

# USA Tutor

No Time to Paint

Analysis by David Yang

# Statement Summary

$N \leq 1e5$  paints

$Q \leq 1e5$  queries

Answer the query(L,R) such that you find  $\text{prefix}[L] + \text{suffix}[R]$

$\text{Prefix}[L]$  = minimum number of brush movements to paint up to L.

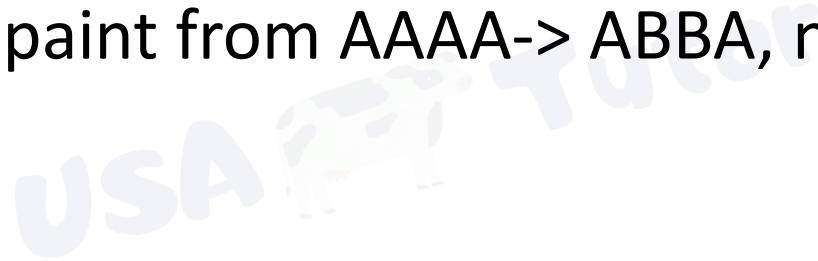
$\text{Suffix}[R]$  = minimum number of brush movements to paint up to R from the back.

# How to calculate a prefix[i]?

I would approach this with a greedy algorithm

We want to minimize the number of brush movements

And we also can only paint from AAAA  $\rightarrow$  ABBA, not BBBB  $\rightarrow$  ABBA



# Prefix[i]

If we want to minimize the number of brush movements

Then we want to paint as little as possible

Same thing as “extend a segment as far as possible”

How to extend?

# Extending a Segment

We only ever extend a segment if we can, but then how CAN we?



Sample

0 0 0 0 0 0 0 0  
A B B A A B C B

Sample

1 0 0 0 0 0 0 0  
A B B A A B C B  
↑  
+1

Sample

1 2 0 0 0 0 0 0  
A B B A A B C B  
↑  
t1



Sample

1 2 2 0 0 0 0 0  
A B B A A B C B  
↑  
+0

Sample

1 2 2 2 0 0 0 0  
A B B A A B C B  
↑  
+ D

Sample

1 2 2 2 2 0 0 0  
A B B A A B C B  
↑  
to

Sample

1 2 2 2 2 3 0 0  
A B B A A B C B  
↑  
+1

Sample

1 2 2 2 2 3 4 0  
A B B A A B C B  
↑  
+1

Sample

1 2 2 2 2 3 4 4  
A B B A A B C B  
↑

# Explanation of the Sample

We Added 1 if it didn't exist

Or if there was a contradiction.

BAA-B was a contradiction, because you could not build BAAB in 2 moves, that is just impossible.

But also, how can you check for this in code?

# Dealing with Contradictions

Segment Tree will be used, we need this to find the minimum element between a range.

In the case of BAAB, the minimum element between the Bs is an A.

$A < B$ , so this is a contradiction. You must paint a new segment



# Coding Stuff

To be able to query a range, you need to know your bounds.

You know your Right Bound. This is the current index.

The left bound must be stored.

$\text{last}['c']$  = most recent occurrence of 'c', or -1 if not existed.

Sample

$$1a_5 + = [-1, -1, -1]$$

0 0 0 0 0 0 0 0  
A B B A A B C B

Sample

$$1a_5 + = [0, -1, -1]$$

1 0 0 0 0 0 0 0  
A B B A A B C B  
↑  
+1

Sample

$$1a_5 + = [0, 1, -1]$$

1 2 0 0 0 0 0 0  
A B B A A B C B  
↑  
t1

Sample

$$1_{AS} += [0, 2, -1]$$

$\min(1, 2) = B$

1	2	2	0	0	0	0	0
A	B	B	A	A	B	C	B

↑  
+0

Sample

$$I_{AS} += [3, 2, -1]$$

$$Min(0, 3) = A$$

1	2	2	2	0	0	0	0
A	B	B	A	A	B	C	B
			↑				
			+D				

Sample

$$I_{AS} += [4, 2, -1]$$

1	2	2	2	2	0	0	0
A	B	B	A	A	B	C	B
				↑			
				to			

Sample

$$I_{AS} + = [4, 5, -1]$$

$\min(2, 5) = A$

$A < B, +1$

1	2	2	2	2	3	0	0
A	B	B	A	A	B	C	B
					↑		
					+1		



Sample

$$1_{as} + = [4, 5, 6]$$

1 2 2 2 2 3 4 0  
A B B A A B C B  
↑  
+1

Sample

$$1_{as} + = [4, 7, 6]$$

1 2 2 2 2 3 4 4  
A B B A A B C B  
↑

# Coding Nuances

You use the segment tree that can support

`update(index, value)`

`min(left, right)`

Store an array that takes a character as an index.

Then take a prefix sum. For the suffix, reverse the string.