Triplets with Smaller Sum (medium)

We'll cover the following

- Problem Statement
- Try it yourself
- - Solution
- Code
- Time complexity
- Space complexity
- - Similar Problems
- Time complexity
- Space complexity

Problem Statement#

Given an array `arr` of unsorted numbers and a target sum, **count all triplets** in it such that **`arr[i] + arr[j] + arr[k] < target`** where `i`, `j`, and `k` are three different indices. Write a function to return the count of such triplets.

Example 1:

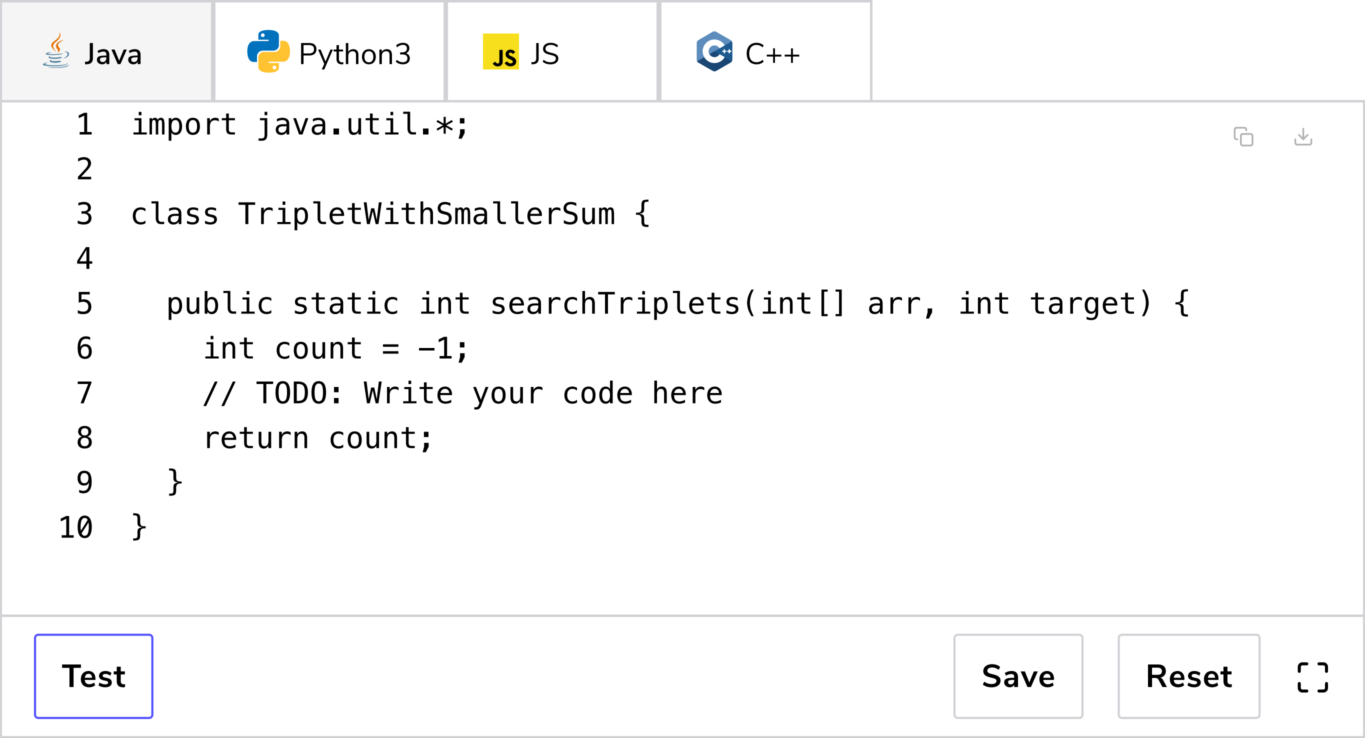
```
Input: [-1, 0, 2, 3], target=3
Output: 2
Explanation: There are two triplets whose sum is less than the target: [-1, 0, 3], [-1, 0, 2]
```

Example 2:

```
Input: [-1, 4, 2, 1, 3], target=5
Output: 4
Explanation: There are four triplets whose sum is less than the
target:
   [-1, 1, 4], [-1, 1, 3], [-1, 1, 2], [-1, 2, 3]
```

Try it yourself#

Try solving this question here:



```java
import java.util.*;

class TripletWithSmallerSum {

  public static int searchTriplets(int[] arr, int target) {
    int count = -1;
    // TODO: Write your code here
    return count;
  }
}
```

Solution#

This problem follows the **Two Pointers** pattern and shares similarities with Triplet Sum to Zero (https://www.educative.io/collection/page/5668639101419520/5671464854355968/5679549973004288/). The only difference is that, in this problem, we need to find the triplets whose sum is less than the given target. To meet the condition `i != j != k` we need to make sure that each number is not used more than once.

Following a similar approach, first, we can sort the array and then iterate through it, taking one number at a time. Let's say during our iteration we are at number 'X', so we need to find 'Y' and 'Z' such that $X + Y + Z < target$. At this stage, our problem translates into finding a pair whose sum is less than "$target - X$" (as from the above equation $Y + Z == target - X$). We can use a similar approach as discussed in Triplet Sum to Zero (https://www.educative.io/collection/page/5668639101419520/5671464854355968/5679549973004288/).

Code#

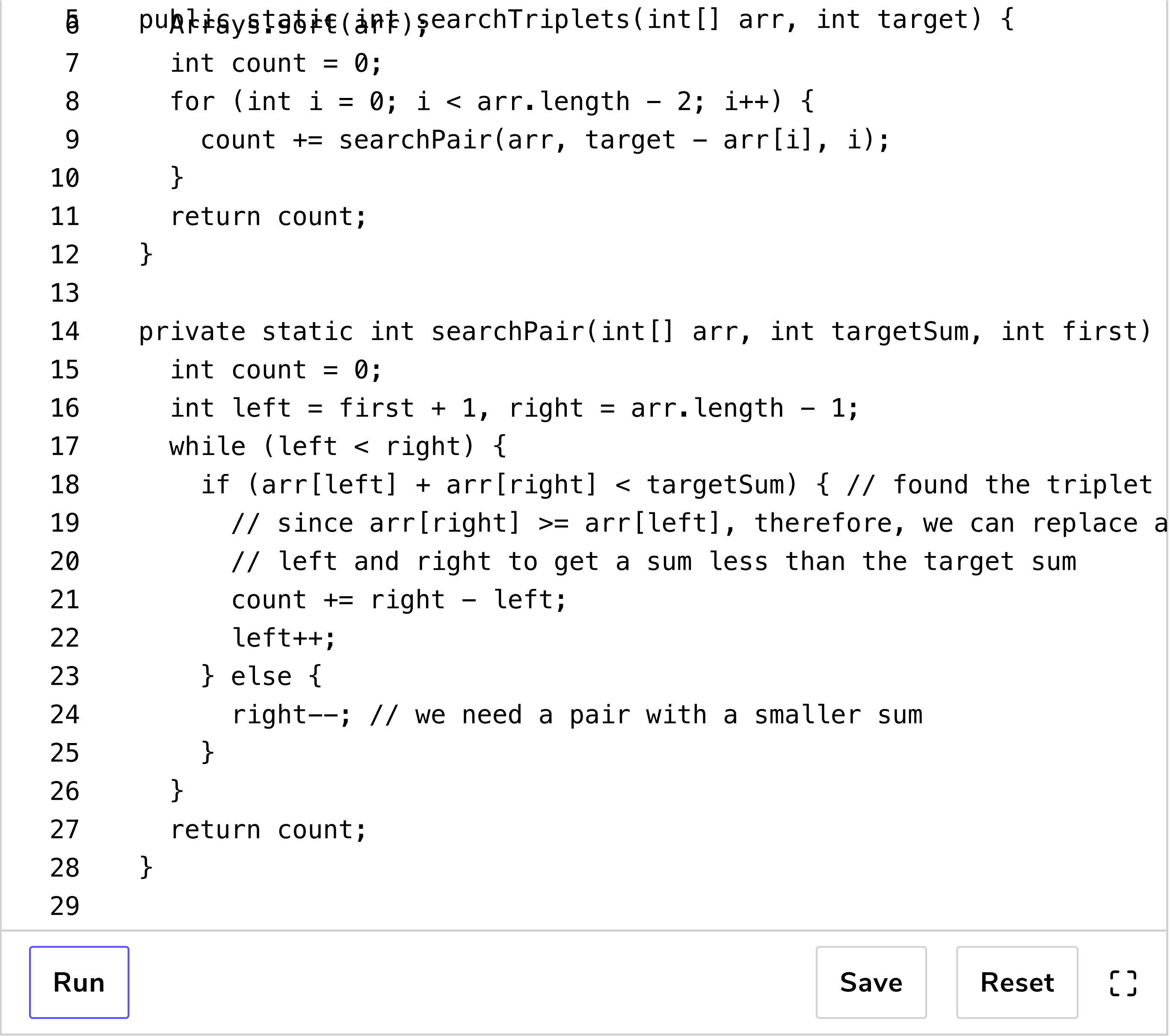
Here is what our algorithm will look like:

Java | Python3 | C++ | JS

```

class TripletWithSmallerSum {

```



```
  public static int searchTriplets(int[] arr, int target) {
    Arrays.sort(arr);
    int count = 0;
    for (int i = 0; i < arr.length - 2; i++) {
      count += searchPair(arr, target - arr[i], i);
    }
    return count;
  }

  private static int searchPair(int[] arr, int targetSum, int first) {
    int count = 0;
    int left = first + 1, right = arr.length - 1;
    while (left < right) {
      if (arr[left] + arr[right] < targetSum) { // found the triplet
        // since arr[right] >= arr[left], therefore, we can replace arr[ri
        // left and right to get a sum less than the target sum
        count += right - left;
        left++;
      } else {
        right--; // we need a pair with a smaller sum
      }
    }
    return count;
  }

```

Time complexity#

Sorting the array will take $O(N * logN)$. The `searchPair()` will take $O(N)$. So, overall `searchTriplets()` will take $O(N * logN + N^2)$, which is asymptotically equivalent to $O(N^2)$.

Space complexity#

The space complexity of the above algorithm will be $O(N)$ which is required for sorting if we are not using an in-place sorting algorithm.

Similar Problems#

Problem: Write a function to return the list of all such triplets instead of the count. How will the time complexity change in this case?

Solution: Following a similar approach we can create a list containing all the triplets. Here is the code - only the highlighted lines have changed:

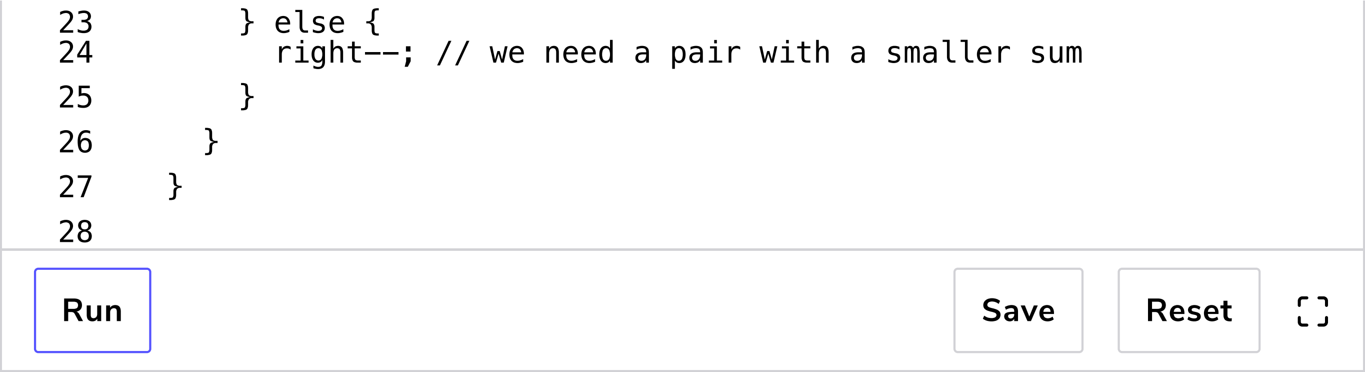
Java Python3 C++ JS

```
import java.util.*;

class TripletWithSmallerSum {

  public static List<List<Integer>> searchTriplets(int[] arr, int target)
    Arrays.sort(arr);
    List<List<Integer>> triplets = new ArrayList<>();
    for (int i = 0; i < arr.length - 2; i++) {
      searchPair(arr, target - arr[i], i, triplets);
    }
    return triplets;
  }

  private static void searchPair(int[] arr, int targetSum, int first, List
    int left = first + 1, right = arr.length - 1;
    while (left < right) {
      if (arr[left] + arr[right] < targetSum) { // found the triplet
        // since arr[right] >= arr[left], therefore, we can replace arr[r
        // left and right to get a sum less than the target sum
        for (int i = right; i > left; i--)
          triplets.add(Arrays.asList(arr[first], arr[left], arr[i]));
        left++;
```



```
      } else {
        right--; // we need a pair with a smaller sum
      }
    }
  }

```

Another simpler approach could be to check every triplet of the array with three nested loops and create a list of triplets that meet the required condition.

Time complexity#

Sorting the array will take $O(N * logN)$. The `searchPair()`, in this case, will take $O(N^2)$; the main `while` loop will run in $O(N)$ but the nested `for` loop can also take $O(N)$ - this will happen when the target sum is bigger than every triplet in the array.

So, overall `searchTriplets()` will take $O(N * logN + N^3)$, which is asymptotically equivalent to $O(N^3)$.

Space complexity#

Ignoring the space required for the output array, the space complexity of the above algorithm will be $O(N)$ which is required for sorting.

← Back

Triplet Sum Close to Target (medium)

Next →

Subarrays with Product Less than a Ta...

☑ Mark as Completed

Report an Issue

Ask a Question (https://discuss.educative.io/tag/triplets-with-smaller-sum-medium__pattern-two-pointers__grokking-the-coding-interview-patterns-for-coding-questions?open=true&ctag=grokking-the-coding-interview-patterns-for-coding-questions__design-gurus&aid=5668639101419520&cid=5671464854355968&pid=5554621957275648)