number to the right of the hexadecimal point is referred to as the fractional part.

In this number system, the successive positions to the left of the Hexa-decimal point having weights of 16^0, 16^1, 16^2, 16^3 and so on. Similarly, the successive positions to the right of the Hexa-decimal point having weights of 16^{-1}, 16^{-2}, 16^{-3} and so on. That means, each position has specific weight, which is **power of base 16**.

Example

Consider the **Hexa-decimal number 1A05.2C4**. Integer part of this number is 1A05 and fractional part of this number is 0.2C4. The digits 5, 0, A and 1 have weights of 16^0, 16^1, 16^2 and 16^3 respectively. Similarly, the digits 2, C and 4 have weights of 16^{-1}, 16^{-2} and 16^{-3} respectively.

Mathematically, we can write it as

$1A05.2C4 = (1 \times 16^3) + (10 \times 16^2) + (0 \times 16^1) + (5 \times 16^0) + (2 \times 16^{-1}) +$

$(12 \times 16^{-2}) + (4 \times 16^{-3})$

After simplifying the right hand side terms, we will get a decimal number, which is an equivalent of Hexa-decimal number on left hand side.

0.25 x 2	0.5	0
0.5 x 2	1.0	1
-	0.0	-

$$\Rightarrow .25.25_{10} = .01.01_2$$

Therefore, the **fractional part** of equivalent binary number is **.01**

$$\Rightarrow 58.2558.25_{10} = 111010.01111010.01_2$$

Therefore, the **binary equivalent** of decimal number 58.25 is 111010.01.

Decimal to Octal Conversion

The following two types of operations take place, while converting decimal number into its equivalent octal number.

- Division of integer part and successive quotients with base 8.
- Multiplication of fractional part and successive fractions with base 8.

Example

Consider the **decimal number 58.25**. Here, the integer part is 58 and fractional part is 0.25.

Step 1 – Division of 58 and successive quotients with base 8.

Operation	Quotient	Remainder
58/8	7	**2**

Binary Number to other Bases Conversion

The procedure for converting a binary number to another base, such as decimal, is distinct from that for translating a binary number to decimal. Let's now talk about how to convert a binary number to the decimal, octal, and hexadecimal number systems, one at a time.

Binary to Decimal Conversion

For converting a binary number into its equivalent decimal number, first multiply the bits of binary number with the respective positional weights and then add all those products.

Example

Consider the **binary number 1101.11**.

Mathematically, we can write it as

$1101.111101.11_2 = (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) + (1 \times 2^{-1}) +$

(1×2^{-2})

$\Rightarrow 1101.111101.11_2 = 8 + 4 + 0 + 1 + 0.5 + 0.25 = 13.75$
$\Rightarrow 1101.111101.11_2 = 13.7513.75_{10}$

Therefore, the **decimal equivalent** of binary number 1101.11 is 13.75.

Binary to Octal Conversion

We know that the bases of binary and octal number systems are 2 and 8 respectively. Three bits of binary number is equivalent to one octal digit, since $2^3 = 8$.

Example

Consider the **decimal number 108**. The binary equivalent of this number is **1101100**. This is the representation of unsigned binary number.

$$108108_{10} = 11011001101100_2$$

It is having 7 bits. These 7 bits represent the magnitude of the number 108.

Representation of Signed Binary Numbers

The Most Significant Bit MSBMSB of signed binary numbers is used to indicate the sign of the numbers. Hence, it is also called as **sign bit**. The positive sign is represented by placing '0' in the sign bit. Similarly, the negative sign is represented by placing '1' in the sign bit.

If the signed binary number contains 'N' bits, then N−1N−1 bits only represent the magnitude of the number since one bit MSBMSB is reserved for representing sign of the number.

There are three **types of representations** for signed binary numbers

- Sign-Magnitude form
- 1's complement form
- 2's complement form

Representation of a positive number in all these 3 forms is same. But, only the representation of negative number will differ in each form.

Example