CSE331: Data Structures and Algorithms

Insertion 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 insertion sort function (this includes the counter (the variable “step”) that is required in Part 3:

```
int insertionSort(int arr[], int len) {
	int step = 0;
	for (int i = 1; i < len; i++) {
		int key = arr[i];
		step++;
		int j = i - 1;
		step++;
		while (j >= 0 && arr[j] > key) {
			arr[j + 1] = arr[j];
			step++;
			j--;
			step++;
		}
		arr[j + 1] = key;
		step++;
	}
	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;
	}
}
```

Additional Part:

Writing a testing function to check if the file has been correctly sorted:

```
bool testSortedFile() {
	int arr[LENGTH];
	ifstream mfile("sortedFile.txt");
	for (int i = 0; i < LENGTH; i++) {
		mfile >> arr[i];
	}
	for (int i = 0; i < LENGTH - 1; i++) {
		if (arr[i] > arr[i + 1])
			return false;
	}
	return true;
}
```

Part 3:

Creating the main function which reads n items using another function from the file generated and executes the insertion 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):

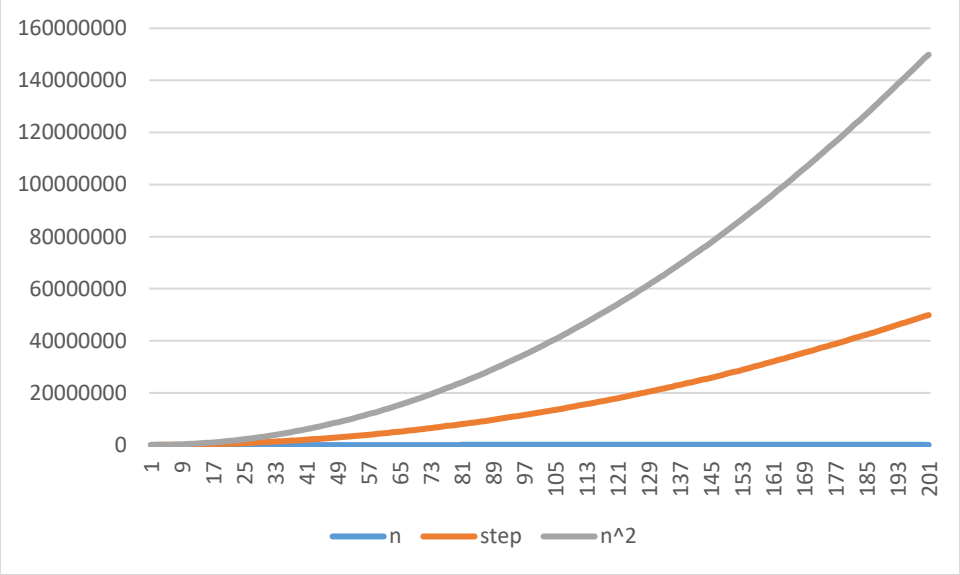
```
void readFile(int arr[], int l) {
	ifstream mfile("unsortedFile.txt");
	for (int i = 0; i < l; i++) {
		mfile >> arr[i];
	}
}
int main() {
	int arr[LENGTH];
	createRandFile();
	readFile(arr, LENGTH);
	ofstream sFile("stepFile.txt");
	int x[LENGTH];
	for (int i = 10; i < 10000; i += 50) {
		for (int j = 0; j < i; j++) {
			x[j] = arr[j];
		}
		sFile << i << ',' << insertionSort(x, i) << endl;
	}
	sFile << 10000 << ',' << insertionSort(arr, 10000) << endl;
	createSortedFile(arr);
	if(testSortedFile())
		cout << "Test for sort is succesful" << endl;
	else
		cout << "Test for sort is not succesful" << endl;
	system("pause");
	return 0;
}
```

Part 4:

The "stepFile.txt" created in the main function is then imported into excel with an added column of (n2). Here's a sample of the table in excel (the full generated excel is in the GitHub repository linked below):

n	step	n^2
10	51	100
60	1971	3600
110	6879	12100
160	14389	25600
210	22247	44100
260	34269	67600
310	47711	96100
360	63457	129600
410	80219	168100
460	97435	211600

Then a generated Graph from the excel is created:



GitHub Repository:
https://github.com/Anthony-Amgad/CSE331InsertionSort19P9880