CODEFORCES REVIEW

Contents

.1   2013D - 1900

Problem 1. [1] *Given an array A and an operator p that for each a_i and a_{i+1} where $i \geq 1$, p may decrease $|a_i - a_{i+1}|$. p can be performed by infinite times and find the minimum $|max_{i=1}^{n}(a_i) - min_{i=1}^{n}(a_i)|$*

Solution 1. *Suppose b_i is the result of performing p on a_i given the prefix of array A $\{a_1, a_2, \ldots, a_i\}$. Create a stack S to load these b_i and the count of it c_i. Then $\{a_1, a_2, \ldots, a_i\}$ is stored in S as $(b_1, c_1), (b_2, c_2), \ldots, (b_m, c_m)$. And we keep the pairs in ascending order of b_i. For each new a_{i+1}, merge it to the top if $a_{i+1} < b_m$ and then merge the top downwards until $b_k > b_{k-1}$. This way, each a_i is loaded in the array for once, the time of merging until a_i is at most i, so the time complexity if $O(n)$.*

.2   2014H - 1900

Problem 2. [2] *Given an array A, check for each a_i, if there exists $A_m = \{a_{m_1}, a_{m_2}, \ldots, a_{m_j}\}$ s.t.$a_i \in A_m$ and j is even.*

Solution 2. *If the size of A is small, for instance, 1e6, then first hashing the A in a much bigger set, for instance, $\{1, 2, \ldots, 2^{64}\}$, and check if the xor sum of the array is 0. The hash is very important, without which, several different numbers can also get xor sum 0 (e.g., $\{1, 2, 3\}$). The possibility of reaching such bad situation after hashing is $\frac{1}{2^{64}}$.*

.3   2035D - 1800

Problem 3. [3] *Given an array A and an operator p that for each a_i and a_j that $i < j$, p can update a_i to $a_i \gg 1$ and a_j to $a_j \ll 1$. p can*

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[1]https://codeforces.com/problemset/problem/2013/D

[2]https://codeforces.com/problemset/problem/2014/H

[3]https://codeforces.com/problemset/problem/2035/D

be performed by infinite times and find the maximum sum of all the prefixes of A.

Solution 3. *A little similar to 2013D. In 2013D, we store b_i and c_i, the information of a_i after p in a stack S. This approach is appliable in this problem too. In this problem $b_i = min\{b_i^j | b_i^j \ll c = a_i\}$, and c_i is the sum of all c_k that $k < i$ that can reach the maximum prefix sum from 1 to i. This sum is obtained by merging from the top of the stack downwards. If $c_k (k < i)$ is added to c_i, then b_k is popped out from the stack and added to the final sum. After the merging is terminated, we push (b_i, c_i) onto S. Each (b_i, c_i) pair is at most pushed to S by once and popped by once. So the time complexity is $O(n)$*

.4   2 0 0 9 G 1 - 1 9 0 0

Problem 4. [4] *Given an array A and an operator op that can change any element a_i to any another value. Find the minimum step required to make A a consecutive array in which $a_{i+1} - a_i = 1$ for any i.*

Solution 4. *Create an array B that $b_i = a_i - i$. Count the frequency f_i of each b_i and the answer is $A.size() - max(f_i)$.*

.5   2 0 0 2 D 1 , 2 0 2 1 C 2 - 1 9 0 0

Problem 5. [56] *Continuously query about a property P with an update before each query.*

Solution 5. *Find another easy-to-maintain property P' s.t.if P' is satisfied then P is satisfied. The time complexity of checking for P' after each update is $O(1)$ or $O(logn)$.*

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[4]https://codeforces.com/problemset/problem/2009/G1
[5]https://codeforces.com/problemset/problem/2002/D1
[6]https://codeforces.com/problemset/problem/2021/C2

.6   1991E - 1900

Takeaway 1. [7] *If I want to use two colors to color an undirected graph G, in which for every v_1, v_2 connected by edge E, their colors are different, the only thing to judge if I can make the coloring is check if the graph is bipartite.*

.7   1991D - 1900

Takeaway 2. [8] *If $a - b = kx$, and x is the power of 2, then $a \bigoplus b = x$ where $\bigoplus$ means XOR*

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[7]https://codeforces.com/problemset/problem/1991/E
[8]https://codeforces.com/problemset/problem/1991/D