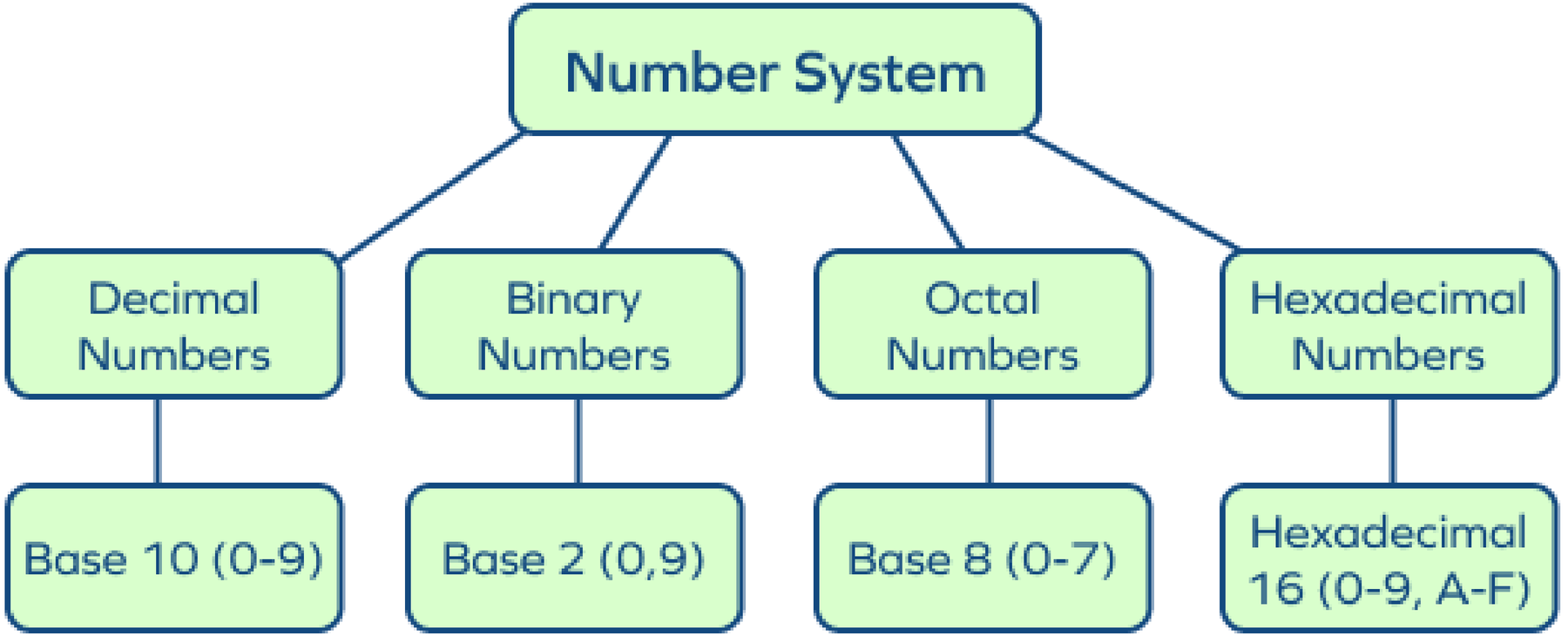
NUMBER SYSTEM

- A number system is a system of representing numbers.
- The number system is a way to represent numbers using a collection of symbols and guidelines.


Number System
Decimal Numbers
Binary Numbers
Octal Numbers
Hexadecimal Numbers
Base 10 (0-9)
Base 2 (0,9)
Base 8 (0-7)
Hexadecimal 16 (0-9, A-F)

Convert Binary to Decimal Numbers

- First, write the given binary number and count the powers of 2 from right to left (powers starting from 0)
- Now, write each binary digit (right to left) with the corresponding powers of 2 from (right to left), such that first binary digit (MSB) will be multiplied with the greatest power of 2.
- Add all the products in the above step
- The final answer will be the required decimal number

- Binary number (1101) base2 into a decimal number :

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

$= 8 + 4 + 0 + 1$

$= 13$

- binary number 1001 to a decimal number :

$(1001)_{base\ 2} = (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$

$= 8 + 0 + 0 + 1$

$= (9)_{10}$

- (1101001)base2 into an equivalent decimal number.

$(1101001)_2 = (1 \times 2^6) + (1 \times 2^5) + (0 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0)$

$= 64 + 32 + 0 + 8 + 0 + 0 + 1$

$= (105)_{10}$

- (11110111)base2 into base-10 number system :

$(11110111)_2 = (1 \times 2^7) + (1 \times 2^6) + (1 \times 2^5) + (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0)$

$= 128 + 64 + 32 + 16 + 0 + 4 + 2 + 1$

$= (247)_{10}$

Decimal to Binary

- decimal number 294 into a binary number : (29410) = (100100110)base2.
- 16010 = (10100000) base2
- 195.25 into binary :
  1. binary equivalent of 195 is 11000011.
  2. fraction part :

Multiply 0.25 by 2 and observe the resulting integer and fractional parts. Renew multiplying the resultant fractional part by 2 until we get a resulting fractional part equal to zero. Then we need to write the integer parts from the results of each multiplication to make the equivalent binary number.

$0.25 \times 2 = 0 + 0.5$

$0.5 \times 2 = 1 + 0$

Here, 0.25 is equivalent to the binary number 0.01.

- convert 6.986 into binary :
  110.11111100
- Binary of 0.125 : 0.125(base 10) = 0.001(base 2)
- **decimal number 10.16 into binary :**
  0.16(base 10) = 0.00101

Octal Number System

- **Octal Number System** has a base of eight and uses the numbers from 0 to 7
- The octal numbers, in the number system, are usually represented by binary numbers when they are grouped in pairs of three.

Decimal to Octal Number conversion

- Decimal number is divided by 8 each time, it yields or gives a remainder.
- The first remainder we get is the least significant digit(LSD) and the last remainder is the most significant digit(MSD).
- CONVERT 560 (DECIMAL) INTO OCTAL : 56010 = (1060) base8

- Convert 0.52 into an octal number :

  The fraction part of the decimal number has to be multiplied by 8.

  0.52 × 8 = 0.16 with carry 4

  0.16 × 8 = 0.28 with carry 1

  0.28 × 8 = 0.24 with carry 2

  0.24 × 8 = 0.92 with carry 1

So, for the fractional octal number, we read the generated carry from up to down.

Therefore, 4121 is the octal number.

Octal to Decimal conversion

- convert (2158)base 8 into decimal :

  2158 = 2 × 8^2 + 1 × 8^1 + 5 × 8^0

  = 2 × 64+ 1 × 8 + 5 × 1 = 128 + 8 + 5

  = 14110

- convert (125) base 8 into decimal :

  1258 = 1× 8^2 + 2 × 8^1 + 5 × 8^0

  = 1 × 64 + 2 × 8 + 5 × 1 = 64+16+5

  =8510

- convert octal (141.14)base8) into decimal :

(141.14)8)=1×8^2+4×8^1+1×8^0+1×8^−1+4×8^−2(141.14)base8)=
1×8^2+4×8^1+1×8^0+1×8^-1+4×8^−2
=16+42+1+0.125+0.25=16+42+1+0.125+0.25
=21.375=21.375
Hence, (141.14)base8=21.37510

Hexadecimal Number System

- base value equal to 16.
- Hexadecimal numbers are represented by only 16 symbols. These symbols or values are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F. Each digit represents a decimal value.
- For example, A is equal to 10
- B - 11
- C -12
- D - 13
- E -14
- F- 15

Hexadecimal to Decimal Conversion

- Convert 7CF (hex) to decimal : 7CF = (7 × 16^2) + (12 × 16^1) + (15 × 16^0)
  = (7 × 256) + (12 × 16) + (15 × 1)
  = 1792 + 192 + 15
  = 1999
- (1DA6)16 to decimal : (1DA6) base16 = (1 × 16^3) + (13 × 16^2) + (10 × 16^1) + (6 × 16^0)
  = (1 × 4096) + (13 × 256) + (10 × 16) + (6 × 1)
  = 4096 + 3328 + 160 + 6
  = 7590 Therefore, (1DA6)16 = (7590)10

- (E8B)16 to decimal system : (E8B)16 = (14 × 16^2) + (8 × 16^1) + (11 × 16^0)
  = (14 × 256) + (8 × 16) + (11 × 1)
  = 3584 + 128 + 11
  = 3723 Therefore, (E8B)BASE 16 = (3723) BASE 10

Decimal to Hexadecimal Conversion

- Firstly divide the number by 16
- Take the quotient and divide again by 16
- The remainder left will produce the hex value
- Repeats the steps until the quotient has become 0

Convert (242)10 into hexadecimal : (242)10 = (F2)16.

16	242	
16	15	$2 \rightarrow 2$
	0	$15 \rightarrow F$

Convert Hexadecimal To Octal

- Consider the given hexadecimal number
- First count the number of digits in the number
- If n is the position of the digit from the right end then multiply each digit with 16n-1
- Add the terms after multiplication
- Resultant is the equivalent decimal form
- Divide the decimal number with 8
- Note down the remainder
- Repeat the previous two steps with the quotient, until the quotient is zero

Write the remainders in reverse order

- The obtained number is the required result

Another Method to Convert Hex to Octal

- For each given hexadecimal number digit, write the equivalent binary number. If any of the binary equivalents are less than 4 digits, add 0’s to the left side.
- Combine and make the groups of binary digits from right to left, each containing 3 digits. Add 0’s to the left if there are less than 3 digits in the last group.
- Find the octal equivalent of each binary group.

Convert 1BC16 into an octal number.

Solution: Given, 1BC16 is a hexadecimal number.

1 → 0001, B → 1011, C →1100

Now group them from right to left, each having 3 digits.

000, 110, 111, 100

000→0, 110 →6, 111→7, 100→4

Hence, 1BC16 = 6748

Find the equivalent octal form of (C1)base16.

Solution: Given, a hexadecimal number is C1
C116 = (C × 161) + (1 × 160)= C × 16 + 1 × 1=12 × 16 + 1 = 192 + 1

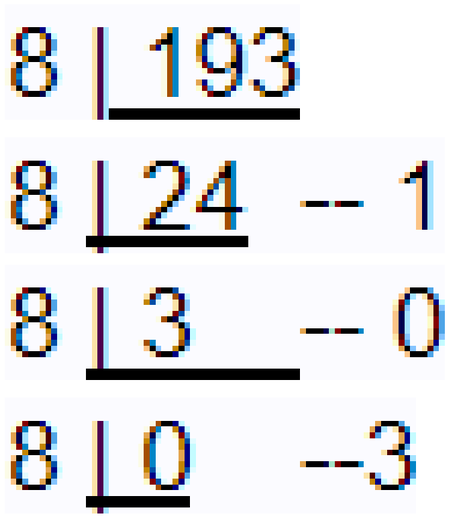
C116 =193 (Decimal form)

Now we have to convert this decimal to octal number;

Hexadecimal to octal example

The octal number is 3018

Hence, C116 = 3018



Practice Questions

Convert ABCD16 to equivalent octal form.

Convert 91216 to equivalent octal form.

Convert 216 to equivalent octal form.

Convert 1016 to equivalent octal form

Find the equivalent octal form of (105) base16

Solution: Given, a hexadecimal number is 105.

10516 = (1 × 16^2) + (0 × 16^1) + (5 × 16^0)

= 1×256 + 0 × 16 + 5 × 1

=256 + 0 +5

= 261(Decimal form)

Now we have to convert this decimal to equivalent octal; (405)base 8