20.13. TIME COMPLEXITY CALCULATION

NESTED FOR LOOP (SOME EXAMPLES BASED ON DECREMENT OPERATOR).

$\mathbf{1}.\,(\boldsymbol{i}--)$

$\boldsymbol{for}(\boldsymbol{i}=\boldsymbol{n};\boldsymbol{i}\leq\mathbf{1};\boldsymbol{i}--)\{$

$\quad\boldsymbol{for}(\boldsymbol{j}=\boldsymbol{n};\boldsymbol{j}\leq\mathbf{1};\boldsymbol{i}--)\{$

$\qquad\boldsymbol{k}=\boldsymbol{k}+\mathbf{1};$

$\quad\}$

$\}$

SOLUTION

$\boldsymbol{Here\ it\ run\ same\ as\ i++i.e.n\ times\ n}$

$n \geq f(n) \geq c \times 1, when\ i = n$

$n \geq \ f(n) \geq 1\ when\ j = n$

$k = k + 1\ , i.e. 1\ time$

$n \geq \ f(n-1) \geq 1\ when\ j = n$

$k = k + 1\ , i.e. 1\ time$

....

$n \geq \ f(2) \geq 1\ when\ j = 2$

$k = k + 1\ , i.e. 1\ time$

$n \geq f(1) \geq 1\ when\ j = 1$

$k = k + 1\ , i.e. 1\ time$

$$T(n) = \sum_{i=1}^{n} 1 = (1 + 1 + 1+.., n\ times) = n$$

$n \geq f(n-1) \geq c \times 1, when\ i = n - 1$

$n \geq f(n) \geq 1\ when\ j = n$

$k = k + 1\ , i.e. 1\ time$

$n \geq \ f(n-1) \geq 1\ when\ j = n$

$k = k + 1\ , i.e. 1\ time$

....

$n \geq \ f(2) \geq 1\ when\ j = 2$

$k = k + 1\ , i.e. 1\ time$

$n \geq f(1) \geq 1\ when\ j = 1$

$k = k + 1\ , i.e. 1\ time$

$$T(n) = \sum_{i=1}^{n} 1 = (1 + 1 + 1+.., n\ times) = n$$

....

$n \geq f(1) \geq c \times 1, when\ i = 1$

$n \geq f(n) \geq 1\ when\ j = n$

$k = k + 1\ , i.e.\ 1\ time$

$n \geq f(n-1) \geq 1\ when\ j = n$

$k = k + 1\ , i.e.\ 1\ time$

....

$n \geq\ f(2) \geq 1\ when\ j = 2$

$k = k + 1\ , i.e.\ 1\ time$

$n \geq\ f(1) \geq 1\ when\ j = 1$

$k = k + 1\ , i.e.\ 1\ time$

$$T(n) = \sum_{i=1}^{n} 1 = (1 + 1 + 1 +.., n\ times) = n$$

Though it stands like $f(n) \geq 1$, *note for loop always run upto n times, hence, we are checking upto n times i.e. Big O or worst complexity. Hence it actually is* $1 \leq f(n) \leq n$. *Though we are using a decrement operator here.*

2. (*Arithmetic Progression*)

```
for(i = n; i ≤ 1; i − −){
    for(j = i; j ≤ 1; i − −){
        k = k + 1;
    }
}
```

SOLUTION

$\boldsymbol{Here\ if\ we\ notice}$:

$$k = k + 1\ prints\ n + n - 1 + \cdots + 3 + 2 + 1 = \sum_{i=n}^{1} n = \sum_{i=1}^{n} n = n^2$$

$\boldsymbol{Hence\ if\ it\ is\ post\ decrement\ , the\ calculations\ are}$

$\boldsymbol{is\ \ similar\ to\ post\ increment\ .}$