



Instituto Politécnico Nacional
Escuela Superior de Cómputo



Fundamentos de Diseño Digital

Práctica no. 2: Minimización Algebraica

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Grupo: 2CM2

Desarrollo

1. Diseñe un comparador de magnitud de dos bits. Observe la tabla funcional y recuerde que tiene dos entradas y tres salidas. Arme su circuito resultante y verifique sus resultados.

#	A	B	F1 A<B	F2 A=B	F3 A>B
0	0	0	0	1	0
1	0	1	1	0	0
2	1	0	0	0	1
3	1	1	0	1	0

- a. Coloque la solución del problema y dibuje su circuito lógico.

#	A	B	F_1 $A < B$	F_2 $A = B$	F_3 $A > B$
0	0	0	0	1	0
1	0	1	1	0	0
2	1	0	0	0	1
3	1	1	0	1	0

$F_1(A, B) = \Sigma(1) = \bar{A}B$
 $F_2(A, B) = \Sigma(0, 3) = \bar{A}\bar{B} + AB = \overline{A \oplus B}$
 $F_3(A, B) = \Sigma(2) = A\bar{B}$

Circuito eléctrico

2. Diseñe un generador de Código Gray de 4 bits, y arme su circuito para verificar su funcionamiento.

Código Gray								
#	A	B	C	D	F1	F2	F3	F4
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	0	0	0	1	1
3	0	0	1	1	0	0	1	0
4	0	1	0	0	0	1	1	0
5	0	1	0	1	0	1	1	1
6	0	1	1	0	0	1	0	1
7	0	1	1	1	0	1	0	0
8	1	0	0	0	1	1	1	0
9	1	0	0	1	1	1	1	1
10	1	0	1	0	1	1	1	1
11	1	0	1	1	1	1	1	0
12	1	1	0	0	1	0	1	0
13	1	1	0	1	1	0	1	1
14	1	1	1	0	1	0	0	1
15	1	1	1	1	1	0	0	0

- a. Coloque la solución de su problema y dibuje su circuito lógico obtenido.

#	A	B	C	D	F ₁	F ₂	F ₃	F ₄
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	0	0	0	1	1
3	0	0	1	1	0	0	1	0
4	0	1	0	0	0	1	1	0
5	0	1	0	1	0	1	1	1
6	0	1	1	0	0	1	0	1
7	0	1	1	1	0	1	0	0
8	1	0	0	0	1	1	0	0
9	1	0	0	1	1	1	0	1
10	1	0	1	0	1	1	1	1
11	1	0	1	1	1	1	1	0
12	1	1	0	0	1	0	1	0
13	1	1	0	1	1	0	1	1
14	1	1	1	0	1	0	0	1
15	1	1	1	1	1	0	0	0

A	Circuito Lógico Combinatorio	F ₁	$F_1(A,B,C,D) = \sum(8,9,10,11,12,13,14,15)$
B		F ₂	$F_2(A,B,C,D) = \sum(4,5,6,7,8,9,10,11)$
C		F ₃	$F_3(A,B,C,D) = \sum(2,3,4,5,10,11,12,13)$
D		F ₄	$F_4(A,B,C,D) = \sum(1,2,5,6,9,10,13,14)$

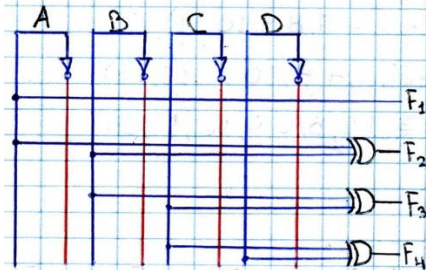
Para

$$\begin{aligned}
 F_1(A, B, C, D) &= \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D \\
 &= A(\bar{B}\bar{C}D + \bar{B}C\bar{D} + \bar{B}C\bar{D} + \bar{B}C\bar{D} + B\bar{C}\bar{D} + B\bar{C}\bar{D} + B\bar{C}\bar{D} + B\bar{C}\bar{D}) \\
 &= A[\bar{B}\bar{C}(\bar{D} + D) + \bar{B}C(\bar{D} + D) + B\bar{C}(\bar{D} + D) + B\bar{C}(\bar{D} + D)] \\
 &= A[\bar{B}(\bar{C} + C) + B(\bar{C} + C)] = A(\bar{B} + B) = A
 \end{aligned}$$

$$\begin{aligned}
 F_2(A, B, C, D) &= \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D \\
 &= \bar{A}\bar{B}\bar{C}(\bar{D} + D) + \bar{A}\bar{B}C(\bar{D} + D) + \bar{A}\bar{B}\bar{C}(\bar{D} + D) + \bar{A}\bar{B}C(\bar{D} + D) \\
 &= \bar{A}\bar{B}(\bar{C} + C) + \bar{A}\bar{B}(C + \bar{C}) = \bar{A}\bar{B} + \bar{A}\bar{B} = A \oplus B
 \end{aligned}$$

$$\begin{aligned}
 F_3(A, B, C, D) &= \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} \\
 &= \bar{A}\bar{B}C(\bar{D} + D) + \bar{A}\bar{B}C(\bar{D} + D) + \bar{A}\bar{B}C(\bar{D} + D) + \bar{A}\bar{B}C(\bar{D} + D) \\
 &= \bar{B}C(\bar{A} + A) + \bar{B}C(\bar{A} + A) = \bar{B}C + \bar{B}C = B \oplus C
 \end{aligned}$$

$$\begin{aligned}
 F_4(A, B, C, D) &= \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}D \\
 &= \bar{B}\bar{C}D(\bar{A} + A) + \bar{B}\bar{C}D(\bar{A} + A) + \bar{B}\bar{C}D(\bar{A} + A) + \bar{B}\bar{C}D(\bar{A} + A) \\
 &= \bar{C}D(\bar{B} + B) + \bar{C}D(\bar{B} + B) = \bar{C}D + \bar{C}D = C \oplus D
 \end{aligned}$$



3. Código BCD a 7 segmentos

#	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	1
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1
10	1	0	1	0	X	X	X	X	X	X	X
11	1	0	1	1	X	X	X	X	X	X	X
12	1	1	0	0	X	X	X	X	X	X	X
13	1	1	0	1	X	X	X	X	X	X	X
14	1	1	1	0	X	X	X	X	X	X	X
15	1	1	1	1	X	X	X	X	X	X	X

Diagrama de un Circuito Lógico Combinacional para el código BCD a 7 segmentos:

#	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	1
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1
10	1	0	1	0	X	X	X	X	X	X	X
11	1	0	1	1	X	X	X	X	X	X	X
12	1	1	0	0	X	X	X	X	X	X	X
13	1	1	0	1	X	X	X	X	X	X	X
14	1	1	1	0	X	X	X	X	X	X	X
15	1	1	1	1	X	X	X	X	X	X	X

Para

$$a(A, B, C, D) = \sum (0, 2, 3, 5-9) + \Phi(10-15)$$

$$= C + A + B\bar{D} + \bar{B}\bar{D} = C + A + \overline{B\bar{D}}$$

1			1
	1		1
1	1		1
1	1		1

$$b(A, B, C, D) = \sum (0-4, 7-9) + \Phi(10-15)$$

$$= \bar{B} + A + C\bar{D} + \bar{C}\bar{D} = A + \bar{B} + \overline{C\bar{D}}$$

1	1	1	1
1			1
1	1		1
1			1

$$c(A, B, C, D) = \sum (0, 1, 3-9) + \Phi(10-15)$$

$$= D + \bar{C} + B$$

1	1		1
1			1
1	1		1
1			1

$$d(A, B, C, D) = \sum (0, 2, 3, 5, 6, 8, 9) + \Phi(10-15)$$

$$= A + C\bar{D} + \bar{B}\bar{D} + \bar{B}C + B\bar{C}\bar{D}$$

1			1
	1		1
1	1		1
			1

$$e(A, B, C, D) = \sum (0, 2, 6, 8) + \Phi(10-15)$$

$$= \bar{A} + \bar{B}\bar{D} + \bar{C}\bar{D}$$

$$= \bar{B}\bar{D} + \bar{C}\bar{D}$$

1			1
1	1		1

$$f(A, B, C, D) = \sum (0, 4-6, 8, 9) + \Phi(10-15)$$

$$= A + B\bar{C} + B\bar{D} + \bar{C}\bar{D}$$

1	1		1
	1		1
			1
1	1		1

$$g(A, B, C, D) = \sum (2-9) + \Phi(10-15)$$

$$= A + B + C$$

	1	1	1
	1		1
1	1		1
1	1		1

Circuito Armado

