ASSIGNMENT:6

AIM: Read the marks obtained by the students of second year in an online examination of a particular subject. Find out maximum and minimum marks obtained in that subject using heap data structure.

OBJECTIVE: To study and learn the concepts of heap data structure.

THEORY: Heap definition- It is a Complete (Binary) Tree with each node having HEAP PROPERTY. Elements are filled level by level from left- to-right. If A is a parent node of B, then the key (the value) of node A is ordered with respect to the key of node B with the same ordering applying across the heap.

Types of heap: 1) Min heap

2) Max heap

- MAX HEAP definition:
  - Complete (Binary) tree with the property that the **value of each node** is at least as large as the value of its children (i.e. >= value of its children)
- MIN HEAP definition:
  - Complete (Binary) tree with the property that the **value of each node** is at most as large as the value of its children (i.e. <= value of its children)

ALGORITHM: To maintain the max heap property i.e. MAXHEAPIFY

MAX-HEAPIFY(A, i, n)

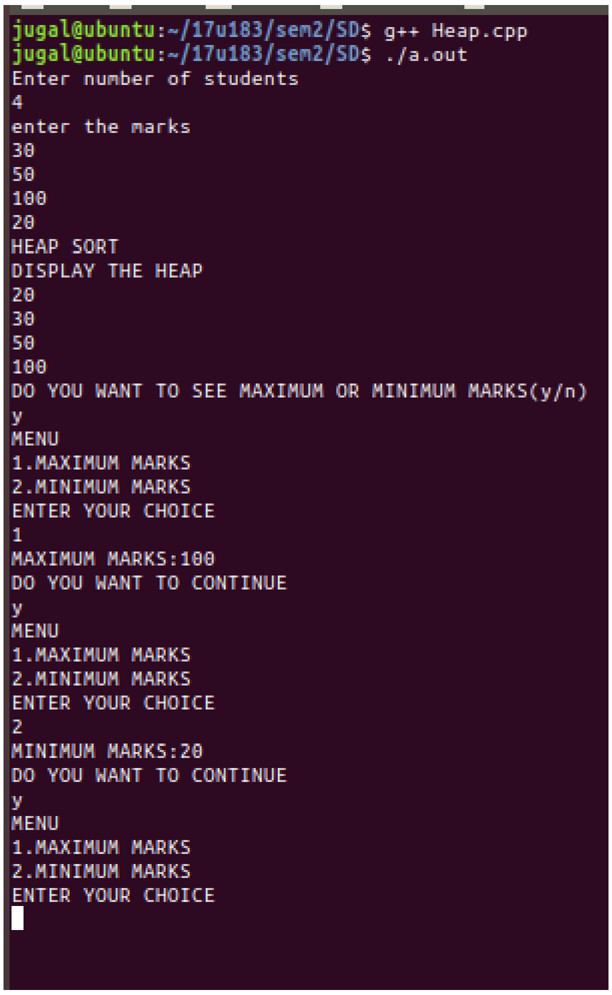
```
1. l ← LEFT(i)
2. r ← RIGHT(i)
3. if l ≤ n and A[l] > A[i]
4.    then largest ←l
5.    else largest ←i
6. if r ≤ n and A[r] > A[largest]
7.    then largest ←r
8. if largest ≠ i
9.    then exchange A[i] ↔ A[largest]
10.          MAX-HEAPIFY(A, largest, n)
```

PROGRAM:

```
#include<iostream>
using namespace std;
class heap
{
public:
void printarray(int a[], int n);
void heapsort(int a[], int n);
void minimum(int a[],int n);
void maximum(int a[],int n);
};
void heapify(int a[],int n,int i);
void heap:: heapsort(int a[], int n)
  {
   for(int i=(n/2)-1; i>=0;i--)
   {
    heapify(a,n,i);
   }
   for(int i=(n-1);i>=0;i--)
   {
     int temp= a[0];
     a[0]= a[i];
     a[i]= temp;
    heapify (a,i,0);
    }
   }
void heapify(int a[],int n, int i)
{
     int largest=i;
     int l= (2*i)+1;
     int r=(2*i)+2;
     if(l<n && a[l]>a[largest])
     largest=l;
     if(r<n && a[r]>a[largest])
     largest=r;

     if(largest!=i)
     {
     int t= a[i];
     a[i]=a[largest];
     a[largest]=t;
     heapify(a,n,largest);
     }
}
void heap:: printarray(int a[],int n)
{
    for(int i=0;i<n;i++)
       {
        cout<<a[i]<<"";
        cout<<"\n";
        }
        }
        void heap::maximum(int a[],int n)
        {
            cout<<"MAXIMUM MARKS:"<<a[n-1]<<endl;
        }
        void heap::minimum(int a[],int n)
        {
            cout<<"MINIMUM MARKS:"<<a[0]<<endl;
        }
int main()
{
  heap h;
  int a[100],n;
  cout<<"Enter number of students"<<endl;
  cin>>n;
  cout<<"enter the marks"<<endl;
  for(int i=0;i<n;i++)
    {
    cin>>a[i];
    }
    cout<<"HEAP SORT"<<endl;
    h.heapsort(a,n);
    cout<<"DISPLAY THE HEAP"<<endl;
    h.printarray(a,n);
    char ch;
    int choice;
    cout<<"DO YOU WANT TO SEE MAXIMUM OR MINIMUM MARKS(y/n)"<<endl;
    cin>>ch;
    while(ch=='y')
    {
    cout<<"MENU"<<endl;
    cout<<"1.MAXIMUM MARKS"<<endl;
    cout<<"2.MINIMUM MARKS"<<endl;
    cout<<"ENTER YOUR CHOICE"<<endl;
    cin>>choice;
    switch(choice)
        {
        case 1:
            h.maximum(a,n);
            break;
        case 2:
            h.minimum(a,n);
            break;
        default:
            cout<<"SORRY!WRONG CHOICE"<<endl;
            break;
        }
        cout<<"DO YOU WANT TO CONTINUE"<<endl;
        cin>>ch;
    }
return 0;
  }
```

OUTPUT:



```
jugal@ubuntu:~/17u183/sem2/SD$ g++ Heap.cpp
jugal@ubuntu:~/17u183/sem2/SD$ ./a.out
Enter number of students
4
enter the marks
30
50
100
20
HEAP SORT
DISPLAY THE HEAP
20
30
50
100
DO YOU WANT TO SEE MAXIMUM OR MINIMUM MARKS(y/n)
y
MENU
1.MAXIMUM MARKS
2.MINIMUM MARKS
ENTER YOUR CHOICE
1
MAXIMUM MARKS:100
DO YOU WANT TO CONTINUE
y
MENU
1.MAXIMUM MARKS
2.MINIMUM MARKS
ENTER YOUR CHOICE
2
MINIMUM MARKS:20
DO YOU WANT TO CONTINUE
y
MENU
1.MAXIMUM MARKS
2.MINIMUM MARKS
ENTER YOUR CHOICE
```

CONCLUSION:

We successfully implemented heap data structure.