

Question 5: Maximum Sum Subarray of Size K

Problem

Find the maximum sum of any subarray of size K in a given array.

Algorithm

1. Initialize maxSum and currentSum to the sum of first K elements.
2. Use sliding window technique to iterate through the array: a. Remove the leftmost element from the current window. b. Add the next element to the current window. c. Update maxSum if currentSum is greater.
3. Return maxSum.

Program Implementation

cpp

```
#include <iostream>
#include <vector>
#include <algorithm>
using namespace std;

int maxSubarraySumOfSizeK(const vector<int>& arr, int k) {
    if (arr.size() < k) {
        return -1; // Invalid input
    }

    int currentSum = 0;

    // Sum of first k elements
    for (int i = 0; i < k; i++) {
        currentSum += arr[i];
    }

    int maxSum = currentSum;

    // Slide the window
    for (int i = k; i < arr.size(); i++) {
        currentSum = currentSum - arr[i - k] + arr[i];
        maxSum = max(maxSum, currentSum);
    }

    return maxSum;
}

int main() {
    vector<int> arr = {1, 4, 2, 10, 2, 3, 1, 0, 20};
    int k = 4;

    int result = maxSubarraySumOfSizeK(arr, k);
    cout << "Maximum sum of subarray of size " << k << " is: " << result << endl;

    return 0;
}
```

Time Complexity

- $O(n)$ where n is the size of the array
- We only make a single pass through the array

Space Complexity

- $O(1)$ as we only use constant extra space

Example Explanation

Let's trace through the array $[1, 4, 2, 10, 2, 3, 1, 0, 20]$ with $k = 4$:

1. Initial sum of first 4 elements $(1+4+2+10) = 17$, so $\text{maxSum} = 17$
2. Sliding window calculations:
 - Remove 1, add 2: $\text{currentSum} = 17-1+2 = 18$, $\text{maxSum} = 18$
 - Remove 4, add 3: $\text{currentSum} = 18-4+3 = 17$, $\text{maxSum} = 18$
 - Remove 2, add 1: $\text{currentSum} = 17-2+1 = 16$, $\text{maxSum} = 18$
 - Remove 10, add 0: $\text{currentSum} = 16-10+0 = 6$, $\text{maxSum} = 18$
 - Remove 2, add 20: $\text{currentSum} = 6-2+20 = 24$, $\text{maxSum} = 24$

The function returns 24, which is the sum of subarray $[3, 1, 0, 20]$.