

Number of subarrays with sum zero

Problem

Given an array $a[]$ of size n . Our task is count the number of subarrays with sum zero.

Example

1	-1	1	-1
---	----	---	----

Subarrays with sum zero are:

1	-1
---	----

,

-1	1
----	---

,

1	-1
---	----

,

1	-1	1	-1
---	----	---	----

Number of subarrays with sum equal to zero are 6.

Brute force approach

1. Iterate over all the subarrays using nested loops, simultaneously calculate *sum* and maintain a variable *cnt*. Increment count whenever sum adds up to zero.

Time Complexity: $O(n^2)$

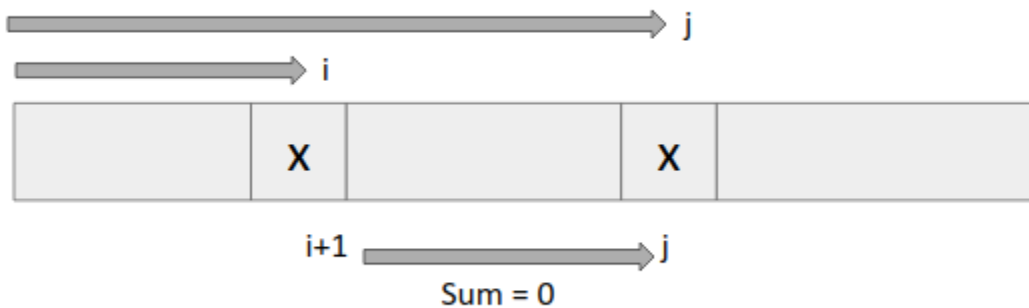
Optimized approach

1. Compute prefix sum array. For the above example, It will look like

1	0	1	0
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2. Main idea: For an array of prefix sum if a value repeats in prefix sum array at indices i and j , it denotes sum of elements from indices $i+1$ till j is zero.

PrefSum Array



So, we have to find the number of ways in which we can choose two same valued elements in the PrefSum array. (Special case for $\text{PrefSum}[i]=0$, as they add upto zero from starting index)

3. Declare a map (say freq) denoting frequency of elements in the prefix sum array.

map<int,int> freq;

4. Iterate over the PrefSum array and just do

freq[PrefSum[i]]++;

5. After our freq map is created, then apply permutation and combination formula to choose 2 elements from the group of m identical items. (mC_2) for each key.

Code

```
void solve()
{
    int n;
    cin >> n;

    vi a(n);

    rep(i,0,n)
        cin >> a[i];

    map<int,int> cnt;

    int prefsum = 0;

    rep(i,0,n)
    {
        prefsum += a[i];
        cnt[prefsum]++;
    }

    int ans = 0;

    for(auto it:cnt)
    {
        int c = it.ss;

        ans += (c*(c-1))/2;

        if(it.ff == 0)
            ans += it.ss;
    }

    cout << ans << endl;
}

signed main()
{
    speed;

    solve();
    return 0;
}
```