9. Heap Sort

TITLE: Implement Heap sort to sort given set of values using max or min heap.

OBJECTIVE:

- Implement Heap sort to sort given set of values using max or min heap.

THEORY:

Sorting: Sorting algorithm is an algorithm that puts elements of a list in a certain order. The most-used orders are numerical order and lexicographical order.

Sorting is a process of linear ordering of list of objects.

- Sorting techniques are categorized into:
    1. Internal sorting
    2. External sorting

❖ **Internal sorting:**

It takes the place in the main memory of a computer.

E.g: Bubble sort, Insertion sort, Shell sort, Quick sort, Heap Sort, etc.

❖ **External sorting:**

It takes the place in secondary memory of a computer, since the number of objects to be stored is too large to fit in main memory.

E.g: Merge sort, Multiway Merge, Polyphase merge.

➢ **Heap sort:**

Heapsort (method) is a comparison-based sorting algorithm, and is part of the selection sort family. Although somewhat slower in practice on most machines than a good implementation of quicksort, it has the advantage of a worst-case $\Theta(n \log n)$ runtime. Heapsort is an in-place algorithm, but is not a stable sort.

In heap sort the array is interpreted as a binary tree. This method has 2

phases. In **phase 1**, binary heap is constructed.

In **phase 2**, delete min routine is performed.

Analysis of the heap sort:

Worst case performance- O(n log n)

Best case performance- O(n log n)

Average case performance- O(n log n)

Advantages of heap sort:

1. It is efficient for sorting large number of elements.

2. It has the advantages of worst case O(N log N) running time.

Limitations:

1. It is not a stable sort.

2. It requires more processing time.

> **Algorithm steps:**

Step1: Read the size of the list.

Step2: Read the elements of the list.

Step3: Binary heap construction.

1) Structrue Property:

For any element in array position I, the left child is in position 2i, the right child is in 2i+1,(i.e) the cell after the left child.

2) Heap Order Property:

The value in the parent node is smaller than or equal to the key value of any of its child node. Build the heap, apply the heap order properly starting from the right. Most non-leaf node at the bottom level.

Step 4: Delete min routine is performed.

INPUT:

Enter No of Elements: 5

Enter Elements to be sorted:

   5
   4
   3
   2
   1

Sorted Elements:

   1
   2
   3
   4
   5

OUTPUT:

1. Display heap sort result.
2. We have implemented Heap sort to sort given set of values using max or min heap.

CONCLUSION: Thus, we have studied and implement heap sort.

FAQ:

1. What is heap sort?
2. What is time complexity of heap sort?
3. What are the limitations of heap sort?