20.12. Time Complexity Calculation Single for Loop (Some Examples Based on Decrement Operator).

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

$$\boldsymbol{for}(\boldsymbol{i}=\boldsymbol{n};\boldsymbol{i}\geq\mathbf{1};\boldsymbol{i}--)\{$$
$$\boldsymbol{k}=\boldsymbol{k}+\mathbf{1};$$
$$\}$$

Solution

$\boldsymbol{k}=\boldsymbol{k}+\mathbf{1}\ \boldsymbol{prints\ every\ 1\ time\ taking\ 1\ unit\ of\ time\ as\ \ i\ iterates}$

$\boldsymbol{from\ n,n-1\ ,\ldots,2,1\ \ and}\ \sum_{i=1}^{n}\mathbf{1}=(\mathbf{1}+\mathbf{1}+\mathbf{1}+\cdots\boldsymbol{n\ times})=\boldsymbol{n}.$

$\boldsymbol{Hence\ O(n)}.$

$\mathbf{2.}\ (\boldsymbol{i-2})$

$\boldsymbol{for(i=n; i \geq 1; i=i-2)\{}$

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

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Solution

1. $\boldsymbol{if\ n\ is\ odd(runs\ upto}$ n $\boldsymbol{times):} \left\lfloor\frac{n}{2}\right\rfloor + 1 = \ \boldsymbol{and}\ \mathrm{O}\ \left(\left\lfloor\frac{n}{2}\right\rfloor + 1\right) = \boldsymbol{O(n)}$

2. $\boldsymbol{if\ n\ is\ even(runs\ upto}$ n-1 $\boldsymbol{times):} \left\lfloor\frac{n-1}{2}\right\rfloor + 1\ \boldsymbol{and}\ \mathrm{O}\ \left(\left\lfloor\frac{n-1}{2}\right\rfloor + 1\right)$

$= \boldsymbol{O(n)}$

ANOTHER APPROACH

$\boldsymbol{1.\ if\ n\ is\ multiple\ of\ 2\ i.e.\ an\ even\ number\ it\ will\ run \frac{n}{2}\ times}$

$\boldsymbol{as\ every\ even\ number\ is\ divisible\ by\ 2\ or\ we\ may\ say\ multiples\ of\ 2\ .}$

$\boldsymbol{hence\ O\left(\frac{n}{2}\right) = O(n)}$

$\boldsymbol{2.\ if\ n\ is\ not\ multiple\ of\ 2\ i.e.\ an\ odd\ number\ it\ will\ run}$

$\boldsymbol{\left\lfloor\frac{n}{2}\right\rfloor + 1\ times\ , hence\ O\left(\left\lfloor\frac{n}{2}\right\rfloor + 1\right) = O(n)}$

$\mathbf{2.}\,(\boldsymbol{i-3})$

$\boldsymbol{for(i = n; i \geq 1; i = i - 3)\{}$

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

$\}$

Solution

1. $\boldsymbol{if\ n\ is\ multiple\ of\ 3}: \frac{n}{3} = \ \boldsymbol{and\ O}\ \left(\frac{n}{3}\right) = \boldsymbol{O(n)}$

2. $\boldsymbol{if\ n\ is\ not\ multiple\ of\ 3}:\ \left\lfloor\frac{n}{3}\right\rfloor + 1\ \boldsymbol{and\ O}\ \left(\left\lfloor\frac{n}{3}\right\rfloor + 1\right)$

$= \boldsymbol{O(n)}$

3. $\boldsymbol{if\ n\ runs\ upto\ n-1\ times}:\ \left\lfloor\frac{n-1}{3}\right\rfloor + 1\ \boldsymbol{and\ O}\ \left(\left\lfloor\frac{n-1}{3}\right\rfloor + 1\right) = \boldsymbol{O(n)}$

$\mathbf{3.}\,\boldsymbol{if\ (for\ loop\ runs\ from\ 0\ to\ n-1)}$

$\boldsymbol{for(i = n - 1; i > 0; i = i - 2)\{}$

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

$\}$

Solution

$\boldsymbol{As\ it\ runs\ up\ to\ 0\ to\ n-1\ times\ , then\ the\ approach\ will\ be}:$

$\mathbf{1.}\,\boldsymbol{if\ n\ is\ multiple\ of\ 2\ i.e.an\ even\ number\ it\ will\ run}\frac{n}{2}\ \boldsymbol{times}$

$\boldsymbol{as\ every\ even\ number\ is\ divisible\ by\ 2\ or\ we\ may\ say\ multiples\ of\ 2}\ .$

$\boldsymbol{hence\ O}\left(\frac{n}{2}\right) = \boldsymbol{O(n)}$

$2. \, if \; n \; is \; not \; multiple \; of \; 2 \; i.e. \, an \; odd \; number \; it \; will \; run$

$\left\lfloor \frac{n}{2} \right\rfloor + 1 \; times \, , hence \; O\left(\left\lfloor \frac{n}{2} \right\rfloor + 1\right) = O(n)$

$4. \, if \; (for \; loop \; runs \; from \; 0 \; to \; n - 1)$

$for(i = n - 1; i > 0; i = i - 3)\{$

$k = k + 1;$

$\}$

$Solution$

$As \; it \; runs \; up \; to \; 0 \; to \; n - 1 \; times \, , then \; the \; approach \; will \; be:$

$1. \, if \; n \; is \; multiple \; of \; 3 \; i.e. \, an \; even \; number \; it \; will \; run \frac{n}{3} \; times$

$as \; every \; even \; number \; is \; divisible \; by \; 3 \; or \; we \; may \; say \; multiples \; of \; 3 \, .$

$hence \; O\left(\frac{n}{3}\right) = O(n)$

$2. \, if \; n \; is \; not \; multiple \; of \; 3 \; i.e. \, an \; odd \; number \; it \; will \; run$

$\left\lfloor \frac{n}{3} \right\rfloor + 1 \; times \, , hence \; O\left(\left\lfloor \frac{n}{3} \right\rfloor + 1\right) = O(n)$

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