WSDM 2021 Tutorial on Conversational Recommendation Systems

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ABSTRACT

Recent years have witnessed the emerging of conversational systems, including both physical devices and mobile-based applications. Both the research community and industry believe that conversational systems will have a major impact on human-computer interaction, and specifically, the IR/DM/RecSys communities have begun to explore Conversational Recommendation Systems. Conversational recommendation aims at finding or recommending the most relevant information (e.g., web pages, answers, movies, products) for users based on textual- or spoken-dialogs, through which users can communicate with the system more efficiently using natural language conversations. Due to users' constant need to look for information to support both work and daily life, conversational recommendation system will be one of the key techniques towards an intelligent web. The tutorial focuses on the foundations and algorithms for conversational recommendation, as well as their applications in real-world systems such as search engine, e-commerce and social networks. The tutorial aims at introducing and communicating conversational recommendation methods to the community, as well as gathering researchers and practitioners interested in this research direction for discussions, idea communications, and research promotions.

CCS CONCEPTS

• **Information systems** → **Recommender systems**; • **Computing methodologies** → **Natural language processing**;

KEYWORDS

Conversational Recommendation; Dialog Systems

1 INTRODUCTION

Among many techniques that compose an intelligent Web, a Conversational System (such as Google Now, Apple Siri, Microsoft

Cortana, and Amazon Alexa) is one that serves as the direct interactive portal for end-users, which is expected to revolutionize human-computer interaction. With recent progress on NLP and Internet of Things (IoT), such systems have also been deployed as physical devices, opening up more opportunities for applications in smart environments. Under this background, Conversational Recommendation System (CRS) has become an important direction to bridge conversational agents and personalized services [20, 29].

Though as an emerging research direction, the basic idea of conversational recommendation has been a core consideration for researchers in the field, from early-stage interactive collaborative filtering methods to assist cold-start users, to later reinforcement learning approaches for modeling user-dialog states, and to more recent deep learning and natural language processing approaches to conversational recommendation [1–3, 13, 19, 20, 23, 28, 29, 31–34].

This tutorial will introduce conversational recommendation from five main perspectives – dataset, method, evaluation, toolkit, and real-world systems. In particular:

Dataset: We introduce current datasets that facilitate conversational recommendation research including three types of existing datasets: fully-synthetic, semi-synthetic, and real-world datasets. Due to their difference in conversational pattern and data scale, different datasets facilitate different types of conversational recommendation research, and we introduce the differences and how to make best use of the datasets in detail. The problem definition of conversational recommendation also highly relies on the datasets and conversational pattern, as a result, we also formalize and introduce the problem definition of conversational recommendation in this part of the tutorial.

Method: In this part of the tutorial, we organize and introduce current methods and algorithms for conversational recommendation. We introduce both algorithmic approaches and user-analysis approaches to conversational recommendation. In particular, we carefully organize existing approaches into a two-dimensional taxonomy. One dimension is conversation paradigm, which can be either system-leading or user-leading. The second dimension is the method for conversation strategies. In this dimension, we first introduce early-stage interactive collaborative filtering methods, and then introduce more recent conversational recommendation approaches in terms of two broad types: dialog-state tracking and natural language understanding, which constitutes two important ingredients of practical conversational recommendation systems.

Evaluation: We introduce both offline and online evaluation methods for conversational recommendation. Evaluation methods can be different according to different conversation paradigms. In system-leading conversations, we introduce evaluation methods for question prediction, conversation efficiency, and recommendation accuracy. In user-leading conversations, we introduce evaluation methods for response accuracy and conversation efficiency. A scope

of important research exists in user-analysis and evaluation for conversational recommendation systems, and we also introduce these researches to facilitate better user-oriented evaluation of conversational recommendation systems.

Toolkit: We introduce existing open-source toolkits and platforms to facilitate conversational recommendation research, such as the Microsoft Conversational AI tools and bot builder SDK. This part of the tutorial includes a hands-on demo about quick building of a working conversational recommender system, so as to help attendees to gain hands-on experience in this research domain.

Real-world systems: Finally, we introduce conversational recommendation in current real-world conversational AI systems in industry, including but not limited to Google Assistant, Amazon Alexa, and Microsoft Cortana. In this part of the tutorial, we also introduce the programming interfaces supported in these systems to help attendees understand how to integrate their conversational recommendation methods into the systems.

Based on the above rich set of materials, this tutorial will greatly help researchers from both academia and industry who are interested in conversational recommendation.

2 THE TUTORIAL TEAM

Dr. Yongfeng Zhang and his group have been consistently working on conversational recommendation systems. Together with co-authors, their work on conversational recommendation [29] provided a standard System Ask–User Respond (SAUR) paradigm for conversational search and recommendation. The paradigm has helped researchers and practitioners to push the frontier in the field for different conversational search and recommendation scenarios. Their other research on conversational recommendation and information seeking includes [2, 14–18, 25–27]. Senior PhD students Zuohui Fu and Yikun Xian have been working on knowledge-graph reasoning approaches to conversational recommendation. A selected subset of their recent publications include [4–12, 21, 22, 24, 30]. Dr. Yi Zhang is a pioneer in conversational recommendation research. Her paper on conversational recommendation [20] is one of the first papers on dialog state controlling for conversational recommender systems, which inspired a sequence of research on this problem. Her experience as the CTO of a Conversational AI tech-company Rulai Inc.[1] further enhances the tutorial by providing hands-on industry experiences to our audiences.

3 BRIEF BIO OF ORGANIZERS

Zuohui Fu[2] is a Ph.D. student in the Department of Computer Science at Rutgers University, jointly advised by Prof. Yongfeng Zhang and Prof. Gerard de Melo. His research interests focus on solving the cutting-edge research problems over Information Retrieval, Natural Language Processing and Machine Learning, with the emphasis on semantic matching, dialogue systems, and decision making over knowledge graphs, etc. His recent research mainly aims at KG-assisted explainable, fair and conversational recommender system. His works have appeared in premier IR and artificial intelligence

conferences including AAAI, SIGIR, WWW, IJCAI, ACL, etc. Besides, he has served as the conference PC member in NeurIPS, AAAI, ACL, EMNLP, CIKM, etc., and the journal reviewer for ACM TOIS, etc. He has presented the Conversational Recommendation tutorial on RecSys 2020.

Yikun Xian[3] is a Ph.D. student at the Department of Computer Science of Rutgers University, jointly advised by Prof. Yongfeng Zhang and Prof. Shan Muthukrishnan. His research interest broadly lies in the intersection of information retrieval and machine learning. His recent research include graph-based explainable decision-making problems with applications to explainable recommendation, knowledge-enhanced and explainable conversational recommendation, as well as interpretable comparative shopping. He mainly develops machine learning techniques such as graph-based reasoning, neural symbolic reasoning and deep reinforcement learning for information retrieval and recommender systems. He has served as PC member/reviewer in top computer science conference/journals such as NeurIPS, EMNLP, CIKM, SIGIR, ECML-PKDD, WWW, ECIR, RecSys, and ACM TOIS. He has presented the Conversational Recommendation tutorial on RecSys 2020.

Yongfeng Zhang[4] is an Assistant Professor in the Department of Computer Science at Rutgers University (The State University of New Jersey). His research interest is in Information Retrieval, Recommender Systems, Machine Learning, and Internet Economics. In the previous he was a postdoc in the Center for Intelligent Information Retrieval (CIIR) at UMass Amherst, and did his PhD and BE in Computer Science at Tsinghua University, with a BS in Economics at Peking Univeristy. He is a Siebel Scholar of the class 2015, and a Baidu Scholar of the class 2014. He has been consistently working on conversational recommendation, explainable recommendation, and the intersection between the two subjects. His recent work on conversational recommendation models includes learning to ask for conversational recommendation, explainable conversational recommendation, and knowledge-enhanced conversational recommendation. He has presented the WWW2019/SIGIR2019/ICTIR2019 Tutorial on Explainable Recommendation and Search, and the RecSys 2020 Tutorial on Conversational Recommendation.

Yi Zhang[5] is a professor in the School of Engineering, University of California Santa Cruz. Her research interests include large scale information retrieval, recommendation systems, internet advertising, data mining, natural language processing, and applied machine learning. She has published chapters, journal articles, and papers at top conferences in these areas, such ACM SIGIR, WWW, CIKM, IEEE ICDM, ICML, COLINGS, HLT. She received NSF Faculty Early Career Award in 2010, an Air Force Research Young Investigator Award in 2008, the Best Paper Award at ACM SIGIR in 2002, and several other awards. Her Information Retrieval and Knowledge Management Lab is doing research sponsored by several government agencies and companies (Microsoft, Yahoo, Google, NEC, Bosch, Nokia etc.). She has served as a consultant or technical advisor for companies. She regularly serves on the program committees

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of the very best conferences in her research areas. She has served as area chair or senior PC member at ACM SIGIR, EMNLP, and ACM Recommender Systems. She has served as conference co-chair in charge of Information Retrieval area at the ACM Conference on Information and Knowledge Management, and tutorial chair for ACM SIGIR. She is serving as an associate editor for ACM Transaction on Information Systems. Dr. Zhang received her Ph.D. from School of Computer Science at CMU, specializing in Language and Information Technologies. She has presented the Conversational Recommendation tutorial on RecSys 2020.

4 FORMAT AND INTERACTION STYLES

The tutorial is delivered as a full tutorial (3 hours plus break). One and a half hours for the dataset and method section with QA, and another 1.5 hour for the evaluation, toolkit and real-world system section with QA. At the end of the tutorial, we aggregate and wrap up different conversational methods, together with a final QA session, so as to encourage idea dissemination and research communication among the audiences.

5 AUDIENCE

The tutorial mainly targets on information retrieval, data mining and especially recommendation system researchers and practitioners. Since we also introduce how recent NLP and Knowledge base techniques will help conversational recommendation, it is also relevant to NLP, Semantic, and Knowledge researchers. Since we also introduce how conversational recommendation are applied in commercial real-world systems such as e-commerce, search engine, and social networks, it is also helpful to industry researchers and practitioners from different areas. For prerequisite, basic understandings of information retrieval and recommendation system knowledge will be preferred, but the tutorial will introduce the basic concepts for better audience engagement.

6 TUTORIAL MATERIALS

Tutorial materials such as the slides and video recordings are provided on the tutorial website (http://conversational-recsys.github.io) to the audiences and the general public.

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