

# Efficient updating Customizable Contraction Hierarchies

## 1 Intro

This is a seminar on "Efficient shortest path index maintenance on dynamic road networks with theoretical guarantees" [4]. The papers generally is about finding the shortest path in road networks. By *shortest* it is meant, the path that requires the less time to get from source  $s$  to a target  $t$ . The route network is modeled as a directed graph  $G(V, E)$  where each street crossing represents a vertex  $v \in V$  and each road between crossings represents an edge  $e \in E$ . The most basic and solid method to find shortest paths between vertices in a graph is Dijkstra's algorithm [2]. This algorithm is proofed to always return the correct shortest path but it is not fast for just in time route planning on large road networks as we know it from services like Google Maps. There are many of different approaches that try to speed up shortest path queries by precomputing any different kind of index structure before doing the shortest path query. The index structure discussed in [4] is CH (Contraction Hierarchies) [3] with some extension. This extension is CCH (Customizable Contraction Hierarchies) [1]. Although the authors of [4] never mention the term CCH their approaches builds the same index structure. The difference lies in updating the CCH index structure. For updating the CCH, [4] will use yet another index structure called *SS-Graph* that help to exactly identify the shortcuts that have to be updated, after some edge weight has changed.

## 2 Core Topic and Findings

In this section it is presumed that the idea of Dijkstra [2] and Contraction Hierarchies [3] is known. We will not look into querying shortest but paths.

## References

- [1] Julian Dibbelt, Ben Strasser, and Dorothea Wagner. Erratum: Customizable contraction hierarchies. In *Experimental Algorithms*, pages E1–E1. Springer International Publishing, 2014.
- [2] E. W. Dijkstra. A note on two problems in connexion with graphs. *Numerische Mathematik*, 1(1):269–271, dec 1959.
- [3] Robert Geisberger, Peter Sanders, Dominik Schultes, and Daniel Delling. Contraction hierarchies: Faster and simpler hierarchical routing in road networks. In *Experimental Algorithms*, pages 319–333. Springer Berlin Heidelberg.
- [4] Dian Ouyang, Long Yuan, Lu Qin, Lijun Chang, Ying Zhang, and Xuemin Lin. Efficient shortest path index maintenance on dynamic road networks with theoretical guarantees. *Proceedings of the VLDB Endowment*, 13(5):602–615, jan 2020.