CMPT 370, Fall 2023 - Lecture Assignment One
Due Friday, September 29th at 23:00

Analyze the following five sorting algorithms using an experimental method: **selection sort, bubble sort, insertion sort, quick sort, and merge sort**. You may select C/C++ or Java as the implementation language, but your choice of language should be consistent for all algorithms. Regarding the experimental method, you should write your own implementation of each algorithm and record the time required by the algorithm to sort a set of integers[1]. As input to each sorting algorithm, you should use sets of random integers, sorted integer sets, and reverse sorted integer sets. **Make copies of your data sets so that all algorithms get the same data**.

Write a report analyzing the results of the tests. In terms of results you should include a set of graphs plotting the number of items to sort versus running time. You should include the following sections in your report: Title/name/date/etc., "Introduction", "Background", "Method", "Results", "Conclusions and Discussion", and "Works Cited". Clearly label each section.

Your introduction should explain why the experiment is interesting and include the expected result with an appropriate justification. If your justification is from a published source include the reference in your "Works Cited" section at the end of your report.

Your background should list three papers from the ACM database related to your experiment. This section need not be fleshed out too much, but ensures you have at least three entries in your works cited section. For example, you may have a single paragraph similar to "Bubble sort is described in …, Merge sort is described in …, etc.". Another way to write your background is "Valjean et. al. (1862) use Bubble sort to …". Three sentences of this sort are usually sufficient for full marks in this section since the background has been covered in class.

Your method section can be brief since some of the details are included in these instructions and the sorting algorithms are well known. In your method section include implementation details such as coding language, details of the algorithm used (such as using a flag in bubble sort), underlying data structure used (array or linked list), and details of the computer used to perform the timing tests (use a machine with the same specifications for all tests). Also include the experimental details in your method section, such as the number of tests averaged to get a data point on your graph (between three and five should be sufficient

[1] At the cost of reduced marks you may use publically available source code. If you do this you must cite your source and clearly attribute what work is not your own. Failure for proper referencing could result in a case of academic dishonesty.

for this assignment). In general, the marker should be able to read the method section and be able to reproduce your results (given a knowledge of CMPT 370 material).

Your results section should include labeled graphs with prose making reference to each graph. For example, "Timing tests of the five sorting algorithms are shown in Figure 1". Note the reader typically looks at the figures when directed to by the prose. Your prose needs to be descriptive enough to understand each graph. Use multiple graphs to zoom in on a larger graphs if the comparison between some algorithm times are not clear due to being too close to see on a larger graph. Remember to include only results in this section and **no conclusions**. For example, "Figure 2 shows that Bubble Sort dominates the other algorithms in all cases" is a statement for the conclusion section, not the results section.

Your conclusion and discussion section should mention which sort(s) is/are best and conditions when the sort is most suitable. In your analysis include any errors or complications in the results (you may find something odd with a small number of items to sort). Suggest a cause for this error or complication. Your discussion should include a brief potential source of errors discussion. This should not be something you did wrong, but rather a limitation of the experiment. For example, "A source of error may be the limited range of input since only multiples of 42 were used".

Your works cited section should include at least three references from the ACM database. You should sort your references by author's last name and include the authors, title, year, publisher, and pages. For example:

- Michael Janzen, Michael Horsch, and Eric Neufeld. 2008. Camera selection using SCSPs. In Proceedings of the 2008 Conference on Future Play: Research, Play, Share (Future Play '08). ACM, New York, NY, USA, 252-253.

Note that this is the ACM Ref format in the ACM digital library so you should be able to copy your reference from the ACM Digital library. For your personal use, keep in mind these automated references are sometimes wrong. For example, Future Play 2008 was held in Toronto, not New York. Include a copy of the PDF paper in your submission in case the marker wants to verify the paper.

Your report need not be long. Approximately three pages of text plus approximately three graphs should suffice (random, sorted, reverse sorted data). As mentioned, you will want to include additional graphs to emphasis details that are difficult to see in an overall results graph. Remember a proper graph has a title, legend, and labelled axes.

Note that, while you may use external sources (textbooks or Internet) to help you form conclusions, you may not simply copy code (without references) or analysis from external sources. Your analysis and conclusions should come from your experiments (a.k.a. timing

tests). During the marking process your code may be examined by a third-party program / service.

Submit your report in PDF form along with your source code, data files, and PDF papers from the ACM database. Compress all your files into one ZIP file for submission via the class Moodle website.

It is advised you re-read these instructions after writing your report but prior to the submission deadline.