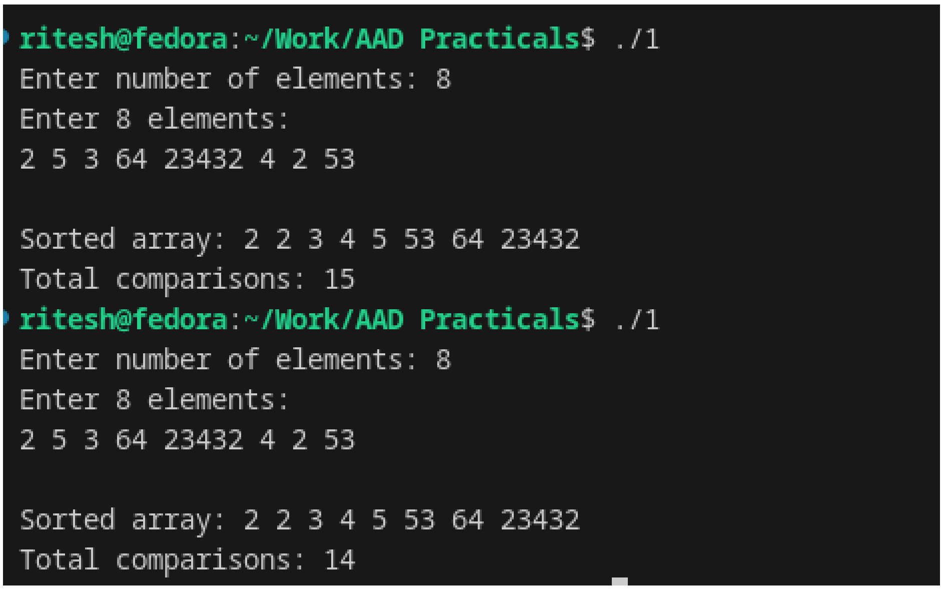
1

Randomized Quick Sort

Code:

```cpp
#include <iostream>
#include <cstdlib>
#include <ctime>
using namespace std;

int comparisons = 0;  // global counter for comparisons

// Function to swap two elements
void swap(int &a, int &b) {
    int temp = a;
    a = b;
    b = temp;
}

// Partition function with randomized pivot
int partition(int arr[], int low, int high) {
    // Randomly choose a pivot index between low and high
    int pivotIndex = low + rand() % (high - low + 1);
    swap(arr[pivotIndex], arr[high]); // move pivot to end

    int pivot = arr[high];
    int i = low - 1;

    for (int j = low; j < high; j++) {
        comparisons++; // each check arr[j] <= pivot is a comparison
        if (arr[j] <= pivot) {
            i++;
            swap(arr[i], arr[j]);
        }
    }
    swap(arr[i + 1], arr[high]);
    return i + 1;
}

// QuickSort function
void randomizedQuickSort(int arr[], int low, int high) {
    if (low < high) {
        int pi = partition(arr, low, high);

        randomizedQuickSort(arr, low, pi - 1);
        randomizedQuickSort(arr, pi + 1, high);
    }
}

int main() {
    srand(time(0));  // seed for random pivot

    int n;
    cout << "Enter number of elements: ";
    cin >> n;

    int arr[n];
    cout << "Enter " << n << " elements:\n";
    for (int i = 0; i < n; i++)
        cin >> arr[i];

    randomizedQuickSort(arr, 0, n - 1);

    cout << "\nSorted array: ";
    for (int i = 0; i < n; i++)
        cout << arr[i] << " ";

    cout << "\nTotal comparisons: " << comparisons << endl;

    return 0;
}
```

Output:



```
ritesh@fedora:~/Work/AAD Practicals$ ./1
Enter number of elements: 8
Enter 8 elements:
2 5 3 64 23432 4 2 53

Sorted array: 2 2 3 4 5 53 64 23432
Total comparisons: 15
ritesh@fedora:~/Work/AAD Practicals$ ./1
Enter number of elements: 8
Enter 8 elements:
2 5 3 64 23432 4 2 53

Sorted array: 2 2 3 4 5 53 64 23432
Total comparisons: 14
```