

BITS Pilani, Pilani Campus
2nd Sem. 2021-22
CS F211 Data Structures & Algorithms

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Lab 9

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Topics: Heaps, Heap Sort and Priority Queues

In today's lab, we will implement heaps, heap sort and Priority Queues.

Please refer to heaps_theory.pdf (uploaded along with this lab sheet) to understand the concept of heaps, heap sort and Priority Queues. Alternately you can also refer to the lecture slides.

1. Implement the function **heapify()** that takes an array, its size and an index in the array. This function should convert the subtree indexed at the above index, into a heap.
2. Create a function **build_heap()** that takes an input data file that is in the format of (value, key) pairs and then builds the heap over the "keys". You can use the "data10000" attached to this assignment to read data. You can assume necessary signatures for this function. And it should use **heapify()** to build the heap.
3. Create a function **heap_sort()** that takes the above data file and sorts the data based on "keys" and writes the sorted list to another file "data_sorted.txt".
4. Create a function **compare_sort_algos()**, which should take an input data file (value, key pairs), sort the data using **1. Quick sort; 2. Merge Sort; 3. Insertion Sort; 4. Heap Sort**. Measure the running time for each algorithm and compare the running time. Run the same for multiple data sets (data100000, data1000000, data10000000) and report the performance.
5. Let us now use heaps to build Priority Queues. You can use data10000 dataset and build priority queues based on the "keys". Implement the following functions:
 - a. **insert(S,x)** // inserts element x into the set S such that the Priority Queue property is maintained.
 - b. **max(S)** // returns the maximum element from set S in O(1) time complexity
 - c. **removeMax(S)** // removes and returns the maximum element from set S in O(1) time complexity.

Solution to be uploaded as a part of this lab: Solve Exercise-4 and upload its solution. You can report the running time of 4 algorithms for various datasets as comments in your single C file that you are going to submit. Name your submissions as YOUR_BITS_ID.c. No need to upload executable files, just upload a single .c file.