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Spotify Recommendation System

University of Verona - Master degree in Data science - Mining Massive Datasets

Introduction

Taking inspiration from the Spotify Million Playlists Dataset Challenge, my goal is to build a recommendation system based on the Million Playlist Dataset (MDP).

MDP contains 1,000,000 playlists, including playlist titles and track titles, created by users on the Spotify platform between January 2010 and October 2017.

I assumed each user has only one playlist (this is not mentioned in the MPD description) in order to build the utility (user/item) matrix.

In the MDP dataset if a song belongs to a playlist, it means that the user is interested in it. Differently from explicit feedback such as rating, this is considered as implicit feedback.

I used 2 different techniques for training a recommender system based on collaborative filtering:

1. **a matrix factorization (MF) using alternating least squares (ALS)**
2. **a matrix factorization (MF) using a deep neural networks (DNN)**

Since serving the models was out of project scope, there is no implementation of retrieval indexing.

Solution description

MF model using ALS

ALS is an iterative algorithm applied to generate the user and item embedding matrices. After initializing user and item embeddings , at each iteration, one matrix is fixed and the other is solved by least squares. Next, the newly-updated factor matrix is held constant to optimize the other matrix. The iterative steps will be repeated until convergence.

I implemented the code in python using the Implicit library.

Mathematical details about the model can be found in the original paper [1].

MF using DNN

DNNs can incorporate side features which can help capture the specific informations about users and items.

I decided to use as additional information to the users the playlist title, which is already present i MDP.

As additional informations to the items I used and speechness and tempo features, which I collected from the Spotify APIs.

Side features were concatenated to the user/item embeddings.

I trained 2 different models:

1. using for each embedding just 1 projection layer without activation function
2. using for each embedding a dense layer with activation function in addition to the projection layer

For both models I implemented the code in python using the Tensorflow Recommender System library, which uses as loss function Categorical Cross Entropy.

This becomes basically a multiclass classification problem.

Mathematical details about the model can be found in the original paper [2].

Results

Training was made on a machine equipped with 2 NVIDIA GeForce RTX 2080 Ti.

Metrics used was Precision@K=10 to make the results from the 2 models comparable.

I trained the neural network models with different SGD optimizers (Adam and Adagrad) and different embedding dimensions (32,64).

All models were trained for 100 epochs with constant learning rate.

The first model always performed better than the second one, in both variants.

This is probably because of the small size of the dataset.

Grid search could be made to find better hyperarameter configuration.

References

[1] Collaborative Filtering for Implicit Feedback Datasets

[2] Neural Collaborative Filtering