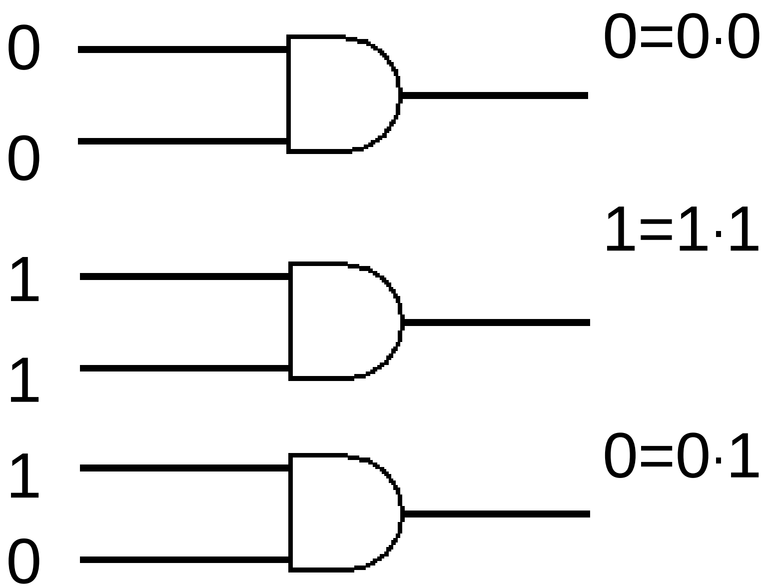
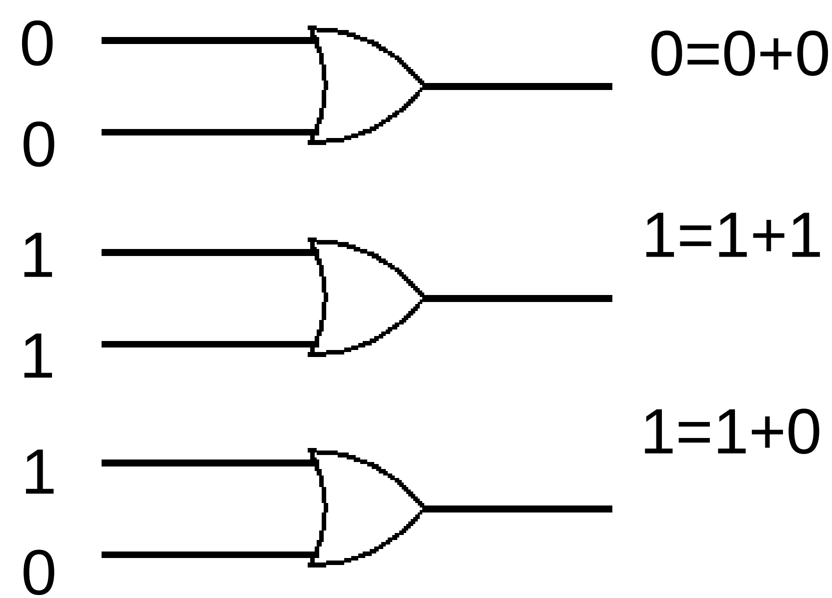
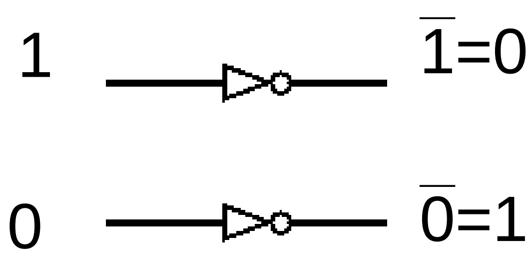
Postulates for AND – OR – NOT

Postulates are self evident truths, facts



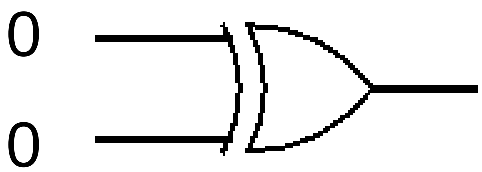




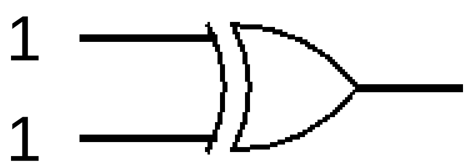
$0 \cdot 0 = 0$	$0 + 0 = 0$
$1 \cdot 1 = 1$	$1 + 1 = 1$
$1 \cdot 0 = 0$	$0 + 1 = 1$
$\overline{0} = 1$	$\overline{1} = 0$

Postulates for XOR – XNOR

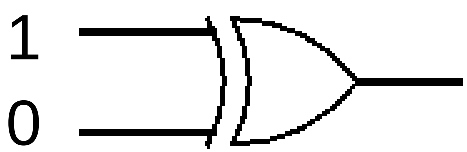
Postulates are self evident truths, facts



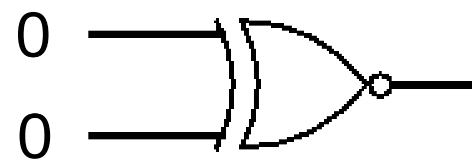
$0 = 0 \oplus 0$



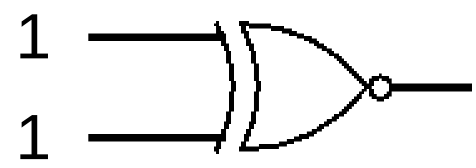
$0 = 1 \oplus 1$



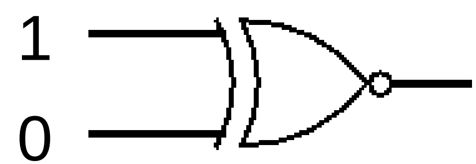
$1 = 1 \oplus 0$



$1 = \overline{0 \oplus 0}$



$1 = \overline{1 \oplus 1}$



$0 = \overline{0 \oplus 1}$

$0 \oplus 0 = 0$	$\overline{0 \oplus 0} = 1$
$1 \oplus 1 = 0$	$\overline{1 \oplus 1} = 1$
$1 \oplus 0 = 1$	$\overline{0 \oplus 1} = 0$

Algebraic Properties

Algebraic properties that we are familiar with

Commutative Property of Addition	$A + B = B + A$
Commutative Property of Multiplication	$A \bullet B = B \bullet A$
Associative Property of Addition	$(A + B) + C = A + (B + C)$
Associative Property of Multiplication	$(A \bullet B) \bullet C = A \bullet (B \bullet C)$
Distributive Property of Addition and Multiplication	$A \bullet (B + C) = AB + AC$ $(A + B) \bullet C = AC + BC$
Reciprocal of Nonzero Number	$A \bullet (1/A) = 1$
Additive Inverse	$A + (-A) = 0$
Additive Identity	$A + 0 = 0 + A = A$
Multiplicative Identity	$A \bullet 1 = 1 \bullet A = A$

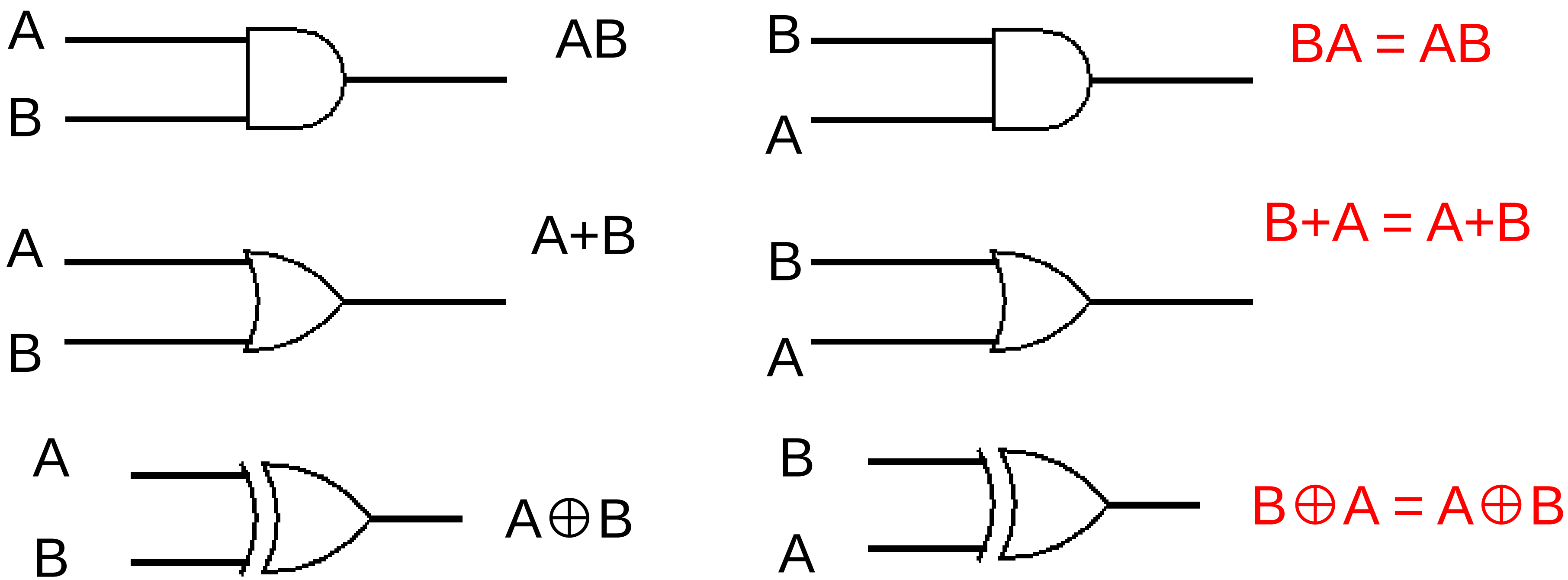
Boolean Algebra Properties

Ordinary algebraic properties also apply to Boolean algebra.
Some are unique to Boolean algebra.

AND	OR	XOR
Commutative		
$AB = BA$	$A + B = B + A$	$A \oplus B = B \oplus A$
Associative		
$A(BC) = AB(C)$	$A + (B + C) = (A + B) + C$	$(A \oplus B) \oplus C = A \oplus (B \oplus C)$
Distributive		
$A(B + C) = AB + AC$	$A + BC = (A + B)(A + C)$	$A(B \oplus C) = AB \oplus AC$ $(A\oplus B)(A\oplus C) = \overline{A}\,B\,C + A\,\overline{B}\,\overline{C}$

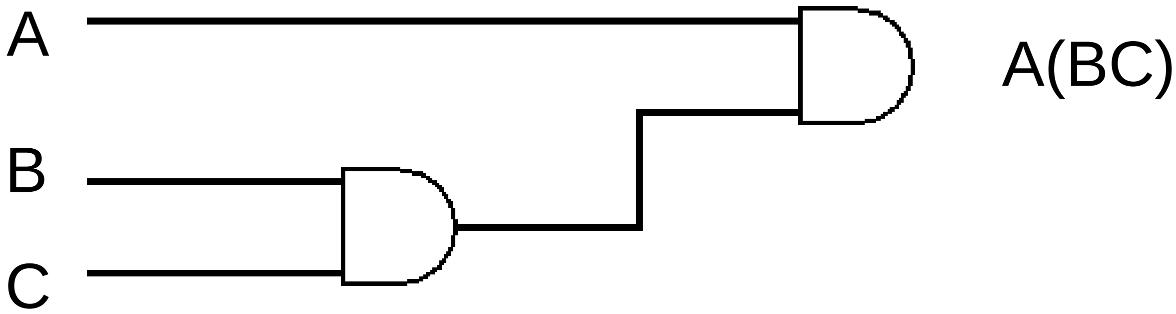
Let us examine the Boolean algebra identities using logic gates

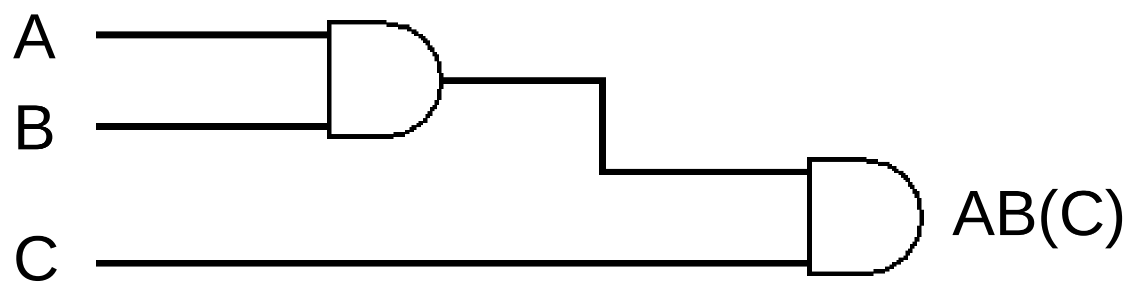
Commutative Properties – Circuit Diagrams



Commutative property implies the circuit is not affected by the order or sequence of the variables (inputs)

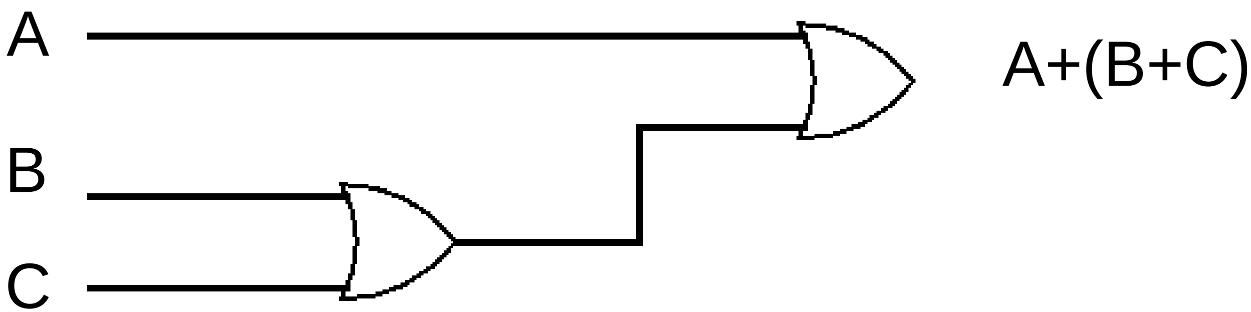
Associative Properties for AND – Circuit Diagrams

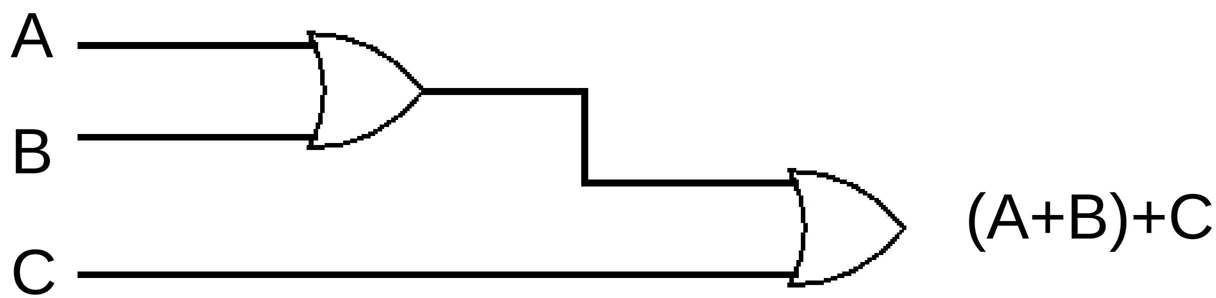




Associative property implies that a sequence exclusively of AND functions is not affected by the placement of the parentheses....A(BC) = AB(C)

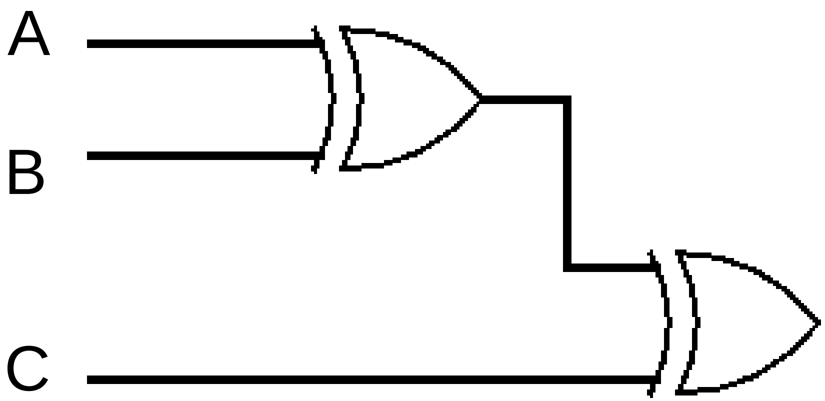
Associative Properties for OR – Circuit Diagrams



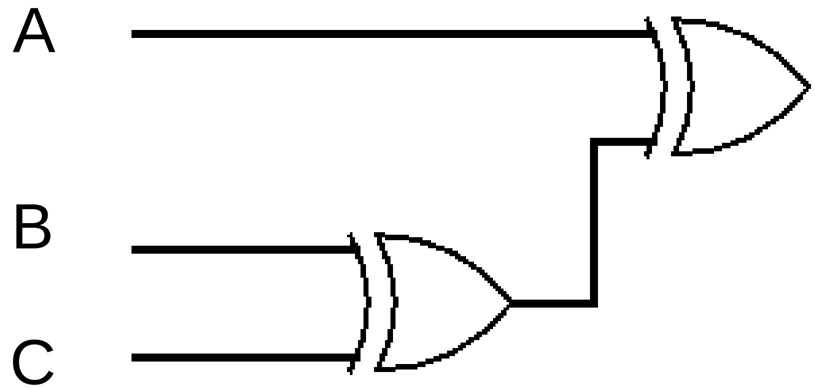


Associative property implies that a sequence exclusively of OR functions is not affected by the placement of the parentheses….
A+(B+C) = (A+B)+C

Associative Properties for XOR – Circuit Diagrams



$(A \oplus B) \oplus C$

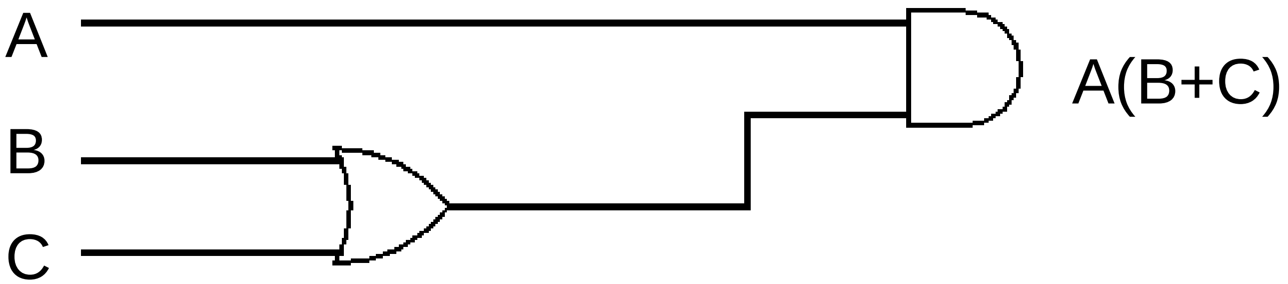


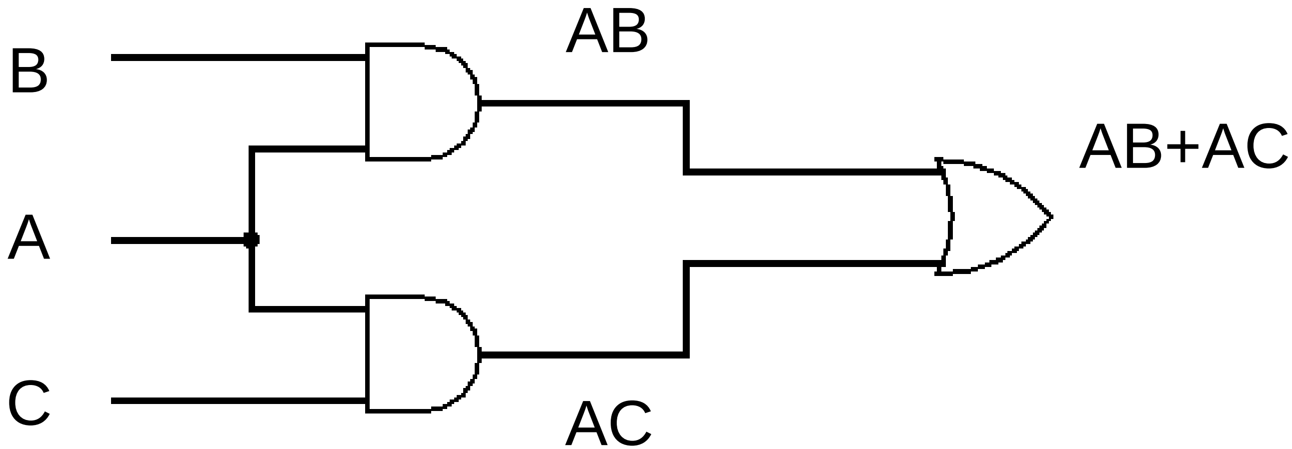
$(B \oplus C) \oplus A$

Associative property implies that a sequence exclusively of OR functions is not affected by the placement of the parentheses....

$(A \oplus B) \oplus C = (B \oplus C) \oplus A$

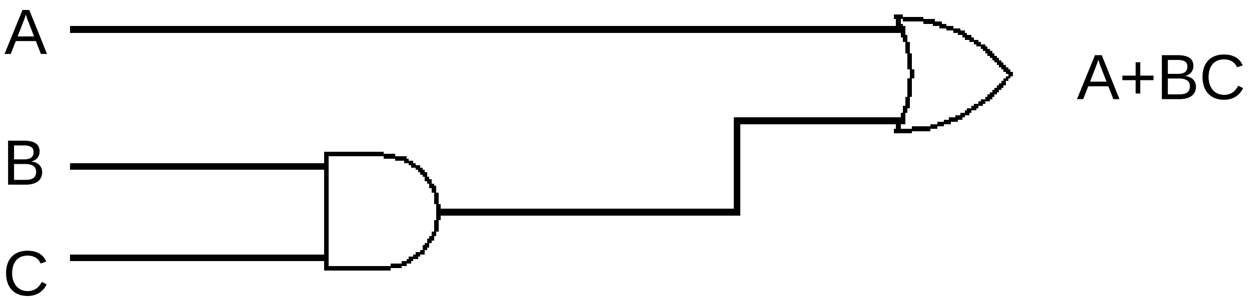
Distributive Properties for AND/OR – Circuit Diagrams

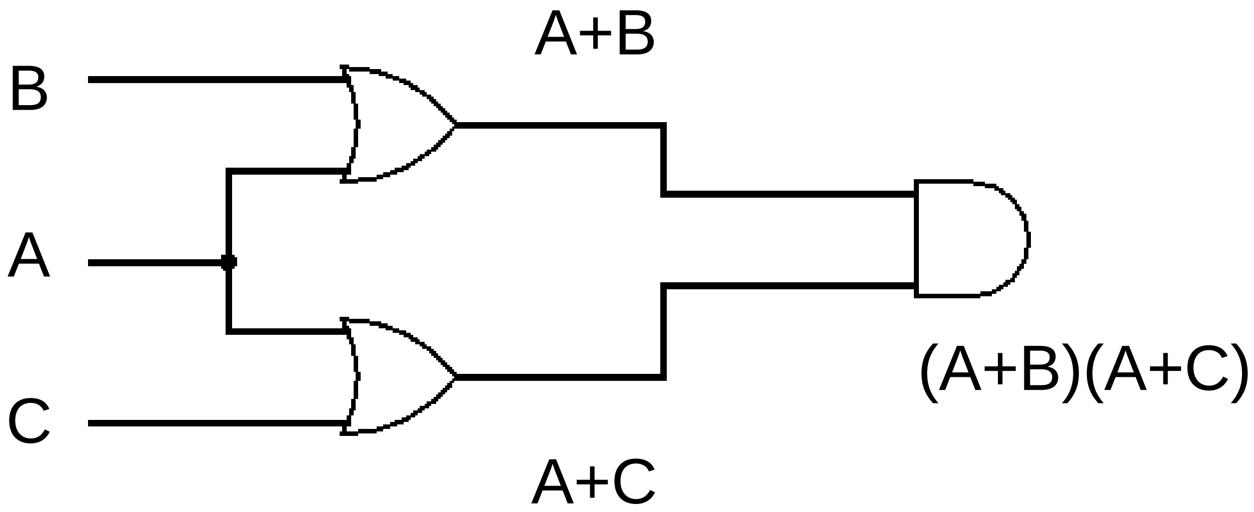




Distributive property produces 2 forms of an expression...2 possible circuits....A(B+C) = AB+AC

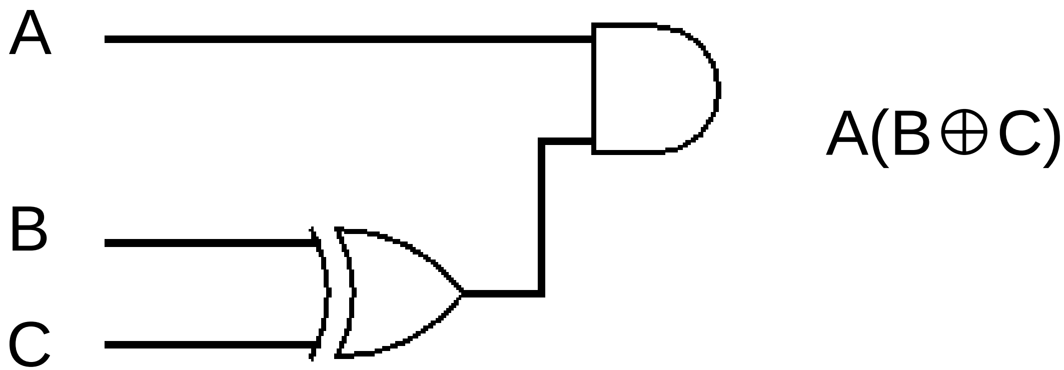
Distributive Properties for AND/OR – Circuit Diagrams

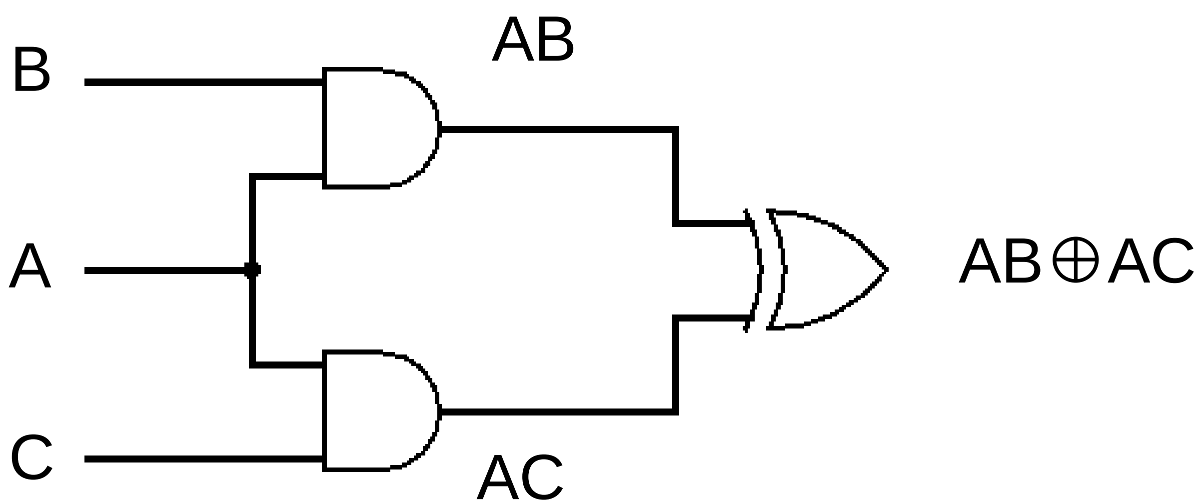




Distributive property produces 2 forms of an expression...2 possible circuits....A+BC=(A+B)(A+C)

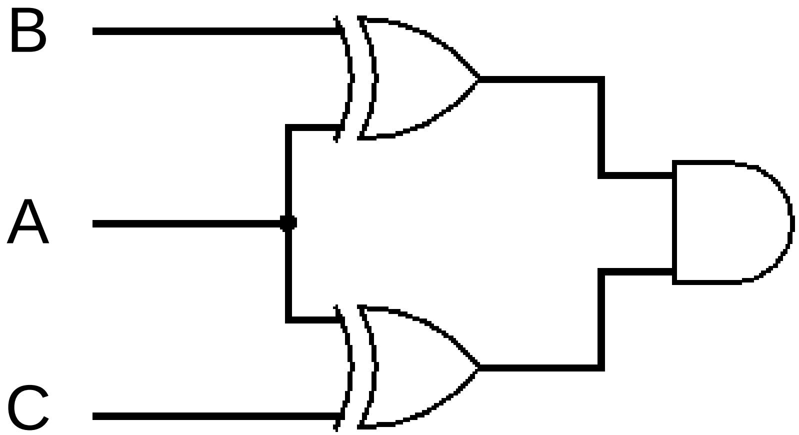
Distributive Properties for XOR – Circuit Diagrams





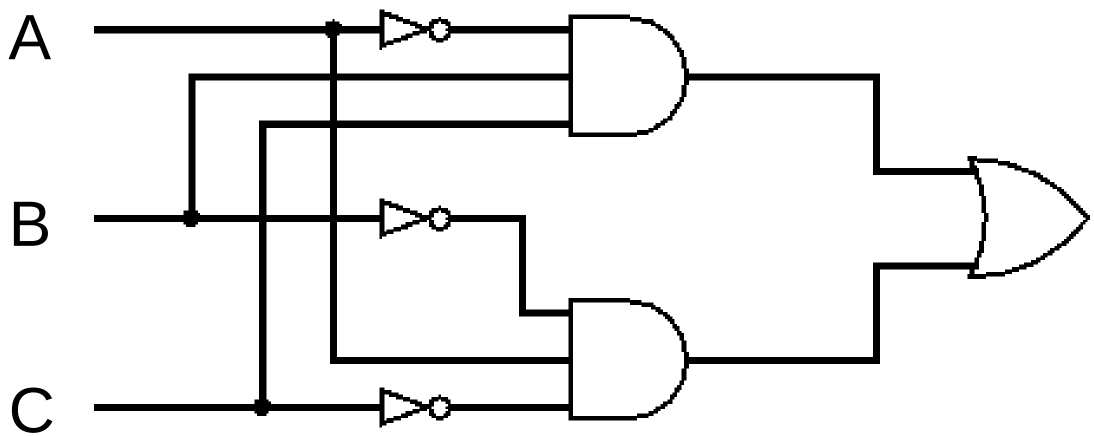
Distributive property produces 2 forms of an expression...2 possible circuits....$A(B \oplus C) = AB \oplus AC$

Distributive Properties for XOR – Circuit Diagrams



$(A \oplus B)(A \oplus C)$

$\overline{A}\,B\,C$



$\overline{A}\,B\,C + A\,\overline{B}\,\overline{C}$

$A\,\overline{B}\,\overline{C}$

Distributive property produces 2 forms of an expression...2 possible circuits....$(A \oplus B)(A \oplus C) = \overline{A}\,B\,C + A\,\overline{B}\,\overline{C}$