Chapter XCI
Innovative Access and Query Schemes for Mobile Databases and Data Warehouses

Alfredo Cuzzocrea
University of Calabria, Italy

1. INTRODUCTION

Thanks to the explosion of the wireless technology, mobile environments are becoming the leading software platforms for extracting knowledge and interacting with enterprise information systems. **Data and services availability** at all times is the major benefit coming from such deployment scenario, but new research challenges pose serious limitations concerning data engineering issues. In fact, although if one can suppose that re-writing and re-adapting data structures, algorithms, and data reliability/dependability schemes is the natural way to support efficient **data management on mobile environments**, new issues and old limitations arise, particularly for what concerns with **data availability and consistency** in wireless network environments.

Furthermore, for a **mobile application**, design and deployment requirements strongly depend on its nature. For a **service-oriented application**, efficient service activation, and fast availability of

data on which services run play a dominant role; on the contrary, for a **data-intensive application**, distributed storage, indexing, and querying are the most important (and problematic) issues. However, for any mobile application, *location-aware services providing* (including data services) is the common deployment requirement to be satisfied. According to these considerations, every mobile software application should be able to provide data and services in *any place* and, above all, in *any time*.

Database Systems (*DBS*) and *Data Warehouse Systems* (*DWS*), which are usually built on the top of very large (and, very often, heterogeneous) data sources, are ready to gain innovative and important improvements by integrating the wireless environment into their application scope. In fact, these systems, which, without loss of generality, we can name as **Data-Intensive Systems** (*DIS*), can find in the mobile ones the natural front-end devices for making their impact on a large variety of applications (falling in even emerging contexts

such as *Business Intelligence* (*BI*)) very successful. In fact, the development and, above all, the usage of many commercial DIS have shown that an on-site, just-in-time, fast, even approximate, computation (achievable through a wireless network infrastructure) can be often more profitable than a distant-in-time, data-intensive computation (achievable through a wired network infrastructure). In other words, mobile environments can reasonably be considered as a *plus-value* for data-intensive applications and systems.

In this respect, the data model assumes a critical role for DIS. As an example, the *multidimensional data model* has became a leading solution for DIS, thanks to its capability of representing and processing data according to a multidimensional and multi-resolution vision of data. This model has been adopted in several systems, with real benefits, such as *e*-banking systems, trading-on-line systems, basket analysis systems etc. **OnLine Analytical Processing** (OLAP) (Gray et al., 1997) is the leading technology for the multidimensional data model. Many of the above-mentioned systems integrate in their core layer an OLAP engine that offers storage and indexing functionalities, query and integration capabilities over multidimensional data.

Similarly to traditional contexts, data accessing and querying are the most relevant aspects to be considered, as they heavily affect the performance of knowledge extraction tasks defined on top of them. A very important solution to this problem is represented by the idea of using **data compression techniques**, which allow us to improve the performance of data access and query activities, as well as to reduce the cost of transmitting data that, due to specific technological constraints, assumes a critical role in mobile environments. On the other hand, the data compression idea is not new in the context of mobile computing, and it has been adopted in others experiences having some relationships with our investigated scenario, i.e. data-intensive mobile applications and systems. For instance, (Franz & Kistler, 1997) proposes

the *slim binary representation*, a technique for compressing mobile code on the basis of adaptive compression of *syntax trees*. This technique allows the performance of code running on handheld devices to be improved significantly. Also, *data summarization*, which is the extraction of a text summary from a given text under the constraint of maintaining an "equal" information content, is a research topic related to data compression issues. In (Buyukkokten et al., 2001), authors propose data summarization techniques for supporting efficient browsing of Web hypermedia via handheld devices.

All considering, we can claim that *data compression represents an innovative access and query scheme for mobile databases and data cubes*. This intuition is also well-motivated by considering the nature of analysis supported by DIS against huge amounts of data. This analysis is usually *qualitative*, meaning that in the query and report phases, decimal precision is not need as, for instance, managers and analysts are often more interested in performing *trend* analysis rather than *punctual* analysis on business data. Following these considerations, providing *approximate answers* to queries against massive databases and data warehouses is more convenient and feasible rather than computing exact answers, mainly because the latter are resource-intensive in terms of both spatial and temporal computational needs. This evidence is also the fundamental motivation of the proliferating of a large number of **approximate query answering techniques** (e.g., (Poosala & Ioannidis, 1997; Gibbons & Matias, 1998; Acharya et al., 1999; Vitter et al., 1998; Ioannidis & Poosala, 1999; Poosala & Ganti, 1999; Gunopulos et al., 2000; Chaudhuri et al., 2001; Garofalakis & Kumar, 2004; Cuzzocrea, 2005a; Cuzzocrea, 2005b; Cuzzocrea, 2006; Cuzzocrea & Wang, 2007)) observed in the last years, whose main goal is devising representation techniques and query algorithms for obtaining fast and approximate answers from huge amounts of data.

Related Content

Future Directions for Public Service Delivery in the Digital Era
(2019). *Information Systems Strategic Planning for Public Service Delivery in the Digital Era (pp. 323-341).*
www.irma-international.org/chapter/future-directions-for-public-service-delivery-in-the-digital-era/233413

Query Expansion by Taxonomy
Troels Andreasenand Henrik Bulskov (2008). *Handbook of Research on Fuzzy Information Processing in Databases (pp. 325-349).*
www.irma-international.org/chapter/query-expansion-taxonomy/20359

Strategic Perspective on Challenges and Opportunities in Big Data Management
Neeta Baporikarand K. S. Sastry Musti (2022). *International Journal of Big Data Intelligence and Applications (pp. 1-15).*
www.irma-international.org/article/strategic-perspective-on-challenges-and-opportunities-in-big-data-management/312853

Discovering Association Rules in Temporal Databases
Juan M. Aleand Gustavo H. Rossi (2005). *Encyclopedia of Database Technologies and Applications (pp. 195-200).*
www.irma-international.org/chapter/discovering-association-rules-temporal-databases/11145

An Enterprise Model Repository: Architecture and System
Heeseok Leeand Jae-Woo Joung (2000). *Journal of Database Management (pp. 16-28).*
www.irma-international.org/article/enterprise-model-repository/3246