TRUTH TABLE → Bir sistemin girişleriyle çıkışları arasındaki davranışlarını gösteren tablodur.

Input			Output
Decimal	A	B	F
0	0	0	1
1	0	1	0
2	1	0	0
3	1	1	1

$n \rightarrow 2^n$

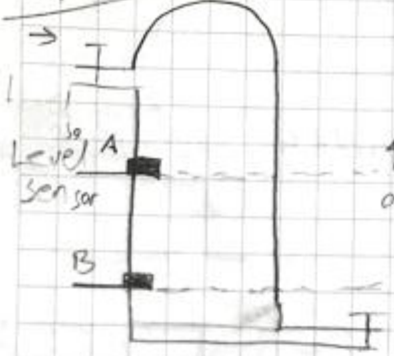
Example → Bir trafik lambasında iki veya daha fazla farklı lamba aynı anda yandığı alarm veren devrenin doğruluk tablosunu çiziniz

R Red
Y Yellow
G Green

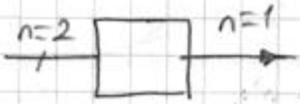
$2^3=8$

Dec	R	Y	G	F
	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

1. problem



Yağ seviyesi A'nın üstüne çıktığı zaman veya yağ seviyesi B'nin altına düştüğünde alarm veren devrenin doğruluk tablosunu çiziniz.

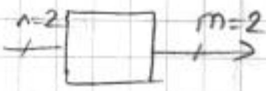


Dec	AB	F
	00	1
	01	0
	10	0 DON'T CARE
	11	1

2. problem

B'nin altındaysa sarı alarm verecek
A'nın üstünde ise kırmızı alarm verecek

Dec	A B	F	FR	Ry
0	0 0	1	0	1
1	0 1	0	0	0
2	1 0	0	Ø	Ø
3	1 1	1	1	0



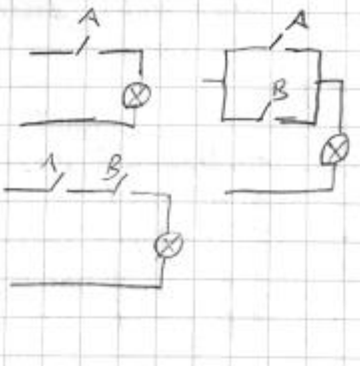
LAWS of BOOLEAN ALGEBRA

Operators

NOT ($-$, ')

AND ($\cdot$)

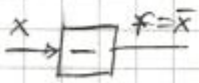
OR ($+$)



NOT operator (Complementation)

Lojik seviye değiştirme

x	$f=\overline{x}$
0	1
1	0



$\overline{\overline{X}} = X$ → Involution

AND operator

Dec	x y	$f=x\cdot y$
0	0 0	0
1	0 1	0
2	1 0	0
3	1 1	1

AND LAWS

$x\cdot 0 = 0$ (Absorber)

$x\cdot 1 = x$ (Neutral, Dummy)

$x\cdot x = x$

$x\cdot\overline{x} = 0$

OR operator

Dec	x, y	$f=x+y$
0	0 0	0
1	0 1	1
2	1 0	1
3	1 1	1

OR LAWS

$0+x=x$

$1+x=1$

$x+x=x$

$x+\bar{x}=1$

DUAL

AND operator

Concept of Duality

$0 \Longleftrightarrow 1$

$(\cdot) \Longleftrightarrow (+)$

AND ve OR operatörleri birbirinin dualidir.

0 gördüğümüz yere 1

· gördüğümüz yere + yazıyoruz

- Associative Laws
- Commutative "
- Distributive "
- Absortive "

Associative Laws (Birleşme yasası)

$\forall\ x, y, z \in B$ (Bool set)

$(x \cdot y) \cdot z = x \cdot (y \cdot z) = x \cdot y \cdot z$ AND op

$(x+y)+z = x+(y+z) = x+y+z$ OR op.

Commutative Laws (Değişme yasası)

$x \cdot y \cdot z = y \cdot x \cdot z = y \cdot z \cdot x$ AND op

$x+y+z = y+x+z = y+z+x$

Distributive Laws

$x \cdot (y+z) = x \cdot y + x \cdot z$

$x+(y \cdot z) = (x+y) \cdot (x+z)$

..../...../200..

osou

Absortive Laws

$x.(\bar{x}+y) = x.y$ → $x.\bar{x} + x.y$ → $0 + x.y = x.y$

$x + (\bar{x}.y) = x+y$

De Morgan Laws.

$\overline{x.y} = \bar{x}+\bar{y}$

$\overline{x+y} = \bar{x}.\bar{y}$

Complementation

$\forall x \exists ! \bar{x}$ $\quad x+\bar{x}=1$

$x.\bar{x}=0$

Neutr Element

$x+0=x$

$x.1=x$

Absorvation element

$x.0=0$

$x+1=1$

Involution

$\bar{\bar{x}}=x$

Idempotens

idem → aynı –
potency → kudret kuvvet tesir
potent → ...

$x.x=x$

$x+x=x$

Exclusive OR (EXOR, XOR) $\oplus$

Equivalence = Exclusive NOR $\odot$

	x y	$x\oplus y$	$x\odot y$
0	0 0	0	1
1	0 1	1	0
2	1 0	1	0
3	1 1	0	1

$x\oplus y = x.\bar{y}+\bar{x}y = \overline{x\odot y}$

$x\odot y = x.y+\bar{x}\bar{y} = \overline{x\oplus y}$

EXOR

	Duality	
$x\oplus 0 = x$		$x\odot 1 = x$
$x\oplus 1 = \bar{x}$	→	$x\odot 0 = \bar{x}$
$x\oplus x = 0$		$x\odot x = 1$
$x\oplus \bar{x} = 1$		$x\odot \bar{x} = 0$

Associative Laws

$(x\odot y)\odot z = x\odot(y\odot z)$

$(x\oplus y)\oplus z = x\oplus(y\oplus z)$

Commutative Laws

$x \odot y \odot z = x \odot z \odot y = z \odot x \odot y$

$x \oplus y \oplus z = x \oplus z \oplus y = z \oplus x \oplus y$

Distributive Laws

$x \cdot (y \oplus z) = (x \cdot y) \oplus (x \cdot z)$

$x + (y \odot z) = (x + y) \odot (x + z)$

Absortive Laws

$x \, (\bar{x} \oplus y) = x \cdot y$

$x + (\bar{x} \odot y) = x + y$

De Morgan Laws.

$\overline{x \oplus y} = \bar{x} \odot \bar{y} = x \odot y$

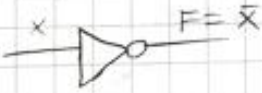
$\overline{x \odot y} = \bar{x} \oplus \bar{y} = x \oplus y$

Logic Gates

NOT circuit = Inverter
AND Gate
OR Gate
NOR Gate
NAND Gate
EXOR Gate
EQV Gate

NOT CIRCUIT = INVERTER

x	f
0	1
1	0



Active High to Low

x	$F = \bar{x}$
LV	HV
HV	LV

Active Low to Active High

$x(H)$	$x(L)$
0	0
1	1

Active Low Indicator

Bubble

Positive logic'ten negatif logic'e çevirir

$x(L)$	$x(H)$
1	1
0	0

Negative logic'ten positive logic'e çevirir

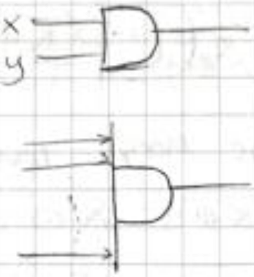
Positive Logic – Negative Logic

HV $\longleftrightarrow$ $1(H) = 0(L)$

LV $\longleftrightarrow$ $0(H) = 1(L)$

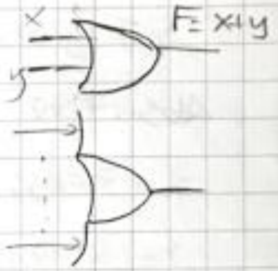
AND GATE

Dec	x y	F=x·y
0	0 0	0
1	0 1	0
2	1 0	0
3	1 1	1



OR GATE

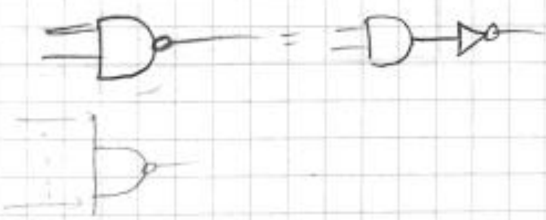
Dec	x y	x+y
	0 0	0
	0 1	1
	1 0	1
	1 1	1



NAND GATE

$f = \overline{x \cdot y} = x \uparrow y$

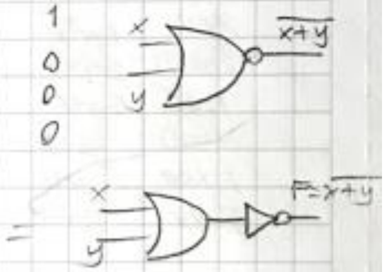
Dec	x y	x·y	$\overline{x \cdot y}$
0	0 0	0	1
1	0 1	0	1
2	1 0	0	1
3	1 1	1	0



NOR GATE (NOT + OR)

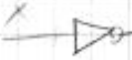
$F = \overline{x+y} = x \downarrow y$

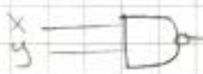
	x y	x+y	$\overline{x+y}$
0	0 0	0	1
1	0 1	1	0
2	1 0	1	0
3	1 1	1	0



UNIVERSALITY of NAND GATES and NOR GATES

NAND Gate Implementation

• Inverter  $f=\overline{x}$



$f=\overline{x.y} = \overline{x.x} = \overline{x}$

y yerine x koyarsak

- AND Gate

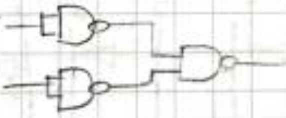
 $f = x \cdot y$

 $f = x \cdot y$

 $f = \overline{x\ y}$

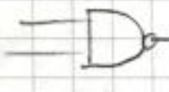
$\overline{\overline{f}} = \overline{\overline{x \cdot y}}_{NAND}$ } NAND (inverter)

$\overline{\overline{f}} = f = \overline{A}$



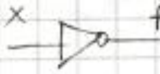
- OR GATE

 $f = x + y$ $\qquad f = \overline{\overline{x + y}}$

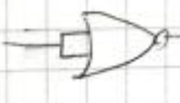
 $f = \overline{x \cdot y}$ $\qquad f = \overline{\overline{x} \cdot \overline{y}}$ $\overline{A \cdot B}$

NAND NAND NAND

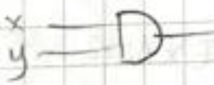
NOR Gate Implementation

- Inverter  $f = \overline{x}$

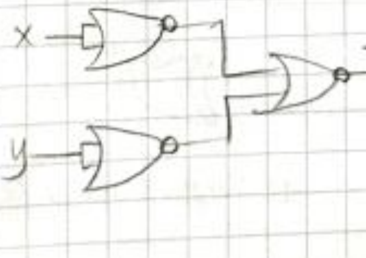
 $f = \overline{x + y} = \overline{x + x} = \overline{x}$

 $f = \overline{x}$

- AND Gate

 $f = x \cdot y = \overline{\overline{x \cdot y}} = \overline{\overline{x} + \overline{y}}$ } NOR

NOR NOR

 $f = x \cdot y$

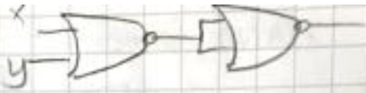
• OR GATE / operatörü

$f = x + y$

$f = \overline{x+y}$

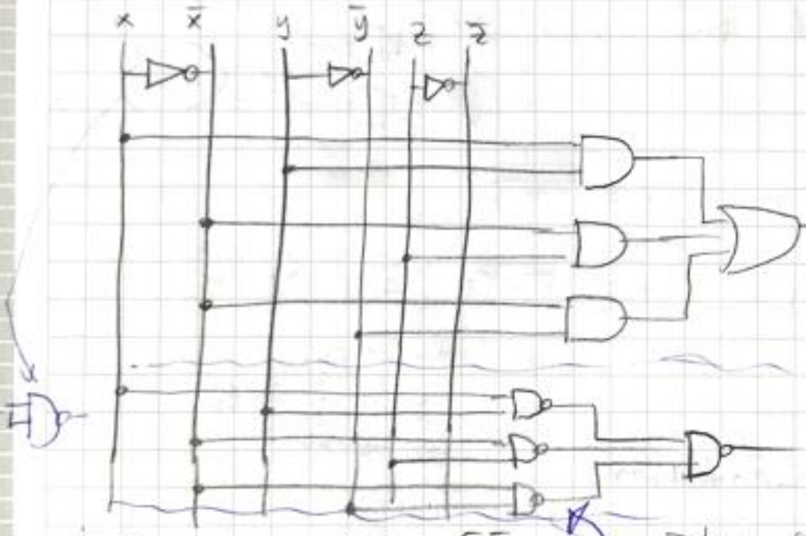
$f = \overline{\overline{x+y}}$ NOR

NOR



örnek

$f = x \cdot y + \bar{x} \cdot z + \bar{x} \cdot \bar{y}$



3 inverter
3 AND gerekli
1 OR

6 gerekli
7 tane NAND kapı

ör/ $f = x \cdot y + \bar{x} z + \bar{x}\bar{y}$ → bu fonksiyonu NAND kullanarak yapınız

$f = \overline{\overline{x \cdot y + \bar{x} \cdot z + \bar{x}\bar{y}}}$

$= \overline{\overline{x \cdot y} \cdot \overline{\bar{x} \cdot z} \cdot \overline{\bar{x} \cdot \bar{y}}}$ } NAND

NAND