7. DELETE ELEMENT AT POSITION IN AN ARRAY

APPROACH:

$Suppose\ we\ have\ size = 5\ and$

$And\ indices: a[0] = 1, a[1] = 2, a[2] = 3, a[3] = 4\ and\ a[4] = 5.$

$And\ we\ want\ to\ delete\ element\ at\ index: 2\ i.e. a[2].$

$Then\ we\ go\ through\ a\ process\ of\ Shifting\ to\ Left:$

$a[2] = a[3] \text{--}\!\!\rightarrow elem: 3\ at\ a[3]\ copied\ to\ a[2]$

$a[3] = a[4] \text{--}\!\!\rightarrow elem: 4\ at\ a[4] copied\ to\ a[3]$

$And\ a[0], a[1\ ] will\ be\ remain\ untouched.$

$Then\ we\ decrement\ the\ size:$

$size = size - 1\ , now\ size\ is\ 4, traversal\ will$

$take\ place\ from\ a[0] = 1, a[1] = 2, a[2] = 4,$

$and\ a[3] = 5\ .$

$Thus\ when\ there\ is: 5\ elements\ , loop\ will\ run\ 2\ times\ and$
$if\ it\ starts\ from\ a[i]\ then\ i\ starts\ from\ pos = 2[index\ to$
$be\ deleted]\ [lower\ bound\ of\ for\ loop]\ and\ \ it\ will\ go\ from$
$2, 3\ i.e. i < 5 - 1\ [upper\ bound\ of\ for\ loop\ i.e.\ size - 1].$

PROGRAM:

```
for (int i = pos ; i <size-1; i++)
        {

            a[i] = a[i + 1];

        }
 size=size-1;
```

TIME COMPLEXITY OF DELETE ELEMENT AT POSITION IN AN ARRAY

$1. \boldsymbol{Best\ Case}: -$

$\boldsymbol{When\ , Pos = \ Size - 1, say\ size = 5\ and\ pos = 4, then}$:

$\boldsymbol{for(i = 4;\ i < 4 - 1 = 3\ i.e.2; i + +)is\ false\ , hence}$:

$\boldsymbol{loop\ fails\ to\ run}$.

$\boldsymbol{i.e\ ., last\ element\ to\ be\ deleted\ hence\ just\ size\ gets\ adjusted,}$

$\boldsymbol{hence}$: $\boldsymbol{\Omega(1)}$.

$2. \boldsymbol{Worst\ Case}$:

$\boldsymbol{When\ we\ have\ to\ delete\ 1st\ element\ i.e.a[0]\ , it\ runs\ from}$

$\boldsymbol{0, 1, 2, 3, \ldots.\,, n - 2\ or\ 1\ to\ n - 1\ i.e.n - 1\ shift.}$

$\boldsymbol{i.e.1\ unit\ of\ time\ at\ first\ shift + 1\ unit\ of\ time\ at\ second}$

$\boldsymbol{shift\ + 1\ unit\ of\ time\ at\ third\ shift + \cdots n - 1\ times = n - 1.}$

$\boldsymbol{Hence\ , O(n - 1) = O(n)}$.

$3.\ \boldsymbol{Average\ Case}$:

$\rightarrow \boldsymbol{deletion\ for\ a[0] = 0\ to\ n-2 = n-1\ shift.}$

$\rightarrow \boldsymbol{deleteion\ for\ a[1] = 1\ to\ n-2 = n-2\ shift.}$

.

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$\rightarrow \boldsymbol{deletion\ for\ a[n-2] = n-2\ to\ n-2 = 1\ shift}$

$\rightarrow \boldsymbol{deletion\ for\ a[n-1] = \qquad\qquad\qquad\qquad 0\ shift}$

$$\boldsymbol{i.e.\ 0 + 1 + 2 + \cdots + n - 2 + n - 1 = \sum_{i=0}^{n-1} i}$$

$$\boldsymbol{= a_0 + \sum_{i=1}^{n-1} i}$$

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

$$\boldsymbol{= \sum_{i=1}^{n-1} i = \frac{n(n-1)}{2}}$$

$\boldsymbol{And\ \ probablity\ of\ deleting\ each\ element\ is}$

$\boldsymbol{equally\ likely = \frac{1}{n}}$

$$\therefore \frac{\boldsymbol{1}}{\boldsymbol{n}} \times \frac{\boldsymbol{n}(\boldsymbol{n}-\boldsymbol{1})}{\boldsymbol{2}}$$

$$= \left(\frac{\boldsymbol{n}-\boldsymbol{1}}{\boldsymbol{2}}\right)$$

***Applying Big Theta we get*:**

$$\approx \boldsymbol{\Theta}\left(\frac{\boldsymbol{n}-\boldsymbol{1}}{\boldsymbol{2}}\right)$$

$$\approx \boldsymbol{\Theta}\left(\frac{\boldsymbol{n}}{\boldsymbol{2}}-\frac{\boldsymbol{1}}{\boldsymbol{2}}\right)$$

$$\approx \boldsymbol{\Theta}\left(\frac{\boldsymbol{n}}{\boldsymbol{2}}\right)-\boldsymbol{\Theta}\left(\frac{\boldsymbol{1}}{\boldsymbol{2}}\right)$$

$$\approx \boldsymbol{\Theta}\left(\frac{\boldsymbol{n}}{\boldsymbol{2}}\right)$$

$$\approx \frac{\boldsymbol{1}}{\boldsymbol{2}} \times \boldsymbol{\Theta}(\boldsymbol{n})$$

$$\approx \boldsymbol{\Theta}(\mathbf{n})$$

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