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Query Processing over Uncertain Databases

Lei Chen
Xiang Lian

SYNTHESIS LECTURES ON DATA MANAGEMENT

M. Tamer Özsu, *Series Editor*

Query Processing Over Uncertain Databases Xiang Lian

JG Myers

Query Processing Over Uncertain Databases Xiang Lian:

Query Processing over Uncertain Databases Lei Chen,Xiang Lian,2022-05-31 Due to measurement errors transmission lost or injected noise for privacy protection uncertainty exists in the data of many real applications However query processing techniques for deterministic data cannot be directly applied to uncertain data because they do not have mechanisms to handle data uncertainty Therefore efficient and effective manipulation of uncertain data is a practical yet challenging research topic In this book we start from the data models for imprecise and uncertain data move on to defining different semantics for queries on uncertain data and finally discuss the advanced query processing techniques for various probabilistic queries in uncertain databases The book serves as a comprehensive guideline for query processing over uncertain databases Table of Contents Introduction Uncertain Data Models Spatial Query Semantics over Uncertain Data Models Spatial Query Processing over Uncertain Databases Conclusion **Query Processing over Incomplete Databases** Yunjun Gao,Xiaoye Miao,2022-06-01 Incomplete data is part of life and almost all areas of scientific studies Users tend to skip certain fields when they fill out online forms participants choose to ignore sensitive questions on surveys sensors fail resulting in the loss of certain readings publicly viewable satellite map services have missing data in many mobile applications and in privacy preserving applications the data is incomplete deliberately in order to preserve the sensitivity of some attribute values Query processing is a fundamental problem in computer science and is useful in a variety of applications In this book we mostly focus on the query processing over incomplete databases which involves finding a set of qualified objects from a specified incomplete dataset in order to support a wide spectrum of real life applications We first elaborate the three general kinds of methods of handling incomplete data including i discarding the data with missing values ii imputation for the missing values and iii just depending on the observed data values For the third method type we introduce the semantics of k nearest neighbor kNN search skyline query and top k dominating query on incomplete data respectively In terms of the three representative queries over incomplete data we investigate some advanced techniques to process incomplete data queries including indexing pruning as well as crowdsourcing techniques Data Processing on FPGAs Jens Teubner,Louis Woods,2022-05-31 Roughly a decade ago power consumption and heat dissipation concerns forced the semiconductor industry to radically change its course shifting from sequential to parallel computing Unfortunately improving performance of applications has now become much more difficult than in the good old days of frequency scaling This is also affecting databases and data processing applications in general and has led to the popularity of so called data appliances specialized data processing engines where software and hardware are sold together in a closed box Field programmable gate arrays FPGAs increasingly play an important role in such systems FPGAs are attractive because the performance gains of specialized hardware can be significant while power consumption is much less than that of commodity processors On the other hand FPGAs are way more flexible than hard wired circuits ASICs and can be integrated into

complex systems in many different ways e g directly in the network for a high frequency trading application This book gives an introduction to FPGA technology targeted at a database audience In the first few chapters we explain in detail the inner workings of FPGAs Then we discuss techniques and design patterns that help mapping algorithms to FPGA hardware so that the inherent parallelism of these devices can be leveraged in an optimal way Finally the book will illustrate a number of concrete examples that exploit different advantages of FPGAs for data processing Table of Contents Preface Introduction A Primer in Hardware Design FPGAs FPGA Programming Models Data Stream Processing Accelerated DB Operators Secure Data Processing Conclusions Bibliography Authors Biographies Index **Scalable Processing of Spatial-Keyword Queries** Ahmed R. Mahmood,Walid G. Aref,2022-05-31 Text data that is associated with location data has become ubiquitous A tweet is an example of this type of data where the text in a tweet is associated with the location where the tweet has been issued We use the term spatial keyword data to refer to this type of data Spatial keyword data is being generated at massive scale Almost all online transactions have an associated spatial trace The spatial trace is derived from GPS coordinates IP addresses or cell phone tower locations Hundreds of millions or even billions of spatial keyword objects are being generated daily Spatial keyword data has numerous applications that require efficient processing and management of massive amounts of spatial keyword data This book starts by overviewing some important applications of spatial keyword data and demonstrates the scale at which spatial keyword data is being generated Then it formalizes and classifies the various types of queries that execute over spatial keyword data Next it discusses important and desirable properties of spatial keyword query languages that are needed to express queries over spatial keyword data As will be illustrated existing spatial keyword query languages vary in the types of spatial keyword queries that they can support There are many systems that process spatial keyword queries Systems differ from each other in various aspects e g whether the system is batch oriented or stream based and whether the system is centralized or distributed Moreover spatial keyword systems vary in the types of queries that they support Finally systems vary in the types of indexing techniques that they adopt This book provides an overview of the main spatial keyword data management systems SKDMSs and classifies them according to their features Moreover the book describes the main approaches adopted when indexing spatial keyword data in the centralized and distributed settings Several case studies of SKDMSs are presentedalong with the applications and query types that these SKDMSs are targeted for and the indexing techniques they utilize for processing their queries Optimizing the performance and the query processing of SKDMSs still has many research challenges and open problems The book concludes with a discussion about several important and open research problems in the domain of scalable spatial keyword processing *Database Systems for Advanced Applications* Xiaofang Zhou,Haruo Yokota,Ke Deng,Qing Liu,2009-03-26 This book constitutes the refereed proceedings of the 14th International Conference on Database Systems for Advanced Applications DASFAA 2009 held in Brisbane Australia in April 2009 The 39 revised full papers and 22 revised short papers presented together with 3 invited

keynote papers 9 demonstration papers 3 tutorial abstracts and one panel abstract were carefully reviewed and selected from 186 submissions The papers are organized in topical sections on uncertain data and ranking sensor networks graphs RFID and data streams skyline and rising stars parallel and distributed processing mining and analysis XML query privacy XML keyword search and ranking Web and Web services XML data processing and multimedia *Transaction Processing on Modern Hardware* Mohammad Sadoghi,Spyros Blanas,2022-05-31 The last decade has brought groundbreaking developments in transaction processing This resurgence of an otherwise mature research area has spurred from the diminishing cost per GB of DRAM that allows many transaction processing workloads to be entirely memory resident This shift demanded a pause to fundamentally rethink the architecture of database systems The data storage lexicon has now expanded beyond spinning disks and RAID levels to include the cache hierarchy memory consistency models cache coherence and write invalidation costs NUMA regions and coherence domains New memory technologies promise fast non volatile storage and expose unchartered trade offs for transactional durability such as exploiting byte addressable hot and cold storage through persistent programming that promotes simpler recovery protocols In the meantime the plateauing single threaded processor performance has brought massive concurrency within a single node first in the form of multi core andnow with many core and heterogeneous processors The exciting possibility to reshape the storage transaction logging and recovery layers of next generation systems on emerging hardware have prompted the database research community to vigorously debate the trade offs between specialized kernels that narrowly focus on transaction processing performance vs designs that permit transactionally consistent data accesses from decision support and analytical workloads In this book we aim to classify and distill the new body of work on transaction processing that has surfaced in the last decade to navigate researchers and practitioners through this intricate research subject *Skylines and Other Dominance-Based Queries* Apostolos N. Papadopoulos,Eleftherios Tiakas,Theodoros Tzouramanis,Nikolaos Georgiadis,Yannis Manolopoulos,2022-06-01 This book is a gentle introduction to dominance based query processing techniques and their applications The book aims to present fundamental as well as some advanced issues in the area in a precise but easy to follow manner Dominance is an intuitive concept that can be used in many different ways in diverse application domains The concept of dominance is based on the values of the attributes of each object An object dominates another object if is better than This goodness criterion may differ from one user to another However all decisions boil down to the minimization or maximization of attribute values In this book we will explore algorithms and applications related to dominance based query processing The concept of dominance has a long history in finance and multi criteria optimization However the introduction of the concept to the database community in 2001 inspired many researchers to contribute to the area Therefore many algorithmic techniqueshave been proposed for the efficient processing of dominance based queries such as skyline queries dominant queries and top dominating queries just to name a few *Answering Queries Using Views, Second Edition* Foto Afrati,Rada

Chirkova,2022-05-31 The topic of using views to answer queries has been popular for a few decades now as it cuts across domains such as query optimization information integration data warehousing website design and recently database as a service and data placement in cloud systems This book assembles foundational work on answering queries using views in a self contained manner with an effort to choose material that constitutes the backbone of the research It presents efficient algorithms and covers the following problems query containment rewriting queries using views in various logical languages equivalent rewritings and maximally contained rewritings and computing certain answers in the data integration and data exchange settings Query languages that are considered are fragments of SQL in particular select project join queries also called conjunctive queries with or without arithmetic comparisons or negation and aggregate SQL queries This second edition includes twonew chapters that refer to tree like data and respective query languages Chapter 8 presents the data model for XML documents and the XPath query language and Chapter 9 provides a theoretical presentation of tree like data model and query language where the tuples of a relation share a tree structured schema for that relation and the query language is a dialect of SQL with evaluation techniques appropriately modified to fit the richer schema **Community Search over Big Graphs** Xin Huang,Laks V.S. Lakshmanan,Jianliang Xu,2022-05-31 Communities serve as basic structural building blocks for understanding the organization of many real world networks including social biological collaboration and communication networks Recently community search over graphs has attracted significantly increasing attention from small simple and static graphs to big evolving attributed and location based graphs In this book we first review the basic concepts of networks communities and various kinds of dense subgraph models We then survey the state of the art in community search techniques on various kinds of networks across different application areas Specifically we discuss cohesive community search attributed community search social circle discovery and geo social group search We highlight the challenges posed by different community search problems We present their motivations principles methodologies algorithms and applications and provide a comprehensive comparison of the existing techniques This book finally concludes by listing publicly available real world datasets and useful tools for facilitating further research and by offering further readings and future directions of research in this important and growing area *Answering Queries Using Views* Foto Afrati,Rada Chirkova,2022-11-10 The topic of using views to answer queries has been popular for a few decades now as it cuts across domains such as query optimization information integration data warehousing website design and recently database as a service and data placement in cloud systems This book assembles foundational work on answering queries using views in a self contained manner with an effort to choose material that constitutes the backbone of the research It presents efficient algorithms and covers the following problems query containment rewriting queries using views in various logical languages equivalent rewritings and maximally contained rewritings and computing certain answers in the data integration and data exchange settings Query languages that are considered are fragments of SQL in particular select project join queries also called conjunctive queries

with or without arithmetic comparisons or negation and aggregate SQL queries **Databases on Modern Hardware** Anastasia Ailamaki,Erietta Liarou,Pınar Tözün,Danica Porobic,Iraklis Psaroudakis,2022-06-01 Data management systems enable various influential applications from high performance online services e g social networks like Twitter and Facebook or financial markets to big data analytics e g scientific exploration sensor networks business intelligence As a result data management systems have been one of the main drivers for innovations in the database and computer architecture communities for several decades Recent hardware trends require software to take advantage of the abundant parallelism existing in modern and future hardware The traditional design of the data management systems however faces inherent scalability problems due to its tightly coupled components In addition it cannot exploit the full capability of the aggressive micro architectural features of modern processors As a result today s most commonly used server types remain largely underutilized leading to a huge waste of hardware resources and energy In this book we shed light on the challenges present while running DBMS on modern multicore hardware We divide the material into two dimensions of scalability implicit vertical and explicit horizontal The first part of the book focuses on the vertical dimension it describes the instruction and data level parallelism opportunities in a core coming from the hardware and software side In addition it examines the sources of under utilization in a modern processor and presents insights and hardware software techniques to better exploit the microarchitectural resources of a processor by improving cache locality at the right level of the memory hierarchy The second part focuses on the horizontal dimension i e scalability bottlenecks of database applications at the level of multicore and multisocket multicore architectures It first presents a systematic way of eliminating such bottlenecks in online transaction processing workloads which is based on minimizing unbounded communication and shows several techniques that minimize bottlenecks in major components of database management systems Then it demonstrates the data and work sharing opportunities for analytical workloads and reviews advanced scheduling mechanisms that are aware of nonuniform memory accesses and alleviate bandwidth saturation **Datalog and Logic Databases** Sergio Greco,Cristian Molinaro,2022-05-31 The use of logic in databases started in the late 1960s In the early 1970s Codd formalized databases in terms of the relational calculus and the relational algebra A major influence on the use of logic in databases was the development of the field of logic programming Logic provides a convenient formalism for studying classical database problems and has the important property of being declarative that is it allows one to express what she wants rather than how to get it For a long time relational calculus and algebra were considered the relational database languages However there are simple operations such as computing the transitive closure of a graph which cannot be expressed with these languages Datalog is a declarative query language for relational databases based on the logic programming paradigm One of the peculiarities that distinguishes Datalog from query languages like relational algebra and calculus is recursion which gives Datalog the capability to express queries like computing a graph transitive closure Recent years have witnessed a revival of

interest in Datalog in a variety of emerging application domains such as data integration information extraction networking program analysis security cloud computing ontology reasoning and many others The aim of this book is to present the basics of Datalog some of its extensions and recent applications to different domains Querying Graphs Angela Bonifati,George Fletcher,Hannes Voigt,Nikolay Yakovets,2022-06-01 Graph data modeling and querying arises in many practical application domains such as social and biological networks where the primary focus is on concepts and their relationships and the rich patterns in these complex webs of interconnectivity In this book we present a concise unified view on the basic challenges which arise over the complete life cycle of formulating and processing queries on graph databases To that purpose we present all major concepts relevant to this life cycle formulated in terms of a common and unifying ground the property graph data model the pre dominant data model adopted by modern graph database systems We aim especially to give a coherent and in depth perspective on current graph querying and an outlook for future developments Our presentation is self contained covering the relevant topics from graph data models graph query languages and graph query specification graph constraints and graph query processing We conclude by indicatingmajor open research challenges towards the next generation of graph data management systems **Similarity Joins in Relational Database Systems** Nikolaus Augsten,Michael Bohlen,2022-05-31 State of the art database systems manage and process a variety of complex objects including strings and trees For such objects equality comparisons are often not meaningful and must be replaced by similarity comparisons This book describes the concepts and techniques to incorporate similarity into database systems We start out by discussing the properties of strings and trees and identify the edit distance as the de facto standard for comparing complex objects Since the edit distance is computationally expensive token based distances have been introduced to speed up edit distance computations The basic idea is to decompose complex objects into sets of tokens that can be compared efficiently Token based distances are used to compute an approximation of the edit distance and prune expensive edit distance calculations A key observation when computing similarity joins is that many of the object pairs for which the similarity is computed are very different from each other Filters exploit this property to improve the performance of similarity joins A filter preprocesses the input data sets and produces a set of candidate pairs The distance function is evaluated on the candidate pairs only We describe the essential query processing techniques for filters based on lower and upper bounds For token equality joins we describe prefix size positional and partitioning filters which can be used to avoid the computation of small intersections that are not needed since the similarity would be too low On Transactional Concurrency Control Goetz Graefe,2022-05-31 This book contains a number of chapters on transactional database concurrency control This volume s entire sequence of chapters can summarized as follows A two sentence summary of the volume s entire sequence of chapters is this traditional locking techniques can be improved in multiple dimensions notably in lock scopes sizes lock modes increment decrement and more lock durations late acquisition early release and lock acquisition

sequence to avoid deadlocks Even if some of these improvements can be transferred to optimistic concurrency control notably a fine granularity of concurrency control with serializable transaction isolation including phantom protection pessimistic concurrency control is categorically superior to optimistic concurrency control i e independent of application workload deployment hardware and software implementation Fault-Tolerant Distributed Transactions on Blockchain Suyash Gupta,Jelle Hellings,Mohammad Sadoghi,2022-06-01 Since the introduction of Bitcoin the first widespread application driven by blockchain the interest of the public and private sectors in blockchain has skyrocketed In recent years blockchain based fabrics have been used to address challenges in diverse fields such as trade food production property rights identity management aid delivery health care and fraud prevention This widespread interest follows from fundamental concepts on which blockchains are built that together embed the notion of trust upon which blockchains are built 1 Blockchains provide data transparancy Data in a blockchain is stored in the form of a ledger which contains an ordered history of all the transactions This facilitates oversight and auditing 2 Blockchains ensure data integrity by using strong cryptographic primitives This guarantees that transactions accepted by the blockchain are authenticated by its issuer are immutable and cannot be repudiated by the issuer This ensures accountability 3 Blockchains are decentralized democratic and resilient They use consensus based replication to decentralize the ledger among many independent participants Thus it can operate completely decentralized and does not require trust in a single authority Additions to the chain are performed by consensus in which all participants have a democratic voice in maintaining the integrity of the blockchain Due to the usage of replication and consensus blockchains are also highly resilient to malicious attacks even when a significant portion of the participants are malicious It further increases the opportunity for fairness and equity through democratization These fundamental concepts and the technologies behind them a generic ledger based data model cryptographically ensured data integrity and consensus based replication prove to be a powerful and inspiring combination a catalyst to promote computational trust In this book we present an in depth study of blockchain unraveling its revolutionary promise to instill computational trust in society all carefully tailored to a broad audience including students researchers and practitioners We offer a comprehensive overview of theoretical limitations and practical usability of consensus protocols while examining the diverse landscape of how blockchains are manifested in their permissioned and permissionless forms **Data Profiling** Ziawasch Abedjan,Lukasz Golab,Felix Naumann,Thorsten Papenbrock,2022-06-01 Data profiling refers to the activity of collecting data about data i e metadata Most IT professionals and researchers who work with data have engaged in data profiling at least informally to understand and explore an unfamiliar dataset or to determine whether a new dataset is appropriate for a particular task at hand Data profiling results are also important in a variety of other situations including query optimization data integration and data cleaning Simple metadata are statistics such as the number of rows and columns schema and datatype information the number of distinct values statistical value distributions and the number of null

or empty values in each column More complex types of metadata are statements about multiple columns and their correlation such as candidate keys functional dependencies and other types of dependencies This book provides a classification of the various types of profilable metadata discusses popular data profiling tasks and surveys state of the art profiling algorithms While most of the book focuses on tasks and algorithms for relational data profiling we also briefly discuss systems and techniques for profiling non relational data such as graphs and text We conclude with a discussion of data profiling challenges and directions for future work in this area **Data Cleaning** Venkatesh Ganti,Anish Das Sarma,2022-05-31 Data warehouses consolidate various activities of a business and often form the backbone for generating reports that support important business decisions Errors in data tend to creep in for a variety of reasons Some of these reasons include errors during input data collection and errors while merging data collected independently across different databases These errors in data warehouses often result in erroneous upstream reports and could impact business decisions negatively Therefore one of the critical challenges while maintaining large data warehouses is that of ensuring the quality of data in the data warehouse remains high The process of maintaining high data quality is commonly referred to as data cleaning In this book we first discuss the goals of data cleaning Often the goals of data cleaning are not well defined and could mean different solutions in different scenarios Toward clarifying these goals we abstract out a common set of data cleaning tasks that often need to be addressed This abstraction allows us to develop solutions for these common data cleaning tasks We then discuss a few popular approaches for developing such solutions In particular we focus on an operator centric approach for developing a data cleaning platform The operator centric approach involves the development of customizable operators that could be used as building blocks for developing common solutions This is similar to the approach of relational algebra for query processing The basic set of operators can be put together to build complex queries Finally we discuss the development of custom scripts which leverage the basic data cleaning operators along with relational operators to implement effective solutions for data cleaning tasks **Data Exploration Using Example-Based Methods** Matteo Lissandrini,Davide Mottin,Themis Palpanas,Yannis Velegrakis,2022-06-01 Data usually comes in a plethora of formats and dimensions rendering the exploration and information extraction processes challenging Thus being able to perform exploratory analyses in the data with the intent of having an immediate glimpse on some of the data properties is becoming crucial Exploratory analyses should be simple enough to avoid complicate declarative languages such as SQL and mechanisms and at the same time retain the flexibility and expressiveness of such languages Recently we have witnessed a rediscovery of the so called example based methods in which the user or the analyst circumvents query languages by using examples as input An example is a representative of the intended results or in other words an item from the result set Example based methods exploit inherent characteristics of the data to infer the results that the user has in mind but may not able to easily express They can be useful in cases where a user is looking for information in an unfamiliar dataset when the task is particularly challenging like finding

duplicate items or simply when they are exploring the data In this book we present an excursus over the main methods for exploratory analysis with a particular focus on example based methods We show how that different data types require different techniques and present algorithms that are specifically designed for relational textual and graph data The book presents also the challenges and the new frontiers of machine learning in online settings which recently attracted the attention of the database community The lecture concludes with a vision for further research and applications in this area

Perspectives on Business Intelligence Raymond T. Ng,Patricia C. Arocena,Denilson Barbosa,Giuseppe Carenini,Luiz Gomes,Stephan Jou,Anthony Leung,Evangelos Milios,Renée J. Miller,John Mylopoulos,Rachel A Pottinger,Frank Tompa,Eric Yu,2022-05-31 In the 1980s traditional Business Intelligence BI systems focused on the delivery of reports that describe the state of business activities in the past such as for questions like How did our sales perform during the last quarter A decade later there was a shift to more interactive content that presented how the business was performing at the present time answering questions like How are we doing right now Today the focus of BI users are looking into the future Given what I did before and how I am currently doing this quarter how will I do next quarter Furthermore fuelled by the demands of Big Data BI systems are going through a time of incredible change Predictive analytics high volume data unstructured data social data mobile consumable analytics and data visualization are all examples of demands and capabilities that have become critical within just the past few years and are growing at an unprecedented pace This book introduces research problems and solutions on various aspects central to next generation BI systems It begins with a chapter on an industry perspective on how BI has evolved and discusses how game changing trends have drastically reshaped the landscape of BI One of the game changers is the shift toward the consumerization of BI tools As a result for BI tools to be successfully used by business users rather than IT departments the tools need a business model rather than a data model One chapter of the book surveys four different types of business modeling However even with the existence of a business model for users to express queries the data that can meet the needs are still captured within a data model The next chapter on vivification addresses the problem of closing the gap which is often significant between the business and the data models Moreover Big Data forces BI systems to integrate and consolidate multiple and often wildly different data sources One chapter gives an overview of several integration architectures for dealing with the challenges that need to be overcome While the book so far focuses on the usual structured relational data the remaining chapters turn to unstructured data an ever increasing and important component of Big Data One chapter on information extraction describes methods for dealing with the extraction of relations from free text and the web Finally BI users need tools to visualize and interpret new and complex types of information in a way that is compelling intuitive but accurate The last chapter gives an overview of information visualization for decision support and text

Unveiling the Magic of Words: A Report on "**Query Processing Over Uncertain Databases Xiang Lian**"

In some sort of defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their power to kindle emotions, provoke contemplation, and ignite transformative change is truly awe-inspiring. Enter the realm of "**Query Processing Over Uncertain Databases Xiang Lian**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve in to the book is central themes, examine its distinctive writing style, and assess its profound affect the souls of its readers.

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Query Processing Over Uncertain Databases Xiang Lian Introduction

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