560. Subarray Sum Equals K

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Given an array of integers and an integer k, you need to find the total number of continuous subarrays whose sum equals to k.

Example 1:

```
Input:nums = [1,1,1], k = 2
Output: 2
```

Constraints:

- The length of the array is in range [1, 20,000].
- The range of numbers in the array is [-1000, 1000] and the range of the integer k is [-1e7, 1e7].

Solution

Approach 1: Brute Force

Algorithm

The simplest method is to consider every possible subarray of the given nums array, find the sum of the elements of each of those subarrays and check for the equality of the sum obtained with the given k. Whenver the sum equals k, we can increment the count used to store the required result.

```
Сору
 Java
  1 public class Solution {
        public int subarraySum(int[] nums, int k) {
            int count = 0;
            for (int start = 0; start < nums.length; start++) {
               for (int end = start + 1; end <= nums.length; end++) {
                   int sum = 0;
                   for (int i = start; i < end; i++)
                       sum += nums[i];
                   if (sum == k)
 10
                        count++;
 11
              }
 12
 13
            return count;
 14
 15 }
Complexity Analysis
```

- Time complexity : $O(n^3)$. Considering every possible subarray takes $O(n^2)$ time. For each of the subarray we calculate the sum taking O(n) time in the worst case, taking a total of $O(n^3)$ time.
- Space complexity: O(1). Constant space is used.

Approach 2: Using Cumulative Sum

Algorithm

Instead of determining the sum of elements everytime for every new subarray considered, we can make use of a cumulative sum array , sum. Then, in order to calculate the sum of elements lying between two indices, we can subtract the cumulative sum corresponding to the two indices to obtain the sum directly, instead of iterating over the subarray to obtain the sum.

In this implementation, we make use of a cumulative sum array, sum, such that sum[i] is used to store the

cumulative sum of nums array upto the element corresponding to the $(i-1)^{th}$ index. Thus, to determine the sum of elements for the subarray nums[i:j], we can directly use sum[j+1] - sum[i].

```
Сору
Java
 1 public class Solution {
      public int subarraySum(int[] nums, int k) {
           int count = 0;
           int[] sum = new int[nums.length + 1];
          sum[\theta] = \theta;
          for (int i = 1; i <= nums.length; i++)
              sum[i] = sum[i - 1] + nums[i - 1];
          for (int start = 0; start < nums.length; start++) {
              for (int end = start + 1; end <= nums.length; end++) {
9
10
                  if (sum[end] - sum[start] == k)
11
                      count++;
12
              }
13
14
           return count;
15
       }
16 }
```

• Time complexity : $O(n^2)$. Considering every possible subarray takes $O(n^2)$ time. Finding out the sum

Complexity Analysis

- of any subarray takes O(1) time after the initial processing of O(n) for creating the cumulative sum Space complexity: O(n). Cumulative sum array sum of size n + 1 is used.

Approach 3: Without Space

Algorithm Instead of considering all the start and end points and then finding the sum for each subarray

corresponding to those points, we can directly find the sum on the go while considering different endpoints. i.e. We can choose a particular start point and while iterating over the end points, we can add the element corresponding to the end point to the sum formed till now. Whenver the sum equals the required k value, we can update the count value. We do so while iterating over all the end indices possible for every start index. Whenver, we update the start index, we need to reset the sum value to 0. Copy Copy Java

```
1 public class Solution {
  2
        public int subarraySum(int[] nums, int k) {
            int count = 0;
            for (int start = 0; start < nums.length; start++) {
                int sum=0;
                for (int end = start; end < nums.length; end++) {
  6
                   sum+=nums[end];
                   if (sum == k)
                        count++;
  10
  11
  12
             return count;
  13
 14 }
Complexity Analysis
```

• Time complexity : $O(n^2)$. We need to consider every subarray possible.

- Space complexity: O(1). Constant space is used.

Algorithm The idea behind this approach is as follows: If the cumulative sum(represented by sum[i] for sum upto i^{th}

Approach 4: Using Hashmap

index) upto two indices is the same, the sum of the elements lying in between those indices is zero.

Extending the same thought further, if the cumulative sum upto two indices, say i and j is at a difference of k i.e. if sum[i] - sum[j] = k, the sum of elements lying between indices i and j is k. Based on these thoughts, we make use of a hashmap map which is used to store the cumulative sum upto all the indices possible along with the number of times the same sum occurs. We store the data in the form: $(sum_i, no.ofoccurences of sum_i)$. We traverse over the array nums and keep on finding the

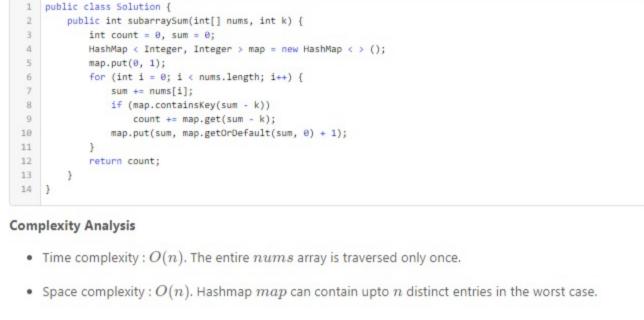
cumulative sum. Every time we encounter a new sum, we make a new entry in the hashmap corresponding to that sum. If the same sum occurs again, we increment the count corresponding to that sum in the hashmap. Further, for every sum encountered, we also determine the number of times the sum sum-k has occured already, since it will determine the number of times a subarray with sum k has occured upto the current index. We increment the count by the same amount. After the complete array has been traversed, the count gives the required result. The animation below depicts the process.

:{(0,1)} map k=7 sum :0 :0 count

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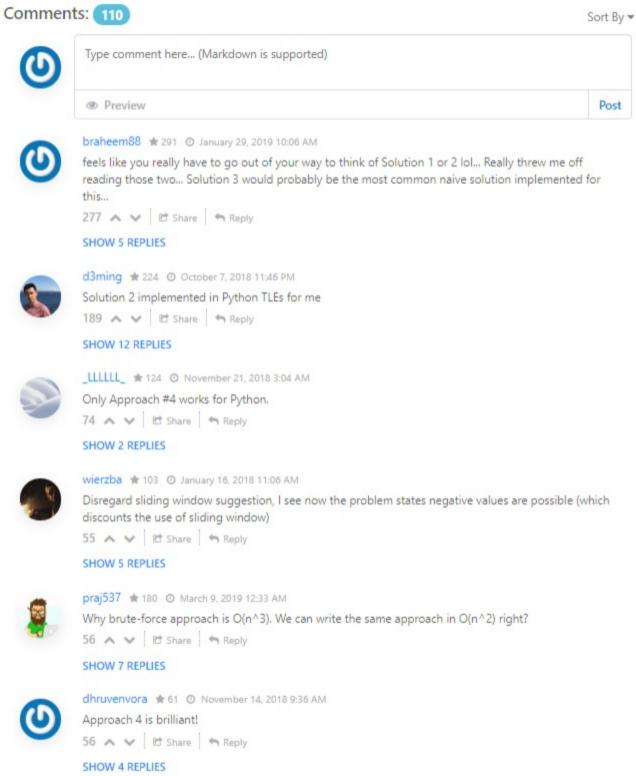
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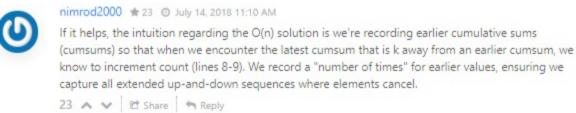


Java

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why are we doing map.put(0, 1);

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