## Map Routing

**Dijkstra's shortest path algorithm**

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ABSTRACT

Dijkstra's algorithm is a classic solution to the shortest path problem. It is described in Sedgewick, Chapter 21. The basic idea is not difficult to understand. We maintain, for every vertex in the graph, the length of the shortest known path from the source to that vertex, and we maintain these lengths in a priority queue. Initially, we put all the vertices on the queue with an artificially high priority and then assign priority 0.0 to the source. The algorithm proceeds by taking the lowest-priority vertex off the PQ, then checking all the vertices that can be reached from that vertex by one edge to see whether that edge gives a shorter path to the vertex from the source than the shortest previously-known path. If so, it lowers the priority to reflect this new information.

1. Introduction

We will implement the classic Dijkstra's shortest path algorithm and optimize it for maps. Such algorithms are widely used in geographic information systems (GIS) including MapQuest and GPS-based car navigation systems (Sedgewick, 2004).

We will optimize Dijkstra’s shortest path algorithm so it can process thousands of queries in sub-linear time. Our goal is to solve this problem without using excessive memory space. There are many ways to improve Dijkstra’s shortest path algorithm. The first approach is to stop the search when we find the shortest path for a query. For the next queries, we can save time by only reinitializing the vertices’ distance values that have been changed in precious queries.

We can also improve it further by applying the triangle properties of an Euclidean network. The distance from s to d is never greater than the distance from s to x plus distance from x to d. So instead of relaxing an edge v-w by updating wt[w] to wt[v] plus the distance from w to v, we “update wt[w] to be the sum of wt[v] plus the distance from v to w *plus* the Euclidean distance from w to d *minus* the Euclidean distance from v to d” (Sedgewick, 2004). This would improve the performance but preserve the correctness.

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3. In the settings at the right side of the window, click on the "Layout & Properties" icon (3rd option).
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REFERENCES

[1] Sedgewick, B., & Wayne, K. (2004). COS 226 Programming Assignment: Map Routing. Retrieved November 05, 2020, from https://www.cs.princeton.edu/courses/archive/spring04/cos226/assignments/map.htmlConference Name:ACM Woodstock conference

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