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Tutorial -1

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* All the Pseudo Code should be Written using non recursive algorithms with Proper format.

1) Sum $= 1+3+5+ --- +n$
2) Addition of 2 matrices
3) $S = 1! + 2! + 3! + ---- + n!$
4) Sum $= \frac{1}{2} + \frac{2}{2} + \frac{3}{2} + --- + \frac{n}{2}$

~~For~~ the above Problems Write the Pseudo code &

1) Identify the basic operation
2) Find how many no of times the basic operation will be executed?
3) What are the Parameters that affect the basic operation execution?
4) ~~Find~~ the efficiency of algorithm?

① ALGORITHM Sum of ODD (N) :

// Description :- Find the Sum of first n odd number.
// Input :- Receives an integer N.
// Output :- Return Sum of odd number up to N.

```
Sum = 0
for i<-1 to n and step by 2 (i=i+2) then.
    Sum = Sum + i

return Sum
```

a) Addition is the basic operation.

b) $(N/2)+1$ times the basic operation will execute.

c) N will affect the basic operation

d) $\sum_{i=1}^{(n/2+1)} 1 = \frac{n}{2}+1-1+1 = \frac{n}{2}+1$

$$\approx \frac{n}{2} \approx \frac{1}{2} \times n.$$

$$c * g(n)$$

$$\frac{1}{2} n \leq n.$$

$\therefore$ The order of growth is $O(n)$.

(2) Addition of Two Matrices :

ALGORITHM MatricesAddition (A[0,...n-1, 0,...n-1], B[0,...n-1, 0,...n-1])

// Description : Addition of 2 matrices with same order.

// Input : A & B are two Matrices

// Output : Returns the Sum matrix

```
Temp [0,... n-1, 0 ... n-1]
for i ← 0 to n
    for j ← 0 to n
        Temp [i] [j] = A[i] [j] + B[i] [j]
return Temp [0, ...n-1, 0 ...n-1]
```

i) Addition

ii) $n \times n$ times n^2

iii) No best, worst, average Condition.

iv) $\sum_{i=0}^{n-1} \sum_{j=0}^{n-1} 1$

$\sum_{i=0}^{n-1} n = n + n + n + \cdots + n$ times

$= n^2$

$\therefore$ The order of growth is $O(n^2)$

③ ALGORITHM Sum of Factorial (N)

// Description :- Find the Sum of Factorial upto N.

// Input :- Integer N.

// Output :- Return the Sum of Factorial.

```
fact = 1
Sum = 0
for i ← 1 to n
    fact = fact * i
    Sum = Sum + fact
return Sum
```

a) Addition & Multiplication.

b) N times.

c) No best, avg and Worst Case.

d) $\sum_{i=1}^{n} i = n-1+1 = n$

$\therefore$ The order of growth is $O(n)$

(4) $Sum = \frac{1}{2} + \frac{2}{2} + \frac{3}{2} + \frac{4}{2} + --- + \frac{N}{2}$

ALGORITHM Sum (N)

// Description :- Find the Sum upto n terms of given Series.

// Input :- Input n Specifying length of Series.

// Output :- Return the sum of Series.

```
Sum = 0
for i<-1 to n.
    Sum = Sum + (i/2)
return Sum
```

a) Basic Operation addition and division.

b) Basic Operation Performed n times.

c) No worst, avg, best case.

d) $\sum_{i=1}^{n} i = n-1+1 = n$

The order of growth is $O(n)$.

(5) Let $g(n) = n^2$. What is the relation b/w n^3, $\frac{1}{2} n \cdot (n-1)$ and $4n^4 + 100n + 5$ using Big Theta and Big Omega Notation.

(6) Prove that $3n^3 + 2n^2 = O(n^3)$.

(5)

i) Big theta

$g(n) = n^2$ & n^3

order of growth is n^2 & n^3

which are not equal

$\therefore n^2 \neq \theta(n^3)$

For Big Omega

$f(n) \geq c * g(n) \ \forall\ n \geq n_0$

i.e $n^3 \geq c * n^2$

which is true.

$\therefore$ the order of growth is $O(n^2)$.

ii) $g(n) = n^2$ $\quad \frac{1}{2}(n)(n-1)$

$\frac{1}{2} n(n-1) = \frac{1}{2}[n^2 - n]$

$\therefore$ The order of $g(n)$ is quadratic

& $\frac{1}{2}n(n-1)$ is also quadratic

$\therefore n^2 \in \theta(n^2)$.

$\therefore$ Big Omega :-

$f(n) \geq c * g(n) \ \forall\ n \geq n_0$

$\frac{1}{2}[n^2 - n] \geq 1 * n^2$

which is true.

$\therefore$ The order of growth is $O(n^2)$.

iii) $g(n) = n^2$ & $4n^4 + 100n + 5$

Big Theta :-

- The order of growth of $4n^4 + 100n + 5$ is n^4.
- Order of growth of $g(n)$ is n^2.

which is not equal.

$\therefore n^2 \notin \theta(n^4)$.

$f(n) \geq c * g(n) \ \forall\ n \geq n_0$

$\therefore 4n^4 + 100n + 5 \geq n^2$

which is true

$\therefore$ order of growth is $O(n^3)$.

(6)

$3n^3 + 2n^2 \in O(n^3)$.

$f(n) = 3n^3 + 2n^2$ $g(n) = n^3$

$\therefore$ order of growth is n^3. (Cubic in nature) | $\therefore$ order of growth is n^3. (Cubic in nature).

As both are equal, order of growth is belong to $O(n^3)$.