CS 146 - Assignment 2

Due Date - Monday, October 10th 12noon

Project Description

In this assignment you will implement two algorithms for sorting positive integers and compare their running times.

You are asked to implement algorithms with different worst case running times.

1. One of **Insertion sort** or **selection sort**, which are $\Theta(n^2)$.
2. One of **Mergesort or Heapsort**, which are $\Theta(n \log n)$.

The goal of the assignment is to study the practical implications of asymptotic running times. To this end, you will conduct an experiment, described below.

Experiments

Prepare a report no longer than 2 pages. In the report, please mention which quadratic ($\Theta(n^2)$) and linearithmic ($\Theta(n \lg n)$) algorithms you implemented. The main part of the report is a summary of the experiment comparing the running times of the two algorithms you implement.

Experiment 1:

Run your algorithms on progressively larger data sets, recording the running times of your solution. The chart should be similar to Slide 3 on the Asymptotic Analysis set of slides. It should have similar format to the table below, indicating actual running times (in seconds, milliseconds, etc) in the cells of the table:

	$\Theta(n \log n)$ algorithm	$\Theta(n^2)$ algorithm
n= 10		
n= 100		
n=1000		
n=10,000		
n=100,000		
n=1,000,000		

Please note that the above values of n are examples, and you may choose your own values, as long as the experiment successfully investigates how the algorithms behave as n grows. Note that when your program takes too long, you may simply indicate that the running time was above a certain threshold, as seen on Slide 3 of the Asymptotic Analysis slides.

In addition to including the charts, briefly discuss the findings of your experiment in the report.

Input and output format

We will test your data on .txt files where the first column will contain positive integers and the second column will contain strings of length at most 20 (you may assume that the strings in the second column are composed entirely of lower and upper case letters, with no spaces).

Here is an example:

7 Alex
3 Maya
8 Steve
87 David
2 Mike

Your program should then sort the data based on the first column and output the results to the screen:

2 Mike
3 Maya
7 Alex
8 Steve
87 David

Given a text file "data.txt," we will run your algorithms as follows:

- insertionsort data.txt
- selectionsort data.txt
- mergesort data.txt
- heapsort data.txt

Please note that you need to implement only one of Insertion Sort and Selection Sort, and only one of Merge Sort or Heap Sort. Further, if the programming language you use necessitates the use of alternate command lines, please note that at the beginning of your README file.

Programming languages and formatting

Feel free to use either Java or C++ for this assignment. However, you should implement the algorithms yourself and NOT use any library implementation of the algorithms.

Submission Guidelines

Your submission must have the following:

- A printed report (up to 2 pages) with the results of your experiment and a brief discussion of your findings. **Please submit your report at the start of class on Monday, October 10th.**
- A README file that describes how the code can be compiled and run. Also list any external dependencies that need to be satisfied for compiling and running the code.
- A Makefile that can be used for compilation.
- Your submission should have a single point of entry for running the code, like a main() method in C or its equivalent in any other language.
- **Please submit your assignment through Canvas. Don't forget to bring a hard copy of your report to the start of class on Monday, October 10th.**

Mark Breakdown

- Report with experiment [30 points]
- Design of program [20 Points]
- Error free compilation [5 Points]
- Correctness [45 Points]