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The Semantic Web

14th International Conference, ESWC 2017
Portorož, Slovenia, May 28 – June 1, 2017
Proceedings, Part I

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Preface

This volume contains the main proceedings of the ESWC 2017 conference. The ESWC conference is established as a yearly major venue for discussing the latest scientific results and technology innovations related to the Semantic Web and linked data. At ESWC, international scientists, industry specialists, and practitioners meet to discuss the future of applicable, scalable, user-friendly, as well as potentially game-changing solutions. This 14th edition took place from May 28 to June 1, 2017, in Portorož (Slovenia). Building on its past success, ESWC is also a venue for broadening the focus of the Semantic Web community to span other relevant research areas in which semantics and Web technology plays an important role. Thus, the chairs of ESWC 2017 organized two special tracks putting particular emphasis on usage areas where Semantic Web technologies are facilitating a leap of progress, namely: “Multilinguality” and “Semantic Web and Transparency.”

Emerging from its roots in AI and Web technology, the Semantic Web today is mainly a Web of linked data, upon which a plethora of services and applications for all possible domains are being proposed. Some of the core challenges that the Semantic Web aims at addressing are the heterogeneity of content and its volatile and rapidly changing nature, its uncertainty, provenance, and varying quality. This in combination with more traditional disciplines — such as logical modelling and reasoning, natural language processing, databases and data storage and access, machine learning, distributed systems, information retrieval and data mining, social networks, Web science and Web engineering — shows the span of topics covered by this conference. The nine regular tracks, in combination with an in-use and applications track, and the two special tracks, constituted the main technical program of ESWC 2017.

The program also included three exciting invited keynotes. Lora Aroyo (Professor Human Computer Interaction Vrije Universiteit Amsterdam, The Netherlands, and Visiting Professor at Columbia University in the City of New York, USA) focused on the notion of ambiguity, discussing how ambiguity can be captured and even taken advantage of by capturing the diversity of interpretations. In particular, she discussed how to capture this diversity and how to allow machines to deal with it. Kevin Crosbie (Chief Product Officer, RavenPack) discussed the role of semantic intelligence in financial markets. In particular, he focused on the challenges of turning unstructured content into structured data, given that many new kinds of alternative data (social media, satellite imagery, etc.) are being used to complement traditional data for use in predictive modelling for financial trading algorithms. John Sheridan (Digital Director, The National Archives) discussed the use and benefits of Semantic Web technologies for digital archiving, in particular for managing heterogeneous metadata, dealing with uncertainty, and in areas such as provenance and trust.

The main scientific program of the conference comprised 51 papers: 40 research and 11 in-use and application papers, selected out of 183 reviewed submissions, which corresponds to an acceptance rate of 25% for the research papers submitted and 52%

for the in-use papers. A special thanks goes to our process improvement chair, Derek Doran, who helped us establish an improved quality assurance process during the paper selection, ensuring the originality and quality of the research papers that were accepted to the conference. This program was completed by a demonstration and poster session, in which researchers had the chance to present their latest results and advances in the form of live demos. In addition, the PhD Symposium program included ten contributions, selected out of 14 submissions.

This year's edition of ESWC's main scientific program presented a significant number of research papers with a focus on solving typical Semantic Web problems, such as entity linking, discoverability, etc., by using methods and techniques from areas such as machine learning and natural language processing, and reflecting in particular the current interest in deep learning. Work on both the fundamental development and use of Semantic Web technologies in relation to transparency is particularly interesting in view of current governmental and institutional open data initiatives.

The conference program also offered 12 workshops, six tutorials, and an EU Project Networking session. This year, an open call also allowed us to select and support five challenges. These associated events create an even more open, multidisciplinary, and cross-fertilizing environment at the conference, allowing for work-in-progress and practical results to be discussed. Workshops ranged from domain-focused topics, including the biomedical, scientific publishing, e-science, robotics, distributed ledgers, and scholarly fields, to more technology-focused topics ranging from RDF stream processing, query processing, data quality and data evolution, to sentiment analysis and semantic deep learning. Tutorial topics spanned NLP, ontology engineering, and linked data, including specific tutorials on knowledge graphs and rule-based processing of data. Proceedings from these satellite events are available in a separate volume.

The General and Program Committee chairs would like to thank the many people who were involved in making ESWC 2017 a success. First of all, our thanks go to the 24 track chairs and 360 reviewers, including 49 external reviewers, for ensuring a rigorous blind review process that led to an excellent scientific program and an average of four reviews per article. The scientific program was completed by an exciting selection of posters and demos chaired by Katja Hose and Heiko Paulheim.

Special thanks go to the PhD symposium chairs, Rinke Hoekstra and Pascal Hitzler, who managed one of the key events at ESWC, the PhD symposium. The brilliant PhD students will become the future leaders of our field, and deserve both encouragement and mentoring, which Rinke and Pascal made sure we could provide. We also had a great selection of workshops and tutorials, as mentioned earlier, thanks to the commitment of our workshop chairs, Agnieszka Ławrynowicz and Fabio Ciravegna, and tutorial chairs, Anna Lisa Gentile and Sebastian Rudolph.

Thanks to our EU Project Networking session chairs, Lyndon Nixon and Maria Maleshkova, we had the opportunity to facilitate meetings and exciting discussions between leading European research projects. Networking and sharing ideas between projects is a crucial success factor for such large research projects.

We are additionally grateful for the work and commitment of Monika Solanki, Mauro Dragoni, and all the individual challenges chairs, who successfully established a challenge track. The five challenges provided researchers and practitioners with the opportunity to compare their latest solutions in these challenge areas, ranging from

topic-focused tasks such as question answering and semantic sentiment analysis, to practical tasks such as storage, semantic publishing, and open knowledge extraction.

We thank STI International for supporting the conference organization, and particularly Alexander Wahler as the conference treasurer. YouVivo GmbH deserve special thanks for the professional support of the conference organization, and for solving all practical matters. Our local chair Marko Grobelnik also deserves a special thanks for selecting the venue and for, together with his local organizers, Marija Kokelj, Monika Krojež, and Spela Sitar, arranging a great on-site experience for our conference attendees.

Further, we are very grateful to Ruben Verborgh, our publicity chair, who kept our community informed throughout the year, and Venislav Georgiev, who administered the website. Of course we also thank our sponsors, listed on the next pages, for their vital support of this edition of ESWC. We would like to stress the great work achieved by the Semantic Technologies coordinators Lionel Medini and Luigi Asprino, who maintained and updated our ESWC mobile app and published our conference dataset. A special thanks also to our proceedings chair, Olaf Hartig, who did an excellent job in preparing this volume with the kind support of Springer.

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Abstract of Keynotes

Bringing Semantic Intelligence to Financial Markets

Kevin Crosbie

RavenPack, New York, US

Abstract. The most successful hedge-funds in today's financial markets are consuming large amounts of alternative data, including satellite imagery, point-of-sale data, news, social media and publications from the web. This new trend is driven by the fact that traditional factors have become less predictive in recent years, requiring sophisticated investors to explore new data sources. The majority of this new alternative content is unstructured and hence must first be converted into structured analytics data in order to be used systematically. Instead of building such capabilities themselves, financial firms are turning towards companies that specialize in this field. In this talk, Kevin will discuss some of the practical challenges of giving structure to unstructured content, how entities and ontologies may be used to link data and the ways in which semantic intelligence can be derived for use in financial trading algorithms.

Disrupting the Semantic Comfort Zone

Lora Aroyo^{1,2}

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Abstract. Ambiguity in interpreting signs is not a new idea, yet the vast majority of research in machine interpretation of signals such as speech, language, images, video, audio, etc., tend to ignore ambiguity. This is evidenced by the fact that metrics for quality of machine understanding rely on a ground truth, in which each instance (a sentence, a photo, a sound clip, etc) is assigned a discrete label, or set of labels, and the machine's prediction for that instance is compared to the label to determine if it is correct. This determination yields the familiar precision, recall, accuracy, and f-measure metrics, but clearly presupposes that this determination can be made. CrowdTruth is a form of collective intelligence based on a vector representation that accommodates diverse interpretation perspectives and encourages human annotators to disagree with each other, in order to expose latent elements such as ambiguity and worker quality. In other words, CrowdTruth assumes that when annotators disagree on how to label an example, it is because the example is ambiguous, the worker isn't doing the right thing, or the task itself is not clear. In previous work on CrowdTruth, the focus was on how the disagreement signals from low quality workers and from unclear tasks can be isolated. Recently, we observed that disagreement can also signal ambiguity. The basic hypothesis is that, if workers disagree on the correct label for an example, then it will be more difficult for a machine to classify that example. The elaborate data analysis to determine if the source of the disagreement is ambiguity supports our intuition that low clarity signals ambiguity, while high clarity sentences quite obviously express one or more of the target relations. In this talk I will share the experiences and lessons learned on the path to understanding diversity in human interpretation and the ways to capture it as ground truth to enable machines to deal with such diversity.

Keywords: Ambiguity · Crowdsourcing · Disagreement · Diversity · Perspectives · Opinions · Machine-crowd computation · Crowdsourcing ground truth

Semantic Web Technologies for Digital Archives

John Sheridan

The National Archives, Kew, UK

Abstract. What will people in the future know of today? As the homes for our collective memory archives have a special role to play. Semantic Web technologies address some important needs for digital archives and are being ever more embraced by the archival community.

Archives face a big challenge. The use of digital technologies has profoundly shaped what types of record are created, captured, shared and made available. Digital records are not just documents or email but all sorts of content such as websites, threaded discussions, video, websites, structured datasets and even computer code. Yet, in the digital era, when so much is encoded as 0s and 1s there is no long term solution to the challenge of preservation. All archives can do is make the institutional commitment to continue to invest, through generations of technological change, in the engineering effort required for records to continue to be available.

The National Archives is one of the world's leading digital archives. Our Digital Records Infrastructure, which makes extensive use of RDF and SPARQL, is capable of safely, securely and actively preserving large quantities of data. Our Web Archive provides a comprehensive record of government on the web. We also lead the maintenance of a register of file format signatures that is used relied on by archives and other memory institutions around the world.

As a digital archive we provide value by preserving digital records, keeping them safe for the future. We maintain the context for the records so their evidential value can be understood in the context of their creation and continuing use. We produce records so that they are available for others to access, and we also enable use.

Semantic Web technologies play a key role in each of these areas and are integral to our approach for preserving, contextualising, presenting and enable use of digital records. This presentation will explain why and how we have used semantic web technologies for digital archiving and the benefits we have seen, for managing heterogeneous metadata and also in areas such a provenance and trust. It will explore new opportunities for archives from using Semantic Web technologies in particular around contextual description, with digital records increasingly contextualising each other. This is part of a shift to a more fluid approach where context grows with an archives collection and in relation to other collections. Finally it will also look at the challenges for archives with using Semantic Web technologies in particular around how best to manage uncertainty in our data as we increasingly use probabilistic approaches.

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