Number System

Binary, Octal, Decimal & Hexadecimal

Binary Number System-2 (o&1)

The binary system plays an important role in computer technology. Because only two digits (or bits) are involved & any binary number can be represented by the positions of a series of **on-off switches. The "on" position corresponds to a 1 and the "off" position to a 0.** Instead of switches, magnetized dots on a magnetic tape or disk also can be used to represent binary numbers. A magnetized dot stands for the digit 1, and the absence of a magnetized dot is the digit 0.

Any decimal number can be expressed in the binary system by the sum of different powers of two.

Arithmetic operations in the binary system are extremely simple . Addition, subtraction, and multiplication are done in a fashion similar to that of the decimal system.

Octal Number System -8 (0,1,2,3,4,5,6 & 7)

The number system that has only 8 digits is called the Octal Number System.

Decimal Number System -10 (0,1,2,3,4,5,6,7,8 & 9)

The number system that has only 10 digits is called the Decimal Number System.

Hexadecimal Number System -16 (0,1,2,3,4,5,6,7,8,9,A,B,C,D,E & F)

The number system that has only 16 digits is called the hexadecimal Number System (A=10, B=11, C=12, D=13, E=14&F=15)

Conversions Between Number Systems

Binary to Decimal

Convert (Binary) 11001_2 to Decimal

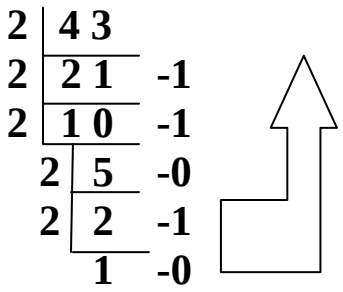
A	**1**		**1**		**0**		**0**		**1**
b	**2^4**		**2^3**		**2^2**		**2^1**		**2^0**
B	**16**		**8**		**4**		**2**		**1**
c	16*1		8*1		4*0		2*0		1*1
C	16		8		0		0		1
d	16 + 8 + 0 + 0 + 1								
D	25								

Answer = 25_{10} (Decimal)

Decimal to Binary

e.g:

Convert (Decimal) 43_{10} to Binary



Answer = 101011_2 (Binary)

Octal to Decimal

e.g:

Convert (Octal) 234_8 to Decimal

A	**2**		**3**		**4**
b **B**	**8^2** **64**		**8^1** **8**		**8^0** **1**
c	**64*2**		**8*3**		**1*4**
C	**128**		**24**		**4**
d	**128**	**+**	**24**	**+**	**4**
D	**156**				

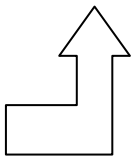
Answer = 156_{10} (Decimal)

Decimal to Octal

e.g:

Convert (Decimal) 239_{10} to Octal

```
8 | 2 3 9
    8 | 2 9   - 7
        3     - 5
```



Answer = 357_8 (Octal)

Binary to Octal

e.g:

Convert (Binary) 10111011_2 to Octal

A	**0**	**1**	**0**		**1**	**1**	**1**		**0**	**1**	**1**
b	2^2	2^1	2^0		2^2	2^1	2^0		2^2	2^1	2^0
B	**4**	**2**	**1**		**4**	**2**	**1**		**4**	**2**	**1**
c	**4*0**	**2*1**	**1*0**		**4*1**	**2*1**	**1*1**		**4*0**	**2*1**	**1*1**
C	**0**	**2**	**0**		**4**	**2**	**1**		**0**	**2**	**1**
d	**2**				**7**				**3**		
D	**273**										

Answer = 273_8 (Octal)

Octal to Binary

e.g:

Convert (Octal) 234_8 to Binary

2 | 2
1 - 0 =010

2 | 3
1 - 1 = 011

2 | 4
2 | 2 - 0
1 - 0 = 100

234		
2	**3**	**4**
010	**011**	**100**
10011100		

Answer = 10011100_2 (Binary)

Hexadecimal to Decimal

e.g :

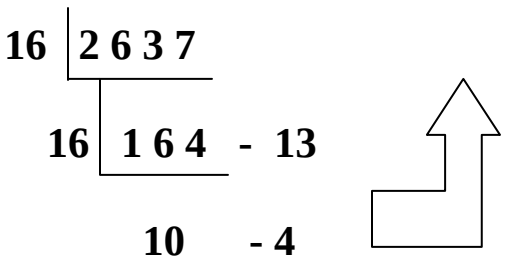
Convert (Hexadecimal) $6A5_{16}$ to Decimal

a **A**	**6** **6**		**A** **10**		**5** **5**
b **B**	**16^2** **256**		**16^1** **16**		**16^0** **1**
c	**256*6**		**16*10**		**1*5**
C	**1536**		**160**		**5**
d	**1536**	**+**	**160**	**+**	**5**
D	**1701**				

Answer = 1701_{10} (Decimal)

Decimal to Hexadecimal

e.g:
Convert (Decimal) 2637_{10} to Hexadecimal



Answer = $A4D_{16}$ (Hexadecimal)

Binary to Hexadecimal

e.g:

Convert (Binary) 11010100101_2 to Hexadecimal

	0110				1010				0101			
A	0	1	1	0	1	0	1	0	0	1	0	1
b B	2^3 8	2^2 4	2^1 2	2^0 1	2^3 8	2^2 4	2^1 2	2^0 1	2^3 8	2^2 4	2^1 2	2^0 1
c	8*0	4*1	2*1	1*0	8*1	4*0	2*1	1*0	8*0	4*1	2*0	1*1
C	0	4	2	0	8	0	2	0	0	4	0	1
d	0 + 4 + 2 + 0				8 + 0 + 2 + 0				0 + 4 + 0 + 1			
D	6				10				5			

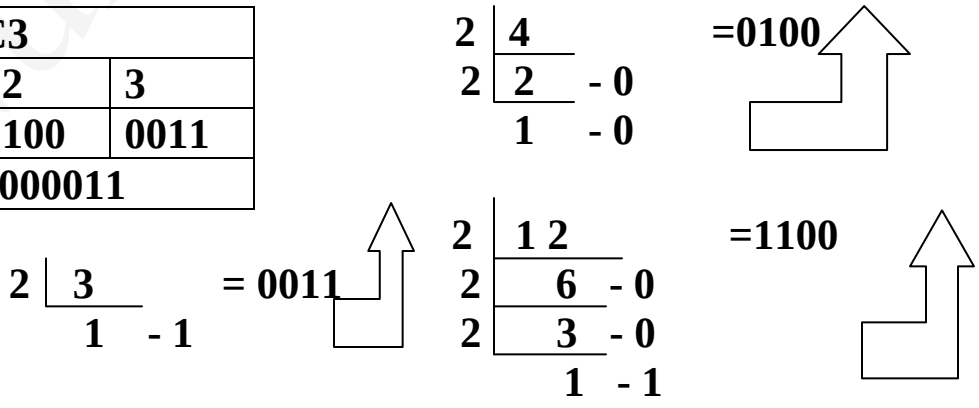
Answer = $6A5_{16}$ (Hexadecimal)

Hexadecimal to Binary

e.g:

Convert (Hexadecimal) $4C3_{16}$ to Binary

4C3		
4	12	3
0100	1100	0011
10011000011		



Answer =10011000011_2 (Binary)

Addition

- **0 + 0 = 0**
- **0 + 1 = 1**
- **1 + 0 = 1**
- **1 + 1 = 10**
- **1 + 1 + 1 = 11**
- **1 + 1 + 1 + 1 = 100**
- **1 + 1 + 1 + 1 + 1 = 101**
- **1 + 1 + 1 + 1 + 1 + 1 = 110**
- **1 + 1 + 1 + 1 + 1 + 1 + 1 = 111**
- **1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 1000**
- **1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 =1001**

1111	10111	1111	1111	1010
+ 11	+ 101	+111	+101	+100
10010_2	11100_2	10110_2	10100_2	1110_2

Subtraction

- **0 - 1 = 0**
- **1 - 0 = 1**
- **1 - 1 = 0**
- **10 - 1 = 1**

10	11	1	111	101
- 1	-10	-1	-100	- 11
1_2	01_2	0_2	011_2	010_2