

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. \geq 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. \leq value of its children)

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

MAX-HEAPIFY(A, i, n)

1. $l \leftarrow \text{LEFT}(i)$
2. $r \leftarrow \text{RIGHT}(i)$
3. **if** $l \leq n$ and $A[l] > A[i]$
4. **then** $\text{largest} \leftarrow l$
5. **else** $\text{largest} \leftarrow i$
6. **if** $r \leq n$ and $A[r] > A[\text{largest}]$

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7. **then** largest \leftarrow r
8. **if** largest \neq i
9. **then** exchange A[i] \leftrightarrow 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);
    }
}
```

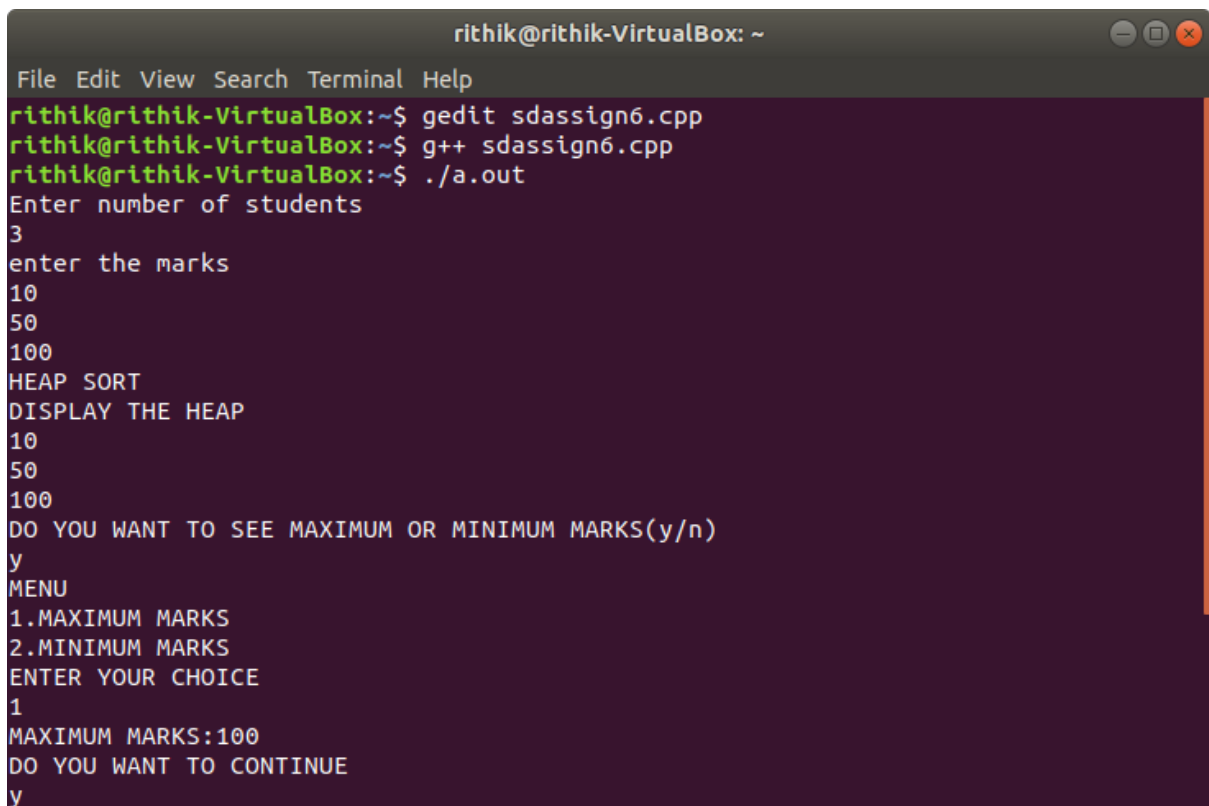
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```
}
void heap:: printarray(int a[],int n)
{
    for(int i=0;i<n;i++)
    {
        cout<<a[i]<<" ";
        cout<<"\n";
    }
}
void heap::maximum(int a[],int n)
{
    cout<<"MAXIMUM MARKS:"<<a[n-1]<<endl;
}
void heap::minimum(int a[],int n)
{
    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;
        }
    }
}
```

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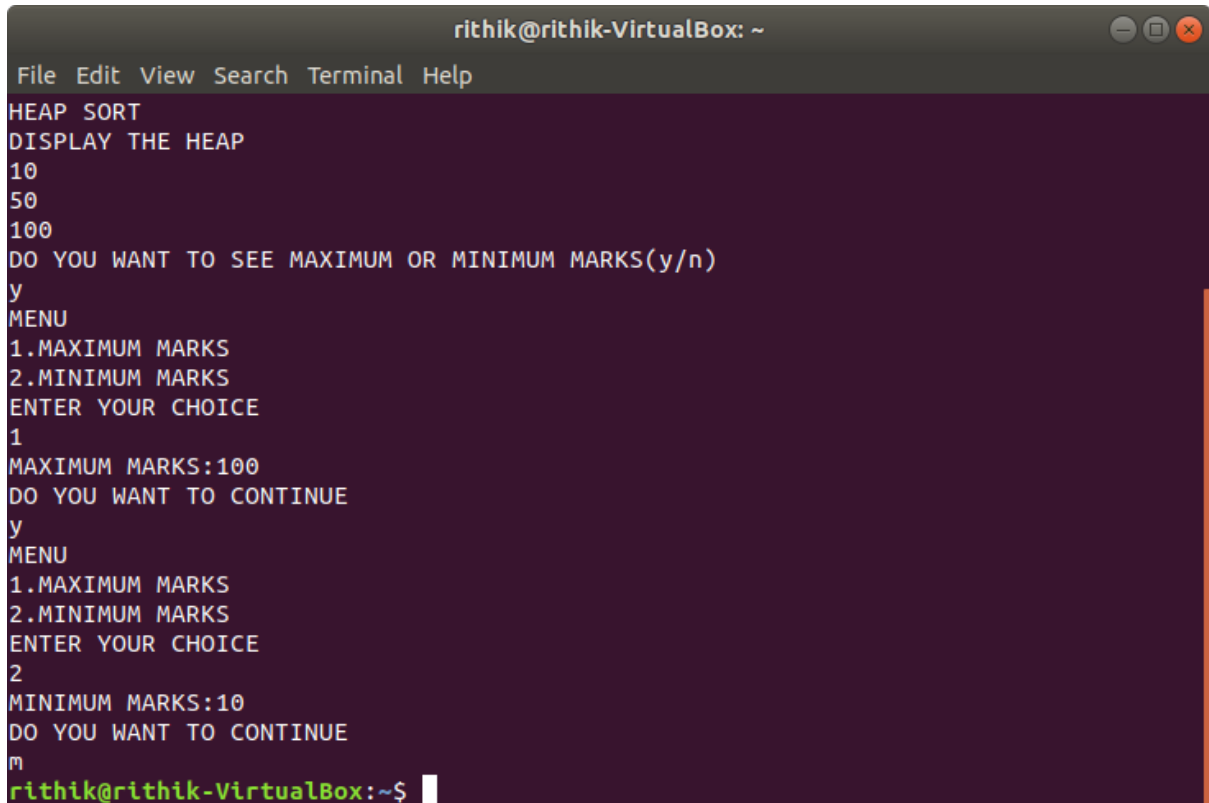
```
        break;
    }
    cout<<"DO YOU WANT TO CONTINUE"<<endl;
    cin>>ch;
}
return 0;
}
```

OUTPUT:



```
rithik@rithik-VirtualBox: ~
File Edit View Search Terminal Help
rithik@rithik-VirtualBox:~$ gedit sdassign6.cpp
rithik@rithik-VirtualBox:~$ g++ sdassign6.cpp
rithik@rithik-VirtualBox:~$ ./a.out
Enter number of students
3
enter the marks
10
50
100
HEAP SORT
DISPLAY THE HEAP
10
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
```

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```
rithik@rithik-VirtualBox: ~  
File Edit View Search Terminal Help  
HEAP SORT  
DISPLAY THE HEAP  
10  
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:10  
DO YOU WANT TO CONTINUE  
y  
rithik@rithik-VirtualBox:~$
```

CONCLUSION: We successfully implemented heap data structure.