Bayesian Rank Prediction Evaluation

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***Abstract*—To be completed**

***Index Terms*—Bayes Theorem, Bayesian Prediction, Item Based Recommendation System, Content Based Recommendation System, AUC, ROC.**

I. Introduction

ITEM recommendation plays a pivotal role in delivering tailored content or products to users, anticipating their preferences and needs. The fundamental objective of this task is to predict a personalized ranking among a myriad of items, such as websites, movies, or products. In this paper, we delve into a prevalent scenario where implicit feedback, including user actions like clicks or purchases, guides the recommendation process.

Common approaches to item recommendation from implicit feedback, such as matrix factorization (MF) or adaptive k-nearest-neighbor (kNN), have been designed with the aim of personalized ranking. However, an intriguing observation surfaces: these methods, despite their intended purpose, are not directly optimized for the intricate task of ranking. In response to this gap, my research uses a set of optimization criterion, termed BPR-Opt [1], specifically tailored for personalized ranking. This criterion arises as the maximum posterior estimator derived from a Bayesian analysis of the problem.

In an effort to enhance the efficacy of our approach, I propose the incorporation of Content-Based analysis and ranking. This strategic addition aims to elevate the probability and evaluation metrics of BPR, further refining the accuracy and relevance of personalized recommendations. In the realm of content-based analysis, I aim to elevate the metrics of BPR through enhancements utilizing Cosine and Jaccard Similarity.

II. Methods and Tools

1. Content Based

Leveraging genres as a pivotal content medium, the extraction process involved meticulously curating a list of movies exhibiting a similarity threshold surpassing 0.9 for each user's set of rankings. Following this, a nuanced approach was implemented to append new ratings to these movies. The methodology for assigning these ratings was intricately tailored to align with the user's existing ranked values, drawing inspiration from the reference movie ranks.

This comprehensive procedure was systematically executed for a dataset comprising 100 movies, ensuring a diverse representation across genres. To validate the robustness of the approach, the examination was extended to 100 users randomly sampled for each movie. This iterative analysis provided a nuanced understanding of how user preferences and rankings were dynamically influenced by the intricate interplay of genres and similarity metrics within the dataset.

1. BPR

Implemented the Bayesian personalized ranking [1] algorithm to forecast rankings using both the pure and extended ratings data frames. Employed the AUC Score metric as a benchmark study, serving as a pivotal measure for evaluating the prediction accuracy.

III. Results

The findings demonstrate a minor improvement, revealing a 0.5% enhancement in the prediction AUC score for the training set and a noteworthy 0.7% improvement for the test set when employing the Bayesian personalized ranking algorithm (BPR). This evaluation encompassed a dataset comprising 100 movies, and the user ranks were systematically shuffled across 100 iterations.

Notably, these positive outcomes underscore the efficacy of the BPR algorithm in refining predictive performance. Moreover, the observed gains hint at the potential for even more remarkable results by augmenting the dataset with an increased number of novel ranks. As the number of ranks expands, there is a promising prospect of further refining the algorithm's ability to capture nuanced patterns and enhance its overall predictive accuracy.

IV. Dataset

Movie Lens 1M

The ML-1M dataset was utilized to extract detailed information, encompassing rankings, movies, user profiles, and genre classifications. This dataset stands as a valuable resource, facilitating a comprehensive exploration and analysis of the intricate relationships and patterns within the realm of movies.

References

[1] S. Rendle, C. Freudenthaler, Z. Gantner, and L. Schmidt-Thieme, "Bpr: Bayesian personalized ranking from implicit feedback," 2012.

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