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Exploiting Ontology in web Personalization/Recommendation

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ABSTRACT: Web pages are personalized based on the characteristics (interests, social category, context, ...) of an individual. Personalization technology enables the lively insertion, customization or hint of content in any format that is pertinent to the individual user, based on the user's implicit actions and inclinations, and explicitly given details. In this work, context is taken out from Ontology in terms of concepts. Ontology is utilized to recognize topics that might be of attention to a specific user. For example, the query 'Python' will be expanded with "programming language", for the users fascinated in computer programming language, and with "snake', for the users fascinated in "wild life".
Keywords: Web Mining, Recommendation, Usage Mining, Personalization

1. INTRODUCTION:

We are in an era often referred to as the information era. In this information era, because we believe that information leads to supremacy and success, and thanks to stylish technologies such as computers, satellites, etc., we have been accumulating tremendous amounts of information. Recommender systems are software applications that provide personalized advice to users about products or services they may be interested .They recommend items to users, based on preferences they have articulated, either overtly or utterly. Recommender systems accumulate user feedback in the form of ratings for items in a given domain and make use of similarities and dissimilarities among profiles of several users in recommendation of an item.

2. ONTOLOGY

Ontology is formal description of knowledge. It is a set of vocabulary and the semantic interconnection constructed by some rules of interference and logic for a general purpose or a particular domain with a set of specific topics. Ontology defines a set of concepts based on the interrelationships existing among the concepts. In the Artificial Intelligence and Web Intelligence community, ontology is a set of objects and their conceptual relationships expressing possible facts in a domain. Ontology is an explicit specification of concepts and relationships that can exist between terms. The set of query terms and the relationships among them are reflected in the representational vocabulary with which query expansion is performed. The set of relations such as subsumption IS-A and meronymy PART-OF describe the semantics of the domain.

Depending on the knowledge stored, ontology can be categorized into two types: domain ontology and generic ontology. Domain ontology expert classified information for a domain provides detailed description for the concepts in the domain. It is the set of domain terms and a set of domain knowledge. The domain terms are generated from the abstract description of the domain knowledge, Domain ontology is designed to represent knowledge relevant to a certain domain type ,e.g. medical, mechanical, university etc. The size of the domain ontology depends on the domain it specifies. The contents of the domain ontology need to be updated regularly by the way of domain knowledge updates.

A generic ontology stores the lexical relations of the concepts in natural language. It is for general purposes and normally in large size. Sometimes a generic ontology can be extended to domain ontology.

3. KEY COMPONENTS OF ONTOLOGY

Ontology consists of a finite list of terms and the relationships between them. The terms denote important concepts (classes of objects) of the domain and the relationships include hierarchies of classes. In general, Ontology is organized in taxonomies and contains modeling primitives such as classes, relations, functions, axioms and instances. The key properties of ontology are described in Table 1.

Table 1: Key properties in an ontology

Classes	A formal, explicit description of concepts, which are organized in a hierarchical classification of concepts from general to specific
Hierarchy	Represented with *is-a* relations (i.e., subsumption). The subsumption (i.e., inheritance from general to specific) property defines implicitly taxonomy of the ontology. A taxonomy is a restricted form of representation, where many properties and relationships cannot be expressed. A taxonomy of classes indicates inheritance through class and subclass memberships
Attributes	Describe properties of classes that can have a *value*. Attributes are associated with each concept
Constraints	Describe restrictions and properties on attribute and attribute values. Axioms specify additional restrictions on attributes.
Relations	(and functions) Define dependencies between concepts, or classes in a taxonomy
Instances	Most specific concepts. Instances are created when they are instantiated from classes in the class hierarchy

Purpose and Benefits of Ontology

The ontology is the basis for a formal encoding of the important entities, attributes, processes and their inter-relationships in the domain of interest. It is another important goal of building ontology.

Ontology can deliver many benefits for Systems Engineering such as it may serve as an index into a repository of information to facilitate information search and retrieval.

4. ONTOLOGY FOR QUERY EXPANSION

The objective is to recognize the user perspective accurately, so search results can be personalized by re-organizing the results returned from a search engine for a given query. In this work, context is taken out from Ontology in terms of concepts. Ontology is utilized to recognize topics that might be of attention to a specific user. For example, the query 'Python' will be expanded with "programming language", for the users fascinated in computer programming language, and with "snake', for the users fascinated in "wild life". To get the appropriate context of query topic, the WordNet is used to retrieve appropriate context using the following algorithm and the user profile is updated accordingly.

Input: Query Topic(QT) and a set of relevant documents RD for any user u
Output: Expanded Query as EQ

Step 1.CON = $\{C_1, ..., C_m\}$, contexts obtained from ontology for query q
Step 2.Search Results SR = $\{W_1, ..., W_n\}$, for query topic QT
Step 3.For each $W_i \in SR$ $\{W_i: 1 \leq i \leq n\}$ do
Step 4.maxFreq= 0;
Step 5.For each $C_j \in CON$ $\{C_j: 1 \leq j \leq m\}$ do
Step6.Compute freq[W_i,C_j]= term_Frequency(W_i,C_j);
Step 7.if freq[W_i,C_j] $\geq$ maxFreq then
Step 8.{Context (u,QT) = C_j; maxFreq = freq[W_i,C_j]}
Step 10. end
Step 11. end
Step 12. EQ= QT+ Context(u,QT) ;
Step 13. end

This algorithm takes a query topic and a set of relevant retrieved documents as input and returns an expanded query as output. Ontology represents a set of concepts and the relationships between those concepts. The hypernym relationships among the noun synsets can be interpreted as specialization relations between

conceptual categories in WordNet. Firstly, all the concepts of a query topic are extracted from WordNet in step 1 using hypernym relationship among the synsets. For example active user has posed query 'Java' and found some documents are relevant. Now, the concepts of query 'java' are searched in WordNet and obtained three concepts; those are "Programming language", "Island" and "Coffee". Further, by processing each relevant retrieved document from set R, frequency of all concepts are counted in step 3 to 11. The concept having maximum frequency is appended to query topic in step 12. Initially, when user submits a new query,each document retrieved is examined by the user and marked as 'relevant' or 'not relevant'. Using WordNet, context of user is extracted and stored in user profile. When learning user interests, system does not perform well until enough information has been collected for user profiling. When a user submits the same query or query in the same context, the search results become precise based on the user's need. The purpose of using ontology is to identify topics that might be of interest to a specific web user. The context is updated in user profile. The use of ontology in building profile allows the user behavior to be matched with existing concepts and/ or sub- concepts in the ontology.

5. CONCLUSION

Fundamentally, ontology is used to improve communication between either humans or computers. The main purpose of ontology is to create a shareable and agreeable semantic resource over a wide range of agents. Building scalable ontology will effectively be a group effort, with ontology growing over time. Therefore, ontology is shared and scalable computer-based resources. The ontology can be used as an interchange format by translating between different modeling methods, paradigms, languages and software tools to achieve inter-operability among computer systems. In this paper we devise a method for user quary expansion using ontology. It seems that it can be very beneficial while recommendation/personalization because now except from user query some other similar ontological terms are also being used in searching.

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