

Arithmetic operations(addition)

octal addition

$$\begin{array}{r}
 (533.44)_8 \text{ to } (471.62)_8 \\
 \downarrow \qquad \qquad \downarrow \\
 \text{Addend} \qquad \qquad \text{Augend} \\
 \begin{array}{r}
 \text{Carry} \rightarrow 1 \quad 1 \quad 10 \\
 533.44 \\
 + 471.62 \\
 \hline
 (1225.26)_8 \checkmark
 \end{array}
 \end{array}$$

② $(B6)_{16}$ to $(32)_{10}$ Perform octal addition

$$(B6)_{16} = ()_8$$

⑪

Hexadecimal to octal

① each Hexa digit represented by 4 bit binary

$$\begin{array}{c}
 010110110 \\
 \leftarrow \quad \leftarrow \quad \leftarrow \\
 \text{Convert} \quad (266)_8 \\
 \text{octal}
 \end{array}$$

$$(32)_{10} = (40)_8$$

$$\begin{array}{r}
 8 \overline{) 32} \\
 \underline{40} \\
 40
 \end{array}$$

$$\begin{array}{r}
 \text{Carry} \rightarrow 1 \quad 10 \\
 266 \\
 + 40 \\
 \hline
 326 \checkmark
 \end{array}$$

③ $(456.7B)_{16}$ to $(24.A6)_{16}$

Carry \rightarrow $\begin{array}{r} 1 \quad 1 \\ 456.7B \\ 24.A6 \\ \hline 47B.21 \end{array}$ ✓

$16 \overline{) 18}$ Carry
 $1 \rightarrow 2$ Sum
 $(18)_{10} = (12)_{16}$

$16 \overline{) 17}$ Carry \rightarrow 1 Sum
 $(17)_{10} = (11)_{16}$

Binary addition (Rules)

(A) Addend	(B) Augend	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0 ✓	1 ✓

$1+1=(2)_{10}$
 MSB LSB
 $(10)_2$
 ↑ ↑
 Carry Sum

$1+1=2$
 $= 10$
 ↑ ↑
 Carry Sum

Binary Subtraction

- ① Direct subtraction ✓
- ② Complement subtraction

Binary Subtraction (Direct subtraction)

A Minuend	B Subtrahend	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

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

subtract $(27)_{10} - (21)_{10}$ using binary

$$\begin{array}{r} (27)_{10} = 11011 \\ - (21)_{10} = 10101 \\ \hline (6)_{10} = (00110)_2 \end{array}$$

unsigned binary numbers maximum range is 0 to 2^{n-1} ✓

for $n = 8 \text{ bit} \Rightarrow 0 \text{ to } 255$

$(r-1)$'s Complement numbers maximum range

$$-(2^{n-1}-1) \text{ to } +(2^{n-1}-1)$$

$$\begin{array}{l} r = 10 \\ r-1 = 9 \end{array}$$

for 8 bit $\Rightarrow -127 \text{ to } +127$

$$\begin{array}{l} r = 8 \\ r-1 = 7 \end{array}$$

r 's Complement numbers maximum range

$$-(2^{n-1}) \text{ to } +(2^{n-1}-1)$$

for 8 bit $\Rightarrow -128 \text{ to } +127$