

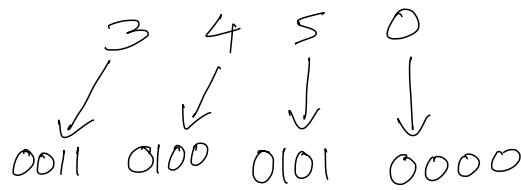
BCD \Rightarrow Binary Coded Decimal

Decimal	BCD ₈₄₂₁
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
	1010
	1011
	1100
	1101
	1110
	1111

Decimal → BCD

$$(3450)_{10} \rightarrow (2.)_{BCD}$$

Step: Convert each Decimal digit into its corresponding BCD Code.

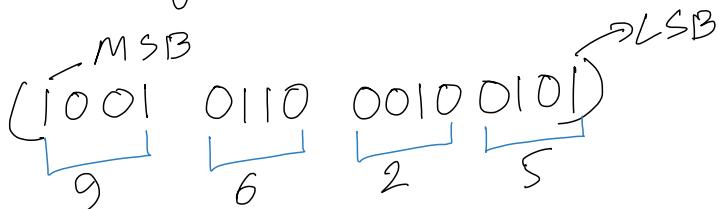


$$(3450)_{10} \rightarrow (\textcolor{red}{0011\ 0100\ 0101\ 0000})_{BCD}$$

BCD → Decimal

$$(10010110\ 00100101)_{BCD} \rightarrow (2.)_{10}$$

Step: Start from LSB and make groups of 4 bits. Then figure out the corresponding Decimal Digits of that group.



$$= (9625)_{10}$$

Ex: 

$$\Rightarrow (0101\ 1111\ 0100)_{10} = (?)_{BCD}$$

\Rightarrow Given number is not valid in BCD

Excess-3

Decimal	Excess-3
0	0011
1	0100
2	0101
3	0110
4	0111
5	1000
6	1001
7	1010
8	1011
9	1100
	1101
	1110
	1111
	0000
	0001
	0010

These
are unused
combinations

Decimal to Excess-N

Step 1: Decimal digit + N

Step 2: Now find the binary
of $(\text{Decimal digit} + N)_{10}$

$\text{BCD} \rightarrow \text{Ex-3}^N$

$$(3)_{10} \rightarrow (?)_{\text{Ex3}}$$

$$= 3+3 = (6)_{10} \rightarrow (?)_2 \\ = 0110$$

$$\text{So, } (3)_{10} = (0110)_{\text{Ex3}}$$

Signed Number Representation:

- (i) sign & magnitude.
- (ii) 1_a complement.
- (iii) 2_a complement.

Sign & Magnitude

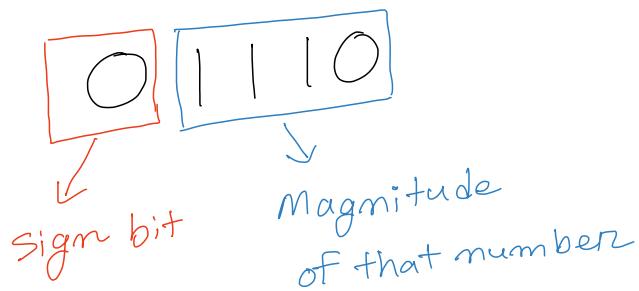
A positive number :

$$+(14)_{10} = (?)_{\text{asm}}$$

+	= 0
-	= 1

Step 1 : $(14)_{10} = (1110)_2$

Step 2 : $+ (14)_{10} = \underbrace{0}_{\swarrow} \underbrace{1110}_{\searrow}$

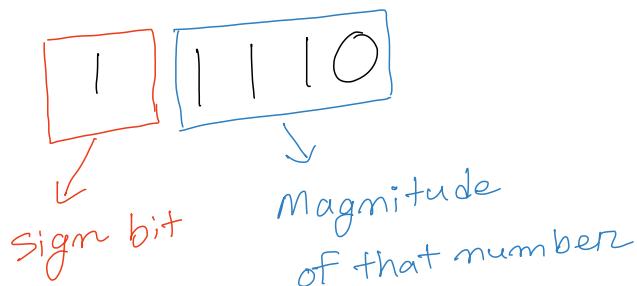


A negative number :

$$-(14)_{10} = (?)_{\text{asm}}$$

Step 1 : $-(14)_{10} = (1110)_2$

Step 2 : $- (14)_{10} = \underbrace{1}_{\swarrow} \underbrace{1110}_{\searrow}$



1_a Complement

Positive Number:

$$+(15)_{10} = (2.)_{10}$$

(i) $15 = 1111$

(ii) $+15 = 01111$
↑
Sign bit

Negative Number:

$$-(15)_{10} = (2.)_{10}$$

(i) $15 = 1111$

(ii) $+15 = 01111$

$-15 = 10000$

(i) Find the binary of the given number without sign.

(ii) Now find positive version of that number

(iii) Invert all the bits
 \downarrow
 $(0 \rightarrow 1)$
 $(1 \rightarrow 0)$

2_a Complement

Positive Number:

$$+(15)_{10} = (2.)_{10}$$

(i) $15 = 1111$

(ii) $+15 = 01111$
↑
Sign bit

Negative Number:

$$-(15)_{10} = (2.)_{10}$$

(i) $15 = 1111$

(ii) $+15 = 01111$

$-15 = \overline{10000} + 1$

(i) Find the binary of the given number without sign.

(ii) Now find positive version of that number

(iii) Perform 1_a complement.

(iv) Add 1 with the answer.

Range Formulas

	Formula
Sign & Magnitude	$-[(2^{n-1})-1] \text{ to } +[(2^{n-1})-1]$
1 _a complement	$-[(2^{n-1})-1] \text{ to } +[(2^{n-1})-1]$
2 _a complement	$-[(2^n)] \text{ to } +[(2^n)-1]$

Representing 0_a

S&M :

$$\begin{aligned} +0 &= 00 \\ -0 &= 10 \end{aligned} \quad \begin{array}{l} \text{two diff.} \\ \text{representa-} \\ \text{tion of} \end{array}$$

1_a :

$$\begin{aligned} +0 &= 00 \\ -0 &= 11 \end{aligned} \quad \begin{array}{l} \text{two diff.} \\ \text{representa-} \\ \text{tion of} \end{array}$$

2_a :

$$\begin{aligned} +0 &= 00 \\ -0 &= 00 \end{aligned} \quad \begin{array}{l} +0 \& -0 \\ \text{are same.} \\ \text{no space} \\ \text{wastage.} \end{array}$$

we discard carry bit in 2_a comp.

$$\begin{array}{r} 111 \\ +1 \\ \hline 100 \\ \times \\ -0 = 00 \end{array}$$

2_n Complement

Addition: A + B

(i) Perform Binary addition

(ii) IF you see a carry out \rightarrow Discard it.

Subtraction: $A - B = A + (-B)$ [No direct sub operation]

(i) Take 2_n complement of B.

(ii) Add the 2_n complement of B. with A.

1_n Complement

Addition: A + B

(i) Perform Binary addition

(ii) IF you see a carry out \rightarrow Add 1 to the result.

Subtraction: $A - B = A + (-B)$ [No direct sub operation]

(i) Take 1_n complement of B.

(ii) Add the 1_n complement of B. with A.

Overflow

Addition:

\Rightarrow Add two same signed numbers

if (answer also has same sign):

No overflow

else

Overflow

\Rightarrow Sub two same signed numbers

Never Overflow.

\Rightarrow Add two different signed numbers

Never Overflow.

\Rightarrow Sub two different numbers

$$+A - (-B) = +A + B \Rightarrow \text{rule 1}$$

$$-A - (+B) = -A + (-B) \Rightarrow \text{rule 1}$$