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Behavioral User Modeling for Point of Interest Recommendation in Smart Museums

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1 Introduction

The Internet of Things (IoT) holds the promise to blend real-world and online behavior in principled ways, yet we are only beginning to understand how to effectively exploit insights from the online realm into effective applications in smart environments. Such smart environments aim to provide an improved, personalized experience based on the trail of user interactions with smart devices, but how does recommendation in smart environments differ from the usual online recommender systems? And can we exploit similarities to truly blend behavior in both realms to address the fundamental cold-start problem?

In this article, we experiment with behavioral user models based on interactions with smart devices in a museum, and investigate the personalized recommendation of what to see after visiting an initial set of Point of Interests (POIs), a key problem in personalizing museum visits or tour guides, and focus on a critical one-shot POI recommendation task—where to go next?

2 Proposed Approach

In order to model users behavior with an aim of providing an effective POI recommendation based on users implicit information interactions, we have logged users' onsite physical information interactions during visits in an IoT-augmented museum exhibition at scale, which is discussed in details in [3, 4]. Furthermore, we have collected an even larger set of search logs of the online museum collection. Users in both sets are unconnected, for privacy reasons we do not have shared IDs. We study the similarities between users' online digital and onsite physical information interaction behaviors, and build new behavioral user models based on the information interaction behaviors in i) the physical exhibition space, ii) the online collection, or iii) both.

Specifically, we propose a deep neural multi-layer perceptron (MLP) based on explicitly given users' contextual information, and set-based extracted features using users' physical information interaction behaviors and similar users' digital information interaction behaviors. According to our experiments detailed in [1, 2], there are number of external factors available in the physical environment contributing as biases in collected information interaction logs, which has to be considered in learning a behavioral user model for POI recommendation. These biases are position and temporal rank bias created based on users'

walk-through behavior [1]. Furthermore, users' behavior is also affected by other visitors around them, which leads to an observation of crowd-bias in collected onsite interaction logs [2].

Our experimental results indicates that the proposed behavioral user modeling approach, using both physical and online user information interaction behaviors, improves the onsite POI recommendation baselines' performances on all evaluation metrics. Our proposed MLP approach achieves 83% precision at rank 1 on the critical one-shot POI recommendation problem, realizing the high accuracy needed for fruitful deployment in practical situations. Furthermore, the MLP model is less sensitive to amount of real world interactions in terms of the seen POIs set-size, by backing of to the online data, hence helps address the cold start problem in recommendation.

3   Conclusions

Our general conclusion is that it is possible to fruitfully combine information interactions in the online and physical world for effective recommendation in smart environments.

Acknowledgments

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