



Lab Report-05

(Finding_kth_smallest_element)

CSE-2212 (Design and Analysis of Algorithms Lab)

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#5_Finding kth smallest element

Problem Definition

Given an array of integers `arr[]` and an integer `k`, the problem is to find the `k`th smallest element in the array.

Formal Statement of Algorithm

- Create a min heap (priority queue) `pq`.
- Insert all elements of the array `arr[]` into the min heap.
- Pop `k - 1` elements from the min heap.
- The element at the top of the min heap after popping `k - 1` elements is the `k`th smallest element.

Complexity Analysis of Algorithm

- Time Complexity:
 - Building the min heap: $O(n \log n)$, where n is the size of the input array `arr[]`.
 - Popping `k - 1` elements from the heap: $O(k \log n)$.
 - Overall time complexity: $O(n \log n + k \log n)$.
- Space Complexity:
 - $O(n)$ for the min heap, as all elements of the array are inserted into the heap.
 - $O(1)$ for other variables.
 - Overall space complexity: $O(n)$.

Actual Code and Output

```
1  #include <iostream>
2  #include <vector>
3  #include <queue>
4
5  using namespace std;
6
7  void kth_Smallest_MinHeap(vector<int>& arr, int k) {
8      priority_queue<int, vector<int>, greater<int>> pq;
9      int n = arr.size();
10
11     for (int i = 0; i < n; i++) {
12         pq.push(arr[i]);
13     }
14
15     int f = k - 1;
16
17     while (f > 0) {
18         pq.pop();
19         f--;
20     }
21
22     cout << "Kth Smallest element: " << pq.top() << "\n";
23 }
24
25 int main() {
26     vector<int> arr = {1, 2, 6, 4, 5, 3};
27
28     kth_Smallest_MinHeap(arr, 3);
29
30     return 0;
31 }
32
```

Kth Smallest element: 3
[Finished in 358ms]