P2 - HeapSort

Problem Statement

Given a list of n integers, sort them in ascending order using the Heapsort algorithm.

Input Format

The input will consist of 2 lines.
The first line contains a single integer n followed immediately by a newline.
The next line contains n space-separated integers.

Output Format

The numbers given in the input must be output in sorted order with a space between adjacent numbers.

Example

Input
10
6 4 3 5 7 1 2 9 8 0
Output
0 1 2 3 4 5 6 7 8 9

Expectations

You are expected to implement a class for the Binary Min-Heap. The heap must be stored in an array, simulating a heap.

It must contain at least the following features having the given time complexities:

a. `insert` O(log n) : Insert/Add an element to the heap
b. `size` O(1) : Must return numbers of elements in the heap
c. `peek` O(1) : Peek/Get the value of the minimum element
d. `remove` O(log n) : Remove/Delete the minimum element from the heap
e. `build` O(n) : Build the heap from given elements
f. `heapify` O(log n) : Correct the heap assuming children are valid heaps and current value is greater than one of the children.
Note: The `heapify` feature must not be exported.

Your heap may contain more features as per convenience, which must have appropriate contract conditions.

Feature: `heapsort`

In addition to the Min-Heap class, the main APPLICATION class must contain a feature named `heapsort` which accepts an array of integers and returns a new array containing the same elements in sorted order. The argument must not be changed. This feature must make use of the heap class for this purpose.

References for Binary Heap:

Preferred : Introduction to Algorithms - CLRS, Chapter : Heapsort
https://en.wikipedia.org/wiki/Binary_heap
https://brilliant.org/wiki/binary-heap/
https://www.hackerearth.com/practice/notes/heaps-and-priority-queues/
http://faculty.cs.niu.edu/~freedman/340/340notes/340heap.htm

Note that most references contain the solution using Max-heap, which is not the case with this assignment. You may only gather the ideas from the references but make proper changes to suit this problem statement.