

Decimal

10^2 10^1 10^0

5 2 4

hundreds tens ones

$$5 \times 100 + 2 \times 10 + 4$$

Binary

2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
0 1 0 1 1 1 0 1

One hundred twenty eight
Sixty four
Thirty two
Sixteen
Eight
Four
Two
One

$$0 \times 128 + 1 \times 64 + 0 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 0 \times 2 + 0 \times 1$$

93

Counting

Decimal is 0-9

Binary is 0-1

0
1
2
3
4
5
6
7
8
9 - 9 ones + 1 = 10 ones
10 1 ten
11
12
13
14
15
16
17
18 1 ten
19 9 ones + 1
20 2 tens

0
1 - no number for 2
so add one to 2s place
10
11 - no number for 2
so add one to 2s
100
101 cant have a 2 in twos
place so add on to 4s
110
111
1000
1001
1010
1011
1100
1101
1101

Converting

Binary to Decimal 00011010

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

— always the same

— fill in yourself

0 + 0 + 0 + 16 + 8 + 0 + 2 + 0 = 26

if 1 in column bring down

Decimal to Binary

70 to binary

70 ²⁰⁻⁶⁴ 6 6 6 6 6 2 0 ^{6-4 2-2} rates
 cant subtract can cant cant cant can can cant

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

~~70-128~~ (70-64) ✓

always the same
 answer

01000110

left to right in chart
 if you can't subtract add 0

if you can add 1

then subtract the numbers and continue

Adding Binary

$$10011110 + 00000101$$

$$\begin{array}{r} 10011110 \\ + 00000101 \\ \hline 10100011 \end{array}$$

Can't have 2 so carry 1

$$\begin{array}{r} 00001111 \\ 00001110 \\ \hline \end{array}$$

$$0001101$$

0
carry one

Can't have 3 instead + 1
2 carry

0 and

Subtracting right to left

$$\begin{array}{r} 101111 \\ - 011010 \\ \hline 100101 \end{array}$$



$$\begin{array}{r} 239 \\ - 58 \\ \hline \end{array}$$

$$\begin{array}{r} 239 \\ - 58 \\ \hline 181 \end{array}$$

Rules $0-0=0$

$1-1=0$

$1-0=1$

$0-1=1$ but need to borrow

$$\begin{array}{r} 1111 \\ 0000 \\ \hline 1111 \end{array}$$

$$\begin{array}{r} 1111 \\ 1110 \\ \hline 0001 \end{array}$$