



Algorithm Design

Term Project





The Kth Largest Element in an Array Problem 215.

Difficulty Level: Medium

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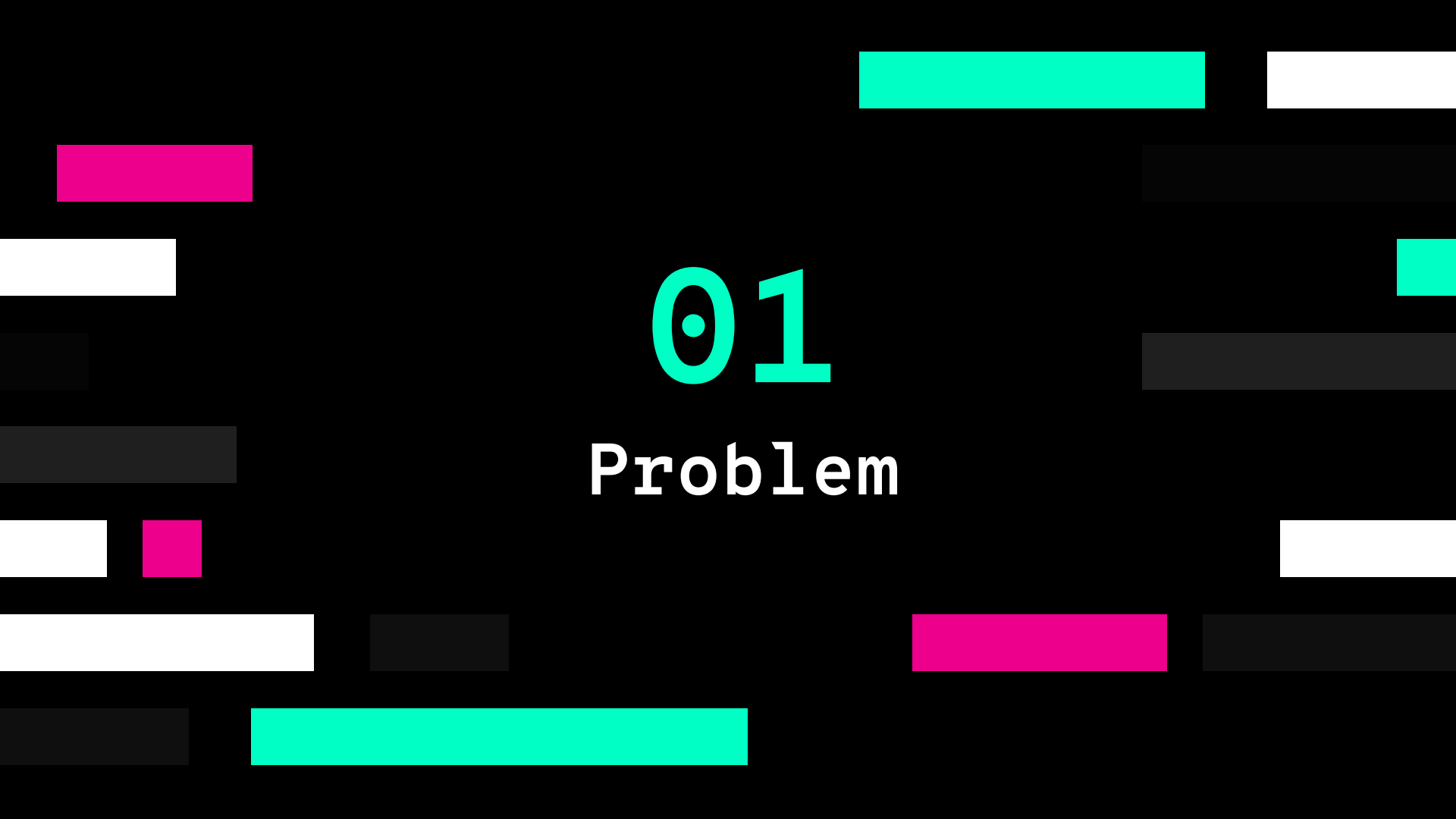
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01

Problem

Details

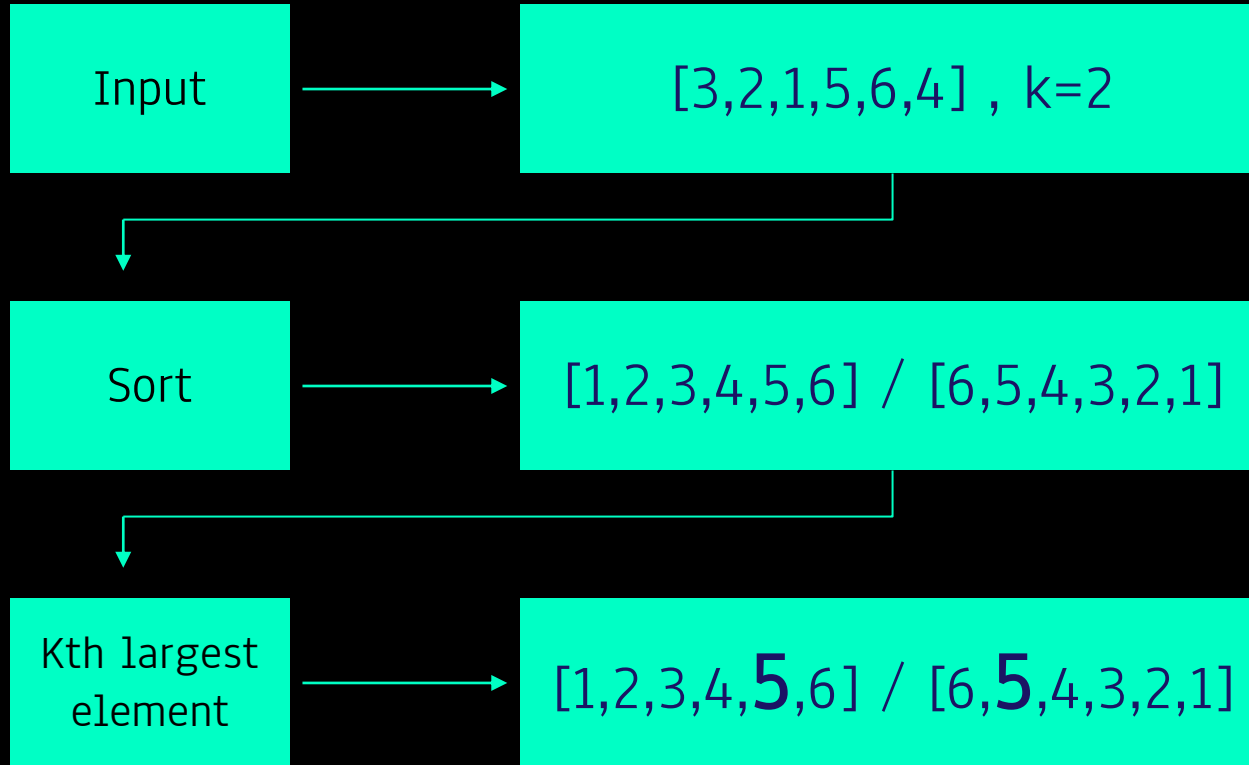
- Find the kth largest element in an unsorted array.
- Note that it is the kth largest element in the sorted order, not the kth distinct element.

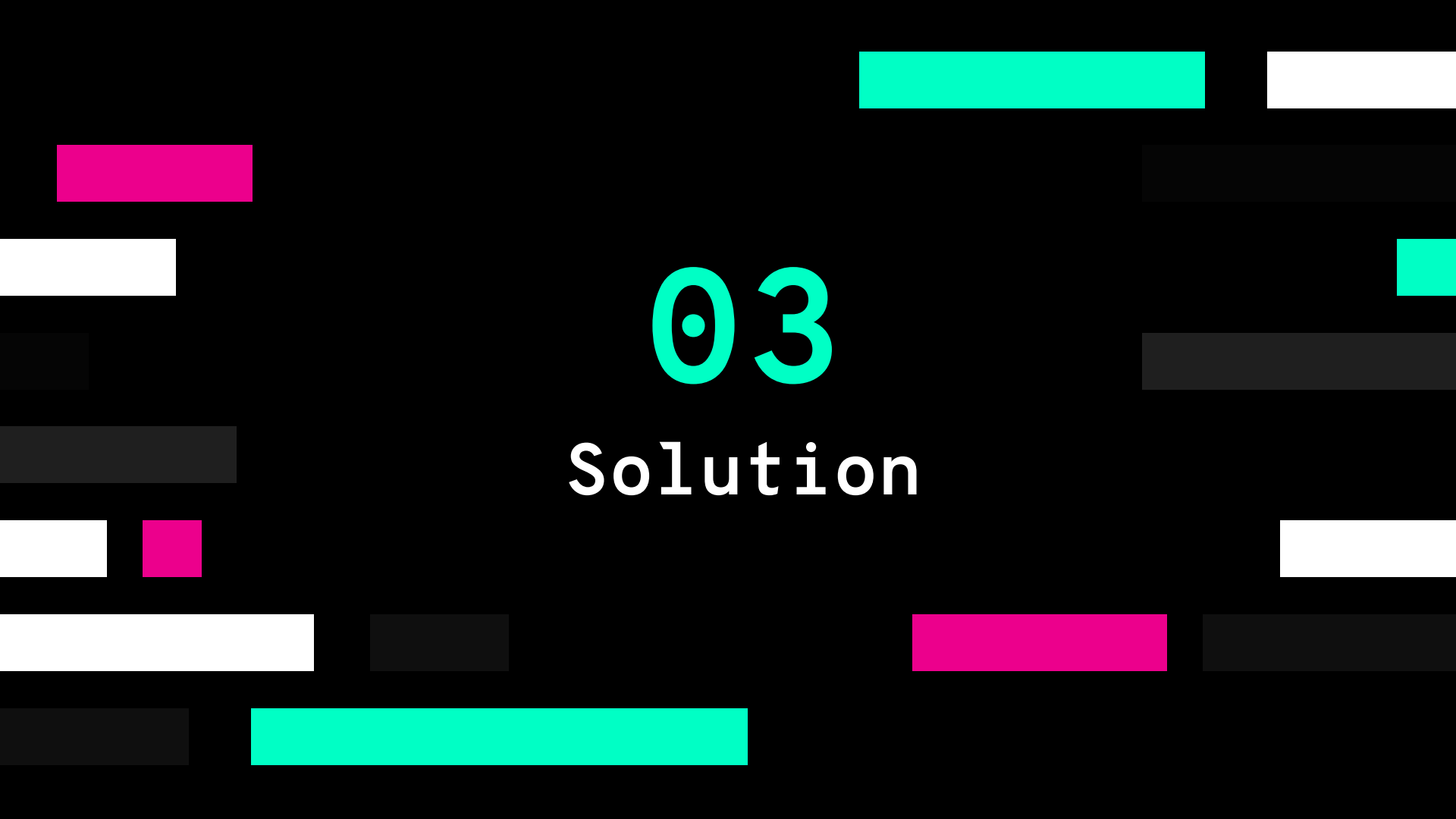




02

Samples





03

Solution

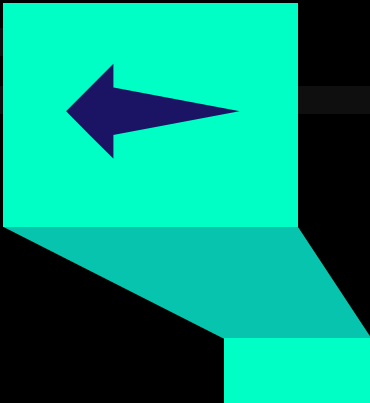
Quicksort Approach

Sorting list in descending order

1. Select a pivot from the list of elements (at random)
2. Create 3 arrays and get length of left and middle array:

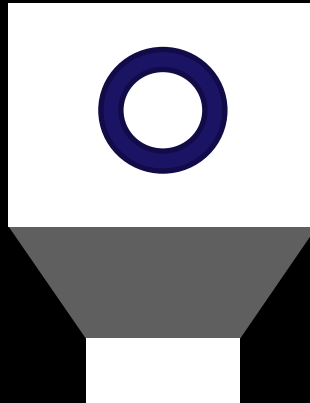
Left

$x > \text{pivot}$



Mid

$x == \text{pivot}$



Right

$x < \text{pivot}$



Recursively finding the kth largest element

```
if k <= L:  
    return self.findKthLargest(left, k)  
  
elif k > (L+M):  
    return self.findKthLargest(right, k-(L+M))  
  
else:  
    return mid[0]
```



Min Heap Approach

Min Heap

Construct Min
Heap of size k

Insert 1st k
element into min
heap

Insert remaining
elements

Repeat until
largest element
is at root

Min Heap code

```
def findKthLargest(self, nums, k):  
  
    n = nums[0:k]  
    heapq.heapify(n)  
  
    for i in range(k, len(nums)):  
  
        if nums[i] > n[0]:  
  
            heapq.heapreplace(n, nums[i])  
  
    return n[0]
```





Sorting with python function

Sort the list using python function 'sorted'
in descending order and find the (k-1)th
index.

Sorting code

```
def findKthLargest(self, nums: List[int], k: int) -> int:  
    sorted_list = sorted(nums, reverse = True)  
    return sorted_list[k-1]
```



04

Result & Analysis

Performance

	Runtime	Speed	Memory Usage
Quicksort	64 ms	72.48%	15.2 MB
Min Heap	60 ms	88.37%	15 MB
Sorting	56 ms	96.26%	15 MB

Time Complexity

$O(n \cdot \log(n))$

Quicksort Algorithm

$O(n \cdot \log(n))$

Min Heap

$O(n \cdot \log(n))$

Sorting

THANKS !

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Full code
submitted in
report

References

[1] Leetcode, 215. Kth Largest Element in an Array

<https://leetcode.com/problems/kth-largest-element-in-an-array/>

[2] Techie Delight, Ace the Technical Interviews, Find the kth largest element (2018)

<https://www.techiedelight.com/find-kth-largest-element-array/>