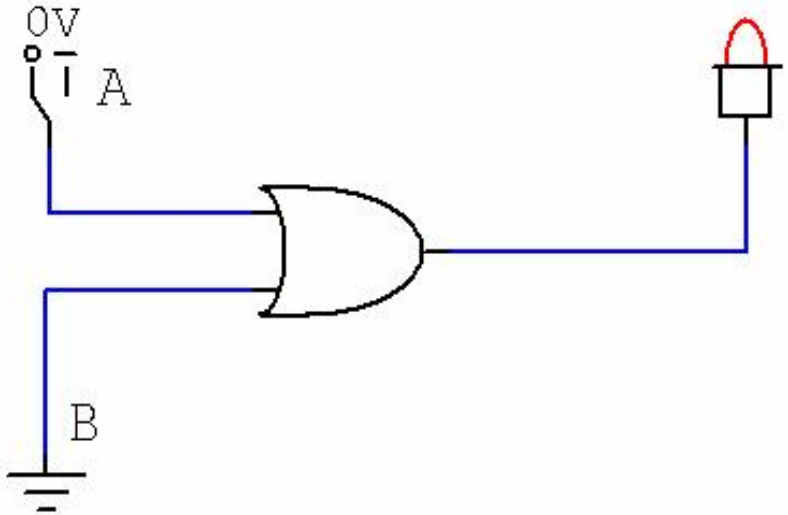
Rule 2: A * 1 = A



A	B	X
0	1	0
1	1	1

Mathematically – Anything times 1 equals itself!

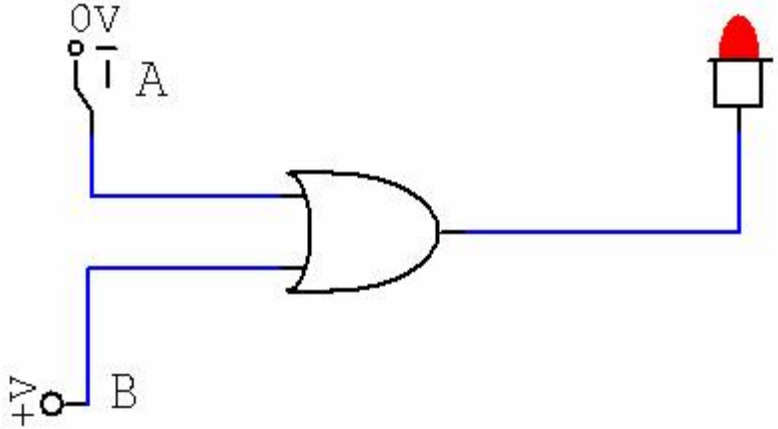
Rule 3: A + 0 = A



A	B	X
0	0	0
1	0	1

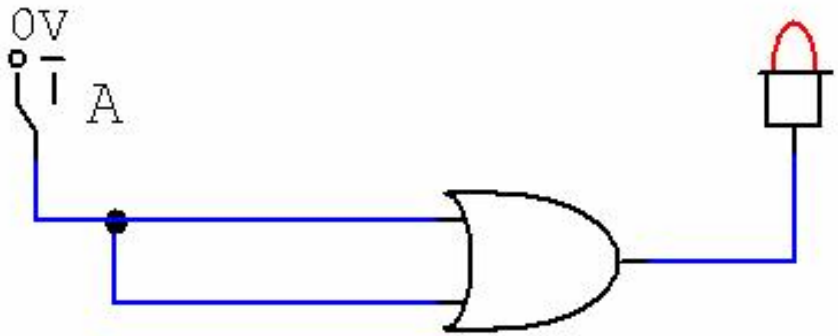
Mathematically – Anything added to 0 equals itself!

Rule 4: A + 1 = 1



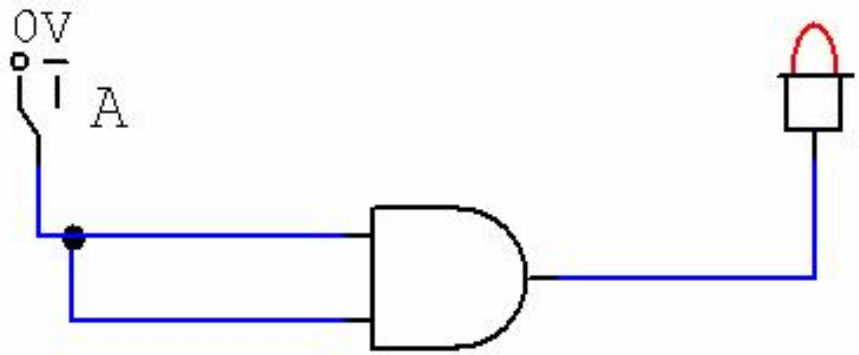
A	B	X
0	1	1
1	1	1

Rule 5: A + A = A

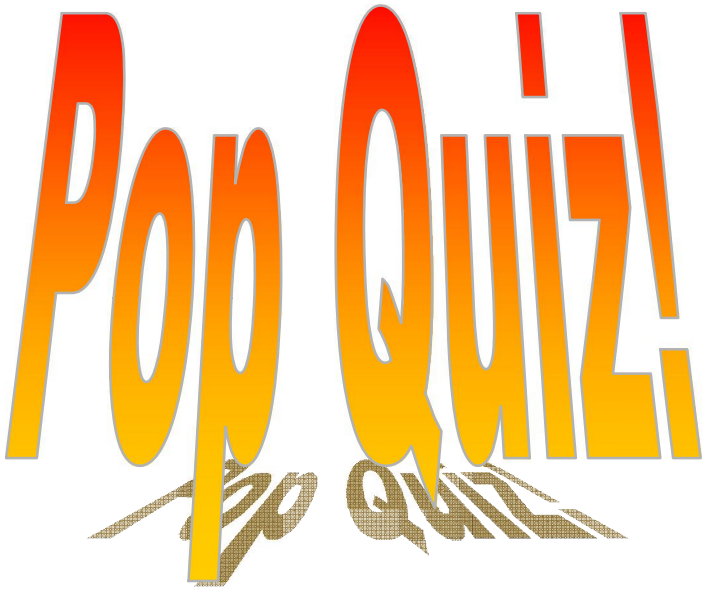


A	A	X
0	0	0
1	1	1

Rule 6: A * A = A



A	A	X
0	0	0
1	1	1


Pop Quiz!

$ABC + 0 = ABC$

$D + 1 = 1$

$C + C = C$

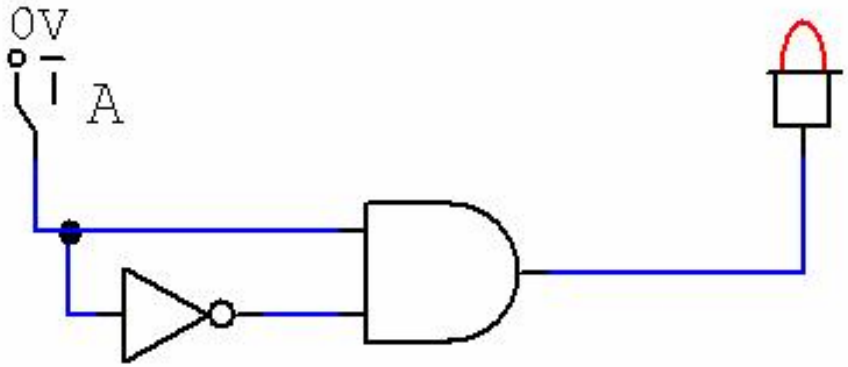
$\bar{A} * \bar{A} = \bar{A}$

$ABC + ABC = ABC$

$B * 0 = 0$

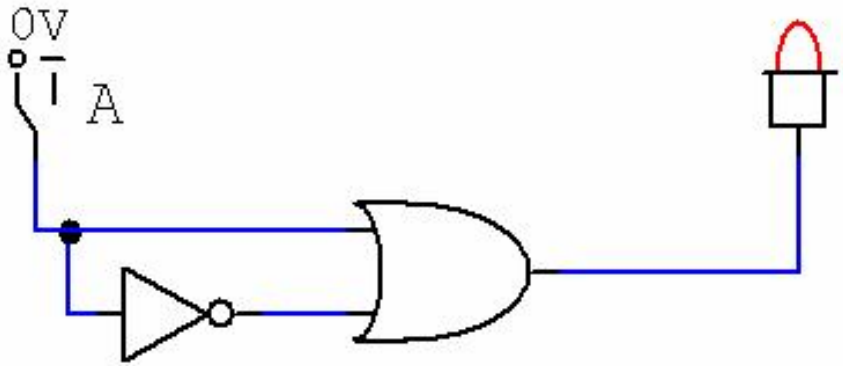
$B * 1 = B$

Rule 7: A * Ā = 0



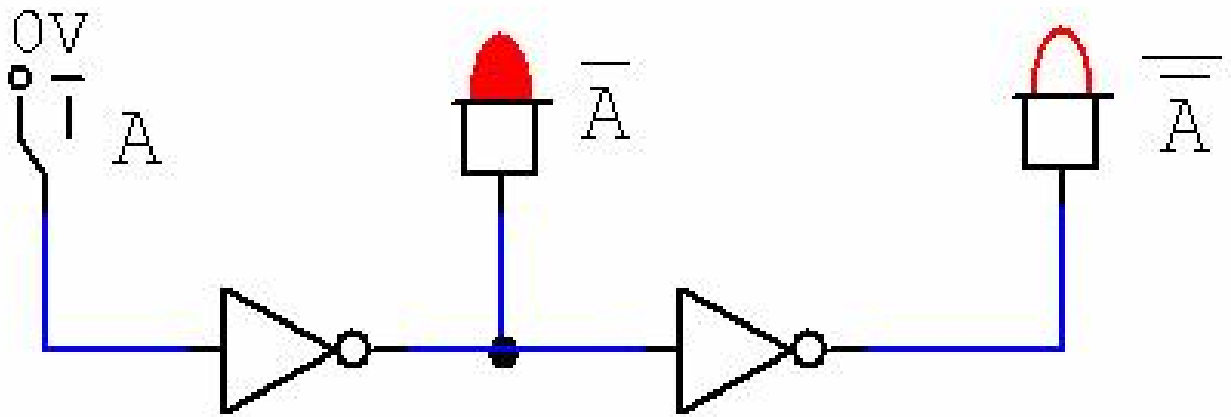
A	Ā	X
0	1	0
1	0	0

Rule 8: A + Ā = 1



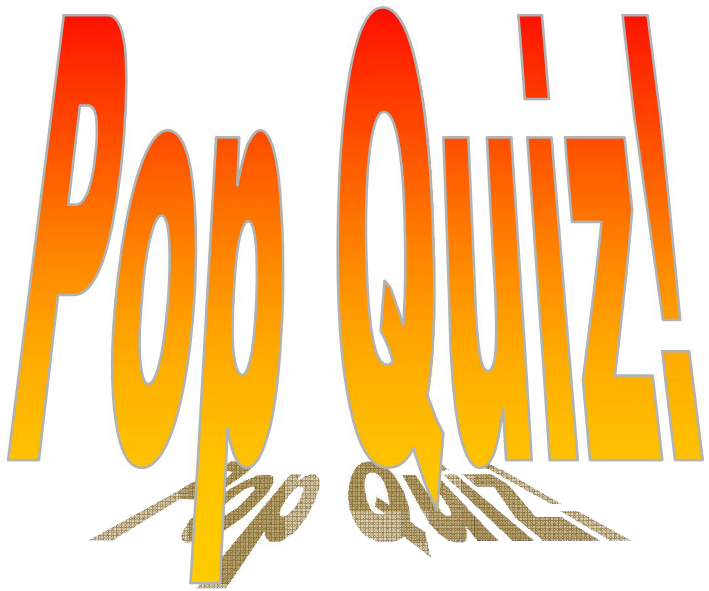
A	Ā	X
0	1	1
1	0	1

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!

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

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

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

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

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

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

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

Credits:

Writer: Donna E. Scribner

Narration: Donna E. Scribner

PLTW Editor: Ed Hughes

Production: CJ Amarosa

Video Production: CJ Amarosa

Audio: CJ Amarosa

Project Manager: Donna E. Scribner