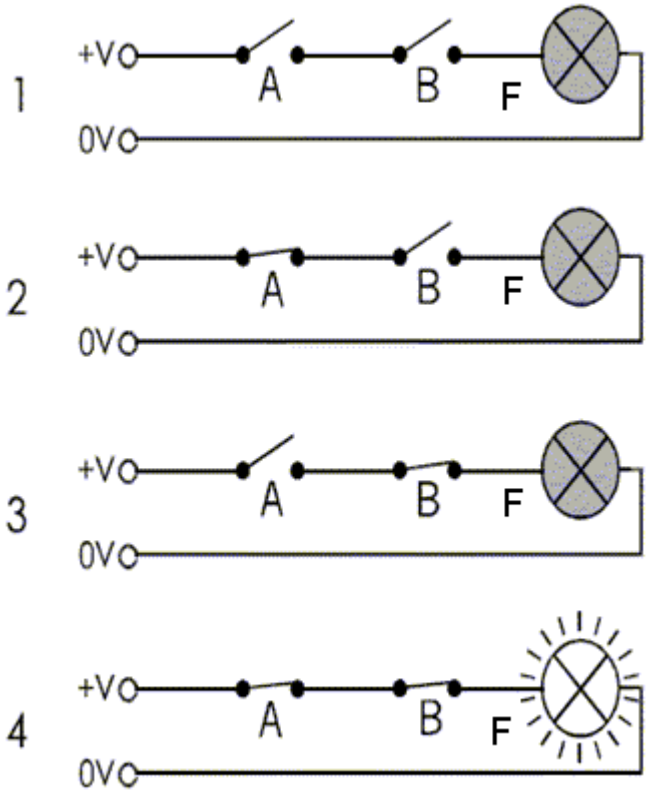
Organisasi & Arsitektur Komputer

Logika Digital



Eko Budi Setiawan, S.Kom., M.T.

See How Computers Add Numbers In One Lesson

Source : Youtube.com

Gerbang Logika

Pengertian Gerbang Logika?

Gerbang *merupakan rangkaian dengan satu atau lebih sinyal input, tetapi hanya menghasilkan satu sinyal output*

Gerbang Logika *dinyatakan dengan dua keadaan*
Tegangan Tinggi / Ada Tegangan = ***Logika 1*** *–*
Tegangan Rendah / Tidak ada Tegangan = ***Logika 0*** *–*

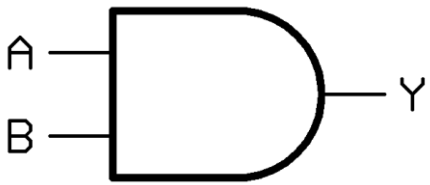
Rangkaian digital dirancang dengan menggunakan Aljabar Boolean

Gerbang Logika Dasar

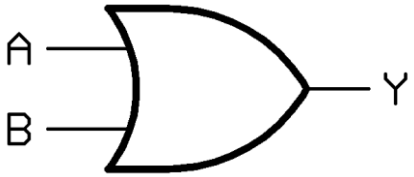
Tipe Gerbang Logika Dasar

Pada sistem digital hanya terdapat tiga buah gerbang logika dasar yaitu

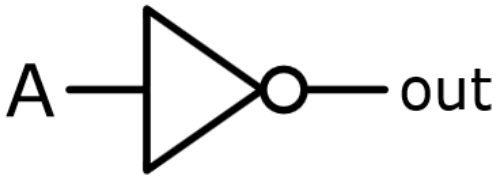
AND



OR



NOT



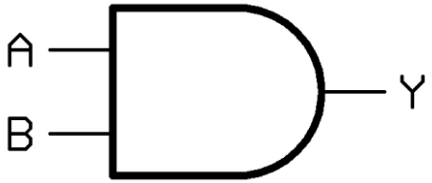
Gerbang Logika AND

Pengertian Gerbang Logika AND?

Gerbang Logika AND *merupakan gerbang logika dasar yang memiliki dua atau lebih sinyal masukan dengan satu sinyal keluaran*

Sinyal keluaran akan tinggi jika ***semua*** *sinyal masukan tinggi*

Gerbang Logika AND



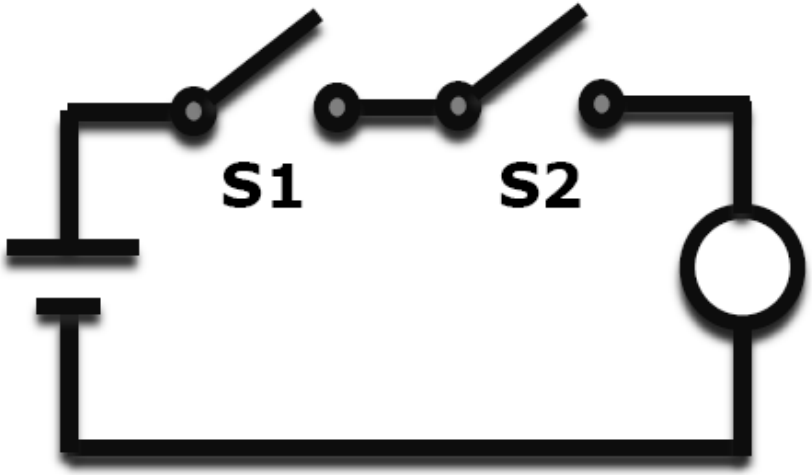
Y = A AND B

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Gerbang Logika AND

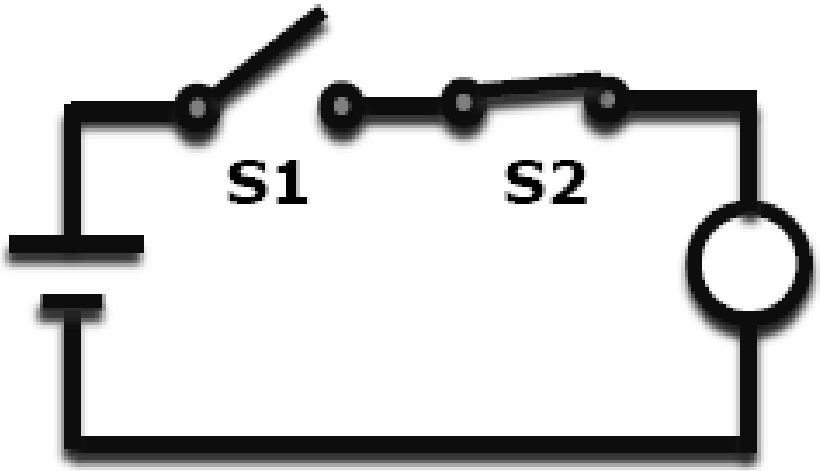
Memiliki konsep seperti dua buah saklar yang dipasangkan secara ***seri***

Gerbang Logika AND



S1	S2	Lampu
OFF	OFF	Mati

Gerbang Logika AND

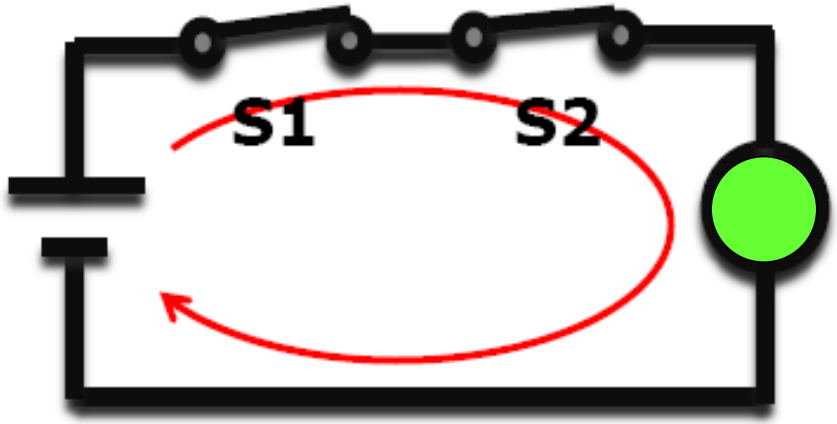


S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Mati

Gerbang Logika AND

S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Mati
ON	OFF	Mati

Gerbang Logika AND



S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Mati
ON	OFF	Mati
ON	ON	Menyala

S1	S2	Lampu
0	0	0
0	1	0
1	0	0
1	1	1

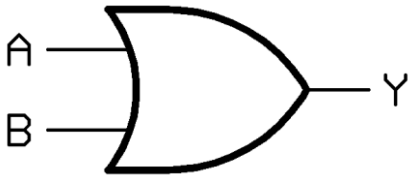
Gerbang Logika OR

Pengertian Gerbang Logika OR?

Gerbang Logika OR *merupakan gerbang logika dasar yang memiliki dua atau lebih sinyal masukan dengan satu sinyal keluaran*

Sinyal keluaran akan tinggi jika ***salah satu*** *sinyal masukan tinggi*

Gerbang Logika OR



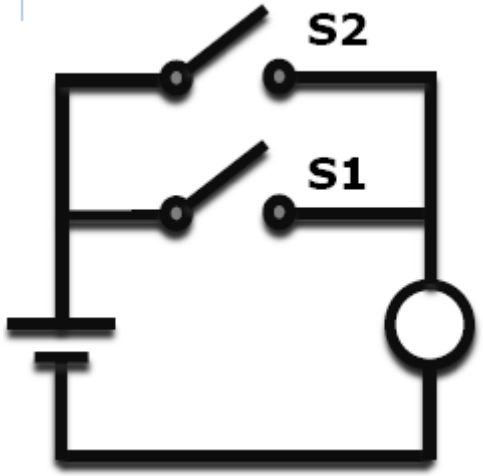
Y = A OR B

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Gerbang Logika AND

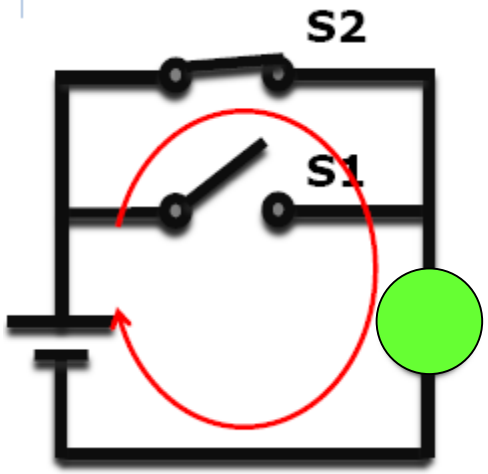
Memiliki konsep seperti dua buah saklar yang dipasangkan secara ***paralel***

Gerbang Logika OR



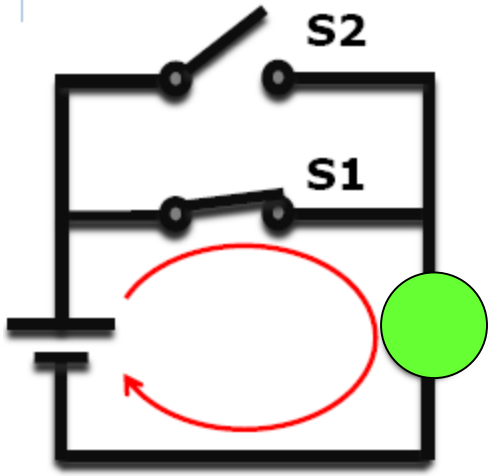
S1	S2	Lampu
OFF	OFF	Mati

Gerbang Logika OR



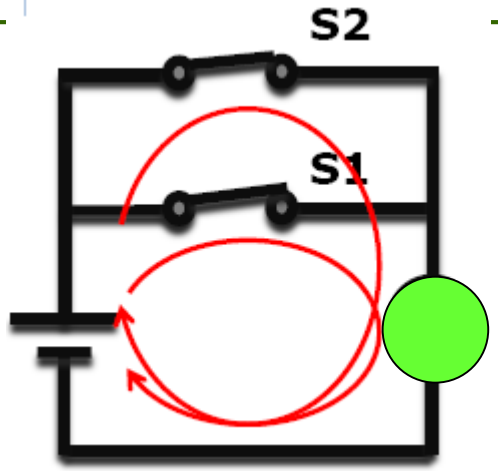
S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Menyala

Gerbang Logika OR



S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Menyala
ON	OFF	Menyala

Gerbang Logika OR



S1	S2	Lampu
OFF	OFF	Mati
OFF	ON	Menyala
ON	OFF	Menyala
ON	ON	Menyala

S1	S2	Lampu
0	0	0
0	1	1
1	0	1
1	1	1

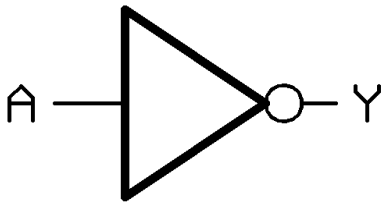
Gerbang Logika NOT

Pengertian Gerbang Logika NOT?

Gerbang Logika NOT *merupakan gerbang logika dasar yang memiliki sebuah sinyal masukan dan sebuah sinyal keluaran*

Sinyal keluaran akan tinggi *jika* ***sinyal masukan rendah***

Gerbang Logika NOT



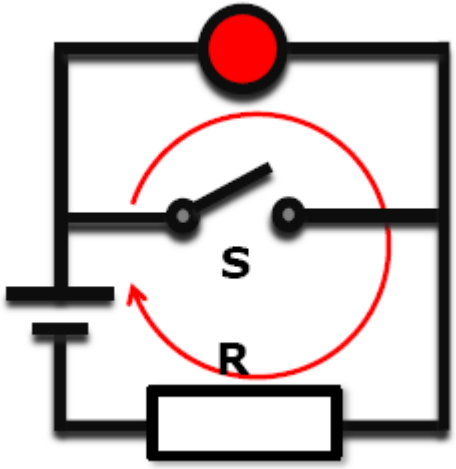
Y = NOT A

A	Y
0	1
1	0

Gerbang Logika NOT

Memiliki konsep seperti ***sebuah saklar*** *yang dipasangkan secara* ***paralel*** *dengan lampu dan* ***diserikan*** *dengan sebuah resistor*

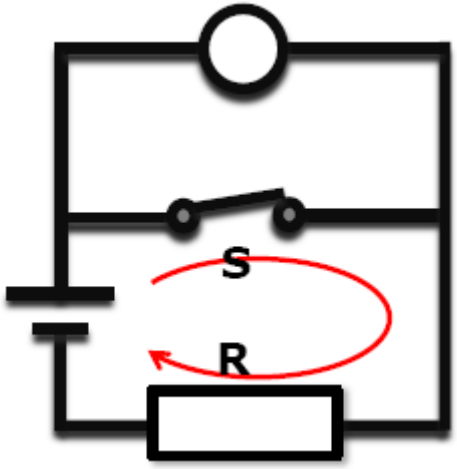
Gerbang Logika NOT



S	Lampu
OFF	Nyala

S	Lampu
0	1

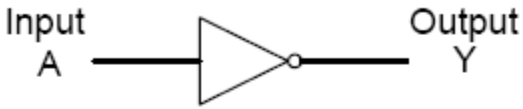
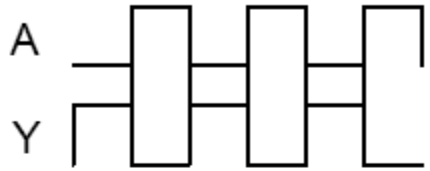
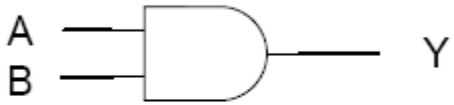
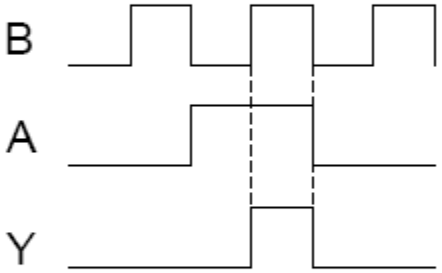
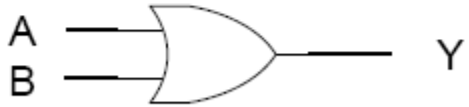
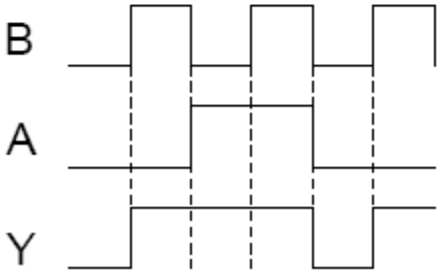
Gerbang Logika NOT



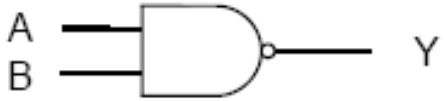
S	Lampu
OFF	Nyala
ON	Mati

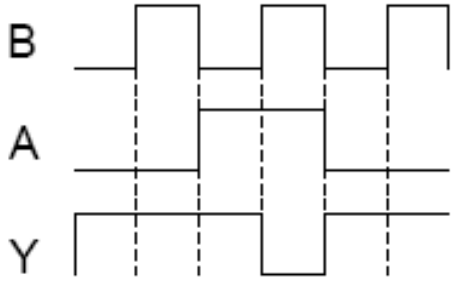
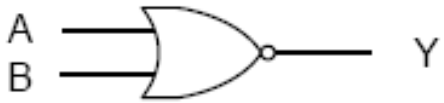
S	Lampu
0	1
1	0

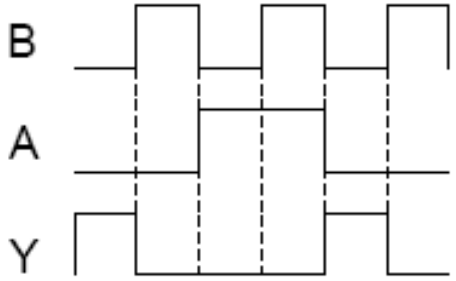
Resume Logika Digital Dasar

Jenis Gerbang	Simbol Grafis dan Fungsi Aljabar	Tabel Kebenaran	Timing Diagram
Inverter (NOT)	 $Y = \overline{A}$	A | Y 0 | 1 1 | 0	
AND	 $Y = A \cdot B$	A | B | Y 0 | 0 | 0 0 | 1 | 0 1 | 0 | 0 1 | 1 | 1	
OR	 $Y = A + B$	A | B | Y 0 | 0 | 0 0 | 1 | 1 1 | 0 | 1 1 | 1 | 1	

Resume Logika Digital Lain

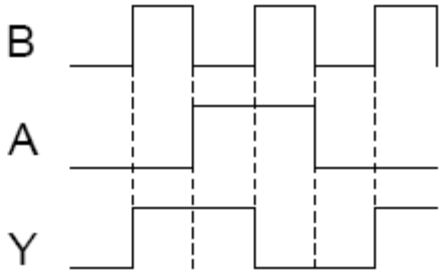
<table>
<tr><th>Jenis Gerbang</th><th>Simbol Grafis dan Fungsi Aljabar</th><th>Tabel Kebenaran</th><th>Timing Dagram</th></tr>
<tr>
<td>NAND
(NOT AND)</td>
<td> 

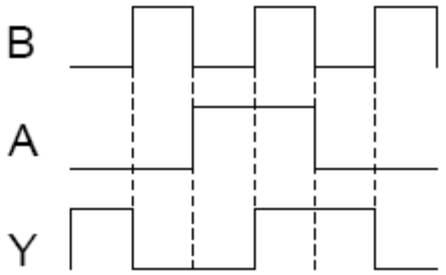
$Y = \overline{A \cdot B}$</td>
<td>
<table>
<tr><th>A</th><th>B</th><th>Y</th></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
</td>
<td> 
</td>
</tr>
<tr>
<td>NOR
(NOT OR)</td>
<td> 

$Y = \overline{A + B}$</td>
<td>
<table>
<tr><th>A</th><th>B</th><th>Y</th></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
</td>
<td> 
</td>
</tr>
</table>

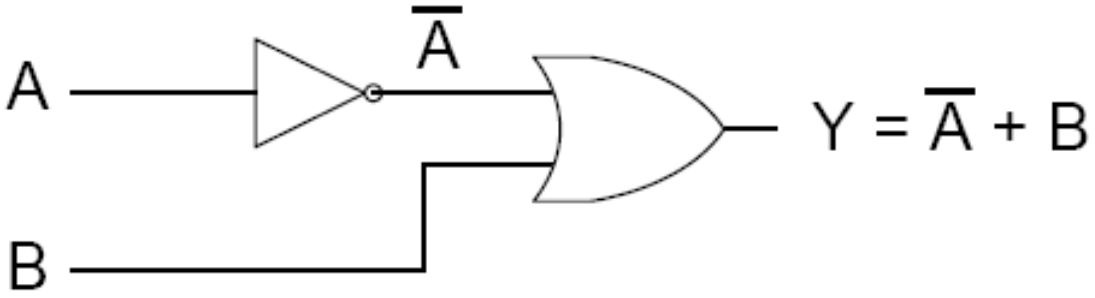
Resume Logika Digital Lain (Cont..)

<table>
<tr><th>Jenis Gerbang</th><th>Simbol Grafis dan Fungsi Aljabar</th><th>Tabel Kebenaran</th><th>Timing Diagram</th></tr>
<tr>
<td>EX-OR</td>
<td> 

$Y = A \oplus B$</td>
<td>
<table>
<tr><th>A</th><th>B</th><th>Y</th></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
</td>
<td> 
</td>
</tr>
<tr>
<td>EX-NOR</td>
<td> 

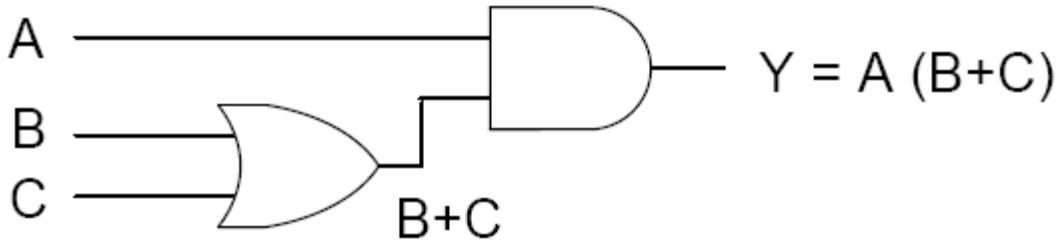
$Y = \overline{A \oplus B}$</td>
<td>
<table>
<tr><th>A</th><th>B</th><th>Y</th></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>
</td>
<td> 
</td>
</tr>
</table>

Menurunkan Tabel Kebenaran



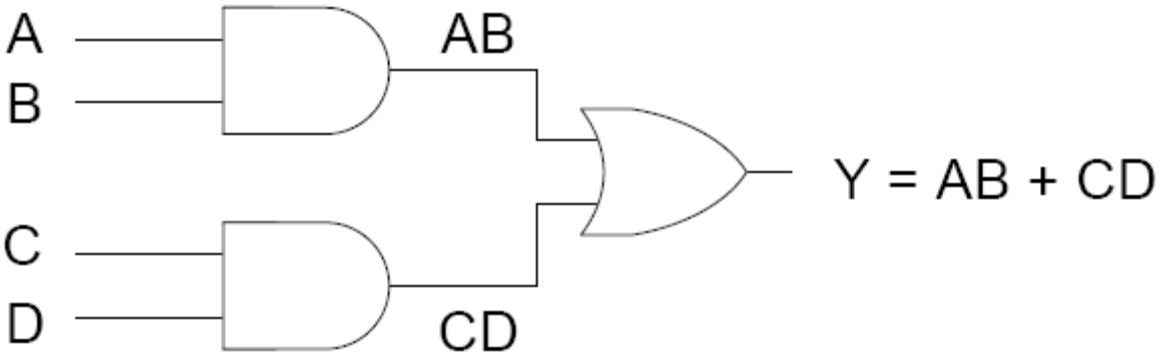
A	B	$\bar{A}$	Y
0	0	1	1
0	1	1	1
1	0	0	0
1	1	0	1

Menurunkan Tabel Kebenaran



A	B	C	B+C	Y
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

Menurunkan Tabel Kebenaran



Y = 1, jika AB = 1 atau CD = 1

- AB = 1, jika A = 1 dan B = 1
- CD = 1, jika C = 1 dan D = 1

A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Aturan Aljabar Boolean

Komutatif	:	$A + B = B + A$
		$A \cdot B = B \cdot A$
Asosiatif	:	$A+(B+C) = (A+B)+C$
		$A.(B.C) = (A.B).C$
Distributif	:	$A.(B+C) = A.B + A.C$
		$A+(B.C) = (A+B).(A+C)$

Aturan Aljabar Boolean

1. $A \cdot 0 = 0$
2. $A \cdot 1 = A$
3. $A \cdot A = A$
4. $A \cdot \overline{A} = 0$

AND

5. $A + 0 = A$
6. $A + 1 = 1$
7. $A + A = A$
8. $A + \overline{A} = 1$

OR

9. $\overline{\overline{A}} = A$
10. $A + \overline{A}\,B = A + B$
11. $\overline{A} + A\,B = \overline{A} + B$

Ket.

Penjabaran aturan 10 :

$$A + \overline{A}\,B = A\,(1+B) + \overline{A}\,B$$
$$= A + AB + \overline{A}\,B$$
$$= A + B\,(A + \overline{A})$$

$A + \overline{A}\,B = A + B$ ($A + \overline{A} = 1$)

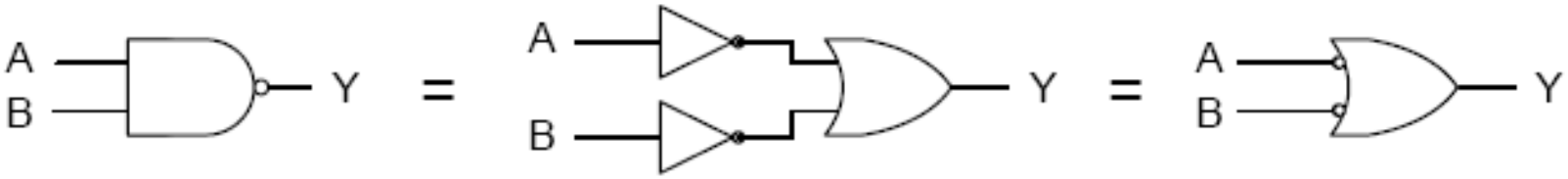
Penjabaran aturan 11 :

$$\overline{A} + A\,B = \overline{A}\,(1+B) + A\,B$$
$$= \overline{A} + \overline{A}\,B + A\,B$$
$$= \overline{A} + B\,(\overline{A} + A)$$

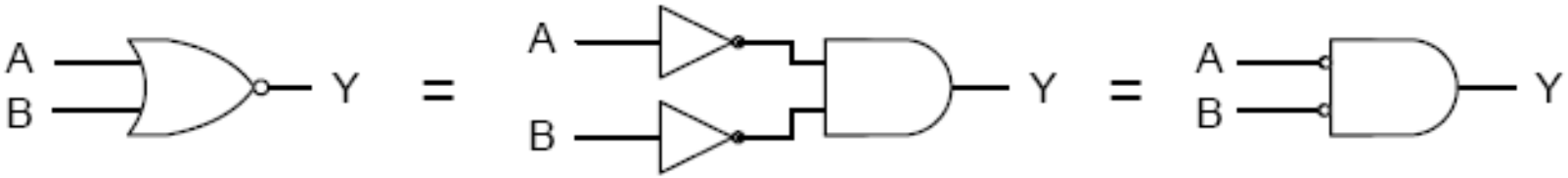
$\overline{A} + A\,B = \overline{A} + B$ ($\overline{A} + A = 1$)

Teorema De Morgan

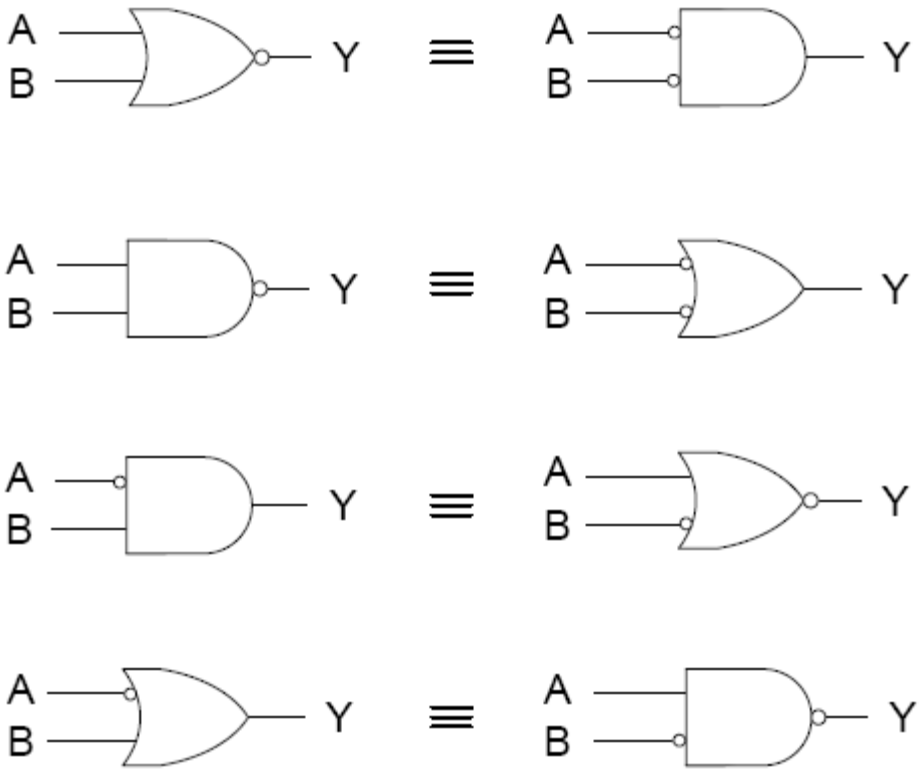
1. $\overline{A \cdot B} = \overline{A} + \overline{B}$ (NAND)



2. $\overline{A + B} = \overline{A} \cdot \overline{B}$ (NOR)



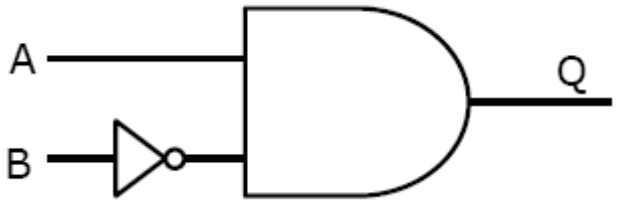
Teorema De Morgan



Rangkaian Kombinasi

Gerbang Logika *dapat dikombinasikan satu dengan yang lainnya untuk mendapatkan fungsi baru*

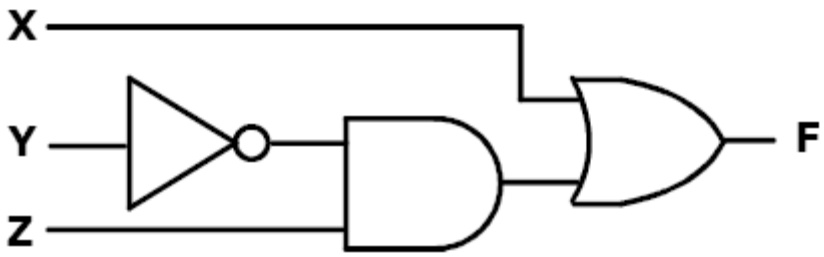
Contoh kombinasi 2 Gerbang :



A	B	$Q=A.\overline{B}$
0	0	0
0	1	0
1	0	1
1	1	0

Rangkaian Kombinasi

Contoh kombinasi 3 Gerbang :



$$F = X + \overline{Y}\,Z$$

X Y Z	$F = X + \overline{Y} . Z$
0 0 0	0
0 0 1	1
0 1 0	0
0 1 1	0
1 0 0	1
1 0 1	1
1 1 0	1
1 1 1	1

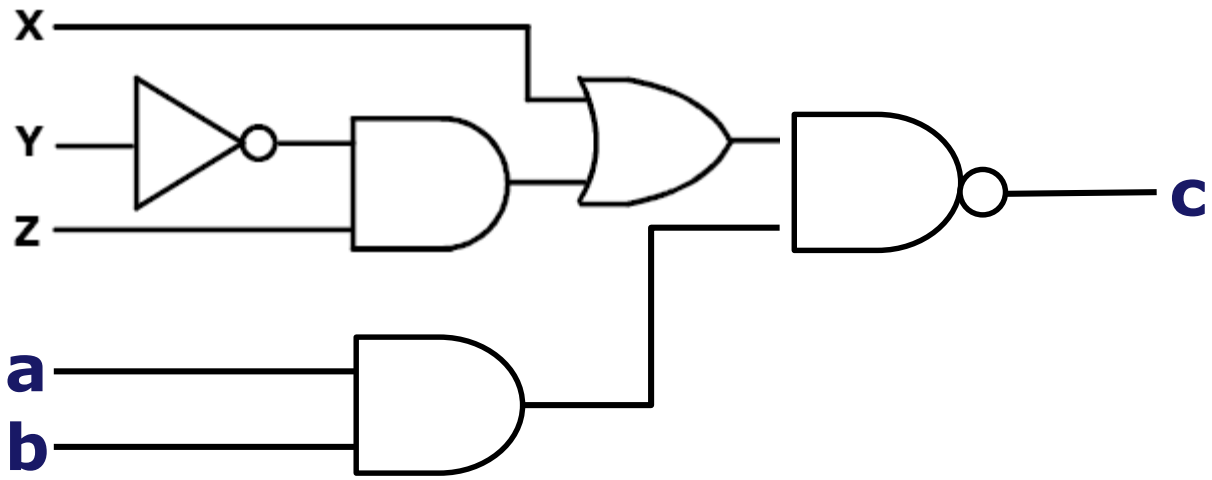
Latihan

A = 1 0 1 0 0 1 0 1
B = 1 0 0 1 1 1 0 0
Y = ?

Buatkan tabel kebenaran Y dengan menggunakan :

1. ***AND***
2. ***OR***
3. ***NOT***
4. ***NAND***
5. ***NOR***
6. ***EX-OR***
7. ***EX-NOR***

Oleh-oleh Kuliah



Buatkan tabel kebenaran c

Thank You

To Be Continued..