

1. Given an array of integers. Find the Inversion Count in the array.
2. For an array, inversion count indicates how far (or close) the array is from being sorted. If array is already sorted then the inversion count is 0. If an array is sorted in the reverse order then the inversion count is the maximum.
3. Formally, two elements $a[i]$ and $a[j]$ form an inversion if $a[i] > a[j]$ and $i < j$.

Handwritten notes for Inversion Count:

Array: 2, 4, 1, 3, 5

Indices: 0, 1, 2, 3, 4

Pairs forming inversions: (2,1), (4,1), (4,3)

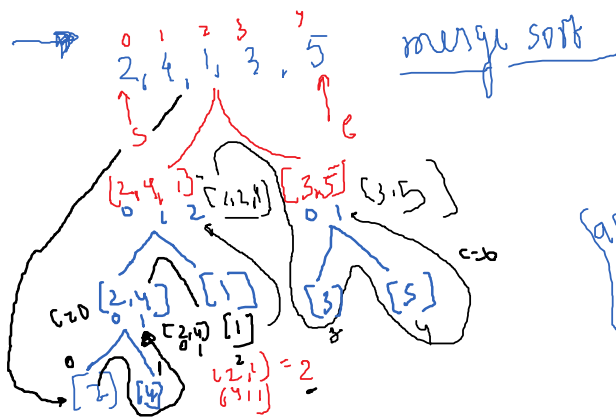
Count: 3

Code snippet:

```
for (i = 0; i < n; i++)
    for (j = i + 1; j < n; j++)
        if (arr[i] > arr[j])
            invr++;
```

Complexity: $O(n^2)$

```
int cntInversion(vector<int>&arr, int n)
{
    int invr = 0;
    for (int i = 0; i < n; i++)
    {
        for (int j = i + 1; j < n; j++)
        {
            if (arr[i] > arr[j] && i < j)
            {
                invr++;
            }
        }
    }
    return invr;
}
```



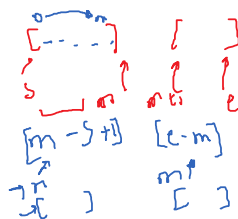
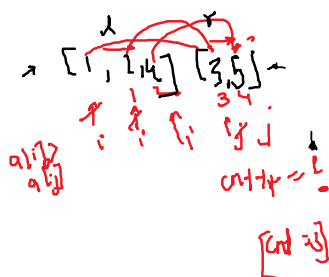
Handwritten notes:

$m = 2$

$a[i] > a[j]$

$i < j$

Handwritten note: **Order - pre - post**



Handwritten notes:

Inv = 2

Count = 0

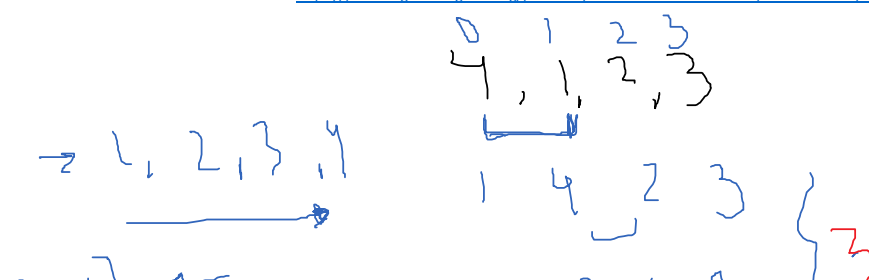
Count = 1

Count = 3

Handwritten note: 2 →

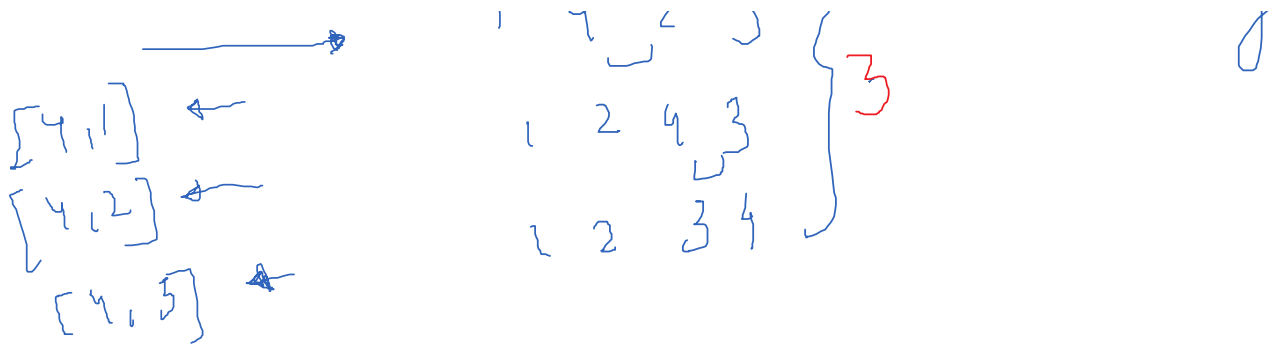
Minimum number of swaps needed

From <https://practice.geeksforgeeks.org/problems/minimum-number-of-swaps-needed2136/1#>



Handwritten note: $a[i] > a[i+1]$

$i < j$



3 →

Global and Local Inversions

1, 0, 2

local or global
 $a[i] > a[i+1]$

inv min → 0 (sorted)
 inv max → n (max)

→ $\begin{matrix} 0 & 1 & 2 \\ 2 & 1 & 0 \end{matrix}$ → $\begin{matrix} (2,1) \\ (2,0) \\ (1,0) \end{matrix}$



✓ $lc=1$ True
 $g=1$

✓ $l \rightarrow l, g$

$0-1=1$
 $1-0=1$
 $2-2=0$



$lc = (2,0) - (1,0)$
 $g = (2,0) - (1,0)$

1 → 2

idx. val [rdx] > 1
 $0-1=1$

$1-2=1$
 $2-0=2$
 $i - a[i]$

Max → dec → 4 3 2 1

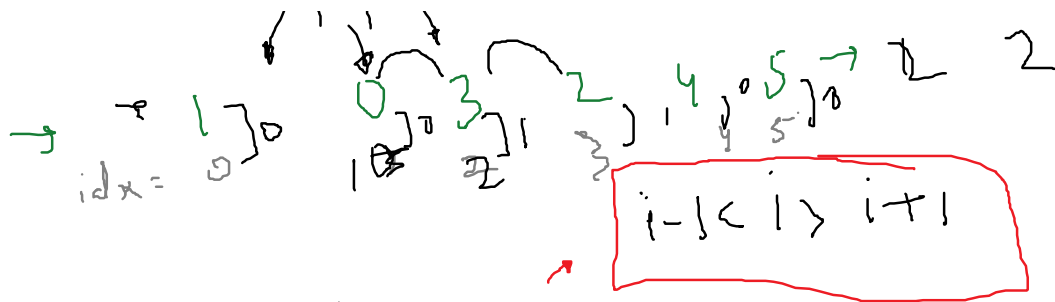
lci gi
 0 0

→ 0 → 0 1 → 0 2 → 3 → 0



2 2





$abs(a[idx]) > 1$ - false
true

arr = [9, 1, 5, 4, 8, 7, 3, 2, 6, 0]

idx = 0 1 2 3 4 5 6 7 8 9

Binary search 1

12 July 2022 08:32

Linear Search.

→ 1 2 4 3 6 7

Worst - $O(n)$
Best - $O(1)$ sorted

① → $O(1)$
② → $O(n)$
③ → $O(n)$

if over array of sorted

Binary Search

nums = [-1, 0, 3, 5, 9, 12], target = 9
4

→ 9

①

0 1 2 3 4 5
-1 0 3 5 9 12

↑
5

↑
3

↑
5

↑
9

↑
12

520
e: n-1

mid = $\frac{5+0}{2} = 2$

⇒ $\frac{3+5}{2} = 4$

9 == 9
mid = 4

3 < 9

7 = 2
mid = $\frac{5+0}{2} = 2$

⇒ 2 < mid
⇒ mid = $\frac{0+1}{2} = 0$

mid = -1

-1 < 2

0 1 2 3 4 5
-1 0 3 5 9 12

↑
5

↑
3

↑
5

↑
9

↑
12

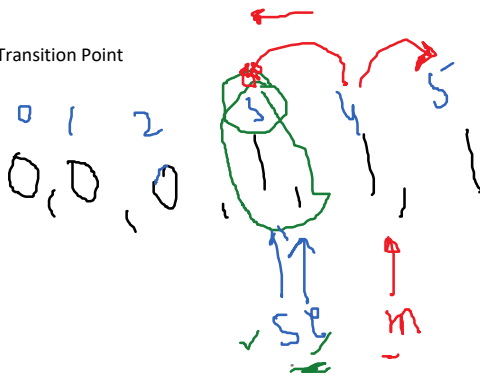
0 = 0
0 = 2

STL ⇒ $\text{binary_search}(\text{num.begin}(), \text{num.end}(), \text{target})$

→ lower-bound
→ upper-bound

3

Find Transition Point



$(s \leftarrow e)$

$Hm = 3$

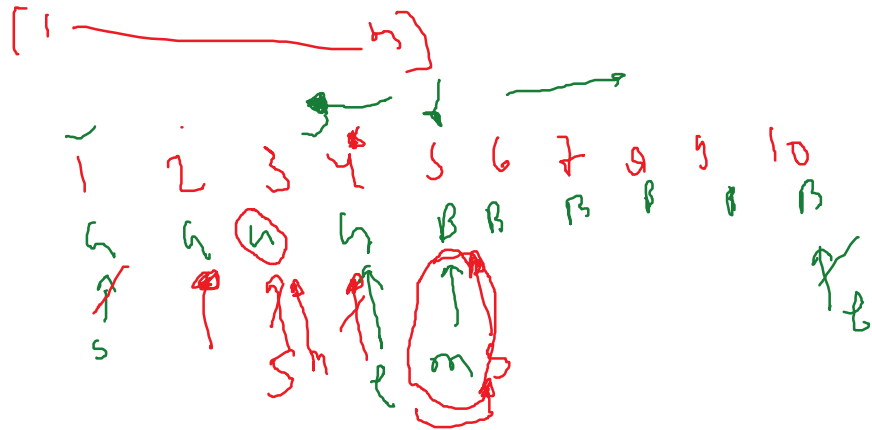
$m = 2$

$m = 4$

$nli] > s, m+1$
 $0 \rightarrow 1 \rightarrow r = m-1$
 $nli] = 1 \rightarrow e = m-1$

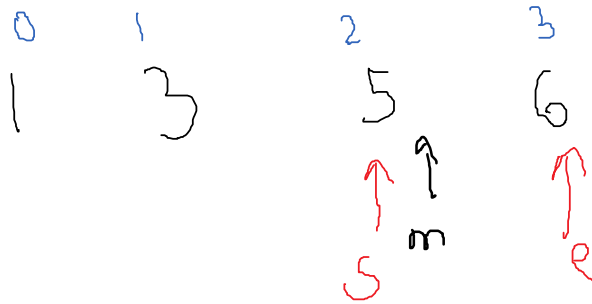
3

Bad value



4

Search Insert Position



{target = 5}

$s = 0$

$e = n-1;$

$while(s < e)$
 $\{$



Find First and Last Position of Element in Sorted Array

0 1 2 3 4 5
 5, 7, 7, 8, 8, 10

$T = 8$

11 12 13 14 15

- 1 first idx
- 2 last idx

Fix

Handwritten notes for a Huffman tree construction. At the top, a partial tree shows a root node with two children, one of which is a leaf node labeled 'a'. Below this, a list of numbers is shown: 0, 1, 2, 3, 4, 5, 6, 7, 7, 8, 8, 10. The number 3 is circled. To the right of the list, there are red arrows pointing to the right and upwards. At the bottom, there are red arrows pointing upwards and the text 'm 5 e'.

$f = 0$
 $g = 0$
 $h = 0$
 $i = 0$
 $j = 0$
 $k = 0$
 $l = 0$
 $m = 0$
 $n = 0$
 $o = 0$
 $p = 0$
 $q = 0$
 $r = 0$
 $s = 0$
 $t = 0$
 $u = 0$
 $v = 0$
 $w = 0$
 $x = 0$
 $y = 0$
 $z = 0$

Binary Search 2

12 July 2022 22:56

No of occ

N = 7, X = 2
Arr[] = {1, 1, 2, 2, 2, 2, 3}
Output: 4

→ 1, 1, 2, 2, 2, 2, 3

5 - 2 ≠ 1

4

22 < 25
25

$m = r/2$

Booker

l wrong

f = mid

4 > 25

smile

res = mid 11/2 = 5

33 < 25
with mid

① val > mid

f = mid
l = m

② val < mid
f = mid
l = m + 1

0 1 2 3 4
[7, 14, 18, 25, 30]

↑ ↑ ↑

18

f = -1
l = 3
mid

→ [5, 6, 9, 10, 11]

f = -1
l = 5

f = 12
l = -1

f = 5
l = 5

3 →
h = [2, 3, 4, 9, 11]

h = [1, 5, 8]

Handwritten diagram illustrating a B-tree structure. The root node is labeled $h = [2, 5, 14, 9, 11]$. The tree has five leaf nodes, each containing a range of values. Annotations include $\log n$ and \log to indicate the height and search complexity of the tree.

Sqrt(x)

100
50

24 25

↑ ↑
 ϵ_m

42 13 18 24

s m e

17

13 Ts

15 M

✓ ✓
1-10

25

6 25 >

(12)

18 12 x 1.2 < 1.4

16 x 9 > 100

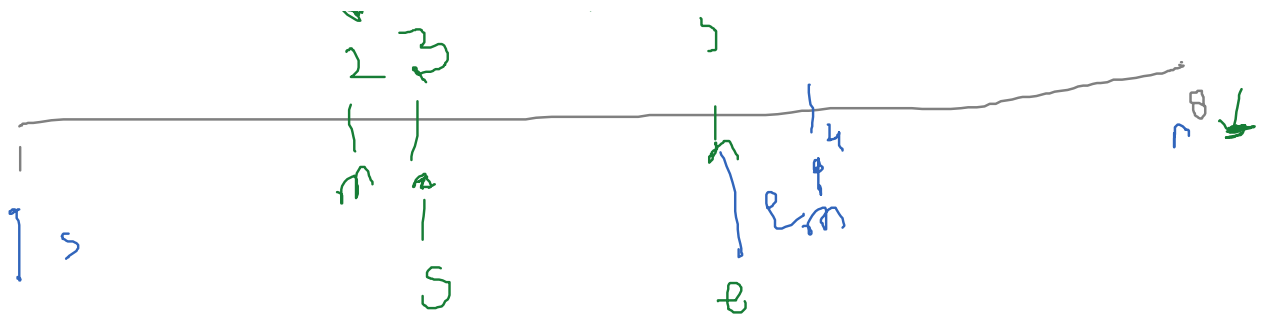
25 x 15 = 100

(8)

① 8 ✓
② 4
③ 64
✓ ④ 100
⑤ 1000

14 1 10
= 100 : 50

2 3



14 July 2022 08:43

Find Minimum in Rotated Sorted Array

Suppose an array of length n sorted in ascending order is **rotated** between 1 and n times. For example, the array `nums = [0,1,2,4,5,6,7]` might become:

- [4,5,6,7,0,1,2] if it was rotated 4 times.
- [0,1,2,4,5,6,7] if it was rotated 7 times.

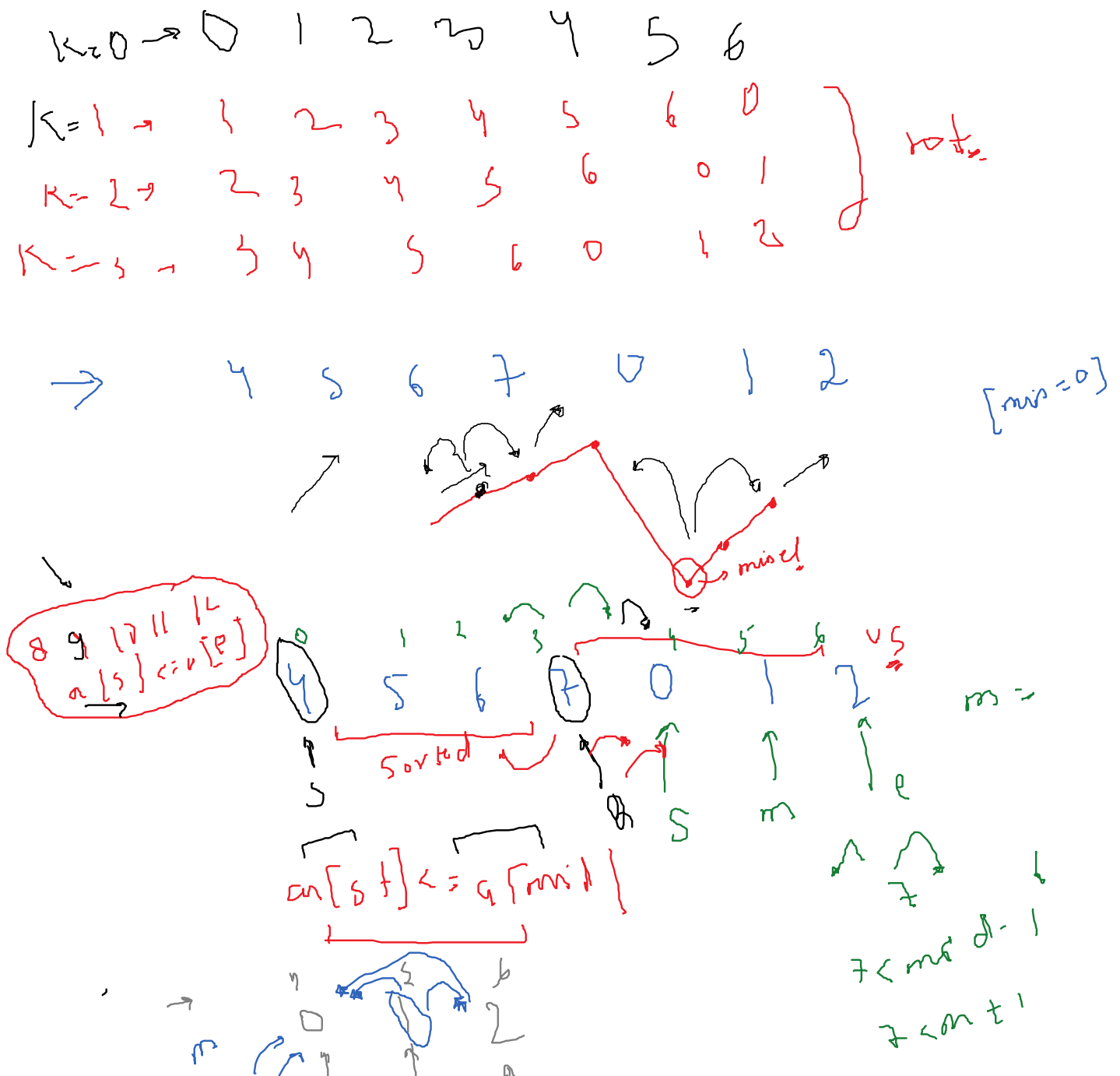
Notice that **rotating** an array $[a[0], a[1], a[2], \dots, a[n-1]]$ 1 time results in the array $[a[n-1], a[0], a[1], a[2], \dots, a[n-2]]$.

Given the sorted rotated array `nums` of **unique** elements, return *the minimum element of this array*.

You must write an algorithm that runs in $O(\log n)$ time.

[4,5,6,7,0,1,2]

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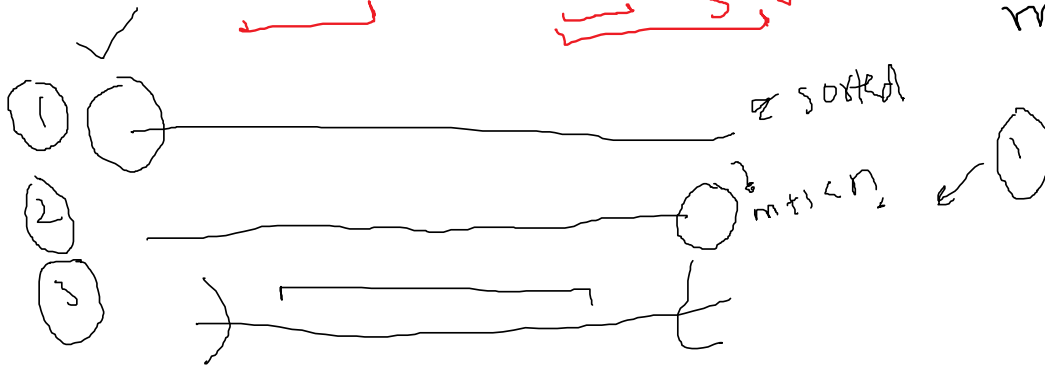
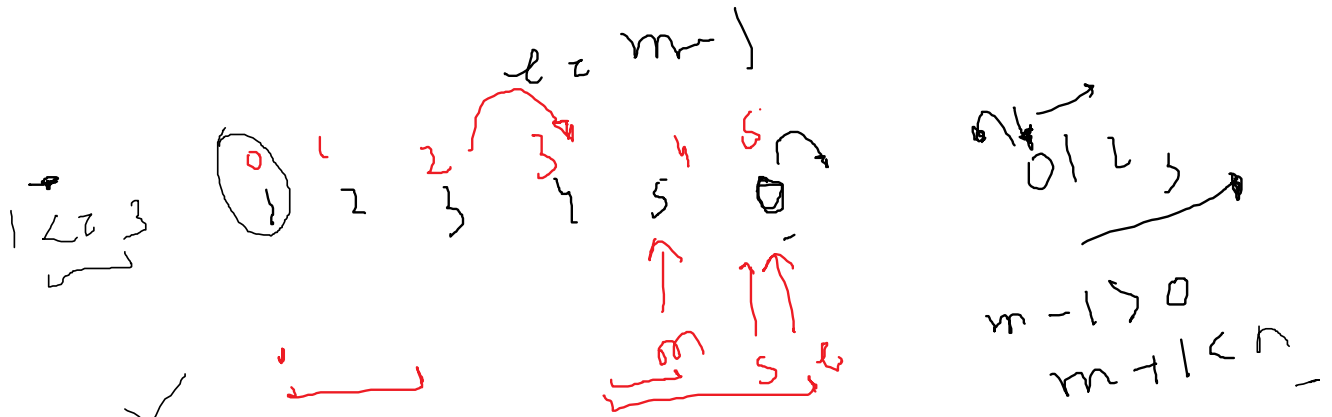


7 cont.

- ① $mid < mid + 1$ & $mid < mid - 1$
- ② $5 \rightarrow 1 \rightarrow$ that el be sorted:
- ③ Move on which dir \rightarrow unsorted

$arr[st] < arr[mid]$

left is sub
 $\rightarrow R = mid$



Number of Rotations

1 2 3 $n = 3$

1/.n = 1	2	3	1
2/.n = 2	3	1	2
3/.n = 3	1	2	3
4/.n = 1	2	3	1

$\begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{matrix}$



Search a 2D Matrix

1	3	5	7
10	11	16	20
23	30	34	60

Input: matrix = [[1,3,5,7],[10,11,16,20],[23,30,34,60]], target = 3
Output: true

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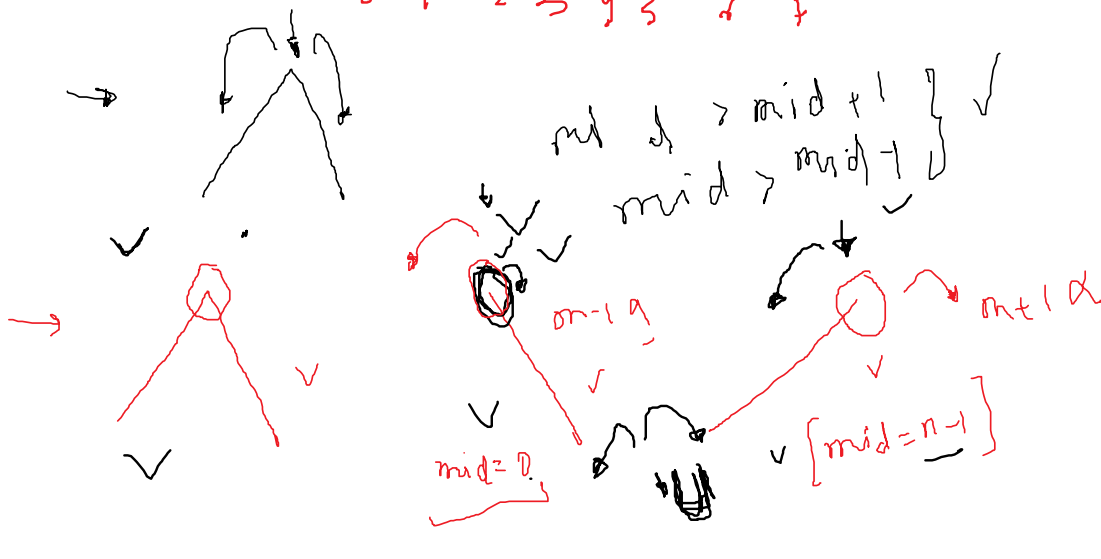
$3177 \checkmark$
 $3120 \checkmark$
 31710α
 34234α
 $34 > 30$

Peak Index in a Mountain Array

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Ans = 4



$4732 \checkmark$
 $4 > 3$



Binary search 4

15 July 2022 08:47

Count zeros in a sorted matrix

$N = 3$

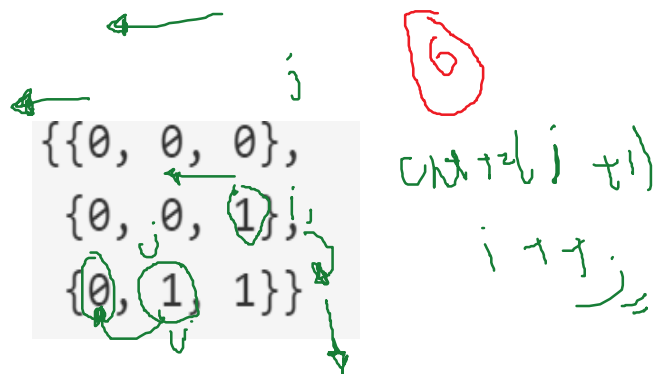
$A = \{\{0, 0, 0\},$
 $\{0, 0, 1\},$
 $\{0, 1, 1\}\}$

Output: 6

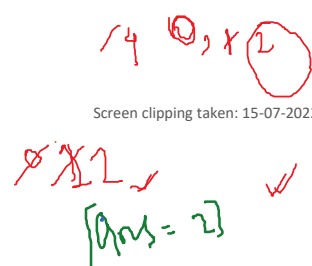
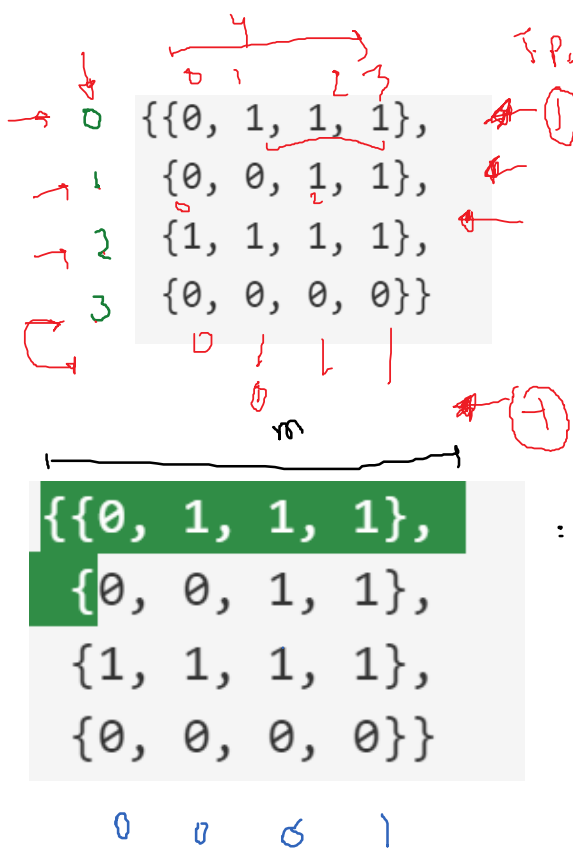
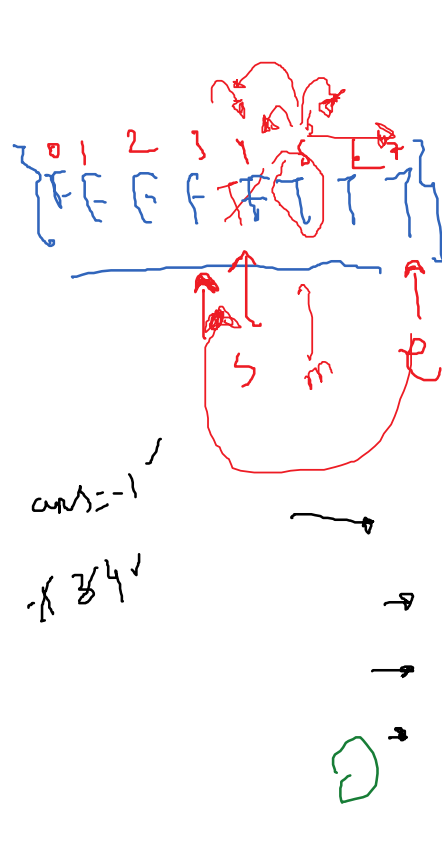
Explanation:

The first, second and third row contains 3, 2 zeroes respectively.

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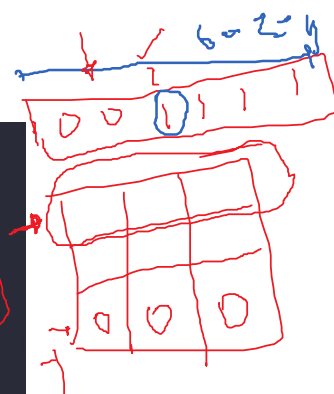


Row with max 1



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```
int rowWithMax1s(vector<vector<int>> arr, int n, int m) {
    int ans = -1;
    int noofones = 0;
    for(int i = 0; i < n; i++)
    {
        int tpo = tp(arr[i], 0, m - 1);
        if(tpo != -1 && m - tpo > noofones)
        {
            ans = i;
            noofones = m - tpo;
        }
    }
    return ans;
}
```



Single Element in a Sorted Array

0 1 2 3 4 5 6 7 8
[1,1,2,3,3,4,4,8,8]

Did A → ... → odd
... → even

even

0 1 2 3 4 5 6 7 8
[1,1,2,3,3,4,4,8,8]

4 - 8
= 4, 10 + 10 = 4

$m := m + 1$
 $m := m - 1$

$m = s + 1$
 $= 4 - 0 + 1 = 5, 1 \cdot 2 = 1$

[3,3,7,7,10,11,11]

3 | 11 = 11

Binary search on ans

16 July 2022 09:02

Allocate minimum number of pages

N = No. of books
 A_i = No. of pages

M = students

You are given N number of books. Every i th book has A_i number of pages. The books are arranged in ascending order.

You have to allocate contiguous books to M number of students. There can be many ways or permutations to do so. In each permutation, one of the M students will be allocated the maximum number of pages. Out of all these permutations, the task is to find that particular permutation in which the maximum number of pages allocated to a student is the minimum of those in all the other permutations and print this minimum value.

Each book will be allocated to exactly one student. Each student has to be allocated at least one book.

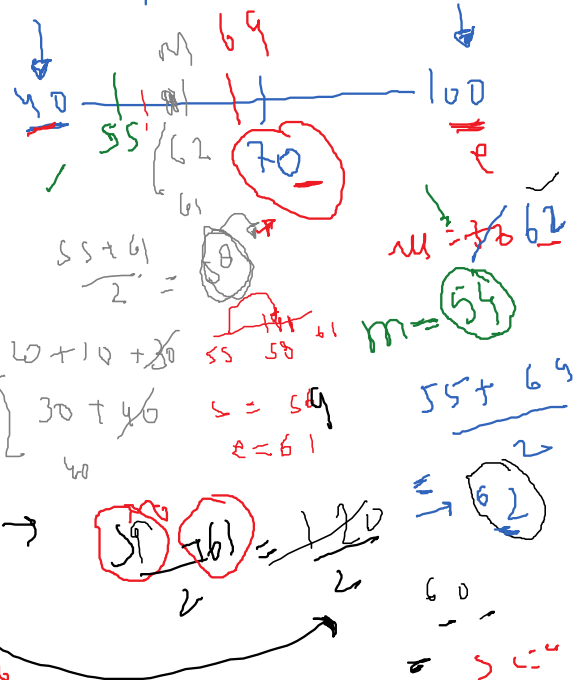
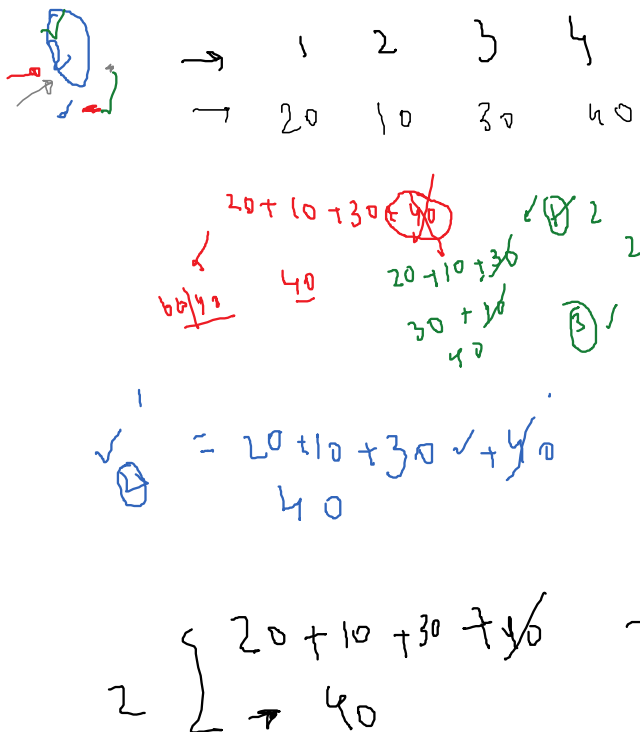
Note: Return -1 if a valid assignment is not possible, and allotment should be in contiguous order (see the explanation for better understanding).

$N = 4$
 $A[] = \{12, 34, 67, 90\}$
 $M = 2$

Output: 113

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Painter's Partition Problem

Given 2 integers A and B and an array of integers C of size N .

Element $C[i]$ represents length of i th board.

You have to paint all N boards $[C_0, C_1, C_2, \dots, C_{N-1}]$. There are A painters available and each of them takes B units of time to paint 1 unit of board.

Calculate and return minimum time required to paint all boards under the constraints that any painter will only paint contiguous sections of board.

- 2 painters cannot share a board to paint. That is to say, a board cannot be painted partially by one painter, and

- 2 painters cannot share a board to paint. That is to say, a board cannot be painted partially by one painter, and partially by another.
- A painter will only paint contiguous boards. Which means a configuration where painter 1 paints board 1 and 3 but not 2 is invalid.

e ans % 10000003

2

52

A = 2

B = 5

C = [1, 10]

nums = [7, 2, 5, 10, 8], m = 2

7 2 5 10 8

② $7+2+5+10$
 $10+8$
 $7+2+5+10$
 $10+8$

10 32
 20 21
 10 20
 15
 18
 16 18
 16 18

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875. Koko Eating Bananas

Medium 4566 202 Add to List Share

Koko loves to eat bananas. There are n piles of bananas, the i^{th} pile has $piles[i]$ bananas. The guards have gone and will come back in h hours.

Koko can decide her bananas-per-hour eating speed of k . Each hour, she chooses some pile of bananas and eats k bananas from that pile. If the pile has less than k bananas, she eats all of them instead and will not eat any more bananas during this hour.

Koko likes to eat slowly but still wants to finish eating all the bananas before the guards return.

Return the minimum integer k such that she can eat all the bananas within h hours.

Input: piles = [3,6,7,11], h = 8
 Output: 4

example 2:

Input: piles = [30,11,23,4,20], h = 5
 Output: 30

3, 6, 7, 11

$h = 8$

$k =$

3, 6, 7, 11

$k =$

$k = 2$

$k = 3$

$k = 4$

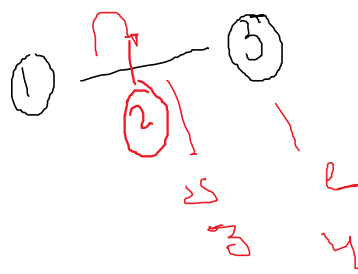
$k = 5$

$3 + 6 + 7 + 11 = 27 \rightarrow F$
 $2 + 3 + 4 + 6 = 15 \rightarrow F$
 $1 + 2 + 3 + 4 = 10 \rightarrow F$
 $1 + 2 + 2 + 3 = 8 \rightarrow T$

$h = 8$

k

1 3 6 11
 2 3 4 6 11
 3 6 7 11
 1 2 2 3



Handwritten diagram showing a sequence of numbers 1, 2, 3. A horizontal line connects 1 and 3. A red circle is drawn around the number 2. Red arrows point from 1 to 2 and from 2 to 3. Below the number 2, the numbers 2, 3, and 4 are written in red.

Handwritten diagram showing a sequence of numbers 1, 2, 3. A horizontal line connects 1 and 3. A red circle is drawn around the number 2. Red arrows point from 1 to 2 and from 2 to 3. Below the number 2, the numbers 2, 3, and 4 are written in red.