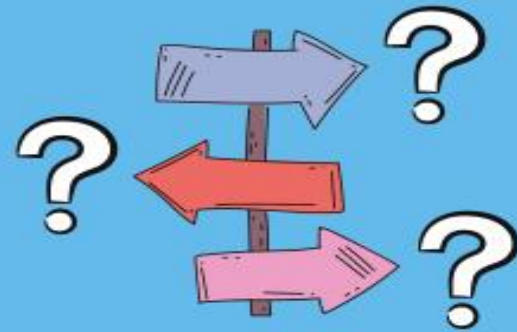


Number System

Guide Question

How to determine
the value of any
digit in a number

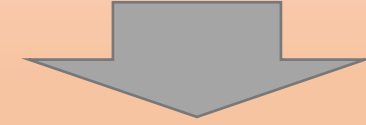
What are the 4
different bases
of number
system?



Content:



➤ **Number System**



- ✓ The Decimal number system
- ✓ The Binary number system
- ✓ The Octal number system and
- ✓ The Hexadecimal number system

Number System

- any of the numerous sets of symbols and the rules for using them to denote numbers
- used to state how many objects are there in a given set.

- Various Types of Number Systems

- Whole Number
- Real Numbers

| Number System | Base value | Set of digits | Example |
|---------------|------------|------------------------------|---------------|
| Base 3 | 3 | 0, 1, 2 | $(123)_3$ |
| Base 4 | 4 | 0, 1, 2, 3 | $(145)_4$ |
| Base 5 | 5 | 0, 1, 2, 3, 4 | $(425)_5$ |
| Base 6 | 6 | 0, 1, 2, 3, 4, 5 | $(225)_6$ |
| Base 7 | 7 | 0, 1, 2, 3, 4, 5, 6 | $(1205)_7$ |
| Base 8 | 8 | 0, 1, 2, 3, 4, 5, 6, 7 | $(105)_8$ |
| Base 9 | 9 | 0, 1, 2, 3, 4, 5, 6, 7, 8 | $(25)_9$ |
| Base 10 | 10 | 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 | $(1125)_{10}$ |

- computer can understand the positional number system where there are only a few symbols

Digits

The value of each digit in a number can be determined using:

- The digit
- The position of the digit in the number
- The base of the number system (where the base is defined as the total number of digits available in the number system)

Place value

- value of the position may increase many times according to the types of number system.

**Decimal Number
System (Base 10)**

**Binary Number
System (Base 2)**

Types of Number Systems

**Octal Number
System (Base 8)**

**Hexadecimal
Number System
(Base 16)**

- uses 10 digits to represent a number
- 0 to 9
- the successive positions to the left of the decimal point represent units, tens, hundreds, thousands, and so on.
- Every position shows a particular power of the base 10

For Example:

The value of 946 is:

$$= 9 \times 10^2 + 4 \times 10^1 + 6 \times 10^0$$
$$= 900 + 40 + 6$$

Try to convert:

The value of 7851 is:?

Decimal Number System (Base 10)

- Any number raised to 0 is equal to one (1)

$$9 \times 10^0$$

$$9 \times 1$$

REMINDERS:

- Any number raised to 0 is equal to one (1)

7851

| | | |
|-----------------|----------------|------|
| 7×10^3 | (10 x 10 x 10) | 1000 |
| 8×10^2 | (10 x 10) | 100 |
| 5×10^1 | (10) | 10 |
| 1×10^0 | (1) | 1 |



| | | |
|-------------------|-------------|------------|
| $7 \times 1000 =$ | 7000 | |
| $8 \times 100 =$ | + 800 | add |
| $5 \times 10 =$ | 10 | |
| $1 \times 1 =$ | <u>1</u> | |
| | 7851 | |

- The combination of 1 and 0 forms binary numbers
- 0 and 1 represent various data
- The binary number system uses positional notation.

Binary Number System (Base 2)

For Example: **Binary to Decimal - 101101** ₂

$$\begin{aligned} &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 \\ &= 1 \times 32 + 0 \times 16 + 1 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1 \\ &= 32 + 8 + 4 + 1 \\ &= (45)_{10} \end{aligned}$$

- Try to convert:
- Binary code of:

11001101₂

Binary Number System (Base 2)

For Example:

Binary to Decimal - 1011011₂

$$= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$= 1 \times 32 + 0 \times 16 + 1 \times 8 + 1 \times 4 + 0 \times 2 + 1 \times 1$$

$$= 32 + 8 + 4 + 1$$

$$= (45)_{10}$$

- ✓ uses digits 0 to 7 (i.e. 8 digits) to represent a number and the numbers are as a base of 8.
- ✓ Each position in an octal number represents a 0 power of the base (8).

Octal Number System (Base 8)

For Example:

Octal Number to Decimal $(38)_8$

$$= 3 \times 8^1 + 8 \times 8^0$$

$$= (32)_{10}$$

$$\underline{3 \times 8 = 24}$$

$$\underline{8 \times 1 = 8 \text{ (add)}}$$

$$32_{10}$$

Octal Number to Decimal

Try to convert:

Octal Number to Decimal - 4123_8

$$\begin{array}{r} 4 \times 8^3 \quad (8 \times 8 \times 8) \\ 1 \times 8^2 \quad (8 \times 8) \\ 2 \times 8^1 \quad (8) \\ 3 \times 8^0 \end{array} \quad \begin{array}{l} = 4 \times 512 = 2048 \\ = 1 \times 64 = 64 \\ = 2 \times 8 = 16 \\ = \underline{3 \times 1 = 3} \end{array}$$

2131₁₀

Hexadecimal Number System (Base 16)

- called as base 16 number system

- Last position in a hexadecimal number represents a x power of the base (16).

- Example
 16^x where x represents the last position - 1

- Uses 10 digits and 6 letters

- A = 10, B = 11,
- C = 12, D = 13,
- E = 14, F = 15

- 0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
- A, B, C, D, E, F
- Letters represent the numbers

Hexadecimal Number System

(Base 16)

Hexadecimal Number System

| Binary No. | Decimal Number |
|--------------|---|
| $19FDE_{16}$ | $((1 \times 16^4) + (9 \times 16^3) + (F \times 16^2) + (D \times 16^1) + (E \times 16^0))_{10}$ |
| $19FDE_{16}$ | $((1 \times 16^4) + (9 \times 16^3) + (15 \times 16^2) + (13 \times 16^1) + (14 \times 16^0))_{10}$ |
| $19FDE_{16}$ | $(65536 + 36864 + 3840 + 208 + 14)_{10}$ |
| $19FDE_{16}$ | 106462_{10} |