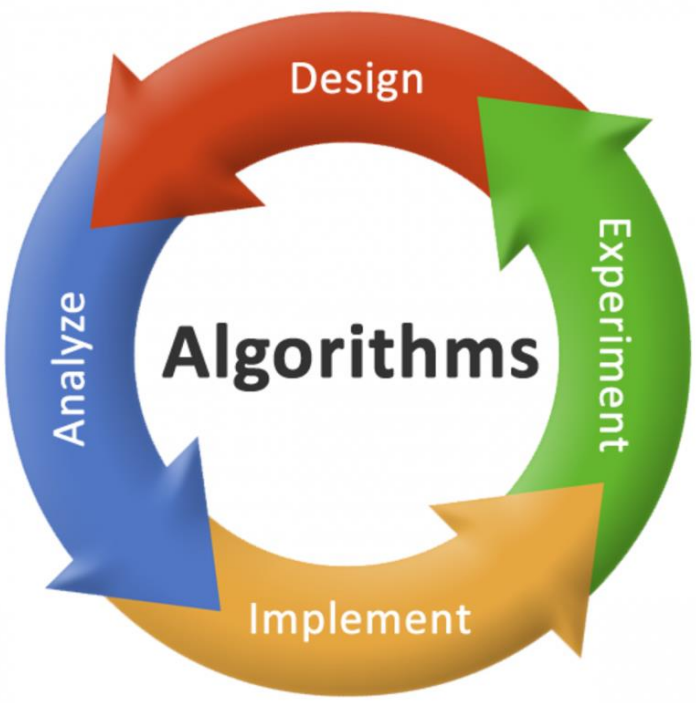
Design and Analysis of Algorithms Practical File



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PRACTICAL 1 : Implement Insertion Sort (The program should report the number of comparisons)

```
#include <bits/stdc++.h>

using namespace std;

//function to sort an array and return the number of comparisons

int insertion_sort(int arr[], int n)

{

   int comparison = 0;

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

   {

      int current = arr[i];

      int j = i - 1;

      while (arr[j] > current && j >= 0)

      {

         arr[j + 1] = arr[j];

         j--;

         comparison++;

      }

      if (j >= 0)

      {

         comparison++;

      }

      arr[j + 1] = current;

   }

   return comparison;

}



//function to generate random array and create .csv file
```

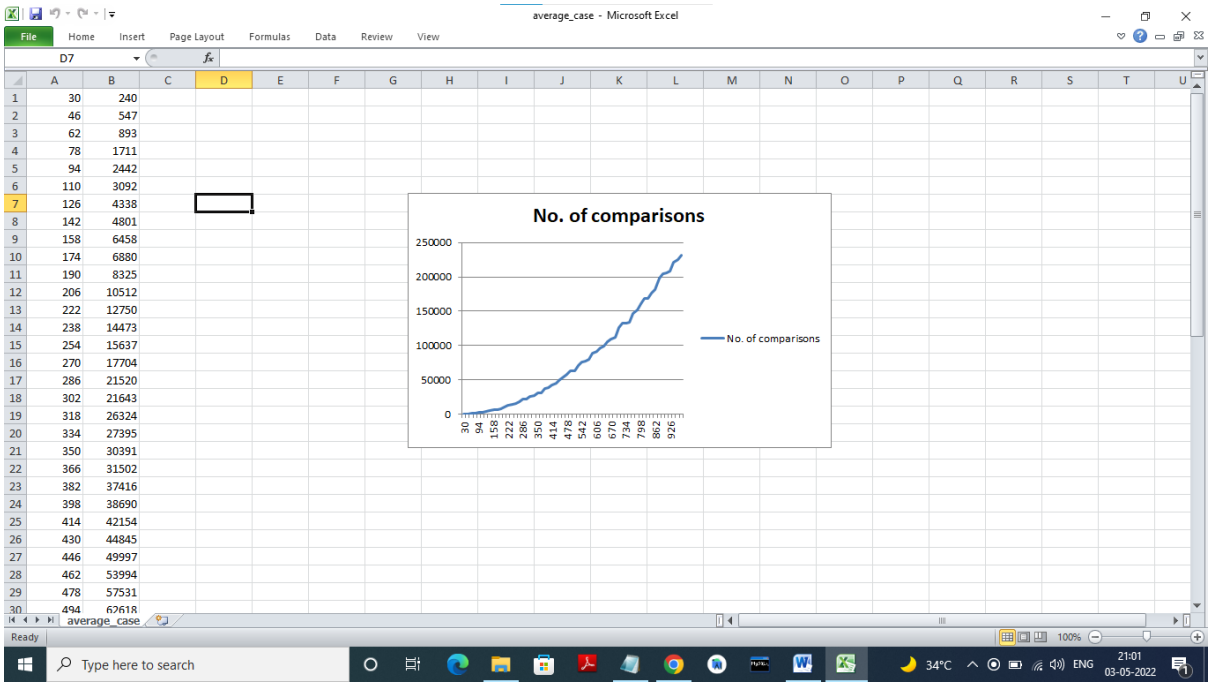
```
void generate_random_array(int size, int check)
{
    fstream fout;
    int comp;
    int arr[size];
    for (int i = 0; i < size; i++)
    {
        arr[i] = (rand() % 100);
    }

    int n = sizeof(arr) / sizeof(arr[0]);

    if (check == 0) //average case
    {
        comp = insertion_sort(arr, size);
        fout.open("average_case.csv", ios::out | ios::app);
        fout << size << "," << comp << endl;
    }

    else if (check == 1) //best_case
    {
        sort(arr, arr + n);
        comp = insertion_sort(arr, size);
        fout.open("best_case.csv", ios::out | ios::app);
        fout << size << "," << comp << endl;
    }
```

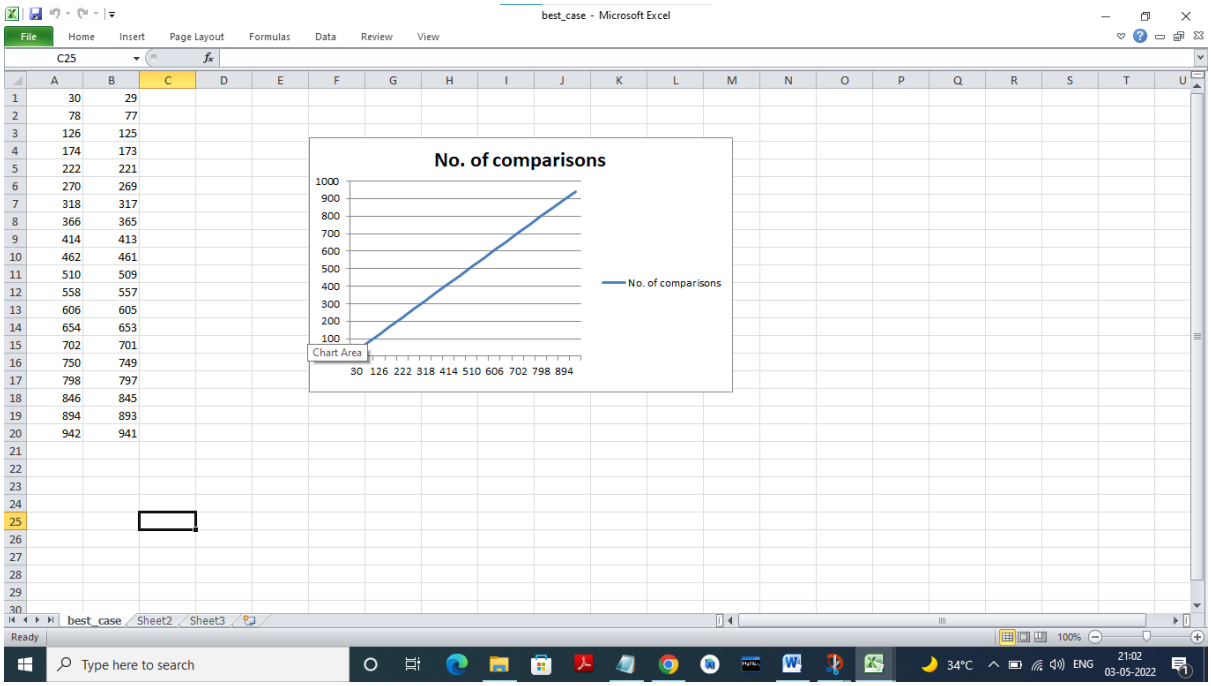
```
    else if (check == 2) //worst_case
    {
        sort(arr, arr + n, greater<int>());
        comp = insertion_sort(arr, size);
        fout.open("worst_case.csv", ios::out | ios::app);
        fout << size << "," << comp << endl;
    }
}

//average case
void average_case(int start, int end)
{
    int interval = (end - start) / 60;
    int count = 0;
    for (int i = start; i < end && count < 60; i += interval)
    {
        generate_random_array(i, 0);
        count++;
    }
}

//best_case
void best_case(int start, int end)
{
    int interval = (end - start) / 20;
    int count = 0;
    for (int i = start; i < end && count < 20; i += interval)
```

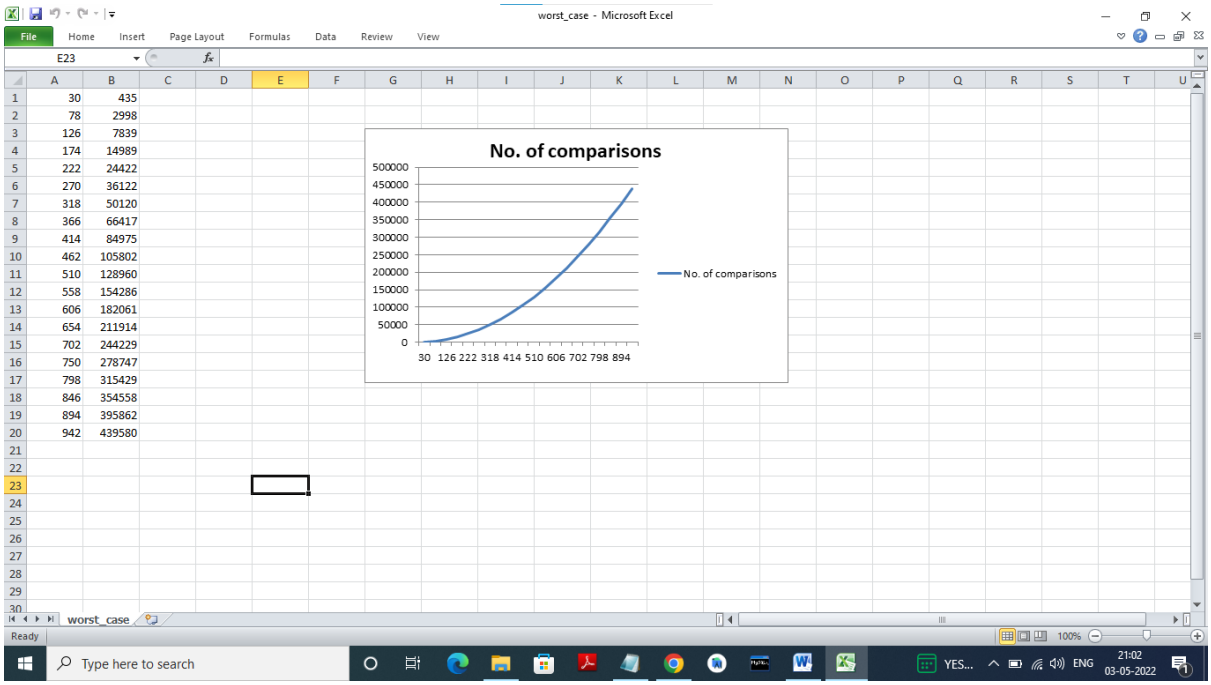
```
    {
        generate_random_array(i, 1);
        count++;
    }
}

//worst_case
void worst_case(int start, int end)
{
    int interval = (end - start) / 20;
    int count = 0;
    for (int i = start; i < end && count < 20; i += interval)
    {
        generate_random_array(i, 2);
        count++;
    }
}

//main function
int main()
{
    int min_value = 30;
    int max_value = 1000;

    average_case(min_value, max_value);
    best_case(min_value, max_value);
    worst_case(min_value, max_value);
```

```
    return 0;
}
```

OUTPUT







PRACTICAL 2: Implement Merge Sort (The program should report the number of comparisons)

```
#include <bits/stdc++.h>

using namespace std;


 int comp = 0;

int n = 0;

void printarray( int size,int comp){

    fstream fout;

    fout.open("merge.csv", ios::out | ios::app);

    fout << size << "," << comp << endl;


}

void merge(int arr[], int leftFirst, int leftLast, int rightFirst, int rightLast, int size){
```

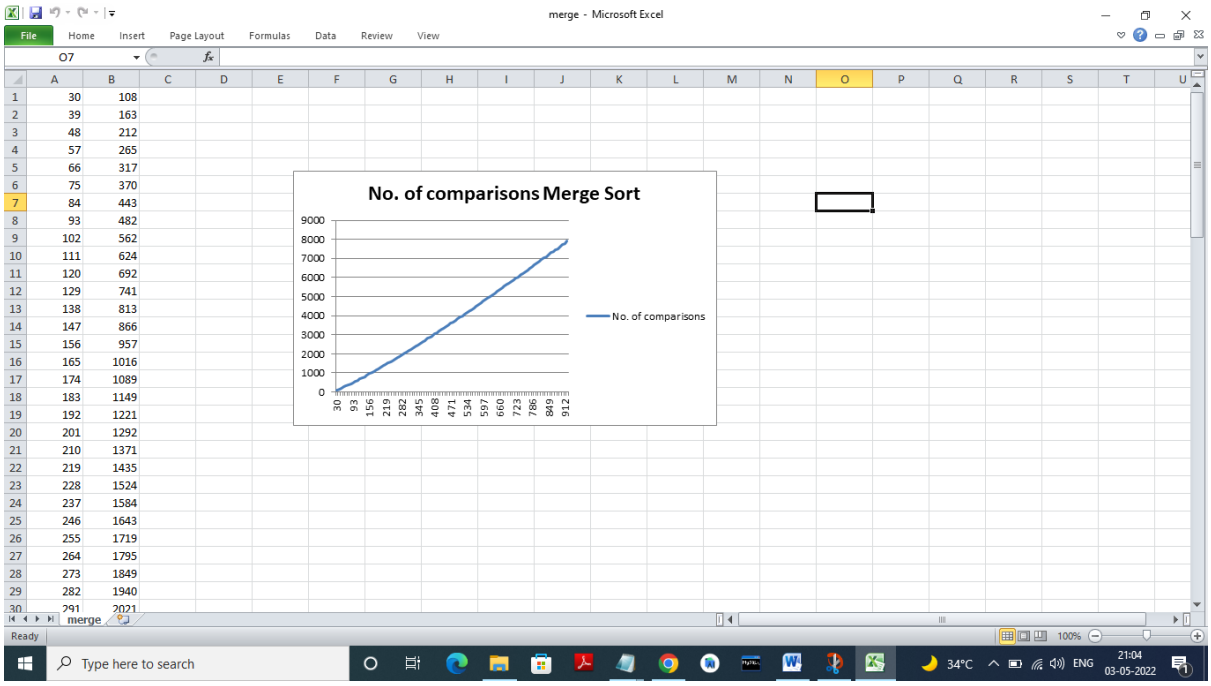
```
 int temparr[size];

        int index = leftFirst;

        int saveFirst = leftFirst;


        while((leftFirst <= leftLast)  && ( rightFirst <= rightLast)){//compare and select
smallest from two subarrays


            if(arr[leftFirst] < arr[rightFirst]){

                temparr[index]  = arr[leftFirst];

                leftFirst++;

            }

            else

            {

                temparr[index]  = arr[rightFirst];

                rightFirst++;

            }

            index++;

            comp++;

        }


        while(leftFirst <= leftLast){


            temparr[index] = arr[leftFirst];

            leftFirst++;

            index++;
```

```
        }
        while(rightFirst <= rightLast){
            temparr[index] = arr[rightFirst];
            rightFirst++;
            index++;

        }

        for(index = saveFirst; index <= rightLast; index++)
            arr[index] = temparr[index];

    }
void mergesort(int a[], int start, int end, int size){
        if(start < end){
        int mid = (start+end)/2;
        int n=mid+1;
        mergesort(a,start, mid,size);
        mergesort(a,n,end,size);
        merge(a, start,mid, n, end, size);
    }
}

void randomNum(int size)
{
```

```
    int arr[size];
    for (int i = 0; i < size; i++)
    {
        arr[i] = (rand() % 100);
    }
    int n = sizeof(arr) / sizeof(arr[0]);
    int start = 0;
    int end = n-1;
    mergesort(arr, start, end, size);
}
int main(){


   int min = 30;
    int max = 1000;
   int interval = (max - min) / 100;
    int count = 0;
    for (int i = min; i < max && count < 100; i += interval)
    {
        randomNum(i );
        printarray(i,comp);


        count++;
        comp=0;
    }
```

}

OUTPUT



PRACTICAL 3 : Implement Heap Sort(The program should report the number of comparisons)

```
#include<iostream>

#include <algorithm>

#include<fstream>

using namespace std;


//Heapify function

void heapify(int arr[],int n,int i,int &count)

{

    int largest=i;


    int l=i*2+1;                //left child
```

```
  int r=(i*2)+2;              //right child

 if(l<n&&(count+=1)&&(arr[l]>arr[largest]))   // If left child is larger than root
  {
     largest=l;

  }

  if(r<n&&(count+=1)&&(arr[r]>arr[largest]))   // If right child is larger than largest so far
  {
     largest=r;

  }

  if(largest != i )   // If largest is not root
  {

     swap(arr[i],arr[largest]);

    heapify(arr,n,largest,count);   // Recursively heapify the affected sub-tree
  }



}
```

```
//heap sort func
int Heap_Sort(int arr[],int n,int &comp)
{
        // For building heap
    for(int i=n/2-1;i>=0;i--)
    {
      heapify(arr,n,i,comp);

    }


    // for deletion from heap
    for(int i=n-1;i>=0;i--)
    {
        swap(arr[i],arr[0]);
        heapify(arr,i,0,comp);

    }

    return comp;
}


// For generating Random array
```

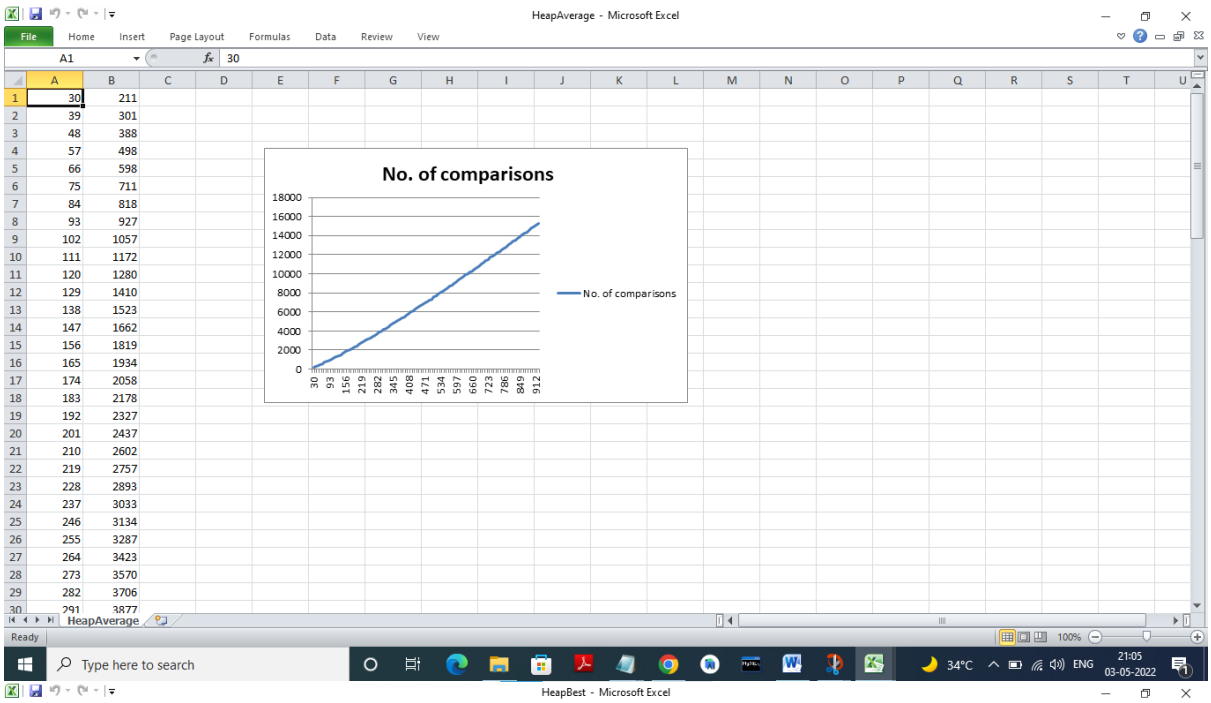
```
void generate_random_array(int arr[], int size)
{
    for (int i = 0; i < size; i++)
    {
        arr[i] = (rand() % 100);
    }
}

 // Average Case

void heap_avg(int num_cases = 100, int min_size = 30, int max_size = 1000)
{
    int interval = (max_size - min_size) / num_cases;
    int comp = 0;
    for (int size = min_size, i = 0; i < num_cases; i++, size += interval)
    {
        int *Arr = new int[size];
        generate_random_array(Arr, size);

        fstream fout1;

        Heap_Sort(Arr,size,comp);

        fout1.open("HeapAverage.csv", ios::out | ios::app);
```

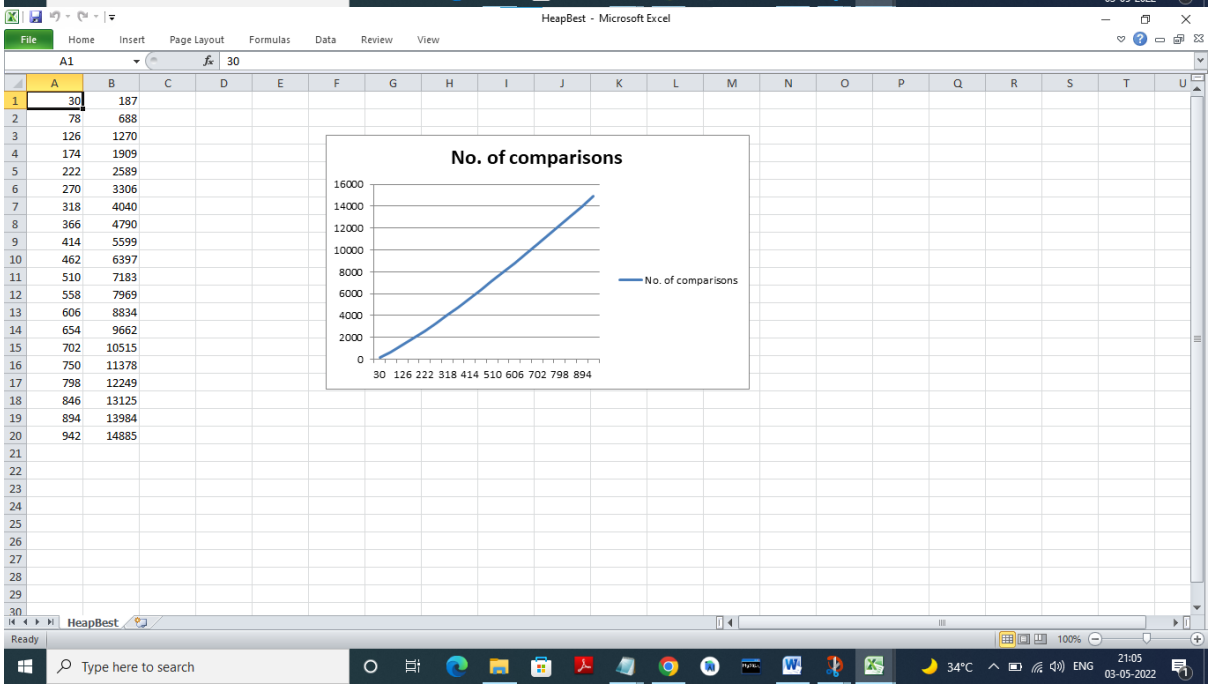
```
        fout1 << size << "," << comp << endl;
        comp = 0;
    }
}

//Best Case
void heap_best(int num_cases = 20, int min_size = 30, int max_size = 1000)
{
    int interval = (max_size - min_size) / num_cases;
    int comp = 0;
    for (int size = min_size, i = 0; i < num_cases; i++, size += interval)
    {
        int *Arr = new int[size];
        generate_random_array(Arr, size);
        sort(Arr, Arr + size, greater<int>());
        fstream fout1;

        Heap_Sort(Arr,size,comp);

        fout1.open("HeapBest.csv", ios::out | ios::app);

        fout1 << size << "," << comp << endl;
        comp = 0;
    }
```

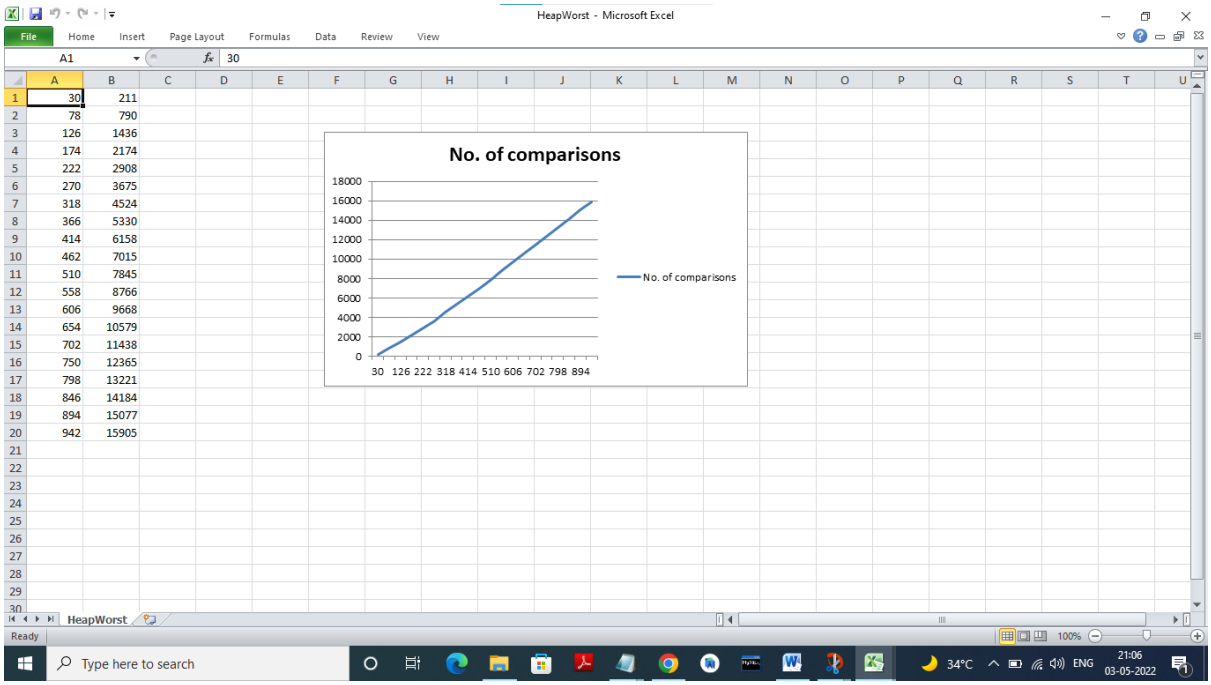
```
}

//Worst Case
void heap_Worst(int num_cases = 20, int min_size = 30, int max_size = 1000)
{
	int interval = (max_size - min_size) / num_cases;
	int comp = 0;
	for (int size = min_size, i = 0; i < num_cases; i++, size += interval)
	{
	   int *Arr = new int[size];
	   generate_random_array(Arr, size);
	   sort(Arr, Arr + size);
	   fstream fout1;

	   Heap_Sort(Arr,size,comp);

	   fout1.open("HeapWorst.csv", ios::out | ios::app);

	   fout1 << size << "," << comp << endl;
	   comp = 0;
	}
}

int main()
{
```

```
    heap_avg();
    heap_best();
    heap_Worst();
     return 0;
}
```

OUTPUT







1	30	211
2	78	790
3	126	1436
4	174	2174
5	222	2908
6	270	3675
7	318	4524
8	366	5330
9	414	6158
10	462	7015
11	510	7845
12	558	8766
13	606	9668
14	654	10579
15	702	11438
16	750	12365
17	798	13221
18	846	14184
19	894	15077
20	942	15905

PRACTICAL 4 : Implement Randomized Quick sort (The program should report the number of comparisons)

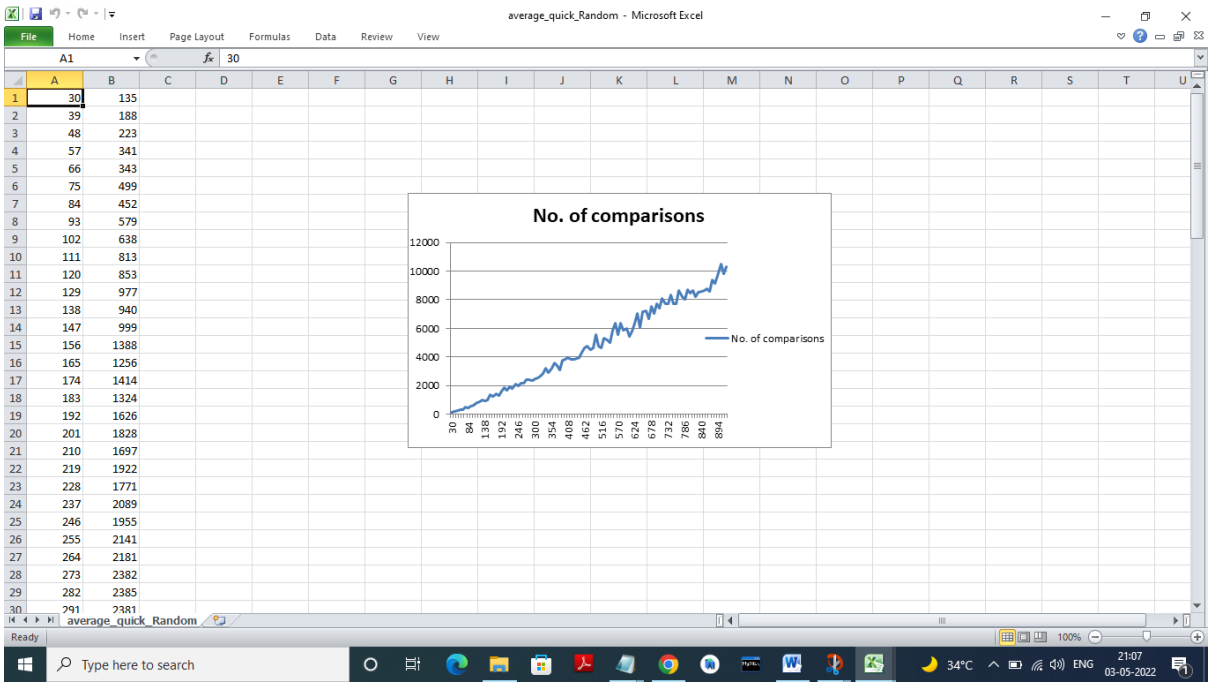
```
#include <iostream>

#include <fstream>

using namespace std;


void swap(int *a, int *b)

{

    int t = *a;

    *a = *b;

    *b = t;

}


int partition(int arr[], int low, int high, int &numOfcomp)

{

    int pivot = arr[high];
```

```
    int i = (low - 1);

    for (int j = low; j <= high - 1; j++)
    {
        if (numOfcomp++, arr[j] < pivot)
        {
            i++;
            swap(&arr[i], &arr[j]);
        }
    }
    swap(&arr[i + 1], &arr[high]);
    return (i + 1);
}

int random_partition(int arr[], int low, int high, int &numOfcomp)
{
    int random_index = (rand() % (high + 1));

    if (arr[random_index] != arr[high])
        swap(&arr[random_index], &arr[high]);

    return partition(arr, low, high, numOfcomp);
}

void random_quickSort(int arr[], int low, int high, int &numOfcomp)
```

```
{
    if (low < high)
    {
        int pi = partition(arr, low, high, numOfcomp);
        random_quickSort(arr, low, pi - 1, numOfcomp);
        random_quickSort(arr, pi + 1, high, numOfcomp);
    }
}

void generate_random_array(int arr[], int size)
{

    for (int i = 0; i < size; i++)
    {
        arr[i] = (rand() % 1000);
    }
}

void average_case(int cases, int min, int max)
{
    ofstream average_case_file("average_quick_Random.csv");
    int interval = (((max - min) / cases) / 10.0) * 10;
    int count = 0;
    for (int i = min; count < cases; i += interval, count++)
    {
```

```
        int *random_array = new int[i];
        generate_random_array(random_array, i);
        int numOfcomp = 0;
        random_quickSort(random_array, 0, i - 1, numOfcomp);
        average_case_file << i << "," << numOfcomp << "\n";
        delete[] random_array;
    }
    average_case_file.close();
}

int main()
{
    average_case(100, 30, 1000);
}
```

OUTPUT



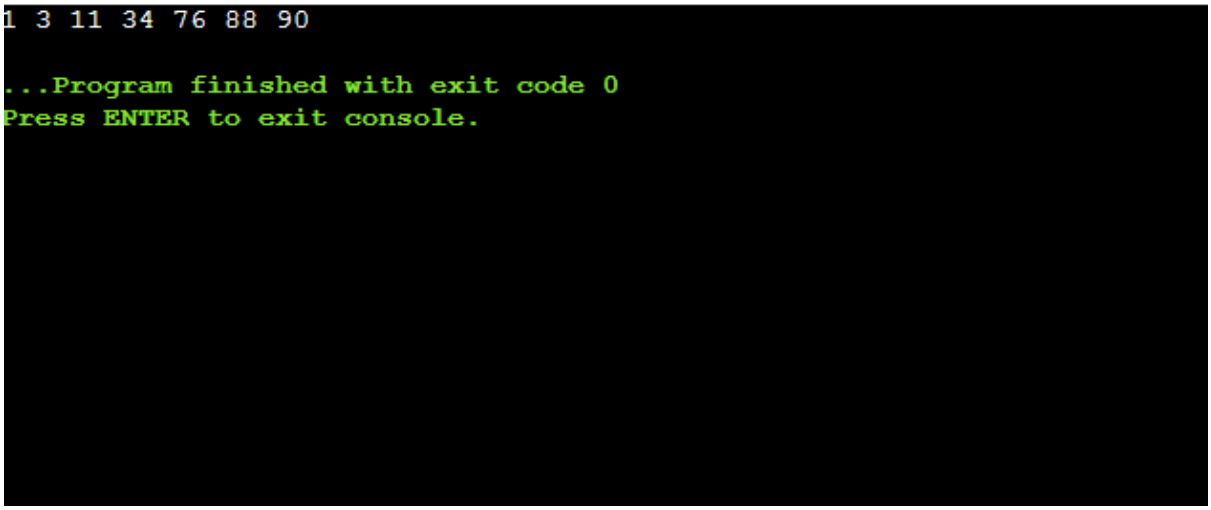
PRACTICAL 5 : Implement Radix Sort

```
#include <iostream>

using namespace std;

 int getMax(int arr[], int n)

{

    int mx = arr[0];

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

        if (arr[i] > mx)

            mx = arr[i];

    return mx;

}


// A function to do counting sort of arr[] according to

// the digit represented by exp.

void countSort(int arr[], int n, int exp)

{

    int output[n];

    int i, count[10] = { 0 };


    // Store count of occurrences in count[]

    for (i = 0; i < n; i++)

        count[(arr[i] / exp) % 10]++;


    // Change count[i] so that count[i] now contains actual

    //  position of this digit in output[]
```

```
    for (i = 1; i < 10; i++)
        count[i] += count[i - 1];

    // Build the output array
    for (i = n - 1; i >= 0; i--) {
        output[count[(arr[i] / exp) % 10] - 1] = arr[i];
        count[(arr[i] / exp) % 10]--;
    }

    for (i = 0; i < n; i++)
        arr[i] = output[i];
}

void radixsort(int arr[], int n)
{
    int m = getMax(arr, n);

    for (int exp = 1; m / exp > 0; exp *= 10)
        countSort(arr, n, exp);
}

void print(int arr[], int n)
{
    for (int i = 0; i < n; i++)
        cout << arr[i] << " ";
```

```
}


int main()
{
    int arr[] = { 76, 34, 11, 88, 90, 3, 1 };
    int n = sizeof(arr) / sizeof(arr[0]);


    radixsort(arr, n);
    print(arr, n);
    return 0;
}
```

OUTPUT



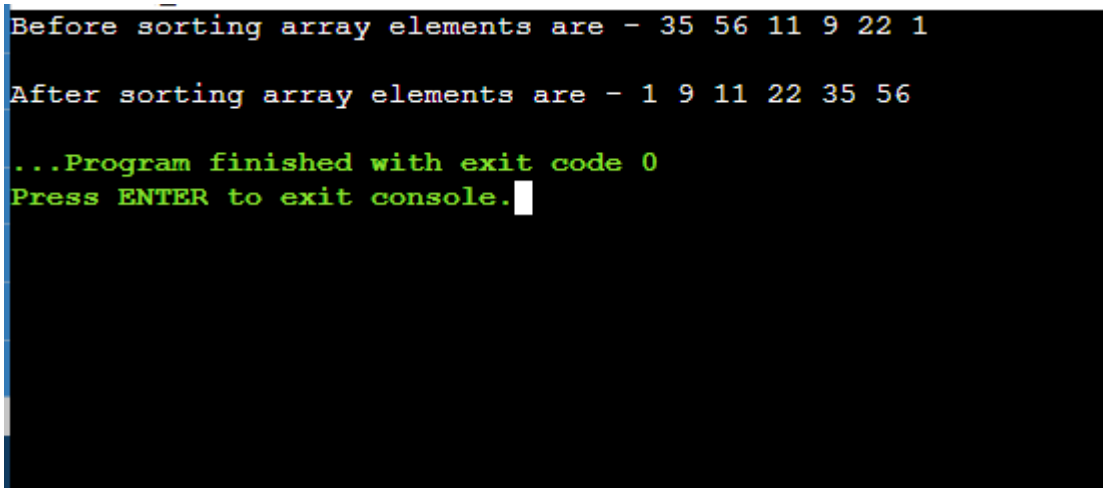
PRACTICAL 6 : Implement Bucket Sort

```
#include <iostream>
using namespace std;
int getMax(int a[], int n) // function to get maximum element from the given array
{
  int max = a[0];
```

```
  for (int i = 1; i < n; i++)
    if (a[i] > max)
      max = a[i];
  return max;
}
void bucket(int a[], int n) // function to implement bucket sort
{
  int max = getMax(a, n); //max is the maximum element of array
  int bucket[max], i;
  for (int i = 0; i <= max; i++)
  {
    bucket[i] = 0;
  }
  for (int i = 0; i < n; i++)
  {
    bucket[a[i]]++;
  }
  for (int i = 0, j = 0; i <= max; i++)
  {
    while (bucket[i] > 0)
    {
      a[j++] = i;
      bucket[i]--;
    }
  }
```

```
}
void printArr(int a[], int n) // function to print array elements
{
  for (int i = 0; i < n; ++i)
    cout<<a[i]<<" ";
}
int main()
{
  int a[] = {35, 56, 11, 9, 22, 1};
  int n = sizeof(a) / sizeof(a[0]); // n is the size of array
  cout<<"Before sorting array elements are - ";
  printArr(a, n);
  bucket(a, n);
  cout<<"\n\nAfter sorting array elements are - ";
  printArr(a, n);
}
```

OUTPUT



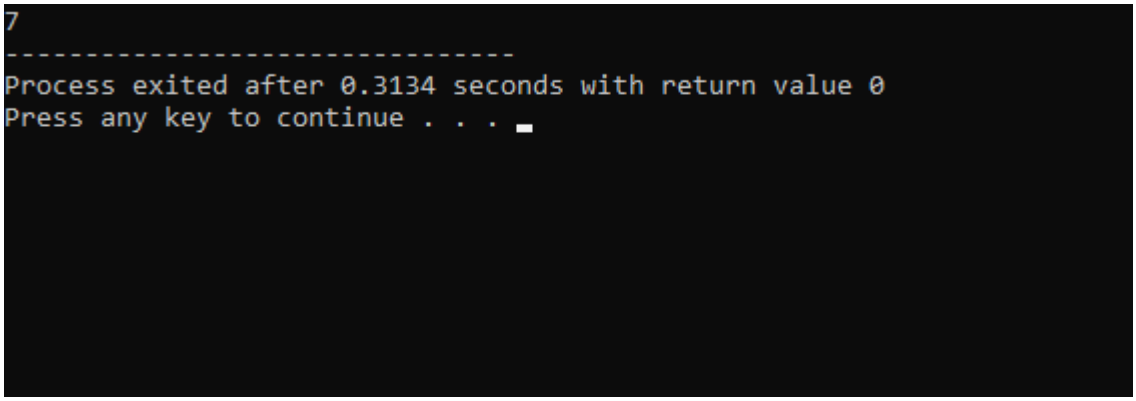
PRACTICAL 7 : Implement Randomized Select

```
#include <iostream>

using namespace std;

int random_partition(int *arr, int start, int end)

{

    int pivotIdx = start + rand() % (end - start + 1);

    int pivot = arr[pivotIdx];

    swap(arr[pivotIdx], arr[end]);

    pivotIdx = end;

    int i = start - 1;


    for (int j = start; j <= end - 1; j++)

    {

        if (arr[j] <= pivot)

        {

            i = i + 1;

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

        }

    }


    swap(arr[i + 1], arr[pivotIdx]);

    return i + 1;

}


int random_selection(int *arr, int start, int end, int k)
```

```
{
    int i = 0;
    if (start == end)
        return arr[start];

    if (k == 0)
        return -1;

    if (start < end)
    {
        int mid = random_partition(arr, start, end);
        i = mid - start + 1;
        if (i == k)
            return arr[mid];
        else if (k < i)
            return random_selection(arr, start, mid - 1, k);
        else
            return random_selection(arr, mid + 1, end, k - i);
    }
}

int main()
{
    int A[] = {9, 5, 7, 1, 10, 2, 3};
    int arr = random_selection(A, 0, 6, 5);
```

```
    cout << arr;
    return 0;
}
```

OUTPUT



PRACTICAL 8 : Implement Breadth-First Search in a graph

```
// Breadth First Search
#include<iostream>
#include <list>
 using namespace std;


// This class represents a directed graph using
// adjacency list representation
class Graph
{
    int V;    // No. of vertices


    // Pointer to an array containing adjacency
    // lists
    list<int> *adj;
```

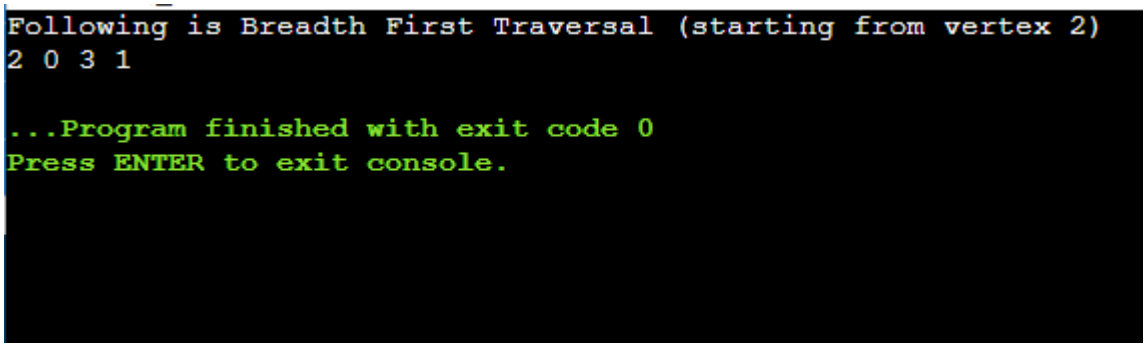
```
public:
    Graph(int V);  // Constructor

    // function to add an edge to graph
    void addEdge(int v, int w);

    // prints BFS traversal from a given source s
    void BFS(int s);
};

Graph::Graph(int V)
{
    this->V = V;
    adj = new list<int>[V];
}

void Graph::addEdge(int v, int w)
{
    adj[v].push_back(w); // Add w to v’s list.
}

void Graph::BFS(int s)
{
    // Mark all the vertices as not visited
    bool *visited = new bool[V];
```

```
for(int i = 0; i < V; i++)
    visited[i] = false;

// Create a queue for BFS
list<int> queue;

// Mark the current node as visited and enqueue it
visited[s] = true;
queue.push_back(s);

// 'i' will be used to get all adjacent
// vertices of a vertex
list<int>::iterator i;

while(!queue.empty())
{
    // Dequeue a vertex from queue and print it
    s = queue.front();
    cout << s << " ";
    queue.pop_front();

    // Get all adjacent vertices of the dequeued
    // vertex s. If a adjacent has not been visited,
    // then mark it visited and enqueue it
    for (i = adj[s].begin(); i != adj[s].end(); ++i)
```

```
        {
            if (!visited[*i])
            {
                visited[*i] = true;
                queue.push_back(*i);
            }
        }
    }
}

// Driver code
int main()
{
    // Create a graph given in the above diagram
    Graph g(4);
    g.addEdge(0, 1);
    g.addEdge(0, 2);
    g.addEdge(1, 2);
    g.addEdge(2, 0);
    g.addEdge(2, 3);
    g.addEdge(3, 3);

    cout << "Following is Breadth First Traversal "
         << "(starting from vertex 2) \n";
    g.BFS(2);
```

```
    return 0;
}
```

OUTPUT



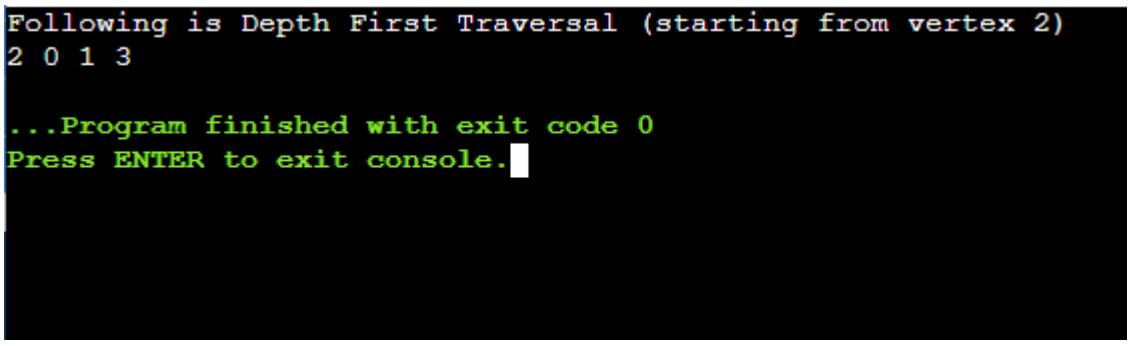
PRACTICAL 9 : Implement Depth-First Search in a graph

```
// Depth First Search
#include <bits/stdc++.h>
using namespace std;

// Graph class represents a directed graph
// using adjacency list representation
class Graph {
public:
    map<int, bool> visited;
    map<int, list<int> > adj;

    // function to add an edge to graph
    void addEdge(int v, int w);

    // DFS traversal of the vertices
```

```
    // reachable from v
    void DFS(int v);
};

void Graph::addEdge(int v, int w)
{
    adj[v].push_back(w); // Add w to v's list.
}

void Graph::DFS(int v)
{
    // Mark the current node as visited and
    // print it
    visited[v] = true;
    cout << v << " ";

    // Recur for all the vertices adjacent
    // to this vertex
    list<int>::iterator i;
    for (i = adj[v].begin(); i != adj[v].end(); ++i)
        if (!visited[*i])
            DFS(*i);
}

// Driver code
```

```
int main()
{
    // Create a graph given in the above diagram
    Graph g;
    g.addEdge(0, 1);
    g.addEdge(0, 2);
    g.addEdge(1, 2);
    g.addEdge(2, 0);
    g.addEdge(2, 3);
    g.addEdge(3, 3);

    cout << "Following is Depth First Traversal"
         " (starting from vertex 2) \n";
    g.DFS(2);

    return 0;
}
```

OUTPUT



PRACTICAL 10 : Write a program to determine the minimum spanning tree of a graph using both Prims and Kruskals algorithm

PRIMS ALGORITHM

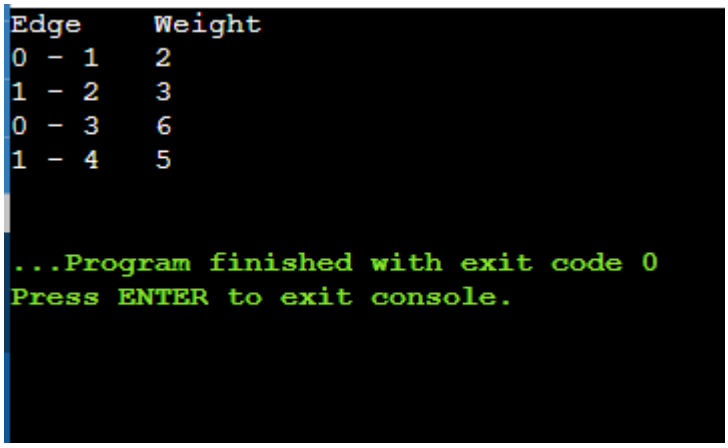
```
#include <bits/stdc++.h>

using namespace std;

 // Number of vertices in the graph

#define V 5

 // A utility function to find the vertex with minimum key value, from the set of vertices not yet included in MST

int minKey(int key[], bool mstSet[])

{

    // Initialize min value

    int min = INT_MAX, min_index;



    for (int v = 0; v < V; v++)

        if (mstSet[v] == false && key[v] < min)

            min = key[v], min_index = v;



    return min_index;

}



// A utility function to print the constructed MST stored in parent[]

void printMST(int parent[], int graph[V][V])

{

    cout<<"Edge \tWeight\n";

    for (int i = 1; i < V; i++)

        cout<<parent[i]<<" - "<<i<<" \t"<<graph[i][parent[i]]<<" \n";
```

```
}


// Function to construct and print MST for a graph represented using adjacency matrix representation

void primMST(int graph[V][V])

{

    int parent[V];   // Array to store constructed MST

     int key[V];   // Key values used to pick minimum weight edge in cut

     bool mstSet[V];  // To represent set of vertices included in MST


    // Initialize all keys as INFINITE

    for (int i = 0; i < V; i++)

        key[i] = INT_MAX, mstSet[i] = false;


    // Always include 1st vertex in MST. Make key 0 so that this vertex is picked as first vertex.

    key[0] = 0;

    parent[0] = -1; // First node is always root of MST


    // The MST will have V vertices

    for (int count = 0; count < V - 1; count++)

    {

        // Pick the minimum key vertex from the set of vertices not yet included in MST

        int u = minKey(key, mstSet);

       mstSet[u] = true;  // Add the picked vertex to the MST Set
```

```
        // Update key value and parent index of  the adjacent vertices of the picked vertex.
        // Consider only those vertices which are not yet included in MST
        for (int v = 0; v < V; v++)

            // graph[u][v] is non zero only for adjacent vertices of m mstSet[v] is false for vertices not yet included in MST
            // Update the key only if graph[u][v] is smaller than key[v]
            if (graph[u][v] && mstSet[v] == false && graph[u][v] < key[v])
                parent[v] = u, key[v] = graph[u][v];
    }

    // print the constructed MST
    printMST(parent, graph);
}

// Driver code
int main()
{
    int graph[V][V] = { { 0, 2, 0, 6, 0 },
                        { 2, 0, 3, 8, 5 },
                        { 0, 3, 0, 0, 7 },
                        { 6, 8, 0, 0, 9 },
                        { 0, 5, 7, 9, 0 } };

    // Print the solution
    primMST(graph);
```

```
    return 0;
}
```

OUTPUT



KRUSKALS ALGORITHM

```
#include <bits/stdc++.h>
using namespace std;

class DSU {
    int* parent;
    int* rank;

public:
    DSU(int n)
    {
        parent = new int[n];
        rank = new int[n];
```

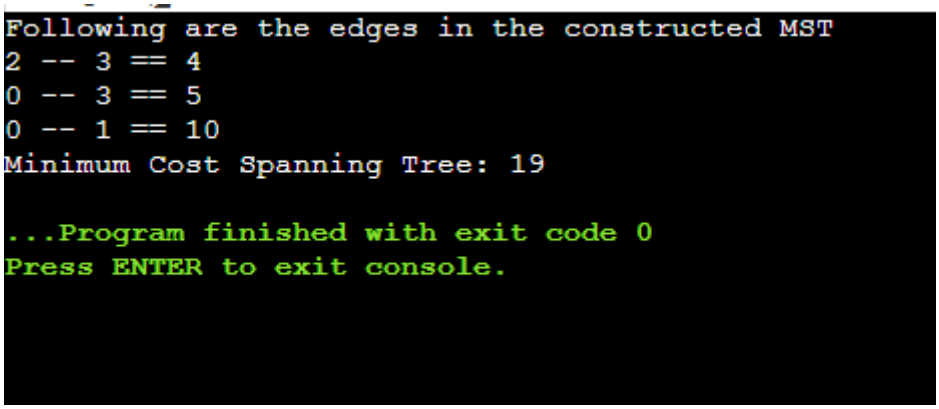
```
    for (int i = 0; i < n; i++) {
        parent[i] = -1;
        rank[i] = 1;
    }
}

// Find function
int find(int i)
{
    if (parent[i] == -1)
        return i;

    return parent[i] = find(parent[i]);
}
// union function
void unite(int x, int y)
{
    int s1 = find(x);
    int s2 = find(y);

    if (s1 != s2) {
        if (rank[s1] < rank[s2]) {
            parent[s1] = s2;
            rank[s2] += rank[s1];
        }
```

```
            else {
                parent[s2] = s1;
                rank[s1] += rank[s2];
            }
        }
    }
};

class Graph {
    vector<vector<int> > edgelist;
    int V;

public:
    Graph(int V) { this->V = V; }

    void addEdge(int x, int y, int w)
    {
        edgelist.push_back({ w, x, y });
    }

    void kruskals_mst()
    {
        // 1. Sort all edges
        sort(edgelist.begin(), edgelist.end());
```

```
        // Initialize the DSU
        DSU s(V);
        int ans = 0;
        cout << "Following are the edges in the "
                "constructed MST"
             << endl;
        for (auto edge : edgelist) {
            int w = edge[0];
            int x = edge[1];
            int y = edge[2];

            // take that edge in MST if it does form a cycle
            if (s.find(x) != s.find(y)) {
                s.unite(x, y);
                ans += w;
                cout << x << " -- " << y << " == " << w
                     << endl;
            }
        }
        cout << "Minimum Cost Spanning Tree: " << ans;
    }
};
int main()
{
    Graph g(4);
```

```
    g.addEdge(0, 1, 10);
    g.addEdge(1, 3, 15);
    g.addEdge(2, 3, 4);
    g.addEdge(2, 0, 6);
    g.addEdge(0, 3, 5);

    g.kruskals_mst();
    return 0;
}
```

OUTPUT



PRACTICAL 11 : Write a program to solve the weighted interval scheduling problem

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

// Data structure to store a Job
struct Job
```

```
{
    int start, finish, weight;
};

void findMaxWeightJobs(vector<Job> jobs)
{
    // sort the jobs according to increasing order of their start time
    // sort(jobs.begin(), jobs.end(),
    //      [](Job &x, Job &y)
    //      {
    //          return x.start < y.start;
    //      });
    //  output:The jobs involved in the maximum weight are (1, 4, 30) (4, 5, 60) (5, 9, 50)

    // sort the jobs according to increasing order of their finish time
    sort(jobs.begin(), jobs.end(),
         [](Job &x, Job &y)
         {
             return x.finish < y.finish;
         });
    //  output:The jobs involved in the maximum weight are (1, 4, 30) (4, 5, 60) (5, 9, 50)

    // get the number of jobs
    int n = jobs.size();
```

```
// base case
if (n == 0)
{
    return;
}

// `tasks[i]` stores the index of non-conflicting jobs involved in the
// maximum weight, which ends with the i'th job
vector<int> tasks[n];

// `maxweight[i]` stores the total weight of jobs in `tasks[i]`
int maxWeight[n];

// consider every job
for (int i = 0; i < n; i++)
{
    // initialize current weight to 0
    maxWeight[i] = 0;

    // consider each `j` less than `i`
    for (int j = 0; j < i; j++)
    {
        // update i'th job if the j'th job is non-conflicting and leading to the
        // maximum weight
        if (jobs[j].finish <= jobs[i].start && maxWeight[i] < maxWeight[j])
```

```
        {
            tasks[i] = tasks[j];
            maxWeight[i] = maxWeight[j];
        }
    }

    // end current task with i'th job
    tasks[i].push_back(i);
    maxWeight[i] += jobs[i].weight;
}

// find an index with the maximum weight
int index = 0;
for (int i = 1; i < n; i++)
{
    if (maxWeight[i] > maxWeight[index])
    {
        index = i;
    }
}

cout << "The jobs involved in the maximum weight are ";
for (int i : tasks[index])
{
    cout << "(" << jobs[i].start << ", " << jobs[i].finish << ", "
```

```
            << jobs[i].weight << ") ";
    }
}

// Main Function(Driver Code)
int main()
{
    vector<Job> jobs{
        {0, 6, 60},
        {5, 9, 50},
        {1, 4, 30},
        {4, 5, 60},
        {5, 7, 30},
        {3, 5, 10},
        {7, 8, 10}};

    findMaxWeightJobs(jobs);

    return 0;
}
```

OUTPUT

```
The jobs involved in the maximum weight are (1, 4, 30) (4, 5, 60) (5, 9, 50)

...Program finished with exit code 0
Press ENTER to exit console.
```

PRACTICAL 12 : Write a program to solve the 0-1 knapsack problem

DYNAMIC PROGRAMMING

// Program to solve the 0-1 knapsack problem using dynamic programming.

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

int max(int x, int y) {
  return (x > y) ? x : y;
}
int knapSack(int W, int w[], int v[], int n) {
  int i, wt;
  int K[n + 1][W + 1];
  for (i = 0; i <= n; i++) {
    for (wt = 0; wt <= W; wt++) {
      if (i == 0 || wt == 0)
      K[i][wt] = 0;
      else if (w[i - 1] <= wt)
        K[i][wt] = max(v[i - 1] + K[i - 1][wt - w[i - 1]], K[i - 1][wt]);
      else
     K[i][wt] = K[i - 1][wt];
    }
  }
  return K[n][W];
}
```

```
int main() {
   int n, W;
   cout << "Enter the number of items in a Knapsack : ";
   cin >> n;
   cout<<endl;
   int v[n], w[n];
   for (int i = 1; i <= n; i++) {
      cout << "Enter profit value and weight for item " << i << ": ";
      cin >> v[i];
      cin >> w[i];
   }
   cout << "\nEnter the capacity of knapsack : ";
   cin >> W;
   cout << "\nDynamic Problem choice solution : "<< knapSack(W, w, v, n);
   return 0;
}
```

OUTPUT

```
Enter the number of items in a Knapsack : 4

Enter profit value and weight for item 1: 3 2
Enter profit value and weight for item 2: 4 3
Enter profit value and weight for item 3: 5 4
Enter profit value and weight for item 4: 6 5

Enter the capacity of knapsack : 5

Dynamic Problem choice solution : 7

...Program finished with exit code 0
Press ENTER to exit console.
```

GREEDY

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

void knapsack(int n, double weight[], double profit[], double capacity)
{
    double total_Profit = 0;
    int c = capacity;

    for (int i = 0; i < n; i++)
    {
        if (weight[i] > c)
            break;
        else
        {
            total_Profit += profit[i];
            c -= weight[i];
        }
    }

    cout << "\nMaximum profit : " << total_Profit;
}

// Main function(Driver Code)
int main()
```

```
{
    double weight[20], profit[20], capacity;


    cout << "\nEnter the no. of objects : ";
    int num;
    cin >> num;
    cout << "\nEnter the weights and profits of each object (With space) : \n";
    for (int i = 0; i < num; i++)
    {
        cin >> weight[i] >> profit[i];
    }
cout << "\nEnter the capacity of knapsack : ";
cin >> capacity;
knapsack(num, weight, profit, capacity);
return 0;
}
```

OUTPUT