IIS: Interactive Information Retrieval via Robust Reinforcement Learning

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Overview

Interactive Information Retrieval (IIR) has recently attracted considerable attention due to its wide range of applications, such as sequential recommendation and conversational search. Compared to the traditional information retrieval paradigm, IIR focuses on the interaction between the user and the system and can be viewed as a sequential decision-making problem. However, there are still large gaps between IIR problem and their sequential decision-making solutions, including mathematical modeling of user's behavior, robustness and adaptation to distribution shift across environments and trustworthiness concerns. In this project, we propose to investigate solutions of IIR via robust reinforcement learning approaches. This project consists of three major research thrusts. First, we propose a unified user behavior modeling in ranking problems via Markov Decision Process, and then develop off-policy reinforcement learning solutions adapting to distribution shifts between online and offline environments. Second, we will study the adversarial robustness of IIR, and propose robust algorithms detecting and tolerant malicious behaviors. Third, we will further generalize the user modeling where users are considered behaving strategically, and study decision-making in IIR from a game-theoretic view. The successful outcome of this project will lead to advances in providing theoretical understandings and practical algorithms for IIR.

Intellectual Merit

We propose to study the novel and significant advances in the intersection of information retrieval and machine learning. The project will systematically study a challenging and important problem of developing next-generation solutions for interactive information retrieval, including but not limited to modeling users behavior via Markov Decision Process, new algorithm that adapts to distribution shifts in offline data, understanding adversarial robustness of IIR, and studying decision-making in IIR from a game-theoretic view. The success of this project will result in a new class of theoretical analysis and practical algorithms serving next-generation search engine and other information retrieval systems.

Broader Impacts

The project will develop new on-policy and off-policy robust reinforcement learning algorithms for interactive information retrieval and understand their theoretical property, thereby broadly impacting future developments of new technologies within the Information Retrieval and Machine Learning communities. Our novel technology has the potential to improve the efficiency, effectiveness, and trustworthiness of a wide range of applications with billions of daily users around the world, such as search engines, recommender systems and conversational customer services. The research will also be tightly integrated with related courses on information retrieval and sequential decision-making at OSU.

Keywords: Reinforcement Learning, Information Retrieval, Robustness, Implicit Feedback