ASSIGNMENT - 7

ANIKEIT SETHI (190001003)

**Code Logic:**

We can see here that, q is the position of the element at the rth index (x = A[r]) after it has been placed correctly at its correct index (according to quick sort) as if the array was sorted. That all indexes before q have their value less than x(A[r]) and all indexes after q have their values > x.

For the specific case when all the elements in the array are the same, we see that the program

returns the value r (when the partition is not modified). This is because, at each iteration, since the condition A[j] <= x satisfies due to the equality, at each iteration, i moves forward by one. Hence, after the for loop, i becomes r - 1 and hence, when we return i + 1, the program returns r. As we can see in the example attached we can see the two outputs from the 2 functions and the difference can be seen easily. Thus, we need to modify the partition function such that in case of all elements being equal, we get the index(q), floor ((p + r)/2) as the answer

Code: -

#include <bits/stdc++.h>

using namespace std;

vector<int> a, b;

// Normal partition function

int partition\_function(int p, int r) {

int x = a[r];

int i = p - 1;

for (int j = p; j < r; j++) {

if (a[j] <= x) {

i++;

swap(a[i], a[j]);

}

}

swap(a[i + 1], a[r]);

return i + 1;

}

// Updated partition function where we return mid of partiton in case all elements are same

int updated\_partition\_function(int p, int r) {

int x = b[r];

int k = p - 1;

int i = p - 1;

for (int j = p; j < r; j++) {

if (b[j] < x) {

k++;

swap(b[k], b[j]);

i++;

} else if (b[j] == x) {

i++;

swap(b[j], b[i]);

}

}

swap(b[i + 1], b[r]);

return (i + k) / 2 + 1;

}

int main() {

int n;

int q;

cout << "Enter size of Array:\n";

cin >> n;

a.resize(n + 1);

b.resize(n + 1);

cout << "Enter elements of Array:\n";

for (int i = 1; i <= n; i++) {

cin >> a[i];

b[i] = a[i];

}

q = partition\_function(1, n);

cout << "Normal Partition Function:\n";

cout << q << endl;

q = updated\_partition\_function(1, n);

cout << "Modified Partition Function:\n";

cout << q << endl;

}

Output: -

