Algorithm Analysis Project

Discrete II

Spring 2017

Description of Project

The goal of this project is to analyze two types of problems (minimum spanning trees and shortest paths), as well getting experience analyzing the quality of references. You may work in groups of up to four people. The project must be typed. There will be no class on 3/6, 3/8, or 3/10 to give you time to complete this project. Do not procrastinate by waiting until the weekend before it is due: there are many parts and you are unlikely to score well if you complete the project at the last minute. Email the instructor at jbeyerl@uca.edu if you have questions while you complete the project.

Learning Objectives

- Analyze algorithms on discrete structures in terms of worst case runtime and worst case space usage.
- Evaluate reliability of reference materials

Part 1: Minimal Spanning Trees. Minimal spanning trees will be discussed in class on March 3rd. Your task will be to find 5 references that describe Kruskal's algorithm for finding a minimal spanning tree, comment on the reliability of the references, and then to analyze the problem itself.

- Find 5 references that describe Kruskal's algorithm. Create a reference list with a citation for each. The citation must include enough detail so that a faculty member can find the reference. For each reference, describe its reliability and accessibility using the tables on the next page. Be sure to explain why you chose the reliability and accessibility measures you chose.
- Describe Kruskal's algorithm. How does it work?
- Let G be an arbitrary graph with n vertices and m edges. Analyze the minimal spanning tree problem by doing the following:
    - Find a meaningful asymptotic lower bound on the time required to find a minimal spanning tree. Justify your bound.
    - Find a meaningful asymptotic upper bound on the time required to find a minimal spanning tree. Justify your bound.
    - Find a meaningful asymptotic lower bound on the space required to find a minimal spanning tree. Justify your bound.
    - Find a meaningful asymptotic upper bound on the space required to find a minimal spanning tree. Justify your bound.

Part 2: Shortest Path Problems. There are three different shortest path problems we want to analyze. For each of these problems, give (1) a meaningful upper bound on the runtime required to solve the problem, (2) a meaningful lower bound on the runtime required to solve the problem, (3) a meaningful upper bound on the space required to solve the problem, (4) a meaningful lower bound on the space required to solve the problem. Each bound should be asymptotic in either big-Oh or big-Omega. Each asymptotic bound should also have a 1-3 sentence explanation to describe why you chose that bound.

- *Shortest Path Between Two Specified Vertices*: Given two vertices, find and output the shortest path between them.
- *Single Source Shortest Path*: Given a single vertex v, find and output the shortest path to each vertex from v.
- *All Pairs Shortest Path*: Find and output the shortest path between every pair of vertices.

Other Specifications

- The write-up should be at least 3 pages. This is not technically a minimum, but probably if your write-up is shorter, you're missing some of your explanations or they are lacking detail.
- You may work in groups (max 4 people) or alone.
- The project should be typed and saved as a PDF, then submitted on Blackboard. The penalty for incorrect submission format is 10% of the maximum score.
- Cite any sources that you use – plagiarism will result in a 0% grade. You may create a standard bibliography in addition to the reference list in part (1). References analyzed in part (1) need not be cited again in the bibliography.
- The project is due on Blackboard Monday March 13th at 9:00am. Assignments submitted late will receive a late penalty of 0.2% per hour.

Reference tables for part 1

Reference reliability scale: "Accuracy" refers to the correctness of the reference.

- 1 – The reference itself gives you reason to question its accuracy.
- 2 – Something other than the reference itself gives you reason to question its accuracy.
- 3 – There is no specific reason to trust or question the accuracy of the reference.
- 4 – Something other than the reference itself gives you reason to trust the reference.
- 5 – The reference itself gives you reason to trust it.

Reference accessibility scale: "Accessible" refers to the understandability of the reference.

- 1 – The reference is not accessible at all.
- 2 – The reference is not very accessible.
- 3 – The reference is in the middle.
- 4 – The reference is accessible.
- 5 – The reference is very accessible.