The chinese postman problem and variants

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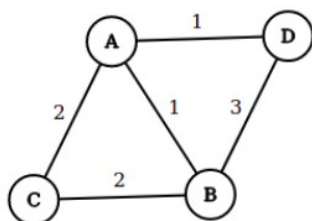
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Objectives

To study and implement solutions to the Chinese postman problem **[Kw60]** and related problems.

The Chinese postman problem is defined by **finding a closed route with minimal cost that passes through every edge of a graph at least once**.

On the example above, an optimal route has cost 9, such as the route *A, B, C, A, B, D, A*, which only passes through *AB* twice.

Some applications of this problem are: **planning of route for postmen, garbage collectors or even snow plows**, as researched in the US **[Ng96]**.

The cost of routes on these examples is generally equal to the distance traveled in repeated streets. Minimizing such distance one can reduce financial costs and enhance service efficiency.

Materials and Methods

The research focused on the understanding of existing papers on the subject and implementation of its algorithmic solutions. The paper was written using LaTeX, the code developed on C++17 and the testing done using the "googletest" framework.

The paper, algorithms and tests developed are available on GitHub: github.com/gafeol/chinese-postman

Results

The paper describes in a mathematically simple manner the problem and the studied solutions. To make the text more understandable, most of the theorems required were proved on the paper and the explanation is richly exemplified.

The core document covers from basic graph theory, on to the Eulerian circuit problem and the Chinese postman problem on undirected and directed graphs. The polynomial solution for such problems were implemented, explained and linked on the text.

This research also covers some harder variations of the main problem such as: the version of the problem on mixed graphs **[Fre79]**, the rural version **[Chr+86** and **Chr76]** and a special case of the windy version **[Kw83]**.

References

[Kw60] Kwan, M., "Graphic programming using odd or even points, 1960

[Ng96] Ng, P. H. "Designing Efficient Snow Plow Routes: A Service-Learning Project", 1996

[Fre79] Frederickson, G. N. "Approximation Algorithms for Some Postman Problems", 1979

[Chr+86] Christofides, N. et al. "An algorithm for the rural postman problem on a directed graph", 1986

[Chr76] Christofides, N. Christofides Algorithm , 1976

[Kw83] Kwan, M. "On the Windy Postman Problem", 1983