

Deber 1

1. Transform the following numbers from one base to another

Decimal to binary.

$$\begin{array}{r} 10 \\ \times 10 \\ \hline 100 \end{array}$$

• 1369:  $1369 \begin{array}{l} \diagdown \diagup \\ 1 \end{array} \begin{array}{l} \diagup \diagdown \\ 684 \end{array} \begin{array}{l} \diagdown \diagup \\ 0 \end{array} \begin{array}{l} \diagup \diagdown \\ 342 \end{array} \begin{array}{l} \diagdown \diagup \\ 0 \end{array} \begin{array}{l} \diagup \diagdown \\ 171 \end{array} \begin{array}{l} \diagdown \diagup \\ 1 \end{array} \begin{array}{l} \diagup \diagdown \\ 85 \end{array} \begin{array}{l} \diagdown \diagup \\ 1 \end{array} \begin{array}{l} \diagup \diagdown \\ 42 \end{array} \begin{array}{l} \diagdown \diagup \\ 0 \end{array} \begin{array}{l} \diagup \diagdown \\ 21 \end{array} \begin{array}{l} \diagdown \diagup \\ 1 \end{array} \begin{array}{l} \diagup \diagdown \\ 10 \end{array} \begin{array}{l} \diagdown \diagup \\ 0 \end{array} \begin{array}{l} \diagup \diagdown \\ 5 \end{array} \Rightarrow 10101011001$

• 9234876:

$$\begin{array}{r}
 9234876 \quad \underline{12} \\
 \underline{-} \quad \underline{0} \quad 4617438 \quad \underline{12} \\
 \underline{\quad} \quad \underline{0} \quad 2308719 \quad \underline{12}
 \end{array}$$

$$\begin{array}{r}
 \Rightarrow 72147 \quad | \\
 \underline{1} \quad 36073 \quad | \\
 \underline{1} \quad 18036 \quad | \\
 \underline{0} \quad 9018 \quad | \\
 \underline{0} \quad 4509 \quad | \\
 \underline{1} \quad 2254 \quad | \\
 \underline{0} \quad 1127 \quad | \\
 \underline{1} \quad 563 \quad | \\
 \underline{1} \quad 281 \quad | \\
 \underline{1} \quad 140 \quad | \\
 \underline{1} \quad 70 \quad | \\
 \underline{0} \quad 35 \quad | \\
 \underline{1} \quad 17 \quad | \\
 \end{array}
 \quad
 \begin{array}{r}
 1154359 \quad | \\
 \underline{1} \quad 577179 \quad | \\
 \underline{1} \quad 288589 \quad | \\
 \underline{1} \quad 14294 \quad | \\
 \underline{0} \quad 72147 \quad | \\
 \end{array}
 \quad
 \Rightarrow 100011001110111100,,$$

• 49 263 749;

$$\begin{array}{r}
 49263749 \quad |2 \\
 \underline{-} \quad 24631874 \quad |2 \\
 \underline{\quad} \quad 0 \quad 12315937 \quad |2 \\
 \quad \quad \quad \underline{-} \quad 6157468 \quad |2 \\
 \quad \quad \quad \quad \quad \underline{-} \quad 3078984 \quad |2 \\
 \quad \quad \quad \quad \quad \underline{-} \quad 0 \quad 1539492 \quad |2 \\
 \quad \quad \quad \quad \quad \quad \quad \quad \underline{-} \quad 0 \quad 769746 \quad |2 \\
 \quad \underline{-} \quad 0 \quad 384873
 \end{array}$$

$$\begin{array}{r}
 384873 \underline{2} \\
 192436 \underline{2} \\
 \hline
 96218 \underline{2}
 \end{array}
 \quad
 \begin{array}{r}
 1539492 \underline{2} \\
 769746 \underline{2} \\
 \hline
 384873
 \end{array}$$

$$\begin{array}{r}
 1871 \boxed{2} \\
 193 \boxed{2} \\
 146 \boxed{1} \\
 \hline
 23 \boxed{2} \\
 11 \boxed{2} \\
 15 \boxed{2} \\
 12 \boxed{2} \\
 \hline
 1 \boxed{1}
 \end{array}
 \Rightarrow 10111011110110100100000101, \boxed{1} \boxed{781} \boxed{2} \boxed{375} \boxed{2} \boxed{187}$$

Decimal to binary using 2's complement.

Use the minimum number of bits required to express the number.

$$\bullet -20 \stackrel{mod 2}{\equiv} \Rightarrow (10100)_2$$

2012  
01012  
0012  
112  
101  
6 bits  $\rightarrow$  010100  
20(1s)  $\rightarrow$  101011  
+ 1  
101100  $\rightarrow$  -20

101100  $\Rightarrow$  -20  $\Rightarrow$  101100 2's comp. //



849254116

6 53078 116

6 3317 116  
5 207 116  
F C  $\Rightarrow$  CFS66ED829 16//

Método corto:

1100	111	0101	0110	0110	110	1100	1000	0010	1001
12	F	S	6	6		14	13	8	2
↓						↓	↓		
C						E	D		

$\Rightarrow$  CFS66ED829 16//

\*100001110001100011000011000111110011.

Método Largo: Bin  $\Rightarrow$  Dec

$$\begin{aligned}
 & 2^0 + 2^1 + 0 \cdot 2^2 + 0 \cdot 2^3 + 2^4 + 2^5 + 2^6 + 2^7 + 2^8 + 2^9 + 0 \cdot 2^{10} + 0 \cdot 2^{11} + 0 \cdot 2^{12} + 2^{13} + 2^{14} + 2^{15} + 0 \cdot 2^{16} + 0 \cdot 2^{17} \\
 & + 0 \cdot 2^{18} + 0 \cdot 2^{19} + 2^{20} + 2^{21} + 0 \cdot 2^{22} + 0 \cdot 2^{23} + 0 \cdot 2^{24} + 2^{25} + 2^{26} + 2^{27} + 0 \cdot 2^{28} + 0 \cdot 2^{29} + 0 \cdot 2^{30} \\
 & + 2^{31} + 2^{32} + 2^{33} + 2^{34} + 0 \cdot 2^{35} + 0 \cdot 2^{36} + 0 \cdot 2^{37} + 0 \cdot 2^{38} + 2^{39} = 582206678003
 \end{aligned}$$

Dec  $\Rightarrow$  Hex

582206678003 116

3 36387917375 116

F 2274244835 116

3 142140302 116

E 8888768 116

X 555235

$\Rightarrow$  555235 116

3 34702 116

E 2168 116

8 135 116

7 8 116

$\Rightarrow$  878E38E3F3 16

Método Corto:

1000	0111	1000	110	0011	1000	110	0011	1111	0011
8	7	8	14	3	8	14	3	15	3
↓			↓		↓	↓		↓	
E					E			F	

$\Rightarrow$  878E38E3F3 16

\*1010110101011100011001010100101010101010

Método Largo: Bin  $\Rightarrow$  Dec

$$\begin{aligned}
 & 0 \cdot 2^0 + 2^1 + 0 \cdot 2^2 + 2^3 + 0 \cdot 2^4 + 2^5 + 0 \cdot 2^6 + 2^7 + 0 \cdot 2^8 + 2^9 + 0 \cdot 2^{10} + 0 \cdot 2^{11} + 0 \cdot 2^{12} + 0 \cdot 2^{13} + 2^{14} + 0 \cdot 2^{15} \\
 & + 2^{16} + 0 \cdot 2^{17} + 2^{18} + 0 \cdot 2^{19} + 2^{20} + 2^{21} + 2^{22} + 0 \cdot 2^{23} + 0 \cdot 2^{24} + 0 \cdot 2^{25} + 2^{26} + 2^{27} + 2^{28} + 0 \cdot 2^{29} + 2^{30} \\
 & + 0 \cdot 2^{31} + 2^{32} + 2^{33} + 0 \cdot 2^{34} + 2^{35} + 0 \cdot 2^{36} + 2^{37} + 0 \cdot 2^{38} + 2^{39} = 744579484330
 \end{aligned}$$

Dec  $\Rightarrow$  Hex

744579484330 116

A 46536217770 116

A 2908513610 116

4 11361381 116

5 710086  $\Rightarrow$

710086 116

$$\begin{array}{r}
 6 \ 44380 \ 116 \\
 - \ 2773 \ 116 \\
 \hline
 - \ 173 \ 116 \\
 \hline
 \ 0 \ A
 \end{array}$$

$\Rightarrow ADSC654AAA_{16}$

Método Corto:

$$\begin{array}{cccccccccc}
 1010 & 1101 & 0101 & 1100 & 0110 & 0101 & 0100 & 1010 & 1010 & 1010 \\
 \checkmark & \checkmark \\
 A & D & S & C & 6 & S & 4 & A & A & A
 \end{array}$$

$\Rightarrow ADSC654AAA_{16}$

• 10100010101010101010 1010 1010 11111110000000

Método Largo: Bin  $\Rightarrow$  Dec

$$\begin{aligned}
 & 0 \cdot 2^0 + 0 \cdot 2^1 + 0 \cdot 2^2 + 0 \cdot 2^3 + 0 \cdot 2^4 + 0 \cdot 2^5 + 0 \cdot 2^6 + 0 \cdot 2^7 + 0 \cdot 2^8 + 0 \cdot 2^9 + 0 \cdot 2^{10} + 0 \cdot 2^{11} + 0 \cdot 2^{12} + 0 \cdot 2^{13} + 0 \cdot 2^{14} + 0 \cdot 2^{15} + 0 \cdot 2^{16} \\
 & + 1 \cdot 2^{17} + 0 \cdot 2^{18} + 0 \cdot 2^{19} + 0 \cdot 2^{20} + 0 \cdot 2^{21} + 0 \cdot 2^{22} + 0 \cdot 2^{23} + 0 \cdot 2^{24} + 0 \cdot 2^{25} + 0 \cdot 2^{26} + 0 \cdot 2^{27} + 0 \cdot 2^{28} + 0 \cdot 2^{29} + 0 \cdot 2^{30} + 0 \cdot 2^{31}
 \end{aligned}$$

Dec  $\Rightarrow$  Hex

698648018880 116

$$\begin{array}{r}
 043665501180116 \\
 - \\
 \hline
 \ 0 \ 43665501180116
 \end{array}$$

F 170568363 116

B 666282 116

$$\begin{array}{r}
 A 2602 116 \\
 - \\
 \hline
 \ 4 162 116 \\
 \hline
 \ 2 A
 \end{array}$$

$\Rightarrow A2AAAAABFC0_{16}$

Método Corto: //

$$\begin{array}{cccccccccc}
 1010 & 0010 & 1010 & 1010 & 1010 & 1010 & 1011 & 1111 & 1100 & 0000 \\
 \checkmark & \checkmark \\
 A & 2 & A & A & A & A & B & F & C & O
 \end{array}$$

$\Rightarrow A2AAAAABFC0_{16}$

Signed binary to octal //

Use the long and short methods.

• 11111000001111000000001110101011:

Método Largo: Bin  $\Rightarrow$  Dec.

(1's comp)  $\Rightarrow 000000011100000111110001010100$

+ 1

000000111100000111110001010101

01's comp)

$$\begin{aligned}
 & 2^0 + 0 \cdot 2^1 + 2^2 + 0 \cdot 2^3 + 2^4 + 0 \cdot 2^5 + 2^6 + 0 \cdot 2^7 + 0 \cdot 2^8 + 0 \cdot 2^9 + 2^{10} + 2^{11} + 2^{12} + 2^{13} + 2^{14} + 2^{15} + 2^{16} + 0 \cdot 2^{17} \\
 & + 0 \cdot 2^{18} + 0 \cdot 2^{19} + 0 \cdot 2^{20} + 0 \cdot 2^{21} + 0 \cdot 2^{22} + 0 \cdot 2^{23} + 0 \cdot 2^{24} + 0 \cdot 2^{25} + 0 \cdot 2^{26} = 130153357
 \end{aligned}$$

Magnitud.

Dec 3 Oct

130153557 (2)

S 16269194 18

2 2033649 18

1 254206 L8

6 31775 18

-75 18

7 3971 18

3 496

3

62 18  
6 7

⇒ -760376125<sub>8</sub>

二

## Método Corto.

111 110 000 011 111 110 001 010  
7 6 0 3 7 6 1 2  $\text{hCO}_3^-$

$$\Rightarrow -760376125_2$$

7

Método Largo: Bin  $\rightarrow$  Dec

$$+ 2^{21} + 0 \cdot 2^{22} + 0 \cdot 2^{23} + 0 \cdot 2^{24} + 2^{25} + 0 \cdot 2^{26} + 2^{27} + 0 \cdot 2^{28} + 2^{29} + 0 \cdot 2^{30} + 2^{31} = 2861709504$$

Dec 3 Oct

2864709504L8

0358688688 18  
D 46

0 44761086 18

7 694341 18

예 18  
7 8347318

17927 12

7 136

7 1365 18  
5 170 18  
- 2 21 18  
- 5 8

⇒ 25257777600

Método Corto: //

010 101 010 101 111 111 111 111 110 000 000  
2 5 2 5 7 7 7 7 6 0 0

252577776008 //

• 1110001110000001111111000001010  
HLSL

## Método Largo: Bits Dec

(its comp) 0001110001111100000000011110101

$$\begin{array}{r}
 \text{+} \\
 \hline
 0001110001111000000001111010110
 \end{array}
 \quad
 \begin{array}{l}
 1 \\
 10^1 \text{ comp} \\
 \text{magnitude}
 \end{array}
 \quad
 \begin{array}{l}
 13 \\
 15 + 0 \cdot 2 \\
 16 + 0 \cdot 2 \\
 17 + 0 \cdot 2 \\
 18 + 0 \cdot 2 \\
 19 + 0 \cdot 2 \\
 20
 \end{array}$$

$$0 \cdot 2^0 + 2^1 + 2^2 + 2^3 + 2^4 + 2^5 + 2^6 + 2^7 + 2^8 + 2^9 + 2^{10} + 2^{11} + 2^{12} + 2^{13} + 2^{14} + 2^{15} + 2^{16} + 2^{17} + 2^{18} + 2^{19} + 2^{20} = 1912080342$$

Dec → Oct

$$\begin{array}{r}
 191208034218 \\
 - \underline{6} \quad 289010041218 \\
 \underline{2} \quad 2987625518 \\
 \underline{7} \quad 893453118 \\
 \underline{3} \quad 46681618 \\
 \underline{0} \quad 5835218 \\
 \underline{0} \quad 729418 \\
 \underline{6} \quad 91118 \\
 \underline{3} \quad 11318 \\
 \underline{1} \quad 1418 \\
 \underline{6} \quad 61
 \end{array}$$

## Método Curb:

Periodo Corr. 111110 001 1111110 000 000 011 111 010 10 6  
 1 6 1 7 6 0 0 3 7 2 6  
 $\Rightarrow -16176003726 //$

• 1010101010100000101010101011111000 .

Método Largo : Bin  $\rightarrow$  Dec

Dec 3 Oct

$$\begin{array}{r}
 572924492418 \\
 \times 71615553 \quad \frac{18}{895} \\
 \hline
 1 \quad 4 \quad 2 \quad 3 \quad 1398741 \quad \frac{18}{174842} \\
 \hline
 5 \quad 5 \quad 0 \quad 11189930 \quad \frac{18}{174842} \\
 \hline
 21855 \quad \frac{18}{2731} \\
 \hline
 3 \quad 341 \quad \frac{18}{5}
 \end{array}$$

## Método Corto.

101 010 101 011 111 010 101 010 100 001 000  
5 2 5 3 7 2 5 2 4 1 0

2 - 52537252410 //

## 2. Boolean circuits

Draw the Boolean circuit and make the truth table for the following.

Multiplication of two binary numbers of length 2 bits

Inputs      Output

A	B	$A * B$
0	0	0
0	1	0
1	0	0
1	1	1

Multiplication  $\Rightarrow$

of two binary numbers of 2 bits:  $A \times B$        $B = 2$

Generate 4 bits  $\Rightarrow M_0, M_1, M_2, M_3$

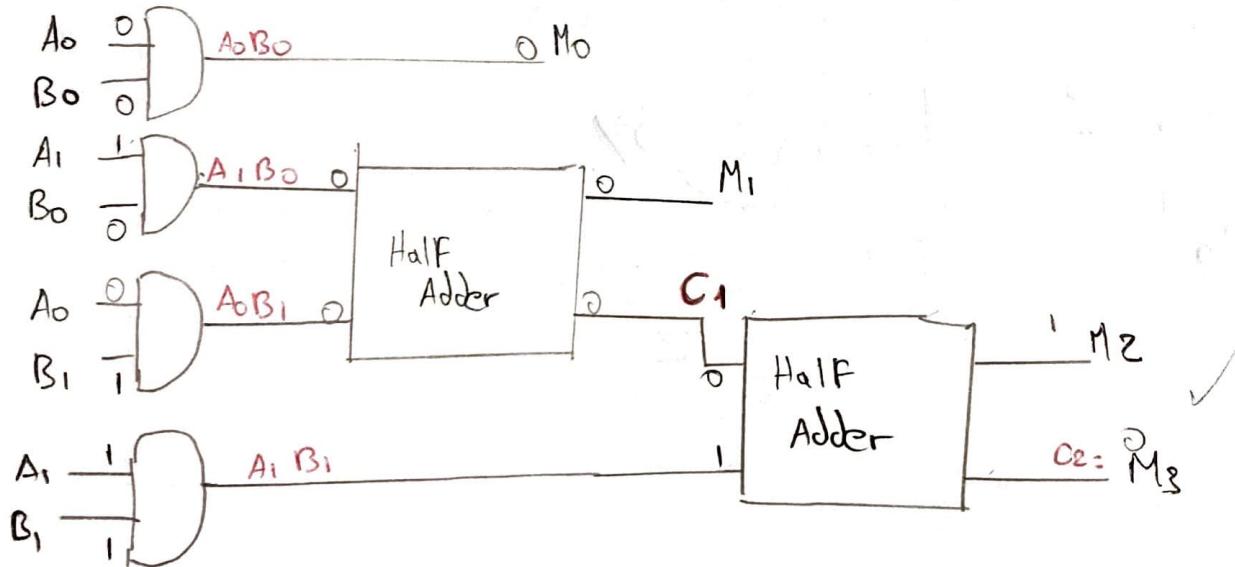
$$\boxed{A = \begin{matrix} A_1 \\ A_0 \end{matrix}}$$

$$B = \begin{matrix} B_1 \\ B_0 \end{matrix}$$

$$\begin{array}{r} A_1 B_1 \times 2^2 \\ A_1 B_0 \times 2^1 \\ \hline A_0 B_1 \times 2^0 \\ A_0 B_0 \times 2^0 \\ \hline M_0 \\ M_1 \\ M_2 \\ M_3 \end{array}$$

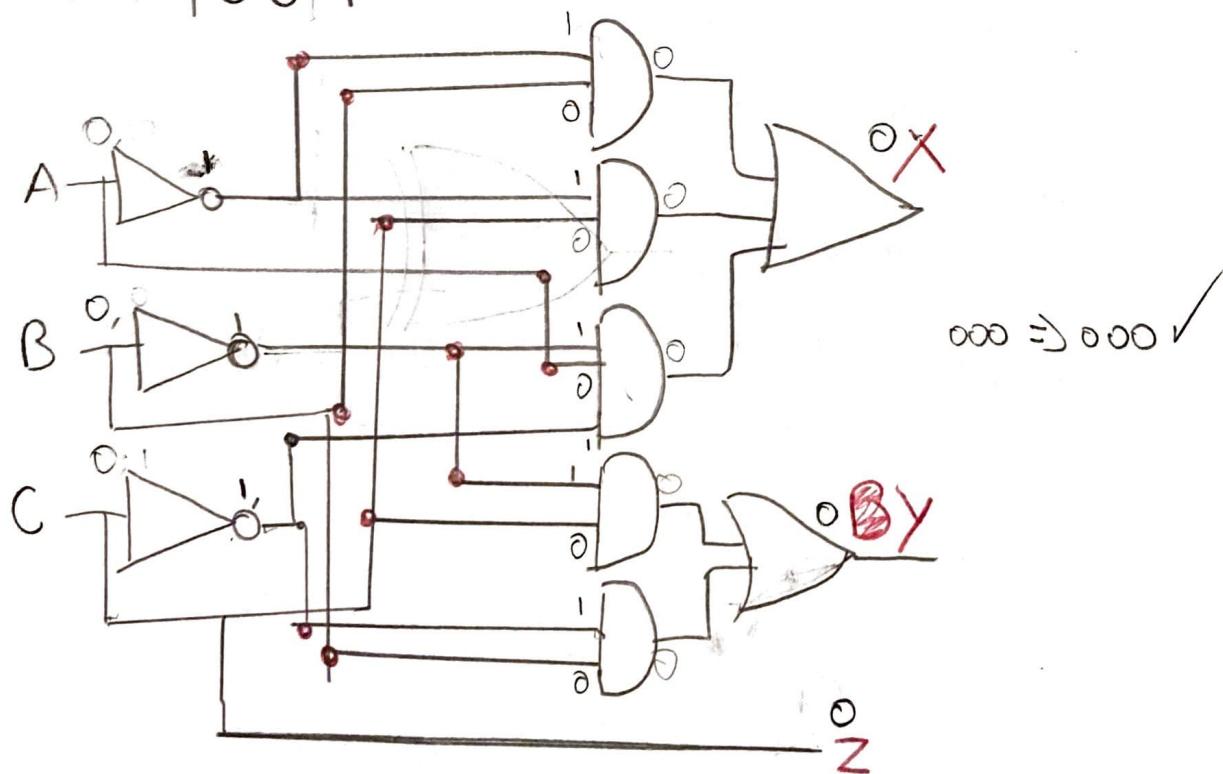
Carry 1

$$M_0 = A_0 B_0, M_1 = A_1 B_0 + A_0 B_1, M_2 = A_1 B_1 + C_1, M_3 = C_2$$



Two complement for a binary number of length 3 bits.

Inputs			Outputs		
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



3. Do the following multiplications in binary.

Use the minimum number of bits required.

•  $-5 \times 8$ :

Operando:  $-5 \Rightarrow 10101$  (1's comp)  
 $\times 8$   $\frac{+1}{1011}$  (2's comp de 5)

$$mr = 8 = 1000$$

$$md = -5 = 0101$$

$$\Rightarrow \begin{array}{r} 0101 \\ 1000110 \\ \hline 0100 \end{array} \Rightarrow \begin{array}{r} 0101 \\ 01000 \\ \hline 0011 \end{array} \Rightarrow \begin{array}{r} 0101 \\ 00100 \\ \hline 0010 \end{array}$$

$$\Rightarrow \begin{array}{r} 0101 \\ 00010 \\ 0001 \\ \hline 0000 \end{array}$$

$$PP = PD - MD$$

$$\begin{array}{r} 0000 \\ -0101 \\ \hline 1101 \end{array}$$

$$\Rightarrow \begin{array}{r} 0101 \\ 00010 \\ 0001 \\ \hline 0000 \end{array} \Rightarrow \boxed{01111000}$$

$$\begin{array}{r} 01111000 \\ \hline -40 \\ \hline 40 \end{array} \Rightarrow \begin{array}{r} 00101000 \\ \hline 40 \end{array}$$

• 2x3:

operando:

$$md = 2 = 010$$

$$mr = 3 = 011$$

010

000 011 0

011

$$PD = PD - Md$$

000

- 010

110

010

110 011 0

011

$$\Rightarrow 111 \begin{matrix} 010 \\ 001 \\ 010 \end{matrix} 1 \Rightarrow 111 \begin{matrix} 010 \\ 100 \\ 001 \end{matrix} 1$$

$$\Rightarrow PD = PD + md \Rightarrow 001 \begin{matrix} 010 \\ 100 \\ 001 \end{matrix} 1$$

$$\begin{matrix} 0110 \\ + 010 \\ \hline 001 \end{matrix}$$

$$\Rightarrow \begin{array}{r} 010 \\ \hline \boxed{000 \quad 110} \quad 0 \\ \hline 000 \end{array} \Rightarrow 000110_2 \Rightarrow 6 //$$