

The Numbering System.

Computer is work and known only one language and the language is **Binary**. binary language have only two digits (**0 and 1**).

Question: so how computer can recognize which key we pressed?

Answer: is magic code the **ASCII**.

The ASCII Code

Binary supports only digits (0 and 1) but the humans understand human readable languages like English, hindi, gujarati and etc. so the characters of language need to be converted in some numbers. All the character are mapped with some unique number and the existing and mostly used system is ASCII.

Full form of ASCII is **American standard code for information interchange**.

Total ASCII Code is 256 and range of ASCII is (0 – 255)

All the characters are mapped with pre-defined ASCII number.

Example.

A = 65 B = 66

a = 97 b = 98

To get the character of specific number use text editors like notepad, Microsoft word and just type ASCII code with **alt**. release the key and you get the character.

Currently we are using four numbering system.

Sr.	Name	Base	Range
1	Binary	2	0 – 1
2	Octal	8	0 – 7
3	Decimal	10	0 – 9
4	Hex Decimal	16	0 – F

- Base means total numbers available in numbering system.
- Largest number is 9.
- Human are used decimal numbering system for general works and calculations.
- Other numbering systems used by computers and machines.

Important

Always write the numbers in **() base** format, because without the base we are not able to recognize correct numbering system.

Example.

100 ← wrong 154 ← wrong
298 ← wrong

(254)₈

← correct

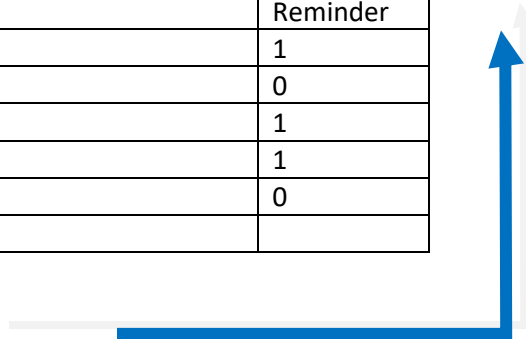
(1010)₂

← correct

To convert any number to another number just divides the number with base of required number system. and array of remainder is answer.

For example convert 45 in decimal to binary. So we required output in binary than we want to divide number with 2 (**base of binary**).

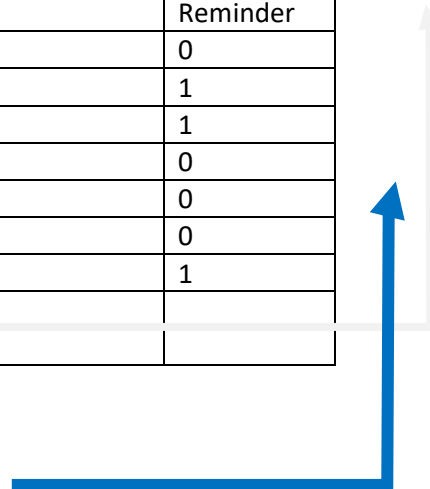
Divide by	Value	Reminder
2	45	1
2	22	0
2	11	1
2	05	1
2	02	0
	1	



Binary of 45 is (101101)

Another Example Convert 198 decimal to binary

Divide by	Value	Reminder
2	198	0
2	099	1
2	049	1
2	024	0
2	012	0
2	006	0
2	003	1
2	1	



Binary of 198 is 11000110

Another way to convert in binary is just values is divide by 2 and put 1 if number is odd or 0 if even.

Example:

1	2	4	8	16	32	64	128	256	512
1	0	0	0	0	0	0	0	0	0

So binary of 512 is 100000000.

Another example

1	2	4	9	18	36	72	145	291	583
1	0	0	1	0	0	0	1	1	1

Convert binary to decimal.

To convert from binary to decimal is done with multiple the value with base of binary and give the power of n^{th} position.

Example 1010110 to decimal

Power	6	5	4	3	2	1	0
Number	$1*2$	$0*2$	$1*2$	$0*2$	$1*2$	$1*2$	$0*2$
Answer	64	0	16	0	4	2	0
Answer is :							86

Another example binary number is : 110010001

Power	8	7	6	5	4	3	2	1	0
Number	$1*2$	$1*2$	$0*2$	$0*2$	$1*2$	$0*2$	$0*2$	$0*2$	$1*2$
Answer	256	128	0	0	16	0	0	0	1
Answer is :									401

Another way to convert binary to decimal is following tricks.

If you noticed the power is always same we just change the as per the availability of 0 and 1. So we can create table of power and value is add in sum if the number is one otherwise skip the values.

Example:

101011001

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	Answer
1024	512	256	128	64	32	16	8	4	2	1	
		1	0	1	0	1	1	0	0	1	345

Practice

Convert Decimal to Binary.

245	198	247	915	1024	775	659	154	554	569
715	659	553	100	154	11	69	254	956	1026

Convert binary to decimal.

1010110	11001	110011101	10010010	11100010	1111101010	110001010	11000	1101010	1110
110010101	11000010	10101101	1000011	11000010	110101110	1100110	11010	10001010	10101

The octal numbers.

Range of octal numbers is 0 to 7

Largest number in octal is 7

Binary of 7 is

2 7 1

2 3 1

2 1

Binary of 7 is 111

2^2 2^1 2^0

4 2 1

Sr.	Decimal	Octal
1	0	000
2	1	001
3	2	010
4	3	011
5	4	100
6	5	101
7	6	110
8	7	111

How to Convert decimal to octal

There are two methods of convert decimal to octal

1 / by 8

2 Binary

Divide by 8

8 24 0

8 3

Octal of 24 is 30

8	144	0
8	18	2
8	2	

Binary method

First you need to convert decimal number in binary. Than group the number in 3 digits.

2	180	0
2	90	0
2	45	1
2	22	0
2	11	1
2	5	1
2	2	0
2	1	

Binary of 180 is **10110100**

Group the answer in 3 bits

010	110	100
2	6	4

Convert octal to decimal

Convert 75 in decimal

7	5
111	101

1024	512	256	128	64	32	16	8	4	2	1	
					1	1	1	1	0	1	= 61

Hex decimal

Range of hex is 0 to F means 0 to 9 , A to F

0 to 9 but A = 10, B = 11 F = 15.

Maximum number is 15 because F = 15

Binary of 15 is

2 15 1
2 7 1
2 3 1
2 1

Binary of 15 is 1111

8 4 2 1

Sr.	Number	Hex	Binary
1	0	0	0000
2	1	1	0001
3	2	2	0010
4	3	3	0011
5	4	4	0100
6	5	5	0101
7	6	6	0110
8	7	7	0111
9	8	8	1000
10	9	9	1001
11	10	A	1010
12	11	B	1011
13	12	C	1100
14	13	D	1101
15	14	E	1110
16	15	F	1111

Convert decimal to hex decimal

16 250 10
16 15

15 10
F A

Convert decimal to binary and binary to hex

2 155 1
2 77 1
2 38 0
2 19 1
2 9 1
2 4 0
2 2 0
2 1

Binary of 155 is 10011011

1001 1011
9 11
9B

Hex to decimal

 F5
 1111 0101
1024 512 256 128 64 32 16 8 4 2 1
 1 1 1 1 0 1 0 1 = 245

Practice:

Decimal to octal

85	86	485	1558	456	915	458	7458	455	326
36	45	48	441	146	215	115	15	54	39

Octal to Decimal

75	65	45	52	10	32	11	5	77	73
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Decimal to Hex

541	115	456	695	141	236	147	169	521	236
658	1025	1554	1459	154	263	95	915	548	569

Hex to decimal

4A	45	98	AFF	F7A	98A	ABD	F5C	C00B	BD1
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