Architecture des ordinateurs

Circuits logiques

L1 MIASHS

UFR Mathématiques et Informatique

(2014 - 2015)

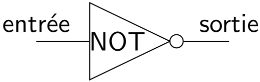
UNIVERSITÉ DE LORRAINE

Circuit Logique

- Circuit dans lequel seules 2 valeurs logiques sont possibles : 0 ou 1
- Circuit électrique (transistors) :
    - Faible tension = 0
    - Tension élevée = 1
- Composants de base : les portes logiques

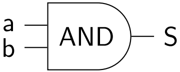
Porte logique

- Permet de combiner les signaux binaires
- Reçoit en entrée une ou plusieurs valeurs binaires
- Renvoie une unique valeur binaire en sortie
- Exemple : porte NON

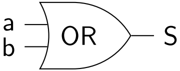


Si la valeur d'entrée est 1, alors la sortie vaut 0.
Si la valeur d'entrée est 0, alors la sortie vaut 1.

Portes ET (AND) et OU (OR)

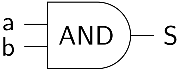


a	b	S
0	0	
0	1	
1	0	
1	1	

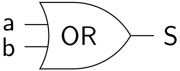


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)

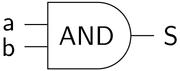


a	**b**	**S**
0	0	0
0	1	
1	0	
1	1	

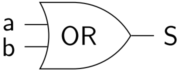


a	**b**	**S**
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)

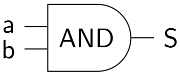


a	b	S
0	0	0
0	1	0
1	0	
1	1	

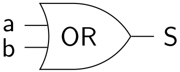


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)

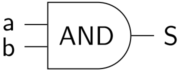


a	b	S
0	0	0
0	1	0
1	0	0
1	1	

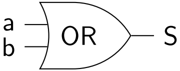


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)

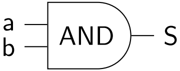


a	**b**	**S**
0	0	0
0	1	0
1	0	0
1	1	1



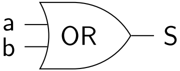
a	**b**	**S**
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)



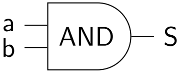
a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

Notation :
$S = a \cdot b = ab$



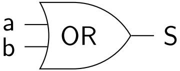
a	b	S
0	0	
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)



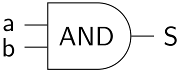
a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

Notation :
$S = a \cdot b = ab$



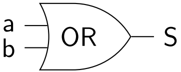
a	b	S
0	0	0
0	1	
1	0	
1	1	

Portes ET (AND) et OU (OR)



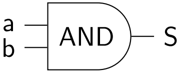
a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

Notation :
$S = a \cdot b = ab$



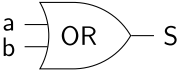
a	b	S
0	0	0
0	1	1
1	0	
1	1	

Portes ET (AND) et OU (OR)



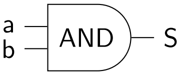
a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

Notation :
$S = a \cdot b = ab$



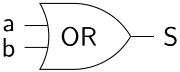
a	b	S
0	0	0
0	1	1
1	0	1
1	1	

Portes ET (AND) et OU (OR)



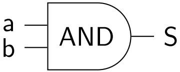
a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

Notation :
$S = a \cdot b = ab$



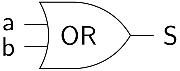
a	b	S
0	0	0
0	1	1
1	0	1
1	1	1

Portes ET (AND) et OU (OR)



a	b	S
0	0	0
0	1	0
1	0	0
1	1	1

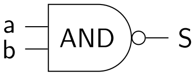
Notation :
$S = a \cdot b = ab$



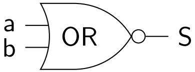
a	b	S
0	0	0
0	1	1
1	0	1
1	1	1

Notation :
$S = a + b$

Portes NON-ET (NAND) et NON-OU (NOR)

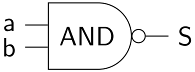


a	b	S
0	0	
0	1	
1	0	
1	1	

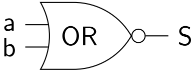


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)

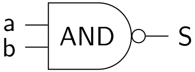


a	b	S
0	0	1
0	1	
1	0	
1	1	

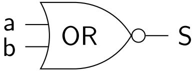


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)

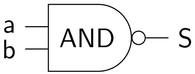


a	**b**	**S**
0	0	1
0	1	1
1	0	
1	1	

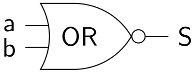


a	**b**	**S**
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)

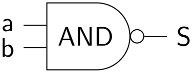


a	b	S
0	0	1
0	1	1
1	0	1
1	1	

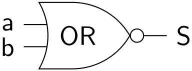


a	b	S
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)

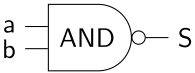


a	b	S
0	0	1
0	1	1
1	0	1
1	1	0



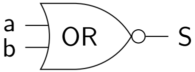
a	b	S
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)



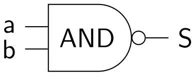
a	**b**	**S**
0	0	1
0	1	1
1	0	1
1	1	0

Notation :
$S = \overline{a \cdot b} = \overline{ab}$



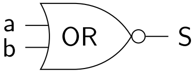
a	**b**	**S**
0	0	
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)



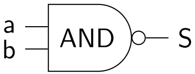
a	b	S
0	0	1
0	1	1
1	0	1
1	1	0

Notation :
$S = \overline{a \cdot b} = \overline{ab}$



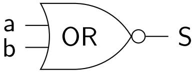
a	b	S
0	0	1
0	1	
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)



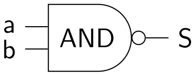
a	**b**	**S**
0	0	1
0	1	1
1	0	1
1	1	0

Notation :
$S = \overline{a \cdot b} = \overline{ab}$



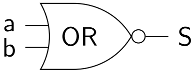
a	**b**	**S**
0	0	1
0	1	0
1	0	
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)



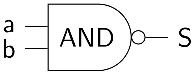
a	**b**	**S**
0	0	1
0	1	1
1	0	1
1	1	0

Notation :
$S = \overline{a \cdot b} = \overline{ab}$



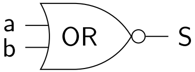
a	**b**	**S**
0	0	1
0	1	0
1	0	0
1	1	

Portes NON-ET (NAND) et NON-OU (NOR)



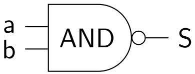
a	b	S
0	0	1
0	1	1
1	0	1
1	1	0

Notation :
$S = \overline{a \cdot b} = \overline{ab}$



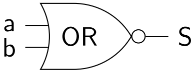
a	b	S
0	0	1
0	1	0
1	0	0
1	1	0

Portes NON-ET (NAND) et NON-OU (NOR)



a	b	S
0	0	1
0	1	1
1	0	1
1	1	0

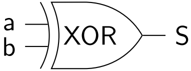
Notation :
$S = \overline{a \cdot b} = \overline{ab}$



a	b	S
0	0	1
0	1	0
1	0	0
1	1	0

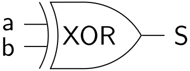
Notation :
$S = \overline{a + b}$

Porte OU-Exclusif (XOR)



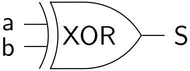
a	**b**	**S**
0	0	
0	1	
1	0	
1	1	

Porte OU-Exclusif (XOR)



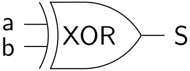
a	b	S
0	0	0
0	1	
1	0	
1	1	

Porte OU-Exclusif (XOR)



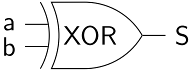
a	b	S
0	0	0
0	1	1
1	0	
1	1	

Porte OU-Exclusif (XOR)



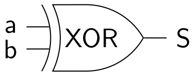
a	**b**	**S**
0	0	0
0	1	1
1	0	1
1	1	

Porte OU-Exclusif (XOR)



a	b	S
0	0	0
0	1	1
1	0	1
1	1	0

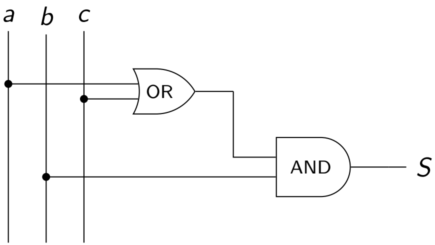
Porte OU-Exclusif (XOR)



a	b	S
0	0	0
0	1	1
1	0	1
1	1	0

Notation :
$S = a \oplus b$

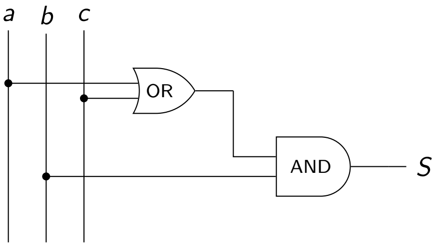
Du circuit logique à la table de vérité



$S = ?$

a	b	c	$a + c$	S
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

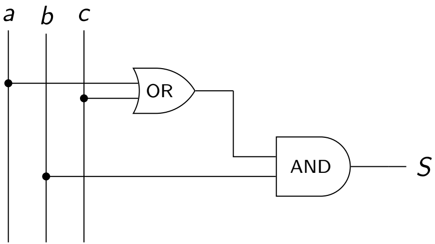
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

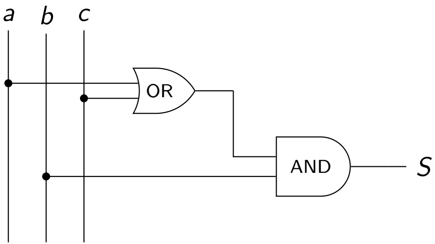
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

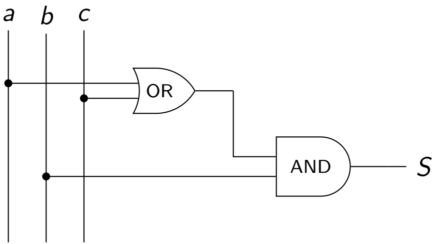
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1	1	
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

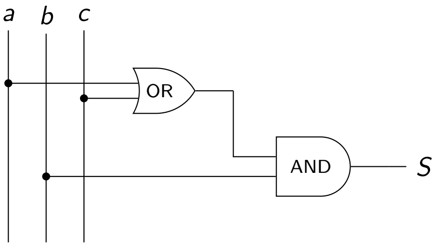
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

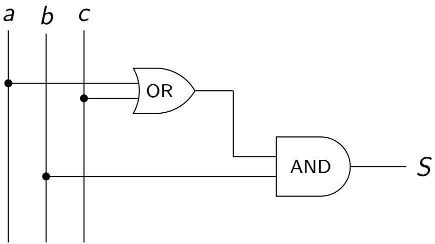
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0		
1	0	1		
1	1	0		
1	1	1		

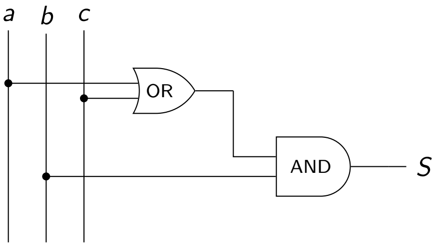
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1		
1	1	0		
1	1	1		

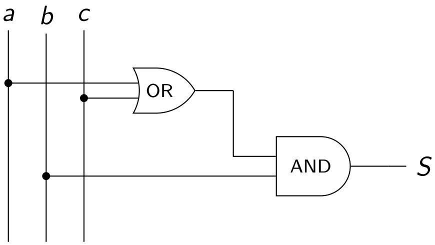
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a+c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0		
1	1	1		

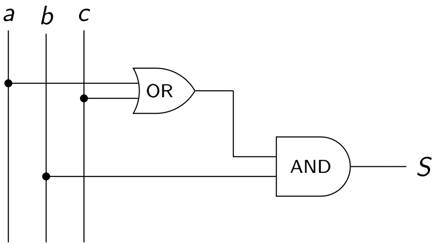
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a+c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1		

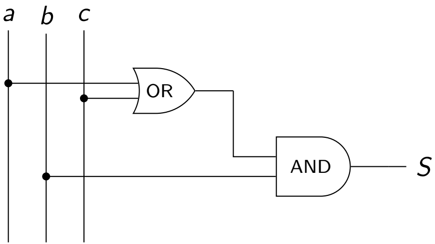
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

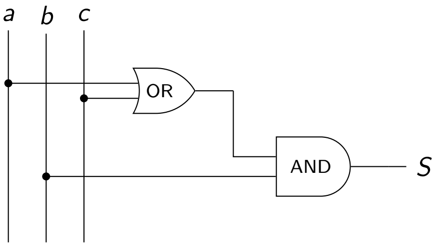
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	0
0	0	1	1	
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

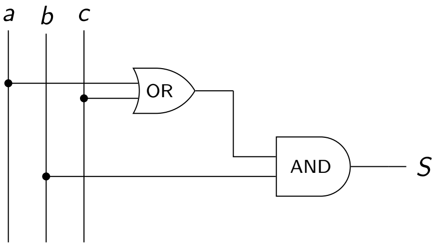
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

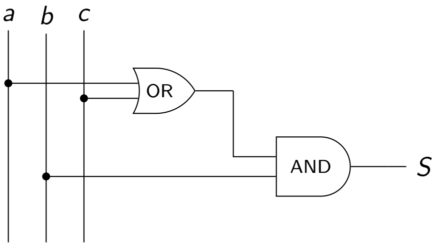
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a+c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

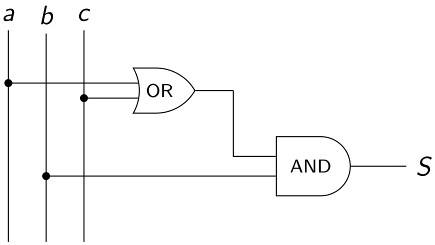
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	
1	0	1	1	
1	1	0	1	
1	1	1	1	

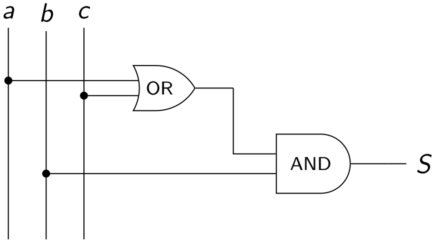
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a+c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	
1	1	0	1	
1	1	1	1	

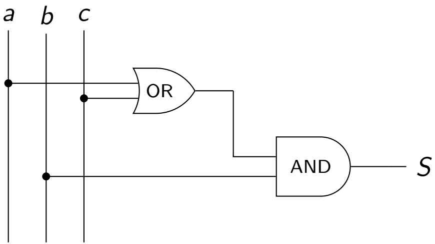
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	
1	1	1	1	

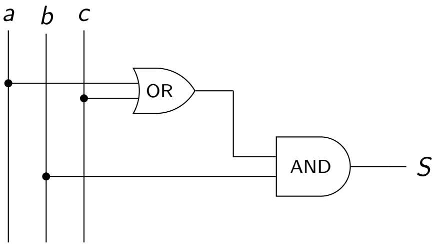
Du circuit logique à la table de vérité



$$S = b(a + c)$$

a	b	c	$a + c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	1
1	1	1	1	

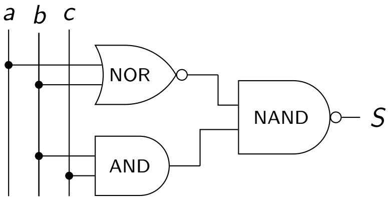
Du circuit logique à la table de vérité



$$S = b(a+c)$$

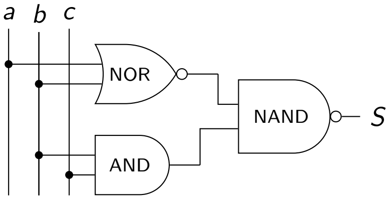
a	b	c	$a+c$	S
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	1
1	1	1	1	1

Du circuit logique à la table de vérité - Exercice



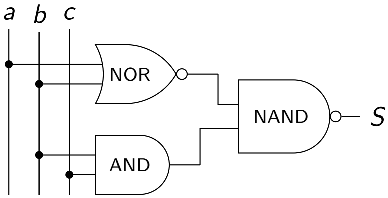
$$S = ?$$

Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

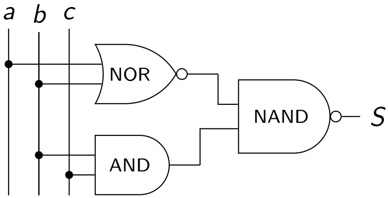
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

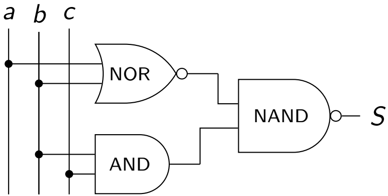
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

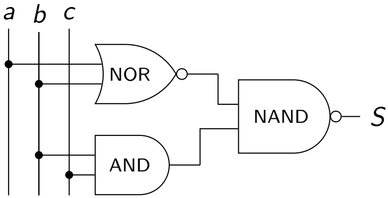
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

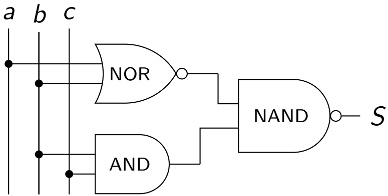
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

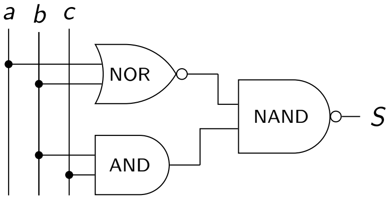
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

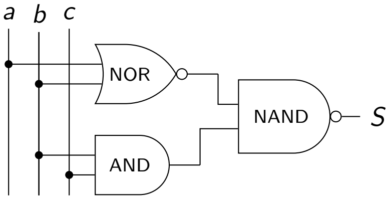
a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0				
1	0	1				
1	1	0				
1	1	1				

Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

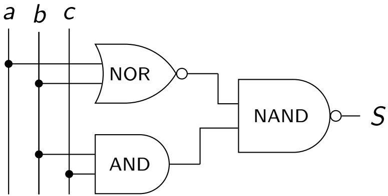
a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1				
1	1	0				
1	1	1				



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0				
1	1	1				

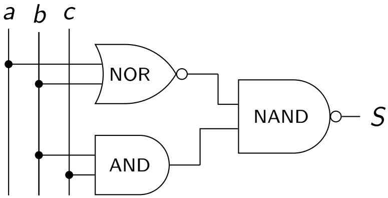
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1				

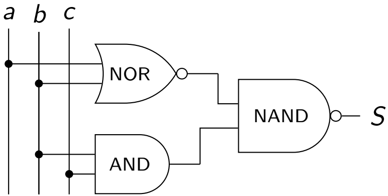
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0			
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1	1			

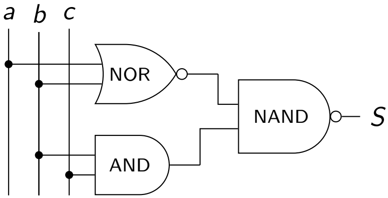
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0			
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1	1			

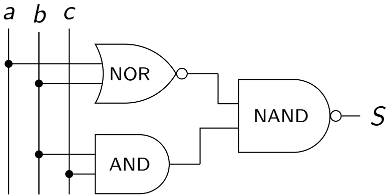
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1			
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1	1			

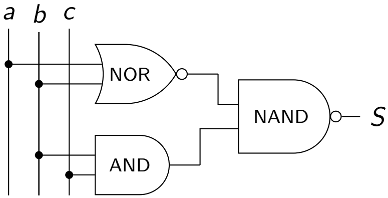
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

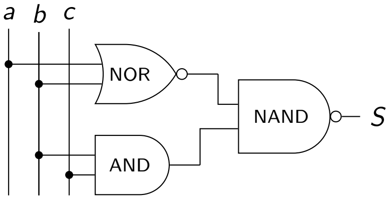
a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1			
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1	1			

Du circuit logique à la table de vérité - Exercice



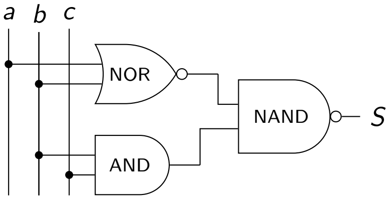
$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1			
1	0	1	1			
1	1	0	1			
1	1	1	1			



$$S = \overline{\overline{(a+b)} \cdot bc}$$

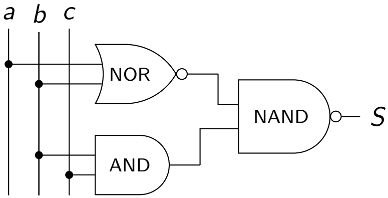
a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1			
1	1	0	1			
1	1	1	1			



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1			
1	1	1	1			

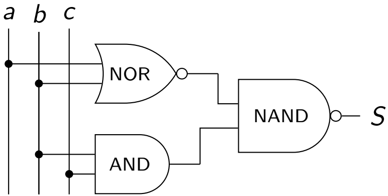
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
1	1	1	1			

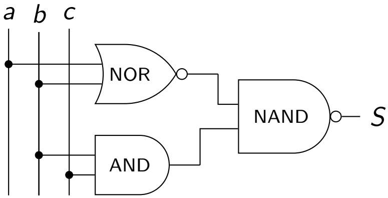
Du circuit logique à la table de vérité - Exercice



$S = \overline{\overline{(a+b)} \cdot bc}$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1		
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
1	1	1	1	0		

Du circuit logique à la table de vérité - Exercice



$S = \overline{\overline{(a+b)} \cdot bc}$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	
0	0	1	0	1		
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
1	1	1	1	0		

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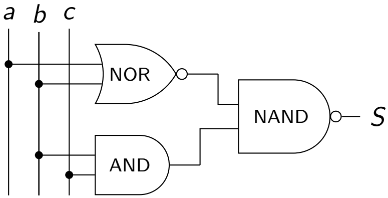

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0	0	1	0	1	0	
0	1	0	1	0		
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
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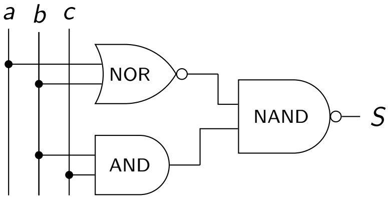

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0	1	0	1	0	0	
0	1	1	1	0		
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
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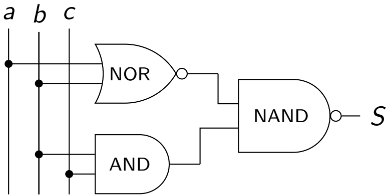

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0	0	1	0	1	0	
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0		
1	0	1	1	0		
1	1	0	1	0		
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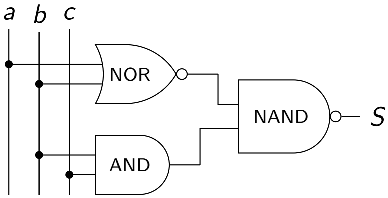

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a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	
0	0	1	0	1	0	
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0		
1	1	0	1	0		
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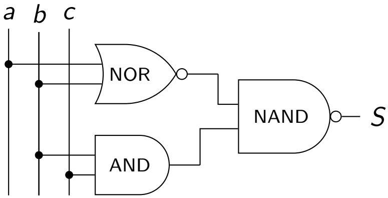

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0	0	1	0	1	0	
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0		
1	1	1	1	0		

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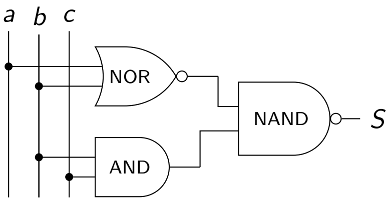

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a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	
0	0	1	0	1	0	
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0	0	
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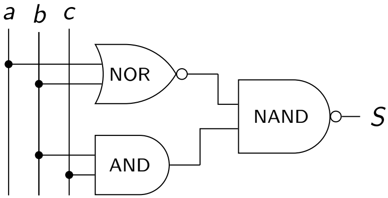

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0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
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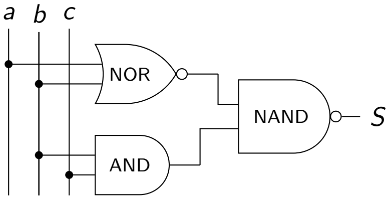

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a	b	c	$a+b$	$\overline{a+b}$	bc	S
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0	0	1	0	1	0	
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0	0	
1	1	1	1	0	1	

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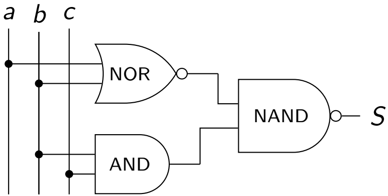

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0	0	1	0	1	0	1
0	1	0	1	0	0	
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0	0	
1	1	1	1	0	1	

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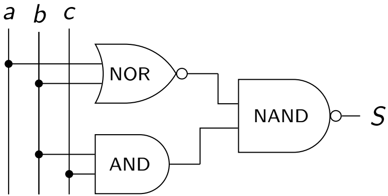

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0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0	0	
1	1	1	1	0	1	

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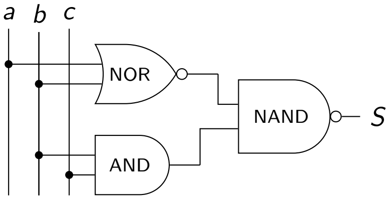

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0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	1	0	0	
1	0	1	1	0	0	
1	1	0	1	0	0	
1	1	1	1	0	1	

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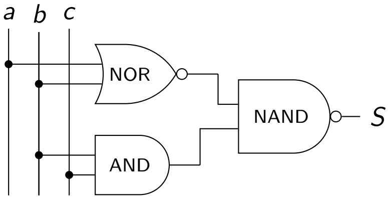

$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
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0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	
1	1	0	1	0	0	
1	1	1	1	0	1	

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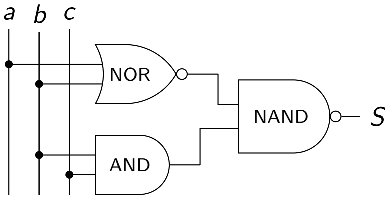
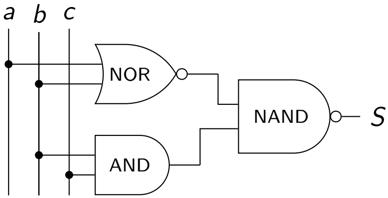


$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	1
0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	1
1	1	0	1	0	0	
1	1	1	1	0	1	

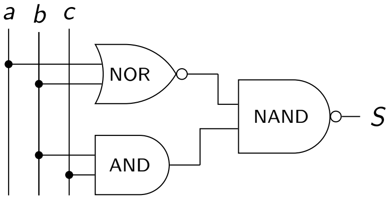
Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	1
0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	1
1	1	0	1	0	0	1
1	1	1	1	0	1	

Du circuit logique à la table de vérité - Exercice



$$S = \overline{\overline{(a+b)} \cdot bc}$$

a	b	c	$a+b$	$\overline{a+b}$	bc	S
0	0	0	0	1	0	1
0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	1
1	1	0	1	0	0	1
1	1	1	1	0	1	1

De la table de vérité au circuit logique

1. Écrire l'équation de la fonction à partir de sa table de vérité

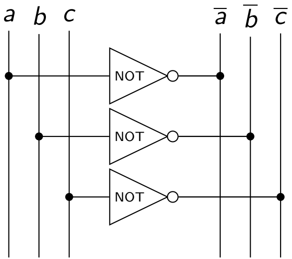
a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

$$\leadsto \quad S = \overline{a}b\overline{c} + a\overline{b}c + abc$$

De la table de vérité au circuit logique

2. Réaliser la négation de toutes les variables d'entrée

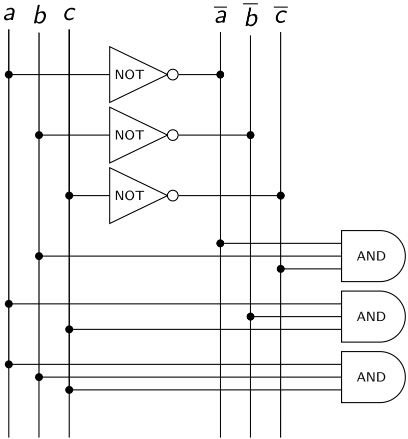
a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



De la table de vérité au circuit logique

3. Construire une porte ET pour chacun des termes égal à 1 dans la colonne S
4. Établir le câblage des portes ET avec les entrées appropriées

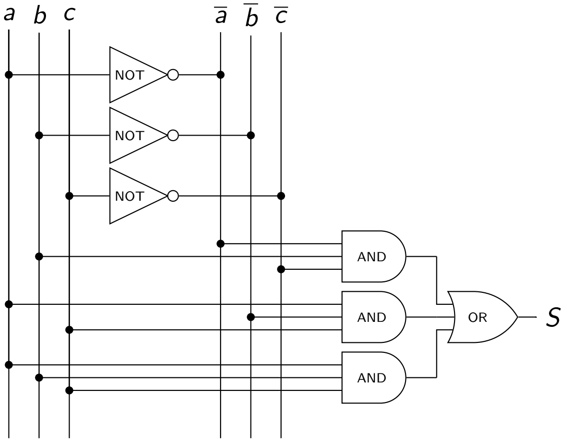
a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



De la table de vérité au circuit logique

5. Réunir l'ensemble des sorties des portes ET vers une porte OU, dont la sortie et le résultat de la fonction

a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1



De la table de vérité au circuit logique - Exercice

a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$S = ?$$

De la table de vérité au circuit logique - Exercice

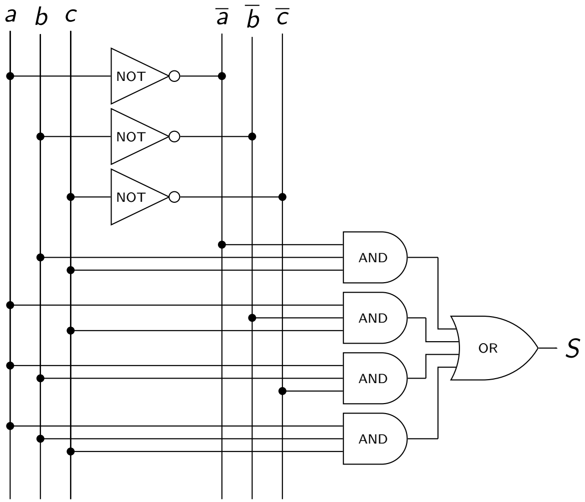
a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$S = \overline{a}bc + a\overline{b}c + ab\overline{c} + abc$

De la table de vérité au circuit logique - Exercice

a	b	c	S
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$S = \overline{a}bc + a\overline{b}c + ab\overline{c} + abc$$



Simplification

$\Rightarrow$ Diminuer le nombre d'opérateurs

$\Rightarrow$ Diminuer le nombre de portes logiques (et donc le coût)

Deux approches :

- Méthode algébrique (algèbre de Boole)

  Exemple : (sortie majoritaire)

$$
\begin{aligned}
S &= \overline{a}bc + a\overline{b}c + ab\overline{c} + abc \\
&= (\overline{a}b + a\overline{b})c + ab(c + \overline{c}) \\
&= (a + b)(\overline{a} + \overline{b})c + ab \\
&= (ac + bc)\overline{ab} + ab \\
&= (ab + ac + bc)(\overline{ab} + ab) \\
&= ab + ac + bc
\end{aligned}
$$

- Méthode des tableaux de Karnaugh