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COSC 520
Assignment 2

Advanced Data Structures

The objective of the assignment is to: (1) explore advanced data structures, and (2) benchmark algorithms.

Consider the list of **advanced** data structures provided at https://iq.opengenus.org/list-of-advanced-data-structures/, and https://www.geeksforgeeks.org/advanced-data-structures/ and at https://en.wikipedia.org/wiki/List_of_data_structures. Other considerable advanced data structures could be Fibonacci Heaps, Van Emde Boas Priority Queues, Dynamic Data Structures for Graph Connectivity/Reachability, Splay Trees/Suffix Trees/Tries. And Persistent Data Structures. Section V of the Introduction to Algorithms book, 3rd edition, by Cormen, Leiserson, Rivest, and Stein (available online and free through UBC Library) contains explanations of four advanced data structures that can be helpful. Select 3 comparable <u>advanced</u> data structures.

Submission

To complete the assignment, submit the following:

1. A concise pdf report including
   - Explanation of the selected data structure briefly and their potential applications,
   - The time and space computational complexity of your data structures,
   - A table summarizing the measured performance,
   - Plots showing the run time complexity for large enough data. You can generate synthetic dataset using Python functions. Aim for at least ten million data points. Then, run your program with different implementations and compare their run time in a plot. Include this analysis in your pdf file and <u>explain if it supports your analysis.</u> If the plots contradict your analysis, analyze them carefully: double check your implementation and review your analysis, provide justifications, and explain your thoughts of why this is happening. Remember to upload your dataset on the web and include a link to the dataset in the pdf file.
   - An explanation of why you selected those data structures (what attracted them; this is totally subjective and personal).

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Use appropriate parameters to describe the complexity. You need to justify the complexity briefly; and explain each parameters used and provide the formula with appropriate references.

2. Python code comparing the data structures selected. You are responsible for generating appropriate data sets for the performance profile. Provide any justification of your choices in the report. Do not hesitate to contact the instructor (a quick email can save you hours for misguided work!). Add the GitHub link of your implementations in the pdf file.

   As for Assignment 1, your code should

   o   Be well documented and clean.
   o   Include unit tests.
   o   follow common practises:
       ▪   appropriate class/variable/method names (not too long and meaningful),
       ▪   appropriate comments
       ▪   comments for each method should indicate input, output, and a short explanation of the method
       ▪   clear setup and running instructions.

How to submit: Submit your PDF file to Canvas, which should also include the links to your GH repository and the dataset you used for testing. Use the [Association for Computing Machinery (ACM) - Small Standard Format Template](#) (Overleaf) for your report. Remove the ACM, journal, and copyright information. The report should be between 5-10 pages, including plots and references.

Usage of GenAI: The use of GenAI is discouraged. However, if you still decide to use online sources or GenAI to generate your code, first, make sure it is correct and executable. Second, make sure to include the resources you have used and/or mention that you used GenAI in your report. There is no penalty of using available code, the only drawback can be that you might not be engaged as writing the code yourself for your future references.

Grading rubric

	Weights	Subtotals

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Report		30
Explanation of the data structures and applications/usage	10	
Complexity analysis	10	
Plots and comparisons	8	
References	2	
Code static		30
naming	5	
comments	5	
running instructions	5	
code design	15	
Code execution		30
syntax-error free, runs	10	
unit tests run	10	
convincing demo	5	
performance	5	
Cross-Check**		10

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Examining and running one of your classmate's assignment and grade it based on the above criteria. It will be assigned to you by the instructor.	10	
Total	100	100

**Cross-Check needs to be submitted within one week of the assignment submission deadline. Other than just checking, use it as a learning opportunity. Include a rationale and degradation feedback and submit it through email to the instructor: fatemeh.fard@ubc.ca.

Submission deadline: Friday Oct 24th, 2025, at 8 PM.