binary - base 2 - 0 1

decimal - base 10 - 0 1 2 3 4 5 6 7 8 9

987

9 | 8 | 7

hundreds tens ones

-1 0 1

1010_2

binary

octal 8

decimal 10

hexadecimal 16

eights	fours	twos	ones
1	0	1	0

$1010_2 = 10_{10}$

byte

$2^7=128$	$2^6=64$	$2^5=32$	$2^4=16$	$2^3=8$	$2^2=4$	$2^1=2$	$2^0=1$
0	0	0	0	1	0	1	0
7	6	5	4	3	2	1	0

$2^7 = 128 \cdot 0 = 0$

$2^3 = 8 \cdot 1 = 8$

$2^2 = 4 \cdot 0 = 0$

$2^6 = 64 \cdot 0 = 0$
$2^5 = 32 \cdot 0 = 0$
$2^4 = 16 \cdot 0 = 0$

$2^1 = 2 \cdot 1 = 2$
$2^0 = 1 \cdot 0 = 0$

$2^7=128$	$2^6=64$	$2^5=32$	$2^4=16$	$2^3=8$	$2^2=4$	$2^1=2$	$2^0=1$
1	1	1	1	1	1	1	1
7	6	5	4	3	2	1	0

$2^7 = 128 \cdot 1 = 128$
$2^6 = 64 \cdot 1 = 64$
$2^5 = 32 \cdot 1 = 32$
$2^4 = 16 \cdot 1 = 16$

$2^3 = 8 \cdot 1 = 8$
$2^2 = 4 \cdot 1 = 4$
$2^1 = 2 \cdot 1 = 2$
$2^0 = 1 \cdot 1 = 1$

$128 + 64 = 192$

$192 + 32 = 224$

$224 + 16 = 240$

$240 + 8 = 248$

$248 + 4 = 252$

$252 + 2 = 254$

$254 + 1 = 255$

128	64	32	16	8	4	2	1
0	1	0	1	1	0	1	0

64
16
8
2

133/2 = 63 r 1
63 · 2 = 12

63
| 264 1=

a r
132/2 = 66 r 0
66/2 = 33 r 0
33/2 = 16 r 1
16/2 = 8 r 0
8/2 = 4 r 0

4/2 = 2 r 0
2/2 = 1 r 0
1/2 = 0 r 1

10000160

128 64 32 16 8 4 2 1
1 0 0 0 0 1 0 0

$5/2 = 2 \text{ r } 1$

$2/2 = 1 \text{ r } 0$

$1/2 = 0 \text{ r } 1$

4 2 1

1 0 1

4 2 1

$111_2 = 7$

$$\begin{array}{r} 1111 \\ 1010 \\ \hline 10001 \end{array} \qquad \begin{array}{r} 7 \\ 10 \\ \hline 17 \end{array}$$

17

16 8 4 2 1

1 0 0 0 1

$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 111 \\ +\ 111 \\ \hline 1110 \end{array} \qquad \begin{array}{r} 7 \\ +\ 7 \\ \hline 14 \end{array}$$

8	4	2	1
1	1	1	0

Base Ten - Decimal

0 1 2 3 4 5 6 7 8 9

8 eight

Base Two - Binary

0 1 Bit

-2^{31} $2^{31}-1$

2	10
0	0
1	1
10	2
11	3
100	4
101	5
110	6
111	7

hundreds	tens	ones
4	9	7

fours twos ones

$2^7=128$	$2^6=64$	$2^5=32$	$2^4=16$	$2^3=8$	$2^2=4$	$2^1=2$	$2^0=1$
1	0	0	1	1	1	0	1
7	6	5	4	3	2	1	0

$$1001101_2 = 157_{10}$$

$128 \cdot 1$
$+ \cancel{64 \cdot 0}$
$+ \cancel{32 \cdot 0}$
$+ 16 \cdot 1$
$+ 8 \cdot 1$
$+ 4 \cdot 1$
$+ \cancel{2 \cdot 0}$
$+ 1 \cdot 1$

128
16
144
8
152
4
156

156
$+1$
157

$$11100001_2 = 225_{10}$$

$1 \cdot 128$ $\cancel{+ 0 \cdot 6}$

128
64

+1.64
+1.32
~~+0.16~~

~~+0.4~~
~~+0~~2
+1.1

192
32
224
1
225

225_{10} =

q r 2

225/2 = 112 r 1

112/2 = 56 r 0

56/2 = 28 r 0

28/2 = 14 r 0

14/2 = 7 r 0

7/2 = 3 r 1

3/2 = 1 r 1

1/2 = 0 r 1

66.2 = 132

hundreds	tens	ones
2	2	5

twos ones

1 1 1 0 0 0 0 1

1110 0001

$$\begin{array}{r} 0 \\ +0 \\ \hline 0 \end{array} \qquad \begin{array}{r} 1 \\ +0 \\ \hline 1 \end{array} \qquad \begin{array}{r} 0 \\ +1 \\ \hline 1 \end{array} \qquad \begin{array}{r} 1 \\ +1 \\ \hline 10 \end{array}$$

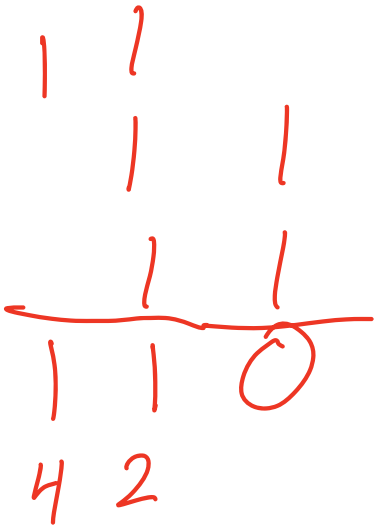
$$\begin{array}{r} 1 \\ 1 \\ +1 \\ \hline 11 \end{array}$$

10 - 2

10 - 2

100 4

$$\begin{array}{rr} 11 & -3 \\ 11 & -3 \\ \hline & 6 \end{array}$$



$$\begin{array}{cccccc} 1 & 1 & 8 & 4 & 2 & 1 \\ & 1 & 1 & 0 & 1 & \cdot \\ & 8 & 4 & 2 & 1 & 0 \\ \hline 1 & 1 & 0 & 1 & 1 & _2 = 27_{10} \\ 16 & 8 & \times & 2 & 1 & \end{array}$$