

Preface

Spatio-temporal networks are spatial networks whose topology and/or attributes change with time. These are encountered in many critical areas of everyday life such as transportation networks, electric power distribution grids, and social networks of mobile users. With the advances in technology, monitoring the temporal changes of such networks is becoming increasingly easier. For example, the increasing use of traffic sensors on transportation networks generates large volumes of data such as congestion levels and it becomes important to incorporate these data into data models and algorithms that deal with spatio-temporal networks.

A spatio-temporal network (STN) typically consists a finite set of nodes with location attributes, relationships between nodes (aka edges), and time-dependent attributes associated with nodes and relationships. STN modeling and computations raise significant challenges. The model must meet the conflicting requirements of simplicity and adequate support for efficient algorithms. Another challenge is to address the change in semantics of common graph operations such as shortest path computation, when temporal dimension is added. For example, shortest path between a start and an end location might be different at different times of day. Also paradigms (e.g., dynamic programming) used in algorithm design may be ineffective since their assumptions (e.g., stationary ranking of candidates) may be violated by the dynamic nature of STNs.

In recent years, STNs have attracted considerable attention in reserach. New representations have been proposed along with algorithms to perform key STN operations, while accounting for their time dependence. Designing a STN database would require the development of data models, query languages, indexing methods to efficiently represent, query, store, and manage time-variant properties of the network.

This book explores this design at conceptual, logical, and physical level. Models used to represent STNs are explored and analyzed. STN operations with emphasis on their altered semantics with addition of temporal dimension, are addressed, illustrating the capability toward answering interesting questions. For example, it is possible to answer queries such as, When is the best time to start so

that I spend the least time on the road? Algorithms to implement these network operations are discussed. A comparative study of various models and algorithms would also be provided.

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