Chapter 1
The End of Relational Databases Domination

ABSTRACT

The chapter gives an overview of the three main stages of database development: hierarchical and network database models, relational database model, and NoSQL databases. It gives a short overview of the pillars of relational databases: relational data model, ACID (atomicity, consistency, isolation, and durability) properties of a transaction, and SQL (structured query language). Also, the concepts that make the base for NoSQL database development are explained, including the CAP (Consistency, Availability, Partitioning) theorem, the BASE (Basically Available, Soft-state, Eventually consistent) approach, and the sharding phenomenon. At last, the limitations of relational databases which led to the development of NoSQL databases are discussed.

INTRODUCTION

Relational databases have been the predominant database model for the last forty years. Since 1970, when E.F. Codd from the IBM Research Laboratory published his famous paper *A relational model for large shared data* (Codd, 1970) the world of databases changed significantly. Codd established the theoretical ground of relational databases that ensured the independence of data presentation (data model) with regard to physical data storage implementation. Relational databases share a common architecture based on three pillars: relational model, ACID (atomicity, consistency, isolation,

durability) transactions, and SQL (structured query language) language. Relational databases even found a way, through constant innovations and implementation of object-oriented features, to respond to object-oriented requests, but the era of massive Web-scale applications created completely different pressures on the relational database, which could not be easily resolved through incremental innovation.

In order to support readers in more easily understanding further chapters and the book as a whole, this chapter gives an overview of the three main stages in database development. In short, this chapter explains the pillars of relational databases, CAP (consistency, availability, partitioning) theorem, BASE (basically available, soft-state, eventually consistent) approach, and limitations of relational databases which led to the development of NoSQL databases.

THREE STAGES IN DATABASE DEVELOPMENT

The very first attempt of the manual filing system digitalization was related to the file-based approach (Figure 1). The file-based approach translated manual file organization (labeled files stored in cabinets) into digital files (Figure 1). However, this approach had two main drawbacks:

- Data definition was inseparable from application programs.
- Data could be accessed and manipulated only through application programs.

The consequences were:

- Any change of file structure forced modifications in all the programs that used that file and resulted with additional programming time and effort.
- Difficulties in combining data from multiple sources caused a high level of redundancy in the file based approach, so the same data was stored in different location (poor data security and consistency).
- Files which were created using one programming language could not be accessed by any other programming language.

It became obvious that inseparability of data and application programs caused huge maintenance problems in file-based systems. Thus, a new

31 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/the-end-of-relational-databases-domination/191979

Related Content

Legal Protection of the Web Page as a Database
Davide Mulaand Mirko Luca Lobina (2009). *Database Technologies: Concepts, Methodologies, Tools, and Applications (pp. 2616-2631).*
www.irma-international.org/chapter/legal-protection-web-page-database/8054

General Strategy for Querying Web Sources in a Data Federation Environment
Aykut Firat, Lynn Wuand Stuart Madnick (2011). *Theoretical and Practical Advances in Information Systems Development: Emerging Trends and Approaches (pp. 62-80).*
www.irma-international.org/chapter/general-strategy-querying-web-sources/52952

A Novel Approach to Managing the Dynamic Nature of Semantic Relatedness
Youngseok Choi, Jungsuk Ohand Jinsoo Park (2016). *Journal of Database Management (pp. 1-26).*
www.irma-international.org/article/a-novel-approach-to-managing-the-dynamic-nature-of-semantic-relatedness/165160

Security in Database Systems: State of the Art
Eduardo Fernandez-Medina Patonand Mario G. Piattini (2001). *Developing Quality Complex Database Systems: Practices, Techniques and Technologies (pp. 331-349).*
www.irma-international.org/chapter/security-database-systems/8283

Visualization of Predictive Modeling for Big Data Using Various Approaches When There Are Rare Events at Differing Levels
Alan Olinsky, John Thomas Quinnand Phyllis A. Schumacher (2018). *Handbook of Research on Big Data Storage and Visualization Techniques (pp. 604-631).*
www.irma-international.org/chapter/visualization-of-predictive-modeling-for-big-data-using-various-approaches-when-there-are-rare-events-at-differing-levels/198779