Fairness-Aware Question Answering for Intelligent Assistants

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Abstract

Voice-based question-answering (QA) systems (e.g., Alexa, Siri, ChatGPT) are increasingly relied upon by diverse users, including individuals with visual impairments, low literacy, and the elderly, across domains such as healthcare, workplaces, and hands-free environments. As reliance on such voice-based QA systems grows across these user populations and applications, the shift away from traditional list-based search interfaces introduces new challenges, particularly in how information is presented.

While such systems are effective at delivering concise, fact-based answers, this mode of information presentation often limits exposure to multiple perspectives, thereby reinforcing biases that can shape user perceptions, preferences, and broader societal attitudes. This limitation is particularly consequential for stakeholders such as policymakers, healthcare professionals, and researchers, who rely on balanced and diverse information to support informed decision-making. Accordingly, this dissertation examines fairness in multi-perspective rankings within top-heavy voice-based QA systems, focusing on the ranking stage, where disproportionate exposure of perspectives can substantially influence user understanding and downstream decisions.

To this end, the dissertation introduces methods for estimating fairness in rankings under both single-attribute and multi-attribute settings, empirically distinguishes fairness from diversity, and adopts a multidimensional framework for evaluating and mitigating biases in ranked outputs to promote balanced representation of perspectives. Additionally, it synthesises insights from conversational search, information science, psychology, cognitive science, and acoustics to characterise relevant resources and experimental settings, and to identify new research directions for investigating user biases in voice-based QA systems, thereby advancing fairness-aware QA for intelligent assistants.

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Selected Publications

Sachin Pathiyan Cherumanal, Damiano Spina, Falk Scholer, and W. Bruce Croft. Evaluating Fairness in Argument Retrieval. In *Proceedings of the 30th ACM International Conference on Information & Knowledge Management*, CIKM '21, page 3363–3367, New York, NY, USA, 2021. Association for Computing Machinery. ISBN 9781450384469. doi: 10.1145/3459637.3482099. URL https://doi.org/10.1145/3459637.3482099.

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