Spatio-Temporal Personalized Web Search

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ABSTRACT

With the proliferation of mobile technologies and the advent of GPS enabled personal devices, spatial as well as temporal data related to a user's presence in different places over time are becoming available. Such data can be useful in understanding and building a personal user profile that reflects their behaviour, activities and general interests. Existing applications, such as Location-based services (LBS) normally rely on 'instantaneous' space and time data values representing user's location at a certain point in time. Several approaches have been proposed in the literature that considers the use of multiple/historical data values of user's location information collected over time. However, only simple numerical interpretations of such information have been presented. In this work, it is argued that a rich spatio-temporal data model of Place is needed that incorporates, as well as facilitates, the analysis and discovery of place semantics, such as for example, the type of place, services offered by the place and relationships between places. Ultimately, such a data model will allow for the analysis of collected spatio-temporal data logs to support the development of rich personal user profiles.

Keywords: user models, spatio-temporal data, personalized web search, ontology, semantic Web.

1. INRODUCTION

The problem of information overload is recognized as a chronic feature of the Web. The amount of the data publicly available for search engine crawlers is massive and keeps growing. Also, search query keywords represent a partial view of the user's information need. Various approaches to personalized web search have been proposed to address this problem. Personalisation refers to the use of "some" information about the user to give them a tailored, personalized, set of results that is more suitable to their information needs.
The following is a list of the main approaches in the literature on the topic of personalized web search.

1. Relevance feedback and query modifications: explicit (or implicit) users feedback is used to re-formulate the search query to get more focused results.
2. Contents-based personalized search: the contents of web resources in the search results are analysed against the user's consuming behavior to identify the user's interests.
3. Hyperlinks-based personalized search: different indexes of the web corps are built, each biased towards a specific topic.
4. Community-based search: collaboration of groups of users' profiles.
5. Personalized mobile search: utilizing the location of the mobile users to enhance the search.
6. Other approaches: many other, less common, approaches exist – though some of which are not pure search utilities. These include; goal-oriented search and browsing, adaptive user interface search portals and recommender systems.

Using spatiotemporal user data in the physical space is of interest to many application domains. Context-aware systems such as LBS, personalize their information and services using several types of contextual information including location. There are many systems that employ the historical spatiotemporal data of the user's navigation in the physical space. In [2] and [3] the spatiotemporal navigation log in the physical space is used to predict the user's movements and identify social patterns as well as socially significant places. In [4] space and time data are used to analyze traveler behavior, e.g. to predict the transportation mean. In [5], spatial proximity over time is used to indicate shared interests between people. Other application employing user-based spatiotemporal data include pre-caching of data and services in mobile computing, network infrastructure optimization in mobile communications networks, and spatial reminder applications.
Several proposals in the literature aim to utilize spatial-temporal data to analyze human spatial behavior, e.g. works on Travel Behavior Analysis (TBA).

2. BUILDING THE USER PROFILE

Follow is an overview of the framework components proposed here as shown in figure 1.

1. The systems $f1$ module is responsible for geocoding the raw spatial data.
2. $f2$ then extracts the concepts reflected by

those places and their relative temporal data (representing the user's being in those places) in conjunction with other knowledgebases such as ConceptNet, the Web (where some info about some places may exist), and/or the system's own knowledgebase of places and the concepts they represent.

3. Every place can reflect more than one concept that is then used to build a personalisation profile in $f3$.
4. $f4$ represent the techniques that utilize the spatiotemporally enhanced user profile for personalising the Web search results (e.g. by clustering the results based on the concepts extracted from the spatiotemporal log).
5. Notable is the $f5$ component that is responsible for interpreting the user's web searches. This would affect the future interpretations of places (in $f3$), and also modify the concepts reflected by the previous places.

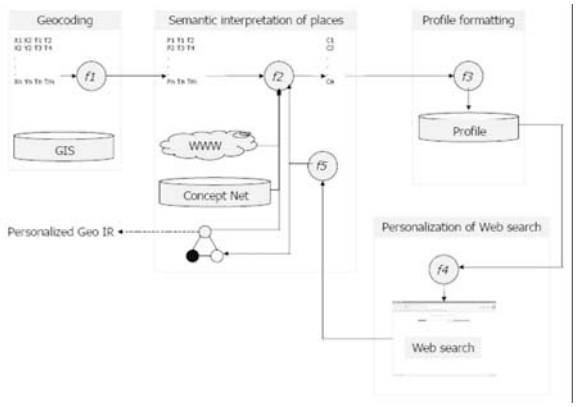

Figure 1. Proposed framework for deriving user personal profile

4. SUMMARY AND WORK PLAN

Building a personalization profile involves two main steps: semantic annotation of space and time data and the development of semantically-rich place data model, and thematic as well as spatio-temporal analysis of the data model to model user activities and behaviour.

A semantically-enriched place model will hold information related to place name, type, relationships between places, as well as other semantics such as the category of services provided by the place. The places identified will be associated with a time stamp to indicate the length of the user's visit in the place. Places are related to concepts that reflect the user's interests and goals. Knowledge bases such as ConceptNet can be used for the identification of such concepts. The project will also consider other sources of information for discovering place semantics including the web.

Reasoning techniques will be used to derive the user's personalization profile and to maintain its currency.

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