Rate, Recommend, Regret – an Expert-based Approach to the Personalization of Guided Tours

Anton Eliëns[1] and Yiwen Wang[2]

[1] Vrije Universiteit, Amsterdam, The Netherlands,
eliens@cs.vu.nl
[2] Technische Universiteit Eindhoven, The Netherlands,
y.wang@tue.nl

Abstract. In this paper we propose an approach to generate personalized guided tours based on a finite collection of tours obtained by tracking the navigation of expert users. Our proposal is based on a variant of decision theory, that uses a regret function to measure the difference between a proposed decision and a finite collection of expert decisions, generalized to a finite sequence of discrete choices. Personalization may then be seen as a minimization problem over a weighting scheme, expressing the relative importance of experts of which tours are available. We illustrate our approach by showing how we may obtain guided tours in 3D digital dossiers containing information on contemporary art installations, and discuss how our approach may be applied in other cultural heritage applications.
keywords: decision theory, personalization, guided tours, digital dossier, cultural heritage

1 Introduction

Leaving all responsibility for interaction to the user is usually not a good choice, in particular when an information system contains complex, highly interrelated information. In Eliens et al. (2006b), we describe the *3D digital dossier* format, in which we presented the information of respectively the Dutch-Serbian artist Marina Abramovic[3] and the Australian artist Jeffrey Shaw[4], contemporary artists with a variety of work, ranging from video to art installations. The *digital dossier* supports navigation using a concept graph and allows for presenting media-rich material, including 3D models of artwork installations. The digital dossiers have been implemented using X3D/VRML[5] to allow for deployment on the web.

Recently we have explored *guided tours* in digital dossiers, van Riel et al. (2006), which actually automate user interaction, by mimicking user actions through events generated by a script. Although this provides an easy way to

[3] www.few.vu.nl/∼dossier05
[4] www.few.vu.nl/∼casus05
[5] www.web3d.org

create guided tours, this does not solve the problem of what to select as elements in the guided tour, or how to personalize these tours in an intelligent manner.

In this short paper, we discuss techniques from decision theory as a means to aid the construction of guided tours by consulting an advice function based on tracking the navigation behavior of expert users. We will also indicate how a similar advice function can be used for personalizing tours in cooperation with a recommender system for artwork, by altering the weight given to particular properties.

structure The structure of this paper is as follows. In section 2 we will give a brief introduction to decision theory, and in section 3 we will discuss how techniques from decision theory can be applied to the construction of guided tours in digital dossiers. In section 4, we will illustrate how to apply decision theory for the personalization of tours in a more conventional cultural heritage application and in section 5 we give our conclusions and indicate directions for future research.

2 Mathematical preliminaries – decision theory

In this section we will give a very brief introduction to decision theory, more in particular a variant of decsion theory introduced in Cesa-Bianchi and Lugosi (2006), that provides a mathematical foundation for our approach.

In classical prediction theory a prediction is a sequence of elements $x_1, x_2, \ldots$ that results from a stationary stochastic process. The risk of the prediction is taken to be the expected value of the accumulated *loss* function, measuring the discrepancey between predicted values and actual outcomes. Cesa-Bianchi and Lugosi (2006) introduce a variant of prediction theory in which no assumption is made with respect to the nature of the source of predictions. Instead, the *forecaster* is considered to be an entity that gives a prediction for an element based on *advice* of one or more *experts*. These experts might be actual sequences stored in a database. The deviation of the forecaster with the actual outcome is measured using a *regret* function, and the prediction task may hence be formulated as minimimizing the *regret* function by choosing the best expert for advice for each element of a prediction sequence.

For example, for the prediction of a bitstring of length n, the forecaster is a vector of n expert indices, that give advice for the bitvalue, *0* or *1*, in that position. In the general case, in which we have no information on the error rate of the experts' advice, we may use a weighting factor $0 \leqslant \beta_i \leqslant 1$ for each expert i, to indicate the credibility of the experts' advice. After each prediction, obtained by taking the majority decision of the experts, according to the weighting scheme, we may verify which experts fail to give the right advice, and decrease their weight, thus eliminating the influence of their advice in the long run.

3 Guided tours in digital dossiers

In digital dossiers, we explored the use of guided tours as a means to present the information in a story-like way, relieving the user of the often cumbersome task to interact, van Riel et al. (2006b). Guided tours, in the digital dossier, may take one of the following forms:

- automated (viewpoint) navigation in virtual space,
- the (narrative) presentation of a sequence of concept nodes, or
- an animation explaining, for example, the construction of an artwork.

In practice, a guided tour may be constructed as a combination of these elements, interweaving, for example, the explanation of concepts, or biographic material of the artist, with the demonstration of the positioning of an artwork in an exhibition space.

A pre-condition for the construction of guided tours based on user tracking is that navigation consists of a small number of discrete steps. This excludes the construction of arbitrary guided tours in virtual space, since it is not immediately obvious how navigation in virtual space may be properly discretized. In this case a guided tour may be constructed using a programmed agent showing the user around.

For navigation in the concept graph, as well as for the activation of the media presentation gadget, the discretization pre-condition holds, and a guided tour may be composed from a finite number of discrete steps, reflecting the choice of the user for a particular node or interaction with the presentation gadget.

For example, in the *abramovic* dossier, the user has the option to go from the *Main* node to either *Artworks*, *Video Installations* or *Interview Fragments*, and from there on further to any of the items under the chosen category. Tracking the actual sequences of choices of a user would suffice to create a guided tour, simply by re-playing all steps.

To obtain more interesting tours, we may track the navigation behavior of several experts for a particular task, for example retrieving information about the installation *Terra degli della Madre*. In case the experts disagree on a particular step in the tour, we may take the majority decision, and possibly correct this by adjusting the weight for one or more experts. When we have a database of tours from a number of experts, we may offer the user a choice of tours, and even allow to give priority to one or more of his/her favorite experts, again simply by adjusting the weighting scheme.

As a technical requirement, it must be possible to normalize interaction sequences, to eliminate the influence of short-cuts, and to allow for comparison between a collection of recordings. For the actual playback, as a guided tour, a decision mechanism is needed that finds the advice at each decision point, from each expert, to select the best step, according to a decision rule that takes the weighting scheme into account. These issues will be investigated in a research project I-GUARD[6] (Intelligent Guidance in Archives and Dossiers).

[6] www.cs.vu.nl/ eliens/i-guard.html

4 Application(s) in cultural heritage

In the CHIP[7] (Cultural Heritage Information Personalization) project, the aim is to develop a recommender system that generates a collection of artworks in accordance with the users' preferences based on the rating of a small sample of artworks. The properties on which the recommendation is based include *Period*, *Artist*, and *Genre*. The recommender system will also be used to generate guided tours, where apart from the already mentioned properties the *Location* (the proximity in the actual museum) will be taken into account.

Using a weighting scheme on the properties, that is a difference metric on the properties, a graph can be created, giving a prioritized accessibilty relation between each artwork and a collection of related artworks. By changing the weight for one of the properties, for example *Location*, in case the tour is generated for the actual museum, the priority ordering may be changed, resulting in a different tour. Moreover, similar as for the digital dossier, user tracking may be deployed to incrementally change the weight of the arcs of the graph, reflecting the actual preference of the user when deviating from an existing guided tour.

5 Conclusions

In this paper we have sketched an approach for the construction or adaptation of guided tours, using techniques from decision theory, in particular the application of a weighting scheme determining the outcome of an *advice* function, based on stored preferences of (expert) users. This technique may also be applied in an incremental fashion to adapt an existing tour to personal preferences, reflecting the actual navigation behavior of users.

The application of these techniques requires that choices are discrete and hence do not apply to arbitrary navigation in virtual environments, unless we find proper ways to encode such navigation as a small finite collection of discrete steps. Also in the discrete case, however, we must be able to normalize navigation paths, in order to compare and weigh the contribution of a collection of experts.

References

Aroyo, L., Rutledge, L., Brussee, R., de Bra, P., Gorgels, P., Stash,, N., Veenstra, M. (2005). Personalized Presentation and Navigation of Cultural Heritage Content, Multimedia and Expo, ICME 2005. IEEE International Conference, 2005

Cesa-Bianchi N. and Lugosi G. (2006), *Prediction, Learning, and Games*, Cambridge University Press

[7] www.chip-project.org

Eliens A., Huang Z., and Visser C. (2002), A platform for Embodied Conversational Agents based on Distributed Logic Programming, AAMAS Workshop – Embodied conversational agents - letś specify and evaluate them!, Bologna 17/7/2002

Eliens A., van Riel C., Wang Y. (2006), Navigating media-rich information spaces using concept graphs – the abramovic dossier, Proc. InSciT2006, 25-28 Oct. 2006, Merida, Spain

Hoorn J., Eliens A., Huang Z., van Vugt H.C., Konijn E.A., Visser C.T. (2004). Agents with character: Evaluation of empathic agents in digital dossiers, Emphatic Agents, AAMAS 2004 New York 19 July - 23 July, 2004

Riel C. van, Eliens A., Wang Y (2006), Exploration and guidance in media-rich information spaces: the implementation and realization of guided tours in digital dossiers, Proc. InSciT2006, 25-28 Oct. 2006, Merida, Spain

Riel C. van, Wang Y. and Eliens A. (2006b), Concept map as visual interface in 3D Digital Dossiers: implementation and realization of the Music Dossier, CMC2006, Costa Rica, Sept 5-8 2006

Robertson G.G. and MacKinlay J.D. (1991) , Cone trees: animated 3D visualizations of hierarchical information, Proc. of the SIGCHI Conference on Human factors in computing systems: Reaching through technology, 189 194, New Orleans, Louisiana, United States, March 1991.

Wang Y., Eliens A., van Riel C. (2006), Content-oriented presentation and personalized interface of cultural heritage in digital dossiers, Proc. InSciT2006, 25-28 Oct. 2006, Merida, Spain

Van Vugt, H. C., Konijn, E. A., Hoorn, J. F., Keur, I., Eliens, A. (2006). Realism is not all! User Engagement with Task-Related Interface Characters, Interacting with Computers, 2006