Analysis and Prediction of User Behaviour in a Museum Environment

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Virtual environments such as internet web sites, virtual maps, and even video game landscapes provide digital representations of conceptual or real spaces. In many cases these virtual maps are best understood by relating them to a corresponding physical environment. Moving around these virtual spaces gives users a feeling of moving through a simulated physical environment.

The way in which a virtual space can describe its physical counterpart allows us to use the information that is easily accessible in the virtual environment to give added meaning to elements of the physical environment. This enables a person in an information-rich physical environment such as a city, town, shop or museum to gain access to this otherwise hidden layer of content through the use of portable technology.

This study aims to find accurate methods of predicting how a user will act in an information-rich space. The space focused on in this research is a museum. The predictions take the form of which exhibits a visitor will visit given a history of previously visited exhibits. These predictions can be used to give the person within the environment recommendations on what locations they may wish to visit in the future, or to relate information to the person that is more relevant to them. A core contribution of this study is its focus on the relative import of heterogeneous information sources a user makes use of in selecting the next exhibit to visit.

Building a Recommender System based on contextual information such as those given in Resnick and Varian (1997) is the major goal here. However the environment in this circumstance is physical, and the actions of visitors are expected to vary within such a space. The effectiveness of statistical information to predict user paths is detailed and summarised in Zukerman and Albrecht (2001). Additionally, the relationship between the nature of the data and the context of the problem in which it is used for prediction is acknowledged.

The relationships exhibits have with one another is key in determining how visitors think about them. An exhibit in a museum may be many kinds of things, and most exhibits will differ in presentation and content. Any conceptual representation of an exhibit must contain the elements which identify it, be they physical attributes, such as size, colour and shape, or detailed descriptions about the content of the exhibit. Similarly it is necessary for any prediction system to have knowledge of how to treat relationships between exhibits.

The domain in which all experimentation takes place is the Australia Gallery of the Melbourne Museum. We categorised each exhibit by way of its **physical attributes** (e.g. size) and taxonomic information about the **exhibit content** (e.g. clothing or animal). We also described each exhibit by way of its **physical location** within the Australia Gallery, relative to a floorplan of the Gallery.

A conceptual model of the exhibition space is created by visitors with a specific task in mind. Interpretation of this conceptual model is key to creating accurate recommendations.

The representation of these intrinsically dynamic models is directly related to the task the visitor has in mind. Hence multiple exhibit similarity measures are necessary.

The models of exhibit representation we examine in this research are exhibit proximity, semantic relatedness and exhibit sequentiality (based on the path data of previous visitors), as well as combinations of the three. For our present purposes,

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semantic content is described by the set of keywords associated with each exhibit, although we hope to extend this in future research to look at full document representations based on associated web documents. Semantic content is represented by way of a term vector, describing the attributes of the exhibit. The three distinct conceptual similarity measures provide insight into how visitors perceive their own paths.

The methods proposed above were tested over a representative sample of three exhibit sequences. These exhibit sequences are designed to test a selection of different conceptual models that may be adopted by museum visitors.

1. v_1: A visitor interested in the history of the Melbourne CBD, a total of 6 exhibits visited.

2. v_2: A visitor interested in aboriginal art and tools, a total of 6 exhibits visited.

3. v_3: A visitor wandering, approaching things that catch his/her eye, a total of 17 exhibits visited.

The goal of testing the predictive methods against the multiple visitors is to infer which form of conceptual model each user is adhering to.

Representations based on physical proximity take into account little of how a visitor conceptualises a museum space. They do however describe the fact that closer exhibits are more visible to visitors, and are hence more likely to be visited. Proximity can be used as an augmentation to conceptual models designed to be used within a physical space.

Our preliminary experiments show that visitors entering the museum with a preconceived conceptual model relate strongly to the semantic information associated within exhibits. Visitors entering the museum with no such model tend to follow the paths of other users, exhibiting behaviour that relates to a collaborative predictive approach augmented by individual perceptions of the semantic space.

References

Paul Resnick and Hal R. Varian. 1997. Recommender systems. *Commun. ACM*, 40(3):56–58.

Ingrid Zukerman and David W. Albrecht. 2001. Predictive statistical models for user modeling. *User Modeling and User-Adapted Interaction*, 11:5–18.