Recursion - A f^n calling itself.

$A(n) \rightarrow \underline{T(n)}$.

$A(n/2) \quad T(n/2)$

$T(n)$

```
A(int n)
{   if(n>1)  return A(n/2) + A(n/2);
    return 1;
}
```

$\text{if}(n>1) \rightarrow 1$

$A(n/2) \rightarrow T(n/2)$, $A(n/2) \rightarrow T(n/2)$

$\text{return } 1; \rightarrow 1$

$$T(n) = \begin{cases} 1 + 2T(n/2), & n > 1 \\ 1, & n = 1 \end{cases} \rightarrow \text{Recurrence Relation.}$$

```
A(int n) {
    if(n>1) return A(n-1);
    return 1;
}
```

$\text{return } 1; \longrightarrow 1$

Let, $A \longrightarrow T(n)$

$1 + T(n-1)$

$A(n-1) \rightarrow T(n-1)$

$$T(n) = \begin{cases} 1 + T(n-1), & n > 1 \\ 1, & n = 1 \end{cases} \quad \text{Recurrence Relat}^n.$$

Back Substitution Method –

$$T(n) = \begin{cases} 1 + T(n-1), & n > 1 \\ 1, & n = 1. \end{cases}$$

$$T(n) = 1 + T(n-1)$$

$$T(n-1) = 1 + T(n-2)$$

$$T(n-2) = 1 + T(n-3)$$

$$\vdots$$

$$T(3) = 1 + T(2)$$

$$T(2) = 1 + T(1)$$

$$T(1) = 1$$

$$T(n) + T(\cancel{n-1}) + T(\cancel{n-2}) + \dots + T(\cancel{3}) + T(\cancel{2}) + T(\cancel{1}) =$$

$$1 + T(\cancel{n-1}) + 1 + T(\cancel{n-2}) + 1 + T(\cancel{n-3}) + \dots + 1 + T(\cancel{2}) + 1 + T(\cancel{1}) + 1$$

$$\Rightarrow T(n) = n \times 1 = n = O(n).$$

Q

$$T(n) = \begin{cases} n + T(n-1), & n > 1 \\ 1, & n = 1. \end{cases}$$

$$T(n) = n + T(n-1)$$

$$T(n-1) = (n-1) + T(n-2)$$

$$T(n-2) = (n-2) + T(n-3).$$

$$\vdots$$

$$T(3) = 3 + T(2)$$

$$T(2) = 2 + T(1)$$

$T(2) = 2 + T(1)$

$T(1) = 1$

$$T(n) + \cancel{T(n-1)} + \cancel{T(n-2)} + \cdots + \cancel{T(3)} + \cancel{T(2)} + \cancel{T(1)} = n + \cancel{T(n-1)} + (n-1) + \cancel{T(n-2)} + (n-2) + \underline{\cancel{T(n-3)}} + \cdots + 3 + \cancel{T(2)} + 2 + \cancel{T(1)} + 1 =$$

$$\Rightarrow T(n) = 1 + 2 + 3 + \cdots + (n-2) + (n-1) + n.$$

$$= \frac{n \times (n+1)}{2} = O(n^2) \,//$$