1 - Preliminaries

Mathematical Notations and Functions

- Floor of a real number: $\lfloor 3.4 \rfloor = 3$.
- Ceiling of a real number: $\lceil 3.4 \rceil = 4$.

Relation between floor & ceil:

$$\lfloor 3.4 \rfloor + 1 = \lceil 3.4 \rceil$$

Modular Arithmetic

- $25 \bmod 7 = 4$
- $25 \bmod 5 = 0$
- $-12 \bmod 7 = 2$

Integer and Absolute value

- $\text{int}(-8.5) = -8$
- $\text{abs}(-4) = 4$

Summation

$$\sum_{i=0}^{n} a_i = a_1 + a_2 + a_3 + \ldots$$

Factorail

$$n! = 1 \times 2 \times 3 \times \ldots \ldots \times (n-1) \times n$$

Permutation

A permutation of a set of n elements is an arrangement of the elements in a given order. For example:

$$\text{abc, acb, bac, cab, cba}$$

Exponents & Logarithm

$$a^m = a \times a \times \ldots \ldots \times a \quad [\text{m times}]$$

$$log_b x = y$$

$$\Rightarrow x = b^y$$

Algorithm Notations

- Steps
- Control
- Exit
- Comments (i.e. $[\text{initalize}]$).

Control Structures

- Single Alternative
- Double Alternation
- Multiple Alternative

Complexity of Algorithm

- **Time Complexity:** It is measured by counting the number of key operations.
- **Space Complexity:** It is measured by counting the maximum of memory need by the algorithm.

Complexity cases: $[\text{The complexity function f(n)}]$

- **Best case:** the minimum possible value of $f(n)$ for any possible input.
- **Worst case:** the maximum possible value of $f(n)$ for any possible input.
- **Average case:** The expected value of $f(n)$.

Asymptotic Notation

It means a line that continually approaches a given curve but does not meet it at any finite distance. i.e. x is a asymptotic with $x + 1$.

- Big-Oh Notation (O) --> Worst case.
- Big-Omega Notation (Ω) --> Best case.
- Big-Theta Notation (θ) --> Average case.
- Little-Oh Notation (o).