

EDBT 2011 Tutorial

Big Data and Cloud Computing: Current State and Future Opportunities

Divy Agrawal, Sudipto Das, and Amr El Abbadi
Department of Computer Science
University of California at Santa Barbara

Data Management In The Cloud Challenges And Opportunities Sudipto Das

Joy Arulraj, Andrew Pavlo



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Data Management in the Cloud Divyakant Agrawal, Sudipto Das, Amr El Abbadi, 2022-05-31 Cloud computing has emerged as a successful paradigm of service oriented computing and has revolutionized the way computing infrastructure is used. This success has seen a proliferation in the number of applications that are being deployed in various cloud platforms. There has also been an increase in the scale of the data generated as well as consumed by such applications. Scalable database management systems form a critical part of the cloud infrastructure. The attempt to address the challenges posed by the management of big data has led to a plethora of systems. This book aims to clarify some of the important concepts in the design space of scalable data management in cloud computing infrastructures. Some of the questions that this book aims to answer are: the appropriate systems for a specific set of application requirements, the research challenges in data management for the cloud, and what is novel in the cloud for database researchers. We also aim to address one basic question: whether cloud computing poses new challenges in scalable data management or it is just a reincarnation of old problems. We provide a comprehensive background study of state of the art systems for scalable data management and analysis. We also identify important aspects in the design of different systems and the applicability and scope of these systems. A thorough understanding of current solutions and a precise characterization of the design space are essential for clearing the cloudy skies of data management and ensuring the success of DBMSs in the cloud, thus emulating the success enjoyed by relational databases in traditional enterprise settings.

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Data Management in Machine Learning Systems Matthias Boehm, Arun Kumar, Jun Yang, 2022-05-31

Large scale data analytics using machine learning. ML underpins many modern data driven applications. ML systems provide means of specifying and executing these ML workloads in an efficient and scalable manner. Data management is at the heart of many ML systems due to data driven application characteristics: data centric workload characteristics and system architectures inspired by classical data management techniques. In this book we follow this data centric view of ML systems and aim to provide a comprehensive overview of data management in ML systems for the end to end data science or ML lifecycle. We review multiple interconnected lines of work: 1. ML support in database DB systems, 2. DB inspired ML systems, and 3. ML lifecycle systems. Covered topics include: in database analytics via query generation and user defined functions, factorized and statistical relational learning, optimizing compilers for ML workloads, execution strategies and hardware accelerators, data access methods such as compression, partitioning and indexing, resource elasticity and cloud markets, as well as systems for data preparation for ML, model selection, model management, model debugging and model serving. Given the rapidly evolving field, we strive for a balance between an up to date survey of ML systems, an overview of the underlying concepts and techniques, as well as pointers to open research questions. Hence this book might serve as a

starting point for both systems researchers and developers

Advanced Data Management Lena Wiese, 2015-10-29

Advanced data management has always been at the core of efficient database and information systems. Recent trends like big data and cloud computing have aggravated the need for sophisticated and flexible data storage and processing solutions. This book provides a comprehensive coverage of the principles of data management developed in the last decades with a focus on data structures and query languages. It treats a wealth of different data models and surveys the foundations of structuring, processing, storing, and querying data according to these models. Starting off with the topic of database design, it further discusses weaknesses of the relational data model and then proceeds to convey the basics of graph, data tree, structured XML, data key-value pairs, and nested semi-structured JSON data, columnar and record-oriented data, as well as object-oriented data. The final chapters round the book off with an analysis of fragmentation, replication, and consistency strategies for data management in distributed databases, as well as recommendations for handling polyglot persistence in multi-model databases and multi-database architectures. While primarily geared towards students of Master-level courses in Computer Science and related areas, this book may also be of benefit to practitioners looking for a reference book on data modeling and query processing. It provides both theoretical depth and a concise treatment of open-source technologies currently on the market.

Non-Volatile Memory Database Management Systems Joy Arulraj, Andrew Pavlo, 2022-06-01. This book explores the implications of non-volatile memory (NVM) for database management systems (DBMSs). The advent of NVM will fundamentally change the dichotomy between volatile memory and durable storage in DBMSs. These new NVM devices are almost as fast as volatile memory, but all writes to them are persistent even after power loss. Existing DBMSs are unable to take full advantage of this technology because their internal architectures are predicated on the assumption that memory is volatile. With NVM, many of the components of legacy DBMSs are unnecessary and will degrade the performance of data-intensive applications. We present the design and implementation of DBMS architectures that are explicitly tailored for NVM. The book focuses on three aspects of a DBMS: 1) logging and recovery, 2) storage and buffer management, and 3) indexing. First, we present a logging and recovery protocol that enables the DBMS to support near-instantaneous recovery. Second, we propose a storage engine architecture and buffer management policy that leverages the durability and byte-addressability properties of NVM to reduce data duplication and data migration. Third, the book presents the design of a range index tailored for NVM that is latch-free yet simple to implement. All together, the work described in this book illustrates that rethinking the fundamental algorithms and data structures employed in a DBMS for NVM improves performance and availability, reduces operational cost, and simplifies software development.

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

Natural Language Data Management and Interfaces Yunyao Li,Davood Rafiei,2022-06-01 The volume of natural language text data has been rapidly increasing over the past two decades due to factors such as the growth of the Web the low cost associated with publishing and the progress on the digitization of printed texts This growth combined with the proliferation of natural language systems for search and retrieving information provides tremendous opportunities for studying some of the areas where database systems and natural language processing systems overlap This book explores two interrelated and important areas of overlap 1 managing natural language data and 2 developing natural language interfaces to databases It presents relevant concepts and research questions state of the art methods related systems and research opportunities and challenges covering both areas Relevant topics discussed on natural language data management include data models data sources queries storage and indexing and transforming natural language text Under naturallanguage interfaces it presents the anatomy of these interfaces to databases the challenges related to query understanding and query translation and relevant aspects of user interactions Each of the challenges is covered in a systematic way first starting with a quick overview of the topics followed by a comprehensive view of recent techniques that have been proposed to address the challenge along with illustrative examples It also reviews some notable systems in details in terms of how they address different challenges and their contributions Finally it discusses open challenges and opportunities for natural language management and interfaces The goal of this book is to provide an introduction to the methods problems and solutions that are used in managing natural language data and building natural language interfaces to databases It serves as a starting point for readers who are interested in pursuing additional work on these exciting topics in both academic and industrial environments

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

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

Information and Influence Propagation in Social Networks Wei Chen, Carlos Castillo, Laks V.S. Lakshmanan, 2022-05-31 Research on social networks has exploded over the last decade To a large extent this has been fueled by the spectacular growth of social media and online social networking sites which continue growing at a very fast pace as well as by the increasing availability of very large social network datasets for purposes of research A rich body of this research has been devoted to the analysis of the propagation of information influence innovations infections practices and customs through networks Can we build models to explain the way these propagations occur How can we validate our models against any available real datasets consisting of a social network and propagation traces that occurred in the past These are just some questions studied by researchers in this area Information propagation models find applications in viral marketing outbreak detection finding key blog posts to read in order to catch important stories finding leaders or trendsetters information feed ranking etc A number of algorithmic problems arising in these applications have been abstracted and studied extensively by researchers under the garb of influence maximization This book starts with a detailed description of well established diffusion models including the independent cascade model and the linear threshold model that have been successful at explaining propagation phenomena We describe their properties as well as numerous extensions to them introducing aspects such as competition budget and time criticality among many others We delve deep into the key problem of influence maximization which selects key individuals to activate in order to influence a large fraction of a network Influence maximization in classic diffusion models including both the independent cascade and the linear threshold models is computationally intractable more precisely P hard and we describe several approximation algorithms and scalable heuristics that have been proposed in the literature Finally we also deal with key issues that need to be tackled in order to turn this research into practice such as learning the strength with which individuals in a network influence each other as well as the practical aspects of this research including the availability of datasets and software tools for facilitating research We conclude with a discussion of various research problems that remain open both from a technical perspective and from the viewpoint of transferring the results of research into industry strength applications

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

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