CS497: Interview Skills
Spring 2023
Homework Assignment 2
Due: Thursday, 2/16/2023 @11:59pm

1) Majority Element

Given an array `nums` of size `n`, return *the majority element*.

The majority element is the element that appears more than ⌊`n / 2`⌋ times. You may assume that the majority element always exists in the array. Solve this problem in Linear time.

Example 1:

```
Input: nums = [3,2,3]
Output: 3
```

Example 2:

```
Input: nums = [2,2,1,1,1,2,2]
Output: 2
```

Constraints:

- `n == nums.length`
- `1 <= n <= 5 * 10^4`
- `-10^9 <= nums[i] <= 10^9`

2) Kth Largest element in an Array

Given an integer array nums and an integer k, return *the* k^{th} *largest element in the array*.
Note that it is the k^{th} largest element in the sorted order, not the k^{th} distinct element.
You must solve it in O(n) time complexity.

Example 1:

```
Input: nums = [3,2,1,5,6,4], k = 2
Output: 5
```

Example 2:

```
Input: nums = [3,2,3,1,2,4,5,5,6], k = 4
Output: 4
```

Constraints:

- `1 <= k <= nums.length <= 10^5`
- `-10^4 <= nums[i] <= 10^4`

3) Maximum Gap

Given an integer array nums, return *the maximum difference between two successive elements in its sorted form*. If the array contains less than two elements, return 0.
You must write an algorithm that runs in linear time and uses linear extra space.

Example 1:

```
Input: nums = [3,6,9,1]
Output: 3
Explanation: The sorted form of the array is [1,3,6,9], either (3,6) or (6,9)
has the maximum difference 3.
```

Example 2:

```
Input: nums = [10]
Output: 0
Explanation: The array contains less than 2 elements, therefore return 0.
```

Constraints:

- `1 <= nums.length <= 10^5`
- `0 <= nums[i] <= 10^9`

4) Remove duplicate letters

Given a string s, remove duplicate letters so that every letter appears once and only once. You must make sure your result is **the smallest in lexicographical order** among all possible results.

Example 1:

```
Input: s = "bcabc"
Output: "abc"
```

Example 2:

```
Input: s = "cbacdcbc"
Output: "acdb"
```

Constraints:

- `1 <= s.length <= 10^4`
- `s` consists of lowercase English letters.

5) Shortest Subarray with Sum at Least K

Given an integer array nums and an integer k, return *the length of the shortest non-empty **subarray** of* nums *with a sum of at least* k. If there is no such **subarray**, return -1.

A **subarray** is a **contiguous** part of an array.

Example 1:

```
Input: nums = [1], k = 1
Output: 1
```

Example 2:

```
Input: nums = [1,2], k = 4
Output: -1
```

Example 3:

```
Input: nums = [2,-1,2], k = 3
Output: 3
```

Constraints:

- $1 <= nums.length <= 10^5$
- $-10^5 <= nums[i] <= 10^5$
- $1 <= k <= 10^9$

Submissions

1) For each question above, explain in detail the algorithm you use to solve the problem including the complexity analysis and efficiency. Include your explanation in a readme file and submit to Canvas

2) Submit your code to a Github private repository and share your repository with instructor and grader using their email addresses

Grader's email address: khassansreedhara@horizon.csueastbay.edu