Conversion between Number Systems

Theory

We use positional Number Systems. $N=\sum_{i=n-1}^{i=0} a\,R^i$

Decimal

- Base: 10
- Symbols: 0,1,2,3,4,5,6,7,8,9
- $197_{10} = 1 *10^2+9*10^1+7*10^0$

Binary

- Base: 2
- Symbols: 0,1
- $101_2=1*2^2+0*2^1+1*2^0=5_{10}$

Octal

- Base: 8
- Symbols: 0,1,2,3,4,5,6,7
- Each octal digit is equivalent to three binary digits.

Hexadecimal

- Base: 16
- Symbols: 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F
- Each hexadecimal digit is equivalent to four binary digits.

Decimal	Binario	Octal	Hexa
0	0000	0	0
1	0001	1	1
2	0010	2	2
3	0011	3	3
4	0100	4	4
5	0101	5	5
6	0110	6	6
7	0111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F

Exercise:

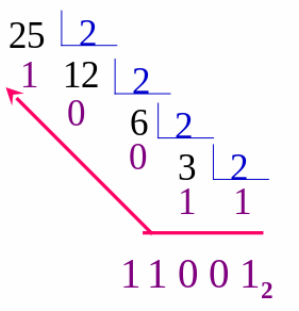
- Why do we use decimal?
- Why do we use binary?
- Why do we use Octal?
- Why do we use Hexadecimal?

Joke:

- There are only 10 kinds of people, those who understand binary and those who don't."

Conversions

- Decimal → Binary
- Octal →Binary
- Hexadecimal → Binary
- Binary → Decimal



Binary Arithmetic

A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	10

When you add two ones, the result is cero and we get a carry.
This is very important when we add numbers with several digits.

$$\begin{array}{rrr} & 011_2 & 3_{10} \\ + & 101_2 & 5_{10} \\ \hline & 1000_2 & 8_{10} \end{array}$$

Example: We add bit by bit, but we have to keep in mind the carry.

Binary Logic

A	B	A AND B	A OR B
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	1

A	NOT A
0	1
1	0

Exercises

1. Convert the following numbers to binary

$49_{(10}=$
$153_{(10}=$
$736_{(8}=$
$428_{(8}=$
$A2E_{(h}=$

2. Convert the following numbers to decimal

$1011_{(2}=$
$126_{(8}=$
$3B_{(16}=$

3. Write the results of the following operations in binary.

$10110_{(2} + 11_{(2}=$ 11001
$4A_{(16} + F1_{(16}=$ 01001010+11110001=100111011

4. Write the results of the following logic operations.

NOT $A_{(h}=$ 0101
$101_{(2}$ AND $010_{(2}=$ 000
$101_{(2}$ OR $010_{(2}=$ 111
$B4_{(16}$ OR $41_{(h}=$ 10110100 or 01000001 = 11110101