Boolean Algebra

Logic Gate Review

Draw:								
A	**B**	**NOT A**	**A AND B**	**A NAND B**	**A OR B**	**A NOR B**	**A XOR B**	**A XNOR B**

Logical Equivalence

If the truth table for two circuits are the same, they are _____.

Boolean Identities and Laws

Logical Inverse	0' =	1' =
Involution Law	A'' =	
Dominance	A + 1 =	A · 0 =
Identity	A + 0 =	A · 1 =

Idempotent Law	A + A =	A · A =
Law of Complementarity	A + A' =	A · A' =
Commutative Law	A + B = B + A	A · B = B · A
Associative Law	(A + B) + C = A + (B + C)	(A · B) · C = A · (B · C)
Distributive Law	A + (B·C) = (A + B)·(A + C)	A · (B + C) = (A·B) + (A·C)
Absorption	A + (AB) = A	A (A + B) = A
De Morgan's Law	A + B = (A'·B')'	A · B = (A' + B')'

De Morgan's Law

1) _____ the inputs, 2) _____, 3) _____ the output

"Break the _____, change the _____"

A + B = (A' · B')'

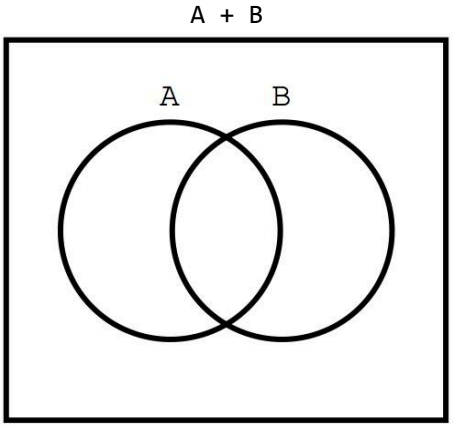
A + B

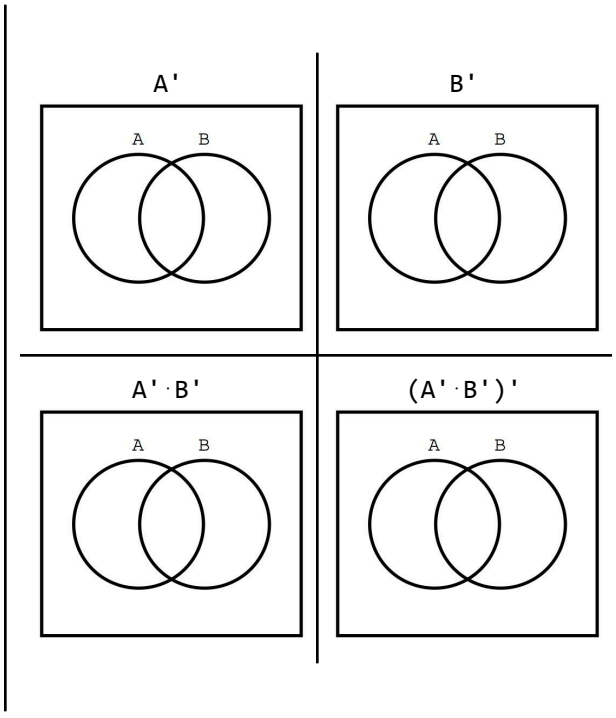
A	B	A + B
0	0	
0	1	
1	0	
1	1	

(A' · B')'

A	B	A'	B'	A' · B'	(A' · B')'
0	0				
0	1				
1	0				
1	1				

Do the truth tables match?





$A \cdot B = (A' + B')'$

$A \cdot B$

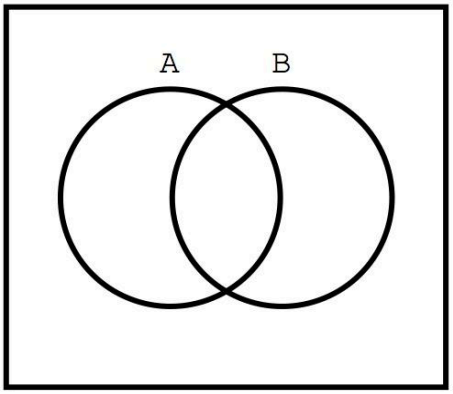
A	B	$A \cdot B$
0	0	
0	1	
1	0	
1	1	

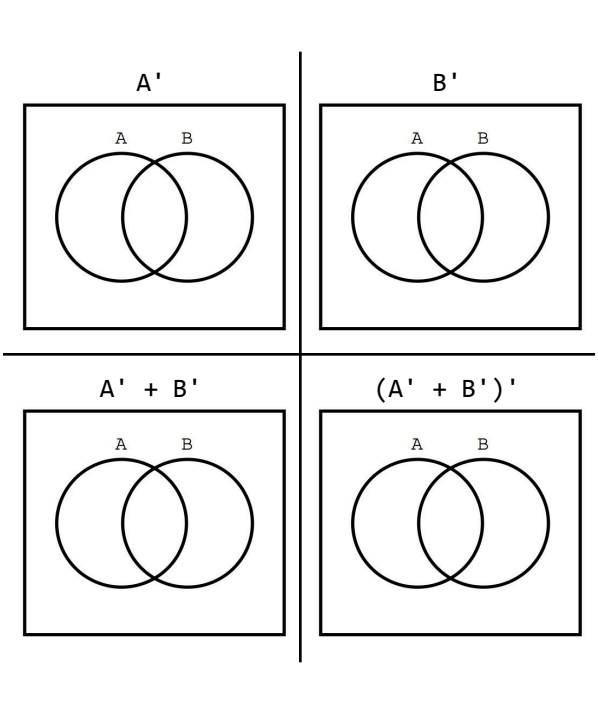
$(A' + B')'$

A	B	A'	B'	A' + B'	(A' + B')'
0	0				
0	1				
1	0				
1	1				

Do the truth tables match?

$A \cdot B$





Example

Show how $(A \cdot B')' = A' + B$

$A \cdot B \cdot C = (A' + B' + C')'$

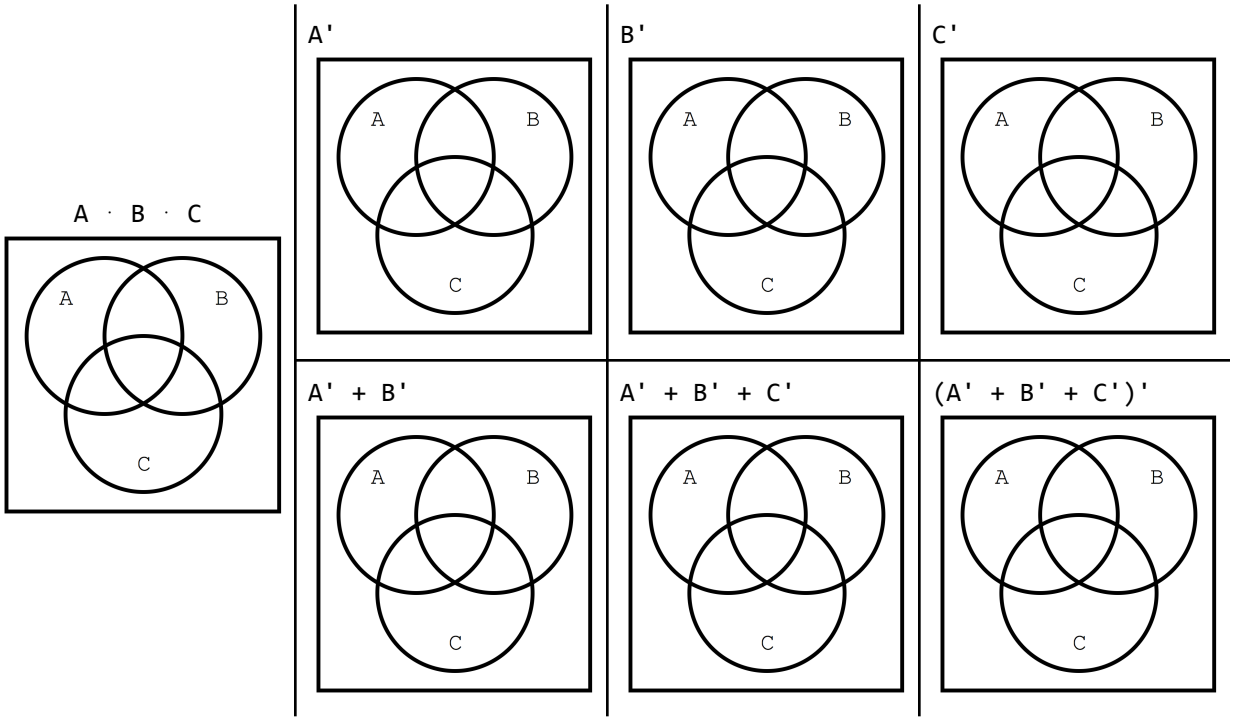
$A \cdot B \cdot C$

A	B	C	A · B	A · B · C
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

$(A' + B' + C')'$

A	B	C	A'	B'	C'	A' + B' + C'	(A' + B' + C')'
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

Do the truth tables match?



Logical Completeness

You can create a circuit for ANY truth table with only _____

In addition, you can complete any truth table with only _____

You can also complete any truth table with only _____

Only NANDS

Finish the truth table for (A · B)'. What happens if both inputs are the same?

A	B	(A · B)'
0	0	
0	1	
1	0	
1	1	

Draw a NOT gate using only NAND gates

Draw an AND gate using only NAND gates

Draw an OR gate using only NAND gates (hint: use DeMorgan's Law)

Draw a NOR gate using only NAND gates (hint: use DeMorgan's Law)

Only NORS

Finish the truth table for (A + B)'. What happens if both inputs are the same?

A	B	(A + B)'
0	0	
0	1	
1	0	
1	1	

Draw a NOT gate using only NOR gates

Draw an OR gate using only NOR gates

Draw an AND gate using only NOR gates (hint: use DeMorgan’s Law)

Draw a NAND gate using only NOR gates (hint: use DeMorgan’s Law)

XOR Example

NAND Implementation

Use DeMorgan's Law to construct an XOR gate out of only NAND gates

Draw an XOR gate and complete the truth table. Generate the SOP equation.
Draw the SOP logic circuit.
Use DeMorgan's Law to convert the OR gate to an AND gate.
Combine the inverter and AND gates to form NAND gates
Convert the inverters on the inputs to NAND gates

NOR Implementation

Use DeMorgan’s Law to construct an XOR gate out of only NOR gates

Draw an XOR gate and complete the truth table. Generate the POS equation.
Draw the POS logic circuit.
Use DeMorgan’s Law to convert the AND gate to an OR gate.
Combine the inverters and OR gates to form NOR gates
Convert the inverters on the inputs to NOR gates

Logical Equivalence

If the truth table for two circuits are the same, they are logically equivalent.

Are these circuit diagrams logically equal?
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