HANDS ON-5

DESIGN ANALYSIS AND ALGORITHMS

RASHMITHA RAMASANI

ID:1002233393

HEAP SORT: Heap Sort is a sorting technique that relies on a binary heap structure to organize elements in an array. The method consists of two key steps: constructing the heap and then extracting elements from it.

Time Complexity:

- **Building the heap** takes O(n) time.
- **Heapifying the heap** takes O(log n) time, and this happens for each of the n elements, making the sorting phase O(n log n).

Given handson description:

The ability to build the heap initially (build_min_heap):

- **Method: heapify_list()**: This method constructs a min heap from an unsorted list by heapifying the elements starting from the last non-leaf node to the root. This achieves the heap-building process.

The ability to heapify:

- **Method: _balance_heap()**: This method ensures the heap property is maintained after elements are added or removed. It is used when building the heap and during insertions/removals to restore the heap's structure.

The ability to get and remove ("pop") the root node from the heap (and re-heapify):

- **Method: extract_minimum()**: This method removes and returns the root node, which is the smallest element in the min heap. It then re-heapifies the structure to maintain the heap property after removal.

The heap is generic and can store different data types:

- The implementation uses a Python list (self.storage) that can hold any data type as long as it supports comparisons using the < operator. It works with both integers and floats, as shown in the test cases.

Demonstrated functionality:

- **Building the heap**: The heapify_list() method correctly demonstrates building a heap from unsorted integer and float lists, producing the expected heap structure.
- **Inserting elements**: The add_element() method correctly inserts new elements into the heap and reorganizes the structure as needed.

- **Extracting the minimum element**: The extract_minimum() method removes and returns the root node, then re-heapifies the structure to maintain the min heap's properties.This demonstrates that all the required functionality has been implemented.

OUTPUT: