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EATOUT: Leveraging the Dynamics of Leadership in Group Recommendation Systems

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1. Introduction

In contemporary society, recommender systems play a pivotal role in shaping our daily experiences by efficiently providing personalized recommendations to individual users. However, these systems are inherently designed to cater to the preferences of a single user at a given time. There are instances, such as group outings to restaurants or travel destinations, where a collective recommendation that aligns with the diverse interests of a group is desirable. To address this, Group Recommender Systems (GRS) have emerged as a specialized area of study. GRS endeavors to synthesize preferences from all group members and generate recommendations that aim to satisfy the collective. Recognizing that each group member possesses unique preferences and tastes, achieving unanimous satisfaction poses a significant challenge. In this paper, we introduce *EATOUT*, a novel system designed to underscore the pivotal role of group leaders and explore multifaceted mutual influences, aiming to enhance overall group satisfaction.

2. Related Work

In the pursuit of generating recommendations that reflect the collective preferences of group members, two predominant methodologies have emerged, both emphasizing item features[1]. The first approach involves aggregating individual profiles to formulate a group profile, subsequently leveraging a content-based filtering technique. Here, features from individual profiles are juxtaposed against item attributes to generate recommendations. Conversely, the second approach centers on collecting individual preferences during deliberative discussions to construct a unified group profile.

While these methodologies prioritize individual preferences and explicit interactions, it is imperative to acknowledge the significance of implicit interactions within a group dynamic. For instance, certain systems accentuate the influence of a group leader during preference aggregation, gauging this influence through metrics such as the frequency of product suggestions[2]. However, such an approach may inadvertently overlook mutual influences within the group.

A consensus-reaching model was proposed which introduces mechanisms that leverage leadership dynamics to adjust member ratings for items[3]. This strategy seeks to mitigate potential biases towards a single leader's preferences, thereby enhancing group satisfaction by acknowledging and incorporating diverse viewpoints. In this study, we endeavor to enhance existing methodologies in the context of restaurant recommendation systems. Our approach involves identifying the group leader through a comprehensive analysis of both implicit and explicit interactions. By leveraging the influence of identified leaders, we aim to refine rating adjustments, ultimately striving to elevate overall user satisfaction.

3. Proposed Approach: Leadership-Oriented Recommendation

To enhance group satisfaction, our approach primarily emphasizes the role of the group leader and the influence of leadership. To ascertain leadership within the group, a multifaceted approach integrating both ratings and interactions is adopted. Initially, each member is assigned a similarity score predicated on their ratings, calculated using cosine similarity metrics between pairwise members. The individual similarity score is derived as the average cosine similarity across all members, as defined in Equation (1).

$$similarity\_score_i = \frac{\sum_{j \in G, j \neq i} cosine\_simjilarity(i,j)}{n-1} \quad (1)$$

Subsequently, an analysis of chat content is undertaken, categorizing it into four distinct facets: chat frequency, average word count per chat, activity gauged against the average word count, and the number of restaurant recommendations. Notably, the activity based on average word count delineates instances where chat frequency surpasses the established average word count. Utilizing these metrics, a chat score is computed for each member, as outlined in Equation (2).

$$chat_{score} = w_1 * chat_{num} + w_2 * average_{word} + w_3 * effective_{count} + w_4 * restaurant\_num \quad (2)$$

Furthermore, interactions are inferred when a member selects a restaurant from another member's preferred list. Such interactions are subsequently utilized to construct a directed graph characterized by weighted edges, facilitating the computation of centrality scores rooted in indegree centrality metrics for each member. Ultimately, the individual exhibiting the highest

cumulative score across similarity scores, chat scores, and centrality scores as the designated group leader. Subsequent adjustments to ratings are informed by calculating leadership impact, as delineated in Equation (3).

$$LeaderImpact = \frac{\sum_{L,i\in G;L\neq u} Similarity_{u,L} + \sum_{L,i\in G;L\neq u} Centrality_{u,L}}{2\times(n-1)} \quad (3)$$

Prior to rating adjustments, it is imperative to compute the weight between pairwise members, anchored on leadership impact metrics, as delineated in Equation (4).

$$weight_{u,v} = \begin{cases} 0.5\times\left(Leaderimpact + \frac{2\times Centrality_{u,v}\times Similarity_{u,v}}{Centrality_{u,v}+Similarity_{u,v}}\right), u\ is\ leader \\ \frac{2\times Centrality_{u,v}\times Similarity_{u,v}}{Centrality_{u,v}+Similarity_{u,v}}, otherwise \end{cases} \quad (4)$$

Subsequent rating modifications are then executed in accordance with Equation (5).

$$new\_rating_{u,i} = rating_{u,i} + \sum_{v=1}^{n} weight_{v,u}\times\left(rating_{v,i} - rating_{u,i}\right) \quad (5)$$

The composite score attributed to each restaurant encompasses two distinct components: an average score and variance. The variance mitigates potential discrepancies arising from significant rating variations among group members. To optimize the weighting scheme, distinct weights are assigned to these two parts. Based on the derived composite scores, the top three restaurant recommendations are subsequently identified.

4. EATOUT: Web-Based Restaurant Recommendation System

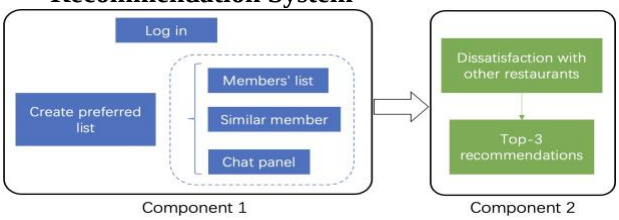

Fig.1 Restaurant Recommendation System Framework

As shown in Fig.1, the system comprises two principal components. Initially, the first component facilitates the collection of users' positive preferences, while the subsequent component focuses on eliciting negative opinions. Each group member possesses a unique account, granting access to a website where they encounter a comprehensive list of restaurants. As shown in Fig.2, they can choose and rate their favorite restaurants.

Fig.2 Homepage: Restaurant List

To foster user engagement, the system incorporates three interactive features. Firstly, users can peruse the preferred restaurant lists of fellow members; if a particular restaurant resonates with their preferences, they can seamlessly integrate it into their own list, thereby recorded as an interaction. Secondly, the system proactively notifies users of individuals exhibiting closely aligned tastes, fostering a sense of community and shared interest. Thirdly, a real-time chat panel enables users to engage in dynamic discussions and real-time restaurant recommendations. Upon completing the initial phase, users transition to the second component, where they encounter restaurants favored by other members. Here, users are prompted to express their dissatisfaction with these recommendations by rating. Failure to provide a rating results in a neutral assessment. Ultimately, based on collective evaluations and interactions, the system generates a curated list of the top three restaurant recommendations.

5. Conclusion

This paper delves into a restaurant recommendation system underscored by the pivotal roles of group leadership and interactions. To capture a comprehensive spectrum of both implicit and explicit interactions, we synergistically leverage chat functionalities and user activities. Specifically, within the chat domain, our objective extends beyond mere textual content. In the future, we aim to extract insights from discussions, encompassing both linguistic nuances and restaurant preferences. Recognizing the inherent challenges in satisfying diverse group dynamics, our system is engineered to facilitate consensus-building processes through these integrated functionalities. Looking ahead, our envisioned trajectory involves refining item scoring mechanisms in real-time, thereby augmenting overall group satisfaction.

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