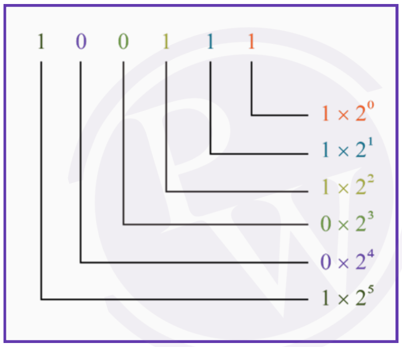
Hexadecimal Number System
The hexadecimal number system uses 16 numbers/alphabets: 0,1,2,3,4,5,6,7,8,9 and A,B,C,D,E,F (base number 16). Here, A-F of the hexadecimal digits represent the 10-15 decimal number system respectively. This system is used by computers to shorten large binary system strings.

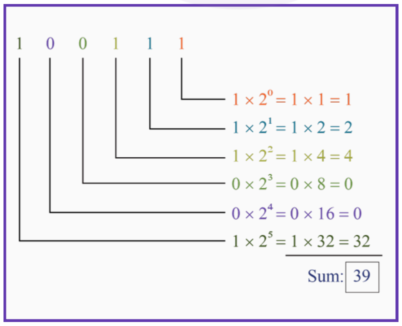
For example, (7B3)base 16, (6F)base 16, and (4B2A)base 16 are some examples of hexadecimal numbers.

Conversion of Number System

1. **. Binary to Decimal Conversion**

Use the following steps to convert a number from binary to decimal.
Step 1: Starting from the rightmost, multiply each digit of the given number by the exponent at the base.
Step 2: The exponent should start at 0 and increase by 1 each time you move from right to left.
Step 3. Simplify and add each product above. Let's understand the steps with the following example where we need to convert the
number from binary to decimal.
Example: Convert (100111)2 to decimal.
Solution:
Step 1: Determine the base of the given number. The base of (100111)2 is 2.
Step 2: Multiply each digit of the given number, starting from the rightmost, by the exponent at the base. The number should start at 0 and increase by 1 each time you move from right to left.
Here, since the base is 2, the number of digits in the given number is multiplied by 20, 21, 22, and so on from right to left.



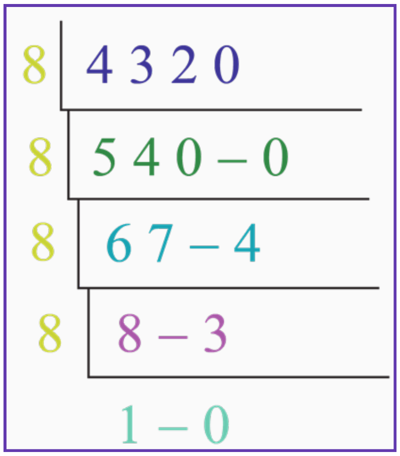


Thus, 1001112 = 3910.

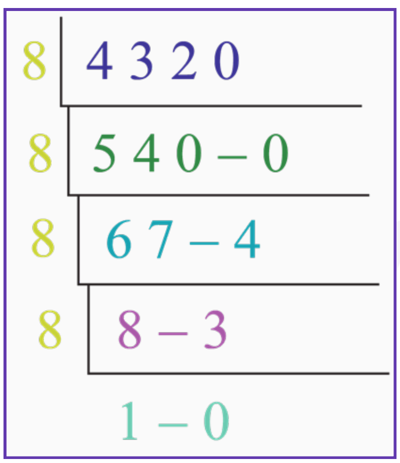
Decimal to Binary/Octal/hexadecimal

Use the following steps to convert a number from decimal to binary/octal/hexadecimal. Shows step by step how to convert a number from decimal to octal.

Example: Converts 432010 to octal.
Solution:
Step 1: Determine the base of the desired number. We need to convert this number to base 8, so the base of the number we want is 8.
Step 2: Divide the given number by the base of the desired number and write the quotient and remainder in quotient-remainder format. Repeat this process until you get a quotient less than the base (redivide the quotient by the base).



Step 3: The given number in the octal number system is obtained just by reading all the remainders and the last quotient from bottom to top.



Therefore, 432010 = 103408

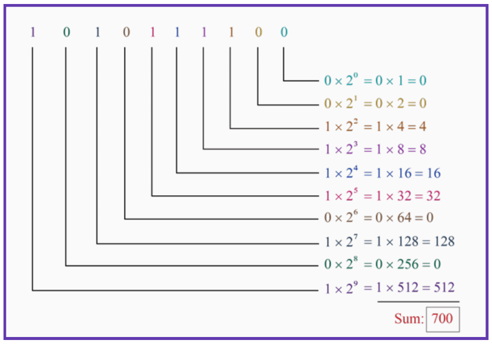
Any Number System to any other Number System

To convert a number from one of the binary/octal/hexadecimal systems to one of the others, first convert to decimal, then use the process above to convert to the required system.

Example: Convert 10101111002 to hexadecimal.

Solution:

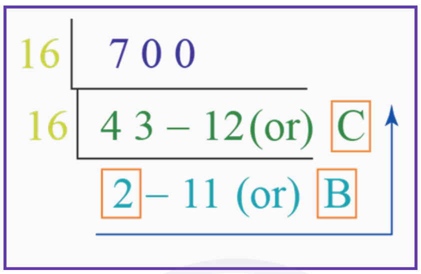
Step 1: Convert this number to decimal as described above.



Thus, 10101111002 = 70010 → (1)

Step 2: Convert the above number (which is in the decimal system), into the required number system (hexadecimal).

Here, we have to convert 70010 into the hexadecimal system using the above-mentioned process. It should be noted that in the hexadecimal system, the numbers 11 and 12 are written as B and C respectively.



Thus, 70010 = 2BC16 → (2)
From the equations (1) and (2), 10101111002 = 2BC16

Bit manipulation:

This can be defined as the process of applying logical operations on sequence of bits where bits is the smallest form of data which is used to store information in a computer.
Broadly bits are either 0 or 1. Combination of these two digits is the foundation of bit manipulation.
Bit manipulation is used because it nearly consumes constant time for operations and is very efficient on all systems.
The most useful bits operator that we will cover in the lecture are as follows:

- AND (&)
- OR (|)
- NOT (!)
- XOR (^)
- Left shift (<<)
- Right shift (>>)

1. AND operator:
Symbol : &
This is a binary operator that operates on two operands. The numbers are converted in their binary format and corresponding bits of both the operands are operated.
This results in 1 if both the bits are 1. Otherwise if any of the bit in both operands is 0 the resultant of this AND