# **Lecture Notes in Computer Science**

# 12731

# Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

#### **Editorial Board Members**

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this subseries at http://www.springer.com/series/7409

Ruben Verborgh · Katja Hose · Heiko Paulheim · Pierre-Antoine Champin · Maria Maleshkova · Oscar Corcho · Petar Ristoski · Mehwish Alam (Eds.)

# The Semantic Web

18th International Conference, ESWC 2021 Virtual Event, June 6–10, 2021 Proceedings



Editors
Ruben Verborgh

Ghent University
Ghent, Belgium

Heiko Paulheim

University of Mannheim

Mannheim, Germany

Maria Maleshkova

University of Siegen
Siegen, Germany

Petar Ristoski 
Bay Inc.
San Jose, CA, USA

Katja Hose (b) Aalborg University Aalborg, Denmark

Pierre-Antoine Champin D ERCIM

Sophia Antipolis, France

Oscar Corcho 
Universidad Politécnica de Madrid
Boadilla del Monte, Spain

Mehwish Alam

FIZ Karlsruhe - Leibniz Institute
for Information Infrastructure
Eggenstein-Leopoldshafen, Germany

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-030-77384-7 ISBN 978-3-030-77385-4 (eBook) https://doi.org/10.1007/978-3-030-77385-4

LNCS Sublibrary: SL3 - Information Systems and Applications, incl. Internet/Web, and HCI

#### © Springer Nature Switzerland AG 2021, corrected publication 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

#### **Preface**

What does it mean to have a conference in these strange times? Semantic drift is biting us once again. The word "conference" has its roots in Latin, where it means bringing things together. If there is one thing we cannot do yet, it is bringing people together.

While we have become moderately good at online meetings and virtual gatherings of all kinds, we still have not found an adequate replacement for a coffee break. The power of spontaneous interactions is immense; undoubtedly, some of the best collaborations in our field have started over coffee — or liquids with similar cohesive abilities — in Crete.

However, "to confer" also means to have discussions and exchange opinions. We believe that dialogue is one of the most important aspects of a healthy research community, and we have made it one of our goals to see how we can further drive such conversations. The results of several of those exchanges can be found in these proceedings, and in the echoes of this year's online conference, which surely will have planted new seeds for the exciting times to come once the world opens up again.

Since these times bring great changes, we took the opportunity to introduce a few more novelties for the 18th edition of the European Semantic Web Conference (ESWC 2021). While the world was closing down, we decided to make the reviewing process more open and switch from the well-established, closed Easychair platform to OpenReview. As a result, the submissions, reviews, and discussions for all papers are now available to the public, moving the paper decisions away from back room discussions to provide a transparent process.

Moreover, some new research track topics were proposed. Two of the more experimental ones are "replication studies", which gives a strong case for analyzing whether research efforts stand the test of time, and "problems to solve before you die", which aims to shift the focus from sometimes very specific solutions for particular problems to a wider research agenda. Moreover, for the first time, "negative result" submissions were invited across all tracks, which garnered particularly good feedback.

Overall, the research track attracted 121 submissions of which 30 were ultimately accepted, with a third undergoing a shepherding process, yielding an acceptance rate of 24.8%. It is particularly remarkable that the acceptance rate for negative results papers was comparable to the overall acceptance rate, which shows that reporting negative results is actually appreciated by the research community.

In the research track, most contributions were submitted to the knowledge graph track, while tracks such as (i) NLP and information retrieval, (ii) matching, integration, and fusion, (iii) data dynamics, quality, and trust, and (iv) ontologies and reasoning also attracted significant numbers of contributions. Moreover, we observed some emerging topics: not quite surprisingly, knowledge graph embeddings were a hot topic among the accepted papers, but there were also enough submissions on autonomous driving to fill a dedicated session in the program.

The resources track attracted a total of 36 submissions, 11 of which were accepted. The track demonstrated very well that the community is not only producing theoretical research but also datasets and artifacts that can be reused by researchers and practitioners. Finally, the in-use track attracted 10 submissions, 2 of which were finally accepted for presentation at the conference. Both the resources and the in-use track demonstrated that the field is clearly moving towards adoption of the developed methods on a large scale and in real projects.

With its 18th edition, ESCW 2021 has officially stepped into adulthood, and it clearly shows in the vibrant and active community. An event like ESWC, be it offline or online, is never the outcome of the work of a few people but an effort that takes a lot of hands. Overall, ESWC 2021 had 23 people on the organization team, plus 20 track chairs for the various topical areas of the research track. 240 reviewers produced a total of 545 reviews, many of them signing with their name and thereby making the review process more transparent. We would like to give a big shout-out to everybody in this community who lent a hand to help - ESWC would not be the same without your contribution! Moreover, we would like to thank STI, OpenReview, and Springer for their support. We finally would like to thank our sponsors for supporting ESWC 2021.

Here's to meeting you all in person for a Greek salad and raki, while making new memories.

April 2021

Ruben Verborgh Katja Hose Heiko Paulheim Pierre-Antoine Champin Maria Maleshkova Oscar Corcho Petar Ristoski Mehwish Alam

# Organization

**General Chair** 

Ruben Verborgh Ghent University, Belgium

**Program Chairs** 

Katja Hose Aalborg University, Denmark Heiko Paulheim University of Mannheim, Germany

**In-Use Chairs** 

Oscar Corcho Universidad Politécnica de Madrid, Spain

Petar Ristoski IBM Research, USA

**Resources Chairs** 

Pierre-Antoine Champin Université Claude Bernard Lyon 1, France

Maria Maleshkova University of Bonn, Germany

**Digital Conference Chairs** 

Violeta Ilik Adelphi University Libraries, USA

Christian Hauschke Leibniz Information Center for Science and

Technology, University Library (TIB), Germany

**Workshop and Tutorial Chairs** 

Femke Ongenae Ghent University, Belgium Riccardo Tommasini University of Tartu, Estonia

**Posters and Demo Chairs** 

Anastasia Dimou Ghent University, Belgium

Aidan Hogan Universidad de Chile and IMFD, Chile

**PhD Chairs** 

Ilaria Tiddi Vrije Universiteit Amsterdam, the Netherlands

Claudia d'Amato University of Bari, Italy

#### Track Chairs

Simon Mayer University of St. Gallen, Switzerland

Arne Bröring Siemens AG, Germany

### **Sponsors Chair**

Daniele Dell'Aglio Aalborg University, Denmark

Christian Dirschl Wolters Kluwer Deutschland GmbH, Germany

### **Project Networking Chair**

Alexandra Garatzogianni Leibniz Information Center for Science and

Technology, University Library (TIB), Germany

# Web and Publicity Chair

Cogan Shimizu Kansas State University, USA

Semantic Chair

François Scharffe Columbia University, USA

## **Proceedings Chair**

Mehwish Alam FIZ Karlsruhe - Leibniz Institute for Information

Infrastructure and Karlsruhe Institute

of Technology, Germany

#### **Subtrack Chairs**

#### **Ontologies and Reasoning**

Cogan Shimizu Kansas State University, USA

Jacopo Urbani Vrije Universiteit Amsterdam, the Netherlands

**Knowledge Graphs** 

Marta Sabou TU Wien, Austria

Axel Polleres Vienna University of Economics and Business, Austria

#### Semantic Data Management, Querying and Distributed Data

Maribel Acosta Ruhr-University Bochum, Germany Hala Skaf-Moli LS2N and University of Nantes, France

Organization

#### Data Dynamics, Quality, and Trust

Emanuele Della Valle Politecnico di Milano, Italy

Anisa Rula University of Milano-Bicocca, Italy

#### Matching, Integration, and Fusion

Catia Pesquita LASIGE and Universidade de Lisboa, Portugal Ernesto Jimenez-Ruiz City, University of London, UK, and University

of Oslo, Norway

#### **NLP** and Information Retrieval

Klaus Berberich Saarland University of Applied Sciences, Germany

Ziqi Zhang University of Sheffield, UK

#### Machine Learning

Michael Cochez Vrije Universiteit Amsterdam, the Netherlands

Daria Stepanova Bosch Center for AI, Germany

#### Science Data and Scholarly Communication

Andrea Giovanni Nuzzolese National Research Council, Italy Rafael Gonçalves Stanford University, USA

Randor Conquires Stanford Chryototty, C.

#### Problems to Solve Before You Die

Harald Sack FIZ Kalrsruhe - Leibniz Institute for Information

Infrastructure and Karlsruhe Institute

of Technology, Germany

Frank van Harmelen Vrije Universiteit Amsterdam, the Netherlands

# **Program Committee**

Aaron Eberhart Kansas State University, USA Achim Rettinger Trier University, Germany Adam Funk University of Sheffield, UK Adila Krisnadhi Universitas Indonesia, Indonesia Saarland University, Germany Aditya Mogadala Universidad Adolfo Ibáñez, Chile Adrian Soto Suarez Adrian Brasoveanu Modul Technology GmbH, Austria Aidan Hogan DCC, Universidad de Chile, Chile Alasdair Gray Heriot-Watt University, UK Alessandra Russo Imperial College London, UK

Alessandro Adamou Bibliotheca Hertziana - Max Planck Institute

for Art History, Italy

Alessandro Faraotti Sapienza University of Rome, Italy
Alsayed Algergawy University of Jena, Germany
Anastasia Dimou Ghent University, Belgium

#### Organization

X

Andrea Pomp University of Wuppertal, Germany

Andrea G. B. Tettamanzi University of Nice Sophia Antipolis, France Karlsruhe Institute of Technology, Germany

Andreea Iana

Andriy Nikolov

Angelo Salatino

Anisa Rula

Antoine Isaac

Antoine Zimmermann

University of Mannheim, Germany

KMI - Open University, UK

KMI - Open University, UK

University of Bonn, Germany

University of Innsbruck, Austria

Europeana, the Netherlands

Mines Saint-Etienne, France

Arkaitz Zubiaga Queen Mary University London, UK
Armando Stellato University of Rome Tor Vergata, Italy
Armin Haller Australian National University, Australia
Audun Stolpe Norwegian Computing Center, Norway

Baris Sertkaya Frankfurt University of Applied Sciences, Germany

Blake Regalia University of California, USA
Blerina Spahiu University of Milan-Bicocca, Italy
Carlos Bobed Lisbona Universidad de Zaragoza, Spain

Carlos Buil-Aranda Universidad Técnica Federico Santa María, Chile

Carole Goble University of Manchester, UK
Carolina Scarton University of Sheffield, UK

Cassia Trojahn Institut de Recherche en Informatique de Toulouse,

France

Catherine Faron University of Cote d'Azur, France

Catherine Roussey INRAE, France

Catia Pesquita Universidade de Lisboa, Lisbon Cedric Pruski Paris Sud University, France

Christoph Lange RWTH Aachen University, Germany University of New Brunswick, Canada

Claudia d'Amato

Claudia Marinica

Cord Wiljes

Dag Hovland

Dagmar Gromann

University of Bari, Italy
Polytech Nantes, France
Bielefeld University, Germany
University of Oslo, Norway
University of Vienna, Austria

Danh Le Phuoc TU Berlin, Germany Daniel Faria INESC-ID, Portugal Daniel Garijo USC/ISI, USA

Daniela Oliveira University of Lisbon, Portugal
Davide Buscaldi École Polytechnique, France
Dennis Diefenbach Jean Monnet University, France
Diego Moussallem Paderborn University, Germany

Dimitris Plexousakis FORTH-ICS, Greece

Domagoj Vrgoc Pontificia Universidad Católica de Chile, Chile Dominic Seyler University of Illinois Urbana-Champaign, USA

Edna Ruckhaus Magnus Universidad Simón Bolívar, Venezuela

Eero Hyvonen University of Helsinki, Finland

Elena Demidova University of Bonn, Germany Elena Simperl King's College London, UK

Emanuel Sallinger TU Wien, Vienna

Enrico Daga KMI - Open University, UK
Eva Blomqvist Linköping University, Sweden
Fabian M. Suchanek Telecom ParisTech, France
Fabio Vitali University of Bologna, Italy

Fajar J. Ekaputra TU Wien, Austria

Fatiha Saïs Paris Saclay University, France

Felix Sasaki Technische Hochschule Brandenburg, Germany

Fernando Bobillo Universidad de Zaragoza, Spain

Filip Ilievski USC/ISI, USA

Flavius Frasincar Erasmus University Rotterdam, the Netherlands Fouad Zablith American University of Beirut, Lebanon

Francesca Alessandra Lisi University of Bari, Italy

Francesco Corcoglioniti Free University of Bozen-Bolzano, Italy

Francesco Osborne KMI - Open University, UK

Francisco Martin-Recuerda Universidad Politécnica de Madrid, Spain

Frederique Laforest INSA Lyon, France

Gayo Diallo University of Bordeaux, France

Gengchen Maigeng UC Santa Barbara, USA

Georg Rehm Deutsches Forschungszentrum für Künstliche

Intelligenz, Germany

George Papadakis University of Athens, Greece Georgeta Bordea University of Bordeaux, France

Gerardo Simari Universidad Nacional del Sur, Argentina

Gerd Stumme Universität Kassel, Germany

Gerhard Wohlgenannt Vienna University of Economics and Business, Austria

Gezim Sejdiu University of Bonn, Germany

Ghislain Atemezing Mondeca, France

Gianluca Demartini University of Queensland, Australia Giuseppe Pirrò Sapienza University of Rome, Italy

Giuseppe Rizzo LINKS Foundation, Italy Gong Cheng Nanjing University, China

Gregory Todd Williams Rensselaer Polytechnic Institute, USA

Guangyuan Piao National University of Ireland, Maynooth, Ireland

Guohui Xiao Free University of Bozen-Bolzano, Italy Hajira Jabeen University of Cologne, Germany Hala Skaf-Molli University of Nantes, France

Hamada M. Zahera Paderborn University

Hanna Ćwiek-Kupczyńska Polish Academy of Sciences, Poland

Harald Sack Karlsruhe Institute of Technology, Germany

Haridimos Kondylakis FORTH, Greece

Harshvardhan J. Pandit
Henry Rosales-Méndez
Universidad de Chile, Chile
KAUST, Saudi Arabia

Ilaria Tiddi Vrije Universiteit Amsterdam, the Netherlands

Inah Omoronyia University of Glasgow, UK

Cefriel, Italy Irene Celino

Ismini Lourentzou Virginia Tech, USA

Fondazione Bruno Kessler, Italy Ivan Donadello

Jürgen Umbrich Vienna University of Economics and Business, Austria Javier D. Fernandez Vienna University of Economics and Business, Austria University of Applied Sciences and Arts Western Jean-Paul Calbimonte

Switzerland, Switzerland

Jerome David University of Grenoble-Alpes, France

Jesualdo Tomas Universidad de Murcia, Spain

Fernandez-Breis

Jetzabel Serna-Olvera Goethe University, Germany

Guangdong University of Foreign Studies, China Jianfeng Du

University of Oxford, UK Jiaoyan Chen

University of Illinois Urbana-Champaign, USA Jodi Schneider Joe Raad Vrije Universiteit Amsterdam, the Netherlands

University of Sheffield, UK Johann Petrak

Johann Wanja Schaible GESIS - Leibniz Institute for the Social Sciences,

Huawei Technologies Ltd., Ireland

Germany expert.ai, Spain

Jose Manuel Gomez-Perez

Jose Mora

Josiane Xavier Parreira Siemens Corporate Research, Austria

Pontificia Universidad Católica de Chile, Chile Juan L Reutter data.world, USA

Juan Sequeda

Carnegie Mellon University, USA Jun Ma

Kavitha Srinivas IBM Research, USA

Kewen Wang Griffith University, Australia

Kjetil Kjernsmo Inrupt Inc., Norway

Kody Moodley Maastricht University, the Netherlands

Konstantin Schekotihin Alpen-Adria University of Klagenfurt, Austria

Konstantin Todorov University of Montpellier, France

Krzysztof Janowicz UC Santa Barbara, USA

Lars Gleim RWTH Aachen University, Germany

University of Claude Bernard Lyon 1, France Lionel Medini

Fondazione Bruno Kessler, Italy Loris Bozzato

Ludger van Elst German Research Center for AI, Germany

Lukas Schmelzeisen University of Stuttgart, Germany

Manolis Koubarakis National and Kapodistrian University of Athens,

Greece

Manuel Atencia University of Grenoble-Alpes, France

University of Malaga, Spain Maria del Mar

Roldon-Garcia

Maria Poveda-Villalon Universidad Politécnica de Madrid, Spain

Marc Spaniol Caen University, France Marco Luca Sbodio IBM Research, Ireland

Maria Angela Pellegrino University of Salerno, Italy

Maria Koutraki L3S, Germany

Mariano Fernandez-Lopez Universidad CEU San Pablo, Spain

Marieke van Erp KNAW Humanities Cluster, the Netherlands

Martin G. Skjæveland University of Stavanger, Norway

Martin Theobald University of Luxembourg, Luxembourg

Matteo Palmonari University of Milan-Bicocca, Italy

Matthias Klusch German Research Center for AI, Germany

Maulik Kamdar Stanford University, USA
Maurizio Atzori University of Cagliari, Italy
Mauro Dragoni University of Trento, Italy
Maxime Lefrancois Mines Saint-Etienne, France

Mayank Kejriwal USC/ISI, USA

Mehwish Alam FIZ Karlsruhe - Leibniz Institute for Infrastructure,

Germany

Michael Cochez

Miguel A. Martinez-Prieto

Milan Dojchinovski

Muhammad Saleem

Mustafa Jarrar

Nadine Steinmetz

VU Amsterdam, the Netherlands
University of Valladolid, Spain
Leipzig University, Germany
Leipzig University, Germany
Birzeit University, Palestine
TU Ilmenau, Germany

Nandana IBM, USA

Mihindukulasooriya

Naouel Karam Fraunhofer FOKUS, Germany Natanael Arndt Leipzig University, Germany

Nathalie Aussenac-Gilles CNRS, France Nathalie Hernandez IRIT, France

Nathalie Pernelle University Sorbonne Paris Nord, France

Natthawut Kertkeidkachorn National Institute of Advanced Industrial Science

and Technology, Japan

Nicolas Heist University of Mannheim, Germany

Oana Inel Delft University of Technology, the Netherlands

Olaf Hartig Linköping University, Sweden
Oliver Lehmberg University of Mannheim, Germany
Olivier Corby University Cote d'Azur, France

Ondej Zamazal Prague University of Economics and Business,

Czech Republic

Oscar Corcho Universidad Politécnica de Madrid
Panos Alexopoulos Textkernel, the Netherlands
Pascal Hitzler Kansas State University, USA
Pascal Molli University of Nantes, France

Paul Groth University of Amsterdam, the Netherlands

Pavel Shvaiko University of Trento, Italy Pavlos Fafalios ICS-FORTH, Greece

Petar Ristoski eBay, USA

Peter Bloem Vrije Universiteit Amsterdam, the Netherlands

Pierre-Antoine Champin ERCIM, France

Rafael Berlanga Universitat Jaume I, Spain Rafael S. Goncalves Stanford University, USA

Raghava Mutharaju Indraprastha Institute of Information Technology, India

Ralf Krestel Hasso Plattner Institute, Germany

Raphael Troncy Eurecom, France

Ricardo Usbeck Fraunhofer IAIS, Germany Riccardo Tommasini University of Tartu, Estonia

Rigo Wenning ERCIM, France

Rinke Hoekstra Elsevier, the Netherlands
Roghaiyeh Gachpaz Hamed
Roman Kontchakov Elsevier, the Netherlands
Trinity College Dublin, Ireland
Birkbeck, University of London, UK

Ruben Taelman Ghent University, Belgium Rui Zhu UC Santa Barbara, USA

Ruijie Wang University of Illinois Urbana-Champaign, USA Russa Biswas Karlsruhe Institute of Technology, Germany Ryutaro Ichise National Institute of Informatics, Japan

Sabrina Kirrane Vienna University of Economics and Business, Austria

Sahar Vahdati Leipzig University, Germany

Sebastian Neumaier University of Applied Sciences St. Pölten, Austria

Sebastian Richard Bader
Sebastian Tramp
Sebastijan Dumancic
Serena Villata

Fraunhofer IAIS, Germany
eccenca GmbH, Germany
KU Leuven, Belgium
CNRS, France

Sergio José Rodríguez Australian National University, Australia

Méndez

Simon Gottschalk Leibniz University of Hannover, Germany
Simon Razniewski Max Planck Institute for Informatics, Germany

Simon Steyskal Vienna University of Economics and Business, Austria

Simona Colucci Politecnico di Bari, Italy

Songmao Zhang Academy of Mathematics and Systems Science,

Chinese Academy of Sciences, China

Stasinos Konstantopoulos
Stefan Dietze
Steffen Staab
Sven Hertling

NCSR Demokritos, Greece
GESIS and HHU, Germany
University of Stuttgart, Germany
University of Mannheim, Germany

Tassilo Pellegrini University of Applied Sciences St. Pölten, Austria Tobias Kaefer Karlsruhe Institute of Technology, Germany

Tobias Weller University of Mannheim, Germany

Tomi Kauppinen Aalto University, Finland Torsten Hahmann University of Maine, USA

Umberto Straccia ISTI-CNR, Italy

Vadim Ermolayev Zaporizhzhia National University, Ukraine

Valentina Anita Carriero

Valentina Presutti

Varish Mulwad

University of Bologna, Italy
University of Bologna, Italy
General Electric, USA

Victor de Boer Vinh Nguyen Wei Hu Wolfgang Faber Xander Wilcke Xingyi Song Ying Ding Yuan-Fang Li Ziqi Zhang Vrije Universiteit Amsterdam, the Netherlands U.S. National Library of Medicine, USA

Nanjing University, China

Alpen-Adria University of Klagenfurt, Austria Vrije Universiteit Amsterdam, the Netherlands

University of Sheffield, UK

University of Texas at Austin, USA

Monash University, Australia University of Sheffield, UK

### **Sponsors**

#### **Platinum**



#### Silver



#### **Bronze**





#### Supporter



# **Contents**

| Ontologies and Reasoning   |     |
|--|-----|
| Streaming Partitioning of RDF Graphs for Datalog Reasoning   | 3   |
| Parallelised ABox Reasoning and Query Answering with Expressive  Description Logics  | 23  |
| Analysing Large Inconsistent Knowledge Graphs Using Anti-patterns  | 40  |
| Processing SPARQL Property Path Queries Online with Web Preemption<br>Julien Aimonier-Davat, Hala Skaf-Molli, and Pascal Molli                             | 57  |
| Ontology-Based Map Data Quality Assurance  | 73  |
| Knowledge Graphs (Understanding, Creating, and Exploiting)   |     |
| Applying Grammar-Based Compression to RDF  | 93  |
| HDT Bitmap Triple Indices for Efficient RDF Data Exploration   | 109 |
| Programming and Debugging with Semantically Lifted States Eduard Kamburjan, Vidar Norstein Klungre, Rudolf Schlatte, Einar Broch Johnsen, and Martin Giese | 126 |
| Do Embeddings Actually Capture Knowledge Graph Semantics? Nitisha Jain, Jan-Christoph Kalo, Wolf-Tilo Balke, and Ralf Krestel                              | 143 |
| A Semantic Framework to Support AI System Accountability and Audit Iman Naja, Milan Markovic, Peter Edwards, and Caitlin Cottrill                          | 160 |
| Semantic Data Management, Querying and Distributed Data  |     |
| Comparison Table Generation from Knowledge Bases   | 179 |

| Incremental Schema Discovery at Scale for RDF Data  | 195 |
|---|-----|
| HTTP Extensions for the Management of Highly Dynamic Data Resources                         | 212 |
| Lars Gleim, Liam Tirpitz, and Stefan Decker   |     |
| Expressibility of OWL Axioms with Patterns  | 230 |
| Data Dynamics, Quality, and Trust   |     |
| Refining Transitive and Pseudo-Transitive Relations at Web Scale                            | 249 |
| Data Reliability and Trustworthiness Through Digital Transmission                           |     |
| Contracts   | 265 |
| Matching, Integration, and Fusion   |     |
| Neural Knowledge Base Repairs   | 287 |
| Natural Language Inference over Tables: Enabling Explainable Data                           |     |
| Exploration on Data Lakes   | 304 |
| NLP and Information Retrieval   |     |
| Grounding Dialogue Systems via Knowledge Graph Aware Decoding with Pre-trained Transformers | 323 |
| Debanjan Chaudhuri, Md Rashad Al Hasan Rony, and Jens Lehmann                               |     |
| WEB-SOBA: Word Embeddings-Based Semi-automatic Ontology Building                            |     |
| for Aspect-Based Sentiment Classification   | 340 |
| Context Transformer with Stacked Pointer Networks for Conversational                        |     |
| Question Answering over Knowledge Graphs  | 356 |

| Neural Multi-hop Reasoning with Logical Rules on Biomedical   |     |
|---|-----|
| Knowledge Graphs  | 375 |
| Augmenting Ontology Alignment by Semantic Embedding and Distant Supervision   | 392 |
| Convolutional Complex Knowledge Graph Embeddings  | 409 |
| RETRA: Recurrent Transformers for Learning Temporally Contextualized Knowledge Graph Embeddings   | 425 |
| Injecting Background Knowledge into Embedding Models for Predictive Tasks on Knowledge Graphs   | 441 |
| Science Data and Scholarly Communication  |     |
| Structured Semantic Modeling of Scientific Citation Intents   | 461 |
| Discovering Research Hypotheses in Social Science Using Knowledge Graph Embeddings  | 477 |
| Problems to Solve Before You Die  |     |
| Towards a Linked Open Code  | 497 |
| A Polyvocal and Contextualised Semantic Web   | 506 |
| Resources   |     |
| The WASABI Dataset: Cultural, Lyrics and Audio Analysis Metadata About 2 Million Popular Commercially Released Songs  Michel Buffa, Elena Cabrio, Michael Fell, Fabien Gandon, Alain Giboin, Romain Hennequin, Franck Michel, Johan Pauwels, Guillaume Pellerin, Maroua Tikat, and Marco Winckler | 515 |

**Machine Learning** 

| RuBQ 2.0: An Innovated Russian Question Answering Dataset  | 532 |
|--|-----|
| A Knowledge Organization System for the United Nations Sustainable Development Goals   | 548 |
| RSP4J: An API for RDF Stream Processing  | 565 |
| WasmTree: Web Assembly for the Semantic Web  | 582 |
| ParaQA: A Question Answering Dataset with Paraphrase Responses for Single-Turn Conversation  | 598 |
| kgbench: A Collection of Knowledge Graph Datasets for Evaluating Relational and Multimodal Machine Learning  Peter Bloem, Xander Wilcke, Lucas van Berkel, and Victor de Boer  | 614 |
| The SLOGERT Framework for Automated Log Knowledge Graph Construction   | 631 |
| P2P-O: A Purchase-To-Pay Ontology for Enabling Semantic Invoices Michael Schulze, Markus Schröder, Christian Jilek, Torsten Albers, Heiko Maus, and Andreas Dengel   | 647 |
| KOBE: Cloud-Native Open Benchmarking Engine for Federated Query Processors  Charalampos Kostopoulos, Giannis Mouchakis, Antonis Troumpoukis, Nefeli Prokopaki-Kostopoulou, Angelos Charalambidis, and Stasinos Konstantopoulos | 664 |
| CSKG: The CommonSense Knowledge Graph  | 680 |
| In-Use Track   |     |
| A Knowledge Graph-Based Approach for Situation Comprehension in Driving Scenarios  | 699 |

| Contents   | xxi |
|--|-----|
| Pay-as-you-go Population of an Automotive Signal Knowledge Graph Yulia Svetashova, Lars Heling, Stefan Schmid, and Maribel Acosta                  | 717 |
| Correction to: A Semantic Framework to Support AI System Accountability and Audit.  Iman Naja, Milan Markovic, Peter Edwards, and Caitlin Cottrill | C1  |
| Author Index   | 737 |