

Q4 Sort the array consisting of 0s, 1s & 2s without any sorting algorithm

i/p  $\rightarrow \{2, 0, 2, 1, 1, 0\}$

o/p  $\rightarrow \{0, 0, 1, 1, 2, 2\}$

Approach-1

- 1) Count no. of zeroes, ones & two in the array.
- 2) Place that many zeroes at the start, then that many ones after the zeroes, & then that many two after the ones.

This approach works in  $O(n)$  complexity but requires multiple traversals of the array.

Approach-2 (3 pointer approach)

- 1) Take 3 variables namely  $s$ ,  $m$  &  $e$ . Initialize  $s$  &  $m$  with 0 index & end  $e$  with the last index.
- 2) Run a loop until  $m \leq e$  and under this loop there will be 3 conditions.

$\rightarrow$  if ( $\text{nums}[m] == 0$ )

$\hookrightarrow$   $\text{nums}$  is the array name

So swap it with  $\text{nums}[s]$  as  $s$  was meant for zeroes. After Swapping increment both by 1.

$\rightarrow$  if ( $\text{nums}[m] == 1$ )

No swapping required as  $m$  was meant for 1s & hence it is at the right place.

Simply increment  $m$  by 1.

→ if ( $\text{nums}[m] == 2$ )

Swap it with  $\text{nums}[e]$  as  $e$  was meant for 2s & after swapping just decrement  $e$  by 1.

Dry-run

1)  $\{2, 0, 2, 1, 1, 0\}$   
 $\begin{array}{cccccc} & \uparrow & & & & \uparrow \\ & s, m & & & & e \end{array}$

$\text{nums}[m] == 2$

Swap  $\text{nums}[m]$  &  $\text{nums}[e]$ . Decrement  $e$

2)  $\{0, 0, 2, 1, 1, 2\}$   
 $\begin{array}{cccccc} & \uparrow & & & & \uparrow \\ & s, m & & & & e \end{array}$

$\text{nums}[m] == 0$

Swap  $\text{nums}[m]$  &  $\text{nums}[s]$ . Increment both.

3)  $\{0, 0, 2, 1, 1, 2\}$   
 $\begin{array}{cccccc} & \uparrow & & & & \uparrow \\ & s, m & & & & e \end{array}$

$\text{nums}[m] == 0$

swap ( $\text{nums}[m]$ ,  $\text{nums}[s]$ ) . Increment both

4)  $\{0, 0, 2, 1, 1, 2\}$   
 $\begin{array}{cccccc} & \uparrow & & & & \uparrow \\ & s, m & & & & e \end{array}$

$\text{nums}[m] == 2$

Swap  $\text{nums}[m]$  &  $\text{nums}[e]$ . Decrement  $e$

5)  $\{0, 0, 1, 1, 2, 2\}$   
 $\begin{array}{cccccc} & \uparrow & & \uparrow \\ & s, m & & e \end{array}$

$\text{nums}[m] == 1$

So simply  $m++$ .

6) {0, 0, 1, 1, 2, 2}

$\uparrow$     $\uparrow$   
 s   m, e

nums[m] == 1

Simply m++.

7) {0, 0, 1, 1, 2, 2}

$\uparrow$     $\uparrow$     $\uparrow$   
 s   e   m

Now  $m > e$  & hence exit the loop.

At the end we have got the sorted array.

Code

```
void sortColors (vector<int> & nums) {
```

```
    int s = 0; // For replacing 0s
```

```
    int m = 0; // For replacing 1s
```

```
    int e = nums.size() - 1; // For replacing 2s
```

```
    while (m <= e) {
```

```
        // 3 conditions discussed in approach-2
```

```
        if (nums[m] == 0)
```

```
            swap(nums[s++], nums[m++]);
```

```
        else if (nums[m] == 1)
```

```
            m++;
```

```
        else
```

```
            swap(nums[m], nums[e--]);
```

```
    }
```

```
}
```