BLIND ~ 75

- ★
- ★★
- ★★★

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Arrays and Hashing - Revision.

① #217 Contains Duplicate

[1, 2, 3, 4, 5, 1, 2]

Return true if contains duplicate

Approach 1 → - Sort the array
- Iterate and check.

Tc :- - Sorting is $O(n \log n)$ ★
- Searching is $O(n)$

∴ Tc is $O(n \log n)$

Sc :- $O(1)$

Approach 2 → - Have a hash map
- check in HM as you iterate

Tc → $O(n)$ → searching in HM is $O(1)$

Sc → $O(n)$

② Valid Anagram

Q: given 2 strings check if one is te anagram of the other.

"abc" "def"

M_1 M_2

M_1 M_2

a b c d e f

If deleting characters from M_1 based on char from M_2 makes M_1 0 then it is anagram.

---

③ Two sum ②

Given an array of numbers

Find the indices that add upto given value. We cant sort

[2 7 11 15] : 9

ARR T

4+5 = 7

[3, 2, 4] : 6

i j

Approach 1 $O(n^2)$ Runtime.

```
for i in range (len(nums))
    for j in range (i+1, len(nums))
        check i+j == Target.
```

Approach ② $O(n)$ Runtime

2 pass hash table

- 1st pass to store values in a table
- 2nd pass to check if compliment exists.

Approach 3 :- 1 pass hash table

- Have a hash table TC $O(n)$
- as you iterate keep checking if value exists a complimentary value

Character count pattern

Hash map & sorted string : [achal/str]

④ Grouping anagrams :

Q:- Given a array of words group the anagrams.

Anagrams :- Words with same characters.

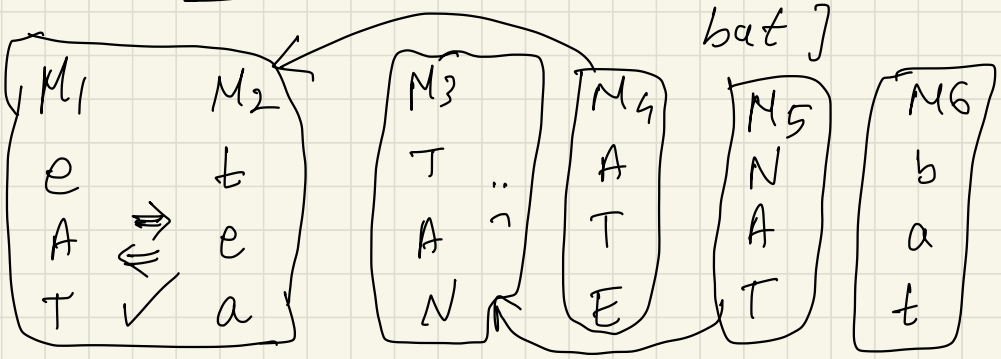
concept :- Hashing . char count

Brute force

$O(n^2)$ Each word check other words.

Approach 2

[eat, tea, tan, ate, nat, bat]



Maps = $O(n)$

checking is $O(n)$ $\therefore O(n^2)$

Sort the strings

[aet, aet, ant, aet, ant, abt]

(Use map to store old values)

Map

aet :- [eat, tea, ate]

abt :- [bat]

ant :- [tan, nat]

TC :- N : length of strings arr.

k : length of longest string

log k : time for sorting the string.

$O(N \cdot k \cdot \log k)$

Approach 3 :- Using number count

- Have a map of string : arraylist
- for each string have an array of size 26 (representing 26 alphabets)
- Set the count in array based on frequency of occurance of characters
- Convert array to string representation.
  #count a #count b #count c ....
- add this and string to map
- Return values at the end.

---

⑤ # 347 Top k frequent elems.

Q:- Given array of nums, find top k frequent nums.

[1, 1, 1, 2, 2, 3]

C

- 10^5 nums
- negative nums
- There will be k unique nums

No info about sort.

TC better than $O(n \log n)$

App 1

Frequency count

$O(n)$

basically $O(n)$ or $O(\log n)$

TC

Naive approach

① num → Map → freq. $O(n)$

② Sort (Map, freq) $O(N \log N)$

③ loop (Map, k) $O(k)$

SC

$O(n)$

as the hash map is sorted when we loop, we can access top k or bottom k elements.

Optimizing this approach

For problems that talk about top k or bottom k elements

it is a good idea to use

Heap

In this problem we only care about the top k most frequent elements.

We are going to use min heap.

Min Heap - Priority queue

is the data structure for creating a heap.

1. Complete binary tree
2. Each node is ≤ value of children
   - We use min heap as we want to keep track of highest freq elems.

Eg:- [1, 1, 1, 2, 2, 3, 4], k = 2

① Make the hash map.

{1 : 3, 2 : 2, 3 : 1, 4 : 1}

Here the focus is on the frequency.

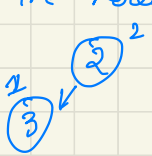
Look into how min heap works

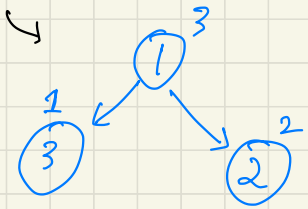
① Insert node 1 with value of 3.

② Insert 2 with value of 2

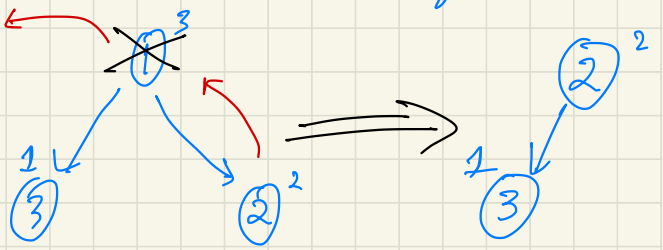
③ since min heap has property 2 the nodes flip.

④ Insert 3,

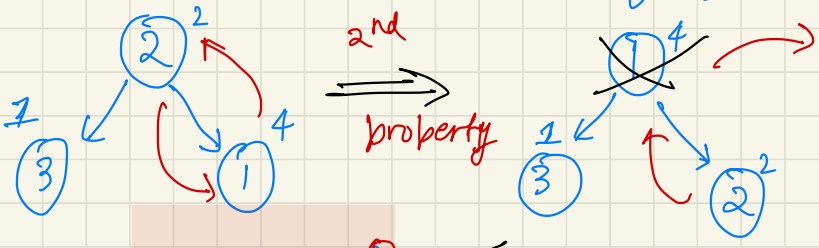


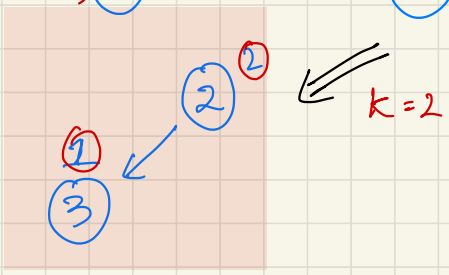


⑤ Now since we only need top 2 frequent elements, we cut down the elements in the heap and keep only top 2 elements.



⑥ Insert 4 that has freqency of 1

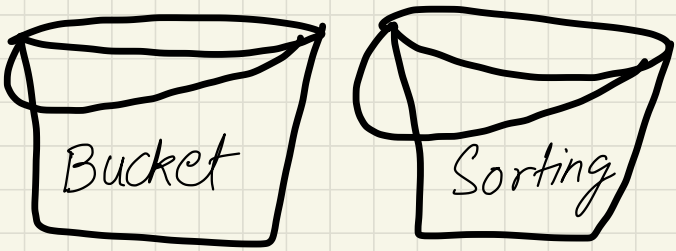




⑦ Extract the elements from the heap.

[2, 1]

Approach 3



In an array of elements of size N.

Each element can have a frequency of 1 or N.

∴ We create N buckets to hold the various elements.

Step 1 :- Create N buckets (an array of arrays)

Space complexity O(n)

TC :- O(1)

Step 2 :- Create a hash map and make note of all frequencies.

TC :- O(n)

SC :- O(n)

Step 3 :- Iterate through HM and add nums to bucket matching the frequency.

TC :- O(n)

No SC for this step.

Step 4 :- Reverse iterate the bucket array and pour all elements into a single array.

TC

O(n)

SC(O(n))

Step 5 :- Iterate through array list / array and return top k elems.

TC :- O(k)

Total TC is O(N)

(6) Product of array except self

#238

→ given an array of numbers, return an array that has product of all numbers except itself.

→ Do not use division.

→ Write alg in O(n) TC.

Eg:- [-1, 1, 0, -3, 3] [1, 2, 3, 4]

out [0, 0, 9, 0, 0] [24, 12, 8, 6]

Brute force without using division

Approach 1

① create an array → O(n) SC
keep filling with left product

② Iterate from other end.
create a right product array

③ Combine both arrays.

O(1) Space complexity

Approach 2

Last problem, we had O(n) SC as we created 2 separate arrays and then merged them at the end.

Here we do it with 1 single output array.

Eg:- [-1, 1, 0, -3, 3]

lp 1 rp 1

L [1, -1, -1, 0, 0]

R [0, 0, -9, 3, 1]

out [0, 0, 9, 0, 0]

7) K^{th} Largest element #703

703. Kth Largest Element in a Stream

Easy 3.6K 2.1K

Amazon Facebook Google ...

Design a class to find the k^{th} largest element in a stream. Note that it is the k^{th} largest element in the sorted order, not the k^{th} distinct element.

Implement `KthLargest` class:

- `KthLargest(int k, int[] nums)` Initializes the object with the integer `k` and the stream of integers `nums`.
- `int add(int val)` Appends the integer `val` to the stream and returns the element representing the k^{th} largest element in the stream.

Example 1:

Input
```
["KthLargest", "add", "add", "add", "add", "add"]
[[3, [4, 5, 8, 2]], [3], [5], [10], [9], [4]]
```
Output
```
[null, 4, 5, 5, 8, 8]
```

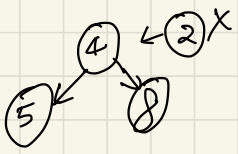
Explanation
```
KthLargest kthLargest = new KthLargest(3, [4, 5, 8, 2]);
kthLargest.add(3);   // return 4
kthLargest.add(5);   // return 5
kthLargest.add(10);  // return 5
kthLargest.add(9);   // return 8
kthLargest.add(4);   // return 8
```

```java
class KthLargest {

    public KthLargest(int k, int[] nums) {

    }

    public int add(int val) {

    }
}

/**
 * Your KthLargest object will be instantiated and called as such:
 * KthLargest obj = new KthLargest(k, nums);
 * int param_1 = obj.add(val);
 */
```

Solution Approach 1

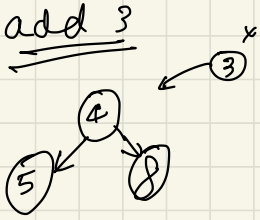
- We maintain a heap that only holds the top k elements.
- This must be a min heap - the smaller element is tossed out.
- [[3, [4, 5, 8, 2]], [3], [5], [10], [9] [5]]

k = (3). We can hold 3 elements.

(1) 

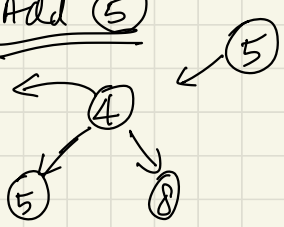
2 is added and also popped out.

(2) add 3



3 is popped out
So 4 is the 3rd largest element in the heap.

(3) Add (5)



When 5 is added 4 is popped out
∴ 5 is 3rd largest element present.

Likewise
keep adding, popping and Return the kth largest elem present.

(8) #1046 Last Stone Weight

- Int array of stone weights.
- In each turn choose 2 heaviest stones and combine them together.

based on some rule.

- At the end there is only 1 left

Return its weight.

- If none remains, ret = 0.

Eg:- (2, 7, 4, 1, 8, 1)

(1) Construct a max priority queue.

The highest element will be polled first.

(2) Poll 2 elements and add the combined result.