# Deber 1

## 1) Decimal a binario

$(10)_{10} = 1010$

10 | 2
0 — 5 | 2
1 — 2 | 2
0 — 1
1

$(1369)_{10} = 10101011001$

1369 | 2
1 — 684 | 2
0 — 342 | 2
0 — 171 | 2
1 — 85 | 2
1 — 42 | 2
0 — 21 | 2
1 — 10 | 2
0 — 5 | 2
1 — 2 | 2
0 — 1
1

Impar 1
par 0

$(9234876)_{10} = 100011001110100110111100$

9234876 | 2
0 — 4617438 | 2
0 — 2308719 | 2
1 — 1154359 | 2
1 — 577179 | 2
1 — 288589 | 2
1 — 144294 | 2
0 — 72147 | 2
1 — 36073 | 2
1 — 18036 | 2
0 — 9018 | 2
0 — 4509 | 2
1 — 2254 | 2
0 — 1127 | 2
1 — 563 | 2
1 — 281 | 2
1 — 140 | 2
0 — 70 | 2
0 — 35 | 2
1 — 17 | 2
1 — 8 | 2
0 — 4 | 2
0 — 2 | 2
0 — 1
1

$(49263749)_{10} = 10111011111011010010000101$

49263749 | 2
1 — 24631874 | 2
0 — 12315937 | 2
1 — 6157968 | 2
0 — 3078984 | 2
0 — 1539492 | 2
0 — 769746 | 2
0
384873 | 2
1 — 192436 | 2
0 — 96218 | 2
0 — 48109 | 2
1 — 24054 | 2
0 — 12027 | 2
1 — 6013 | 2
1
3006 | 2
0 — 1503 | 2
1 — 751 | 2
1 — 375 | 2
1 — 187 | 2
1 — 93 | 2
1 — 46 | 2
0
23 | 2
1 — 11 | 2
1 — 5 | 2
1 — 2 | 2
0 — 1
1

# Decimal to binary 2s complement

## $(-20)_{10} \rightarrow$

$$
\begin{array}{l}
20 \lfloor 2 \\
0 \quad 10 \lfloor 2 \\
\quad 0 \quad 5 \lfloor 2 \\
\quad\quad 1 \quad 2 \lfloor 2 \\
\quad\quad\quad 0 \quad 1 \\
\quad\quad\quad\quad 1
\end{array}
$$

$(20)_{10} = 10100 \rightarrow$ invertimos $= 01011$

$$
\begin{array}{r}
01011 \\
+ \quad\quad 1 \\
\hline
01100
\end{array}
$$

Como -20 es negativo agregamos 1 al inicio para representar el signo

Se requieren al menos 6 bits para representar

101100 //

## $(-1025)_{10} \rightarrow$

$$
\begin{array}{l}
1025 \lfloor 2 \\
1 \quad 512 \lfloor 2 \\
\quad 0 \quad 256 \lfloor 2 \\
\quad\quad 0 \quad 128 \lfloor 2 \\
\quad\quad\quad 0 \quad 64 \lfloor 2 \\
\quad\quad\quad\quad 0 \quad 32 \lfloor 2 \\
\quad\quad\quad\quad\quad 0 \quad 16 \lfloor 2 \\
\quad\quad\quad\quad\quad\quad 0 \quad 8 \lfloor 2 \\
\quad\quad\quad\quad\quad\quad\quad 0 \quad 4 \lfloor 2 \\
\quad\quad\quad\quad\quad\quad\quad\quad 0 \quad 2 \lfloor 2 \\
\quad\quad\quad\quad\quad\quad\quad\quad\quad 0 \quad 1 \\
\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad 1
\end{array}
$$

$(1025)_{10} \rightarrow 10000000001$

$$
10000000001 \xrightarrow{\text{Comp 1}} \begin{array}{r}
01111111110 \\
+ \quad\quad 1 \\
\hline
01111111111
\end{array}
$$

El numero minimo de bits para representar -1025 es 12 por lo cual

101111111111 //

## $(-3925)_{10}$

$$
\begin{array}{l}
3925 \lfloor 2 \\
1 \quad 1962 \lfloor 2 \\
\quad 0 \quad 981 \lfloor 2 \\
\quad\quad 1 \quad 490 \lfloor 2 \\
\quad\quad\quad 0 \quad 245 \lfloor 2 \\
\quad\quad\quad\quad 1 \quad 122 \lfloor 2 \\
\quad\quad\quad\quad\quad 0 \quad 61 \\
\quad\quad\quad\quad\quad\quad 1
\end{array}
\qquad
\begin{array}{l}
61 \lfloor 2 \\
1 \quad 30 \lfloor 2 \\
\quad 0 \quad 15 \lfloor 2 \\
\quad\quad 1 \quad 7 \lfloor 2 \\
\quad\quad\quad 1 \quad 3 \lfloor 2 \\
\quad\quad\quad\quad 1 \quad 1 \\
\quad\quad\quad\quad\quad 1
\end{array}
$$

$(3925)_{10} \rightarrow 111101010101$

$111101010101 \xrightarrow{\text{1 comp}} 000010101010$

0000 10101010
\+ 1
000010101011 → El minimo de bits para representar -1025 es 13 por lo que

1000010101011 //

-104596

104596 |2
0 52298 |2
0 26149 |2
1 13074 |2
0 6537 |2
1 3268 |2
0 1634
0

817 |2
1 408 |2
0 204 |2
0 102 |2
0 51 |2
1 25 |2
1 12 |2
0

6 |2
0 3 |2
1 1
1

$(104596)_{10}$ → 11001100010010100

11001100010010100 $\xrightarrow{\text{1 comp}}$ 00110011101101011
\+ 1
1 00110011101101100 → El numero minimo de bits para representar -104596 es 18 por lo que

100110011101101100 //

## Unsigned binary to hex

### Short method

- 1100 1111 0101 0110 0110 1110 1101 1000 0010 1001
  C F 5 6 6 E D 8 2 9
  CF566ED829 //

- 1000 0111 1000 1110 0011 1000 1110 0011 1111 0011
  8 7 8 E 3 8 E 3 F 3
  878E38E3F3 //

- 1010 1101 0101 1100 0110 0101 0100 1010 1010 1010

  A D 5 C 6 5 4 A A A

  AD5C654AAA //

- 1010 0010 1010 1010 1010 1010 1011 1111 1100 0000

  A 2 A A A A B F C 0

  A2AAAABFC0

Long method

- 1100 1111 0101 0110 0110 1110 1101 1000 0010 1001

$$(1\cdot 2^{39})+(1\cdot 2^{38})+(0\cdot 2^{37})+(0\cdot 2^{36})+(1\cdot 2^{35})+(1\cdot 2^{34})+(1\cdot 2^{33})+(1\cdot 2^{32})+$$
$$(0\cdot 2^{31})+(1\cdot 2^{30})+(0\cdot 2^{29})+(1\cdot 2^{28})+(0\cdot 2^{27})+(1\cdot 2^{26})+(1\cdot 2^{25})+(0\cdot 2^{24})+$$
$$(0\cdot 2^{23})+(1\cdot 2^{22})+(1\cdot 2^{21})+(0\cdot 2^{20})+(1\cdot 2^{19})+(1\cdot 2^{18})+(1\cdot 2^{17})+(0\cdot 2^{16})+$$
$$(1\cdot 2^{15})+(1\cdot 2^{14})+(0\cdot 2^{13})+(1\cdot 2^{12})+(1\cdot 2^{11})+(0\cdot 2^{10})+(0\cdot 2^{9})+(0\cdot 2^{8})+(0\cdot 2^{7})$$
$$(0\cdot 2^{6})+(1\cdot 2^{5})+(0\cdot 2^{4})+(1\cdot 2^{3})+(0\cdot 2^{2})+(0\cdot 2^{1})+(1\cdot 2^{0})=$$

$(890508335145)_{10} \longrightarrow$ 890508335145/16 = 55656770946 res = 9
55656770946/16 = 3478548184 res = 2
3478548184/16 = 217409261 res = 8
217409261/16 = 13588078 res = 13 → D en Hex
13588078/16 = 849255 res = 14 → E
849255/16 = 53078 res = 6
53078/16 = 3317 res = 6
3317/16 = 207 res = 5
207/16 = 12 res = 15 (F) en Hex
12/16 = 0 res = 12 (C) en Hex

CF566ED829

- 1000 0111 1000 1110 0011 1000 1110 0011 1111 0011

$$(1\cdot 2^{39})+(0\cdot 2^{38})+(0\cdot 2^{37})+(0\cdot 2^{36})+(0\cdot 2^{35})+(1\cdot 2^{34})+(1\cdot 2^{33})+(1\cdot 2^{32})+$$
$$(1\cdot 2^{31})+(0\cdot 2^{30})+(0\cdot 2^{29})+(0\cdot 2^{28})+(1\cdot 2^{27})+(1\cdot 2^{26})+(1\cdot 2^{25})+(0\cdot 2^{24})+$$
$$(0\cdot 2^{23})+(0\cdot 2^{22})+(1\cdot 2^{21})+(1\cdot 2^{20})+(1\cdot 2^{19})+(0\cdot 2^{18})+(0\cdot {}^{17})+(0\cdot 2^{16})+$$
$$(1\cdot 2^{15})+(1\cdot 2^{14})+(1\cdot 2^{13})+(0\cdot 2^{12})+(0\cdot 2^{11})+(0\cdot 2^{10})+(1\cdot 2^{9})+(1\cdot 2^{8})+(1\cdot 2^{7})$$
$$(1\cdot 2^{6})+(1\cdot 2^{5})+(1\cdot 2^{4})+(0\cdot 2^{3})+(0\cdot 2^{2})+(1\cdot 2^{1})+(1\cdot 2^{0})=$$

$(582206678003)_{10} \longrightarrow$ /16 = 36387917375 res = 3
36387917375/16 = 2274244835 res = F
2274244835/16 = 142140302 res 3
142140302/16 = 8883768 res = E
8883768/16 = 555235 res = 8

555233/16 = 34702 res = 3
34702/16 = 2168 res = E
2168/16 = 135 res = 8
135/16 = 8 res = 7
8/16 = res = 8

878E38E3F3

- 1010 1101 0101 1100 0110 0101 0100 1010 1010 1010

$$(1\cdot 2^{39}) + (0\cdot 2^{38}) + (1\cdot 2^{37}) + (0\cdot 2^{36}) + (1\cdot 2^{35}) + (1\cdot 2^{34}) + (0\cdot 2^{33}) + (1\cdot 2^{32}) +$$
$$(0\cdot 2^{31}) + (1\cdot 2^{30}) + (0\cdot 2^{29}) + (1\cdot 2^{28}) + (1\cdot 2^{27}) + (1\cdot 2^{26}) + (0\cdot 2^{25}) + (0\cdot 2^{24}) +$$
$$(0\cdot 2^{23}) + (0\cdot 2^{22}) + (0\cdot 2^{21}) + (0\cdot 2^{20}) + (0\cdot 2^{19}) + (1\cdot 2^{18}) + (0\cdot 17) + (1\cdot 2^{16}) +$$
$$(0\cdot 2^{15}) + (1\cdot 2^{14}) + (0\cdot 2^{13}) + (0\cdot 2^{12}) + (1\cdot 2^{11}) + (0\cdot 2^{10}) + (1\cdot 2^{9}) + (0\cdot 2^{8}) + (1\cdot 2^{7})$$
$$(0\cdot 2^{6}) + (1\cdot 2^{5}) + (0\cdot 2^{4}) + (1\cdot 2^{3}) + (0\cdot 2^{2}) + (1\cdot 2^{1}) + (0\cdot 2^{0}) =$$

$(744579484330)_{10}$ = 46536217770/16 res=A res=A
2908513610/16 res=A
181782100/16 res=4
11361381/16 res=5 AD5C654AAA
710086/16 res=6
44380/16 res=C
2773/16 res=5
173/16 res=D
10/16 res=A

- 1010 0010 1010 1010 1010 1010 1011 1111 1100 0000

$$(1\cdot 2^{39}) + (0\cdot 2^{38}) + (1\cdot 2^{37}) + (0\cdot 2^{36}) + (0\cdot 2^{35}) + (0\cdot 2^{34}) + (1\cdot 2^{33}) + (0\cdot 2^{32}) +$$
$$(1\cdot 2^{31}) + (0\cdot 2^{30}) + (1\cdot 2^{29}) + (0\cdot 2^{28}) + (1\cdot 2^{27}) + (0\cdot 2^{26}) + (1\cdot 2^{25}) + (0\cdot 2^{24}) +$$
$$(1\cdot 2^{23}) + (0\cdot 2^{22}) + (1\cdot 2^{21}) + (0\cdot 2^{20}) + (1\cdot 2^{19}) + (0\cdot 2^{18}) + (1\cdot 17) + (0\cdot 2^{16}) +$$
$$(1\cdot 2^{15}) + (0\cdot 2^{14}) + (1\cdot 2^{13}) + (1\cdot 2^{12}) + (1\cdot 2^{11}) + (1\cdot 2^{10}) + (1\cdot 2^{9}) + (1\cdot 2^{8}) + (1\cdot 2^{7})$$
$$(1\cdot 2^{6}) + (0\cdot 2^{5}) + (0\cdot 2^{4}) + (0\cdot 2^{3}) + (0\cdot 2^{2}) + (0\cdot 2^{1}) + (0\cdot 2^{0}) =$$

698648018880 /16 res=0

43665501180/16 res=C
2729093823/16 res=F
170568363/16 res=B
10660522/16 res=A A2AAAABFC0
666282/16 res=A
41642/16 res=A
2602/16 res=A
162/16 res=2
10/16 res A

# Signed binary to octal

## Short method

- 111111000001111100000001110101011

↓ 2s comp

000 000 111 110 000 011 111 110 001 010 101

0 0 7 6 0 3 7 6 1 2 5

−00760376125

- 010101010101111111111111110000000

↓ 2s comp

101 010 101 010 000 000 000 000 001 111 111 ,

1

01 0000 000

101 010 101 010 000 000 000 000 010 000 000

2 2 5 2 0 0 0 0 2 0 0 → 22520000200

- 1110001110000001111111100000101010

111 110 001 110 000 001 111 111 100 000 101 010

000 001 110 001 111 110 000 000 011 111 010 101

1

000 001 110 001 111 110 000 000 011 111 010 110

0 1 6 1 7 6 0 0 3 7 2 6 → −016176003726

- 1010101010100000101010101011111000

111 010 101 010 100 000 101 010 101 011 111 000

000 101 010 101 011 111 010 101 010 100 000 111

1

000 101 010 101 011 111 010 101 010 100 001 000

0 5 2 5 3 7 2 5 2 4 1 0 → −052537252410

# Boolen circuits

$A = A_1 \quad A_0$ ($2^1$, $2^0$)

$B = B_1 \quad B_0$

| | | |
|---|---|---|
| $C_1$ | $A_1B_0$ | $A_0B_0$ |
| $A_1B_1$ | $A_0B_1$ | |

| | | | |
|---|---|---|---|
| $C_2$ | $A_1B_1$ | $A_1B_0 +$ | $A_0B_0$ |
| | $C_1$ | $A_0B_1 +$ | |
| | $C_2$ | $C_1$ | |

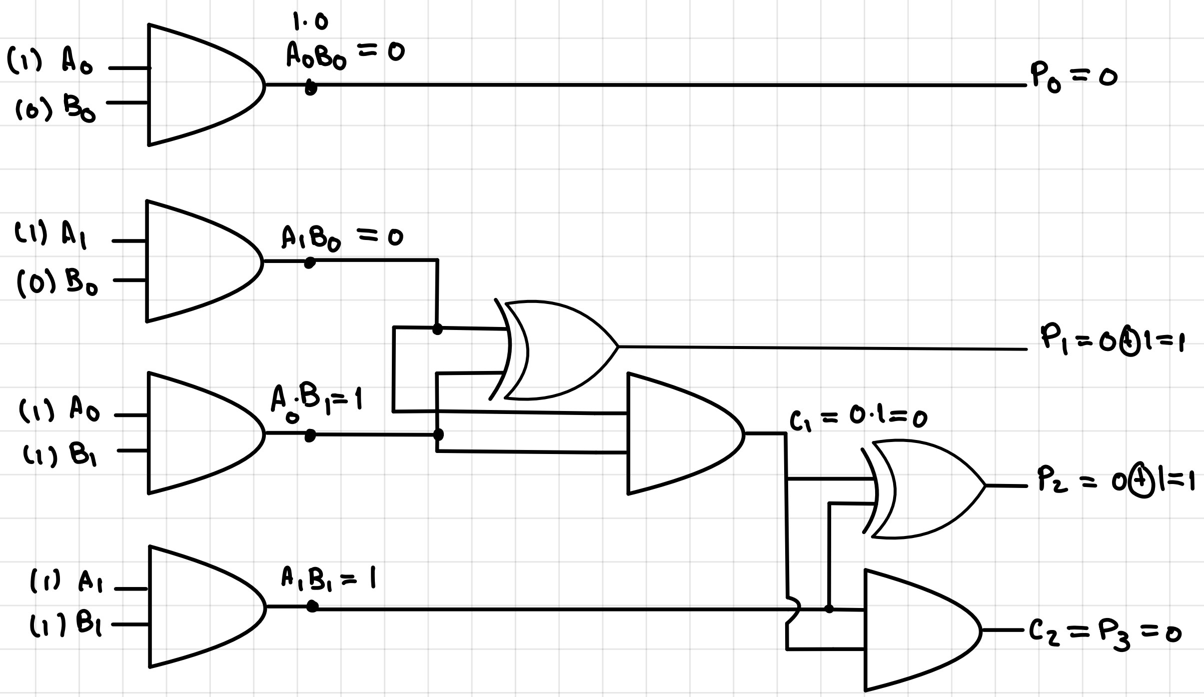
$R =$ 4bit nvo $\longrightarrow$

$P_0 = A_0B_0$

$P_1 = A_1B_0 + A_0B_1 \longrightarrow$ Half adder

$P_2 = A_1B_1 + C_1 \longrightarrow$ Half adder

$P_3 = C_2$




$A = 1 \; 1$

$B = 1 \; 0$

$\overline{\quad 0 \; 0}$

$1 \; 1$

$\overline{0 \; 1 \; 1 \; 0}$ (6)

| $A_1$ | $A_0$ | $B_1$ | $B_0$ | $P_3$ | $P_2$ | $P_1$ | $P_0$ |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |

$\longrightarrow$ Resultado

La respuesta para este ejercicio se obtuvo del siguiente enlace https://m.youtube.com/watch?v=7Bz9IgFNhDo&ab_channel=NesoAcademy

# 2's complement for a binary number of 3 bits

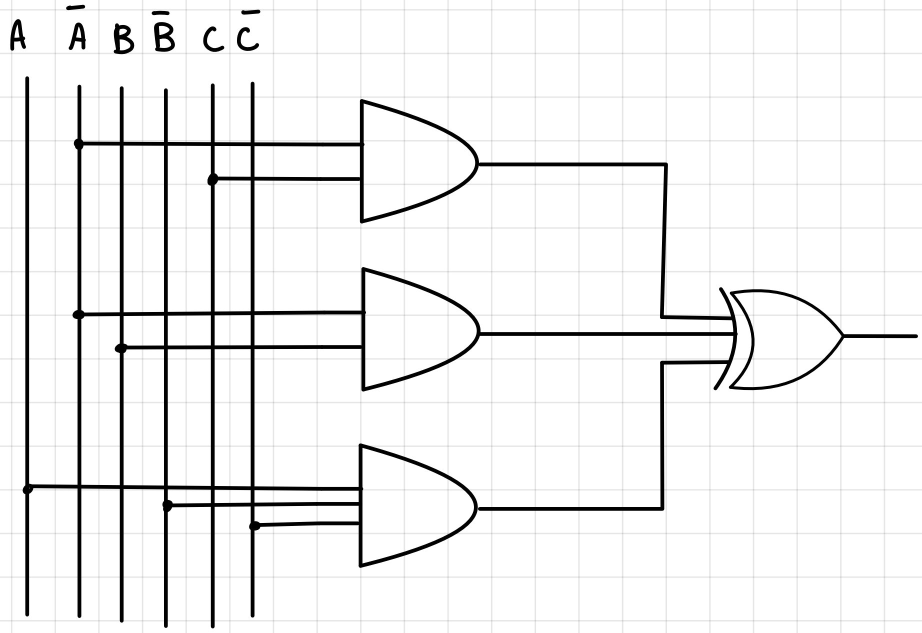
Creamos una tabla de verdad con los inputs que son numeros de 3 bits y la salida es el complemento de 2

| A | B | C | X | Y | Z |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 |

La respuesta para este ejercicio se obtuvo del siguiente enlace https://m.youtube.com/watch?v=cxRy_9ZR-E0&ab_channel=DKavitha

Para obtener el circuito utilizamos mapas de Karnaugh (contenido de electronica basica)

Para X

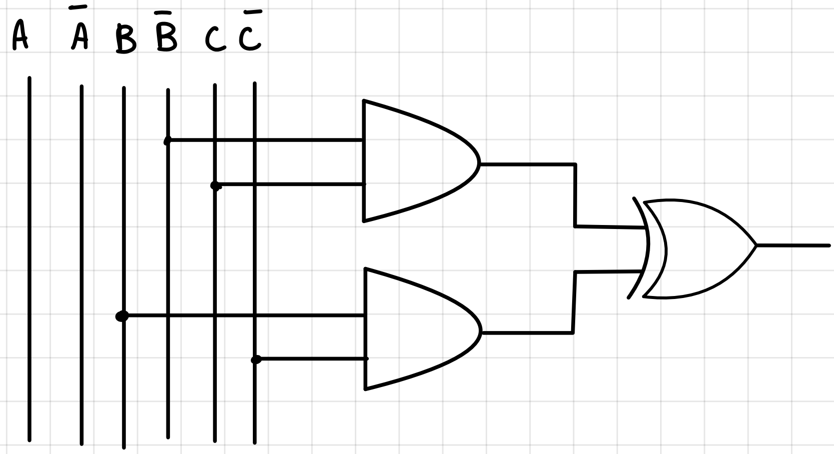



Para X

Map

| | $\bar{C}$ | $C$ |
|---|---|---|
| $\bar{A}\bar{B}$ | 0 | 1 |
| $\bar{A}B$ | 1 | 1 |
| $AB$ | 0 | 0 |
| $A\bar{B}$ | 1 | 0 |

Para Y

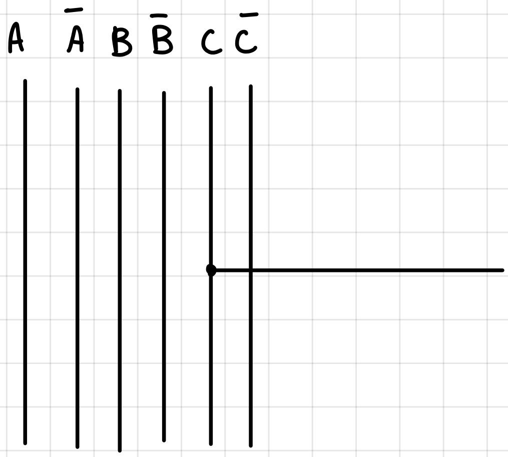



Para Y

Map

| | $\bar{C}$ | $C$ |
|---|---|---|
| $\bar{A}\bar{B}$ | 0 | 1 |
| $\bar{A}B$ | 1 | 0 |
| $AB$ | 1 | 0 |
| $A\bar{B}$ | 0 | 1 |

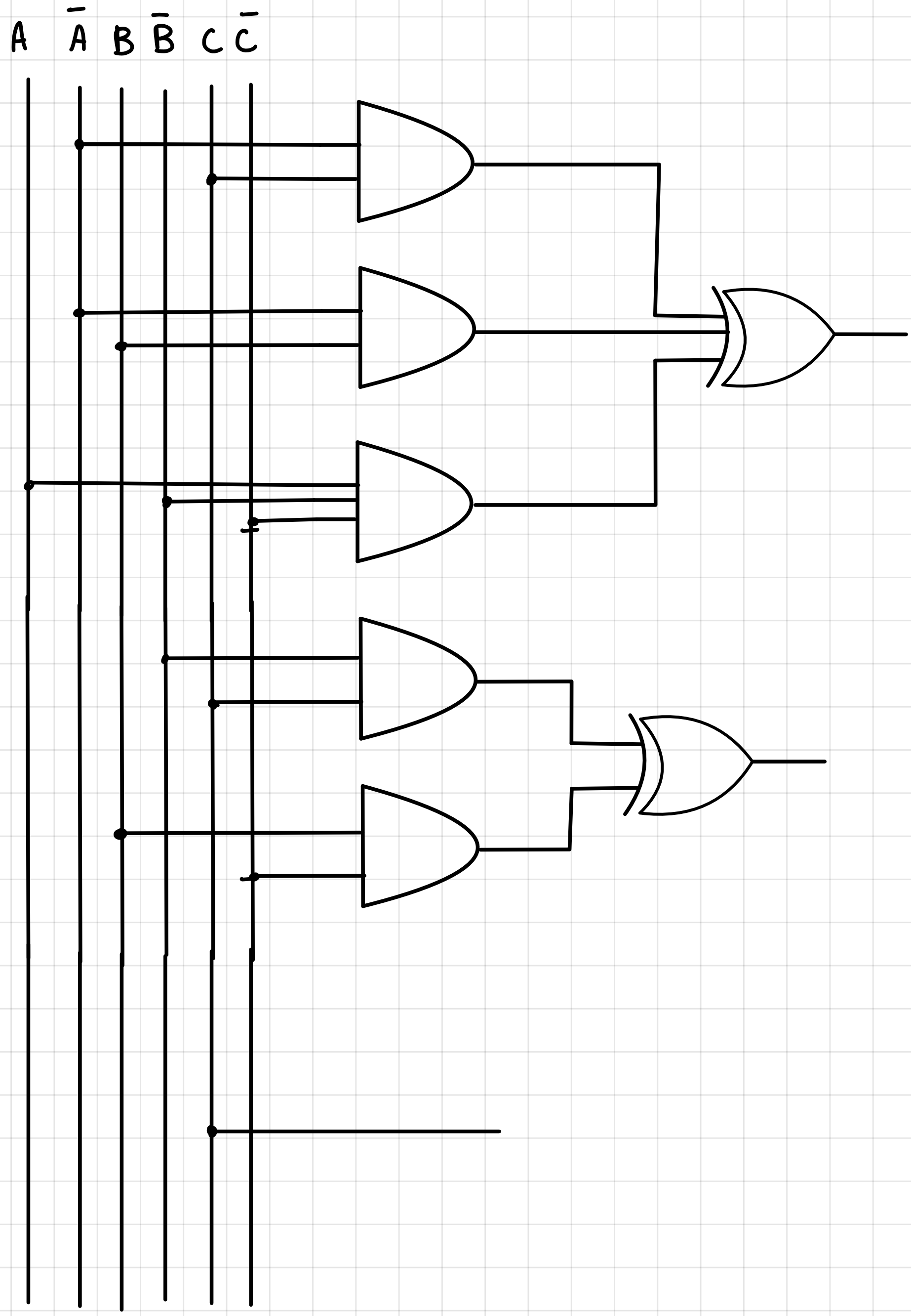
Para Z




Para Z

| | $\bar{C}$ | $C$ |
|---|---|---|
| $\bar{A}\bar{B}$ | 0 | 1 |
| $\bar{A}B$ | 0 | 1 |
| $AB$ | 0 | 1 |
| $A\bar{B}$ | 0 | 1 |

Unimos



# Do the following multiplications in binary

10 PD − MD
01 PD + MD

(−5) x (8)
11011 01000

11011
000000 01000 0 → 000000 00100 0
5 4

11011
000000 00010 0 → 000000 00001 0 →

00100
+ 1
00101

00000
− 00101
00101

11011
00101 00001 0 → 00010 10000 1 →

00010
+ 11011
11101

→ 11101 10000 1
2 ... 1 ... 2

11011
11110 11000 0 → 11110 11000 $\xrightarrow{2's}$ 00001 00111 → 0000101000
0

$(-40)_{10}$

00001 00111
+ 1
00001 01000

$(40)_{10}$

---

11 x (−10)
01011 10110

01011
000000 10110 0 → 00000 01011 0 →
5 4

10100
+ 1
10101

00000
− 10101
10101

01011
10101 01011 0 → 11010 10101 1 → 11101 01010 1 →
4 3 2

11101
+ 01011
01000

01011
01000 01010 1 → 00100 00101 0 →
2 1

00100
− 01011
11001

→ 11001 00101 0
1

$(11100\ 10010)_2$ → 00011 01101
+ 1
$(00011\ 01110)_2$ = $(110)_{10}$

$(-110)_2$

---

2x3
010 011

010
000 011 0 →
3

101
+ 1
110

000
− 110
110

→ 110 011 0 → 111 001 1
3 2

010
111 100 1 →

111
+ 010
001

→ 001 100 1 → 000 110 0 → 000 110
1 1 0

$(000110)_2$ = $(6)_{10}$

$(-4) \times (-8)$

$11100 \times 11000$

| | 11100 | | | | 11100 | | | | 11100 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 00000 | 11000 | 0 | $\longrightarrow$ | 00000 | 01100 | 0 | $\longrightarrow$ | 00000 | 00110 | 0 |
| | 5 | | | | 4 | | | | 3 | |

| | 11100 | | | | | | 11100 | |
|---|---|---|---|---|---|---|---|---|
| 00000 | 00011 | 0 | $\longrightarrow$ | $\begin{array}{r} 00011 \\ +\ \ \ \ \ 1 \\ \hline 00100 \end{array}$ | $\begin{array}{r} 00000 \\ -\ 00100 \\ \hline 00100 \end{array}$ $\longrightarrow$ 00100 | | 00011 | 0 |
| | 2 | | | | | | 2 | |

| | 11100 | | | | 11100 | | |
|---|---|---|---|---|---|---|---|
| 00010 | 00001 | 1 | $\longrightarrow$ | 00001 | 00000 | 1 | $\longrightarrow (00001\ 00000)_2 = 32$ |
| | 1 | | | | 0 | | |