Experiment No. – 3.1

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Branch: 20BCC1 **Section/Group: A**
Semester: 5th **Date of Performance: 11/10/2022**
Subject Name: ADVANCED PROGRAMMING LAB
Subject Code: 20CSP-334

1. **Aim/Overview of the practical:**

Design a quick sort with random pivoting using Lomuto partition scheme.

2. **Task to be done:**

Design a quick sort with random pivoting using Lomuto partition scheme.

3. **Steps for practical**:

Lomuto's Partition Scheme:

This algorithm works by assuming the pivot element as the last element. If any other element is given as a pivot element then swap it first with the last element. Now initialize two variables i as low and j also low, iterate over the array and increment i when arr[j] <= pivot and swap arr[i] with arr[j] otherwise increment only j. After coming out from the loop swap arr[i] with arr[hi]. This i stores the pivot element.

```
partition(arr[], lo, hi)
    pivot = arr[hi]
    i = lo     // place for swapping
    for j := lo to hi – 1 do
        if arr[j] <= pivot then
            swap arr[i] with arr[j]
            i = i + 1
    swap arr[i] with arr[hi]
```

```
return i

partition_r(arr[], lo, hi)
r = Random Number from lo to hi
Swap arr[r] and arr[hi]
return partition(arr, lo, hi)

quicksort(arr[], lo, hi)
if lo < hi
   p = partition_r(arr, lo, hi)
   quicksort(arr, lo , p-1)
   quicksort(arr, p+1, hi)
```

4 . Code:

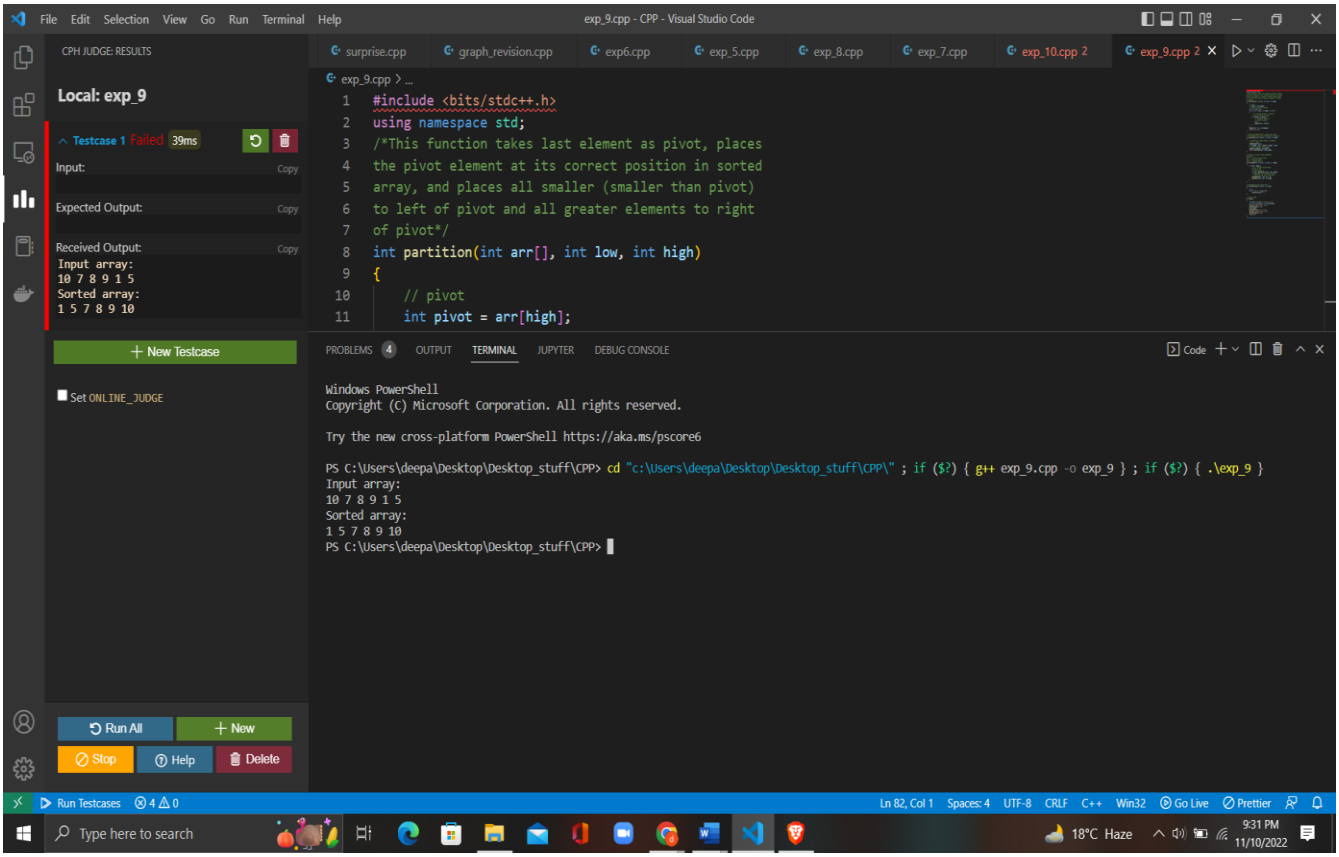
```
#include <bits/stdc++.h>
using namespace std;
/*This function takes last element as pivot, places
the pivot element at its correct position in sorted
array, and places all smaller (smaller than pivot)
to left of pivot and all greater elements to right
of pivot*/
int partition(int arr[], int low, int high)
{
    // pivot
    int pivot = arr[high];
    // Index of smaller element
    int i = (low - 1);
    for (int j = low; j <= high - 1; j++)
    {
        // If current element is smaller
        // than or equal to pivot
        if (arr[j] <= pivot) {
            // increment index of
            // smaller element
            i++;
```

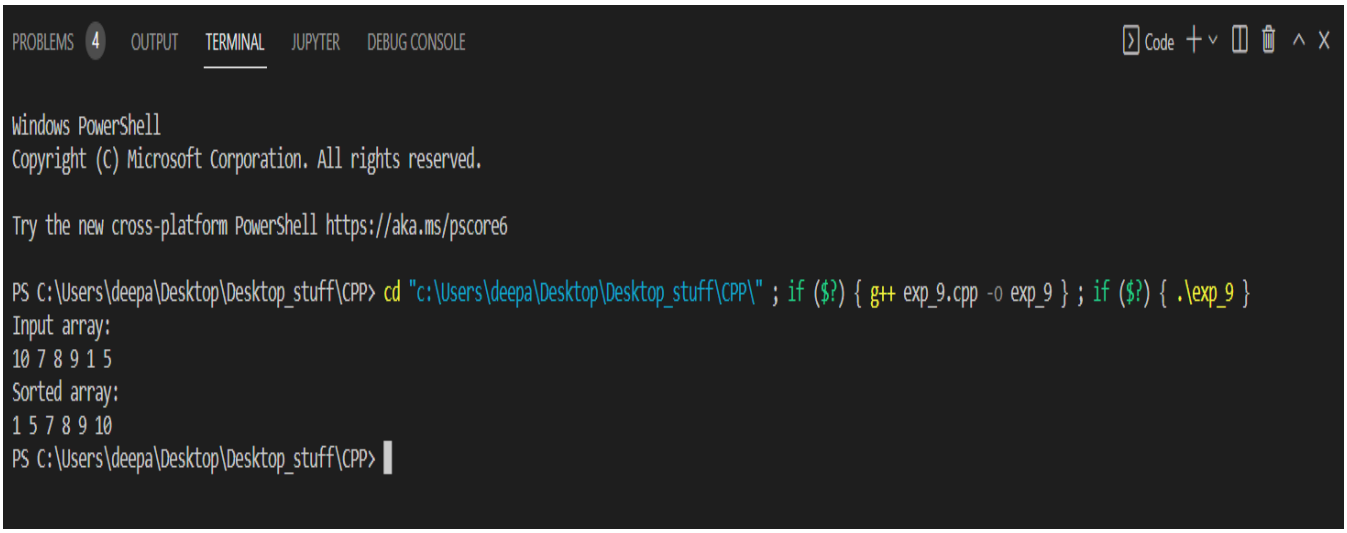
```
            swap(arr[i], arr[j]);
        }
    }
    swap(arr[i + 1], arr[high]);
    return (i + 1);
}

// Generates Random Pivot, swaps pivot with
// end element and calls the partition function
int partition_r(int arr[], int low, int high)
{
    // Generate a random number in between
    // low .. high
    srand(time(NULL));
    int random = low + rand() % (high - low);
    // Swap A[random] with A[high]
    swap(arr[random], arr[high]);
    return partition(arr, low, high);
}

/* The main function that implements
QuickSort
arr[] --> Array to be sorted,
low --> Starting index,
high --> Ending index */
void quickSort(int arr[], int low, int high)
{
    if (low < high) {
        /* pi is partitioning index,
        arr[p] is now
        at right place */
        int pi = partition_r(arr, low, high);
        // Separately sort elements before
        // partition and after partition
        quickSort(arr, low, pi - 1);
        quickSort(arr, pi + 1, high);
```

```
    }
}

/* Function to print an array */
void printArray(int arr[], int size)
{
    int i;
    for (i = 0; i < size; i++)
        cout<<arr[i]<<" ";
}

// Driver Code
int main()
{
    int arr[] = { 10, 7, 8, 9, 1, 5 };
    int n = sizeof(arr) / sizeof(arr[0]);
    printf("Input array: \n");
    printArray(arr, n);
    cout<<endl;
    quickSort(arr, 0, n - 1);
    printf("Sorted array: \n");
    printArray(arr, n);
    return 0;
}
```

5. Output:

a)


exp_9.cpp - CPP - Visual Studio Code
#include <bits/stdc++.h>
using namespace std;
/*This function takes last element as pivot, places
the pivot element at its correct position in sorted
array, and places all smaller (smaller than pivot)
to left of pivot and all greater elements to right
of pivot*/
int partition(int arr[], int low, int high)
{
// pivot
int pivot = arr[high];
Testcase 1 Failed 39ms
Input:
Expected Output:
Received Output:
Input array:
10 7 8 9 1 5
Sorted array:
1 5 7 8 9 10
New Testcase
Set ONLINE_JUDGE
Run All
New
Stop
Help
Delete
PROBLEMS 4
OUTPUT
TERMINAL
JUPYTER
DEBUG CONSOLE
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.
Try the new cross-platform PowerShell https://aka.ms/pscore6
PS C:\Users\deepa\Desktop\Desktop_stuff\CPP> cd "c:\Users\deepa\Desktop\Desktop_stuff\CPP\" ; if ($?) { g++ exp_9.cpp -o exp_9 } ; if ($?) { .\exp_9 }
Input array:
10 7 8 9 1 5
Sorted array:
1 5 7 8 9 10
PS C:\Users\deepa\Desktop\Desktop_stuff\CPP>


PROBLEMS 4
OUTPUT
TERMINAL
JUPYTER
DEBUG CONSOLE
Code
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/pscore6
PS C:\Users\deepa\Desktop\Desktop_stuff\CPP> cd "c:\Users\deepa\Desktop\Desktop_stuff\CPP\" ; if ($?) { g++ exp_9.cpp -o exp_9 } ; if ($?) { .\exp_9 }
Input array:
10 7 8 9 1 5
Sorted array:
1 5 7 8 9 10
PS C:\Users\deepa\Desktop\Desktop_stuff\CPP>

6. Learning Outcomes:

- Decide and implement an appropriate graph algorithm and hashing function in computer networks for data security.
- Learn Lomuto Partition Scheme
- Revise the basics of Quick Sort algorithm

Evaluation Grid (To be created as per the SOP and Assessment guidelines by the faculty):

Sr. No.	Parameters	Marks Obtained	Maximum Marks
1.			
2.			
3.			