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Module for topics recommendation

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Abstract

Recommending activities to elderly people is a key factor to attract them for attending diverse events and thus improve their social inclusion. An efficient event recommendation system considers the past attendance as a clue of individual interests, and positions the user within a social network to exploit the preferences of like-minded users. In this report, we propose a SPARQL-based method that infers the user profile based on an ontological representation of the user's activities. This method allows to incrementally update the user's interests that vary over the time. Finally, we propose to utilize a hybrid recommender system that combines content-based and collaborative filtering approaches to recommend events closely related to the user's interests and sufficiently diverse.

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1 Executive Summary

Recommending activities to elderly people is a key factor to attract them for attending diverse events and thus improve their social inclusion. An efficient event recommendation system considers the past attendance as a clue of individual interests, and positions the user within a social network to exploit the preferences of like-minded users. In this report, we propose a SPARQL-based method that infers the user profile based on an ontological representation of the user's activities. This method allows to incrementally update the user's interests that vary over the time. Finally, we propose to utilize a hybrid recommender system that combines content-based and collaborative filtering approaches to recommend events closely related to the user's interests and sufficiently diverse.

2 Abbreviations and Acronyms

CB	Content-based recommendation
CF	Collaborative Filtering recommendation
FOAF	The Friend Of A Friend
LODE	An ontology for Linking Open Descriptions of Events.
LOD	Linked Open Data
RDF	The Resource Description Framework is a knowledge representation language based on a triple model, and serves as foundation for other semantic web languages such as RDFS or OWL
SIOC	Semantically-Interlinked Online Communities
SPARQL	The Semantic Web query language

3 Introduction

The ALIAS project aims to develop a mobile robot platform that assists elderly users in their daily life and promotes their social inclusion. The robot supports, among other services, the functionality to help users to attend social events of interest for entertainment and social integration purposes. In such scenarios, a recommendation mechanism is required to suggest interesting topics and events that enhance users' participation in social activities and sustain their relationships.

Two tasks are required for recommending content to best fit the user's needs. Firstly, it is imperative to construct a sufficiently-detailed model of the user's interests through preference elicitation. The user profile can be obtained either explicitly from the user's metadata or implicitly by observing behavioral patterns. Secondly, a ranking function will predict the top recommended future events according to each user's profile.

In this deliverable, we first propose a method for modeling users' profiles based on semantic web technologies in order to build a recommendation system (Chapter 4). We then describe some existing event recommender systems which take the user's past activities as well as like-minded users into account (Chapter 5). Finally, we give our conclusions and outline future work in Chapter 6.

4 User Modeling

A user model represents all kind of information related to a user's context exploited to provide personalized user experience. It describes various features of the user such as demographic information (age, gender, country, etc.) and his interests (news topics and hobbies-related topics) [2]. The content of the model can be explicitly provided by the user or learned by observing user's activities, such as attended events and browsing histories. It is in general represented by a set of weighted topics, in which each weight indicates the intensity of the user's interest in the topic. A typical method is to represent the user model by weighted vectors of keywords using the term frequency/inverse document frequency(TF-IDF) [7, 3]. In this work, we propose a semantic approach to model the user context around events, so that the user's model could straightforwardly be constructed by means of SPARQL queries.

4.1 User Context

In order to conveniently describe the user context in event-based service, we propose the ontological model in Figure 4.1, in which a set of known vocabularies have been used such as LODE[1], SIOC[2] and FOAF[3]. This model provides an insight about user's past activities formalized in a machine-readable format. It depicts the semantic relationships linking the user identified by "Gabriela Pirela" on Last.fm with other items such as event, location and agent. By detecting what events, locations, artists in which the user has been interested in, we identify a set of social interests that could be exploited in recommender systems.

4.2 SPARQL-based User Modeling

Using the SPARQL queries, we mine the semantic relationships that link a user with different concepts. We attempt to discover the user's interests related to events, locations and agents considered as part of the user's profile. The past attended events present a clue to find the topics and locations of interest. We consider that the weight of each concept in the user model depends on the frequency of attendance. This method allows to incrementally update the weights of the user's interests that vary over the time. Based on the ontological model of the user context, we define a set of SPARQL queries to detect the topics of attended events, the artists of interest and the visited places. For example,

[1] http://linkedevents.org/ontology/

[2] http://sioc-project.org/ontology

[3] http://xmlns.com/foaf/spec/

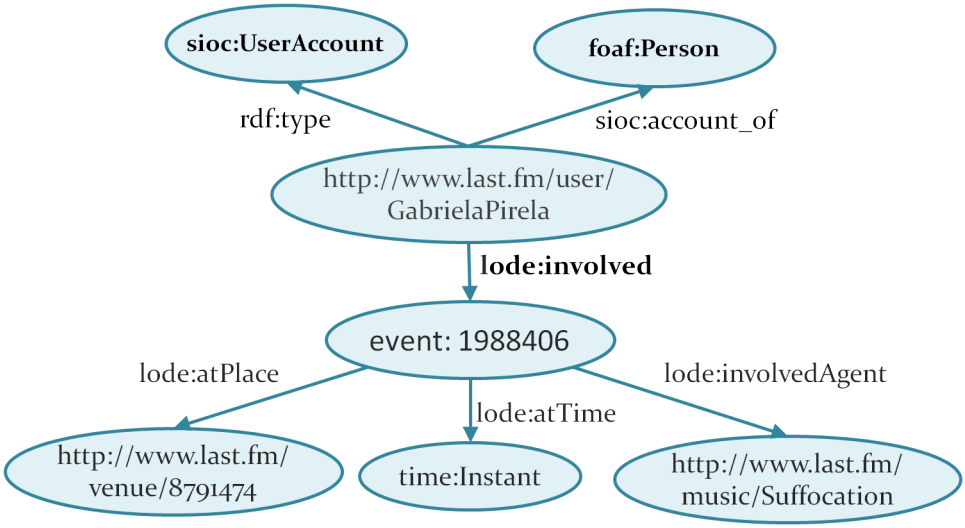


Figure 4.1: The metadata attached to the user named *Gabriela Pirela*

Listing 4.1 illustrates the SPARQL query to retrieve the list of topics of attended events. More details about the SPARQL queries are available in the deliverable D4.4 [10].

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX lode: <http://linkedevents.org/ontology/>
PREFIX dc: <http://purl.org/dc/elements/1.1/>
SELECT ?user (sql:group_digest(?topic , ', ', 1000, 1)) as ?topics
WHERE {

  ?event rdf:type lode:Event .
  ?event lode:involved ?user .
  { ?event lode:hasCategory ?topic } union { ?event dc:subject ?topic }

} GROUP BY ?user
```

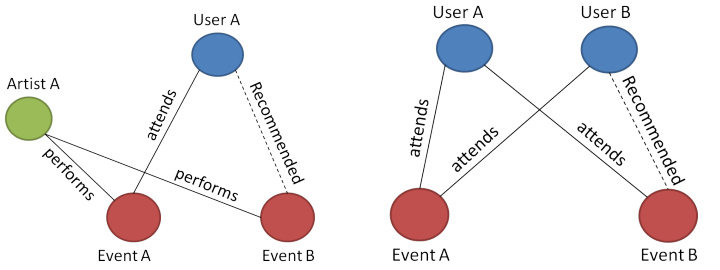
Listing 4.1: SPARQL query to retrieve event topics of users' interests

Once the concepts are extracted, they can be enriched by a semantic background knowledge from Linked Open Data (LOD). This task exploits the open datasets reconciled with EventMedia such as DBpedia, MusicBrainz and Foursquare, to further retrieve additional information about the user's interests. For example, the work in [1] highlights the role of LOD-based background information to enhance the quality of the user modeling and recommendation process.

5 Event Recommendation

The event recommendation has recently gained momentum in some online services to suggest relevant events that take place nearby. In contrast to general item recommendation systems, the event recommendation should consider the short life time of an event. It is only valid after the event is created and before the event starts. Therefore, the system has to recommend items for which there is no feedback. This distinguishes events from other information items, like movies, for which some user feedback is directly available and continues to be useful [9]. Some approaches towards event recommendation exist. They exploit the two main strategies of recommender systems namely, the content-based (CB) and collaborative filtering (CF). Several techniques of these strategies have been presented in details in [8]. The content-based approach recommends items that are similar to those in which the user has been interested in the past (Figure 5.1-a). It compares representations of content describing an item (often by a vector of weighted words) to representations of content which interests the user. In the event scenario, the CB algorithm compares the metadata of a future event such as title, artists and keywords, to the user's profile built from his past experience. However, the produced CB recommendation has a limited diversity since only events similar to the user's past preference could be suggested. To tackle this limitation, there is need for a collaborative modeling of the user preferences that positions the user within a network of like-minded individuals (Figure 5.1 b). This modeling is employed in CF recommender systems, a widely used technique in many well-known services such as Amazon, Faceboook, LinkedIn, MySpace and Last.fm. The system makes automatic predictions (filtering) about the interests of a user by collecting preferences from similar users (collaborating).

The CB an CF approaches are largely complementary and most of research studies attempt to build hybrid systems. For example, Cornelis et al. [4] propose a hybrid approach



(a) Content-based recommendation: events in neighbourhood similarity

(b) Collaborative filtering recommendation: like-minded users

Figure 5.1: The basis methods for CB and CF recommender systems

within a fuzzy relational framework. The underlying idea is to recommend future events if they are similar to past events that similar users have liked. Minkov et al. [9] follow the same intuition and propose a low rank collaborative methods to predict the ratings of future events. They highlight the performance of a collaborative approach over a pure content based approach, however location of the event is not considered. In [6], Kayaalp et al. use a hybrid system to recommend future events within a social network. They created "Eventer", a Facebook application that collect events from third websites and compute event similarities using content-based and collaborative methods. A user-centric evaluation comparing various algorithms based on various characteristics showed that this straightforward combination of CF and CB recommendations outperforms both individual algorithms on almost qualitative metrics such as accuracy, novelty, diversity, satisfaction, and trust [5]. Based on these findings, we decide to integrate a hybrid recommender system in EventMedia that exploits Linked Data to enhance the quality of user and event profiles.

6 Conclusion

This deliverable describes the user modeling and recommendation techniques required to build an efficient system to recommend events in ALIAS. Using an ontological user profiling, we have been able to track the users' interests directly from their attendance at known events. Both user and event profiles will be used to suggest upcoming events, a particular problem where there is no previous user feedback on items to recommend. To solve this, several techniques exploit the past activities of the user as well the structure of his social network. Such a system is important in ALIAS to provide diverse activities and appealing experiences for elderly people, and to maintain an active social network. In this context, we believe that the recommendation should put an emphasis on cultural and lifestyle events considered as primary topics for elderly people.

Bibliography

[1] F. Abel, C. Hauff, G.-J. Houben, and K. Tao. Leveraging user modeling on the social web with linked data. In *12th International Conference on Web Engineering*, Berlin, Heidelberg, 2012.

[2] M. Barla. Towards social-based user modeling and personalization. In *Information Sciences and Technologies Bulletin of the ACM Slovakia*, volume 3, pages 52–60, 2011.

[3] D. Billsus and M. J. Pazzani. A personal news agent that talks, learns and explains. In *3rd Annual Conference on Autonomous Agents*, Seattle, Washington, United States, 1999.

[4] C. Cornelis, X. Guo, J. Lu, and G. Zhang. A fuzzy relational approach to event recommendation. In *2nd Indian International Conference on Artificial Intelligence*, Pune, India, 2005.

[5] S. Dooms, T. D. Pessemier, and L. Martens. A user-centric evaluation of recommender algorithms for an event recommendation system. In *RecSys'11 Workshop on Human Decision Making in Recommender Systems*, 2011.

[6] M. Kayaalp, T. Özyer, and S. T. Özyer. A collaborative and content based event recommendation system integrated with data collection scrapers and services at a social networking site. In *The 2009 International Conference on Advances in Social Networks Analysis and Mining*, 2009.

[7] H. Lieberman, C. Fry, and L. Weitzman. Exploring the web with reconnaissance agents. In *Communications of the ACM*, pages 69–75, Aug. 2001.

[8] P. Melville and V. Sindhwani. Recommender systems. In *Encyclopedia of Machine Learning*, pages 829–838. Springer, 2010.

[9] E. Minkov, B. Charrow, J. Ledlie, S. J. Teller, and T. Jaakkola. Collaborative future event recommendation. In *19th ACM Conference on Information and Knowledge Management*, Toronto, Ontario, Canada, 2010.

[10] R. Troncy and H. Khrouf. Module for personalized discovery of new contacts on line. ALIAS, Deliverable 4.4, 2012.