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ORIGINAL ARTICLE

Neural group recommendation based on a probabilistic semantic aggregation

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Abstract
Recommendation to groups of users is a challenging subfield of recommendation systems. Its key concept is how and where to make the aggregation of each set of user information into an individual entity, such as a ranked recommendation list, a virtual user, or a multi-hot input vector encoding. This paper proposes an innovative strategy where aggregation is made in the multi-hot vector that feeds the neural network model. The aggregation provides a probabilistic semantic, and the resulting input vectors feed a model that is able to conveniently generalize the group recommendation from the individual predictions. Furthermore, using the proposed architecture, group recommendations can be obtained by simply feedforwarding the pre-trained model with individual ratings; that is, without the need to obtain datasets containing group of user information, and without the need of running two separate trainings (individual and group). This approach also avoids maintaining two different models to support both individual and group learning. Experiments have tested the proposed architecture using three representative collaborative filtering datasets and a series of baselines; results show suitable accuracy improvements compared to the state of the art.

Keywords Group recommender system · Collaborative filtering · Aggregation models · Deep learning

1 Introduction

Personalization is one of the fields of Artificial Intelligence (AI) that has a greater impact on the lives of individuals. We can find a multitude of services that provide us with a personalized choice of news, videos, songs, restaurants, clothes, travels, etc. The most relevant tech companies make extensive use of personalization services: Amazon, Netflix, Spotify, TripAdvisor, Google, TikTok, etc. These companies generate their personalized recommendations using Recommender System (RS) [1] applications. Recommender System (RS) provides to their users personalized products or services (items) by filtering the most relevant information regarding the logs of items consumed by the users, the time and place that took place, as well as the existing information about users, their social networks, and the content of items (texts, pictures, videos, etc.). We can classify Recommender System (RS) attending to their filtering strategy as demographic [2], content-based [3], context-aware [4], social [5], Collaborative Filtering (CF) [6, 7] and filtering ensembles [8, 9]. Currently, the Matrix Factorization (MF) [10] machine learning model is used to obtain accurate and fast recommendations between input data (votes). Matrix Factorization (MF) translates the very sparse and huge matrix of discrete votes (from users to items) into two dense and relatively small matrices of real values. One of the matrices contains the set of short and dense vectors representing users, whereas the second matrix vectors represent items. Each vector element (real

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