Boolean Sign 1 = True 0 = False	Logical Sign T = True F = False
Multiplication *	AND (^)
Addition +	OR (V)
Complement (bar) $\overline{0} = 1$	NOT (~)
Circuit **Closed** = **1** Circuit **Open** = **0**	=> Electric **can** flow through => Electric **can't** flow through

Idempotent laws:	x + x = x	x • x = x
Associative laws:	(x + y) + z = x + (y + z)	(xy)z = x(yz)
Commutative laws:	x + y = y + x	xy = yx
Distributive laws:	x + yz =(x + y)(x + z)	x(y + z) =xy + xz
Identity laws:	x + 0 = x	x • 1 = x
Domination laws:	x + 1 = 1	x • 0 = 0
Double complement law:	$\overline{\overline{x}} = x$	
Complement laws:	$x + \overline{x} = 1$ $\overline{0} = 1$	$x\overline{x} = 0$ $\overline{1} = 0$
De Morgan's laws:	$\overline{x + y} = \overline{x}\,\overline{y}$	$\overline{xy} = \overline{x} + \overline{y}$
Absorption laws:	x + (xy) = x	x(x + y) = x

Minterms are included for the rows in which the function evaluates to 1. New row is (+) - Or
Find expressions of Minterm , if **x** = 1 then **x Bar** = 0.

Maxterm is similar to Minterms but the negation (bar) of the variable will be flipped.
Find expressions of Minterm , if **x** = 0 then **x Bar** = 1.

Table representation of a boolean function with input variables x, y, z

Find an equivalent boolean expression for f

Find each row where f(x, y, z) = 1

x	y	z	f(x, y, z)	
0	0	0	0	
0	0	1	0	
0	1	0	0	$\overline{x}yz$ = 1 if and only if x = 0, y = 1, z = 1
0	1	1	1	$\overline{x}\,y\,z$
1	0	0	1	$x\,\overline{y}\,\overline{z}$
1	0	1	1	$x\,\overline{y}\,z$
1	1	0	0	
1	1	1	1	$x\,y\,z$

Now add them together

f(x, y, z) = $\overline{x}\,y\,z + x\,\overline{y}\,\overline{z} + x\,\overline{y}\,z + x\,y\,z$

$$f(x, y, z) = \overline{x}yz + x\overline{y}\overline{z} + x\overline{y}z + xyz.$$

Captions

1. To find an equivalent Boolean expression for function f expressed by a table, first find the rows in which the value of f is 1.
2. f is 1 when $x = 0, y = 1, z = 1$. $\overline{x}yz = 1$ if and only if $x = 0, y = 1, z = 1$.
3. The row 100 (representing $x = 1, y = 0, z = 0$), corresponds to $x\overline{y}\overline{z}$.
4. 101 corresponds to $x\overline{y}z$ and 111 corresponds to xyz. Now add all the terms together.
5. $f(x, y, z) = \overline{x}yz + x\overline{y}\overline{z} + x\overline{y}z + xyz$.

Conj = (A*B)   **Disj = (A+B)**

DNF Form: Conj-Disj-Conj-...
xyz +xy + w

CJF Form: Dish-Conj-Disj-...
(x+y+z)*xy*w*(x+w)

Example: How many different Boolean functions of degree *n* are there?

Solution: By the product rule for counting, there are 2^n different *n*-tuples of 0s and 1s. Because a Boolean function is an assignment of 0 or 1 to each of these different n-tuples, by the product rule there are 2^{2^n} different Boolean functions of degree *n*. The example tells us that there are 16 different Boolean functions of degree two. We display these in Table 3.

TABLE 4 The Number of Boolean Functions of Degree *n*.

Degree	Number
1	4
2	16
3	256
4	65,536
5	4,294,967,296
6	18,446,744,073,709,551,616

TABLE 3 The 16 Boolean Functions of Degree Two.

x	y	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9	F_{10}	F_{11}	F_{12}	F_{13}	F_{14}	F_{15}	F_{16}
1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
1	0	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0
0	1	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

- Degree is how many variables we have. For example **x,y** are degrees of 2.

2^2^n => 2^2^2 equals 16. That mean we're having 16 combination of Zeros (0) and Ones (1) from **x,y**

The NAND Operator mean Not And (Opposite with And)
Symbol: Arrow Up

The NOR Operator mean Not OR (Opposite with Or)
Symbol: Arrow Down

Elimination of addition (+) in DNF

De Morgan's law with three terms $a + b + c = \overline{\bar{a} \cdot \bar{b} \cdot \bar{c}}$

is applied with a = $\bar{x}\,\bar{y}$, b = $\bar{x}y$, and c = xy.

Another Morgan Law

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

The NAND operation (which stands for "not and") is denoted by the symbol ↑. The expression x ↑ y is equivalent to xy. The NOR operation (which stands for "not or") is denoted by the symbol ↓. The expression x ↓ y is equivalent to x + y.

Some others:

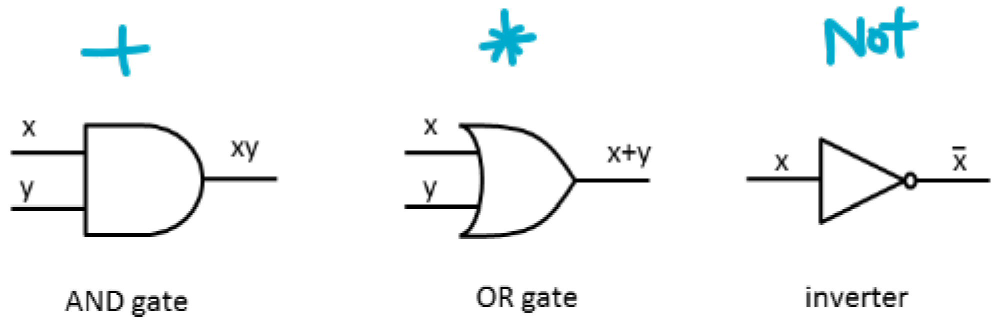
$\bar{a} = a \uparrow a$

$xy = \overline{x \uparrow y} = (x \uparrow y) \uparrow (x \uparrow y)$

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

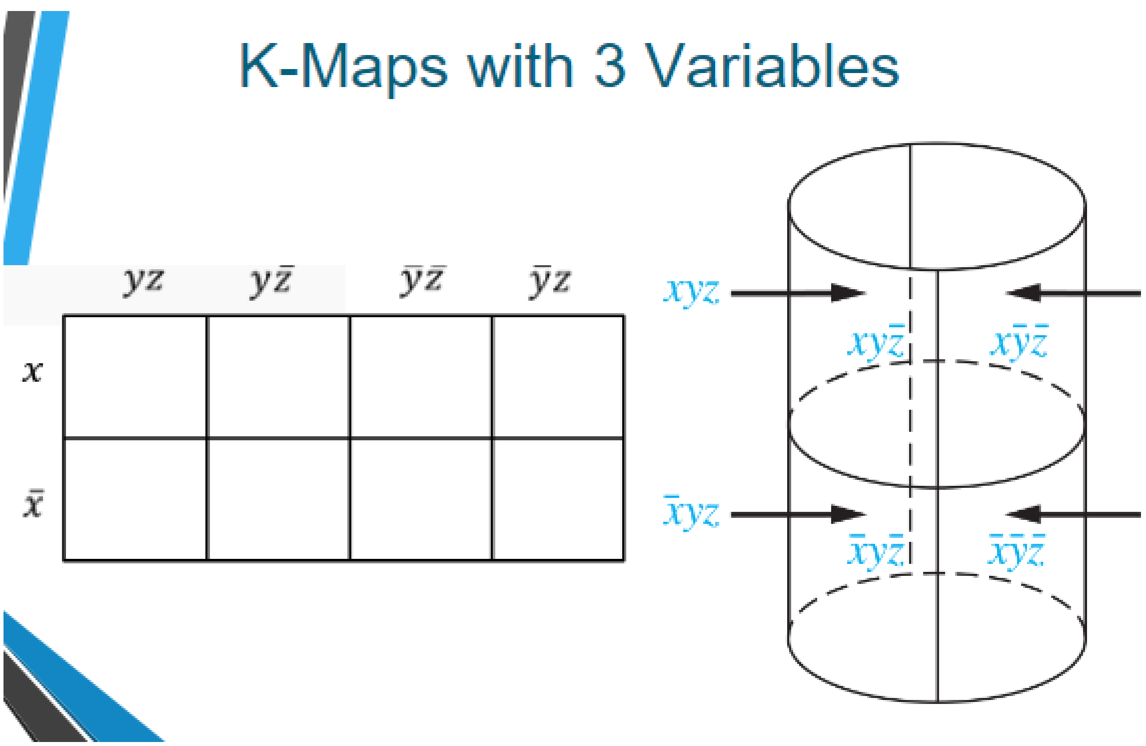
Expression satisfied is when its final produce equal to 1

Digital Circuit



K MAP

The position is matter so follow template below:
To simplify expression, we put 1 into squares that indicate each element in our expression.



For example:

Step 1: xy~z, then we put 1 on the row of x and column that display y~z.

Step 2: circle them but based on an even number, can't be 3, 5 or diagonal line.

Step 3: Because this K map is a cylinder so check the edges.

Step 4: To simplify check if that variable is staying the same or different. if x + x then it's x but if it's y + ~y, then it's 0 (cancelled)

	yz	$y\bar{z}$	$\bar{y}\bar{z}$	$\bar{y}z$
x	0	1	1	0
$\bar{x}$	0	1	1	0

$$xy\bar{z} + x\bar{y}\bar{z} + \bar{x}y\bar{z} + \bar{x}\bar{y}\bar{z} = \bar{z}$$

	yz	$y\bar{z}$	$\bar{y}\bar{z}$	$\bar{y}z$
x	0	0	0	0
$\bar{x}$	1	1	1	1

$$\bar{x}yz + \bar{x}y\bar{z} + \bar{x}\bar{y}\bar{z} = \bar{x}$$

Blue shapes indicate cylinder shape. Simplify them.
~xyz and ~x~yz => ~xz because ~x and z are not changed.

	yz	$y\bar{z}$	$\bar{y}\bar{z}$	$\bar{y}z$
x			1	1
$\bar{x}$	1		1	1