

A Survey of Controllable Learning: Methods and Applications in Information Retrieval

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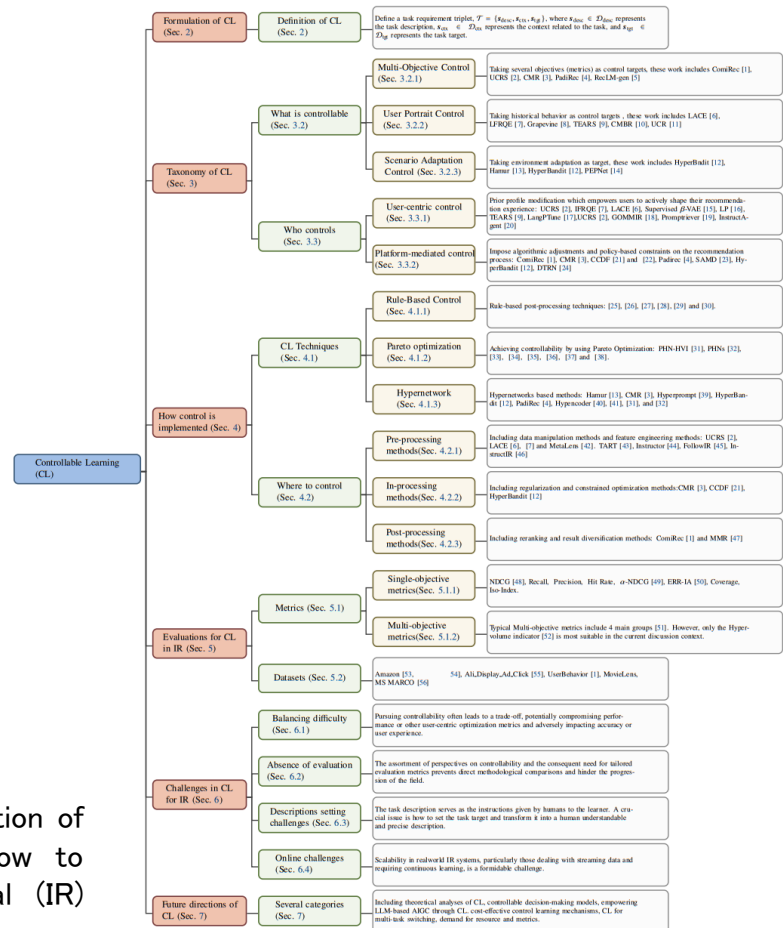
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Problems & Ideas

- Problems of Controllable Learning in Information Retrieval:
 - Urgent need for real-time adaptability.
 - Misalignment between training objectives and runtime demands.
 - Demand for trust, transparency, and compliance.

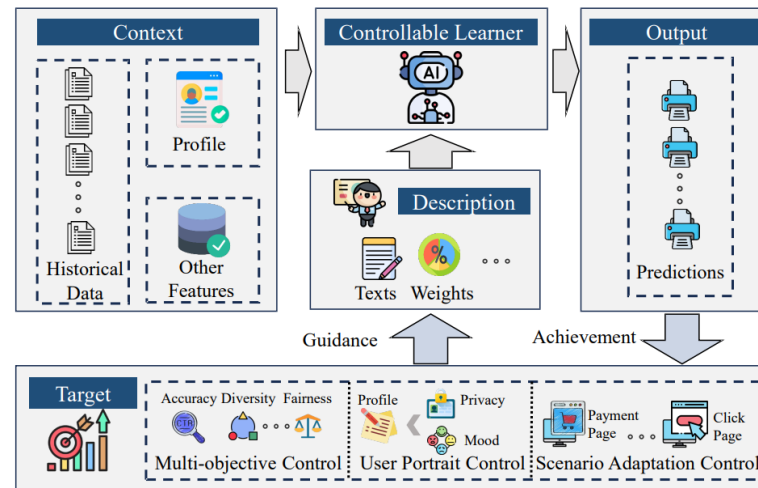
- Ideas: Controllable learning is in urgent demand in information retrieval, yet it still lacks a systematic definition and synthesis. We begin with its formal definition, systematically categorize existing works, and highlight the problems and challenges faced by controllable learning, while clarifying its future directions.

Overview of the survey of CL. This survey includes formulation of CL, taxonomy of CL, implementation methods of CL, how to evaluate the effectiveness of CL in information retrieval (IR) applications, and challenges of applying CL in IR.



Main Contributions

- Contributions:
 - We define controllable learning (CL) .
 - We organize CL research along four axes—What is controlled (e.g., objectives, user portraits), Who drives control (users vs. platforms), How it's implemented (rule-based, Pareto MTL, hypernetworks), and Where it occurs (pre-, in-, post-processing).
 - We collate standard metrics and datasets for fair evaluation, survey representative methods in real IR tasks, and highlight open challenges—scalability, evaluation standards, and integrating CL with large language models.



The procedure of CL. The context contains the historical interaction data, user profile, and other side information. The task target is categorized into three types: multi-objective control, user portrait control, and scenario adaptation control. The task description is a representation of the task target, such as the preference weights of multi objective, natural language and so on. The controllable learner consists of the control function and the learner, taking the task description and context as input and outputting a new learner to accomplish recommendation consistent of the task target.