Synthesis Lectures on Data Management

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# User-Centered Data Management

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# User Centered Data Management Alan Dix

Tiziana Catarci

**User Centered Data Management Alan Dix:**

User-centered Data Management Tiziana Catarci,2010 About Synthesis **User-Centered Data Management** Tiziana Catarci,Alan Dix,Stephen Kimani,Giuseppe Santucci,2022-05-31 This lecture covers several core issues in user centered data management including how to design usable interfaces that suitably support database tasks and relevant approaches to visual querying information visualization and visual data mining Novel interaction paradigms e g mobile and interfaces that go beyond the visual dimension are also discussed Table of Contents Why User Centered The Early Days Visual Query Systems Beyond Querying More Advanced Applications Non Visual Interfaces Conclusions Relational and XML Data Exchange Marcelo Arenas,Pablo Barcelo,Leonid Libkin,Filip Murlak,2022-05-31 Data exchange is the problem of finding an instance of a target schema given an instance of a source schema and a specification of the relationship between the source and the target Such a target instance should correctly represent information from the source instance under the constraints imposed by the target schema and it should allow one to evaluate queries on the target instance in a way that is semantically consistent with the source data Data exchange is an old problem that re emerged as an active research topic recently due to the increased need for exchange of data in various formats often in e business applications In this lecture we give an overview of the basic concepts of data exchange in both relational and XML contexts We give examples of data exchange problems and we introduce the main tasks that need to addressed We then discuss relational data exchange concentrating on issues such as relational schema mappings materializing target instances including canonical solutions and cores query answering and query rewriting After that we discuss metadata management i e handling schema mappings themselves We pay particular attention to operations on schema mappings such as composition and inverse Finally we describe both data exchange and metadata management in the context of XML We use mappings based on transforming tree patterns and we show that they lead to a host of new problems that did not arise in the relational case but they need to be addressed for XML These include consistency issues for mappings and schemas as well as imposing tighter restrictions on mappings and queries to achieve tractable query answering in data exchange Table of Contents Overview Relational Mappings and Data Exchange Metadata Management XML Mappings and Data Exchange Data-Intensive Workflow Management Daniel C. M. de Oliveira,Ji Liu,Esther Pacitti,2022-06-01 Workflows may be defined as abstractions used to model the coherent flow of activities in the context of an in silico scientific experiment They are employed in many domains of science such as bioinformatics astronomy and engineering Such workflows usually present a considerable number of activities and activations i e tasks associated with activities and may need a long time for execution Due to the continuous need to store and process data efficiently making them data intensive workflows high performance computing environments allied to parallelization techniques are used to run these workflows At the beginning of the 2010s cloud technologies emerged as a promising environment to run scientific workflows By using clouds scientists have expanded beyond single parallel

computers to hundreds or even thousands of virtual machines More recently Data Intensive Scalable Computing DISC frameworks e g Apache Spark and Hadoop and environments emerged and are being used to execute data intensive workflows DISC environments are composed of processors and disks in large commodity computing clusters connected using high speed communications switches and networks The main advantage of DISC frameworks is that they support and grant efficient in memory data management for large scale applications such as data intensive workflows However the execution of workflows in cloud and DISC environments raise many challenges such as scheduling workflow activities and activations managing produced data collecting provenance data etc Several existing approaches deal with the challenges mentioned earlier This way there is a real need for understanding how to manage these workflows and various big data platforms that have been developed and introduced As such this book can help researchers understand how linking workflow management with Data Intensive Scalable Computing can help in understanding and analyzing scientific big data In this book we aim to identify and distill the body of work on workflow management in clouds and DISC environments We start by discussing the basic principles of data intensive scientific workflows Next we present two workflows that are executed in a single site and multi site clouds taking advantage of provenance Afterward we go towards workflow management in DISC environments and we present in detail solutions that enable the optimized execution of the workflow using frameworks such as Apache Spark and its extensions *Foundations of Data Quality Management* Wenfei Fan,Floris Geerts,2022-05-31 Data quality is one of the most important problems in data management A database system typically aims to support the creation maintenance and use of large amount of data focusing on the quantity of data However real life data are often dirty inconsistent duplicated inaccurate incomplete or stale Dirty data in a database routinely generate misleading or biased analytical results and decisions and lead to loss of revenues credibility and customers With this comes the need for data quality management In contrast to traditional data management tasks data quality management enables the detection and correction of errors in the data syntactic or semantic in order to improve the quality of the data and hence add value to business processes While data quality has been a longstanding problem for decades the prevalent use of the Web has increased the risks on an unprecedented scale of creating and propagating dirty data This monograph gives an overview of fundamental issues underlying central aspects of data quality namely data consistency data deduplication data accuracy data currency and information completeness We promote a uniform logical framework for dealing with these issues based on data quality rules The text is organized into seven chapters focusing on relational data Chapter One introduces data quality issues A conditional dependency theory is developed in Chapter Two for capturing data inconsistencies It is followed by practical techniques in Chapter 2b for discovering conditional dependencies and for detecting inconsistencies and repairing data based on conditional dependencies Matching dependencies are introduced in Chapter Three as matching rules for data deduplication A theory of relative information completeness is studied in Chapter Four revising the classical Closed World Assumption and

the Open World Assumption to characterize incomplete information in the real world A data currency model is presented in Chapter Five to identify the current values of entities in a database and to answer queries with the current values in the absence of reliable timestamps Finally interactions between these data quality issues are explored in Chapter Six Important theoretical results and practical algorithms are covered but formal proofs are omitted The bibliographical notes contain pointers to papers in which the results were presented and proven as well as references to materials for further reading This text is intended for a seminar course at the graduate level It is also to serve as a useful resource for researchers and practitioners who are interested in the study of data quality The fundamental research on data quality draws on several areas including mathematical logic computational complexity and database theory It has raised as many questions as it has answered and is a rich source of questions and vitality Table of Contents Data Quality An Overview Conditional Dependencies Cleaning Data with Conditional Dependencies Data Deduplication Information Completeness Data Currency Interactions between Data Quality Issues **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 **Web Page Recommendation Models** Sule Gunduz-Oguducu,2022-06-01 One of the application areas of data mining is the World Wide Web WWW or Web which serves as a huge widely distributed global information service for every kind of information such as news advertisements consumer information financial management education government e commerce health services and many other information services The Web also contains a rich and dynamic collection of hyperlink information Web page access and usage information providing sources for data mining The amount of information on the Web is growing

rapidly as well as the number of Web sites and Web pages per Web site Consequently it has become more difficult to find relevant and useful information for Web users Web usage mining is concerned with guiding the Web users to discover useful knowledge and supporting them for decision making In that context predicting the needs of a Web user as she visits Web sites has gained importance The requirement for predicting user needs in order to guide the user in a Web site and improve the usability of the Web site can be addressed by recommending pages to the user that are related to the interest of the user at that time This monograph gives an overview of the research in the area of discovering and modeling the users interest in order to recommend related Web pages The Web page recommender systems studied in this monograph are categorized according to the data mining algorithms they use for recommendation Table of Contents Introduction to Web Page Recommender Systems Preprocessing for Web Page Recommender Models Pattern Extraction Evaluation Metrics

**Fundamentals of Object Databases** Suzanne Dietrich,Susan Urban,2022-05-31 Object oriented databases were originally developed as an alternative to relational database technology for the representation storage and access of non traditional data forms that were increasingly found in advanced applications of database technology After much debate regarding object oriented versus relational database technology object oriented extensions were eventually incorporated into relational technology to create object relational databases Both object oriented databases and object relational databases collectively known as object databases provide inherent support for object features such as object identity classes inheritance hierarchies and associations between classes using object references This monograph presents the fundamentals of object databases with a specific focus on conceptual modeling of object database designs After an introduction to the fundamental concepts of object oriented data the monograph provides a review of object oriented conceptual modeling techniques using side by side Enhanced Entity Relationship diagrams and Unified Modeling Language conceptual class diagrams that feature class hierarchies with specialization constraints and object associations These object oriented conceptual models provide the basis for introducing case studies that illustrate the use of object features within the design of object oriented and object relational databases For the object oriented database perspective the Object Data Management Group data definition language provides a portable language independent specification of an object schema together with an SQL like object query language LINQ Language INtegrated Query is presented as a case study of an object query language together with its use in the db4o open source object oriented database For the object relational perspective the object relational features of the SQL standard are presented together with an accompanying case study of the object relational features of Oracle For completeness of coverage an appendix provides a mapping of object oriented conceptual designs to the relational model and its associated constraints Table of Contents List of Figures List of Tables Introduction to Object Databases Object Oriented Databases Object Relational Databases **Advanced Metasearch Engine Technology** Weiyi Meng,Clement Yu,2022-05-31 Among the search tools currently on the Web search engines are the most well known thanks to the popularity

of major search engines such as Google and Yahoo While extremely successful these major search engines do have serious limitations This book introduces large scale metasearch engine technology which has the potential to overcome the limitations of the major search engines Essentially a metasearch engine is a search system that supports unified access to multiple existing search engines by passing the queries it receives to its component search engines and aggregating the returned results into a single ranked list A large scale metasearch engine has thousands or more component search engines While metasearch engines were initially motivated by their ability to combine the search coverage of multiple search engines there are also other benefits such as the potential to obtain better and fresher results and to reach the Deep Web The following major components of large scale metasearch engines will be discussed in detail in this book search engine selection search engine incorporation and result merging Highly scalable and automated solutions for these components are emphasized The authors make a strong case for the viability of the large scale metasearch engine technology as a competitive technology for Web search Table of Contents Introduction Metasearch Engine Architecture Search Engine Selection Search Engine Incorporation Result Merging Summary and Future Research *Database Replication* Bettina Kemme,Ricardo Jimenez-Peris,Marta Patino-Martinez,2022-05-31 Database replication is widely used for fault tolerance scalability and performance The failure of one database replica does not stop the system from working as available replicas can take over the tasks of the failed replica Scalability can be achieved by distributing the load across all replicas and adding new replicas should the load increase Finally database replication can provide fast local access even if clients are geographically distributed clients if data copies are located close to clients Despite its advantages replication is not a straightforward technique to apply and there are many hurdles to overcome At the forefront is replica control assuring that data copies remain consistent when updates occur There exist many alternatives in regard to where updates can occur and when changes are propagated to data copies how changes are applied where the replication tool is located etc A particular challenge is to combine replica control with transaction management as it requires several operations to be treated as a single logical unit and it provides atomicity consistency isolation and durability across the replicated system The book provides a categorization of replica control mechanisms presents several replica and concurrency control mechanisms in detail and discusses many of the issues that arise when such solutions need to be implemented within or on top of relational database systems Furthermore the book presents the tasks that are needed to build a fault tolerant replication solution provides an overview of load balancing strategies that allow load to be equally distributed across all replicas and introduces the concept of self provisioning that allows the replicated system to dynamically decide on the number of replicas that are needed to handle the current load As performance evaluation is a crucial aspect when developing a replication tool the book presents an analytical model of the scalability potential of various replication solution For readers that are only interested in getting a good overview of the challenges of database replication and the general mechanisms of how to implement

replication solutions we recommend to read Chapters 1 to 4 For readers that want to get a more complete picture and a discussion of advanced issues we further recommend the Chapters 5 8 9 and 10 Finally Chapters 6 and 7 are of interest for those who want get familiar with thorough algorithm design and correctness reasoning Table of Contents Overview 1 Copy Equivalence and Consistency Basic Protocols Replication Architecture The Scalability of Replication Eager Replication and 1 Copy Serializability 1 Copy Snapshot Isolation Lazy Replication Self Configuration and Elasticity Other Aspects of Replication

*Managing Event Information* Amarnath Gupta,Ramesh Jain,2022-05-31 With the proliferation of citizen reporting smart mobile devices and social media an increasing number of people are beginning to generate information about events they observe and participate in A significant fraction of this information contains multimedia data to share the experience with their audience A systematic information modeling and management framework is necessary to capture this widely heterogeneous schemaless potentially humongous information produced by many different people This book is an attempt to examine the modeling storage querying and applications of such an event management system in a holistic manner It uses a semantic web style graph based view of events and shows how this event model together with its query facility can be used toward emerging applications like semi automated storytelling Table of Contents Introduction Event Data Models Implementing an Event Data Model Querying Events Storytelling with Events An Emerging Application Conclusion **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 **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 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 *Big Data Integration* Xin Luna Dong,Divesh Srivastava,2022-05-31 The big data era is upon us data are being generated analyzed and used at an unprecedented scale and data driven decision making is sweeping through all aspects of society Since the value of data explodes when it can be linked and fused with other data addressing the big data integration BDI challenge is critical to realizing the promise of big data BDI differs from traditional data integration along the dimensions of volume velocity variety and veracity First not only can data sources contain a huge volume of data but also the number of data sources is now in the millions Second because of the rate at which newly

collected data are made available many of the data sources are very dynamic and the number of data sources is also rapidly exploding Third data sources are extremely heterogeneous in their structure and content exhibiting considerable variety even for substantially similar entities Fourth the data sources are of widely differing qualities with significant differences in the coverage accuracy and timeliness of data provided This book explores the progress that has been made by the data integration community on the topics of schema alignment record linkage and data fusion in addressing these novel challenges faced by big data integration Each of these topics is covered in a systematic way first starting with a quick tour of the topic in the context of traditional data integration followed by a detailed example driven exposition of recent innovative techniques that have been proposed to address the BDI challenges of volume velocity variety and veracity Finally it presents merging topics and opportunities that are specific to BDI identifying promising directions for the data integration community

**Veracity of Data** Laure Berti-Équille,Javier Borge-Holthoefer,2022-05-31 On the Web a massive amount of user generated content is available through various channels e g texts tweets Web tables databases multimedia sharing platforms etc Conflicting information rumors erroneous and fake content can be easily spread across multiple sources making it hard to distinguish between what is true and what is not This book gives an overview of fundamental issues and recent contributions for ascertaining the veracity of data in the era of Big Data The text is organized into six chapters focusing on structured data extracted from texts Chapter 1 introduces the problem of ascertaining the veracity of data in a multi source and evolving context Issues related to information extraction are presented in Chapter 2 Current truth discovery computation algorithms are presented in details in Chapter 3 It is followed by practical techniques for evaluating data source reputation and authoritativeness in Chapter 4 The theoretical foundations and various approaches for modeling diffusion phenomenon of misinformation spreading in networked systems are studied in Chapter 5 Finally truth discovery computation from extracted data in a dynamic context of misinformation propagation raises interesting challenges that are explored in Chapter 6 This text is intended for a seminar course at the graduate level It is also to serve as a useful resource for researchers and practitioners who are interested in the study of fact checking truth discovery or rumor spreading **Incomplete Data and Data Dependencies in Relational Databases** Sergio Greco,Cristian Molinaro,Francesca Spezzano,2022-06-01 The chase has long been used as a central tool to analyze dependencies and their effect on queries It has been applied to different relevant problems in database theory such as query optimization query containment and equivalence dependency implication and database schema design Recent years have seen a renewed interest in the chase as an important tool in several database applications such as data exchange and integration query answering in incomplete data and many others It is well known that the chase algorithm might be non terminating and thus in order for it to find practical applicability it is crucial to identify cases where its termination is guaranteed Another important aspect to consider when dealing with the chase is that it can introduce null values into the database thereby leading to incomplete data Thus in several scenarios where the chase is

used the problem of dealing with data dependencies and incomplete data arises This book discusses fundamental issues concerning data dependencies and incomplete data with a particular focus on the chase and its applications in different database areas We report recent results about the crucial issue of identifying conditions that guarantee the chase termination Different database applications where the chase is a central tool are discussed with particular attention devoted to query answering in the presence of data dependencies and database schema design Table of Contents Introduction Relational Databases Incomplete Databases The Chase Algorithm Chase Termination Data Dependencies and Normal Forms Universal Repairs Chase and Database Applications **Data Protection from Insider Threats** Elisa Bertino,2022-05-31 As data represent a key asset for today s organizations the problem of how to protect this data from theft and misuse is at the forefront of these organizations minds Even though today several data security techniques are available to protect data and computing infrastructures many such techniques such as firewalls and network security tools are unable to protect data from attacks posed by those working on an organization s inside These insiders usually have authorized access to relevant information systems making it extremely challenging to block the misuse of information while still allowing them to do their jobs This book discusses several techniques that can provide effective protection against attacks posed by people working on the inside of an organization Chapter One introduces the notion of insider threat and reports some data about data breaches due to insider threats Chapter Two covers authentication and access control techniques and Chapter Three shows how these general security techniques can be extended and used in the context of protection from insider threats Chapter Four addresses anomaly detection techniques that are used to determine anomalies in data accesses by insiders These anomalies are often indicative of potential insider data attacks and therefore play an important role in protection from these attacks Security information and event management SIEM tools and fine grained auditing are discussed in Chapter Five These tools aim at collecting analyzing and correlating in real time any information and event that may be relevant for the security of an organization As such they can be a key element in finding a solution to such undesirable insider threats Chapter Six goes on to provide a survey of techniques for separation of duty SoD SoD is an important principle that when implemented in systems and tools can strengthen data protection from malicious insiders However to date very few approaches have been proposed for implementing SoD in systems In Chapter Seven a short survey of a commercial product is presented which provides different techniques for protection from malicious users with system privileges such as a DBA in database management systems Finally in Chapter Eight the book concludes with a few remarks and additional research directions Table of Contents Introduction Authentication Access Control Anomaly Detection Security Information and Event Management and Auditing Separation of Duty Case Study Oracle Database Vault Conclusion **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

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