National University of Computer and Emerging Sciences

Laboratory Manual

for

Data Structures Lab

Department of Computer Science

FAST-NU, Lahore, Pakistan

Objectives:

In this lab, students will practice:

1. Implementation of Min Heap Using Arrays

Question 1:

a. Create a struct HeapItem as follows:

```
template <typename k, typename v>
struct HeapItem
{
        k key;
        v value;
};
```

b. Now create a MinHeap class which contains:

1. A pointer to HeapItem, “arr”.
2. An int variable “capacity” which stores the total capacity of a heap.
3. An int variable “totalItems” which contains the count of the current total number of items stored.

Provide the following member functions for your MinHeap class:

1. A default constructor which assigns nullptr to arr pointer. MinHeap()

2. An overloaded constructor which takes as argument the value of capacity and allocates the memory of the required capacity to arr pointer. MinHeap(int _capacity).

3. An insert function which takes as argument a key value pair. It then inserts the key value pair into the heap array such that, the resultant heap tree is a complete binary tree and it follows minheapordering. If totalItems==capacity, then double the capacity of heap array and insert the keyvaluepair. There must not be any memory leaks. void insert(k key, v value)

4. A function isEmpty which returns true if the heap has no element. bool isEmpty() const 11. A destructor

—----------Practice Questions for heap—----------

5. Determine if the array is a binary heap or not.
6. Increase key (p,m) increases the value of key at index p by m6. Decrease Key(p,m) decreases the value of key at index p in the array by m7. Convert Min heap to max heap

7.. A getMin function which assigns the value of that HeapItem, whose key is minimum, to the parameter passed by reference. It does not delete that HeapIte from the heap. Useassert(totalItems>0) to throw an error if the heap is empty. void getMin(v&_value)

8. A deleteMin function which deletes the HeapItem which has the minimum key. The Heap Must Remain a complete binary tree and it must follow min heap ordering after deleteMinis called. User assert(totalItems>0) to throw an error if the heap is empty. void deleteMin()

9. Implement the heap sort function

Question 3:
Run the following main program

```
int main()
{
    MinHeap<int, Student> stdHeap;
    buildStudentHeap("students.txt", stdHeap);

    while (!stdHeap.isEmpty())
    {
            Student s;
            stdHeap.getMin(s);
            cout << s <<endl<<endl;
            stdHeap.deleteMin();
    }

    system("pause");
}
```