

7:05  
AM

requests if you know an optimized idea of a problem, that is great! though please wait for the flow of class content till we reach to optimized solution step by step. thanks.

Topics:  
1. String 'ag' pairs.  
2. Shortest subarray Max Min  
3. Leaders of subarray

tip:  
Consistency  
is key

## Carry Forward

P1 Given a string  $S$  of lower case alphabet,

Amazon return count of  $(i, j)$  such that:  
Constraint ( $\text{len}(S) \leq 10^5$ )

$i < j$   
 $S[i] \rightarrow 'a'$   
 $S[j] \rightarrow 'g'$

ex  $S = a^0 b^1 e^2 g^3 a^4 g^5$   
1  $\overset{i}{(0, 3)}$   
2  $(0, 5)$   
3  $(4, 5)$

ans=3

'ag'  
'a...g'  
~~'g...a'~~?

Quiz

$S = a^0 c^1 g^2 d^3 g^4 a^5 g^6$   
 $(i, j)$   
1  $0, 2$   
2  $0, 4$   
3  $0, 6$   
4  $5, 6$

ans=4

Quiz

$S = b^0 c^1 a^2 g^3 g^4 a^5 a^6 g^7$   
 $(i, j)$   
1  $2, 3$   
2  $2, 4$   
3  $2, 7$

ans=5

## idea 1

```
int countAg1 (string s){  
    n = s.Len // Length of string s
```

Quiz

TC:  $O(n^2)$

SC:  $O(1)$

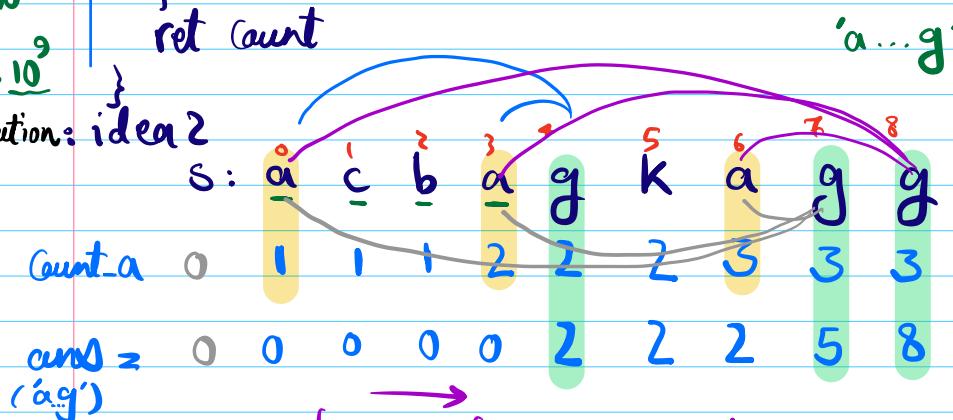
$$(10^5)^2 = 10^{10}$$

each itr is 100 op.

$$100 \times 10^{10} = 10^{12}$$
$$\approx 10^2 \times 10^10$$
$$= 10^{12} \rightarrow 10^9$$

```
    Count = 0  
    for(i=0; i<n, i++){  
        if(s[i] == 'a'){  
            for(j=i+1; j<n; j++){  
                if(s[j] == 'g'){  
                    Count += 1  
                }  
            }  
        }  
    }  
    ret Count
```

optimization: idea 2



start from left, go to right, keep track of

#of 'a's so far. if we observe a 'g', this new 'g'

makes a new 'a...g' pair with all prev. 'a's.

g x y z a b g  
Count-a 0 0 0 0 1 1

Quiz

TC: O(n)

SC: O(1)

```
int CountAg2(string s){  
    n = s.Len  
    countA = 0  
    ans = 0  
    for(i=0; i<n; i++){  
        if(s[i] == 'a'){  
            countA += 1 // increase #of 'a's so far  
        }  
        else if(s[i] == 'g'){  
            ans += countA  
        }  
    }  
    ret ans  
}
```

## Amazon

P2

Given an array, return the length of the smallest

continuous section of an array

sub array which contains both min & max of the array.

$[s, e]$  endIndex

$s \leq e$  startIndex

int

inclusive

$e - s + 1 \leftarrow \text{len}$

ans = 2

$\min = 1$

$(0, 1)$

$s=0$

$S=1$

$S=2$

$\max = 100$

$(1, 5)$

$(0, 6)$

$(1, 1)$

$(2, 2)$

$\frac{5}{5}$

$(4, 5)$

$(0, 0)$

$(2, 1)$

$(2, 3)$

$\frac{2}{2}$

$\frac{5}{2}$

$(1, 2)$

$(2, 2)$

$\frac{(n-1, n-1)}{\#1}$

$\vdots$

$\vdots$

$(0, 1)$

$(1, 2)$

$\vdots$

$\vdots$

$\vdots$

$(0, 2)$

$(1, 3)$

$\vdots$

$\vdots$

$\vdots$

$(0, 3)$

$(1, 4)$

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$(0, 4)$

$(1, 5)$

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$(0, 5)$

$(1, 6)$

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$(0, 6)$

$(1, 7)$

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$(0, 7)$

$(1, 8)$

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$\vdots$

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$(0, 8)$

$(1, 9)$

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$(0, 9)$

$(1, 10)$

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$(0, 10)$

$(1, 11)$

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$(1, 48)$

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$(1, 49)$

$\vdots$

$\vdots$

$\vdots$

$(0, 49)$

$(1, 50)$

$\vdots$

$\vdots$

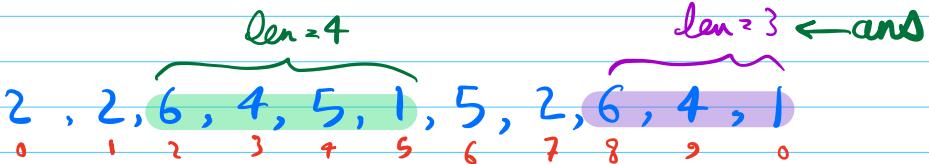
$\vdots$

</div

ex      

$\min = 1$

$\max = 6$

Quiz      

$\min = 1$

$\max = 6$

break



optimized

please

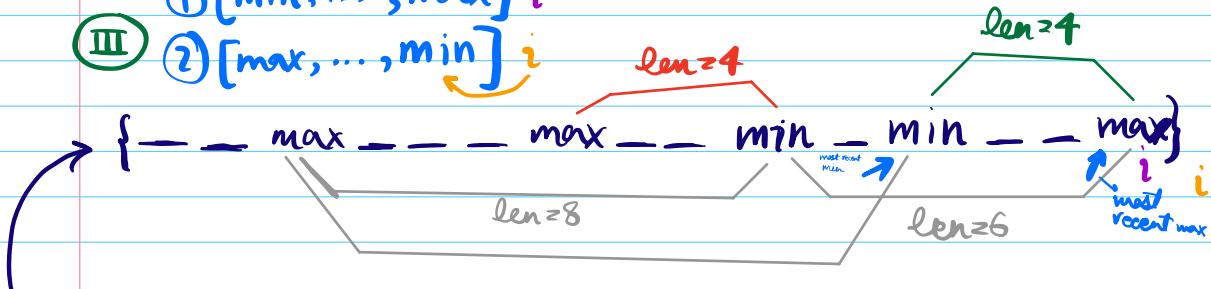
implementation idea?

pay attention

(I) shortest subarray that contain min & max has exactly one occurrence of min and one occurrence of max  
 $(\min \dots \max \times \times)$

(II) in the shortest subarray that contain min & max, the min & the max are at the edges of the subarray  
 $[\min, \dots, \max, \times \times]$

(III)  $\begin{cases} 1. [\min, \dots, \max] \\ 2. [\max, \dots, \min] \end{cases}$



3 4 6 3 2 3 6 2 3 1 3 1 3 4 6

int smallestSubarrayMinMax(int a[]){  
 min, max, ans = INT-MAX → or n ← len of array  
 // find min & max in array a O(n)

l MinIndex = -1 // most recent min on the left of i

l MaxIndex = -1 // most recent max on the left of i

for(i=0; i<n; i++){

TC: O(n+n) = O(n); if(a[i] == min){

SC: O(1)

l MinIndex = i

if(lMaxIndex != -1){

ans = Math.min(ans, i - lMaxIndex + 1)

$e-s+1$   
len

x  
else if(a[i] == max){

bug

l MaxIndex = i

if(lMinIndex != -1){

ans = Math.min(ans, i - lMinIndex + 1)

$e-s+1$   
len

ret ans

}

	$5 - 2 + 1 = 4$ $8 - 5 + 1 = 4$	$10 - 8 + 1 = 3$
dry run?	$2, 2, 6, 4, 5, 1, 5, 2, \underbrace{6, 4, 1}_{i}$ 0 1 2 3 4 5 6 7 8 9 10	
$\min = 1$	$lMaxIndex$	-1   -1 -1 2 2 2 2 2 8 8 8
$\max = 6$	$lMinIndex$	-1   -1 -1 -1 -1 -1 5 5 5 5 5 10
	$ans$	+∞ +∞ +∞ +∞ +∞ 4 4 4 4 4 3

bug

5 or 0

edge case: {7, 7, 7, 7, 7} optional

Correct answer = 1

HW

what above code returns?

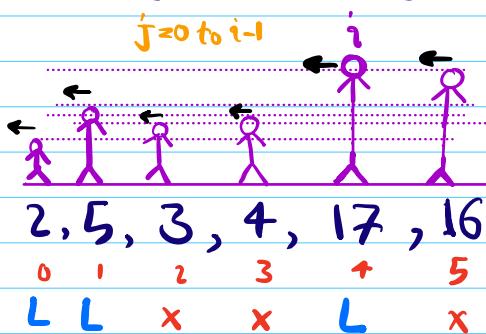
### P3 Leaders of an array

Given an array find the number of Leaders. <sup>int</sup>

Leader: An element that is greater than  
all the elements on the left side.

$$a[i] > a[0, i-1]$$

ex



idea 1, brute force

TC:  $O(n^2)$

SC:  $O(1)$

Carry Forwards: start from left, move to right.  
keep track of max so far.

optimized idea

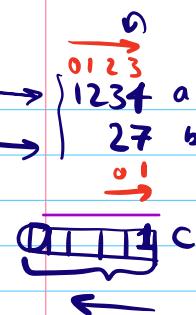
$$\text{len}(a) >= 1$$

TC:  $O(n)$  int leaders(int a[]) {  
SC:  $O(1)$  maxSofar = a[0] // max so far on the left  
CountL = 1  
for ( $i = 1; i < n; i++$ ) {  
    if ( $a[i] > \text{maxSofar}$ )  
        CountL += 1  
    maxSofar = a[i]  
}  
ret CountL;  
}

hints

for

bigInt  
add



Carry = 0

hint 1 & start from end

$$2 + 4 = 6 \leq 10$$

$$\begin{cases} r[i] \leftarrow c[i] \\ r[i] += \text{carry} \end{cases}$$

$$r = \text{Carry} + a[i] + b[i]$$

7  
4

⑤