PROBLEM INTRODUCTION:

Heap Sort is one of the efficient sorting algorithms.It uses the “heap” data structure.Heap sort is the implementation of simple sort with the correct data structure.The heap data structure helps in completing the sorting in-place with logarithmic time.

ALGORITHM STEPS:

REQUIRED INPUTS: The input for the heap sort is an unsorted array of numbers. We also need the Heap data structure to implement the algorithm.

OUTPUT: Completely built heap which can be used for sorting. To get the sorted order of elements we always extract the root node of the heap.

CORE STRATEGY:

THE HEAP DATA STRUCTURE:

The heap data structure follows the structure of a complete binary tree to avoid holes in the heap.

The heap data structures maintain partial order of elements which is stronger than unsorted random order but weaker than sorted order.

The partial order of heap is maintained such that every parent dominates its children by the heap property.

Example: The Max-Heaps follow the property of the parent node being always greater than its children.

STEPS:

CONSTRUCTION OF HEAP:

1. Take the unsorted array as input
2. Repeat steps 3 and 4 for every element in the input array
3. Insert the elements at appropriate positions in the heap, i.e, to maintain the properties of complete binary tree, always insert the element from the extreme left positions until each level is filled with its maximum capacity(The maximum capacity of level x will be (2^ x-1)).
4. Validate the heap property and swap the elements accordingly.
5. Repeat steps 3 and 4 until every input element is inserted into the heap.

DELETION OF ELEMENTS FROM THE HEAP:

1. Swap the root element with the element of the recently inserted node of the heap.
2. Delete the recently inserted node of the heap.
3. Heapify the heap by swapping its elements accordingly to maintain the property of heap.

SORTING:

1. Insert the elements into the heap.
2. Perform deletion on the root node.
3. Insert the deleted element into the array.
4. Repeat steps 2 and 3 until all the elements are deleted from the heap.
5. The resultant array will give the sorted order of elements.

TIME AND SPACE COMPLEXITY: The heap sort takes the logarithmic time i.e, O(log n).For sorting n elements it takes time of O(n log n )