Requirements, Constraints, and Engineering Standards

Senior Design I

Project Title	Interactive evaluation of shortest path methods
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1 Problem Statement

What problem is your project trying to solve? Use non-technical jargon as much as possible.

Algorithm research has come up with different variations for shortest-path calculations that have their own limitations, proficiencies, and intended use cases. Efficiency is always a major consideration for algorithms, and it is often complicated to explain just how efficient one is relative to the other. Because there is not a clear way to compare or visualize these algorithms, it impedes researchers from explaining their work, educators from teaching students, and the general audience from understanding the purpose of their existence. Thus, how can you effectively share knowledge and examples of these complex algorithms in an accessible yet detailed format? Our project consists of addressing these needs by creating an application with various algorithms and datasets available for testing, and outputting detailed comparisons and reports between them. This knowledge is of great importance to researchers, engineers, and designers alike whose focus is on understanding and implementing the optimal algorithms for a given situation.

2 Requirements & Constraints

The following sections list out various requirements and constraints for the product as derived from its project description and the client's advisory.

2.1 Functional requirements

To fulfill the purpose of the project and address the problem statement, the product must:

- Enable seamless integration of multiple algorithms and their execution of various datasets.
- Provide correct measurements of the runtime of different algorithms on the individual datasets.
- Distinguish algorithms based on different edge weights (e.g., traffic data changes)
- Allow users to select datasets and algorithms to test.
- Provide informative visualizations of algorithm outcomes and compare these against each other.
- Generate a report of algorithm efficiency and related data.
- Provide the user with the format to create datasets for executing algorithms, such that the product can use them.

2.2 Resource requirements

Given that we aim for a proof-of-concept implementation, immediate requirements are generally lax; a simple server will suffice. That said, the implementation must:

- Use resources optimally per algorithm run.
- Support parallel, independent workloads.
- Store reports and records of algorithm-dataset runs.

2.3 UI requirements

The user interface must:

- Provide a method to visualize partial executions of the algorithms.
- Display the shortest path between the given source and destination as advised by a given algorithm.
- Allow for users to upload datasets and select which algorithms to test them against.

In addition, there are qualitative & aesthetics requirements that should be met:

- Present information neatly for easy understanding.
- Provide detailed information as an option for reports and visualizations.

2.4 Constraints

The constraints defined for this project are minimal, but they are significant nonetheless.

- The system must provide all functionality as a full-stack solution.
- The overall implementation should be within a "reasonable" budget (e.g., no more than $200).

3 Engineering Standards

What Engineering standards are likely to apply to your project? For each standard listed, also provide a brief justification.

IEEE/ISO/IEC 26514-2021: Systems and software engineering – Design and development of information for users

To provide the user with the tools to make the most informed decision when picking an algorithm, it's important to keep everyone on the team informed through familiar and standardized documentation. The standard above provides a guide to a consistent approach to document creation and management throughout the project. Within the framework of our project, this will assist us in the design documentation of the User Interface, API, and many areas throughout the software system in a manner that provides structure and consistent formatting of information for all project stakeholders.

IEEE/ISO/IEC 29119-1-2021: Software and systems engineering – Software testing – Part 1: General concepts

This document provides guidance on creating a comprehensive and consistent approach to software testing. Additionally, it provides insights to reduce risks associated with software failures with the aim of improving the quality of a software product. In the context of our project, this will guide us in designing the respective unit, integration and acceptance testing scenarios, as well as in defining meaningful regression tests.

IEEE/ISO/IEC 42010-2022: Software, systems and enterprise – Architecture description

The document emphasizes focusing on stakeholder perspectives while creating the architecture. Because our target audience is researchers and educators, they represent a narrow user group in the grand scheme of things but those who have very particular needs and certain expectations regarding the system features and the potential for adapting and/or extending them.

4 Intended Users and Uses

Who benefits from the results of your project? Who cares that it exists? How will they use it?

This project is designed to benefit educators, students, and researchers by allowing them to see and compare multiple shortest-path algorithms as well as see how their performance varies based on different datasets. This will allow students to better understand the purpose of each method of calculating the shortest path, and it gives educators a new tool to educate people about the different algorithms. Finally, researchers and engineers will be able to use the product to generate reports on the efficiency of many various shortest-path algorithms and compare them with each other, which will help them to choose which algorithms they should use for their own projects based on the peculiarity of the datasets they work with.