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

原创 ML\_RSer [机器学习与推荐算法](javascript:void(0);) 2023-05-29 08:11 发表于北京

收录于合集#推荐系统干货分享242个

**嘿，记得给“机器学习与推荐算法”添加星标**

本文精选了上周（0522-0528）最新发布的19篇推荐系统相关论文，主要研究方向包括隐私保护推荐系统、大型语言模型赋能推荐系统、对话推荐系统、图推荐系统、推荐中的异质性、多模态推荐系统、推荐中的低维灾难等。



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. PPGenCDR: A Stable and Robust Framework for Privacy-Preserving  Cross-Domain Recommendation, AAAI20232. UniTRec: A Unified Text-to-Text Transformer and Joint Contrastive  Learning Framework for Text-based Recommendation, ACL20233. Exploring and Exploiting Data Heterogeneity in Recommendation4. Collaborative Recommendation Model Based on Multi-modal Multi-view  Attention Network: Movie and literature cases5. Bert4CMR: Cross-Market Recommendation with Bidirectional Encoder  Representations from Transformer6. How Graph Convolutions Amplify Popularity Bias for Recommendation? Frontiers of Computer Science7. Revenge of MLP in Sequential Recommendation8. VIP5: Towards Multimodal Foundation Models for Recommendation9. Text Is All You Need: Learning Language Representations for Sequential  Recommendation, KDD202310. Conversational Recommendation as Retrieval: A Simple, Strong Baseline11. Rethinking the Evaluation for Conversational Recommendation in the Era  of Large Language Models12. Attentive Graph-based Text-aware Preference Modeling for Top-N  Recommendation13. It's Enough: Relaxing Diagonal Constraints in Linear Autoencoders for  Recommendation, SIGIR202314. Graph Meets LLM: A Novel Approach to Collaborative Filtering for Robust  Conversational Understanding15. Representation Online Matters: Practical End-to-End Diversification in  Search and Recommender Systems16. Exploring Adapter-based Transfer Learning for Recommender Systems: Empirical Studies and Practical Insights17. Advances and Challenges of Multi-task Learning Method in Recommender  System: A Survey18. Optimizing Long-term Value for Auction-Based Recommender Systems via  On-Policy Reinforcement Learning19. Curse of "Low" Dimensionality in Recommender Systems, SIGIR2023

### **1. PPGenCDR: A Stable and Robust Framework for Privacy-Preserving  Cross-Domain Recommendation, AAAI2023**

Xinting Liao, Weiming Liu, Xiaolin Zheng, Binhui Yao, Chaochao Chen

https://arxiv.org/abs/2305.16163

Privacy-preserving cross-domain recommendation (PPCDR) refers to preserving the privacy of users when transferring the knowledge from source domain to target domain for better performance, which is vital for the long-term development of recommender systems. Existing work on cross-domain recommendation (CDR) reaches advanced and satisfying recommendation performance, but mostly neglects preserving privacy. To fill this gap, we propose a privacy-preserving generative cross-domain recommendation (PPGenCDR) framework for PPCDR. PPGenCDR includes two main modules, i.e., stable privacy-preserving generator module, and robust cross-domain recommendation module. Specifically, the former isolates data from different domains with a generative adversarial network (GAN) based model, which stably estimates the distribution of private data in the source domain with Renyi differential privacy (RDP) technique. Then the latter aims to robustly leverage the perturbed but effective knowledge from the source domain with the raw data in target domain to improve recommendation performance. Three key modules, i.e., (1) selective privacy preserver, (2) GAN stabilizer, and (3) robustness conductor, guarantee the cost-effective trade-off between utility and privacy, the stability of GAN when using RDP, and the robustness of leveraging transferable knowledge accordingly. The extensive empirical studies on Douban and Amazon datasets demonstrate that PPGenCDR significantly outperforms the state-of-the-art recommendation models while preserving privacy.

### **2. UniTRec: A Unified Text-to-Text Transformer and Joint Contrastive  Learning Framework for Text-based Recommendation, ACL2023**

Zhiming Mao, Huimin Wang, Yiming Du, Kam-fai Wong

https://arxiv.org/abs/2305.15756

Prior study has shown that pretrained language models (PLM) can boost the performance of text-based recommendation. In contrast to previous works that either use PLM to encode user history as a whole input text, or impose an additional aggregation network to fuse multi-turn history representations, we propose a unified local- and global-attention Transformer encoder to better model two-level contexts of user history. Moreover, conditioned on user history encoded by Transformer encoders, our framework leverages Transformer decoders to estimate the language perplexity of candidate text items, which can serve as a straightforward yet significant contrastive signal for user-item text matching. Based on this, our framework, UniTRec, unifies the contrastive objectives of discriminative matching scores and candidate text perplexity to jointly enhance text-based recommendation. Extensive evaluation shows that UniTRec delivers SOTA performance on three text-based recommendation tasks. Code is available at https://github.com/Veason-silverbullet/UniTRec

### **3. Exploring and Exploiting Data Heterogeneity in Recommendation**

Zimu Wang, Jiashuo Liu, Hao Zou, Xingxuan Zhang, Yue He, Dongxu Liang, Peng Cui

https://arxiv.org/abs/2305.15431

Massive amounts of data are the foundation of data-driven recommendation models. As an inherent nature of big data, data heterogeneity widely exists in real-world recommendation systems. It reflects the differences in the properties among sub-populations. Ignoring the heterogeneity in recommendation data could limit the performance of recommendation models, hurt the sub-populational robustness, and make the models misled by biases. However, data heterogeneity has not attracted substantial attention in the recommendation community. Therefore, it inspires us to adequately explore and exploit heterogeneity for solving the above problems and assisting data analysis. In this work, we focus on exploring two representative categories of heterogeneity in recommendation data that is the heterogeneity of prediction mechanism and covariate distribution and propose an algorithm that explores the heterogeneity through a bilevel clustering method. Furthermore, the uncovered heterogeneity is exploited for two purposes in recommendation scenarios which are prediction with multiple sub-models and supporting debias. Extensive experiments on real-world data validate the existence of heterogeneity in recommendation data and the effectiveness of exploring and exploiting data heterogeneity in recommendation.

### **4. Collaborative Recommendation Model Based on Multi-modal Multi-view  Attention Network: Movie and literature cases**

Zheng Hu, Shi-Min Cai, Jun Wang, Tao Zhou

https://arxiv.org/abs/2305.15159

The existing collaborative recommendation models that use multi-modal information emphasize the representation of users' preferences but easily ignore the representation of users' dislikes. Nevertheless, modelling users' dislikes facilitates comprehensively characterizing user profiles. Thus, the representation of users' dislikes should be integrated into the user modelling when we construct a collaborative recommendation model. In this paper, we propose a novel Collaborative Recommendation Model based on Multi-modal multi-view Attention Network (CRMMAN), in which the users are represented from both preference and dislike views. Specifically, the users' historical interactions are divided into positive and negative interactions, used to model the user's preference and dislike views, respectively. Furthermore, the semantic and structural information extracted from the scene is employed to enrich the item representation. We validate CRMMAN by designing contrast experiments based on two benchmark MovieLens-1M and Book-Crossing datasets. Movielens-1m has about a million ratings, and Book-Crossing has about 300,000 ratings. Compared with the state-of-the-art knowledge-graph-based and multi-modal recommendation methods, the AUC, NDCG@5 and NDCG@10 are improved by 2.08%, 2.20% and 2.26% on average of two datasets. We also conduct controlled experiments to explore the effects of multi-modal information and multi-view mechanism. The experimental results show that both of them enhance the model's performance.

### **5. Bert4CMR: Cross-Market Recommendation with Bidirectional Encoder  Representations from Transformer**

Zheng Hu, Fuji Ren

https://arxiv.org/abs/2305.15145

Real-world multinational e-commerce companies, such as Amazon and eBay, serve in multiple countries and regions. Obviously, these markets have similar goods but different users. Some markets are data-scarce, while others are data-rich. In recent years, cross-market recommendation (CMR) has been proposed to enhance data-scarce markets by leveraging auxiliary information from data-rich markets. Previous works fine-tune the pre-trained model on the local market after freezing part of the parameters or introducing inter-market similarity into the local market to improve the performance of CMR. However, they generally do not consider eliminating the mutual interference between markets. Therefore, the existing methods are neither unable to learn unbiased general knowledge nor efficient transfer reusable information across markets. In this paper, we propose a novel attention-based model called Bert4CMR to simultaneously improve all markets' recommendation performance. Specifically, we employ the attention mechanism to capture user interests by modelling user behavioural sequences. We pre-train the proposed model on global data to learn the general knowledge of items. Then we fine-tune specific target markets to perform local recommendations. We propose market embedding to model the bias of each market and reduce the mutual inference between the parallel markets. Extensive experiments conducted on seven markets show that our model is state-of-the-art. Our model outperforms the suboptimal model by 4.82%, 4.73%, 7.66% and 6.49% on average of seven datasets in terms of four metrics, respectively. We conduct ablation experiments to analyse the effectiveness of the proposed components. Experimental results indicate that our model is able to learn general knowledge through global data and shield the mutual interference between markets.

### **6. How Graph Convolutions Amplify Popularity Bias for Recommendation? Frontiers of Computer Science**

Jiajia Chen, Jiancan Wu, Jiawei Chen, Xin Xin, Yong Li, Xiangnan He

https://arxiv.org/abs/2305.14886

Graph convolutional networks (GCNs) have become prevalent in recommender system (RS) due to their superiority in modeling collaborative patterns. Although improving the overall accuracy, GCNs unfortunately amplify popularity bias -- tail items are less likely to be recommended. This effect prevents the GCN-based RS from making precise and fair recommendations, decreasing the effectiveness of recommender systems in the long run.

In this paper, we investigate how graph convolutions amplify the popularity bias in RS. Through theoretical analyses, we identify two fundamental factors: (1) with graph convolution (i.e., neighborhood aggregation), popular items exert larger influence than tail items on neighbor users, making the users move towards popular items in the representation space; (2) after multiple times of graph convolution, popular items would affect more high-order neighbors and become more influential. The two points make popular items get closer to almost users and thus being recommended more frequently. To rectify this, we propose to estimate the amplified effect of popular nodes on each node's representation, and intervene the effect after each graph convolution. Specifically, we adopt clustering to discover highly-influential nodes and estimate the amplification effect of each node, then remove the effect from the node embeddings at each graph convolution layer. Our method is simple and generic -- it can be used in the inference stage to correct existing models rather than training a new model from scratch, and can be applied to various GCN models. We demonstrate our method on two representative GCN backbones LightGCN and UltraGCN, verifying its ability in improving the recommendations of tail items without sacrificing the performance of popular items. Codes are open-sourced https://github.com/MEICRS/DAP

### **7. Revenge of MLP in Sequential Recommendation**

Yiheng Jiang, Yuanbo Xu

https://arxiv.org/abs/2305.14675

Sequential recommendation models sequences of historical user-item interactive behaviors (or referred as token) to better infer dynamic preferences. Fueled by the improved neural network architectures such as RNN, CNN and Transformer, this field has enjoyed rapid performance boost in the past years. Recent progress on all-MLP models lights on an efficient method with less intensive computation, token-mixing MLP, to learn the transformation patterns among historical behaviors. However, due to the inherent fully-connection design that allows the unrestricted cross-token communication and ignores the chronological order, we find that directly applying token-mixing MLP into sequential recommendation leads to subpar performance. In this paper, we present a purely MLP-based sequential recommendation architecture TriMLP with a novel Triangular Mixer where the modified MLP endows tokens with ordered interactions. As the cross-token interaction in MLP is actually matrix multiplication, Triangular Mixer drops the lower-triangle neurons in the weight matrix and thus blocks the connections from future tokens, which prevents information leakage and improves prediction capability under the standard auto-regressive training fashion. To further model long and short-term preferences on fine-grained level, the mixer adopts a dual-branch structure based on the delicate MLP described above, namely global and local mixing, to separately capture the sequential long-range dependencies and local patterns. Empirical study on 9 different scale datasets (contain 50K\textasciitilde20M behaviors) of various benchmarks, including MovieLens, Amazon and Tenrec, demonstrates that TriMLP attains promising and stable accuracy/efficiency trade-off, i.e., averagely surpasses several state-of-the-art baselines by 5.32% and saves 8.44% inference time cost.

### **8. VIP5: Towards Multimodal Foundation Models for Recommendation**

Shijie Geng, Juntao Tan, Shuchang Liu, Zuohui Fu, Yongfeng Zhang

https://arxiv.org/abs/2305.14302

Computer Vision (CV), Natural Language Processing (NLP), and Recommender Systems (RecSys) are three prominent AI applications that have traditionally developed independently, resulting in disparate modeling and engineering methodologies. This has impeded the ability for these fields to directly benefit from each other's advancements. With the increasing availability of multimodal data on the web, there is a growing need to consider various modalities when making recommendations for users. With the recent emergence of foundation models, large language models have emerged as a potential general-purpose interface for unifying different modalities and problem formulations. In light of this, we propose the development of a multimodal foundation model by considering both visual and textual modalities under the P5 recommendation paradigm (VIP5) to unify various modalities and recommendation tasks. This will enable the processing of vision, language, and personalization information in a shared architecture for improved recommendations. To achieve this, we introduce multimodal personalized prompts to accommodate multiple modalities under a shared format. Additionally, we propose a parameter-efficient training method for foundation models, which involves freezing the backbone and fine-tuning lightweight adapters, resulting in improved recommendation performance and increased efficiency in terms of training time and memory usage.

### **9. Text Is All You Need: Learning Language Representations for Sequential  Recommendation, KDD2023**

Jiacheng Li, Ming Wang, Jin Li, Jinmiao Fu, Xin Shen, Jingbo Shang, Julian McAuley

https://arxiv.org/abs/2305.13731

Sequential recommendation aims to model dynamic user behavior from historical interactions. Existing methods rely on either explicit item IDs or general textual features for sequence modeling to understand user preferences. While promising, these approaches still struggle to model cold-start items or transfer knowledge to new datasets. In this paper, we propose to model user preferences and item features as language representations that can be generalized to new items and datasets. To this end, we present a novel framework, named Recformer, which effectively learns language representations for sequential recommendation. Specifically, we propose to formulate an item as a "sentence" (word sequence) by flattening item key-value attributes described by text so that an item sequence for a user becomes a sequence of sentences. For recommendation, Recformer is trained to understand the "sentence" sequence and retrieve the next "sentence". To encode item sequences, we design a bi-directional Transformer similar to the model Longformer but with different embedding layers for sequential recommendation. For effective representation learning, we propose novel pretraining and finetuning methods which combine language understanding and recommendation tasks. Therefore, Recformer can effectively recommend the next item based on language representations. Extensive experiments conducted on six datasets demonstrate the effectiveness of Recformer for sequential recommendation, especially in low-resource and cold-start settings.

### **10. Conversational Recommendation as Retrieval: A Simple, Strong Baseline**

Raghav Gupta, Renat Aksitov, Samrat Phatale, Simral Chaudhary, Harrison Lee, Abhinav Rastogi

https://arxiv.org/abs/2305.13725

Conversational recommendation systems (CRS) aim to recommend suitable items to users through natural language conversation. However, most CRS approaches do not effectively utilize the signal provided by these conversations. They rely heavily on explicit external knowledge e.g., knowledge graphs to augment the models' understanding of the items and attributes, which is quite hard to scale. To alleviate this, we propose an alternative information retrieval (IR)-styled approach to the CRS item recommendation task, where we represent conversations as queries and items as documents to be retrieved. We expand the document representation used for retrieval with conversations from the training set. With a simple BM25-based retriever, we show that our task formulation compares favorably with much more complex baselines using complex external knowledge on a popular CRS benchmark. We demonstrate further improvements using user-centric modeling and data augmentation to counter the cold start problem for CRSs.

### **11. Rethinking the Evaluation for Conversational Recommendation in the Era  of Large Language Models**

Xiaolei Wang, Xinyu Tang, Wayne Xin Zhao, Jingyuan Wang, Ji-Rong Wen

https://arxiv.org/abs/2305.13112

The recent success of large language models (LLMs) has shown great potential to develop more powerful conversational recommender systems (CRSs), which rely on natural language conversations to satisfy user needs. In this paper, we embark on an investigation into the utilization of ChatGPT for conversational recommendation, revealing the inadequacy of the existing evaluation protocol. It might over-emphasize the matching with the ground-truth items or utterances generated by human annotators, while neglecting the interactive nature of being a capable CRS. To overcome the limitation, we further propose an interactive Evaluation approach based on LLMs named iEvaLM that harnesses LLM-based user simulators. Our evaluation approach can simulate various interaction scenarios between users and systems. Through the experiments on two publicly available CRS datasets, we demonstrate notable improvements compared to the prevailing evaluation protocol. Furthermore, we emphasize the evaluation of explainability, and ChatGPT showcases persuasive explanation generation for its recommendations. Our study contributes to a deeper comprehension of the untapped potential of LLMs for CRSs and provides a more flexible and easy-to-use evaluation framework for future research endeavors. The codes and data are publicly available at https://github.com/RUCAIBox/iEvaLM-CRS

### **12. Attentive Graph-based Text-aware Preference Modeling for Top-N  Recommendation**

Ming-Hao Juan, Pu-Jen Cheng, Hui-Neng Hsu, Pin-Hsin Hsiao

https://arxiv.org/abs/2305.12976

Textual data are commonly used as auxiliary information for modeling user preference nowadays. While many prior works utilize user reviews for rating prediction, few focus on top-N recommendation, and even few try to incorporate item textual contents such as title and description. Though delivering promising performance for rating prediction, we empirically find that many review-based models cannot perform comparably well on top-N recommendation. Also, user reviews are not available in some recommendation scenarios, while item textual contents are more prevalent. On the other hand, recent graph convolutional network (GCN) based models demonstrate state-of-the-art performance for top-N recommendation. Thus, in this work, we aim to further improve top-N recommendation by effectively modeling both item textual content and high-order connectivity in user-item graph. We propose a new model named Attentive Graph-based Text-aware Recommendation Model (AGTM). Extensive experiments are provided to justify the rationality and effectiveness of our model design.

### **13. It's Enough: Relaxing Diagonal Constraints in Linear Autoencoders for  Recommendation, SIGIR2023**

Jaewan Moon, Hye-young Kim, Jongwuk Lee

https://arxiv.org/abs/2305.12922

Linear autoencoder models learn an item-to-item weight matrix via convex optimization with L2 regularization and zero-diagonal constraints. Despite their simplicity, they have shown remarkable performance compared to sophisticated non-linear models. This paper aims to theoretically understand the properties of two terms in linear autoencoders. Through the lens of singular value decomposition (SVD) and principal component analysis (PCA), it is revealed that L2 regularization enhances the impact of high-ranked PCs. Meanwhile, zero-diagonal constraints reduce the impact of low-ranked PCs, leading to performance degradation for unpopular items. Inspired by this analysis, we propose simple-yet-effective linear autoencoder models using diagonal inequality constraints, called Relaxed Linear AutoEncoder (RLAE) and Relaxed Denoising Linear AutoEncoder (RDLAE). We prove that they generalize linear autoencoders by adjusting the degree of diagonal constraints. Experimental results demonstrate that our models are comparable or superior to state-of-the-art linear and non-linear models on six benchmark datasets; they significantly improve the accuracy of long-tail items. These results also support our theoretical insights on regularization and diagonal constraints in linear autoencoders.

### **14. Graph Meets LLM: A Novel Approach to Collaborative Filtering for Robust  Conversational Understanding**

Zheng Chen, Ziyan Jiang, Fan Yang

https://arxiv.org/abs/2305.14449

Conversational AI systems (e.g. Alexa, Siri, Google Assistant, etc.) need to understand queries with defects to ensure robust conversational understanding and reduce user frictions. The defective queries are often induced by user ambiguities and mistakes, or errors in the automatic speech recognition (ASR) and natural language understanding (NLU).

Personalized query rewriting (personalized QR) targets reducing defects in the torso and tail user query traffic, and it typically relies on an index of past successful user interactions with the conversational AI. This paper presents our "Collaborative Query Rewriting" approach that focuses on rewriting novel user interactions unseen in the user history. This approach builds a "user Feedback Interaction Graph" (FIG) consisting of historical user-entity interactions, and leverages multi-hop customer affinity to enrich each user's index (i.e. the Collaborative User Index) that would help cover future unseen defective queries. To counteract the precision degradation from the enlarged index, we introduced additional transformer layers to the L1 retrieval model and added multi-hop affinity and guardrail features to the L2 re-ranking model.

Given the production constraints of storage cost and runtime retrieval latency, managing the size of the Collaborative User Index is important. As the user index can be pre-computed, we explored using a Large Language Model (LLM) for multi-hop customer affinity retrieval on the Video/Music domains. In particular, this paper looked into the Dolly-V2 7B model. Given limited user index size, We found the user index derived from fine-tuned Dolly-V2 generation significantly enhanced coverage of unseen user interactions. Consequently, this boosted QR performance on unseen user interactions compared to the graph traversal based user index.

### **15. Representation Online Matters: Practical End-to-End Diversification in  Search and Recommender Systems**

Pedro Silva, Bhawna Juneja, Shloka Desai, Ashudeep Singh, Nadia Fawaz

https://arxiv.org/abs/2305.15534

As the use of online platforms continues to grow across all demographics, users often express a desire to feel represented in the content. To improve representation in search results and recommendations, we introduce end-to-end diversification, ensuring that diverse content flows throughout the various stages of these systems, from retrieval to ranking. We develop, experiment, and deploy scalable diversification mechanisms in multiple production surfaces on the Pinterest platform, including Search, Related Products, and New User Homefeed, to improve the representation of different skin tones in beauty and fashion content. Diversification in production systems includes three components: identifying requests that will trigger diversification, ensuring diverse content is retrieved from the large content corpus during the retrieval stage, and finally, balancing the diversity-utility trade-off in a self-adjusting manner in the ranking stage. Our approaches, which evolved from using Strong-OR logical operator to bucketized retrieval at the retrieval stage and from greedy re-rankers to multi-objective optimization using determinantal point processes for the ranking stage, balances diversity and utility while enabling fast iterations and scalable expansion to diversification over multiple dimensions. Our experiments indicate that these approaches significantly improve diversity metrics, with a neutral to a positive impact on utility metrics and improved user satisfaction, both qualitatively and quantitatively, in production.

### **16. Exploring Adapter-based Transfer Learning for Recommender Systems: Empirical Studies and Practical Insights**

Junchen Fu, Fajie Yuan, Yu Song, Zheng Yuan, Mingyue Cheng, Shenghui Cheng, Jiaqi Zhang, Jie Wang, Yunzhu Pan

https://arxiv.org/abs/2305.15036

Adapters, a plug-in neural network module with some tunable parameters, have emerged as a parameter-efficient transfer learning technique for adapting pre-trained models to downstream tasks, especially for natural language processing (NLP) and computer vision (CV) fields. Meanwhile, learning recommendation models directly from raw item modality features -- e.g., texts of NLP and images of CV -- can enable effective and transferable recommender systems (called TransRec). In view of this, a natural question arises: can adapter-based learning techniques achieve parameter-efficient TransRec with good performance?

To this end, we perform empirical studies to address several key sub-questions. First, we ask whether the adapter-based TransRec performs comparably to TransRec based on standard full-parameter fine-tuning? does it hold for recommendation with different item modalities, e.g., textual RS and visual RS. If yes, we benchmark these existing adapters, which have been shown to be effective in NLP and CV tasks, in the item recommendation settings. Third, we carefully study several key factors for the adapter-based TransRec in terms of where and how to insert these adapters? Finally, we look at the effects of adapter-based TransRec by either scaling up its source training data or scaling down its target training data. Our paper provides key insights and practical guidance on unified & transferable recommendation -- a less studied recommendation scenario. We promise to release all code & datasets for future research.

### **17. Advances and Challenges of Multi-task Learning Method in Recommender  System: A Survey**

Mingzhu Zhang, Ruiping Yin, Zhen Yang, Yipeng Wang, Kan Li

https://arxiv.org/abs/2305.13843

Multi-task learning has been widely applied in computational vision, natural language processing and other fields, which has achieved well performance. In recent years, a lot of work about multi-task learning recommender system has been yielded, but there is no previous literature to summarize these works. To bridge this gap, we provide a systematic literature survey about multi-task recommender systems, aiming to help researchers and practitioners quickly understand the current progress in this direction. In this survey, we first introduce the background and the motivation of the multi-task learning-based recommender systems. Then we provide a taxonomy of multi-task learning-based recommendation methods according to the different stages of multi-task learning techniques, which including task relationship discovery, model architecture and optimization strategy. Finally, we raise discussions on the application and promising future directions in this area.

### **18. Optimizing Long-term Value for Auction-Based Recommender Systems via  On-Policy Reinforcement Learning**

Ruiyang Xu, Jalaj Bhandari, Dmytro Korenkevych, Fan Liu, Yuchen He, Alex Nikulkov, Zheqing Zhu

https://arxiv.org/abs/2305.13747

Auction-based recommender systems are prevalent in online advertising platforms, but they are typically optimized to allocate recommendation slots based on immediate expected return metrics, neglecting the downstream effects of recommendations on user behavior. In this study, we employ reinforcement learning to optimize for long-term return metrics in an auction-based recommender system. Utilizing temporal difference learning, a fundamental reinforcement learning algorithm, we implement an one-step policy improvement approach that biases the system towards recommendations with higher long-term user engagement metrics. This optimizes value over long horizons while maintaining compatibility with the auction framework. Our approach is grounded in dynamic programming ideas which show that our method provably improves upon the existing auction-based base policy. Through an online A/B test conducted on an auction-based recommender system which handles billions of impressions and users daily, we empirically establish that our proposed method outperforms the current production system in terms of long-term user engagement metrics.

### **19. Curse of "Low" Dimensionality in Recommender Systems, SIGIR2023**

Naoto Ohsaka, Riku Togashi

https://arxiv.org/abs/2305.13597

Beyond accuracy, there are a variety of aspects to the quality of recommender systems, such as diversity, fairness, and robustness. We argue that many of the prevalent problems in recommender systems are partly due to low-dimensionality of user and item embeddings, particularly when dot-product models, such as matrix factorization, are used.

In this study, we showcase empirical evidence suggesting the necessity of sufficient dimensionality for user/item embeddings to achieve diverse, fair, and robust recommendation. We then present theoretical analyses of the expressive power of dot-product models. Our theoretical results demonstrate that the number of possible rankings expressible under dot-product models is exponentially bounded by the dimension of item factors. We empirically found that the low-dimensionality contributes to a popularity bias, widening the gap between the rank positions of popular and long-tail items; we also give a theoretical justification for this phenomenon.