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Database and Expert Systems Applications

32nd International Conference, DEXA 2021
Virtual Event, September 27–30, 2021
Proceedings, Part I

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Preface

The volume at hand represents the result of joint efforts of contributing researchers, reviewers, and organizers, and contains the papers presented at the 32nd International Conference on Database and Expert Systems Applications (DEXA 2021). This year, DEXA was held for the second time as a virtual conference during September 27–30, 2021, instead of in Linz, Austria, as originally planned. The decision to organize another virtual version of DEXA was driven by the intention to provide stable conditions for all DEXA participants and set a good example in temporarily suspending on-site meetings. We put our trust in the loyalty of DEXA community and look forward to personal DEXA meetings in 2022.

We are proud to report that authors from 43 different countries submitted papers to DEXA this year. The number of submissions was similar to those of the past few years. Our Program Committee conducted more than 500 reviews. We would like to sincerely thank our Program Committee members for their rigorous and critical, and at the same time motivating, reviews of these submissions. Based on the total number of accepted papers, we can report that the acceptance rate this year was 27%, a rate comparable to DEXA conferences of the last few years.

The conference program this year covered a wide range of important topics such as data management and analytics; consistency; integrity; quality of data; data analysis and data modeling; data mining; databases and data management; information retrieval; prediction and decision support; authenticity, privacy, security, and trust; cloud databases and workflows; data and information processing; knowledge discovery; machine learning; semantic web and ontologies; stream data processing; and temporal, spatial, and high dimensional databases.

We tried to follow our on-site face-to-face format. Thus, the authors of the accepted papers presented their research online using video conference software over four days. Presentations were performed live in 12 different thematic clusters structured as 15 sessions, each one with an assigned session chair. The scientific presentations, discussions, and question-and-answer time were all live and part of each session. As we were aware of time difference issues, for example, for participants from Australia or South American countries having to present or participate during unusual times of the day, we tried to minimize this inconvenience.

We would like to express our gratitude to the distinguished keynote speakers for illuminating us on their leading-edge topics: Elisa Bertino (Purdue University, USA) for her talk on “Privacy in the Era of Big Data, Machine Learning, IoT, and 5G”, Amit Sheth (University of South Carolina, USA) for his talk on the third wave of AI, and Torben Bach Pedersen (Aalborg University, Denmark) for his talk on “Extreme-Scale Model-Based Time Series Management with ModelarDB”.

In addition, we had a panel discussion on “Big Minds Sharing their Vision on the Future of AI” led by Bernhard Moser (SCCH, Austria), with Battista Biggio (University of Cagliari, Italy), Claudia Diaz (Katholieke Universiteit Leuven,

Belgium), Heiko Paulheim (University of Mannheim, Germany), and Olga Saukh (Complexity Science Hub, Austria).

As is the tradition of DEXA, all accepted papers were published in "Lecture Notes in Computer Science" (LNCS) and made available by Springer. Authors of selected papers presented at the conference will be invited to submit substantially extended versions of their conference papers for publication in special issues of international journals. The submitted extended versions will undergo a further review process.

The 32nd edition of DEXA featured six international workshops – three established ones and three brand-new ones – covering a variety of specific topics:

- The 12th International Workshop on Biological Knowledge Discovery from Data (BIOKDD 2021)
- The 5th International Workshop on Cyber-Security and Functional Safety in Cyber-Physical Systems (IWCFS 2021)
- The 3rd International Workshop on Machine Learning and Knowledge Graphs (MLKgraphs 2021)
- The 1st International Workshop on Artificial Intelligence for Clean, Affordable, and Reliable Energy Supply (AI-CARES 2021)
- The 1st International Workshop on Time Ordered Data (ProTime2021)
- The 1st International Workshop on AI System Engineering: Math, Modelling, and Software (AISys2021)

The success of the conference is due to the continuous and generous support of its participants and their relentless efforts. Our sincere thanks go to the dedicated authors, renowned Program Committee members, session chairs, organizing and steering committee members, and student volunteers who worked tirelessly to ensure the continuity and high quality of DEXA 2021.

We would also like to express our thanks to all institutions actively supporting this event, namely:

- Institute of Telekooperation, Johannes Kepler University Linz (JKU), Austria
- Software Competence Center Hagenberg (SCCH), Austria
- Web Applications Society (@WAS)

We hope you have enjoyed the conference! We are looking forward to seeing you again next year.

September 2021 Christine Strauss

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Abstracts of Keynote Talks

Privacy in the Era of Big Data, Machine Learning, IoT, and 5G

Elisa Bertino

Samuel Conte Professor of Computer Science, Cyber2SLab, Director,
CS Department, Purdue University, West Lafayette, Indiana, USA

Abstract. Technological advances, such as IoT devices, cyber-physical systems, smart mobile devices, data analytics, social networks, and increased communication capabilities are making possible to capture and to quickly process and analyze huge amounts of data from which to extract information critical for many critical tasks, such as healthcare and cyber security. In the area of cyber security, such tasks include user authentication, access control, anomaly detection, user monitoring, and protection from insider threat. By analyzing and integrating data collected on the Internet and the Web one can identify connections and relationships among individuals that may in turn help with homeland protection. By collecting and mining data concerning user travels, contacts and disease outbreaks one can predict disease spreading across geographical areas. And those are just a few examples. The use of data for those tasks raises however major privacy concerns. Collected data, even if anonymized by removing identifiers such as names or social security numbers, when linked with other data may lead to re-identify the individuals to which specific data items are related to. Also, as organizations, such as governmental agencies, often need to collaborate on security tasks, data sets are exchanged across different organizations, resulting in these data sets being available to many different parties. Privacy breaches may occur at different layers and components in our interconnected systems. In this talk, I first present an interesting privacy attack that exploits paging occasion in 5G cellular networks and possible defenses. Such attack shows that achieving privacy is challenging and there is no unique technique that one can use; rather one must combine different techniques depending also on the intended use of data. Examples of these techniques and their applications are presented. Finally, I discuss the notion of data transparency – critical when dealing with user sensitive data, and elaborate on the different dimensions of data transparency.

Don't Handicap AI without Explicit Knowledge

Amit Sheth

University of South Carolina, USA

Abstract. Knowledge representation as expert system rules or using frames and variety of logics, played a key role in capturing explicit knowledge during the hay days of AI in the past century. Such knowledge, aligned with planning and reasoning are part of what we refer to as Symbolic AI. The resurgent AI of this century in the form of Statistical AI has benefitted from massive data and computing. On some tasks, deep learning methods have even exceeded human performance levels. This gave the false sense that data alone is enough, and explicit knowledge is not needed. But as we start chasing machine intelligence that is comparable with human intelligence, there is an increasing realization that we cannot do without explicit knowledge. Neuroscience (role of long-term memory, strong interactions between different specialized regions of data on tasks such as multimodal sensing), cognitive science (bottom brain versus top brain, perception versus cognition), brain-inspired computing, behavioral economics (system 1 versus system 2), and other disciplines point to need for furthering AI to neuro-symbolic AI (i.e., hybrid of Statistical AI and Symbolic AI, also referred to as the third wave of AI). As we make this progress, the role of explicit knowledge becomes more evident. I will specifically look at our endeavor to support human-like intelligence, our desire for AI systems to interact with humans naturally, and our need to explain the path and reasons for AI systems' workings. Nevertheless, the variety of knowledge needed to support understanding and intelligence is varied and complex. Using the example of progressing from NLP to NLU, I will demonstrate the dimensions of explicit knowledge, which may include, linguistic, language syntax, common sense, general (world model), specialized (e.g., geographic), and domain-specific (e.g., mental health) knowledge. I will also argue that despite this complexity, such knowledge can be scalability created and maintained (even dynamically or continually). Finally, I will describe our work on knowledge-infused learning as an example strategy for fusing statistical and symbolic AI in a variety of ways.

Extreme-Scale Model-Based Time Series Management with ModelarDB

Torben Bach Pedersen

Aalborg University, Denmark

Abstract. To monitor critical industrial devices such as wind turbines, high quality sensors sampled at a high frequency are increasingly used. Current technology does not handle these extreme-scale time series well, so only simple aggregates are traditionally stored, removing outliers and fluctuations that could indicate problems. As a remedy, we present a model-based approach for managing extreme-scale time series that approximates the time series values using mathematical functions (models) and stores only model coefficients rather than data values. Compression is done both for individual time series and for correlated groups of time series. The keynote will present concepts, techniques, and algorithms from model-based time series management and our implementation of these in the open source Time Series Management System (TSMS) ModelarDB. Furthermore, it will present our experimental evaluation of ModelarDB on extreme-scale real-world time series, which shows that that compared to widely used Big Data formats, ModelarDB provides up to 14x faster ingestion due to high compression, 113x better compression due to its adaptability, 573x faster aggregation by using models, and close to linear scale-out scalability.

Big Minds Sharing their Vision on the Future of AI (Panel)

Panelists

Battista Biggio, University of Cagliari, Italy
Claudia Diaz, Katholieke Universiteit Leuven, Belgium
Heiko Paulheim, University Mannheim, Germany
Olga Saukh, Complexity Science Hub, Austria

Moderator

Bernhard Moser, Software Competence Center Hagenberg and Austrian Society for Artificial Intelligence, Austria

Abstract. While we are currently mainly talking about narrow AI systems, in the future, neural networks will increasingly be combined with graph-based and symbolic-logical approaches (3rd wave of AI).

How will this technological trend affect the key issues of security such as integrity protection or privacy protection, and environmental impact? In this context, in this interactive panel discussion, technology experts will discuss current and envisioned challenges to AI from the research perspective of their respective fields.

Contents – Part I

Information Retrieval

Prediction and Decision Support

Contents – Part II

Knowledge Discovery

Machine Learning