

Preface

Spatial Network Big Data (SNBD) refers to spatial network datasets whose size, variety, or update rate exceeds the capacity of commonly used spatial network computing and spatial network database technologies to learn, manage, and process with reasonable effort. SNBD has the potential to transform society via next-generation routing services, emergency and disaster response, and discovery of potentially useful patterns embedded in these datasets. The use of SNBD is rapidly expanding into the transportation arena to improve the management and security of transportation infrastructure and enable data-driven decision-making. However, there are significant challenges to the use of SNBD because current methods, models, and algorithms do not always scale and/or perform well when storing, managing, and analyzing large volumes of data. Interestingly, most of the SNBD collected today are not used at all, and data that are used are not fully exploited. In addition, SNBD datasets tend to be used mostly for real-time control or anomaly detection, rather than optimization or prediction based on historical data, which is where their greatest value lies. Investigating novel SNBD storage and processing platforms, such as database systems and data analytics tools, is critical to realize the full value of SNBD.

Developing Spatial Network Big Database Systems (SNBDS) requires overcoming three key challenges. First, it requires new data models to represent the complex and interrelated structure of SNBD. Second, fully exploiting SNBD requires scalable query processing and optimization methods, which are currently lacking. Finally, SNBDS require I/O efficient storage and access methods that leverage scalability and efficiency of big data query processing. These challenges lead us to rethink both existing theories and models. This book presents a collection of concepts, algorithms, and techniques that effectively harness the power of SNBD. Reading this book is a first step toward understanding the immense challenges and novel applications of SNBD database systems. This book is organized in seven chapters. After reviewing some preliminaries in Chap. 1, we

introduce basic graph algorithms in Chap. 2. Chapters 3–5 formally model spatial network query problems and explore algorithms that minimize the computational cost for query processing. Chapter 6 introduces strategies to develop I/O efficient storage and access methods. Chapter 7 summarizes the book’s major themes.

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