Algorithms

CMPT 435

Assignment 3 - 100 points

Goals

- to implement graph and tree data structures, and to understand their performance

Requirements and Notes

- Develop several of **your own** implementations of an *undirected graph*. The file `graphs1.txt` contains data describing multiple undirected graphs. Read it and create three versions of each graph: as a **matrix**, as an **adjacency list**, and as **linked objects**. For each graph, print the matrix and adjacency list versions. For the linked objects version of each graph, perform depth-first and breadth-first traversals, printing each vertex's IDs as you encounter it. (I.e., print all of the vertex IDs in "depth-first" order and then in "breadth-first" order.) You must read and process the file one line at a time without making any assumptions about the length of the file or its contents. Consider the (real) possibility that some mean professor might run your code on different versions of the file. [40 points]
- Develop **your own** implementation of a *binary search tree*. Populate your BST with our `magicitems.txt`. As you insert each item into your BST, print out the "path" from the root to where you placed the item. For example, "L, R, L, L" would mean the path to the new node from the root node was left child, right child, left child, left child. Then print out the entire BST with an **in-order** traversal. [20 points]
- Read `magicitems-find-in-bst.txt` and look up each one in your BST. Print the "path" (e.g., "R, L, R, R") and number of comparisons for each lookup. Compute the overall average when you're done.
- In your LaTeX code documentation and analysis document, analyze the asymptotic running time of both graph traversals and **explain why they are that way**. Also analyze the asymptotic running time of BST lookups and **explain that as well**. (Don't forget your code listings and explanations. I still enjoy reading those.) [40 points]

As usual, your code must separate structure from presentation, be professionally formatted yet uniquely yours (show some personality), use and demonstrate best practices, and make me proud to be your teacher. [−∞ if not]

Note: I will run your code on different versions of the text files in the same format. In other words, there will be more or different graphs or items, but the structure of the files will be the same as those referenced above. Your code must react to the contents of the file; you cannot hard-code any aspect.

Resources

- Graphs are described in the 3rd edition of our text in 22.1 and in notes on our web page.
- Breadth-first and depth-first traversals are described in the 3rd edition of our text in sections 22.2 and 22.3 respectively.
- Trees are described in the 3rd edition of our text in chapters 12, 13, and 18.

Submitting Your Work

In addition to your source code, commit your LaTeX document in both .tex and .pdf forms to your GitHub repository. For your code, make **many** commits to GitHub. If you don't make enough commits, I will not accept your work. Be sure that you make your final commit for this assignment on or before the due date. (See our syllabus for those details.)