Ethan Nguyen
ethantn04@csu.fullerton.edu
CPSC 335 Algorithm Engineering
Project 2 - Algorithm 3

Project Report - Algorithm 3

Pseudocode

First, the min-heap is initialized with a priority queue to store the values that have been defined in our struct, value, indexarray, and index_in_array.
An empty list also needs to be initialized in order to store the merged output of the list.
The min-heap stores the first element of each array as well as its index in the array as well as its position.
If the heap is not empty, the program will extract the smallest element from the heap and append the element to the list.
The program will continue to extract and append these elements until it will output the resulting merged list.
Once all of the elements have been properly appended by increasing order, the program will return the resulting merged list.

Sample input:

{2, 5, 9, 21},

{-1, 0, 2},

{-10, 81, 121},

{4, 6, 12, 20, 150}

Sample output:
Merged List: -10 -1 0 2 2 4 5 6 9 12 20 21 81 121 150

Sample :

in2c.txt
[2, 5, 9, 21]
[-1, 0, 2]
[-10, 81, 121]
[4, 6, 12, 20, 150]
[10, 17, 18, 21, 29]
[-3, 0, 3, 7, 8, 11]
[81, 88, 121, 131]
[9, 11, 12, 19, 29]
[-4, -2, 0, 2, 7]
[4, 6, 12, 14]

[10, 15, 25]
[5, 6, 10, 20, 24]

output:
Merged List: -10 -4 -3 -2 -1 0 0 0 2 2 2 3 4 4 5 5 6 6 6 7 7 8 9 9 10 10 10 11 11 12 12 12 14 15 17 18 19 20 20 21 21 24 25 29 29 81 81 88 121 121 131 150

Mathematical Analysis & Efficiency Class

Let n be the average number of elements in each of the arrays.
Let k be the number of input arrays which in the sample case is 4.
The total number of elements can be represented by N = k*n which gives us the total elements.

When building the min-heap, inserting the first element from each of the arrays into the heap leads to a complexity of O(k log k).
Extracting from the heap and appending new elements into the resulting string happens an N amount of times.
The operations done in the heap take O(log k) which include the insert and extraction of elements.
The operations in the heap result in an overall complexity of O(N log k).

Considering the complexity of building the min-heap as well as the operations within it, we have a final complexity of O(k log k) + O(N log k) which will result in = O(N log k). There are no further indications of an increase of complexity, so this can be considered the final overall complexity of the algorithm.