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BCA Sem - 2
Computer Organization and Architecture

Conversion of numbers from one number system to another

- **Decimal to Binary and Vice-Versa**
- **Decimal to Octal and Vice-Versa**
- **Decimal to Hexadecimal and Vice-Versa**
- **Octal To Binary and Vice-Versa**
- **Hexadecimal To Binary and Vice-Versa**
- **Octal to Hexadecimal and Vice-Versa**

a) Conversion between binary and decimal number

To convert a binary number to a decimal number, we proceed as follows:

- First, write the place values starting from the right hand side.
- Write each digit under its place value.
- Multiply each digit by its corresponding place value.
- Add up the products. The answer will be the decimal number in base ten.

EXAMPLE

Convert 101101_2 to base 10(or decimal) number

Place value	2^5	2^4	2^3	2^2	2^1	2^0
Binary digits	1	0	1	1	0	1

Multiply each digit by its place value

$$N_{10}=(1 \times 2^5) +(0 \times 2^4)+(1 \times 2^3)+(1 \times 2^2)+(0 \times 2^1)+(1 \times 2^0)$$

N_{10}=32+0+8+4+0+1

=45_{10}

32*1=32

16*0=0

8*1=8 4*1=4

2*0=0

1*1=1

=45_{10}

Converting Decimal to binary

The Process of conversion is :

Divide the decimal number by 2 (base) continuously by keeping the remainder and making the quotient as divide number till the quotient be zero. Finally arrange all remainder in most coming series .

For example

	Number as quotient	remainder
	13	
2	6	1
2	3	0
2	1	1
2	0	1

$(13)_{10}$ - $(1101)_2$

Alternative Method

Find the fraction of the given number in the power of 2 so that sum of all fraction should be the number . put 1 against the fractional(Power of 2) value used in creating decimal number otherwise put 0 (zero).

for example :

$(13)_{10}$ - 8 + 4 + 0 + 1

- $1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

- $(1101)_2$

b) Converting Decimal to octal :

Divide the decimal number by 8 (base) continuously by keeping the remainder and making the quotient as divide number till quotient be zero. Finally arrange all remainder in most coming series .

For example

	Number as quotient	remainder
	98	
8	12	2
8	1	4
8	0	1

$(98)_{10} \rightarrow (142)_8$

Octal to decimal :

Find sum of multiplication of each digit and Place value (power of 8 : starting from 0 to n-1) of octal number . where n is the place number of the octal number digit . result will be the decimal number.

i.e

$$(N)_{10} = \sum od \times 8^{n-1}$$

Example :-

$(567)_8 = 7 \times 8^0 + 6 \times 8^1 + 5 \times 8^2 = 7 + 48 + 320 = (375)_{10}$

c) Decimal to Hexadecimal :

Divide the decimal number by 16 (base) continuously by keeping the remainder and making the quotient as divide number till the quotient be zero. Finally arrange all remainder in most coming series .

For example

	Number as quotient	remainder
	1981	
16	123	13
16	7	11
16	0	7

$(1981)_{10} \rightarrow (7\ 11\ 13)_{16} = (7BD)_{16}$

Hexadecimal to decimal :

Find sum of multiplication of each digit and Place value (power of 16 : starting from 0 to n-1) of octal number . where n is the place number of the octal number digit . result will be the decimal number.

i.e

$$(N)_{10} = \sum hd \times 16^{n-1}$$

Example :-

$(568)_{16} = 8 \times 16^0 + 6 \times 16^1 + 5 \times 16^2 = 8 + 96 + 1280 = (1384)_{10}$

d) Conversion octal to Binary :

Convert each octal digit into 3-bit binary number the resultant binary bit combination will be the binary value of octal number.

Example:

$(675)_8 = (6\ 7\ 5)_8 = (110\ 111\ 101)_2$

Conversion of Binary to Octal :

Group the binary digit in combination of three bit from right most bit, then convert each group of bit in corresponding octal digit. The resultant will be Octal Number .

$(11\ 110\ 111\ 101)_2 = (\underline{11}\ \underline{110}\ \underline{111}\ \underline{101})_2 = (3\ 6\ 7\ 5)_8$

e) Conversion Hexadecimal to binary

Convert each Hexadecimal digit into 4-bit binary number from right side ,the resultant binary bit combination will be the binary value of Hexadecimal number number.

Example

$(6A5D)_{16}$ = (6 A 5 D) $_{16}$ = $(0110\ 1010\ 0101\ 1101)_2$

Conversion of Binary to Hexadecimal :

Group the binary digit in combination of four bit from right left most bit, then convert each group of bit in corresponding Hexadecimal digit. The resultant will be Hexadecimal Number .

$(11\ 110\ 111\ 101)_2$ = $(\underline{0111}\ \underline{1011}\ \underline{1101})_2$ = $(7\ B\ B)_{16}$

f) **Conversion of Hexadecimal to Octal**

The Simplest way to Convert Hexadecimal to Octal is

Hexadecimal → Binary → Octal

Example :

$(7\ B\ B)_{16}$ → $(\underline{0111}\ \underline{1011}\ \underline{1101})_2$ →$(0\underline{11}\ \underline{110}\ \underline{111}\ \underline{101})_2$→ $(3\ 6\ 7\ 5)_8$

Similarly

Octal to Hexadecimal

Octal → Binary → Hexadecimal

$(3\ 6\ 7\ 5)_8$ →$(0\underline{11}\ \underline{110}\ \underline{111}\ \underline{101})_2$→ $(\underline{0111}\ \underline{1011}\ \underline{1101})_2$ → $(7\ B\ B)_{16}$