

## **Project Summary**

### **Scientific Merit**

Digital library users, like many Web users, often are overwhelmed by the amount of information available both when browsing and searching collections. Recommendation systems suggest documents and services that other users with similar tasks and interests have selected. Recommendation systems have been shown to very effectively guide users in selecting appropriate documents for their tasks. However, recommendation systems have only been implemented in limited domains (e.g., e-commerce) and not been implemented and their effects little studied in digital libraries. Furthermore, they have been implemented separately, making them difficult to adapt for new systems.

This project proposes a general recommendation engine (GRE) that any NSDL system can integrate. GRE offers an entirely new approach to selecting resources both within and across NSDL systems. It makes individual technological advances in each of the three most dominant recommendation technologies – collaborative filtering (CF), content-based filtering (CB), and knowledge-based recommendation (KB). Furthermore, it combines all three technologies to offer a far superior level in recommendation services.

This project proposes a comprehensive investigation on the impacts of recommendation systems on digital library users. Upon completion, this project should provide extensive understanding of: 1) whether and how recommendations improve digital library users' information search; 2) how recommendations change digital library users' information search behavior; and 3) whether a particular type of recommendation and presentation method is more effective for a certain type of subject domain or information search. This will help digital library system developers plan more effective ways to implement recommendation systems and present recommendations to their users in the future.

In order to further improve the recommendation accuracy, this project proposes to refine a preliminary proof-of-concept user task module by implementing an 'implicit user profiler' that learns the current user task from user behavior. This project will also investigate optimal configurations of the three recommendation engines in different situations – e.g., for varying subject domains, user types, and user tasks. The speed of recommendation generation is also critical. This project will design integrated engine scalability to work seamlessly with data from hundreds of thousands of users.

Upon completion, this project will provide a working general recommendation engine that can be plugged into any partner digital library to provide recommendation services that greatly improve digital library effectiveness. The partner digital libraries will be able to set the level of integration with GRE and adjust it as needed. Adapting a general recommendation engine will substantially save digital library system developers time and effort to implement recommendation features.

### **Broader Impact**

Unlike recommendation systems for individual collections that generate recommendations for that single collection, within the NSDL GRE will generate 'cross-collection' recommendations comprising useful resources from multiple collections. Cross-collection recommendations will give NSDL users chances to explore materials in other collections that they would not have considered otherwise.

As GRE is implemented and incorporated with more NSDL collections, it increasingly will improve the information search of NSDL users. GRE especially will benefit users who are not familiar with a subject area and its available resources. Recommendation systems select the relevant materials for users, be they students doing assignments, teachers preparing for classes, or researchers trying to understand a new topic area.

In the longer-term, this research provides the infrastructure for a much larger investigation. Our long-term research goals concern improving personalization of digital libraries such as the NSDL. Personalization involves all types of customization, such as adapting the layout of a page to re-organizing its contents. Since recommendation is a basic feature of personalization, we have chosen it as our starting point to research the impacts of and the more effective ways of personalization. If extended further, the GRE engine can be a test bed for many personalization features.