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## Grokking the Coding Interview: Patterns for Coding Questions

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### Pattern: Two Pointers



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## Dutch National Flag Problem (medium)

We'll cover the following ^

- Problem Statement
- Try it yourself
- Solution
  - Code
  - Time complexity
  - Space complexity

### Problem Statement #

Given an array containing 0s, 1s and 2s, sort the array in-place. You should treat numbers of the array as objects, hence, we can't count 0s, 1s, and 2s to recreate the array.

The flag of the Netherlands consists of three colors: red, white and blue; and since our input array also consists of three different numbers that is why it is called Dutch National Flag problem ([https://en.wikipedia.org/wiki/Dutch\\_national\\_flag\\_problem](https://en.wikipedia.org/wiki/Dutch_national_flag_problem)).

### Example 1:

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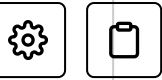
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## Pattern: Two Pointers



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Input: [1, 0, 2, 1, 0]  
Output: [0 0 1 1 2]



### Example 2:

Input: [2, 2, 0, 1, 2, 0]  
Output: [0 0 1 2 2 2]

### Try it yourself #

Try solving this question here:

Java

Python3

JS

C++

```
1 class DutchFlag {
2
3     private static void swap(int[] arr,int i,int j)
4     {
5         int temp = arr[i];
6         arr[i] = arr[j];
7         arr[j] = temp;
8     }
9     public static void sort(int[] arr) {
10         // TODO: Write your code here
11         int n = arr.length;
12         int start = 0, end = n-1;
13         for(int i=0;i<=end;)
14         {
15             if(arr[i]==0) {
16                 swap(arr,start,i);
17                 start++;
18                 i++;
19             }
20             else if(arr[i]==2){
21                 swap(arr,end,i);
22                 end--;
23             }
```



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```

23         }
24         else{
25             i++;
26         }
27     }
28 }
29 }
30

```



## Test

**Save \***

## Reset



### Show Results

Show Console



 2 of 2 Tests Passed

Result	Input	Expected Output	Actual Output	Reason
✓	sort([1, 0, 2, 1, 0])	[0, 0, 1, 1, 2]	[0, 0, 1, 1, 2]	Succeeded
✓	sort([2, 2, 0, 1, 2, 0])	[0, 0, 1, 2, 2, 2]	[0, 0, 1, 2, 2, 2]	Succeeded

3.054s

## Solution #

The brute force solution will be to use an in-place sorting algorithm like Heapsort (<https://en.wikipedia.org/wiki/Heapsort>) which will take  $O(N * \log N)$ . Can we do better than this? Is it possible to sort the array in one iteration?

We can use a **Two Pointers** approach while iterating through the array. Let's say the two pointers are called `low` and `high` which are pointing to the first and the last element of the array respectively. So while iterating, we will move all 0s before `low`

and all 2s after high so that in the end, all 1s will be between low and high.



Code #

Here is what our algorithm will look like:



Java



Python3



C++



JS

```
1 class DutchFlag {
2
3     public static void sort(int[] arr) {
4         // all elements < low are 0 and all elements >
5         // all elements from >= low < i are 1
6         int low = 0, high = arr.length - 1;
7         for (int i = 0; i <= high; i++) {
8             if (arr[i] == 0) {
9                 swap(arr, i, low);
10                // increment 'i' and 'low'
11                i++;
12                low++;
13            } else if (arr[i] == 1) {
14                i++;
15            } else { // the case for arr[i] == 2
16                swap(arr, i, high);
17                // decrement 'high' only, after the swap th
18                high--;
19            }
20        }
21    }
22
23    private static void swap(int[] arr, int i, int j) {
24        int temp = arr[i];
25        arr[i] = arr[j];
26        arr[j] = temp;
27    }
28
29    public static void main(String[] args) {
30        int[] arr = new int[] { 1, 0, 2, 1, 0 };
31        DutchFlag.sort(arr);
32    }
33 }
```



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### Time complexity #

The time complexity of the above algorithm will be  $O(N)$  as we are iterating the input array only once.

### Space complexity #

The algorithm runs in constant space  $O(1)$ .

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Problem Challenge 1

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