COMPUTER - NUMBER CONVERSION

There are many methods or techniques which can be used to convert numbers from one base to another. We'll demonstrate here the following:

- Decimal to Other Base System
- Other Base System to Decimal
- Other Base System to Non-Decimal
- Shortcut method - Binary to Octal
- Shortcut method - Octal to Binary
- Shortcut method - Binary to Hexadecimal
- Shortcut method - Hexadecimal to Binary

Decimal to Other Base System

steps

- **Step 1 -** Divide the decimal number to be converted by the value of the new base.
- **Step 2 -** Get the remainder from Step 1 as the rightmost digit *leastsignificantdigit* of new base number.
- **Step 3 -** Divide the quotient of the previous divide by the new base.
- **Step 4 -** Record the remainder from Step 3 as the next digit *totheleft* of the new base number.

Repeat Steps 3 and 4, getting remainders from right to left, until the quotient becomes zero in Step 3.

The last remainder thus obtained will be the most significant digit *MSD* of the new base number.

Example

Decimal Number : 29_{10}

Calculating Binary Equivalent:

Step	Operation	Result	Remainder
Step 1	29 / 2	14	1
Step 2	14 / 2	7	0
Step 3	7 / 2	3	1
Step 4	3 / 2	1	1
Step 5	1 / 2	0	1

As mentioned in Steps 2 and 4, the remainders have to be arranged in the reverse order so that the first remainder becomes the least significant digit *LSD* and the last remainder becomes the most significant digit *MSD*.

Decimal Number : 29_{10} = Binary Number : $11101_{2.}$

Other base system to Decimal System

Steps

- **Step 1 -** Determine the column *positional* value of each digit *thisdependsonthepositionofthedigitandthebaseofthenumbersystem*.
- **Step 2 -** Multiply the obtained column values *inStep*1 by the digits in the corresponding columns.
- **Step 3 -** Sum the products calculated in Step 2. The total is the equivalent value in decimal.

Example

Binary Number : 11101_2

Calculating Decimal Equivalent:

Step	Binary Number	Decimal Number
Step 1	11101_2	$((1 \times 2^4) + (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0))_{10}$
Step 2	11101_2	$16 + 8 + 4 + 0 + 1_{10}$
Step 3	11101_2	29_{10}

Binary Number : 11101_2 = Decimal Number : 29_{10}

Other Base System to Non-Decimal System

Steps

- **Step 1 -** Convert the original number to a decimal number *base*10.
- **Step 2 -** Convert the decimal number so obtained to the new base number.

Example

Octal Number : 25_8

Calculating Binary Equivalent:

Step 1 : Convert to Decimal

Step	Octal Number	Decimal Number
Step 1	25_8	$((2 \times 8^1) + (5 \times 8^0))_{10}$
Step 2	25_8	$16 + 5_{10}$
Step 3	25_8	21_{10}

Octal Number : 25_8 = Decimal Number : 21_{10}

Step 2 : Convert Decimal to Binary

Step	Operation	Result	Remainder

Step 1	21 / 2	10	1
Step 2	10 / 2	5	0
Step 3	5 / 2	2	1
Step 4	2 / 2	1	0
Step 5	1 / 2	0	1

Decimal Number : 21_{10} = Binary Number : 10101_2

Octal Number : 25_8 = Binary Number : 10101_2

Shortcut method - Binary to Octal

Steps

- **Step 1 -** Divide the binary digits into groups of three *startingfromtheright*.
- **Step 2 -** Convert each group of three binary digits to one octal digit.

Example

Binary Number : 10101_2

Calculating Octal Equivalent:

Step	Binary Number	Octal Number
Step 1	10101_2	010 101
Step 2	10101_2	2_8 5_8
Step 3	10101_2	25_8

Binary Number : 10101_2 = Octal Number : 25_8

Shortcut method - Octal to Binary

Steps

- **Step 1 -** Convert each octal digit to a 3 digit binary number *theoctaldigitsmaybetreatedasdecimalforthisconversion*.
- **Step 2 -** Combine all the resulting binary groups *of*3*digitseach* into a single binary number.

Example

Octal Number : 25_8

Calculating Binary Equivalent:

Step	Octal Number	Binary Number

Step 1	25_8	$2_{10}\ 5_{10}$
Step 2	25_8	$010_2\ 101_2$
Step 3	25_8	010101_2

Octal Number : 25_8 = Binary Number : 10101_2

Shortcut method - Binary to Hexadecimal

Steps

- **Step 1 -** Divide the binary digits into groups of four *startingfromtheright*.
- **Step 2 -** Convert each group of four binary digits to one hexadecimal symbol.

Example

Binary Number : 10101_2

Calculating hexadecimal Equivalent:

Step	Binary Number	Hexadecimal Number
Step 1	10101_2	0001 0101
Step 2	10101_2	$1_{10}\ 5_{10}$
Step 3	10101_2	15_{16}

Binary Number : 10101_2 = Hexadecimal Number : 15_{16}

Shortcut method - Hexadecimal to Binary

steps

- **Step 1 -** Convert each hexadecimal digit to a 4 digit binary number *thehexadecimaldigitsmaybetreatedasdecimalforthisconversion*.
- **Step 2 -** Combine all the resulting binary groups *of4digitseach* into a single binary number.

Example

Hexadecimal Number : 15_{16}

Calculating Binary Equivalent:

Step	Hexadecimal Number	Binary Number
Step 1	15_{16}	$1_{10}\ 5_{10}$
Step 2	15_{16}	$0001_2\ 0101_2$
Step 3	15_{16}	00010101_2

Hexadecimal Number : 15_{16} = Binary Number : 10101_2