Abstract

The male fashion industry's growth and escalating popularity of affordable street-wear outfits demand the intervention of effective data analytics and recommender systems for male street-wears. A major fraction of the twenty-first-century's young male population wants to portray social status and different personality traits through clothing fashion. But choosing the right set of items to create an outfit that attracts others' attention is challenging. One should not expect to express fashion by dressing up with a random collection of items.

Fashionable outfits are generally created by expert fashionistas, who use their creativity and in-depth understanding of fashion to compose attractive outfits. Some men have an aesthetic sense of fashion. But those who lack such skills require tips from experts. However, creating fashionable outfits can be automated, which can help users who cannot afford to pay a hefty amount to fashionistas for getting fashion guidance. In this regard, we try to solve three challenging problems. To understand the problems, we consider different use case scenarios from the perspective of users and sellers.

First, let us consider a scenario where a user has created an outfit consisting of three or more items but unsure whether the outfit is good enough and requests assistance from an autonomous system. According to the user's requirements, what should be the basic building blocks of such a system? To solve the problem mentioned above, we build a classifier that accurately predicts an outfit's attractive quotient. Further, we build a recommendation system - MalOutRec - which provides pointed recommendations of minimal edits in outfits (i.e., changing a part of an outfit if the outfit looks unattractive). We employ an innovative methodology that uses personalized PageRank in designing MalOutRec. We collect several images of male subjects in casual wear and pose, assiduously annotate and carefully select discriminating features for the classifier. Experimental results show that MalOutRec outperforms the meta-path based baseline algorithm.

The second use case is about a composite recommendation. Suppose a user has a maximum total shopping budget and wants to update his wardrobe by purchasing a set of fashion items that are mostly compatible with each other. With the plethora of cataloged items available online, the user is confused to make the final purchase decision and wants suggestions to utilize his money most efficiently. In this scenario, what are the factors that should be taken care of by a recommender system? Most of the existing outfit recommendation systems focus on pairwise item compatibility prediction (using

visual and text features) to score an outfit combination having several items. Then provides recommendations of top-n outfits or a capsule wardrobe having a collection of outfits based on the user's fashion taste. However, none of these consider the user's preference of price-range for individual clothing types or an overall shopping budget for a set of items.

We propose a box recommendation framework - BOXREC - which at first, collects sample items across different item types (namely, top-wear, bottom-wear, and foot-wear), including the price-range of each type as a proxy for user preferences. It is essential to know about each item type's price-range because recommending items irrespective of their price may not satisfy the user's needs. BOXREC retrieves all types of preferred items from the database (according to user-specified preferences, including price-ranges). It then creates all possible combinations of three preferred items (belonging to distinct item types), verifies each combination using an outfit scoring framework - BOXREC-OSF, and generates a set of preferred outfits. Finally, BOXREC provides a box full of fashion items. Different combinations of the items maximize the number of outfits suitable for an occasion while satisfying the maximum shopping budget.

We create an extensively annotated dataset of male fashion items across various types and categories (each having associated price) and a manually annotated outfit (both positive and negative) dataset. We consider a set of recently published pairwise compatibility prediction methods as competitors of BOXREC-OSF. Empirical results show the superior performance of BOXREC-OSF over the baseline methods. We also perform both quantitative and qualitative analysis of the recommendations produced by BOXREC with encouraging results. Finally, based on user feedback corresponding to the recommendations given by BOXREC, we show that disliked or unpopular items could be a part of attractive outfits.

The third use case is inspired by the observations that we had about items that are not liked by users as a single entity but are part of outfits that are liked by them. Most fashion recommender systems exclude long-tail items with sparse rating information and concentrate on top-rated items liked by most users. Long-tail items are either unpopular (disliked by many users) or niche (visually appealing, but with very few user ratings). We propose a novel solution for promoting long-tail items via outfit recommendation by creating attractive outfits from niche, popular and unpopular fashion items. Identification of popular and unpopular items is an easy task by utilizing the user ratings as an implicit signal. However, assigning a label of niche or unpopular to items having low user ratings is relatively challenging. We regard a newly launched item as niche only if it is visually appealing, otherwise consider it unpopular.

The first part of the solution involves sorting the type-specific fashion items (e.g., top-wear, bottom-wear, and foot-wear) using a novel pairwise image ranker (PiRanker)

framework representing a comparator for identifying the niche, popular and unpopular items. In the second part, we first compose outfit combinations by mixing niche, popular, and unpopular items, then verifying each outfit combination's compatibility using a node-wise type-specific graph neural network (NTGNN). The verified compatible outfit combinations make candidate outfit recommendation sets. Experimental results exhibit the superior performance of PiRanker and NTGNN over baseline methods. NTGNN incorporates a type-specific message passing mechanism in place of the category-specific technique of the existing node-wise graph neural network (NGNN) and employs an enhanced training strategy that enables it to perform better than NGNN. Finally, we show successful promotion of 100% of the niche and unpopular items across different item types.

Keywords: male street attire, minimal edits, outfit, attractive, unattractive, conformative, individualistic, average, e-commerce, fashion, online shopping, outfit generation, outfit compatibility scoring, neural networks, optimization, pagination, composite recommendation, capsule wardrobe, convolutional neural network, gated recurrent unit neural network, graph neural network, pairwise ranking, long-tail, recommender systems