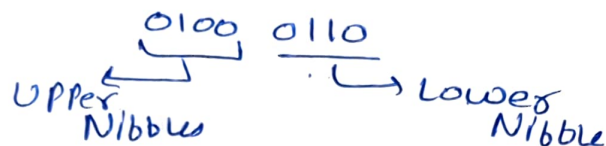


Addition in BCD

→ Groups of 4-bits ^{in BCD} are called Nibbles



Auxiliary carry : carry Generated from the LN to the UN

Rules of BCD Addition

① If $LN > 9$ & $AC = 0$
Then add '6' to the Result

Ex

$$\begin{array}{r} (46)_{10} \rightarrow 0100 \ 0110 \\ + (47)_{10} \quad 0100 \ 0111 \\ \hline (93)_{10} \quad 8 \leftarrow 1000 \ 1101 \rightarrow 13 \\ \quad \quad \quad 0000 \ 0110 \quad \downarrow \\ \quad \quad \quad 1001 \ 0011 \quad LN > 9 \\ \quad \quad \quad \quad \quad \quad AC \quad \quad \quad AC = 0 \end{array}$$

Add '6'

② If $LN < 9$ & $AC = 1$
Then Add '6' to the result

$$\begin{array}{r} (28)_{10} \\ + (29)_{10} \\ \hline (57) \end{array}$$

$$\begin{array}{r} \quad \quad \quad \leftarrow AC \\ 0010 \ 1000 \\ 0010 \ 1001 \\ \hline 0101 \ 0001 \\ \quad \quad \quad 0000 \ 0110 \quad AC = 1 \\ \hline 0101 \ 0111 \end{array}$$

⇒ If $(LN > 9 \ \& \ AC = 0 \ || \ LN < 9 \ \& \ AC = 1)$
then add '6' to the result (0110)

⇒ Why add '6' → BCD → 4 bits, range 0..15
So, ~~and~~ there is a gap of 6 from 9 to 15:

Binary Subtraction (9's complement) ~~1's complement~~

- ① Take the (1's) 9's complement for subtrahend
- ② Add it to the minuend using BCD Addition
- ③ If the result is invalid BCD (i.e. greater than 9) correct it by Adding 6.
- ④ Shift the carry to the next bits (nibble)
- ⑤ If end carry is generated, then add it to the result.

eg, $98.3 - 81.2$ → subtrahend

$98.3 - 18.7$ → 9's complement

\downarrow → point

$0001, 1000, 0111$

Then, using BCD Addition

$$98.3 \rightarrow 1001, 1000, 0011$$

→

$$\begin{array}{r} 1001 \ 1000.0011 \\ + 0001 \ 1000.0111 \\ \hline 1010 \ 0000.1010 \end{array}$$

invalid

\swarrow Incorrect
 \searrow Correct but carry

$0110 \ 0110.0110$

Add 6/
(0110) →

$$\begin{array}{r} 10000.0110.0000 \\ \downarrow \text{carry} \quad \downarrow \text{carry} \quad \downarrow \text{carry} \\ \hline \end{array}$$

$$\boxed{0001 \ 0111.0001} = \text{Answer}$$

10's complement / 2's complement

Last
step

① ^{EOC}
if carry : Discard the carry, the
result is +ve & valid

② if No EOC : ~~Result~~ Result is -ve & consider
the 10's complement
of the result to get the
number.