PDI 1 - Report

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The aim of the thesis

Survey and comparison of Single-Source Shortest Paths algorithms

Description:

- Implementation and analysis of classic and modern SSSP algorithms: Bellman-Ford, Dijkstra, Floyd-Warshall, Wulf-Nilsen.
- Focus mainly on negative-weight variant of the problem, when edge weights are integral and can be negative. (https://arxiv.org/abs/2203.03456)

Summary of the plan and technical details of the work

Thesis structure

I. Introduction

A. Background

- Brief explanation of Single-Source Shortest Paths (SSSP) problem
- Importance of SSSP in graph theory and practical applications
- Challenges posed by negative weight edges

B. Objectives of the Study

- Present and explain the selected SSSP algorithms
- Compare and contrast the algorithms in various scenarios, with a focus on negative weight variants
- Perform experimental analysis of the selected algorithms

II. Literature Review

A. Single-Source Shortest Paths (SSSP) Algorithms

- Brief history of the development of SSSP algorithms
- Importance and application of SSSP in real world

B. Negative-Weight Problems in Graphs

- Explanation of the nature of negative-weight problems
- Explanation of the challenges and peculiarities in solving negative-weight SSSP problems

III. Theoretical Analysis

A. Bellman-Ford Algorithm

- Explanation and theoretical complexity
- Advantage / Disadvantage
- Behavior with negative weights

B. Dijkstra's Algorithm

- Explanation and theoretical complexity
- Advantage / Disadvantage
- Behavior with negative weights

C. Floyd-Warshall Algorithm

- Explanation and theoretical complexity
- Advantage / Disadvantage
- Behavior with negative weights

D. Wulf-Nilsen Algorithm

- Explanation and theoretical complexity
- Advantage / Disadvantage
- Behavior with negative weights

E. Comparative Analysis

- Theoretical comparison of the four algorithms

IV. Experimental Analysis

A. Experiment Design

- Description of testing environments
- Explanation of the metrics used for comparison
- Description of test data and how they will be generated

B. Experiment Results

- Presentation of the results of the testing
- Analysis and interpretation of results

C. Comparative Analysis

- Comparison of the algorithms based on the experimental results

V. Discussion

A. Summary of Findings

- Summarization of the theoretical and experimental findings

B. Implications of Findings

- Discussion of what the results imply for the use of these algorithms in practice

C. Limitations and Future Work

- Discussion of any limitations encountered in the study
- Suggestions for future research in the area

VI. Conclusion

A. Restatement of Objectives and Findings

B. Final Thoughts

VII. References

A. List of all sources referenced in the thesis

VIII. Appendices

A. Source code of the implementations

B. Raw data from experiments

C. Additional resources and material

Time plan:

- June – September / 2023 : Literature review, writing report, implement algorithms, prepare unit test.
- October – December / 2023 : Write up of Theretical Analysis, seting up Experimental Environment, run Experiments and Gather Data, analyse Data
- January / 2024 : Write Discussion and Conclusion
- February / 2024 : Revision and Final Editing
- March / 2024 : Submission / Defence