Graph-based Recommendation in the Museum

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Abstract. Mobile Cultural Heritage (CH) is a challenging area for recommendation. On the one hand visitors to CH sites have their own identity and preferences and on the other hand they may be open for new experiences. Still, in a mobile setting, successful recommendations are those that appear at the top 1 or top 3 results, given the small size of the mobile device screen and the limited attention of the users. We present how graph based techniques may enable combining visitors preferences and contextual aspects for recommendations in CH.

1 Introduction

Museums are a particular subset of the cultural heritage institutions. They are usually indoors and consist of series of exhibits that can be spread over several rooms, several floors and even several buildings. Even small museums, the number of exhibits is large enough to make it impossible to view all exhibits in one visit (an average visit to a museum is usually 30 minutes of focused attention at the beginning of the visit, and as the visit progresses the visitor interest decreases [Davey 2005]). "Once inside a museum, many choices of where to go and what to see present themselves" [Falk and Dierking 1992]. It seems that questions like where to go next, what exhibit to see next and how to find quickly an interesting exhibit are not easy to answer when visitors are facing information overload introduced by the richness of the museum content. This task becomes more complicated the bigger the museum gets. Moreover, the museum visit is a leisure activity, where visitors follow their own paths at their own pace. Falk [2009] identifies five main types of museum visitors' identities: explorer, facilitator, experience seeker, professional/hobbyist and recharger, where each type may have different needs and as result may need different support. Since different visitors have different preferences and needs during the visit, it is important to build up knowledge and to understand their needs, interests and preferences in order to accommodate them. This challenge is addressed by CH recommender systems that take into account user needs and preferences and recommend relevant information out of a much larger body of information that may be available as surveyed by Ardissono et al. [2012].

This research aims to explore the potential contribution of graph-based recommender system to the museum visit experience. It seems natural to implement a graph-based recommendation algorithm in the museum environment since parts of the

underlying data can be represented naturally by a graph that consists of typed entities and relations. In particular, nodes in the graph may denote exhibits, and the graph edges may denote semantic relatedness, as well as physical proximity relations. Given the graph, various metrics can be used to evaluate the similarity between nodes, which are not directly linked in the graph. We apply graph-walk based metrics to rank exhibits by their similarity to other items that are known to be of interest to a user, thus perform graph-based recommendation in a graph that represents multiple aspects of the museum environment. To this end, the following questions are explored:

1. How can a museum visit be represented using a heterogeneous entity-relation graph, taking into account physical, thematic and other relations between exhibits?
2. Is the application of graph walk techniques advantageous, compared with classical vector-based approaches, in creating a personalized tour for the museum visitor?

2   Initial results and discussion

We used a data set of real museum visit, recorded over a period of 3 years at the Hecht museum [Kuflik et al. 2011]. The dataset includes feedback scores collected from visitors with respect to offered presentations, which are available to them on a personal mobile device, near each exhibit. We experimented with classical content based (CB) and collaborative filtering (CF), matrix factorization (MF) as well as with three graph variants, performing 10-fold cross validation experiments:

— Museum structure graph (G-S): including *presentation, position* and *theme* nodes.
— Visitors graph (G-V): including *presentation* and *visitors* nodes, having presentation nodes linked to visitors who assigned them high feedback scores.
— Combined graph (G-C) of visitors and museum information

As in a mobile setting, a visitor may not be willing to scroll down a list of results, especially when using a mobile device with a small screen, we evaluated the results using the top 1 and top 3 measurements – top 1 may represent a proactive situation where the system proactively presents information to the visitor while top 3 represents a situation where the visitor remains in control, but chooses from a small list using her/his mobile device. The results (see by table 1) show that using the graph for recommendation provides the best results. The graph that describes the museum structural information is competitive with content-based recommendation. The visitors and combined graph variants outperform collaborative filtering and matrix factorization.

Table 1. Precision at top-K per exhibit

	CB	CF	MF	G-S	G-V	G-C
Top-1	0.34	0.40	0.46	0.41	**0.64**	**0.64**
Top-3	0.80	0.83	0.83	0.82	0.93	**0.94**

We believe that the graph representation is advantageous especially with respect to the data sparcity and the contextual aspects it encapsulates with respect to classical recommendation approaches

3 References

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