1. Take performance data from \texttt{SortCompAsgnMain} and fill out the following tables:

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>200</th>
<th>400</th>
<th>800</th>
<th>1600</th>
<th>2400</th>
<th>3200</th>
<th>4000</th>
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</tbody>
</table>

Figure 1. Number of comparisons.

<table>
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<tr>
<th>Algorithm</th>
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</tbody>
</table>

Figure 2. Number of assignments.

Analyze your data as follows:

Graph the number of comparisons as a function of the number of values sorted with the graphing feature of \texttt{R}. See the following RStudio documentation on the course web site.

- Setup for RStudio
- Data management in RStudio
- Curve fitting in RStudio
- Plotting basics in RStudio

Your graph should have five lines, one for each sort. Also graph the number of assignments as a function of the number of values sorted. Your second graph should also have five lines, one for each sort.

Use \texttt{R} to curve fit each graph to two equations, one quadratic and one $n \lg(n)$. The program gives you an RSE, which is the “residual standard error.” When you fit one curve with these two equations, the equation with the smaller RSE is the better fit.

Write a paper that addresses the following questions plus any other interesting questions that may arise in your investigation:
(a) What is the theoretical $\Theta$ of the insertion sort, selection sort, heap sort, merge sort, and quick sort?

(b) Explain how your graphs either confirm or do not confirm your answer to part (a). Explain RSE, and quote the specific RSE values in the body of your text that lead you to your conclusion.

(c) Of the five sort algorithms, which is best in practice according to your data?

Your paper must discuss the results of your experiment according to the following outline:

Title, Name, Date

Abstract
In one short paragraph, describe the purpose of your paper and your conclusions in general.

1. Introduction
Explain in one paragraph the assignment as if the reader were a stranger who does not know you or Pepperdine University. Explain in a second paragraph what each following section describes.

2. Method
Include the following subsections.

2.1 Sort algorithms
Describe the characteristics of each sort.

2.2 Data collection
Describe the OO design pattern used to take the data. Describe the computer runs that took the data.

2.3 Analysis
Define mathematically the RSE and explain how it is used to determine the asymptotic run time. Explain how to determine the best sort.

3. Results
Include the following subsections with appropriate plots and/or tables.

3.1 Raw data
Show the raw data in table form and graphically and discuss any interesting overall features of it.

3.2 Insert sort
Analyze the insert sort.

3.3 Select sort
Analyze the select sort.

3.4 Heap sort
Analyze the heap sort.

3.5 Merge sort
Analyze the merge sort.

3.6 Quick sort
Analyze the quick sort.

3.6 Sort comparisons
Analyze which sort is best.

IMPORTANT: The writing style in this section should be to make a statement, then back it up by quoting data or referring to graphs, then discuss. Make another statement, back it up by quoting data or referring to
graphs, then discuss, etc. If any data appears unusual or is not what you would expect, try to explain it. You might try analyzing the data a different way as a result of your analysis. If so, describe what you tried.

4. Conclusion
One paragraph of the conclusions from your experiment. This section is a summary of your results section with specific conclusions. It differs from the abstract, which summarizes the conclusions in general.

\texttt{\LaTeX} requirement
You must use \LaTeX to typeset your paper. See the following documents on the course web page on how to use \LaTeX.

- Setup for \LaTeX
- paper-template.pdf
- Paper-Template.zip

The last document contains the \LaTeX source code for a sample paper that you can modify to create your own paper.

Style guidelines
See the sample research paper to give you an idea of the organization and style of English to use in your paper. Here are some style guidelines to which your paper must adhere.

(a) Do not use the two-column format, and use 1.5 line spacing on your text. This format is provided in the sample paper template.

(b) As much as possible, avoid personal pronouns “I” and “we”.

(c) As much as possible, use present tense. For example, instead of “Section 3 will explain how the data was gathered…” write “Section 3 explains how the data was gathered…”.

(d) As much as possible, use active voice instead of passive voice. For example, instead of “Tables of the raw data are shown in Section 4.” write “Section 4 shows tables of the raw data.” Using passive voice unnecessarily is probably the most common stylistic mistake in the technical literature. Try hard to make all your sentences active instead of passive. Conversion of a sentence from the passive voice to the active voice usually decreases the number of words in the sentence and makes it crisper.

(e) How you place your figures and tables in your paper is crucial. Follow these rules:

- Each table and figure must be numbered, have a caption, and appear at the top of the page. This format is provided in the sample paper template.

- A common mistake is to clump all the tables and figures together separate from the running text of the paper. Instead, you must intersperse your figures and tables throughout the text, so that each figure, as much as possible, is on the same page as the paragraph in which the first reference to it occurs.

- Every figure and table must be introduced for the first time by a descriptive statement in the running text. A standard way to introduce a figure is, “Figure \textit{x} shows…”.

- When you introduce a figure you will invariably repeat some of the phrases in the caption of the figure. For example, suppose Table 2 has the caption, “Signal occupancies of shared resources (nsec).” The first reference to this table might be, “Table 2 shows the occupancies of the shared resources used with the four systems.”
This is a direct quote from the sample paper. Check it out. Note the placement of the table after the paragraph that first refers to it.

This assignment is due in two parts.

- For the first part, take all the data and turn in an incomplete paper that includes the following.
  - The two tables with the raw data as shown in 1. above.
  - A plot of the raw data.
  - At least one plot of two curve fits for quadratic and \( n \lg n \) for one set of data.
  - A statement that reports which of the two curve fits is better based on the Residual Standard Error (RSE).

Create a pdf version of your incomplete paper in a file named a09written.pdf which must be typeset with \LaTeX{} and hand it electronically per the instructions for your course.

- The second part is the final paper, which is due as part of Assignment 14.