

K-Map (8C)

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Boolean Function with Maxterms

https://en.wikiversity.org/wiki/The_necessities_in_Digital_Design

K-Map 3 variables (1)

index

0
1
2
3
4
5
6
7

0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

minterms

$\bar{x}\bar{y}\bar{z}$
 $\bar{x}\bar{y}z$
 $\bar{x}y\bar{z}$
 $\bar{x}yz$
 $x\bar{y}\bar{z}$
 $x\bar{y}z$
 $xy\bar{z}$
 xyz

	x	y	z		
		00	01	11	10
0		0	1	3	2
1		4	5	7	6

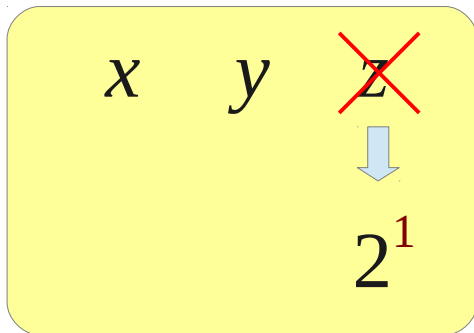
	y=0		y=1	
	z=0	z=1		z=0
x=0	0	1	3	2
x=1	4	5	7	6

K-Map 3 variables (2)

index				minterms	
0	0	0	0	$\bar{x}\bar{y}\bar{z}$	} $\bar{x}\bar{y}$
1	0	0	1	$\bar{x}\bar{y}z$	
2	0	1	0	$\bar{x}y\bar{z}$	} $\bar{x}y$
3	0	1	1	$\bar{x}yz$	
4	1	0	0	$x\bar{y}\bar{z}$	} $x\bar{y}$
5	1	0	1	$x\bar{y}z$	
6	1	1	0	$xy\bar{z}$	} xy
7	1	1	1	xyz	

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

a group of 2 minterms



		y=0		y=1	
		z=0	z=1	z=0	z=1
		00	01	11	10
0 = \bar{x}	0	0 $\bar{x}\bar{y}$	1 $\bar{x}y$	3 $\bar{x}\bar{y}$	2 $\bar{x}y$
1 = x	1	4 $x\bar{y}$	5 xy	7 $x\bar{y}$	6 xy

K-Map 3 variables (3)

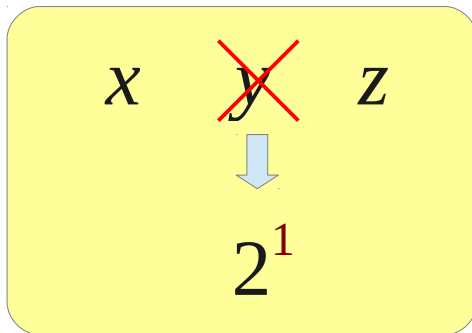
index

minterms

0	0	0	$\bar{x}\bar{y}\bar{z}$	$\bar{x}\bar{z}$
1	0	1	$\bar{x}\bar{y}z$	$\bar{x}z$
2	0	1	$\bar{x}y\bar{z}$	
3	0	1	$\bar{x}yz$	
4	1	0	$x\bar{y}\bar{z}$	$x\bar{z}$
5	1	0	$x\bar{y}z$	xz
6	1	1	$xy\bar{z}$	
7	1	1	xyz	

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

a group of 2 minterms



		y=0		y=1	
		z=0	z=1		z=0
		00	01	11	10
	0	0 $\bar{x}\bar{z}$	1 $\bar{x}z$	3 $\bar{x}z$	2 $\bar{x}\bar{z}$
	1	4 $x\bar{z}$	5 xz	7 xz	6 $x\bar{z}$
0=x					
1=x					

K-Map 3 variables (4)

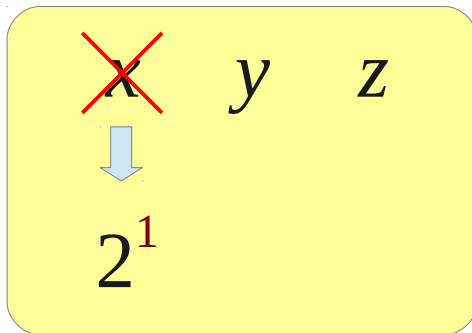
index

minterms

0	0	0	0	$\bar{x}\bar{y}\bar{z}$	$\bar{y}\bar{z}$
1	0	0	1	$\bar{x}\bar{y}z$	$\bar{y}z$
2	0	1	0	$\bar{x}y\bar{z}$	$y\bar{z}$
3	0	1	1	$\bar{x}yz$	yz
4	1	0	0	$x\bar{y}\bar{z}$	
5	1	0	1	$x\bar{y}z$	
6	1	1	0	$xy\bar{z}$	
7	1	1	1	xyz	

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

a group of 2 minterms

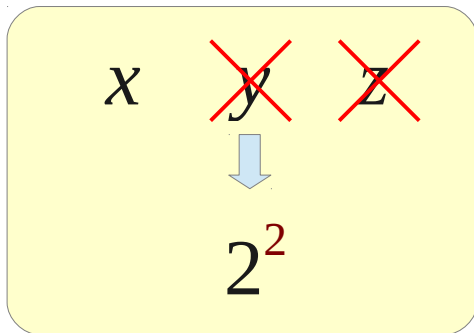


		y=0		y=1	
		z=0	z=1		z=0
		00	01	11	10
x	0	0 $\bar{y}\bar{z}$	1 $\bar{y}z$	3 yz	2 $y\bar{z}$
	1	4	5	7	6

K-Map 3 variables (5)

index				minterms	
0	0	0	0	$\bar{x}\bar{y}\bar{z}$	}
1	0	0	1	$\bar{x}\bar{y}z$	
2	0	1	0	$\bar{x}y\bar{z}$	
3	0	1	1	$\bar{x}yz$	
4	1	0	0	$x\bar{y}\bar{z}$	}
5	1	0	1	$x\bar{y}z$	
6	1	1	0	$xy\bar{z}$	
7	1	1	1	xyz	

a group of 4 minterms

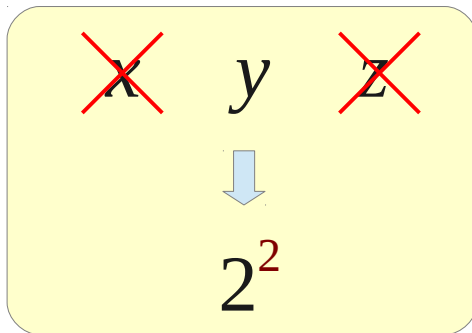


		y=0		y=1	
		z=0	z=1	z=0	z=1
		00	01	11	10
x	0	0	1	\bar{x}	2
	1	4	5	x	6

K-Map 3 variables (5)

index				minterms
0	0	0	0	$\bar{x}\bar{y}\bar{z}$
1	0	0	1	$\bar{x}\bar{y}z$
2	0	1	0	$\bar{x}y\bar{z}$
3	0	1	1	$\bar{x}yz$
4	1	0	0	$x\bar{y}\bar{z}$
5	1	0	1	$x\bar{y}z$
6	1	1	0	$xy\bar{z}$
7	1	1	1	xyz

a group of 4 minterms

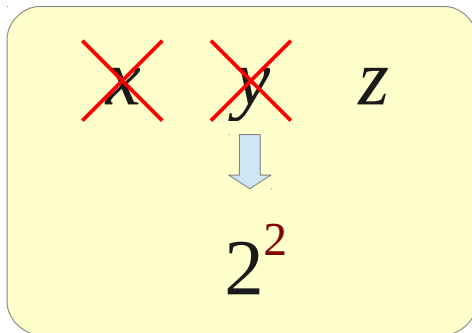


		y=0		y=1	
		z=0	z=1	z=0	z=1
		00	01	11	10
x	0	0	1	3	2
	1	4	5	7	6

K-Map 3 variables (5)

index		minterms
0	0 0 0	$\bar{x}\bar{y}\bar{z}$
1	0 0 1	$\bar{x}\bar{y}z$
2	0 1 0	$\bar{x}y\bar{z}$
3	0 1 1	$\bar{x}yz$
4	1 0 0	$x\bar{y}\bar{z}$
5	1 0 1	$x\bar{y}z$
6	1 1 0	$xy\bar{z}$
7	1 1 1	xyz

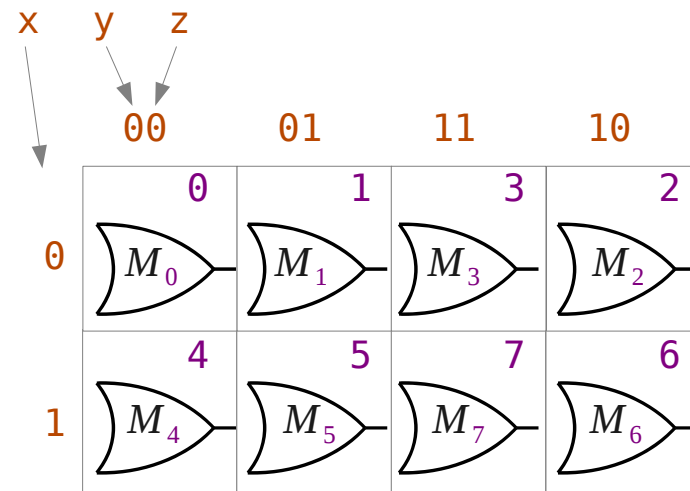
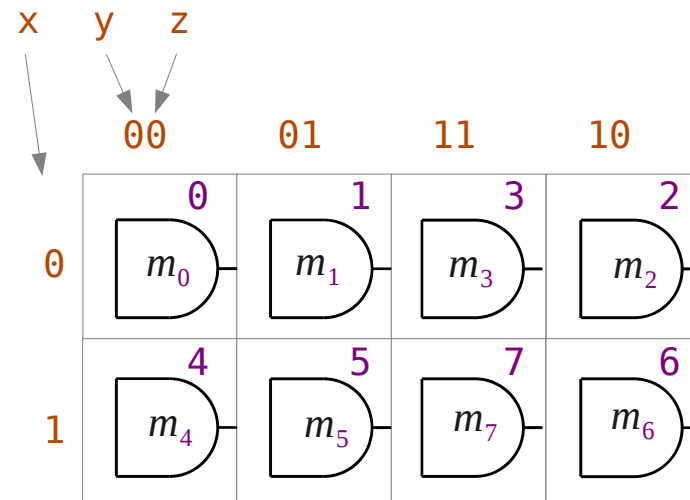
a group of 4 minterms



		y=0		y=1	
		z=0	z=1		z=0
		00	01	11	10
x	0	0	1	3	2
	1	4	5	7	6
		\bar{z}	z		

K-Map, minterms, and Maxterms

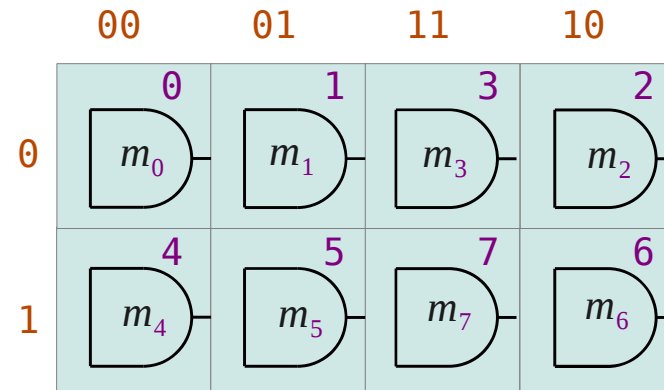
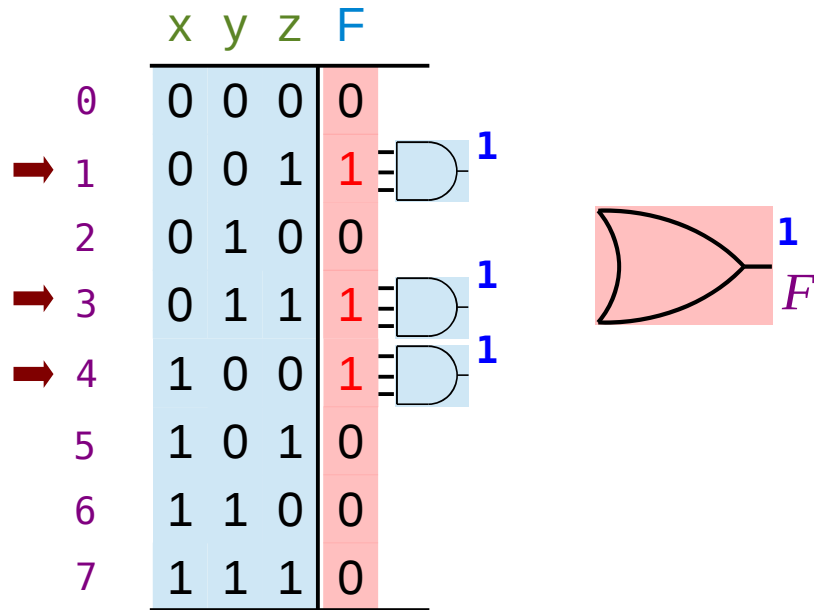
index				minterms
0	0	0	0	$\bar{x}\bar{y}\bar{z}$
1	0	0	1	$\bar{x}\bar{y}z$
2	0	1	0	$\bar{x}y\bar{z}$
3	0	1	1	$\bar{x}yz$
4	1	0	0	$x\bar{y}\bar{z}$
5	1	0	1	$x\bar{y}z$
6	1	1	0	$xy\bar{z}$
7	1	1	1	xyz



Each rectangle is associated with a minterm or a maxterm which represents a particular input variable conditions.

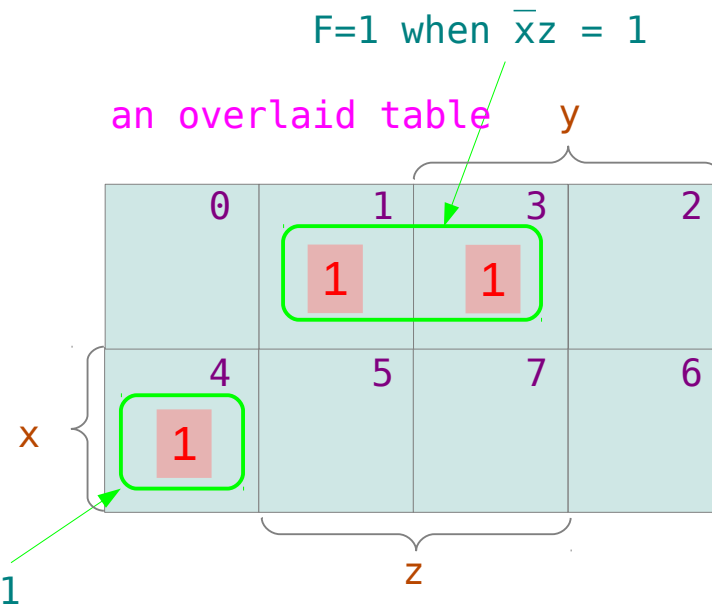
In this table, output function value is overlaid

Boolean Function with minterms

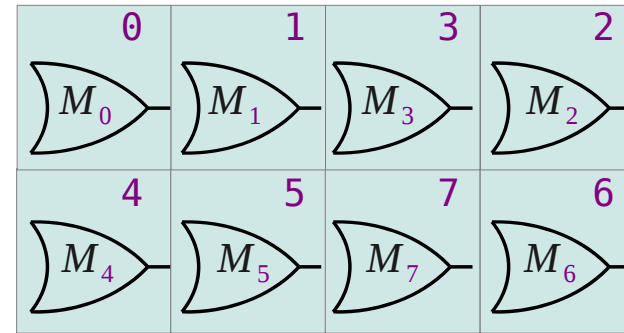
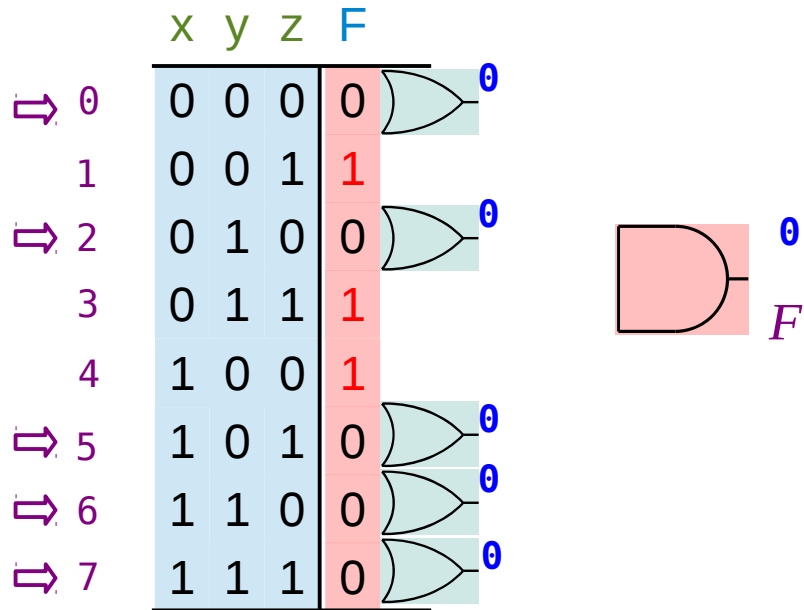


a simplified function

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

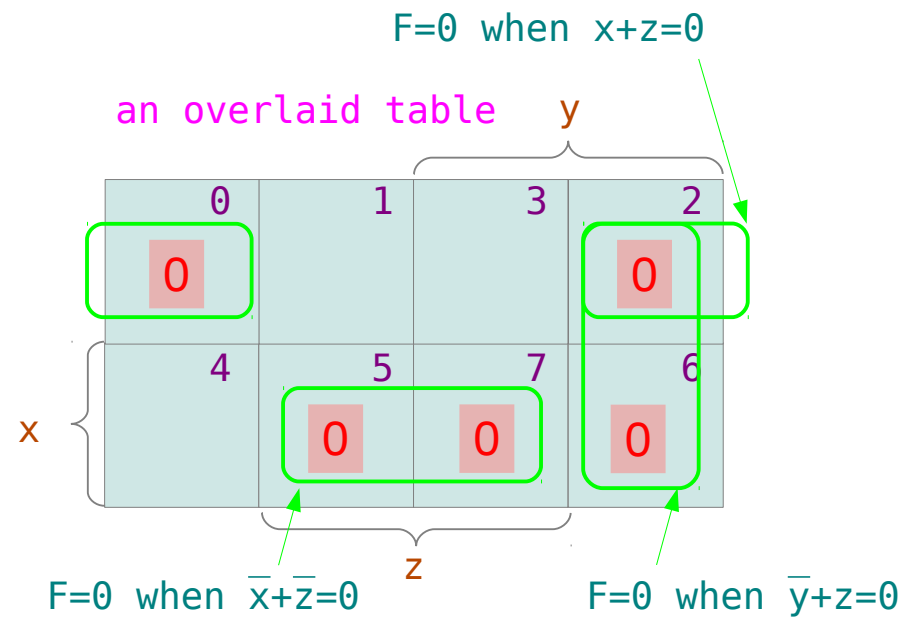


Boolean Function with Maxterms



a simplified function

$$F = (\bar{x} + \bar{z})(\bar{y} + z)(x + z)$$



K-Map 4 variables (1)

index minterms

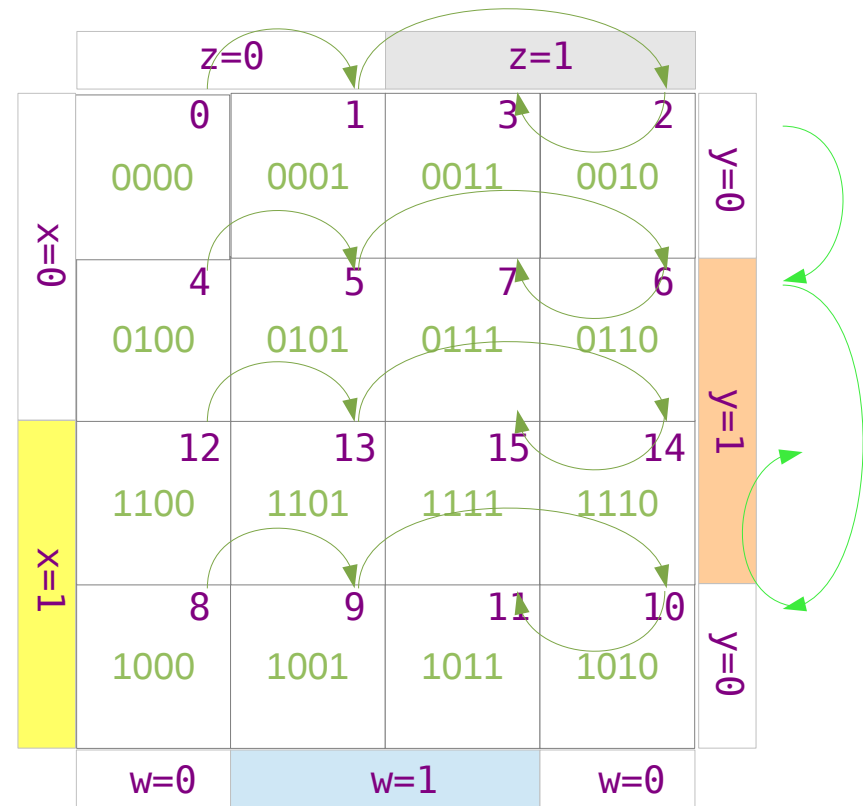
0	0	0	0	0	$\bar{x}\bar{y}\bar{z}\bar{w}$
1	0	0	0	1	$\bar{x}\bar{y}\bar{z}w$
2	0	0	1	0	$\bar{x}\bar{y}z\bar{w}$
3	0	0	1	1	$\bar{x}\bar{y}zw$
4	0	1	0	0	$\bar{x}y\bar{z}\bar{w}$
5	0	1	0	1	$\bar{x}y\bar{z}w$
6	0	1	1	0	$\bar{x}yz\bar{w}$
7	0	1	1	1	$\bar{x}yzw$
8	1	0	0	0	$x\bar{y}\bar{z}\bar{w}$
9	1	0	0	1	$x\bar{y}\bar{z}w$
10	1	0	1	0	$x\bar{y}z\bar{w}$
11	1	0	1	1	$x\bar{y}zw$
12	1	1	0	0	$xy\bar{z}\bar{w}$
13	1	1	0	1	$xy\bar{z}w$
14	1	1	1	0	$xyz\bar{w}$
15	1	1	1	1	$xyzw$

		z=0		z=1	
		w=0	w=1		w=0
		00	01	11	10
y	0	0 0000	1 0001	3 0011	2 0010
	1	4 0100	5 0101	7 0111	6 0110
	1	12 1100	13 1101	15 1111	14 1110
	0	8 1000	9 1001	11 1011	10 1010
x		0=0	1=1		0=0

K-Map 4 variables (2)

index minterms

0	0	0	0	0	$\bar{x}\bar{y}\bar{z}\bar{w}$
1	0	0	0	1	$\bar{x}\bar{y}\bar{z}w$
2	0	0	1	0	$\bar{x}\bar{y}z\bar{w}$
3	0	0	1	1	$\bar{x}\bar{y}zw$
4	0	1	0	0	$\bar{x}y\bar{z}\bar{w}$
5	0	1	0	1	$\bar{x}y\bar{z}w$
6	0	1	1	0	$\bar{x}yz\bar{w}$
7	0	1	1	1	$\bar{x}yzw$
8	1	0	0	0	$x\bar{y}\bar{z}\bar{w}$
9	1	0	0	1	$x\bar{y}\bar{z}w$
10	1	0	1	0	$x\bar{y}z\bar{w}$
11	1	0	1	1	$x\bar{y}zw$
12	1	1	0	0	$xy\bar{z}\bar{w}$
13	1	1	0	1	$xy\bar{z}w$
14	1	1	1	0	$xyz\bar{w}$
15	1	1	1	1	$xyzw$



References

- [1] <http://en.wikipedia.org/>
- [2]