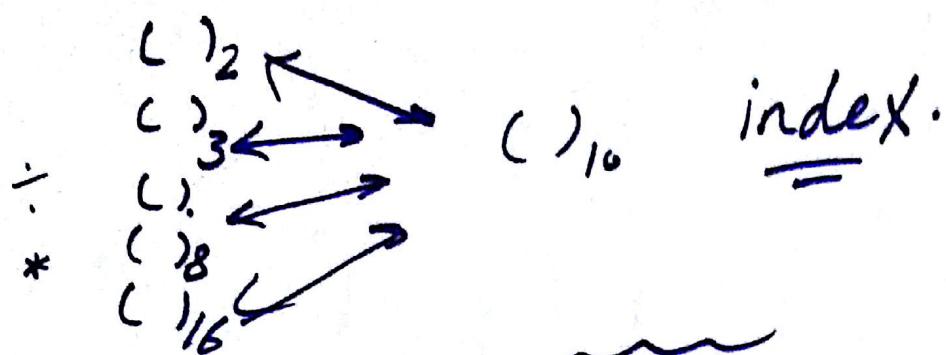


بسم الله الرحمن الرحيم

\* Number 5 in 3 forms.



\* Direct       $( )_2$       3 bits       $( )_8$       0 → 7  
                  111

$( )_2$       ↔       $( )_4$   
2 bits      11

$( )_2$       ↔       $( )_{16}$   
4 bits      0 → 15  
                  1111



1) Addition      for Binary System.  
2) Subtraction      0, 1

\* Addition (0, 1)

16 8 4 2 /

$$\begin{array}{r}
 \xrightarrow{\leftarrow} \\
 \begin{array}{r}
 + 0 \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{r}
 + 0 \\
 \hline
 1
 \end{array}
 \quad
 \begin{array}{r}
 + 1 \\
 \hline
 1
 \end{array}
 \quad
 \begin{array}{r}
 + 1 \\
 \hline
 0
 \end{array}
 \quad
 \begin{array}{r}
 1 \\
 \hline
 1
 \end{array}
 \end{array}$$

Ex-1

$$\begin{array}{r}
 1 1 1 1 1 1 \\
 | | 0 | | | 0 | \\
 + 0 1 1 0 1 1 1 \\
 \hline
 1 0 1 0 0 1 1 0 0
 \end{array}$$

Carry  $\leftarrow$    

Ex-2.

$$\begin{array}{r}
 1 1 1 1 1 \\
 | | 0 | | . 0 | \\
 + 1 0 1 1 1 \\
 \hline
 1 1 0 0 1 1 0
 \end{array}$$

Subtraction

Direct

Direct  
1's Comp.  
2's Comp.

$$\begin{array}{r} 0 \text{ } 11 \text{ } 17 \\ + 2 \text{ } 7 \\ \hline - 9 \text{ } 9 \\ \hline 2 \text{ } 8 \end{array}$$

subtract:

Decimal  
( )<sub>10</sub>

$$\begin{array}{r} 0 \quad 1 \quad 1 \quad 0 \\ - 0 \quad 1 \quad 0 \quad 1 \\ \hline 0 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1 \end{array}$$

to +  
1 & borrow 1

Ex.

$$\begin{array}{r} 0 \quad 1 \quad 1 \quad 1 \quad 2 \quad 2 \quad 1 \quad 0 \\ - 1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 1 \quad 0 \quad 1 \\ \hline 0 \quad 0 \quad 0 \quad 0 \quad 1 \quad 1 \quad 1 \end{array}$$

Binary ( )<sub>2</sub>

$$\begin{array}{r} 0 \text{ } 11 \text{ } 17 \\ + 2 \text{ } 7 \\ \hline - 9 \text{ } 9 \\ \hline 2 \text{ } 8 \end{array}$$

Decimal  
( )<sub>10</sub>

Ex.

$$\begin{array}{r} 0 \quad 1 \quad 1 \quad 1 \quad . \quad 1 \quad 0 \quad 1 \quad 0 \\ - 0 \quad 1 \quad 0 \quad 1 \quad 1 \quad . \quad 1 \quad 0 \quad 1 \quad 0 \\ \hline 0 \quad 1 \quad 1 \quad 0 \quad 1 \quad 1 \quad . \quad 1 \quad 0 \quad 1 \end{array}$$

$$\begin{array}{r}
 \begin{array}{c}
 \begin{array}{ccccc}
 & 1 & 2 & 1 & 2 \\
 & \swarrow & \searrow & & \\
 0 & 0 & 1 & 1 & 1
 \end{array} \\
 - \quad \underline{\quad \quad \quad \quad \quad} \\
 0 \quad 1 \quad 0 \quad 0 \cdot 1 \quad 0 \quad 1
 \end{array}$$

Complement      10's Comp.

Decimal  $(\ )_{10}$

$\xrightarrow{9's \text{ Comp.}}$        $\xrightarrow{10's \text{ Comp.}}$

Ex.  $(6923)_{10} \rightarrow (?)_{9's \text{ comp.}}$

$(3076)_{9's \text{ comp.}}$

$$\begin{array}{r}
 \overline{3 \ 0 \ 7 \ 7} \rightarrow 10's \text{ Comp} \\
 \rightarrow (?)_{10's \text{ comp.}}
 \end{array}$$

①  $(?)_{9's \text{ comp}} + 1$

②  $(6923)_{10} \rightarrow (?)_{10's \text{ comp.}}$

3077 ✓

④

$$(375 \cdot 600)_{10} \rightarrow (?)_{10 \text{ comp.}}$$

$$(624 \cdot 399)_{10 \text{ comp.}} \\ \begin{array}{r} 00000001+ \\ \hline \end{array}$$

$$\overline{(624 \cdot 400)_{10 \text{ comp.}}}$$

$$(375 \cdot 600)_{10} \rightarrow (?)_{10 \text{ comp.}}$$

$$(624 \cdot 400)$$

Binary  $( )_2$

1's Comp.

2's Comp.

$$(1011 \cdot 011)_2$$

$\hookrightarrow 1's \text{ Comp.} + 1$

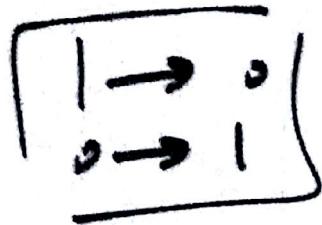
$$\overline{(01000 \cdot 100)_{10 \text{ comp.}}}$$

$\hookrightarrow \#$

$$(01011111)_2$$

$$(0101000000)_{10 \text{ comp.}}$$

\* in 1's Comp.



\* 2's Comp.  $\rightarrow$  1's Comp. + 1

10111.011

↳ 1's Comp. =

$$\begin{array}{r} 01000:100 \\ \hline 01000.101 \leftarrow 2's \text{ Comp.} \end{array}$$

10111.011



→ ممدوحة بعد أول حاصل  
(نسبة بكل المسبق (هـ) ودخول ممدوحة  
لـ 1's Comp.)

01000.101

$$(10101/100)_2$$

$$01010 + 00 \leftarrow 2's \text{ Comp.}$$



\* Subtraction methods:

- 1) Direct
- 2) 1's Comp.
- 3) 2's Comp.

$(\ )_2 \rightarrow (\ )_{10} \rightarrow \text{index}$

$$\begin{array}{ccccccc} 1 & 0 & 1 & 1 & 1 & 0 & 1 \\ 128 & 64 & 32 & 16 & 8 & 4 & 2 & 1 \\ 2^7 & 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \\ (1011101)_2 & & & & & & & \end{array}$$

$$(1 * 2^7) + 2^7 + 2^5 + 2^4 + 2^3 + 2^1 + \textcircled{2}^0 + 2^{-1} + 2^{-2} + 2^{-4}$$

$(\ . \ -)_{10}$

$$128 + 32 + 16 + 8 + 2 + 1$$

$$\begin{array}{cccccc} 2^3 & \overline{8} & 4 & 2 & 1 & 2^{-1} \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 2^3 & 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} \\ (101101)_2 & & & & & \end{array}$$

$$8 + 2 + 1 + \frac{1}{2}$$

(11.5)

8.1

$(\ )_2 \rightarrow (\ )_{10} \rightarrow \text{index}$

$$\begin{array}{ccccccc} 1 & 2 & 8 & 3 & 6 & 4 & 3 \\ 2 & 2 & 2 & 2 & 2 & 2 & 2 \\ 1 & 0 & 1 & 1 & 0 & 1 & 1 \\ (1 & 0 & 1 & 1 & 0 & 1 & 1) \\ \downarrow & & & & & & \end{array}_2$$

$$(1 * 2^7) + 2^7 + 2^5 + 2^4 + 2^3 + 2^1 + 2^{-4} + 2^{-2} + 2^{-1}$$

$$(\underline{\quad \cdot \quad})_{10}$$

$$128 + 32 + 16 + 8 + 2 + 1$$

$$\begin{array}{ccccc} 2^3 & \overline{8 & 4 & 2 & 1} & 2^{-1} \\ 1 & 0 & 1 & 1 & 1 \end{array}$$

$$8 + 2 + 1 + \frac{1}{2}$$

$$(11.5)$$

8.1

2's Comp.

1100.11 - 0111.10

$$\begin{array}{r}
 1100.11 \\
 + 1000.10 \\
 \hline
 \cancel{0}101.01
 \end{array}$$

discard

the verification:

10's Comp.

$$\begin{array}{r}
 12.75 \rightarrow 12.75 \\
 - 07.50 \rightarrow + 92.50 \\
 \hline
 \cancel{0}5.25
 \end{array}$$

10's Comp.

$$\begin{array}{r}
 -9 -9 -10 \\
 07.50 \\
 92.50 \\
 \hline
 10's Comp.
 \end{array}$$

$$\begin{array}{r}
 0111.10 \\
 2's Comp \rightarrow 1000.10
 \end{array}$$

$$\begin{array}{r}
 0111.10 \\
 1000.01
 \end{array}$$

$$\begin{aligned}
 \text{The result} &= -1^{\text{st}} \text{ comp. of } (1010 \cdot 10) \\
 &\quad (-0101 \cdot 01) \\
 &= -5.25
 \end{aligned}$$

## The sterilization (9's comp.)

$$\begin{array}{r}
 07.50 \\
 + 87.24 \\
 \hline
 94.74
 \end{array}$$

The result =

$$\begin{array}{r}
 12.75 \\
 - 9.9 \\
 \hline
 2.75
 \end{array}$$

$-9.9$  Comp. of  
 $(94.74)$

$\Rightarrow 87.24 - 05.25$

$9.9$  Comp.

2's Comp.

0111.10 - 1100.11

$$\begin{array}{r} \text{2's Comp.} \\ \hline 0111.10 \\ + 0011.01 \\ \hline 1010.11 \end{array}$$

0011.01  
2's Comp

→ The result = - 2's Comp. of (1010.11)  
= - 0101.01  
- 5.25

The verification using 10's Comp

$$\begin{array}{r} 07.50 \rightarrow 07.50 \\ - 12.75 \\ \hline 87.25 \end{array}$$

12.75  
- 10

87.25  
10's Comp.  
(- 05.25)

94.75  
The result = - 10's Comp.  
(89.75)

\* Addition

\* Subtraction.

Direct

Sub - Ans  
→

Verify by  
Decimal

10's Comp.

Verification (9's  
Comp.)

+ 10's Comp.

~~11~~ → 1 +

2's Comp.

Verification  
(10's Comp.)

+ 2's Comp

~~11~~

int - int

Direct

Decim.

.....

1's Comp.

+ 1's Comp

9's Comp.

↳ The result =  
- 1's Comp.

2's Comp

10's Comp.

+ 2's Comp

↳ The result = - 2's Comp. 01

(14)

\* Subtract       $0111 \cdot 10 - 1100.11$

$$7.5 - 12.75$$

$$= -5.25$$

Direct

$$\begin{array}{r} 0\overset{2}{1}\overset{2}{1} \\ 0111 \cdot X 0 \\ - 1100.11 \\ \hline \cancel{X} 010.11 \end{array}$$

The verification

$$\begin{array}{r} 0111 \cdot 10 \\ - 0111 \cdot 11 \\ \hline - 101.01 \end{array} \rightarrow \begin{array}{r} 07.50 \\ - 12.75 \\ \hline - 5.25 \end{array}$$

\* Subtract

$$867.125 - 932.610$$

using 9's Comp., 10's Comp.

+ 9's Comp.

$$\begin{array}{r} 867.125 \\ + 067.389 \\ \hline 934.514 \end{array}$$

$$\begin{array}{r} .9.9.9 \quad .9.9.9 \\ 932.610 \\ \hline 067.389 \end{array}$$

→ \* the result =  
- 9's Comp. of  $(\begin{array}{r} .9.9.9 \quad .9.9.9 \\ 934.514 \\ -065.485 \end{array})$

\* 10's Comp

$$\begin{array}{r} 867.125 \\ + 067.390 \\ \hline 934.515 \end{array}$$

$$\begin{array}{r} 10's Comp \\ .9.9.9 \quad .9.9.9 \\ 932.610 \\ \hline 067.390 \end{array}$$

→ the result = - 10's Comp. of  $(\begin{array}{r} .9.9.9 \quad .9.9.9 \\ 934.515 \\ -065.485 \end{array})$

(15)