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# Beyond Databases, Architectures and Structures


Facing the Challenges of Data Proliferation  
and Growing Variety


14th International Conference, BDAS 2018  
Held at the 24th IFIP World Computer Congress, WCC 2018  
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Proceedings


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# Preface

Collecting, processing, and analyzing data have become important branches of computer science. Many areas of our existence generate a wealth of information that must be stored in a structured manner and processed appropriately in order to permit the extraction of knowledge. Databases have become a ubiquitous way of collecting and storing data. They are used to hold data describing many areas of human life and activity, and as a consequence, they are also present in almost every IT system. Today's databases have to face the problem of data proliferation and growing variety. Increasingly efficient methods for data processing are needed more than ever. New areas of interest that deliver data require innovative algorithms for data analysis.

Beyond Databases, Architectures, and Structures (BDAS) constitutes a series of conferences located in Central Europe that are very important for this geographic region. The conference intends to present the state of the art of the research that satisfies the needs of modern, widely-used database systems, architectures, models, structures, and algorithms focused on processing various types of data. The aim of the conference is to reflect the most recent developments of databases and allied techniques used for solving problems in a variety of areas related to database systems, or even to go one step forward – beyond the horizon of existing databases, architectures, and data structures.

The 14th International BDAS Scientific Conference (BDAS 2018), held in Poznan Poland during September 18–20, 2018, was a continuation of the highly successful BDAS conference series started in 2005. This edition of the BDAS conference was organized within the IFIP World Computer Congress (IFIP WCC 2018), which took place in Poznan, Poland during September 17–21, 2018. Over the years, BDAS has attracted thousands of researchers and professionals working in the field of databases. Among the attendees of our conference have been scientists and representatives of IT companies. Several editions of BDAS were supported by our commercial, world-renowned partners, developing solutions for the database domain, such as IBM, Microsoft, Sybase, Oracle, and others.

BDAS annual meetings have become an arena for exchanging information on widely-used database systems and data processing algorithms. BDAS 2018 was the 14th conference in the series, organized under the technical co-sponsorship of the International Federation for Information Processing (IFIP) and the IEEE Poland Section. We also continued our successful cooperation with Springer, which resulted in the publication of this book.

The conference attracted participants from 15 different countries, who made this conference a successful and memorable event. There were several keynote and invited talks given during IFIP WCC and BDAS by leading scientists. The keynote speeches, tutorials and plenary sessions allowed participants to gain insight into new areas of data analysis and data processing.

BDAS focuses on all aspects of databases. It is intended to have a broad scope, including different kinds of data acquisition, processing, and storing, and this book reflects fairly well the large span of research presented at BDAS 2018.

This volume consists of 38 carefully selected papers that have been assigned to 6 thematic groups:

- Big Data and Cloud Computing
- Architectures, Structures and Algorithms for Efficient Data Processing
- Artificial Intelligence, Data Mining and Knowledge Discovery
- Text Mining, Natural Language Processing, Ontologies and the Semantic Web
- Image Analysis and Multimedia Mining
- Data Mining Applications

The first group, containing four papers, is devoted to Big Data and Cloud Computing. Papers in this group discuss the hot topics of using Spark and Hadoop big data frameworks in the identification of entities and their representation in the digital world and in solving problems related to scalable and cloud-supported processing of various types of biological and biomedical data, and streaming data from production lines. The second group contains eight papers devoted to various database architectures and models, data structures, and algorithms used for efficient data processing. Papers in this group discuss the effectiveness of query execution, performances, and the consistency of various database systems, including relational and NoSQL databases, new data models for data warehouses, and various techniques for parallel and distributed data processing. The third group contains six papers devoted to various methods used in data mining, knowledge discovery, and knowledge representation. Papers assembled in this group show a wide spectrum of applications of various exploration techniques, including decision rules, knowledge-based systems, clustering, and classification algorithms, to solve many real problems. The fourth group consists of five papers devoted to natural language processing, text mining, ontologies, and the Semantic Web. These papers discuss problems of Semantic Web services matchmaking with the use of ontologies, knowledge maintenance for synonym-set definitions, semantic metadata reconciliation, and extensive text searching in JSON documents and relational databases. The fifth group includes seven papers elaborating different aspects of image segmentation, compression, reconstruction, and recognition. The last group consists of eight papers covering issues connected with various applications of data mining in industry (such as the motor or wind power industries), networking, or human identification. We hope that the broad scope of topics related to databases covered in this proceedings volume will help the reader to understand that databases have become an important element of nearly every branch of computer science.

We would like to thank all Program Committee members and additional reviewers for their effort in reviewing the papers. Special thanks to Piotr Kuźniacki, builder and, for the past 14 years, administrator of our website [bdas.polsl.pl](http://bdas.polsl.pl), and Paweł Benecki,

new member of our team and copyeditor of this book. The conference organization would not have been possible without the technical staff: Dorota Huget and Jacek Pietraszuk.

June 2018

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