

COEN 12 - Project 5

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.

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.
- 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.
- **Please submit your assignment through Camino.**

Bonus [up to 10 additional points]

Implement quick sort and compare it against your linearithmic and quadratic algorithms. Consider how to choose the pivot. You may also want to compare the algorithms on different types of data (ex. sorted or nearly sorted data VS random data). Summarize your findings by expanding the chart in your experiment and discuss your findings.