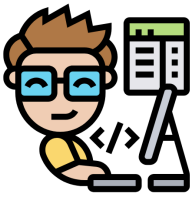

DAILY PROGRAMMING CHALLENGE

WISDOM SPROUTS
IT Training Hub

Find All Subarrays with Zero Sum

You are given an integer array arr of size n. Your task is to find all the subarrays whose elements sum up to zero. A subarray is defined as a contiguous part of the array, and you must return the starting and ending indices of each subarray.

Input:
An integer array arr of size n where n represents the number of elements in the array.
Example :
Input: [1, 2, -3, 3, -1, 2]

Output:

- Return a list of tuples, where each tuple contains two integers. The starting index (0-based) of the subarray. The ending index (0-based) of the subarray.
- The output should list all subarrays that sum to zero. If no such subarrays are found, return an empty list.

Example
Output: [(0, 2), (1, 3)]

Explanation

- Subarray [1, 2, -3] (from index 0 to 2) has a sum of 0.
- Subarray [2, -3, 3] (from index 1 to 3) also has a sum of 0.

Constraints:

- $1 \leq n \leq 10^5$ (Array length can be up to 100,000)
- $-10^9 \leq arr[i] \leq 10^9$ (Elements of the array can range from -1 billion to 1 billion)
- The input array can contain both positive and negative integers, including zero.

Test Cases:

1. Input: [4, -1, -3, 1, 2, -1]
   Output: [(1, 2), (0, 3)]
2. Input: [1, 2, 3, 4]
   Output: []
3. Input: [0, 0, 0]
   Output: [(0, 0), (0, 1), (0, 2), (1, 1), (1, 2), (2, 2)]

4. Input: [-3, 1, 2, -3, 4, 0]
   Output: [(0, 3), (4, 4)]
5. Input: [1, -1, 2, -2, 3, -3] * 10^4
   Output: [(0, 1), (2, 3), ..., (19998, 19999)]

Edge Cases:

1. If the array contains only a single element 0, it is considered a subarray with zero sum, as [0] sums to 0.
2. If all elements in the array are zero, every possible subarray will sum to zero.
3. Handle cases where positive and negative numbers cancel each other out to sum to zero.
4. Ensure the algorithm performs efficiently for large arrays with repeated patterns that sum to zero.