Fourth Knowledge-aware and Conversational Recommender Systems Workshop (KaRS)

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ABSTRACT

In the last few years, a renewed interest of the research community in conversational recommender systems (CRSs) has been emerging. This is likely due to the massive proliferation of Digital Assistants (DAs) such as Amazon Alexa, Siri, or Google Assistant that are revolutionizing the way users interact with machines. DAs allow users to execute a wide range of actions through an interaction mostly based on natural language utterances. However, although DAs are able to complete tasks such as sending texts, making phone calls, or playing songs, they still remain at an early stage in terms of their recommendation capabilities via a conversation. In addition, we have been witnessing the advent of increasingly precise and powerful recommendation algorithms and techniques able to effectively assess users' tastes and predict information that may be of interest to them. Most of these approaches rely on the collaborative paradigm (often exploiting machine learning techniques) and neglect the huge amount of knowledge, both structured and unstructured, describing the domain of interest of a recommendation engine. Although very effective in predicting relevant items, collaborative approaches miss some very interesting features that go beyond the accuracy of results and move in the direction of providing novel and diverse results as well as generating explanations for recommended items. Knowledge-aware side information becomes crucial when a conversational interaction is implemented, in particular for preference elicitation, explanation, and critiquing steps.

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CCS CONCEPTS

• **Information systems** → **Recommender systems**; **Semantic web description languages**; • **Computing methodologies** → **Natural language processing**.

KEYWORDS

Recommender systems, Knowledge Graphs, Natural Language Processing, Conversational Agents, Semantic Web, Knowledge Representation

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1 WORKSHOP DESCRIPTION

Recommender systems are becoming part of our daily life in many and diverse situations. Nevertheless, they start showing their limits in the tight interaction with human users [25]. During the last years, owing in part to the new wave of deep learning approaches, a plethora of data-driven algorithms have been proposed that seek to identify latent connections among users and items [4, 20]. Despite their excellent results in terms of accuracy in recommending new items, such approaches very often miss a fundamental actor in the loop: the end-user. For this reason, current research is focusing on new challenges such as privacy [3], emotion awareness [30], and new paradigms such as federated learning [6, 7]. The exploitation of the knowledge about the domain of interest of a catalog via automated reasoning as well as critiquing approaches are very common in the normal behavior of a human user, but they are not well codified in recommendation engine behaviors. Knowledge-based

approaches began to appear two decades ago [10, 11, 14, 19, 37]. Nonetheless, they became more widely used with the advent of the Linking Open Data[1] initiative when a huge number of knowledge-graphs started being released and were made freely available. These include encyclopedic datasets such as DBpedia[2] and Wikidata[3], where semantics-aware information is available on different knowledge domains and applications [5]. The exploitation of such datasets together with their ontologies is at the basis of many approaches to recommendation and challenges proposed in the last years such as Knowledge Graph embeddings [16, 26–28, 40], hybrid recommendation [11, 13], link prediction [15, 16, 21, 29, 32, 33, 35], knowledge transfer [20], interpretable recommendation [11, 12, 36], and user modeling [8, 17, 18, 34]. Successful workshops and international conferences in the last few years (ISWC, ACM Recommender Systems, UMAP, AAAI, ECAI, IJCAI, SIGIR) show the growing interest and research potential of these systems.

Furthermore, this side information associated with items becomes crucial when the interaction requires content features. This is the case of Conversational Recommender Systems (CRSs) [41]. CRSs are characterized by a multi-turn dialogue between the user and the system [24] and are exploited in several domains [31]. Note that "conversational" as defined here, is not restricted to CRSs that conduct dialogues in natural language. A CRS might converse in natural language, but it may allow more constrained modes of user interaction as well [23]. This kind of interaction introduces new challenges, since it blurs the difference between recommendation and retrieval. A CRS ought to be able to exploit both short- and long-term preferences, for example. Furthermore, a CRS should be able to adapt its behaviour in a timely manner when user feedback is provided. These are just some peculiarities of this kind of interaction. As we can imagine, another sensitive issue is the evaluation of CRSs [39], since also in this case we need to go beyond simple accuracy metrics. The limited availability of datasets is an additional obstacle to the evaluation of these systems [22]. While research and development into CRSs has never gone away, it has certainly been less prominent for a while. Only recently has the literature on this topic been growing again quite notably [24].

1.1 Objectives

The *Fourth Knowledge-aware and Conversational Recommender Systems* (KaRS) Workshop focuses on all aspects related to the exploitation of external and explicit knowledge sources to feed and build a recommendation engine, and on the adoption of interactions based on the conversational paradigm. The aim is to go beyond the traditional accuracy goal [25] and to start a new generation of algorithms and approaches with the help of the methodological diversity embodied in fields such as Machine Learning (ML), Human–Computer Interaction (HCI), Information Retrieval (IR), and Information Systems (IS). Hence, the focus lies on research improving the user experience and following goals such as user engagement and satisfaction or customer value as has also been advocated by Zanker et al. [38]. The aim of this fourth edition of KaRS [1, 9] is to bring together researchers and practitioners around the topics of designing and evaluating novel approaches for recommender systems in order to (i) share research and techniques, including new design technologies, (ii) identify next key challenges in the area, (iii) identify emerging topics in the field. The workshop aims to establish an interdisciplinary community with a focus on the exploitation of (semi-)structured knowledge and conversational approaches for recommender systems and promoting collaboration opportunities.

1.2 Topics

Topics of interest include, but are not limited to:

- **Models and Feature Engineering**: Data models based on structured knowledge sources (e.g., Linked Open Data, Wikidata, BabelNet, etc.), Semantics-aware approaches exploiting the analysis of textual sources (e.g., Wikipedia, Social Web, etc.), Knowledge-aware user modeling, Methodological aspects (evaluation protocols, metrics, and datasets), Logic-based modeling of a recommendation process, Knowledge Representation and Automated Reasoning for recommendation engines, Deep learning methods to model semantic features
- **Beyond-Accuracy Recommendation Quality**: Using knowledge bases and knowledge graphs to increase recommendation quality (e.g., in terms of novelty, diversity, serendipity, or explainability), Explainable Recommender Systems, Knowledge-aware explanations (compliant with the General Data Protection Regulation)
- **Online Studies**: Knowledge sources for cross-lingual recommendations, Applications of knowledge-aware recommenders (e.g., music or news recommendation, off-mainstream application areas), User studies (e.g., on the user's perception of knowledge-based recommendations), field studies
- **Design of a Conversational Agent**: Design and implementation methodologies, Dialogue management (end-to-end, dialogue-state-tracker models), UX design, Dialogue protocol design
- **User Modeling and Interfaces**: Critiquing and user's feedback exploitation, Short- and Long-term user profiling and modeling, Preference elicitation, Natural language, multimodal, and voice-based interfaces, Next-question problem
- **Methodological and Theoretical aspects**: Evaluation and metrics, Datasets, Theoretical aspects of conversational recommender systems

2 RELATED WORKSHOPS

In this section, we briefly review the recent workshops (WSs) related to Knoweldge-aware and Conversational Systems.

- **1st, 2nd, and 3rd International Workshop on Knowledge-aware and Conversational Recommender Systems**[4]. These are the previous editions of the WS [1, 2, 9].
- **3rd International Workshop on EntitY Retrieval and lEarning (EYRE 2020 @ CIKM)**[5] This WS is focused on Entity Retrieval, which is substantially different from Recommender System. They are slightly related because also in EYRE structured data are exploited for Information Retrieval tasks.

[1] http://linkeddata.org
[2] https://dbpedia.org
[3] https://wikidata.org

[4] https://kars-workshop.github.io/2018/, https://kars-workshop.github.io/2019/, https://kars-workshop.github.io/2021/
[5] https://sites.google.com/view/eyre20/home

- **3rd International Workshop on ExplainAble Recommendation and Search (EARS 2020 @ SIGIR)**[6] This WS is based on explainable recommendations. However, the focus is different because we promote the adoption of structured knowledge, and we cover also different topics as Conversational agents.
- **Joint Workshop on Bibliometric-enhanced Information Retrieval and Natural Language Processing for Digital Libraries (BIRDNL 2019)**[7] The focus of this WS is on Digital Libraries. Structured knowledge and Information Retrieval are promoted, but the audience is not from Recommender Systems or Conversational Agents fields.
- **1st Workshop on Conversational Interaction Systems (WCIS 2019)**[8] This WS is only focused on Conversational Agents. In details, they focus more on speech recognition, spoken language understanding, language generation, and multi-modal question answering communities.
- **2nd International Workshop on Deep Learning on Graphs: Methods and Applications (DLG 2020 @ KDD)**[9] The WS is related since they promote the adoption of deep learning techniques on graphs. However, Recommender systems, Conversational Agents and representations different from graphs are not considered.
- **Deep Learning for Knowledge Graphs (DL4KG 2020 @ ESWC)**[10] This WS is related because they promote the adoption of deep learning techniques on graphs. However, Recommender systems and knowledge representations different from graphs are not considered.
- **6th Semantic Deep Learning (SemDeep-6 @ IJCAI-PRICAI 2020)**[11] The WS promote the adoption of Deep Learning techniques together with semantics. The focus of the WS is basically on (semi-automated) ontology learning, ontology alignment, ontology annotation, duplicate recognition, ontology prediction, knowledge base completion, relation extraction, and semantically grounded inference, which are topics that are very different from ours.
- **Explainable User Models and Personalized Systems (ExUM 2020 @ UMAP)**[12] The WS focuses on Transparent Personalization Methods based on Heterogeneous and Personal Data. They cover the explainability of user modeling. However, Recommender Systems, Conversational Agents and structured knowledge representation are not considered.

3 PROGRAM COMMITTEE

The members of the Program Committee of KaRS 2022 are: **Aris Anagnostopoulos** (Sapienza University of Rome), **Vito Walter Anelli** (Politecnico di Bari), **Marco Angelini** (Sapienza University of Rome), **Pierpaolo Basile** (Dipartimento di Informatica - University of Bari), **Roberto Basili** (Dept. of Enterprise Engineering - Univ. of Roma Tor Vergata), **Alejandro Bellogin** (Universidad Autonoma de Madrid), **Ludovico Boratto** (University of Cagliari), **Eric Charton** (Banque Nationale du Canada), **Giandomenico Cornacchia** (Politecnico di Bari), **Fabio Crestani** (Università della Svizzera Italiana) (USI), **Danilo Croce** (Dept. of Enterprise Engineering - Univ. of Roma Tor Vergata), **Marco de Gemmis** (University of Bari Aldo Moro, Dept. of Computer Science), **Tommaso Di Noia** (Politecnico di Bari), **Davide Di Ruscio** (Università degli Studi dell'Aquila), **Fabrizio Falchi** (ISTI-CNR), **Antonio Ferrara** (Politecnico di Bari), **Maurizio Ferrari Dacrema** (Politecnico di Milano), **Andrea Iovine** (Università degli Studi di Bari Aldo Moro), **Dietmar Jannach** (University of Klagenfurt), **Daniele Malitesta** (Polytechnic University of Bari), **Rubén Francisco Manrique** (Universidad de los Andes), **Olga Marino** (Universidad de los Andes), **David Massimo** (Free University of Bolzano), **Franco Maria Nardini** (ISTI-CNR), **Fedelucio Narducci** (Politecnico di Bari), **Raffaele Perego** (ISTI-CNR), **Marco Polignano** (Università degli Studi di Bari Aldo Moro), **Claudio Pomo** (Politecnico di Bari), **Yongli Ren** (RMIT University), **Gaetano Rossiello** (IBM Research AI), **Pablo Sánchez** (Universidad Autónoma de Madrid), **Giovanni Semeraro** (University of Bari), **Damiano Spina** (RMIT University), **Alain Starke** (Wageningen University & Research)

[6] https://ears2020.github.io/
[7] http://www.sigir.org/sigir2019/program/workshops/birdnl/
[8] https://sites.google.com/view/wcis/home
[9] https://deep-learning-graphs.bitbucket.io/dlg-kdd20/
[10] https://alammehwish.github.io/dl4kg_eswc_2020/
[11] https://www.dfki.de/~declerck/semdeep-6/
[12] https://um.org/umap2020/attending/workshops-and-tutorials/

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