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Preface

The 31th International Conference on Advanced Information Systems Engineering (CAiSE 2019) was held in Rome, Italy, during June 3–7, 2019.

The CAiSE conference continues its tradition as the premiere venue for innovative and rigorous research across the whole spectrum of Information Systems Engineering, while placing a special emphasis on the theme of "Responsible Information Systems." The theme acknowledges that trends like IoT, big data analytics, artificial intelligence, machine learning, as well as blockchain technology are expected to push digital transformation even further. While many of these technologies bear huge potential for information systems that are flexible enough for digital transformation and support high-velocity decision-making, they also pose new challenges for designing information systems that are responsible by considering privacy, security, and ethical concerns and providing trustworthiness.

The CAiSE program included three invited keynotes on important perspectives for Information Systems Engineering, by Prof. Annie Antón (Georgia Institute of Technology, USA), Dr. Ethan Hadar (Accenture Labs and Accenture Cyber Fusion Center in Tel Aviv, Israel), and Prof. Maurizio Lenzerini (Sapienza Università di Roma, Italy).

The accepted research papers (formal and/or technical, empirical, experience, exploratory) address facets related to the theme "Responsible Information Systems," as well as the core topics associated with IS Engineering: novel approaches; models, methods, and techniques; architectures and platforms; and domain-specific and multi-aspects IS.

We received 206 full paper submissions and we followed the selection process consolidated in the previous years: each paper was initially reviewed by at least two Program Committee (PC) members; papers with consistent negative evaluations were rejected; all papers with at least one positive evaluation were reviewed by a member of the Program Board (PB); all reviewers then engaged in an online discussion led by another PB member; finally, during the physical meeting of the PB meeting in Rome (February 21–22, 2019), the final decision was made about the acceptance or rejection of each paper. The overall evaluation process of the papers resulted in the selection of 41 high-quality papers, which amounts to an acceptance rate of 20%. The final program of CAiSE 2019 was complemented by CAiSE Forum, workshops, co-located working conferences, and a PhD consortium. For each of these events, separate proceedings were published.

We would like to thank the general chairs, Barbara Pernici and Massimo Mecella, and the whole organization team (Andrea Marrella, Francesco Leotta, Francesco Sapio, Lauren S. Ferro, Simone Agostinelli, Eleonora Bernasconi, Miguel Ceriani, Consulta Umbria – the organizing agency) for their support and incredible work. We thank also the forum chairs, Cinzia Cappiello and Marcela Ruiz, workshop chairs, Henderik A. Proper and Janis Stirna, tutorial chairs, Devis Bianchini and Marlon Dumas, doctoral consortium chairs, Manfred Reichert, Pierluigi Plebani, and Marcello La Rosa,

publicity chairs, Artem Polyvyanyy, Estefania Serral Asensio, and Lin Liu, for their extraordinary and professional work. Finally, we would like to thank all PC and PB members, who played a fundamental role in the selection process.

CAiSE 2019 was organized with the support of Sapienza Università di Roma and Politecnico di Milano.

April 2019

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Invited Keynote Talks

Keynote: The Post-digital Era – Technology Trends and Needed Research

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Abstract. The digital era is here. Digitization enables companies today to understand their customers with a new depth of granularity. There are more digital ecosystems and potential partners to help companies create holistic experiences. Companies are facing entirely new set of expectations from customers, employees and business partners, combining innovative services and hyper-personalization to change the way the market itself works. Now we are entering the post-digital era, where companies are asking what's next? Now, companies must first earn a level of trust that meets their customers, employees and business partners' goals, and they must use that trust responsibly. Such changes include addressing privacy, safety, ethics, and governance questions. This keynote presents Accenture Technology Vision 2019 which outlines five technology trends and challenges for research organizations and universities. The first trend outlines the new generation of technologies of Distributed Ledger, Artificial Intelligence, Extended Reality, and Quantum Computing, and applying these technologies in combination. The second through fifth trends describe what this post digital world will look like from the lens of consumers, employees, security and overall market dynamics.

The keynote contains insights from executive leaders of Accenture discussing the vision and trends definition including examples.

Keywords: Consumers · Personalization · Technology trends · Cyber security · New markets

Reference

1. Accenture Technical Vision 2019. https://www.accenture.com/t20190304T094157Z__w__/us-en/_acnmedia/PDF-94/Accenture-TechVision-2019-Tech-Trends-Report.pdf. Accessed 29 Mar 2019

Direct and Reverse Rewriting in Data Interoperability

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Introduction

Data interoperability refers to the issue of accessing and processing data from multiple sources in order to create more holistic and contextual information for improving data analysis, for better decision-making, and for accountability purposes. In the era towards a data-driven society, the notion of data interoperability is of paramount importance. Looking at the research work in the last decades, several types of data interoperability scenarios emerged, including the following.

1. In Data Integration, we have a multitude of information sources, and we want to access them by means of a global schema, that somehow accommodates an integrated view of all data at the sources [12, 17].
2. In Data Exchange, we have a source database, and a target database, and we want to move the data from the source to the target according to some specified criteria [3, 15].
3. In P2P Data Coordination, we have a network of information nodes (peers), and we want to let them communicate to each other in order to exchange data or queries [5, 22].
4. In Ontology-Based Data Management (OBDM), we have a collection of data sources and an ontology representing a semantic model of the domain of interest, and we want to govern (i.e., query, update, monitoring, etc.) the data at the sources through the ontology, rather than by interacting directly with the sources [10, 18].

A fundamental component of all the above data interoperability frameworks is the mapping. Indeed, put in an abstract way, all the above scenarios are characterized by an architecture constituted by various autonomous nodes (called databases, data sources, peers, etc.) which hold information, and which are linked to other nodes by means of mappings. A mapping is a statement specifying that some relationship exists between pieces of information held by one node and pieces of information held by another node. Specifically, in Data Integration the mappings relate the data sources to the global schema, in Data Exchange they relate the source database to the target database, in P2P Coordination they relate the various peers in the network, and in OBDM they relate the various data sources to the ontology.

In the last years, many papers investigate the notion of mapping, from various points of view, and with different goals (see [16] and references therein). By looking at these papers, one could argue that one of the most important role of mapping is to allow reformulating queries expressed over a node into queries expressed over other mapped nodes.

Such reformulation task is crucial, for example, for answering queries expressed over the global schema in a data integration system. Indeed, to compute the answer, the system has to figure out which queries to ask to the data sources (where the real data are located), and this is done by a step that we call *direct rewriting*: rewrite the query over the global schema in terms of a query over the data sources. A similar task has been studied in the other data interoperability scenarios. In OBDM, for instance, given a user queries expressed over the ontology, the aim is to find a direct rewriting of the query, i.e., a query over the source schema, that, once executed over the data, provides the user query answers that are logically implied by the ontology and the mapping.

While the notion of direct rewriting has been the subject of many investigations in data interoperability in the last decades, in this paper we aim at discuss also a new notion of rewriting, that we call *inverse rewriting*. The importance of this new notion emerges when we consider the following task in the OBDM scenario: Given a query q over the sources, find the query over the ontology that characterizes q at best (independently from the current source database). Note that the problem is reversed with respect to the one where the traditional (direct) rewriting is used: here, we start with a source query, and we aim at deriving a corresponding query over the ontology. Thus, we are dealing with a sort of reverse engineering problem, which is novel in the investigation of data interoperability. We argue that this problem is relevant in a plethora of application scenarios. For the sake of brevity, we mention only three of them. *(1)* Following the ideas in [8], the notion of reverse rewriting can be used to provide the semantics of open data and open APIs published by organizations, which is a crucial aspect for unchaining all the potentials of open data. *(2)* Although the architecture of many modern Information Systems is based on data services, that are abstractions of computation done on data sources, it is often the case that the semantics of such computations is not well specified or documented. Can we automatically produce a semantic characterization of a data service, having an OBDA specification available? The idea is to exploit a new reasoning task over the OBDA specification, that works as follows: we express the data service in terms of a query over the sources, and we use the notion of reverse rewriting for deriving the query over the ontology that best describes the data service, given the ontology and the mapping. *(3)* It can be shown that the concept of reverse rewriting is also useful for a semantic-based approach to source profiling [1], in particular for describing the structure and the content of a data source in terms of the business vocabulary.

The goal of this paper is to provide a brief account of both direct and reverse rewritings in data interoperability, focusing in particular on OBDM. The plan of the paper is as follows: in Sect. 2 we describe the basic characteristics of the OBDM paradigm, in Sects. 3 and 4 we discuss the notions of direct and reverse rewriting, respectively, and in Sect. 5 we conclude the paper by illustrating some possible directions for the research on reverse rewriting.

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