CSE331: Data Structures and Algorithms

Quick, Counting and Radix Sort Lab Report

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<u>The Full Project is in a GitHub Repository Below</u>

Here are the used libraries and definitions:

```
#include <iostream>
#include <fstream>
#include <ctime>
#include <cstdlib>
#define LENGTH 10000
using namespace std;
int step = 0;
```

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 partition(int arr[], int s, int l) {
	int temp;
	int x = arr[l];
	int i = s - 1;
	for (int j = s; j < l; j++) {
		if (arr[j] <= x) {
			i++;
			temp = arr[i];
			arr[i] = arr[j];
			arr[j] = temp;
			step += 4;
		}
	}
	temp = arr[l];
	arr[l] = arr[i + 1];
	arr[i + 1] = temp;
	step += 5;
	return i + 1;
}

void quickSort(int arr[], int s, int l) {
	if (s < l) { int m = partition(arr, s, l);
		quickSort(arr, s, m - 1);
		quickSort(arr, m + 1, l);
		step += 2;}
}
```

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:

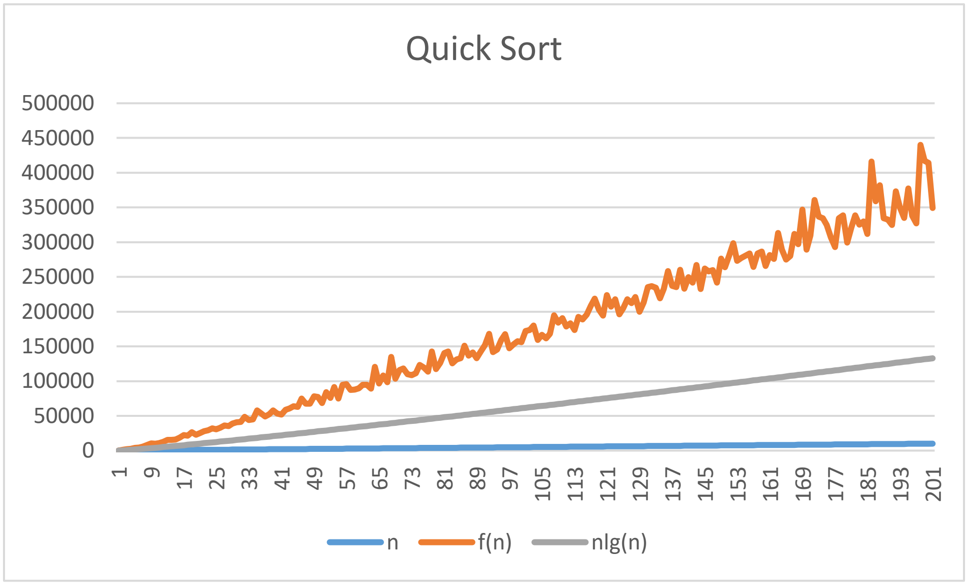
Creating the main function which reads n items using another function from the file generated and executes the heap algorithm with step 50 and writes a file that includes pairs of n and f(n) (“step”) (the full generated txt is in the GitHub repository linked below):

```
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 aFile("quickStepFile.txt");
	ofstream bFile("radixStepFile.txt");
	ofstream cFile("countingStepFile.txt");
	int x[LENGTH];
	int y[LENGTH];
	int z[LENGTH];

	for (int i = 10; i < 10000; i += 50) {
		for (int j = 0; j < i; j++) {
			x[j] = arr[j];
			y[j] = arr[j];
			z[j] = arr[j];
		}
		step = 0;
		quickSort(x, 0, i - 1);
		aFile << i << ',' << step << endl;
		step = 0;
		radixSort(y,i);
		bFile << i << ',' << step << endl;
		step = 0;
		countingSort(z, i);
		cFile << i << ',' << step << endl;

	}
	for (int j = 0; j < LENGTH; j++) {
		x[j] = arr[j];
		y[j] = arr[j];
}
```

```
        step = 0;
        quickSort(x, 0, LENGTH - 1);
        aFile << LENGTH << ',' << step << endl;
        step = 0;
        radixSort(y, LENGTH);
        bFile << LENGTH << ',' << step << endl;
        step = 0;
        countingSort(arr, LENGTH);
        cFile << LENGTH << ',' << step << endl;
        createSortedFile(arr);
        system("pause");
        return 0;
}
```

Part 4:

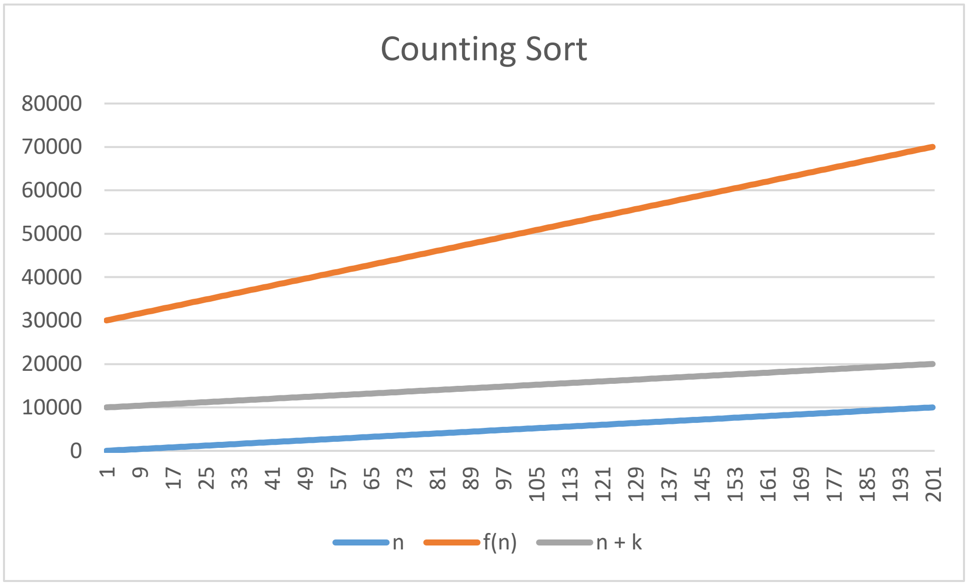
The "quickStepFile.txt" created in the main function is then imported into excel with an added column of (nlg(n)). Then a generated Graph from the excel is created:



The same steps are then repeated but with Counting Sort. It requires the following function:

```
void countingSort(int arr[], int len) {
        step += 3;
        int outarr[LENGTH];
        for (int j = 0; j < LENGTH; j++) {
                outarr[j] = 0;
                step++;
        }
        int count[LENGTH+1];
        for (int j = 0; j <= LENGTH; j++) {
                count[j] = 0;
                step++;
        }
        for (int i = 0; i < len; i++) {
                count[arr[i]] = count[arr[i]] + 1;
                step++;
        }
        for (int i = 1; i <= LENGTH; i++) {
                count[i] = count[i] + count[i - 1];
                step++;
        }
        for (int i = len - 1; i >= 0; i--) {
                outarr[count[arr[i]]-1] = arr[i];
                count[arr[i]] = count[arr[i]] - 1;
                step += 2;
        }
        for (int i = 0; i < len; i++) {
                arr[i] = outarr[i];
                step++;
        }
}
```

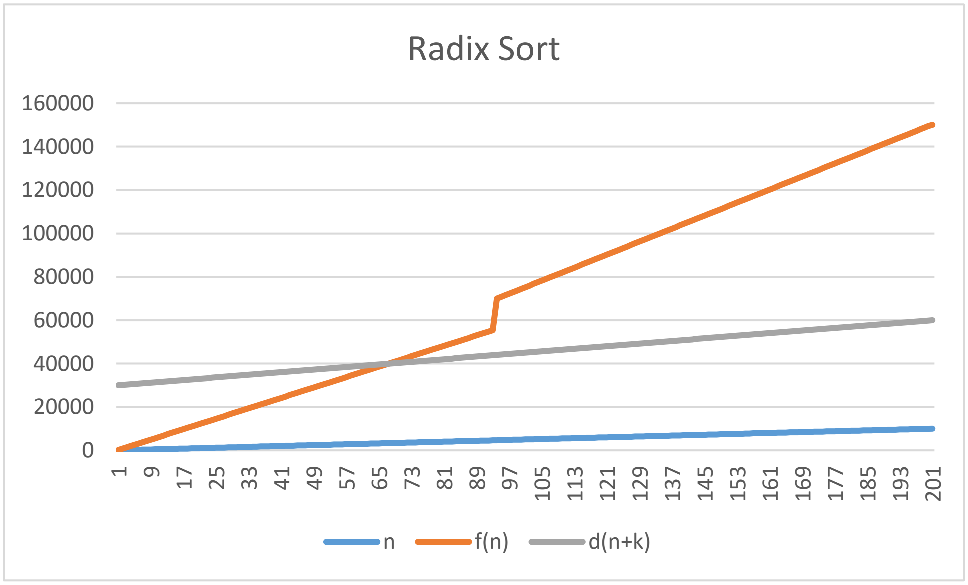
The "countingStepFile.txt" created in the main function is then imported into excel with an added column of (n + k). Then a generated Graph from the excel is created:



The same steps are then repeated but with Radix Sort. It requires the following functions:

```
void countingRadSort(int arr[], int d, int len) {
        int count[10] = { 0,0,0,0,0,0,0,0,0,0 };
        for (int i = 0; i < len; i++) {
                count[(arr[i] / d) % 10]++;
                step++;
        }
        for (int i = 1; i < 10; i++) {
                count[i] += count[i - 1];
                step++;
        }
        int outarr[LENGTH];
        step += 2;
        for (int i = len - 1; i >= 0; i--) {
                outarr[--count[(arr[i] / d) % 10]] = arr[i];
                step++;
        }
        for (int i = 0; i < len; i++) {
                arr[i] = outarr[i];
                step++;
        }
}

void radixSort(int arr[], int len) {
        int max = arr[0];
        step++;
        for (int i = 1; i < len; i++) {
                if (max < arr[i]) {
                        max = arr[i];
                        step++;
                }
        }
        for (int d = 1; max / d > 0; d *= 10) {
                countingRadSort(arr, d, len);
        }
}
```

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



GitHub Repository:
https://github.com/Anthony-Amgad/CSE331QuickCountRadixSort19P9880