CSE331: Data Structures and Algorithms

Heap Sort Lab Report

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The Full Project is in a GitHub Repository Below

Here are the used libraries and definitions:

```
#include <iostream>
#include <fstream>
#include <ctime>
#include <cstdlib>
#define LENGTH 10000
using namespace std;
```

Part 1:

Writing a C++ function to generate 10,000 random numbers between 1 and 10,000 and save them in a file (the full generated txt is in the GitHub repository linked below):

```
void createRandFile() {
	ofstream mfile("unsortedFile.txt");
	srand(time(0));

	for (int i = 0; i < LENGTH; i++) {
		mfile << ((rand() % LENGTH) + 1) << endl;
	}
}
```

Part 2:

Writing the Heap sort functions (this includes the counter (the variable “step”) that is required in Part 3:

```
int maxHeapify(int arr[], int i, int len) {
	int step = 3;
	int l = (2 * i) + 1;
	int r = (2 * i) + 2;
	int largest;
	if (l < len && arr[l] > arr[i]) {
		largest = l;
		step++;
	}
	else {
		largest = i;
		step++;
	}
	if (r < len && arr[r] > arr[largest]) {
		largest = r;
		step++;
	}
	if (largest != i) {
		int temp = arr[i];
		arr[i] = arr[largest];
		arr[largest] = temp;
		step += 3;
		step += maxHeapify(arr, largest, len);
	}
	return step;

}
```

```
int buildMaxHeap(int arr[], int l) {
	int step = 0;
	for (int i = l / 2; i >= 0; i--) {
		maxHeapify(arr, i, l);
		step++;
	}
	return step;
}

int heapSort(int arr[], int l) {
	int temp, step=0;
	step += buildMaxHeap(arr, l);
	for (int i = l-1; i > 0; i--) {
		temp = arr[0];
		arr[0] = arr[i];
		arr[i] = temp;
		step += 3;
		step += maxHeapify(arr, 0, i);
	}
	return step;
}
```

Writing a function to write the resultant array into a file (the full generated txt is in the GitHub repository linked below):

```
void createSortedFile(int arr[]) {
	ofstream mfile("sortedFile.txt");
	for (int i = 0; i < LENGTH; i++) {
		mfile << arr[i] << endl;
	}
}
```

Part 3:

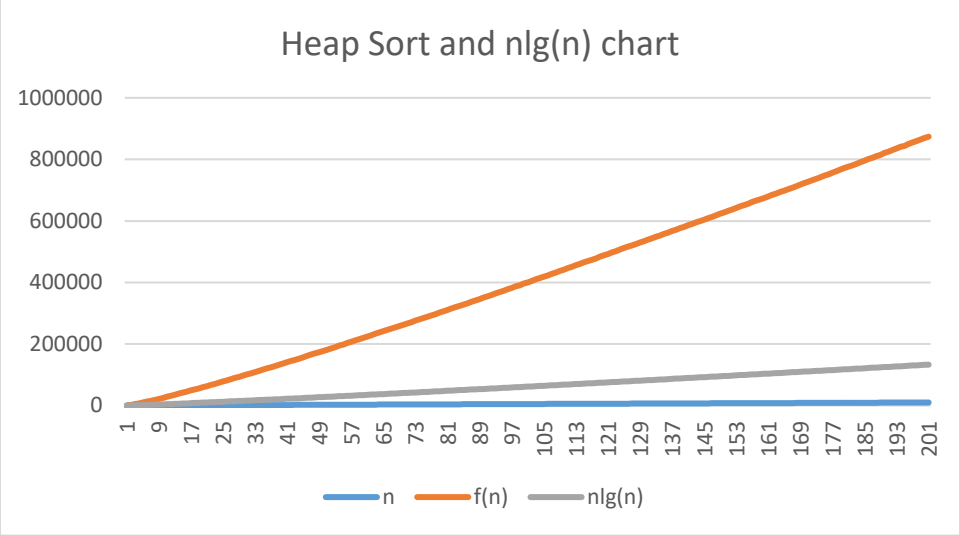
Creating the main function which reads n items using another function from the file generated and executes the heap algorithm with step 50 and writes a file that includes pairs of n and f(n) (“step”) (the full generated txt is in the GitHub repository linked below):

```
void readFile(int arr[], int l) {
	ifstream mfile("unsortedFile.txt");
	for (int i = 0; i < l; i++) {
		mfile >> arr[i];
	}
}
int main() {
	int arr[LENGTH];
	createRandFile();
	readFile(arr, LENGTH);
	ofstream sFile("stepFile.txt");
	int x[LENGTH];
	for (int i = 10; i < LENGTH; i += 50) {
		for (int j = 0; j < i; j++) {
			x[j] = arr[j];
		}
		sFile << i << ',' << heapSort(x, i) << endl;
```

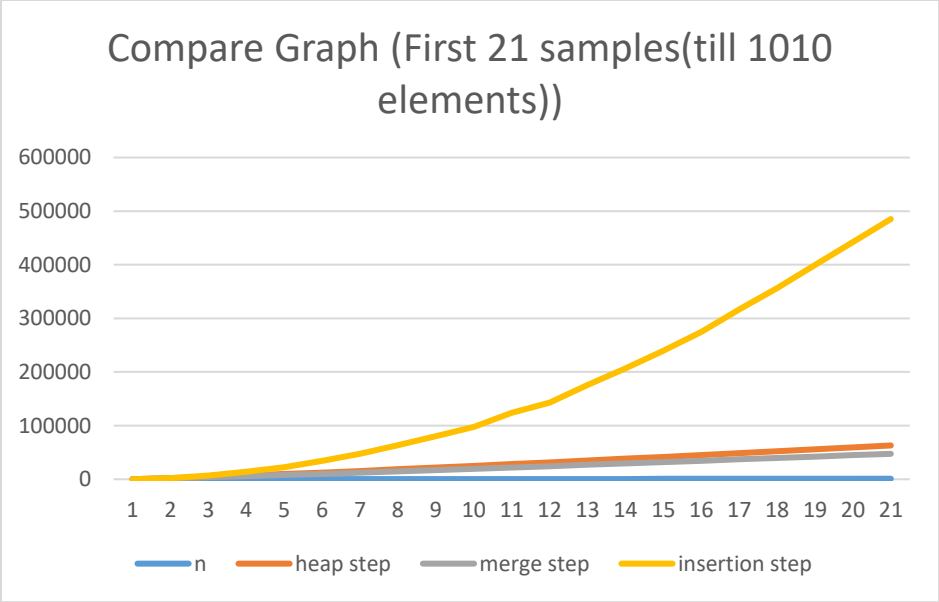
```
        }
        sFile << LENGTH << ',' << heapSort(arr, LENGTH) << endl;
        createSortedFile(arr);
        system("pause");
        return 0;
}
```

Part 4:

The "stepFile.txt" created in the main function is then imported into excel with an added column of (nlg(n)). Then a generated Graph from the excel is created:



Another graph that compares merge, insertion and heap sort is created:



GitHub Repository:
https://github.com/Anthony-Amgad/CSE331HeapSort19P9880