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Biases in Algorithms

Said Aliyev[1]

[1]West Park High School, Roseville, California

ARTICLE INFORMATION	ABSTRACT
	In recent years, recommendation algorithms have become increasingly common on digital platforms. If a person is interested in something and they search for specific content, then that leads to more of the same content showing up in their recommendations. This study investigates, does a simple recommendation algorithm develop bias over time? The hypothesis was that recommendations depend on past user clicks; bias would increase over time. I created a python simulation with three content categories that were run for 50 cycles. The algorithm increased recommendation probability based on users clicks. One category became dominant while others decreased. Investigation concludes that simple algorithms can unintentionally create bias.

1. Introduction

Personalized recommendation algorithms are used on digital platforms to provide users with customized content (Gomez-Uribe & Hunt, 2015). Such algorithms affect the way people are presented with videos, posts, or articles through the process of choosing the content according to user behavior (Ricci et al., 2015).

The first concern associated with recommendation systems is algorithmic bias. Algorithmic bias refers to the situation where algorithmic outcomes tend to favor some results over others because of feedback processes and imbalances in data (Barocas et al., 2019). Algorithmic bias in recommendation systems can arise from the continuous use of past interactions between users and the system, which can create feedback processes that tend to favor similar items (Mansoury et al., 2020).

2. Aim of the Research

The aim of this research was to explore whether or not bias emerges in a simple recommendation algorithm over time. It was hypothesized that if the recommendations were based on the previous click behavior of the user, one category would emerge as more popular, and the other categories would decrease in popularity. A simulation using Python was employed to test the hypothesis. It was found that one category emerged as more popular than the other, and the diversity of the content available dropped.

3. Findings

Figure 1: Recommendation frequency of three content categories over time.
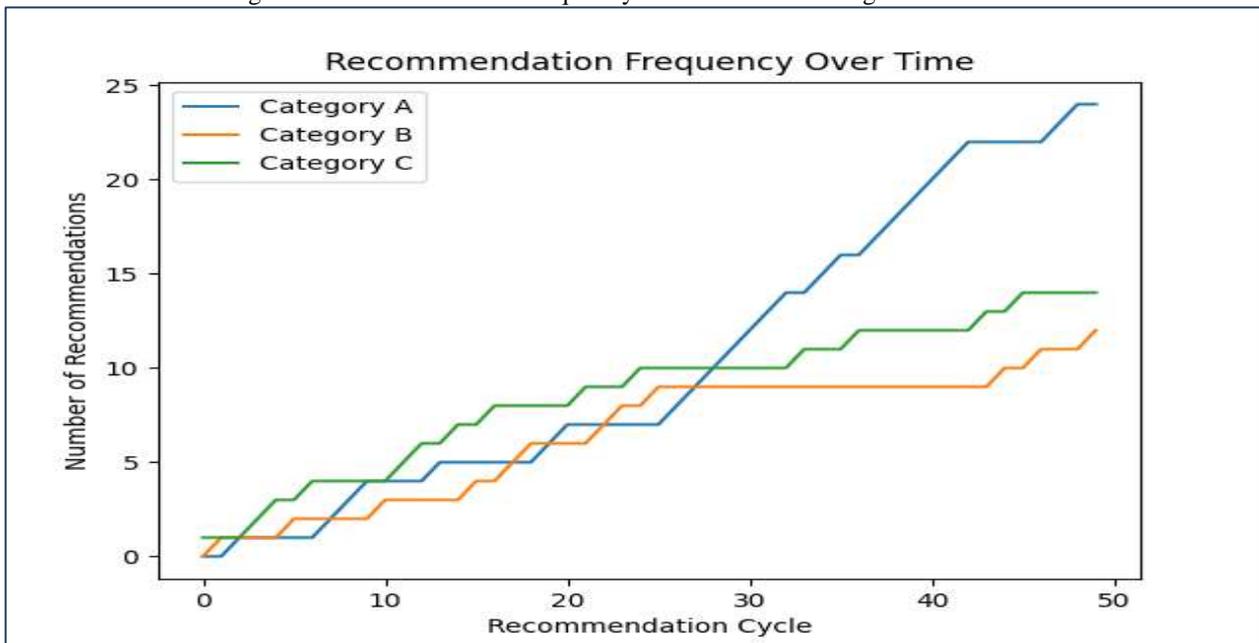
Line graph showing how often each content category was recommended across 50 recommendation cycles in a Python based simulation.

Table 1: Final distribution of content recommendations after 50 cycles.

Content Category	Number of Recommendations	Percentage of Total
A	34	68%
B	9	18%
C	7	14%

Table 1 shows the total number and percentage of recommendations for each content category recorded during the simulation.

4. Conclusion and Recommendations

4.1 Conclusion

The research demonstrated that a straightforward recommendation algorithm could gradually lead to bias in its recommendations over time, nudging it toward certain types of content based on what users had previously interacted with. One content category begins to dominate, and others end up with fewer recommendations, and overall content diversity gets reduced. This provides evidence that the hypothesis is still valid.

4.2 Recommendations

Several reasons may explain the bias in the results of the experiment. First, the test was conducted using a simplified environment: only one simulated user, and three types of content. Conditions would be far more challenging, with a substantial number of users and more variables and algorithms at play. Additionally, the simulation ran for a set of cycles, so running it for a different number of cycles or starting the simulation under different conditions, would have produced different conclusions.

References

[1] Gomez-Uribe, Carlos A., and Neil Hunt. "The Netflix Recommender System: Algorithms, Business Value, and Innovation." ACM Transactions on Management Information Systems, vol. 6, no. 4, pp. 1–19.

[2] Ricci, Francesco, Lior Rokach, and Bracha Shapira. Recommender Systems Handbook. Springer.

[3] Barocas, Solon, Moritz Hardt, and Arvind Narayanan. Fairness and Machine Learning. MIT Press.

[4] Mansoury, Masoud, et al. "Feedback Loop and Bias Amplification in Recommender Systems." arXiv.

Appendix
Github(code created for this research)
Said0640/Research-Project