Recommender Systems in Tourism

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I. INTRODUCTION

The huge amount of information about tourism and leisure activities available on the Web has turned the preparation of a trip into a very challenging task, ripe for the application of recommender systems. Travellers are very keen on using tools that may support their decision making processes when they are planning a travel, including the choice of destination, the selection of attractions to visit, the construction of a multi-day plan, the suggestion of appropriate accommodations and restaurants, etc. Complex problems such as automated planning, semantic knowledge management, group recommendation or context-awareness have by now been heavily studied in this area [2]. The studies reported at the RecSys-2015 workshop on Tourism Recommender Systems (TouRS), briefly commented in this report, provide a glimpse of the state of the art in the field and of its main current challenges.

II. MAIN LINES OF WORK

Tourism Recommender Systems (TRS) usually employ a combination of diverse types of recommendation techniques: content-based, knowledge-based, collaborative filtering, demographic, etc. However, the particular characteristics of this domain lead to continuous appearance of novel problems and the need of developing new techniques (which, in turn, could be later adopted in other domains). In the following subsections we comment on some of the most relevant areas of work in this field and on the proposals made in the TouRS workshop, which was held in Vienna in September 2015 within RecSys-2015 (9th ACM Conference on Recommender Systems), the premier international scientific venue for the study of recommender methods, techniques and applications.

A. Group recommendation

Classical recommender systems try to filter the domain items that may be more relevant for a particular user, given her demographic data, her past ratings or purchasing history and her preferences. This approach can be very suitable to recommend specific items such as books, songs or films. However, travelling is an activity that is usually carried out in groups of people (couple, family, friends, colleagues); thus, it is necessary to take into account the preferences and tastes of all the travellers when providing recommendations [4].

There are two basic options to deal with group recommendations: to merge the lists of items recommended to each group member, or to start by fusing the individual preferences into a group profile and then compute a single list of group recommendations. The two works presented in the TouRS workshop that addressed this issue chose the first alternative.

In the system *TravelWithFriends*, the first step is to build a recommendation list for each user and to merge them (using the *average without misery* strategy) to obtain a destinations shortlist. Afterwards, each group member rates all these options and a Borda count is used to determine the best five destinations to be recommended. The second work dealing with group recommendation in the workshop presented the system *CLG-REJA*, which is an extension of the *REJA* restaurant recommender for the city of Jaén in Spain [8]. In this case the first step is also the construction of a list of recommendations for each group member, taking into account her ratings. In a second step, an automatic consensus-reaching process is applied [3]. This is an iterative process in which individual preferences are continuously updated until a high degree of agreement between all the group members is reached.

B. Planning

Planning the order in which recommended tourist activities have to be visited is a complex problem that has received a great deal of attention in the last years [11]. Kurata et al. presented in the workshop *CT-Planner5*, which is the latest version of the well-known *CT-Planner* [6]. The system engages with the user in a collaborative process to construct a route. The user keeps refining her constraints iteratively, until the system can build a satisfying plan. The user may specify physical factors such as the duration of the visit, the moving speed or the difficulty to walk. It can also provide degrees of interest on nature, culture, art, shopping or entertainment activities. The user can also request more detailed requirements such as the addition of popular attractions or the inclusion of activities for children. Genetic algorithms are employed in the planning procedure.

C. Use of semantic information

The use of semantic domain knowledge in the recommendation process, usually represented in the form of an ontology, has heavily increased in recent years [12] as exemplified by three of the works presented in the workshop. Borràs et al. propose to improve the diversity of the results provided by the *SigTur* recommender [9] using a semantic clustering procedure. The semantic similarity between two concepts is defined as the ratio between the number of different ancestors and the total number of ancestors of both concepts [10]. The items to be recommended are clustered according to this semantic similarity and the recommendation procedure iteratively selects the best item from random clusters. It is shown that this procedure increases the diversity of the results while keeping their accuracy and an

acceptable computational cost. The system *Troovel* also contains an ontology with information about the different kinds of tourist activities. The degree of relationship of each item with respect to each category has been automatically computed from TripAdvisor ratings. The user profile, which is continuously updated through the analysis of the interaction of the user with the recommended items, stores a preference degree with respect to each category, which is used by a hybrid recommender system to provide the appropriate suggestions to the users. Semantic information can also be used to determine the items to be recommended in a personalized visit to a museum [1]. More concretely, Lo Bue et al. presented a mobile guide in which both the user profile and the domain items are represented with bags of DBpedia topic categories [7]. A shortest-path semantic distance is used to determine the museum objects that should be recommended to the user.

D. Theoretical results

Sánchez-Vilas et al. showed in their contribution to the workshop a surprising result: the performance of recommender systems based on k-Nearest Neighbours improves when user profiles which are quite different to the current user are considered. This result is explained in terms of the diversity prediction theorem [5], which says that a higher diversity of the items considered in the recommendation leads to a smaller global error.

E. Demo session

The TouRS workshop interactive character was especially present in a practical session, in which all the attendants were briefly presented some recommender systems applied in the Tourism area and they had the opportunity to try them on-line and to comment and discuss them directly with their developers. Apart from the systems commented in the theoretical papers, three more systems were described in this hands-on section. Jazdarreh et al. used Canterbury Cathedral as the case study of a recommender system in which tourists may physically interact with NFC smart posters to obtain more information about a touristic site. Borràs et al. presented a Web-based recommender and planner of tourist activities in the Mediterranean geographical area of Costa Daurada and Terres de l'Ebre. This application makes a complex dynamic management of the preferences of the user through the continuous analysis of her interaction with the system. Finally, Donohue et al. described the mobile application *relEVENTcity*, a personalized recommender of events that combines semantic information about activities, management of user preferences and collaborative filtering techniques.

III. CONCLUSIONS

Tourism is a very exciting field of application of recommender systems [2], which is currently attracting a very high level of attention. The TouRS workshop, held at the RecSys-2015 conference, had over 40 attendants both from academia and industry. They witnessed the presentation of both theoretical and practical results that highlighted some of the most relevant areas of current work in this field, including planning, group recommendation and the management of semantic knowledge. There was a strong interaction and lively discussions between the authors and the audience.

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