Álgebra Booleana

Teoremas de Múltiples Variables

$$x+y=y+x$$
$$x\cdot y=y\cdot x$$
$$x+(y+z)=(x+y)+z=x+y+z$$
$$x(yz)=(xy)z=xyz$$
$$x(y+z)=xy+xz$$
$$(w+x)(y+z)=wy+xy+wz+xz$$
$$x+xy=x$$
$$x+\bar{x}y=x+y$$
$$\bar{x}+xy=\bar{x}+y$$

Teoremas de Morgan

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

Teoremas de una Variable

AND	OR
$x\cdot 0=0$	$x+0=x$
$x\cdot 1=1$	$x+1=x$
$x\cdot x=x$	$x+x=x$
$x\cdot\bar{x}=0$	$x+\bar{x}=1$

Números Binarios

Binario a Decimal

2^4	2^3	2^2	2^1	2^0
1	0	0	1	1

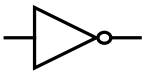
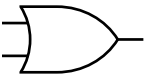
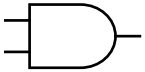
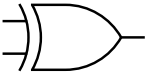
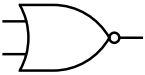
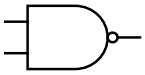
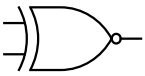
$16+2+1=19$

BCD (Binary-coded decimal)

2^3	2^2	2^1	2^0
0	1	0	1

4 bits representan un entero del 0 al 9

Circuitos Lógicos

Operación	Definición	Símbolo	Compuerta
NOT	$\bar{x}$	~	
OR	$x+y$	~	
AND	$x\cdot y$	~	
XOR	$(x+y)(\bar{x}+\bar{y})$ $x\bar{y}+\bar{x}y$	$x\oplus y$	
NOR	$\overline{x+y}=\bar{x}\cdot\bar{y}$	$x\downarrow y$	
NAND	$\overline{x\cdot y}=\bar{x}+\bar{y}$	$x\uparrow y$	
XNOR	$(x+\bar{y})(\bar{x}+y)$ $xy+\bar{x}\bar{y}$	$x\odot y$	

Universalidad de las Compuertas NAND y NOR

Operación	NAND	NOR
NOT	$\overline{A \cdot A}$	$\overline{A + A}$
OR	$\overline{\overline{A \cdot B}}$	$\overline{\overline{A + B}}$
AND	$\overline{\overline{A \cdot B}}$	$\overline{\overline{A} + \overline{B}}$
XOR	$\overline{(A \cdot \overline{B})}\,\overline{(\overline{A} \cdot B)}$	$\overline{(A + B)} + \overline{(\overline{A} + \overline{B})}$
NOR	$\overline{\overline{A} \cdot \overline{B}}$	~
NAND	~	$\overline{\overline{A} + \overline{B}}$
XNOR	$\overline{(A \cdot B) \cdot (\overline{A} \cdot \overline{B})}$	$\overline{(A + \overline{B}) + (\overline{A} + B)}$

Notación de Suma

$$f(\underbrace{x, y, z}_{\text{Variables}}) = \underbrace{\sum m(0,4,5,6)}_{\text{Valores de activación}} + \underbrace{\sum d(9,14)}_{\text{Redundancía}}$$

Mapa de Karnaugh

Número de Variables es Par	Número de Variables Impar
$\text{renglones} = \text{columnas} = \sqrt{2^{\text{variables}}}$	$\text{columnas} = \sqrt{2^{\text{variables}+1}}$ $\text{renglones} = \frac{\text{columnas}}{2}$

Construcción del Mapa-K

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

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

Tablas de Diseño de Flip-Flops

Flip-Flop SR

$Q^n \rightarrow Q^{n+1}$	S	R
0 → 0	0	x
0 → 1	1	0
1 → 0	0	1
1 → 1	x	0

Flip-Flop JK

$Q^n \rightarrow Q^{n+1}$	J	K
0 → 0	0	x
0 → 1	1	x
1 → 0	x	1
1 → 1	x	0

Flip-Flop D

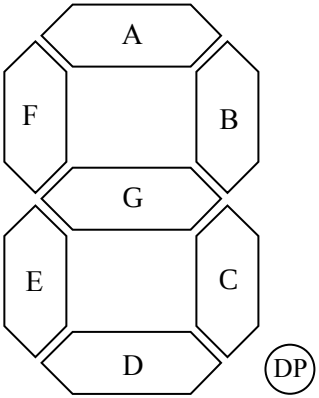
$Q^n \rightarrow Q^{n+1}$	D
0 → 0	0
0 → 1	1
1 → 0	0
1 → 1	1

Flip-Flop D

$Q^n \rightarrow Q^{n+1}$	D
0 → 0	0
0 → 1	1
1 → 0	1
1 → 1	0

7-Segment Display

Layout



DEC	BIN	SEGMENTOS
0	0000	ABCEDF
1	0001	BC
2	0010	ABCDEG
3	0011	ABCDG
4	0100	BCFG
5	0101	ACDFG
6	0110	ACDEFG
7	0111	ABC
8	1000	ABCDEFG
9	1001	ABCFG

Sistemas Numéricos

DEC	CUA	OCT	HEX	BIN	Gray	$COMP_1$	$-COMP_2$
0	0	0	0	0000	0000	1111	00000
1	1	1	1	0001	0001	1110	11111
2	2	2	2	0010	0011	1101	11110
3	3	3	3	0011	0010	1100	11101
4	10	4	4	0100	0110	1011	11100
5	11	5	5	0101	0111	1010	11011
6	12	6	6	0110	0101	1001	11010
7	13	7	7	0111	0100	1000	11001
8	20	10	8	1000	1100	0111	11000
9	21	11	9	1001	1101	0110	10111
10	22	12	A	1010	1111	0101	10110
11	23	13	B	1011	1110	0100	10101
12	30	14	C	1100	1010	0011	10100
13	31	15	D	1101	1011	0010	10011
14	32	16	E	1110	1001	0001	10010
15	33	17	F	1111	1000	0000	10001

Tablas de Verdad

Dos variables

AB	XOR	NOR	NAND	XNOR
00	0	1	1	1
01	1	0	1	0
10	1	0	1	0
11	0	0	0	1

Tres variables

ABC	XOR	NOR	NAND	XNOR
000	0	1	1	1
001	1	0	1	0
010	1	0	1	0
011	0	0	1	1
100	1	0	1	0
101	0	0	1	1
110	0	0	1	1
111	1	0	0	0

25 de mayo del 2022