

MACHINE LEARNING

Mini Project Report

Building the Optimal Book Recommender and measuring the role of Book Covers in predicting user ratings

Abstract

This project presents a Book Recommendation System that leverages collaborative filtering and neural network approaches to predict user preferences. Inspired by prior research on combining textual and visual data, the system utilizes Goodreads datasets containing book metadata, user ratings, and cover images. Matrix Factorization with Alternating Least Squares (ALS) was employed for collaborative filtering, achieving an RMSE of approximately 0.834, while a hybrid neural network incorporating book cover features further enhanced prediction accuracy. The study demonstrates the value of blending traditional recommendation techniques with deep learning for richer, more diverse recommendations.

1. Introduction

Recommender systems play a crucial role in helping users navigate large volumes of content. Platforms such as Amazon, Netflix, and Goodreads use algorithmic systems to suggest books, movies, or other media based on user behavior. The goal of this project is to predict user ratings for books they have not yet read, using both collaborative filtering and neural network techniques, and to generate personalized top-10 book recommendations.

2. Dataset and Features

The dataset used was derived from Goodreads and includes book metadata (title, author, genre, year, ISBN), user ratings, and book cover images. After cleaning and preprocessing, the data was divided into training, validation, and test sets in a 65-15-20 split. Approximately 15,000 users rated around 8,000 books, generating 2 million data points.

3. Methodology

Three main approaches were implemented:

1. Popularity and Naïve Bayes Baseline – A simple model ranking books by popularity and text-based sentiment.
2. Item-Item Affinity using TF-IDF – Represented book snippets as TF-IDF vectors and used cosine similarity to infer ratings.
3. Collaborative Filtering with Matrix Factorization – Used ALS to decompose the user-book matrix into latent factors and minimize RMSE.
4. Neural Networks – Combined MLP and CNN architectures to incorporate both metadata and visual features (book covers) for improved predictions.

4. Results and Discussion

The optimized Matrix Factorization ALS model achieved an RMSE of 0.834, outperforming the Netflix Prize benchmark (0.8712). TF-IDF also performed well with a high nDCG score and stronger diversity. The combined neural network (MLP + CNN) model achieved the best results overall, confirming that while cover images alone are weak predictors, combining them with metadata enhances performance.

5. Conclusion and Future Work

The project successfully demonstrates that Matrix Factorization and Neural Network methods can be effectively combined to improve book recommendation accuracy. Future work includes improving diversity, exploring hybrid ensemble models, and extending the model to personalized recommendations based on deeper user profiling.

6. References

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