# 论文周报 | 推荐系统领域最新研究进展，含KDD, SIGIR, UAI等顶会论文

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**嘿，记得给“机器学习与推荐算法”添加星标**

本文精选了上周（0605-0611）最新发布的19篇推荐系统相关论文，主要研究方向包括对话推荐系统、公平性推荐、大型语言模型赋能推荐系统、图推荐系统、多模态推荐系统等。

以下整理了论文标题以及摘要，如感兴趣可移步原文精读。

1. CTRL: Connect Tabular and Language Model for CTR Prediction

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19. Path-Specific Counterfactual Fairness for Recommender Systems, KDD2023

### **1. CTRL: Connect Tabular and Language Model for CTR Prediction**

Xiangyang Li, Bo Chen, Lu Hou, Ruiming Tang

https://arxiv.org/abs/2306.02841

Traditional click-through rate (CTR) prediction models convert the tabular data into one-hot vectors and leverage the collaborative relations among features for inferring user's preference over items. This modeling paradigm discards the essential semantic information. Though some recent works like P5 and M6-Rec have explored the potential of using Pre-trained Language Models (PLMs) to extract semantic signals for CTR prediction, they are computationally expensive and suffer from low efficiency. Besides, the beneficial collaborative relations are not considered, hindering the recommendation performance. To solve these problems, in this paper, we propose a novel framework CTRL, which is industrial friendly and model-agnostic with high training and inference efficiency. Specifically, the original tabular data is first converted into textual data. Both tabular data and converted textual data are regarded as two different modalities and are separately fed into the collaborative CTR model and pre-trained language model. A cross-modal knowledge alignment procedure is performed to fine-grained align and integrate the collaborative and semantic signals, and the lightweight collaborative model can be deployed online for efficient serving after fine-tuned with supervised signals. Experimental results on three public datasets show that CTRL outperforms the SOTA CTR models significantly. Moreover, we further verify its effectiveness on a large-scale industrial recommender system.

### **2. Embracing Uncertainty: Adaptive Vague Preference Policy Learning for  Multi-round Conversational Recommendation**

Gangyi Zhang, Chongming Gao, Wenqiang Lei, Xiaojie Guo, Shijun Li, Lingfei Wu, Hongshen Chen, Zhuozhi Ding, Sulong Xu, Xiangnan He

https://arxiv.org/abs/2306.04487

Conversational recommendation systems (CRS) effectively address information asymmetry by dynamically eliciting user preferences through multi-turn interactions. Existing CRS widely assumes that users have clear preferences. Under this assumption, the agent will completely trust the user feedback and treat the accepted or rejected signals as strong indicators to filter items and reduce the candidate space, which may lead to the problem of over-filtering. However, in reality, users' preferences are often vague and volatile, with uncertainty about their desires and changing decisions during interactions.

To address this issue, we introduce a novel scenario called Vague Preference Multi-round Conversational Recommendation (VPMCR), which considers users' vague and volatile preferences in CRS.VPMCR employs a soft estimation mechanism to assign a non-zero confidence score for all candidate items to be displayed, naturally avoiding the over-filtering problem. In the VPMCR setting, we introduce an solution called Adaptive Vague Preference Policy Learning (AVPPL), which consists of two main components: Uncertainty-aware Soft Estimation (USE) and Uncertainty-aware Policy Learning (UPL). USE estimates the uncertainty of users' vague feedback and captures their dynamic preferences using a choice-based preferences extraction module and a time-aware decaying strategy. UPL leverages the preference distribution estimated by USE to guide the conversation and adapt to changes in users' preferences to make recommendations or ask for attributes.

Our extensive experiments demonstrate the effectiveness of our method in the VPMCR scenario, highlighting its potential for practical applications and improving the overall performance and applicability of CRS in real-world settings, particularly for users with vague or dynamic preferences.

### **3. Modeling Dual Period-Varying Preferences for Takeaway Recommendation, KDD2023**

Yuting Zhang, Yiqing Wu, Ran Le, Yongchun Zhu, Fuzhen Zhuang, Ruidong Han, Xiang Li, Wei Lin, Zhulin An, Yongjun Xu

https://arxiv.org/abs/2306.04370

Takeaway recommender systems, which aim to accurately provide stores that offer foods meeting users' interests, have served billions of users in our daily life. Different from traditional recommendation, takeaway recommendation faces two main challenges: (1) Dual Interaction-Aware Preference Modeling. Traditional recommendation commonly focuses on users' single preferences for items while takeaway recommendation needs to comprehensively consider users' dual preferences for stores and foods. (2) Period-Varying Preference Modeling. Conventional recommendation generally models continuous changes in users' preferences from a session-level or day-level perspective. However, in practical takeaway systems, users' preferences vary significantly during the morning, noon, night, and late night periods of the day. To address these challenges, we propose a Dual Period-Varying Preference modeling (DPVP) for takeaway recommendation. Specifically, we design a dual interaction-aware module, aiming to capture users' dual preferences based on their interactions with stores and foods. Moreover, to model various preferences in different time periods of the day, we propose a time-based decomposition module as well as a time-aware gating mechanism. Extensive offline and online experiments demonstrate that our model outperforms state-of-the-art methods on real-world datasets and it is capable of modeling the dual period-varying preferences. Moreover, our model has been deployed online on Meituan Takeaway platform, leading to an average improvement in GMV (Gross Merchandise Value) of 0.70%.

### **4. Set-to-Sequence Ranking-based Concept-aware Learning Path Recommendation**

Xianyu Chen, Jian Shen, Wei Xia, Jiarui Jin, Yakun Song, Weinan Zhang, Weiwen Liu, Menghui Zhu, Ruiming Tang, Kai Dong, Dingyin Xia, Yong Yu

https://arxiv.org/abs/2306.04234

With the development of the online education system, personalized education recommendation has played an essential role. In this paper, we focus on developing path recommendation systems that aim to generating and recommending an entire learning path to the given user in each session. Noticing that existing approaches fail to consider the correlations of concepts in the path, we propose a novel framework named Set-to-Sequence Ranking-based Concept-aware Learning Path Recommendation (SRC), which formulates the recommendation task under a set-to-sequence paradigm. Specifically, we first design a concept-aware encoder module which can capture the correlations among the input learning concepts. The outputs are then fed into a decoder module that sequentially generates a path through an attention mechanism that handles correlations between the learning and target concepts. Our recommendation policy is optimized by policy gradient. In addition, we also introduce an auxiliary module based on knowledge tracing to enhance the model's stability by evaluating students' learning effects on learning concepts. We conduct extensive experiments on two real-world public datasets and one industrial dataset, and the experimental results demonstrate the superiority and effectiveness of SRC. Code will be available at https://gitee.com/mindspore/models/tree/master/research/recommend/SRC

### **5. PANE-GNN: Unifying Positive and Negative Edges in Graph Neural Networks  for Recommendation**

Ziyang Liu, Chaokun Wang, Jingcao Xu, Cheng Wu, Kai Zheng, Yang Song, Na Mou, Kun Gai

https://arxiv.org/abs/2306.04095

Recommender systems play a crucial role in addressing the issue of information overload by delivering personalized recommendations to users. In recent years, there has been a growing interest in leveraging graph neural networks (GNNs) for recommender systems, capitalizing on advancements in graph representation learning. These GNN-based models primarily focus on analyzing users' positive feedback while overlooking the valuable insights provided by their negative feedback. In this paper, we propose PANE-GNN, an innovative recommendation model that unifies Positive And Negative Edges in Graph Neural Networks for recommendation. By incorporating user preferences and dispreferences, our approach enhances the capability of recommender systems to offer personalized suggestions. PANE-GNN first partitions the raw rating graph into two distinct bipartite graphs based on positive and negative feedback. Subsequently, we employ two separate embeddings, the interest embedding and the disinterest embedding, to capture users' likes and dislikes, respectively. To facilitate effective information propagation, we design distinct message-passing mechanisms for positive and negative feedback. Furthermore, we introduce a distortion to the negative graph, which exclusively consists of negative feedback edges, for contrastive training. This distortion plays a crucial role in effectively denoising the negative feedback. The experimental results provide compelling evidence that PANE-GNN surpasses the existing state-of-the-art benchmark methods across four real-world datasets. These datasets include three commonly used recommender system datasets and one open-source short video recommendation dataset.

### **6. Computational Technologies for Fashion Recommendation: A Survey**

Yujuan Ding, Zhihui Lai, P. Y. Mok, Tat-Seng Chua

https://arxiv.org/abs/2306.03395

Fashion recommendation is a key research field in computational fashion research and has attracted considerable interest in the computer vision, multimedia, and information retrieval communities in recent years. Due to the great demand for applications, various fashion recommendation tasks, such as personalized fashion product recommendation, complementary (mix-and-match) recommendation, and outfit recommendation, have been posed and explored in the literature. The continuing research attention and advances impel us to look back and in-depth into the field for a better understanding. In this paper, we comprehensively review recent research efforts on fashion recommendation from a technological perspective. We first introduce fashion recommendation at a macro level and analyse its characteristics and differences with general recommendation tasks. We then clearly categorize different fashion recommendation efforts into several sub-tasks and focus on each sub-task in terms of its problem formulation, research focus, state-of-the-art methods, and limitations. We also summarize the datasets proposed in the literature for use in fashion recommendation studies to give readers a brief illustration. Finally, we discuss several promising directions for future research in this field. Overall, this survey systematically reviews the development of fashion recommendation research. It also discusses the current limitations and gaps between academic research and the real needs of the fashion industry. In the process, we offer a deep insight into how the fashion industry could benefit from fashion recommendation technologies. the computational technologies of fashion recommendation.

### **7. Tree based Progressive Regression Model for Watch-Time Prediction in  Short-video Recommendation**

Xiao Lin, Xiaokai Chen, Linfeng Song, Jingwei Liu, Biao Li, Peng Jiang

https://arxiv.org/abs/2306.03392

An accurate prediction of watch time has been of vital importance to enhance user engagement in video recommender systems. To achieve this, there are four properties that a watch time prediction framework should satisfy: first, despite its continuous value, watch time is also an ordinal variable and the relative ordering between its values reflects the differences in user preferences. Therefore the ordinal relations should be reflected in watch time predictions. Second, the conditional dependence between the video-watching behaviors should be captured in the model. For instance, one has to watch half of the video before he/she finishes watching the whole video. Third, modeling watch time with a point estimation ignores the fact that models might give results with high uncertainty and this could cause bad cases in recommender systems. Therefore the framework should be aware of prediction uncertainty. Forth, the real-life recommender systems suffer from severe bias amplifications thus an estimation without bias amplification is expected. Therefore we propose TPM for watch time prediction. Specifically, the ordinal ranks of watch time are introduced into TPM and the problem is decomposed into a series of conditional dependent classification tasks which are organized into a tree structure. The expectation of watch time can be generated by traversing the tree and the variance of watch time predictions is explicitly introduced into the objective function as a measurement for uncertainty. Moreover, we illustrate that backdoor adjustment can be seamlessly incorporated into TPM, which alleviates bias amplifications. Extensive offline evaluations have been conducted in public datasets and TPM have been deployed in a real-world video app Kuaishou with over 300 million DAUs. The results indicate that TPM outperforms state-of-the-art approaches and indeed improves video consumption significantly.

### **8. ColdNAS: Search to Modulate for User Cold-Start Recommendation**

Shiguang Wu, Yaqing Wang, Qinghe Jing, Daxiang Dong, Dejing Dou, Quanming Yao

https://arxiv.org/abs/2306.03387

Making personalized recommendation for cold-start users, who only have a few interaction histories, is a challenging problem in recommendation systems. Recent works leverage hypernetworks to directly map user interaction histories to user-specific parameters, which are then used to modulate predictor by feature-wise linear modulation function. These works obtain the state-of-the-art performance. However, the physical meaning of scaling and shifting in recommendation data is unclear. Instead of using a fixed modulation function and deciding modulation position by expertise, we propose a modulation framework called ColdNAS for user cold-start problem, where we look for proper modulation structure, including function and position, via neural architecture search. We design a search space which covers broad models and theoretically prove that this search space can be transformed to a much smaller space, enabling an efficient and robust one-shot search algorithm. Extensive experimental results on benchmark datasets show that ColdNAS consistently performs the best. We observe that different modulation functions lead to the best performance on different datasets, which validates the necessity of designing a searching-based method.

### **9. Personalized Federated Domain Adaptation for Item-to-Item Recommendation, UAI2023**

Ziwei Fan, Hao Ding, Anoop Deoras, Trong Nghia Hoang

https://arxiv.org/abs/2306.03191

Item-to-Item (I2I) recommendation is an important function in most recommendation systems, which generates replacement or complement suggestions for a particular item based on its semantic similarities to other cataloged items. Given that subsets of items in a recommendation system might be co-interacted with by the same set of customers, graph-based models, such as graph neural networks (GNNs), provide a natural framework to combine, ingest and extract valuable insights from such high-order relational interactions between cataloged items, as well as their metadata features, as has been shown in many recent studies. However, learning GNNs effectively for I2I requires ingesting a large amount of relational data, which might not always be available, especially in new, emerging market segments. To mitigate this data bottleneck, we postulate that recommendation patterns learned from existing mature market segments (with private data) could be adapted to build effective warm-start models for emerging ones. To achieve this, we propose and investigate a personalized federated modeling framework based on GNNs to summarize, assemble and adapt recommendation patterns across market segments with heterogeneous customer behaviors into effective local models. Our key contribution is a personalized graph adaptation model that bridges the gap between recent literature on federated GNNs and (non-graph) personalized federated learning, which either does not optimize for the adaptability of the federated model or is restricted to local models with homogeneous parameterization, excluding GNNs with heterogeneous local graphs.

### **10. Learning Similarity among Users for Personalized Session-Based  Recommendation from hierarchical structure of User-Session-Item**

Jisoo Cha, Haemin Jeong, Wooju Kim

https://arxiv.org/abs/2306.03040

The task of the session-based recommendation is to predict the next interaction of the user based on the anonymized user's behavior pattern. And personalized version of this system is a promising research field due to its availability to deal with user information. However, there's a problem that the user's preferences and historical sessions were not considered in the typical session-based recommendation since it concentrates only on user-item interaction. In addition, the existing personalized session-based recommendation model has a limited capability in that it only considers the preference of the current user without considering those of similar users. It means there can be the loss of information included within the hierarchical data structure of the user-session-item. To tackle with this problem, we propose USP-SBR(abbr. of User Similarity Powered - Session Based Recommender). To model global historical sessions of users, we propose UserGraph that has two types of nodes - ItemNode and UserNode. We then connect the nodes with three types of edges. The first type of edges connects ItemNode as chronological order, and the second connects ItemNode to UserNode, and the last connects UserNode to ItemNode. With these user embeddings, we propose additional contrastive loss, that makes users with similar intention be close to each other in the vector space. we apply graph neural network on these UserGraph and update nodes. Experimental results on two real-world datasets demonstrate that our method outperforms some state-of-the-art approaches.

### **11. Improving Conversational Recommendation Systems via Counterfactual Data  Simulation, KDD2023**

Xiaolei Wang, Kun Zhou, Xinyu Tang, Wayne Xin Zhao, Fan Pan, Zhao Cao, Ji-Rong Wen

https://arxiv.org/abs/2306.02842

Conversational recommender systems (CRSs) aim to provide recommendation services via natural language conversations. Although a number of approaches have been proposed for developing capable CRSs, they typically rely on sufficient training data for training. Since it is difficult to annotate recommendation-oriented dialogue datasets, existing CRS approaches often suffer from the issue of insufficient training due to the scarcity of training data. To address this issue, in this paper, we propose a CounterFactual data simulation approach for CRS, named CFCRS, to alleviate the issue of data scarcity in CRSs. Our approach is developed based on the framework of counterfactual data augmentation, which gradually incorporates the rewriting to the user preference from a real dialogue without interfering with the entire conversation flow. To develop our approach, we characterize user preference and organize the conversation flow by the entities involved in the dialogue, and design a multi-stage recommendation dialogue simulator based on a conversation flow language model. Under the guidance of the learned user preference and dialogue schema, the flow language model can produce reasonable, coherent conversation flows, which can be further realized into complete dialogues. Based on the simulator, we perform the intervention at the representations of the interacted entities of target users, and design an adversarial training method with a curriculum schedule that can gradually optimize the data augmentation strategy. Extensive experiments show that our approach can consistently boost the performance of several competitive CRSs, and outperform other data augmentation methods, especially when the training data is limited. Our code is publicly available at https://github.com/RUCAIBox/CFCRS

### **12. Graph Transformer for Recommendation, SIGIR2023**

Chaoliu Li, Lianghao Xia, Xubin Ren, Yaowen Ye, Yong Xu, Chao Huang

https://arxiv.org/abs/2306.02330

This paper presents a novel approach to representation learning in recommender systems by integrating generative self-supervised learning with graph transformer architecture. We highlight the importance of high-quality data augmentation with relevant self-supervised pretext tasks for improving performance. Towards this end, we propose a new approach that automates the self-supervision augmentation process through a rationale-aware generative SSL that distills informative user-item interaction patterns. The proposed recommender with Graph TransFormer (GFormer) that offers parameterized collaborative rationale discovery for selective augmentation while preserving global-aware user-item relationships. In GFormer, we allow the rationale-aware SSL to inspire graph collaborative filtering with task-adaptive invariant rationalization in graph transformer. The experimental results reveal that our GFormer has the capability to consistently improve the performance over baselines on different datasets. Several in-depth experiments further investigate the invariant rationale-aware augmentation from various aspects. The source code for this work is publicly available at: https://github.com/HKUDS/GFormer

### **13. Large Language Model Augmented Narrative Driven Recommendations**

Sheshera Mysore, Andrew McCallum, Hamed Zamani

https://arxiv.org/abs/2306.02250

Narrative-driven recommendation (NDR) presents an information access problem where users solicit recommendations with verbose descriptions of their preferences and context, for example, travelers soliciting recommendations for points of interest while describing their likes/dislikes and travel circumstances. These requests are increasingly important with the rise of natural language-based conversational interfaces for search and recommendation systems. However, NDR lacks abundant training data for models, and current platforms commonly do not support these requests. Fortunately, classical user-item interaction datasets contain rich textual data, e.g., reviews, which often describe user preferences and context - this may be used to bootstrap training for NDR models. In this work, we explore using large language models (LLMs) for data augmentation to train NDR models. We use LLMs for authoring synthetic narrative queries from user-item interactions with few-shot prompting and train retrieval models for NDR on synthetic queries and user-item interaction data. Our experiments demonstrate that this is an effective strategy for training small-parameter retrieval models that outperform other retrieval and LLM baselines for narrative-driven recommendation.

### **14. Generative Flow Network for Listwise Recommendation, KDD2023**

Shuchang Liu, Qingpeng Cai, Zhankui He, Bowen Sun, Julian McAuley, Done Zheng, Peng Jiang, Kun Gai

https://arxiv.org/abs/2306.02239

Personalized recommender systems fulfill the daily demands of customers and boost online businesses. The goal is to learn a policy that can generate a list of items that matches the user's demand or interest. While most existing methods learn a pointwise scoring model that predicts the ranking score of each individual item, recent research shows that the listwise approach can further improve the recommendation quality by modeling the intra-list correlations of items that are exposed together. This has motivated the recent list reranking and generative recommendation approaches that optimize the overall utility of the entire list. However, it is challenging to explore the combinatorial space of list actions and existing methods that use cross-entropy loss may suffer from low diversity issues. In this work, we aim to learn a policy that can generate sufficiently diverse item lists for users while maintaining high recommendation quality. The proposed solution, GFN4Rec, is a generative method that takes the insight of the flow network to ensure the alignment between list generation probability and its reward. The key advantages of our solution are the log scale reward matching loss that intrinsically improves the generation diversity and the autoregressive item selection model that captures the item mutual influences while capturing future reward of the list. As validation of our method's effectiveness and its superior diversity during active exploration, we conduct experiments on simulated online environments as well as an offline evaluation framework for two real-world datasets.

### **15. RecAgent: A Novel Simulation Paradigm for Recommender Systems**

Lei Wang, Jingsen Zhang, Xu Chen, Yankai Lin, Ruihua Song, Wayne Xin Zhao, Ji-Rong Wen

https://arxiv.org/abs/2306.02552

Recommender system has deeply revolutionized people's daily life and production, bringing a large amount of business value. In the recommendation domain, simulation and real data-based studies are two typical research paradigms, with each having different advantages. Previously, real data-based studies occupy more important positions, since accurately simulating the user preference is quite difficult. Recently, large language models (LLM) have shown great potential to achieve human-like intelligence, which provides new opportunities to overcome the shortcomings of simulation-based studies and thus highlight their advantages, such as much more application scenarios and cheaper data acquisition strategies. To shed lights on this direction, in this paper, we introduce an LLM-based recommender simulator called RecAgent. Our simulator is composed of two modules: (1) the user module and (2) the recommender module. The user module can browse the recommendation website, communicate with other users and broadcast messages on the social media. The recommender module is designed to provide search or recommendation lists to the users, and one can design different models to implement the recommender. All the users take actions based on LLMs, and can freely evolve like in the real world. We present several case studies to demonstrate that the users in our simulator can indeed behave in a reasonable manner as expected. Our project has been released at https://github.com/RUC-GSAI/YuLan-Rec

### **16. Fresh Content Needs More Attention: Multi-funnel Fresh Content  Recommendation, KDD2023**

Jianling Wang, Haokai Lu, Sai zhang, Bart Locanthi, Haoting Wang, Dylan Greaves, Benjamin Lipshitz, Sriraj Badam, Ed H. Chi, Cristos Goodrow, Su-Lin Wu, Lexi Baugher, Minmin Chen

https://arxiv.org/abs/2306.01720

Recommendation system serves as a conduit connecting users to an incredibly large, diverse and ever growing collection of contents. In practice, missing information on fresh (and tail) contents needs to be filled in order for them to be exposed and discovered by their audience. We here share our success stories in building a dedicated fresh content recommendation stack on a large commercial platform. To nominate fresh contents, we built a multi-funnel nomination system that combines (i) a two-tower model with strong generalization power for coverage, and (ii) a sequence model with near real-time update on user feedback for relevance. The multi-funnel setup effectively balances between coverage and relevance. An in-depth study uncovers the relationship between user activity level and their proximity toward fresh contents, which further motivates a contextual multi-funnel setup. Nominated fresh candidates are then scored and ranked by systems considering prediction uncertainty to further bootstrap content with less exposure. We evaluate the benefits of the dedicated fresh content recommendation stack, and the multi-funnel nomination system in particular, through user corpus co-diverted live experiments. We conduct multiple rounds of live experiments on a commercial platform serving billion of users demonstrating efficacy of our proposed methods.

### **17. Safe Collaborative Filtering**

Riku Togashi, Tatsushi Oka, Naoto Ohsaka, Tetsuro Morimura

https://arxiv.org/abs/2306.05292

Excellent tail performance is crucial for modern machine learning tasks, such as algorithmic fairness, class imbalance, and risk-sensitive decision making, as it ensures the effective handling of challenging samples within a dataset. Tail performance is also a vital determinant of success for personalised recommender systems to reduce the risk of losing users with low satisfaction. This study introduces a "safe" collaborative filtering method that prioritises recommendation quality for less-satisfied users rather than focusing on the average performance. Our approach minimises the conditional value at risk (CVaR), which represents the average risk over the tails of users' loss. To overcome computational challenges for web-scale recommender systems, we develop a robust yet practical algorithm that extends the most scalable method, implicit alternating least squares (iALS). Empirical evaluation on real-world datasets demonstrates the excellent tail performance of our approach while maintaining competitive computational efficiency.

### **18. On Manipulating Signals of User-Item Graph: A Jacobi Polynomial-based  Graph Collaborative Filtering**

Jiayan Guo, Lun Du, Xu Chen, Xiaojun Ma, Qiang Fu, Shi Han, Dongmei Zhang, Yan Zhang

https://arxiv.org/abs/2306.03624

Collaborative filtering (CF) is an important research direction in recommender systems that aims to make recommendations given the information on user-item interactions. Graph CF has attracted more and more attention in recent years due to its effectiveness in leveraging high-order information in the user-item bipartite graph for better recommendations. Specifically, recent studies show the success of graph neural networks (GNN) for CF is attributed to its low-pass filtering effects. However, current researches lack a study of how different signal components contributes to recommendations, and how to design strategies to properly use them well. To this end, from the view of spectral transformation, we analyze the important factors that a graph filter should consider to achieve better performance. Based on the discoveries, we design JGCF, an efficient and effective method for CF based on Jacobi polynomial bases and frequency decomposition strategies. Extensive experiments on four widely used public datasets show the effectiveness and efficiency of the proposed methods, which brings at most 27.06% performance gain on Alibaba-iFashion. Besides, the experimental results also show that JGCF is better at handling sparse datasets, which shows potential in making recommendations for cold-start users.

### **19. Path-Specific Counterfactual Fairness for Recommender Systems, KDD2023**

Yaochen Zhu, Jing Ma, Liang Wu, Qi Guo, Liangjie Hong, Jundong Li

https://arxiv.org/abs/2306.02615

Recommender systems (RSs) have become an indispensable part of online platforms. With the growing concerns of algorithmic fairness, RSs are not only expected to deliver high-quality personalized content, but are also demanded not to discriminate against users based on their demographic information. However, existing RSs could capture undesirable correlations between sensitive features and observed user behaviors, leading to biased recommendations. Most fair RSs tackle this problem by completely blocking the influences of sensitive features on recommendations. But since sensitive features may also affect user interests in a fair manner (e.g., race on culture-based preferences), indiscriminately eliminating all the influences of sensitive features inevitably degenerate the recommendations quality and necessary diversities. To address this challenge, we propose a path-specific fair RS (PSF-RS) for recommendations. Specifically, we summarize all fair and unfair correlations between sensitive features and observed ratings into two latent proxy mediators, where the concept of path-specific bias (PS-Bias) is defined based on path-specific counterfactual inference. Inspired by Pearl's minimal change principle, we address the PS-Bias by minimally transforming the biased factual world into a hypothetically fair world, where a fair RS model can be learned accordingly by solving a constrained optimization problem. For the technical part, we propose a feasible implementation of PSF-RS, i.e., PSF-VAE, with weakly-supervised variational inference, which robustly infers the latent mediators such that unfairness can be mitigated while necessary recommendation diversities can be maximally preserved simultaneously. Experiments conducted on semi-simulated and real-world datasets demonstrate the effectiveness of PSF-RS.