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Adaptation for the Social Web

Workshop Proceedings

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Workshop on Adaptation for the Social Web

The Social Web can be defined as a network similar to today's World Wide Web, linking people, organization, and concepts rather than documents. The main principle behind the Social Web is to harness the collective wisdom of communities of users. Over the last few years, we have observed the growth of several Social Web technologies. Social tagging, social networking, social search, social navigation, collaborative sharing and publishing are examples of these technologies. The technologies have been implemented in social systems such as Facebook (social networking), LiveJournal (blog), Del.icio.us (social bookmarking). They are all categorized by their user contributed information and knowledge in the form of user created content and user feedback.

Growth of social systems and abundance of user created information highlight the importance of adaptation and personalization. Collective information distilled by social technologies is an excellent source for adaptation reasoning. While a set of classical community based adaptation technologies can be applied in social systems, the experience can enrich adaptive hypermedia in return. The goal of this workshop is to study the challenges of adaptation in the Social Web, and influences of the Social Web research on AH and vice versa.

This workshop is third in the series, following the successful workshop on Social Navigation and Community Based Adaptation Technologies held in conjunction with AH2006, and SociUM: Adaptation and Personalization in Social Systems: Groups, Teams, Communities held in conjunction with UM 2007.

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Generating and sharing personal information spaces

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Abstract. Applications based on the Web 2.0 approach show several limitations: among them, knowledge is usually manually generated by users and can not be structured and shared in effective ways.
This paper presents an innovative architecture, conceived in terms of a multi-agent systems and aimed at creating, managing and sharing personal information spaces. Data and knowledge may be directly added by users, but also collected and structured with the support of content retrieval, filtering and automatic tagging techniques. Conceptual spaces organize personal information spaces using zz-structures, an innovative system of conventions for data and computing, capable of representing, by means graph-centric views, contextual interconnections among heterogeneous information.

1 Introduction

The concepts of the participative Web, mass collaboration and collective intelligence grow out of a Web which is increasingly influenced by innovative web services that empower the user. This is more and more engaged in the development, rating, and distribution of content, in the customization of applications, and in collaborative knowledge construction. As the Web is more embedded in people's lives, users express themselves through User-Generated Content (UGC) [18]. UGC is one of the cornerstones of Web 2.0; examples of UGC range from *social bookmarking* (e.g., del.icio.us, Digg, Furl, Spurl, etc.) to *photo and video sharing* (e. g., Flickr and YouTube), from *social networking sites* (e.g., Myspace, Friendster, Facebook) to *virtual world content* (e.g., Second Life), from *wikis* (e.g., Wikipedia) to *social-media blogs* (e.g., BoingBoing, Engadget) and *podcasting*.
UGC suggests new value chains and business models; it proposes innovative social, cultural and economic opportunities and impacts, originating new types of information. However existing models, methodologies and tools devoted to information retrieval, knowledge management and navigation support highlight severe limitations. Open issues emerge: information overload, flatness of information and knowledge extraction methodologies, personal information spaces constituted by weakly structured knowledge and lacks of personalization techniques for open corpus of documents. Our aim is to extend potentialities expressed by Web 2.0 tools empowering social bookmarking tools with deeper semantic organization and with adaptive features. Social bookmarking represents a meaningful part of Web 2.0, enabling interconnections among multiple information sources. Tools like del.icio.us, Digg, Furl, Spurl, Shadows, Scuttle, and so on,

allow users to easily add sites of their choice to their personal collection of links, categorize those sites with keywords (tags) and share their collections. Unfortunately, existing social bookmarking tools do not include adequate mechanisms for organizing user information and for personalizing it according to users' preferences and needs. Moreover, it is important to augment Web 2.0 social sites with new navigation and search tools, to integrate heterogeneous and dynamic information coming from diversified Web 2.0 sources, to structure and personalize the user concept space, and to adapt it to his/her needs and preferences. More specifically, in this paper we focus on *open and dynamic models for structuring data and personal information* in more complex users' concept spaces. For this goal, we use an extension of zz-structures [11], [4], [5], innovative data structures that gather and organize all information relevant to the user, enabling more thorough, personalized searches, directly correlated to the semantics of documents [9]. As a result, a better exploitation and sharing of knowledge can be achieved. In this work we consider the specific domain of tourism; in particular we are interested in proposing an architecture for organization, generation and sharing of knowledge related to journeys, transportations, accommodations, cultural sites and so on. Users can search and navigate a databank of relevant documents, add their own information units (in a del.icio.us style), and arrange them into personal information spaces, generating customized concept spaces and views. Our model allows users to access adaptive content in a structured way and to share the ways such content is organized and visualized. In the proposed model, we consider two different classes of potential users of our systems: employees of travel agencies or similar, interested in monitoring customer opinions, experiences and needs, in order to improve their commercial offers, gain new customers or promote their services; customers and travellers, interested in sharing knowledge from their previous experiences and trying to acquire new information for planning vacations or journeys.

The following of paper is organized as follows: next Section 2 presents related works; Section 3 introduces and exploits the proposed architectural model, applying it to our specific case study. Finally, conclusions and future works are in Section 4.

2 Related Work

Our work describes a general architecture that tackles problems connected to personal information management [19] and adaptive knowledge sharing/discovery by social networks for a more intelligent information exploitation and to provide more sophisticated search-tools systems [9]. Tools based on social networks like iVisTo [14], Friend-of-a-Friend (FOAF)[1], Huminity[2], can improve information sharing and discovery [15], implementing the idea that people prefer to obtain information from their trusted friends [7]. For this reason they analyze relationships and information flows among people, but don't allow users to organize their personal concept spaces. The importance of defining suitable concept spaces is highlighted in [3]: these provide an

[1] http://www.foaf-project.org
[2] http://www.huminity.com

ontology of the subject matter including the concepts and their relationships to one another. Concept spaces are traditionally showed by concept maps using hierarchical and static relations, which increase the difficulty of viewing and understanding the structure of the concept space and can't visualize dynamic knowledge and environments [17, 6]. Many innovative tree visualization (as Treemaps [13] or Botanical trees [8]) cannot easily differentiate between relationship types; other models (e. g. [2], based on hyperbolic geometry, or [16], based on S-nodes) are not able to dynamically switch from a view to another one. So, we propose a flexible information organization by zz-structures that allow users to express their own views, differently from current systems (de.li.cio.us, WebTagger, PowerBookmarks or Siteseer), that neither support a comprehensive analysis of users' needs and demands. By zz-structures, we simplify the authoring process, in which the users may assume the role of an author, organizing the knowledge base, creating personalized views, highlighting interests, enabling the re-use of previously created material, clustering resources and users, and so supporting recommendation of new items. A simple approach toward information structuring is common to same adaptive systems in tourism domain, like NutKing[3] (also described in [12]), where users can compose their travel selecting interesting items. We also apply our architecture in tourism domain empowering this aspect and supporting both short-term interests, returning reports based on reviews of other users, and long-term stable interests, monitoring activities of personal information management over long periods of time.

3 General Architecture

This section describes our general architecture, shown in Figure 1. Internal modules will

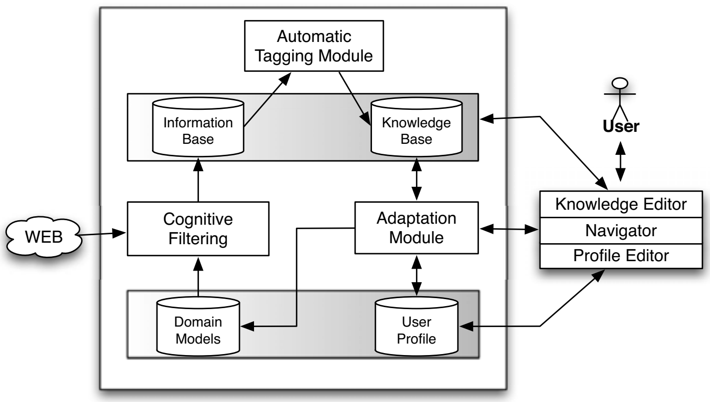

Fig. 1. A system diagram representing the components of our proposed architecture.

[3] http://nutking.ectrldev.com/nutking

be discussed in the next subsections with reference to the a specific case study. The proposed architecture is based on a set of interacting agents, aimed at information gathering and processing, and on a set of client components, aimed at implementing interaction between the application and the end-users. Data storage is achieved by means of two different kind of shared repositories: the *Information Base* (IB) and the *Knowledge Base* (KB). Users can interact with both such repositories using the modules implementing client interface: in particular users can access, navigate and enquire both IB and KB accordingly to the specific kind of data such repositories contain.
Users can also, accordingly with the Web 2.0 philosophy of social and collaborative participation to content authoring, enrich the data stored in both the IB and the KB, in order to improve the effectiveness of the system and give an advice to the other participants of the community. Users can access every document constituting the IB and, eventually, provide new contents by means of a specific function included in the client interface and described in detail in the following sections.

3.1 Generating the Information Base

The Information Base is a collection of records representing text documents users can access, browse and enquire by means of unstructured queries. The IB is filled with documents retrieved from the Web and properly filtered by the *Cognitive Filtering* (CF) module, a software agent based on the features provided by the ifMONITOR textual filtering service, developed by one of the authors.
The ifMONITOR service is aimed at periodically monitoring and downloading the contents available in a heterogeneous set of web sources, by means of a sophisticated Java agent. The agent is able to crawl the sources and scrap selected data from the browsed contents, in order to filter out not relevant parts like ads or navigational links. Scraping is achieved by source dependent regular and XPath expressions; source scraping allows the identification of updated textual contents, which are represented as textual documents. Scraped documents are filtered by implementing and applying the IFT algorithm [1], [10], a supervised information filtering technique based on textual similarity between the input documents and a set of *Domain Model* (DMs). A DM is defined as a semantic network representing a specific information need, constituted by nodes, representing domain keywords (or their respective stemmed representation) and edges, representing co-occurrences between keywords.
IFT generates a semantic network representation of any input document; such structure is matched against the predefined set of DMs and if a relevance threshold is reached with respect to at least one DM, the document is inserted into the IB. More specifically, for each relevant document, the textual content and the list of satisfied DMs is stored.
The IB is strongly dependent on the set of DMs defined initially to perform filtering; DMs can be generalized to other domains, representing different information needs, and their internal structure, in particular the weights assigned to the entities constituting the semantic networks, can be adjusted by users by means of relevance feedback.
The CF module acts as an adapter between our proposed architecture and the existing ifMONITOR infrastructure; more specifically CF module is aimed at adding relevant documents, retrieved by ifMONITOR, to the IB, at starting the document automatic extraction process on incoming data and at committing the users relevance feedback

to ifMONITOR. CF module is activated each time a document is provided by ifMONITOR or by a user; users can explicitly add textual contents to the IB by the client interface, uploading the desired document as a file or passing its URL as a parameter. Manually added documents are retrieved, redirected to ifMONITOR for relevance evaluation and, independently from the result of the relevance evaluation, included into the IB. Relevance evaluation is performed to fulfil the requirements of the automatic tagging activity described in detail in the next section. Each time a new document is added to the IB, the CF sends a new event to the automatic tagging module to activate its functionalities.
The online sources considered for filtering include vertical portals and web sites, horizontal search engines, and in the wave of Web 2.0 also UGC sites (blogs, forums and so on). In this work we focus only on textual documents retrieved from an open (like the whole World Wide Web) or closed digital repository.

3.2 From information to knowledge: the Automatic Tagging Module

In order to move from information to knowledge, we introduce in our architecture the *Automatic Tagging* (AT) module, whose purpose is the extraction of knowledge from the textual features of the documents included in the IB. The AT module has a pipeline structure, constituted by several annotators working sequentially, each one annotating the input documents with its own annotation set. The tags assigned automatically by the AT module are used, in addition to those assigned by the users of the proposed application, to arrange the documents of the IB into a set concept maps representing the overall knowledge, stored in the KB.
The AT module is activated by an event raised by the CF each time a new content is provided to the IB by ifMONITOR or by users. When AT module is activated, a new tagging activity is started on the newly available documents.
The main annotators included into the core pipeline of the AT module are:

1. the *Information Extraction* module (IE), responsible to extract basic named entities (e.g. person and company names, organizations, location names, prices, dates, currency, etc.) from the input documents. In our specific domain, we are interested in extracting entities like geographical locations, names and star ratings of hotels, specific facilities provided by hotels (e.g. swimming pool, etc.), information about events (e.g. musical nights, opera, etc.). Information extraction is achieved by means of regular expressions and gazetteers collecting domain dependent terms. Using IE module, the documents of the IB, for example related to London, are tagged with location (e.g. *Knightsbridge, Islington, Greenwich*), with visiting places (e.g. *Tate Modern, British Museum, National Gallery*), while documents related to hotels are tagged with their names (e.g. *The Gainsborough Hotel, Radisson Edwardian Vanderbilt Hotel*) and/or with provided services (e.g. *currency exchange, gym, foreign languages spoken*).
2. the *IFT-based* module, which annotates each document with the most weighted keywords appearing in the set of DMs associated with the document. More specifically the IFT-based module is aimed at tagging each document with respect to a set of relevant terms defined by the DMs developer to describe our case study information needs. With respect to our case study, using IFT-based module, documents

concerning the city of London are annotated with the following terms (e.g. *visit London, London hotels, travel diary UK, London tourism*).

More automatic annotators will be developed and integrated in the future, in order to increase the effectiveness of the AT module.

3.3 Structuring the user concept space

The knowledge extracted from each document of the IB by the AT module or provided by users by means of manual tagging, is organized in a concept space, stored into the KB. The KB implementation provides the business logic needed to move from a set of annotated documents to a conceptual map representing the extracted knowledge in a structured way.
In this work we propose an implementation of the KB based by means of zz-structures, first introduced by Nelson [11] and then formally described in [4] and [5]; zz-structures provide a new, graph-centric system of conventions for data and computing. A zz-structure can be thought of as a space filled with cells. Cells are connected together with links of the same colour into linear sequences called *dimensions*. A single series of cells connected in the same dimension is called *rank*, i.e., a rank is in a particular dimension. Moreover, a dimension may contain many different ranks. For any dimension, the degree (no. of in/out links of a given colour) of each cell cannot be greater than 2; this restriction ensures that all paths are non-branching, and thus it provides the simplest possible mechanism for traversing links.
In our approach a cell corresponds to a document stored in the IB and a link connects two cells corresponding to two documents whenever the same tag has been assigned to the two documents: in such a way the document collection is augmented with dimensions derived from the automatic and manual tagging process and they constitute in such a way new possible (navigation) paths.
An example of a zz-structure is given in Fig. 2. The vertices $(v_1, \ldots, v_{13})$ of the zz-structure represent some hotels in London, described by documents of the IB and tagged by AT module; connections reflect similarities among hotels in terms of location, rating, price and attitude expressed by customers. Normal, thick, dotted and dashed lines represent, respectively, the dimensions D^{city}, D^{stars}, D^{price} and $D^{judgement}$. In D^{city}, vertices $(v_1, \ldots, v_7)$ group 7 hotels in London, constituting the rank R^{city}_{London} = $(v_1, \ldots, v_7)$, while remaining group in $R^{city}_{Edinburgh}$ = $(v_8, \ldots, v_{13})$ hotels in Edinburgh.

In this way, depending on the specific tags, dimensions and/or ranks considered, it is possible to perform different abstractions, relevant for different user needs and perspectives. The union of zz-structure-based concept maps generates the user concept space: it can be defined [5] in terms of a multi-agent system constituted by five types of agent classes respectively related to concept maps, dimensions, ranks, composite and atomic cells.
These five agent classes represent five abstraction levels in the user concept space. Concept agents split the concept space into topic-related zz-structures; they know and directly manipulate dimensions and isolated cells, including concepts and relationships between concepts (organized in dimensions). Dimensions agents, uniquely identified by dimensions' colour, know and manipulate their connected components (ranks). Ranks

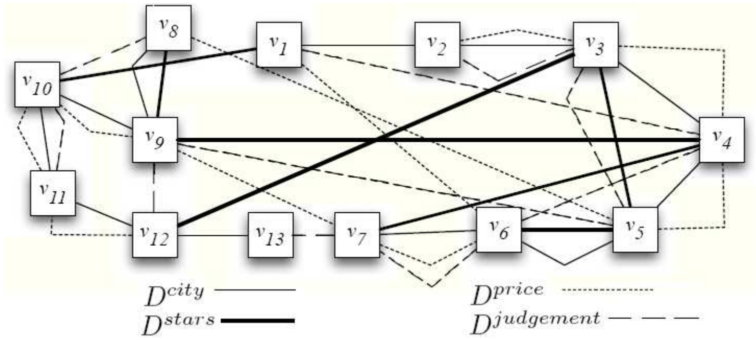

Fig. 2. A concept map for hotels in London.

know and coordinate the cells and the links that connect them; finally, composite cells agents contain concept maps related to more specific topics, while atomic cells agents are primary entities and directly refer to documents. Agents collaborate in order to manage, maintain and visualize concept spaces, or part of them.

3.4 Personalized access to knowledge

The KB is the set of conceptual units, representing cells and edges, users can organize in order to compose their own conceptual space and their own view on such conceptual space. More specifically each user can generate a set of conceptual maps, whose goal is to allow him/her to better organize knowledge and information related with the tourism domain, to improve the effectiveness of retrieved documents and, at the end, satisfy user's goals like, for example, trip planning.
Each user, by means of interaction with the *Knowledge editor* and *Navigator* components, is allowed to create and store a set of conceptual spaces, that initially are visualized as an empty piece of paper, and to fill them with the conceptual units extracted from the KB. This goal is achieved by allowing user: (1) to enquire unstructured and structured queries both IB and KB and then to import the retrieved results, represented as cells and edges of a zz-structure; (2) to provide new contents for the IB or (3) to manually add tags to the entities included in his/her conceptual space.
Each user can search, browse and import in its conceptual spaces all the cells and the automatically added edges constituting the zz-structure implementing the KB. Edges added by other users as tags can be accessed and used only if shared by their owner; private edges are visible only to their owner. Each user can modify the access policies of tags he/she created. Concept sharing is achieved by selecting the edge user wants to share and declaring it as public. When a new edge is added to a conceptual space, it is not stored into the global KB until it is declared as public by its owner.
Fig. 3 shows a set of conceptual maps views for three different users.
The structure of each conceptual space, constituted by a set of links to items (cells and edges) included into the KB and a set of private items, is stored into the *User Profile* (UP). A UP is assigned to each registered user; it is used to store, in addition to data

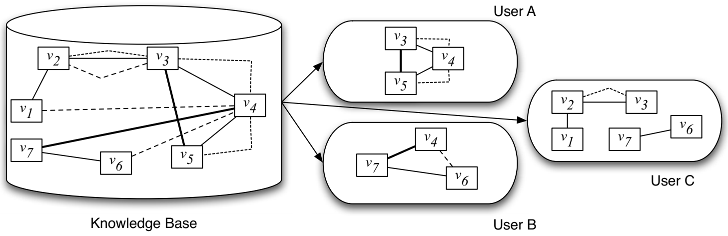

Fig. 3. Personalized sub-concept maps of the KB based on three different UPs.

representing user's conceptual spaces, user information collected both implicitly and explicitly. Users can access and edit their profile using the *Profile Editor*. UP is also devoted to store the browsing and tagging history of each single user. Examples of user activities tracked in the UP are: documents observed and time spent on them, selected dimensions and views, submitted queries, manually added documents and tags.

Visualization of knowledge and information is an important aspect of our model. One central reason for this is that visualization exploits several characteristic features of the human cognitive processing system. Knowledge visualization may help users to organize and reorganize, structure and restructure, assess, evaluate, elaborate, communicate, and co-construct knowledge, and to utilize ideas and thoughts, as well as knowledge, about relevant contents and resources [17]. Visualization is one of the features to whom the Navigator module is devoted. There may be many different ways to visualize zz-structures, choosing different dimensions and different structures in a dimension. Among them the most common are the *two-dimensional rectangular views*: the cells are placed on a Cartesian plane where the dimensions increase going down and to the right. Obviously some cells will not fit in these two dimensions and will have to be omitted.

I-views and H-views, formally described in [4], [5], are two examples of two-dimensional rectangular views; an example of H-view, related to Fig. 2, is shown in Fig. 4 (a). The H-view of size 5 is focused on cell v_3 and dimensions D^{city} and D^{stars}.

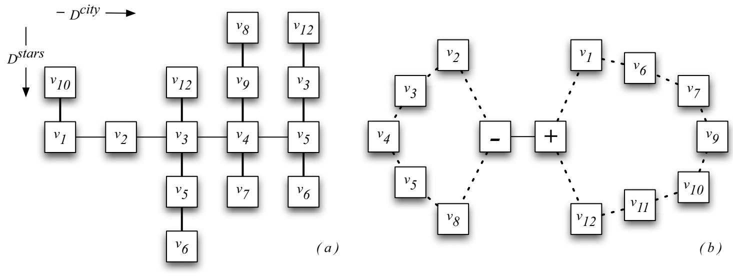

Fig. 4. Two views related to the zz-structure of Fig. 2: an H-view (a) and a Dipolar-view (b).

In this work, we introduce a new type of view, the $Dipolar$-view to visualize effectively dimensions of a zz-structure related with a polarity (i.e., positive or negative opinions) expressed in the information units. Fig. 4 (b) shows an example that refers to the zz-structure of Fig. 2: the $Dipolar$-view is centred on two position cells, $-$ and $+$, that act as placeholders of the dichotomous dimension $D^{judgement}$.
The *Adaptation* module is devoted to perform content personalization accordingly with user profile, in order to achieve a more effective interaction between users and the proposed architecture. More specifically the adaptation module is aimed at selecting, among the entities included in the KB, the cells to be shown to the user and arranging them in a suitable view.
The adaptation module is also devoted to the identification of the items, stored into both IB or KB, which are more useful for users to express and organize their knowledge; effectiveness of each item (cell or link) can be defined as the number of users conceptual spaces in which such item has been included. The assumption is to consider as more effective cells and edges used by the largest set of users; on the other hand users will not include into their respective conceptual spaces documents or, more generally, conceptual items, which are not providing relevance or, more generally, additional knowledge. Such information can be used by the adaptation module to dynamically modify the DMs used by the platform to retrieve documents of the IB, by means of the relevance feedback feature implemented by ifMONITOR. Useful documents are used as good examples in assigning relevance feedback to the respective DM, while unpopular documents will be used to represent bad examples of retrieved documents. This mechanism will assure that the automatic document retrieval process will adjust in order to satisfy the evolution of users information needs. In this case the community leads the identification of new contents by means of an evaluation of the currently utilized knowledge.

4 Conclusions and future works

In this work an innovative conceptual architecture for delivering of enriched Web 2.0 services has been introduced. In particular we focused to the specific domain of tourism. In our approach we adopt both adaptive personalization techniques, used in document retrieval and content selection, and models for structuring data and information.

Our research is ongoing: we move our attention to the refinement of the proposed features related to adaptation and personalization, defining a formal structure for the UP and a set of heuristics for inference and recommendation. We aim at developing a prototype application implementing the modules that constitutes the proposed architecture and at planning experimental evaluation activities.

Finally, subject of future works will be the integration of ontologies in order to allow moving from a lexical to a semantic representation of the tags and the application of our architecture to non-textual items, such as images and video, rearranging the AT module pipeline.

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