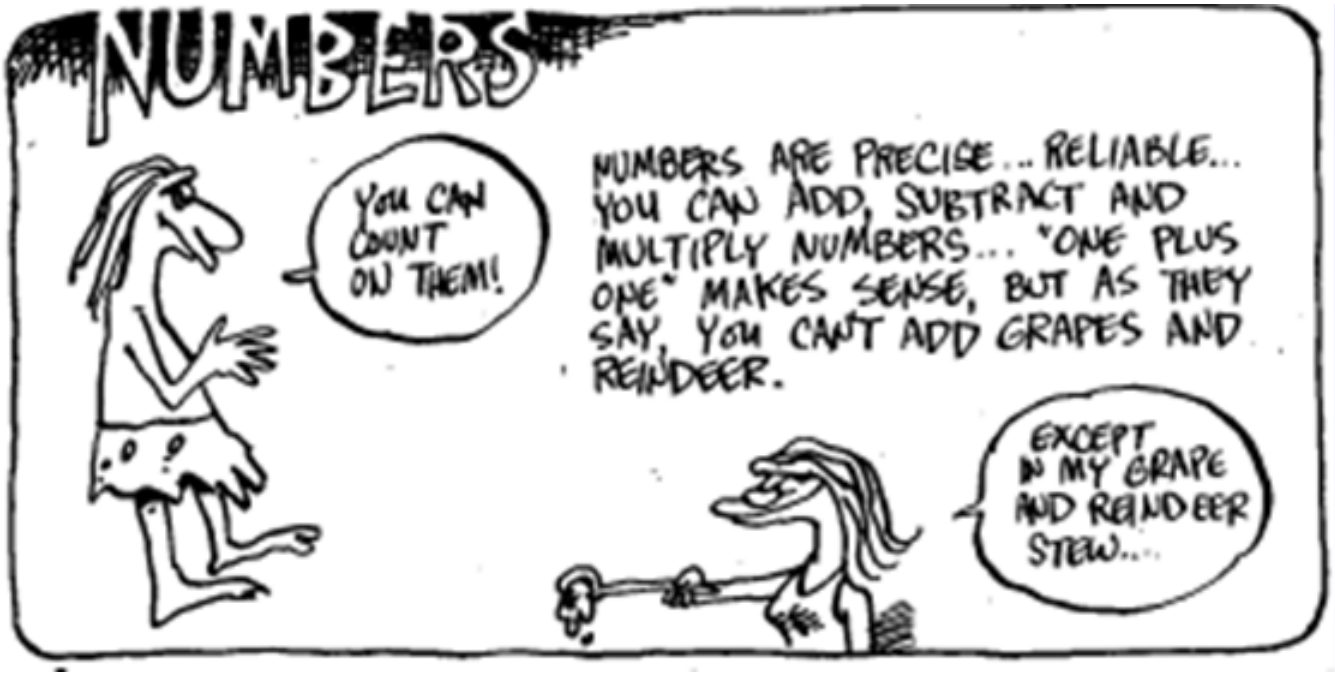

Figure : Number system

Figure Source:Google

- **Why Number System?:**
- Number system is the way to represent the number system in mathematical form.
- Number system is either digit or symbol.
- The numeral represents is called its value.
- Example: 11

- **Types of number systems:**
- Decimal number system.
- Binary number system.
- Octal number system.
- Hexa-decimal number system.
- Others

- **Decimal number system:**
- Most commonly used by us.
- Ten-valued representation.
- Range is 0 to 9 i.e. 10 coefficients.
- Coefficients are multiplied with powers of 10.

- Hence, it has 'base' or 'radix' 10.
- Example:
  $1234 = 1 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0$
- we usually write the coefficients only.

- **Binary number system:**
- It is a different number system.
- it has 'base' or 'radix' 2
- Range is 0 to 1 i.e. 2 coefficients.
- Coefficients are also known as bits (0 or 1).

- Each coefficients are multiplied by powers of 2.
- results are added to get the decimal equivalent number.
- Example:
  1110

- **Why binary system?:**
- It is commonly used for computers.
- Unanimously used by all the digital machines.

- **Equivalence relation between two system:**
  (Number)base-a = (Number)base-b
- **Binary system examples:**
  $1011 = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$
  $1011 = 8+0+2+1$
  $(1011)_2 = (11)_{10}$

- **Exercise:**
- $(101111)_2 = ()_{10}$?
- $(11011)_2 = ()_{10}$?
- $(101001)_2 = ()_{10}$?
- $(10011)_2 = ()_{10}$?
- $(101111)_2 = ()_{10}$?

- **Binary system : Arithmetic operations**
- **Binary ADDITION:**
- Answers should contain with 0's and 1's.
- Similar to decimal addition.
- $1+0 = 0+1 = 1$
- $1+1 = 10$
- $1+1+1 = 11$

Binary addition

- Example:

```
augend:      1 0 1 1 0 1
addend:      1 0 0 1 1 1
          + ---------------
sum:       1 0 1 0 1 0 0
```

- **Exercise:**
- $(10111)_2 + (10111)_2 = ()_2$?
- $(10011)_2 + (10111)_2 = ()_2$?
- $(10101)_2 + (10111)_2 = ()_2$?
- $(10111)_2 + (10111)_2 = ()_2$?
- $(10111)_2 + (11111)_2 = ()_2$?

- **Binary Subtraction:**
- Answers should contain with 0's and 1's.
- Similar to decimal subtraction.
- Except: borrows in a given significant position add '2' to a minuend digit.
- 1-0 = 1
- 1-1 = 0
- 0-1 = 1

Example:

```
minuend:     1 0 1 1 0 1
subtrahend:  1 0 0 1 1 1
           - ___________
difference:  0 0 0 1 1 0
```

- **Exercise:**
- $(10111)_2$ - $(10111)_2$= $()_2$?
- $(10011)_2$ - $(10111)_2$= $()_2$?
- $(10101)_2$ - $(10111)_2$= $()_2$?
- $(10111)_2$ - $(10111)_2$= $()_2$?
- $(10111)_2$ - $(11111)_2$= $()_2$?

- **Binary multiplication:**
- Answers should contain with 0's and 1's.
- Similar to decimal multiplication.
- 1x0 = 0
- 1x1 = 1
- 0x1 = 0
- 0x0 = 0

Example: multiplicand: 1 0 1 1
multiplier: x 1 0 1

```
------------
  1 0 1 1
0 0 0 0
1 0 1 1
------------------
```

product: 1 1 0 1 1 1

- **Octal number system:**
- Eight-valued representation.
- Range is 0 to 7 i.e. 8 coefficients.
- Coefficients are multiplied with powers of 8.
- **Example:**
  $(1257)_8 = (--)_{10}$

- **Hexa-decimal or hexa number system:**
- Sixteen-valued representation.
- Range is 0 to 15 i.e. 16 coefficients.
- Coefficients are multiplied with powers of 16.
- Item 0 to 9 are as per the decimal system.
- A to F letters are used for 10 to 15,respectively.
- **Example:**
  $(A29F)_{16} = (--)_{10}$

- **Application for computer:**
- 1-Byte= 8-bit
  example: 1100 1010 = 1 byte of data
- 2^{10}= KBytes
- 2^{20}= MBytes
- 2^{30}= GBytes
- 2^{40}= TBytes
  Example: computer hard disk capacity