A User Profile Modelling Using Social Annotations: A Survey

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Abstract
As social networks are growing in terms of the number of users, resources and interactions; the user may be lost or unable to find useful information. Social elements could avoid this disorientation like the social annotations (tags) which become more and more popular and contribute to avoid the disorientation of the user. Representing a user based on these social annotations has showed their utility in reflecting an accurate user profile which could be used for a recommendation purpose. In this paper, we give a state of the art of characteristics of social user and techniques which model and update a tag-based profile. We show how to treat social annotations and the utility of modelling tag-based profiles for recommendation purposes.

Categories and Subject Descriptors
A.1 **[General Literature]:** Introductory and Survey; H.3.3 **[Information Storage and Retrieval]**: Information Search and Retrieval - *Information filtering;* H.5.4 **[Information Interfaces and Presentation]:** Hypertext/Hypermedia - *Navigation, User issues.*

General Terms
Documentation.

Keywords
User profile modelling, social user, ontology, tag, social networks.

1. INTRODUCTION
The user is the main entity in any social networks. He participates in discussions, shares knowledge and information, makes relationships, etc. As the social networks are growing in terms of number of users, resources and interactions, the user may be lost or unable to find useful information. Social elements could avoid this disorientation like the social annotations (tags) which become more and more popular and contribute to avoid the disorientation of the user.

In most social adaptation systems, several components exist to achieve the adaptation process like constructing a social network which contains information about relations between different users. Also in social tagging networks like delicious[1], citeulike[2], lastfm[3], etc., we find a component which represents the tag assigned by a user in a specific resource (i.e.: text, bookmarks, picture, etc.). This component is usually represented as 3D matrix [29] (user, tag, resource), and treated as three bi-dimensional matrix due to the complexity of the 3D matrix. We find also another component in adaptation systems which deal with the user through a user profile. This latter contains information about a single user like his personal information, his friends and also his interests.

Researches try to represent the user as accurate as possible through different techniques (i.e.: a weighted vector of terms [11], enriching/extending a user profile [10], etc.) and languages (i.e.: FOAF [9]). Modelling a user profile can be based on classic information (name, age, etc.) or on social annotations (tag-based profile).

In this paper we are interesting in tag-based user profile modelling. In section 2, we present the main characteristics of a social profile, techniques modelling a tag-based profile and techniques for updating tag-based profile. In section 3, we present limits associated with social annotations and how to treat this ambiguity. In section 4, we present methods representing a tag-based profile in a recommendation context. In section 5, we present a conclusion and perspectives.

2. SOCIAL USER PROFILE MODELLING
The social user is characterized with his social activity like sharing information, communicating with other users, etc. A lot of information provided by several users from different activities is represented in the social network. From this information, we need to know for example who tagged which resources or when specific information is shared. But this could be a difficult task if content is not organised and categorized. In order to organize and categorize this lot of information, some researches create social ontology; others use specific techniques according to the context of researches.

2.1 Characteristics of social user
Originally, a user profile is constructed either in a *static* way, by gathering information that rarely changes like name, age, etc., or in a *dynamic* way, by gathering information that frequently changes. Information about a user is obtained *explicitly* by the

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[1] http://www.delicious.com
[2] http://www.citeulike.org
[3] http://www.lastfm.fr

user himself or *implicitly* by observing his behaviour during his session (history, clicks, pages visited, etc.). The user profile contains information such as [33]: 1) *Basic information* which refers to the name, age, address, etc. 2) *Knowledge* of the user which is extracted generally from his web page navigation, 3) *Interests* which are defined through a set of keywords or logical expression, 4) *History* or feedback which design collected information form user's activity and could be deduced from number of clicks, time allowed in consulting resource, etc. and 5) *Preferences* which are characteristics of user describing preferences in specific links or nodes, they could indicated preference in page style presentation, colour, etc.

With the creation of social networks, additional user's behaviours are created. In fact, the user is no longer representing the audience, but has become an active contributor for creating the social information. Users become more *active* (exchange information, participate in groups and blogs, etc), and *curious* (compare for a better information, search for advice, etc). This user's activity has merged new manners like social annotations. Indeed, resources are annotated by users without using defined languages. These annotations are plain keywords, known as "tags" [10]. Tags are a tool to mark resources, on the one hand for guiding others users to have information [16], on the other hand to receive information about a user due to the history of tagging [15].

Tags are useful to improve the social navigation by analysing them. This improvement leads to avoid the disorientation of the user. Also, they are useful to categorize content in an independent way without the need of an intermediary entity (i.e.: administrator) [25]. This categorizing could be used in a recommendation context, where the system recommends information deduced from the user's tagging information.

Tags become popular with tagging social networks like *Flickr* and *Delicious* [15]. Tags are assigned in several type of resource depending on the social network (i.e.: in *Flickr* tags are assigned to photos and in *delicious* tags are assigned to URLs). According to [15] tags are used by users for many purposes like: contributing and sharing, making an opinion, marking a place for a future search, making attention, etc.

Tags are interesting elements for building a social user profile. Some researchers do not consider tag's ambiguity to build a tag-based profile [23] [10] [20] [5] and others do [1] [2] [8]. Approaches which don't consider the tag's ambiguity could have good results in a specific database, but we think that for building a tag-based user profile, tags should be semantically treated in order to have an accurate profile containing meaningful tags.

The action of annotating a resource by a specific user is called *tagging behaviour*. Many users can annotate the same resource by means of several tags which lead to *collaborative tagging systems* [12]. The collaborative tagging behaviour, leads to creating a *folksonomy* [10]. Unlike the ontology, this folksonomy is not structured. There are many models to represent the tagging activities. Researchers like Mika *et al.,*[24] represent the tagging activity in a tripartite model which describes the user (U), the tag (T)and the resource being tagged (R):

$$\text{Tagging: } (U, T, R) \quad (1)$$

An extension of this model is presented by Gruber [13] who added two new parameters compared to the previous model. These parameters are "*source"* which refers to the tag space where the tagger applies the set of tags (i.e.: Delicious, Flickr, etc.) and the parameter "+/-"which represent the *"collaborative filtering of 'bad' tags from spammers" [13]*. This model becomes more popular than the original one. In fact, the space parameter used as a namespace contribute in application which deals with collaborative tagging across multiple applications (can differentiate between tagging data from different systems).

With the popularity of using tags in social networks and their ability to reflect a user's opinion, many studies create a tag-based user profile in different domains (in the context of music recommendation[11], in a social bookmarking context[23], in touristic information sites[7], in micro-blogging sites like twitter [1] or for personalized search in social tagging systems [5]) . Tags appearing in a user's profile could be deduced form resources he accesses [11] or from those chosen by him from a list of suggested tags or from those assigned directly by him [7]. Tags analysed in a user profile could be deduced from all tags like in [28] or by a specific rule like [32] which use tags which are largely used by two users and also tags which are strongly related; or even by a specific formula like in [10] which uses the "*Borda Count*" technique to select candidate tags.

Tag-based user profiles reflect the representation of elements inside this profile such as a user's interests. Interests are deduced based on the analysis of tags [10]. Indeed, [28] consider preferences of a user as his individual tagging history, [11] use tags in order to generate interests,[1] distinguish between an entity-based profiles representation which represent a user in a detailed and fine-grained fashion, and topic-based profiles which describes a user's interests into topics (tweets) considered as tags such as sports, politics or technology.

2.2 Representation of social user

In order to represent information about the social user in a meaningful way, researches utilize for describing users a vector representation or a graphical representation. The graphical representation could be an ontology graph. The ontology graph is a structured representation which defines the relationships between terms, making it a structured vocabulary. Ontology aims to organize the user's content for better exploitation. The most popular ontology describing persons, their activities, and their relations to other people and objects is FOAF. This ontology describes only information related to the user and does not describe his tagging activity. In order to link the user (representing through the FOAF ontology) to the tag, another ontology describing the tag is needed.

2.2.1 Vector

Many studies try to represent a tag-based profile as a vector. Abel *et al.*, [2] represent tag-based profile as a set of weighted tags for cross-system user profile, as well as Firan *et al.*, [11] how represent interest as a weighted vector of tag and by definition: *"Tag-based user profiles are defined as collections of tags together with corresponding scores representing the user's interest in each of these tags."*. From interaction of tagging, Beldjoudi *et al.*, [3] define from the folksonomy, a tag-based profiles as "*a transaction ID and the tags he uses by the set of items which are in this transaction."* for recommending useful resources. Cai *et al.*, [5] also represent a user profile as a vector of interested tags and their degree of preference in order to personalize search in social tagging systems. Xu *et al.*, [31] define the user as *"each user u, is modelled as a vector over a set of tags (or called user tag profile), i.e., u =<w(t1), w(t2), ...,w(t|T|) >, where w(tk) denotes the relationship weight of tag dimension tk with this user u"*, in order to recommend resources.

2.2.2 FOAF Ontology

As a social profile appears with the social networks, new representations and languages are created. The most popular social representation of the user is "Friend Of A Friend"[4] (FOAF). FOAF was introduced in 2005 by Brickley and Miller [4]. It is an RDF/XML vocabulary and so it's easily extensible. It was developed to represent the user in social networks. FOAF is the only representation which describes relations between users through the element "Knows". FOAF describes the user through five dimensions. In table 1, we present the five dimensions and the FOAF specification for each dimension's attribute.

Table 1: the five FOAF dimensions and their FOAF specification

Dimension		FOAF Specification
FOAF Basics	Name	<foaf:name>
		<foaf:familyName>
		<foaf:firstName>
		<foaf:givenName>
		<foaf:lastName>
		<foaf:nick>
	E-mail	<foaf:mbox>
	Photo	<foaf:img>
	Gender	<foaf:gender>
	Age	<foaf:age>
	Birthday	<foaf:birthday>
Personal Information	Blog	<foaf:weblog>
	Interest	<foaf:interest
		<foaf:topic_interest
	Publication	<foaf:publication>
	Relation	<foaf:knows>
Projects and Groups	Project	<foaf:project>
		<foaf:currentProject>
		<foaf:pastProject>
	Group	<foaf:group>
	Organization	<foaf:Organization>
Online Accounts	Account	<foaf:onlineAccount>
		<foaf:onlineChatAccount>
		<foaf:onlineEcommerceAccount>
		<foaf:onlineGamingAccount>
Documents and images	Profile Document	<foaf:personlaProfileDocuement>
	Logo	<foaf:logo>

The first dimension named "*FOAF Basics*" represents the basic information of the user like his name, age, etc. The second dimension, named "*Personal Information*" describes personal information such as user's interest, blogs, etc. The third dimension named *"Projects and Groups"* describes groups in which the user is a member and the user's project (generally his homepage). The fourth dimension named *"Online Accounts"* enumerates accounts associated with the user. The last dimension named *"Documents and images"* describes the image of the user profile and the document profile.

A FOAF representation is used in recommenders systems, especially music recommenders systems [9], in which the user's preferences are exploited through FOAF profiles and combined with musical preferences to recommend music. A FOAF is used also in management the user profile in cross-system context [14] through the *FOAFRealm*, an extension of FOAF.

Since the FOAF ontology doesn't give details about the user's interest, an extension has been made to give more specific information about user's interests. This extension called "e-FAOF"[5]. The *e-foaf:interest* vocabulary has 3 versions: 1) "**e-foaf:interest Basic**", which describes basic information about the interest like e-*foaf:interest_value* , *e-foaf:interest_appear_time*, *e-foaf:interest_has_synonym* and *e-foaf:interest_co-occur_with*, 2)"**e-foaf:interest Complement**", which contains complementary information like *e-foaf:interest_longest_duration* and 3) "**e-foaf:interest Complete**" which is the union of the set of vocabularies from "e-foaf:interest Basic" and "e-foaf:interest Complement". More extension of the FOAF ontology are presented in [17].

2.2.3 Tag ontology

Many researchers represent tags as organized information through different tag ontology. We explain each type of ontology and compare them in table 2, according to specific characteristics (namespace, purpose, etc.)

Newman *et al.* [26] define the first formal tagging ontology as "tags", which define the relationship between tags, resources and the user, as represented in figure 1. The tag ontology defines a tag through its name *tags:tag*, a subclass of *skos:Concept* from the "Simple Knowledge Organization System" (SKOS) vocabulary, the person who makes this tag *tags:taggedBy* which is a sub-property of *foaf:Agent* and the date in which this tag is assigned *tags:taggedOn* is a sub-property of *dc:date* from the "Dublin Core Metadata Element Set".

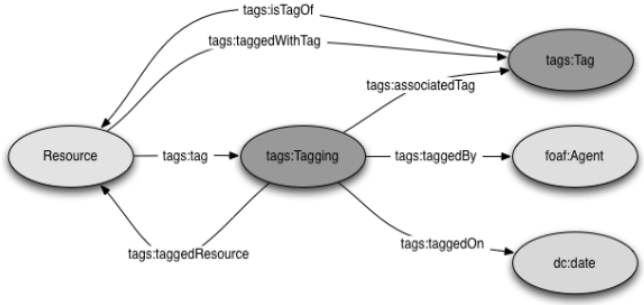

Figure 1: Representation of the tagging activity by the Tags ontology [19]

[4]http://xmlns.com/foaf/spec/

[5]http://wiki.larkc.eu/e-foaf:interest

Table 2: Comparaison between different types of tag ontology

Types / Characteristics	Tag ontology	Meaning of a tag	Social Semantic Cloud of Tags	Common Tag	Nice tag	The Modular Unified Tagging Ontology
Namespace	tags:	moat:	scot:	ctag:	nt:	muto:
Purpose	First formal tagging ontology	:tags extension for semantic tagging	:tags extension for tag clouds	Optimized for RDFa	Tagging as speech acts	Unification, modularization
Tag	tag	tag	tag	tag	tagAction	hasTag
Resource	taggedRessource		tagspace	tagged	taggedResource	hasResource
User	foaf:Agent	foaf:Agent	sioc:user	foaf:maker	sioc:creator	hasUser
Authors	Newmann *et al.*	Passant *et al.*	Kim *el al.*	Tori *el al.*	Limpens *et al.*	Lohmann *et al.*
1st publication	23-03-2005	15-01-2008	23-03-2007	08-06-2009	09-01-2009	02-09-2011
Related vocabulary	FOAF, SKOS, DC	FOAF, SIOC	SIOC, FOAF		FOAF, SIOC	FOAF, SIOC, SKOS, DCTERMS, MOAT…

Tags ontology have been explicitly reused and extended in MOAT[6] (Meaning Of A Tag) ontology. It provides a machine-understandable meaning of free tags. MOAT is related to the FOAF ontology and especially to its *foaf:maker* property to describe which user considers a URI as the meaning of a Tag. Such information is practical when retrieving meanings that have been specified by the user's friends. This tagging ontology integrates the "Semantically Interlinked Online Communities" (SIOC) vocabulary.

SIOC vocabulary is used also in the SCOT[7]ontology (Social Semantic Cloud of Tags), which describes the structure and the semantics of tagging data. SCOT reuses SIOC to represent groups of users via *sioc:Usergroup.* SCOT aims not just to represent the collaborative tagging activities, but also to represent the characteristics of the folksonomy such as tag co-occurrence *scot:Cooccurrence*, sharing of tag clouds *scot:Tagcloud,* etc.

The idea of linking tags with well-defined concepts from the Semantic Web is also adopted by the CTAG[8] (Common Tag) ontology. CTAG is defined using RDFa, a standard format for expressing structured data within HTML. It defines how to create a tag through *ctag:AuthorTag*, if the content creator has specified the tag, through *ctag:ReaderTag* if a content user has specified the tag and through *ctag:AutoTag* if an algorithmic tagging system has generated the tag.

A recent tagging ontology named Nicetag[9] ontology is released by Limpens *et al.,* and aims to be flexible and applicable in any form of tag ontology (i.e.: SCOT, CTAG, etc.). Tags are defined from the entity which creates them. The class *nt:TagAction* specifies this entity as a human entity *ManualTagAction*, a machine tag *MachineTagAction* or even as a collective tagging action *CollectiveTagAction* or an individual tagging action *IndividualTagAction*. This ontology reuses the SIOC through *sioc:User* defined as *foaf:Person*. In order to represent the resource being tagged, this ontology uses the class *nt:TaggedResource.*

More recently, Lohmann *et al.*,[22] developed a new ontology MUTO[10] (Modular Unified Tagging Ontology), which attempts to use many existent ontologies (cited above), in order to enrich them by adding missing concepts and links. The MUTO ontology represents the three basic entities in a folksonomy: user (*muto:hasUser)*, tag (*muto:hasTag)* and resource (*muto:hasResource)*. According to Lohmann *et al.,* users and resources are generic concepts and are better separated from the tagging ontology. So MUTO sets links to *sioc:UserAccount* and *rdfs:Resource* which have been proven useful in the representation of Web users and social networks.

2.3 Tag-based user profile update

The social user is very active and may be interested in many different subjects for a short time. The updating of the social user could be a benefit in order to better know the user's needs. The

[6]http://moat-project.org/
[7]http://scot-project.org
[8]http://www.commontag.org/Home
[9]http://ns.inria.fr/nicetag/2010/09/09/voc.html
[10]http://muto.socialtagging.org/core/v1.html

update is considered as an enrichment of the user profile, in which additional information deduced from the user's behaviour is integrated in his profile. The enrichment of the tag-based profile helps recommenders' systems to collect more information about the user and also in a cross system context, where the user may have multiple profiles. We present some approaches in both context and their respective techniques.

2.3.1 Tag-based user profile update in recommendation context

In order to improve the quality of recommendation in social recommenders' systems; many researches use the tagging behaviour which provides, implicitly, further user's needs. These needs, considered as complementary information about a user, could be used to enrich tag-based user profiles. Indeed, De Meo *et al.*, [10] enrich user profiles by "authoritative" tags, which are tags considered as important (for example tags having a high PageRank). This approach is graph-based, where we find two graphs: the *tag resource graph* called TRG and the *tag user graph* called TUG. These graphs are used in order to filter qualitative tags (i.e.: fun. good, etc.) by the method of [6], then generate list of candidate tags by means of the *IDDS* (Iterative Deeping Depth First Search), and finally merging these candidate lists of tags by the *Borda count* technique. Finally, the user profile is enriched by tags from these candidate lists. This method has shown its usefulness compared to the method of [28] and [32]. Also, tags are automatically filtered and ranked at the same time through the *Borda count* technique. However, it does not consider semantics of tags and the context of user in the recommendation process. There is a risk of having no precise information through the *Borda count* technique even if it's simple to use and fast. Always in a recommendation context, Kim *et al.*, [20] enrich a user model with collaboration from other similar users. The approach uses *locally weighted naïve Bayes* approach to recommend a ranked list of items relevant to the user. The collaborative user modelling is made through detecting a user's neighbour by the *cosine similarity* and then enriching the user profile through the neighbour's topics. Even if the method is promising there is no consideration of the semantic aspect of tags. Finally, Beldjoudi *et al.*, [3] enrich user profiles with relevant resources based on association rules extracted from the social relations. The enrichment is used in resource recommendation context. In fact, for each extracted rule, the system tests if the tag is used by the user. If this is the case, the system recommends each resource which contains the associated tag of the rule. Each user in a folksonomy is represented by a transaction ID and the tags he uses by the set of items which are in this transaction. In order to improve the quality of the recommendation, tag ambiguity is detected by finding similar users and resources through the *cosine similarity* function. Although this approach deals with a tag's ambiguity, it does not consider the semantic ambiguity of these tags.

2.3.2 Tag-based user profile update in cross system context

In a cross-system context, Abel *et al.*, [1] use semantic user modelling based on Twitter posts to create semantically rich user profiles. This method is graph based. The semantic enrichment from Twitter posts follow these steps: first link tweets, then the semantic enrichment is preceded by extracting content (from "BoilerPipe") and information about users (by "OpenCalais") and finally construct a new enriched RDF graph. The enrichment process considers the semantics of tags and the connection between users and also between tweets and articles. The method deals with the user's interests through people of interest, topics, event, etc. Always in a cross system context, [2] enrich tag-based profiles based on association rules deduced from observation across two systems. The Tag-based profile is enriched from different tagging systems by: 1) combining the user's data (from different systems) with 2) a semantic enrichment of tags calculated from tag similarity with the "*JaroWrinkler*" distance and a cross system enrichment based on association rules, and finally with 3) a weighting scheme (like TF-IDF). This approach is a good issue to model a user through his different social profiles, and to enrich this profile with semantic enrichment to decrease a tag's ambiguity. However, these two approaches do not consider the evolution of a user profile through time.

3. TAG'S TREATMENT

Despite these tag's advantages (already cited in section 2.1), tags are user-generated terms and do not follow any rule. This characteristic generates many ambiguous tags. [15] present some problems related to these tags such as *spamming* where a user tags many resources by the same keyword in order to influence other users. Another problem is this folksonomy is very diverse. Indeed, tags may have different forms for the same word (i.e.: blog, blogs, blogging). The folksonomy have a lack of classification and do not handle synonyms and homonyms.

Due to the utility of using tags for many purposes, analyzing tags is required but could be a difficult task due to their ambiguities. Some researchers try to solve ambiguity associated to tags. In fact, [30] try to detect spam by proposing a concept named "*diffusion of attention*", which can reduce the influence of spam in tag distribution and without a filtering process. This technique gives a maximum number of tags for each resource and so limits the influence of the user. Georgia Koutrika *et al.* [21], define tag spam as: *"misleading tags that are generated in order to increase the visibility of some resources or simply to confuse users". T*hey study the impact of spamming through a framework for modelling social tagging system and user tagging behaviour. They evaluate the impact of tag spam with a unit called *SpamFactor*. Also, a tag's ambiguity could be deduced in popular way by using a tool which can detect a natural language, synonyms/homonyms, etc. like WordNet[11] dictionary. It could also be detected by classifying tags according to a specific ontology like [7] who classify social annotation as follow:

- Proposed tags/free tags: This category of tags is not detected by WordNet dictionary. There are invented tags. They could be recommended tags (from the system) or most popular tags or tags inserted by the user for the first time (free tags).
- Generic/specific tags: "*for each event, tags are recognized as "general" if they are mapped on the upper categories of the iCITY ontology; "specific" if they are mapped on instances or lower concepts of WordNet related to the categories of the ontology"*
- Synonym tags: this category is identifiable via WordNet dictionary.
- Contextual tag: *"by means of the WordNet vocabulary, iCITY tries to discover whether the tag is related to the context of the event. It is possible only for tags with a well-defined format (e.g. time) or tags which represent instances of previously identified as contextual concepts in WordNet (e.g. location-based concepts)".*

[11] http://wordnet.princeton.edu/

- Subjective tags: This category is not detectable by the WordNet dictionary. Indeed, these are tags which express a user's opinion
- Organizational tags: Tags which are used to organize an event. They are detectable if two users use them frequently.

This classification is related to the "iCITY" ontology used. But, this classification does not offer meaning to the tag. This idea of using an ontology to avoid tag's problem is existent. Indeed, from a plain space (folksonomy) researches extract a hierarchy (i.e.: programmation/c#) in order to extract a semantic and a comprehensive structure [15].

4. SOCIAL RECOMMENDERS SYSTEMS

Tag-based profile reflects user's interest deduced form the user's tagging behaviour. In consequence, tag-based profiles are widely used to improve the quality of social recommenders systems. In fact, these systems aim to provide information which users might be interested in. This information could be deduced from the user's tagging behaviour, and integrated in a user profile. We present some approaches and their respective techniques, which represent a user from his tagging information in order to use it in social recommenders' systems. Also, we compare in table 3, these approaches based on specific criteria.

Many researchers use the tag-based profile for recommendation: De Meo *et al.*, [10] propose a query expansion in order to improve social recommender systems. The approach is graph-based and recommends tags according to the candidate tags. It represents tags as weighted terms and filters them in order to eliminate the inappropriate ones. Kim *et al.*, [20] propose an approach which can be exploited in social recommender systems by discovering relevant and irrelevant topics for users. Topics contain weighted tags classified as positive and negative according to their rating. In portals, Nauerz, *et al.*, [25] analyze user's tagging behaviour to learn interests and preferences of users, groups, or communities for better adaptation and recommendation of tags and resources. They define a user in a static way through his basics information (name, age, etc.) and in a dynamic way by observing his tagging behaviour. This approach has shown good performance, by 90% of users who classify a recommendation as pertinent. However, it doesn't filter inappropriate tags. Xu *et al.*, [31] represent a tag-based profile for recommending resources based on graph theory. This approach detects a user's preference from a Topic Oriented Graph (TOG), and then based on the graph devise a Topic-Oriented Tag-based Recommendation System (TOAST) by using the preference propagation on the graph. This approach is promising but does not update the user's profile as his preferences change. Pan *et al.*, [27] use a tag-based profile for recommendation by extending neighbour's tag through a co-occurrence analysis, filtering noisy tags through a clustering algorithm.

All these works have shown good results, but do not consider the semantics of tags in the recommendation process. However, Carmagnola, *et al*., in 2008, [7] presented "iCITY" as an adaptive, social, multi-device recommender guide which deals with cultural events taking place in Torino city. These cultural events, considered as resources, are recommended based on the tagging behaviour of users. The user is represented through tags reflecting his interests which are regularly updated. This approach supports the semantics of tags but do not filter inappropriate tags. Another approach which supports the semantic aspect of tags is [8] who proposes an architecture named "iDynamicTv", which recommends TV content (video) and navigates through resources, tags and users. This system initializes a user profile through predefined stereotypes and updates it according to his behaviour (rating, tags, bookmarks, etc.). The "iDynamicTv" architecture is a good way to discover and organize TV content; it takes into consideration the semantic of tags. However, tag ambiguity is treated with a semantic similarity using WordNet dictionary only and doesn't consider spam (i.e.: same tag for many resources) and personal tags (i.e.: like, awesome, etc.) which affect the recommendation quality.

In order to filter inappropriate tags and recommend useful resources, Huang *et al.*, [18] propose a tag-based profile which includes the name of a tag and the corresponding number of items collected by the user for each tag. The tag information is considered as a preference or an interest which contribute to the recommendation of resources (such as books, articles, documents, pictures, audio and video). The method of recommendation creates as a first step the tag-based user profile, then groups similar users, finding similar resources (by the *cosine similarity*) and finally recommending similar items to the user. This method decreases the tag ambiguity by filtering inappropriate tags and then the quality of the recommendation increases. However, this approach does not consider the evolution of the user's interest over time.

In table 3, we compare previous researches according to criteria related to the tag and to the user. The choice of these criteria is based on how they could influence the quality of social recommenders systems.

In fact, for tags criteria, social recommenders systems should recommend the k-most relevant information deduced from tags. To achieve this purpose, tags should be interesting to the user. The *weight of tag* criteria is a variable which reflects how the tag is important (i.e.: popular, recently used). Social recommenders systems may recommend tags which are understood by a user and not by another. That's why treating tags and generate understandable ones is needed. To avoid this problem, the *semantic aspect of tags* could help to detect a tag's ambiguity previously detailed in section 3. Another solution is to filter the folksonomy through the *filtering tag* criteria which eliminates inappropriate tags (deduced from a semantic analysis or from a specific algorithm).

For the user's criteria, we distinguish between user's *representation*, *characteristics* and user's interest update. These criteria are already detailed in section 2. The representation of the user may be a *vector*, graph or other representation. This representation doesn't influence the recommendation process, contrary to the user's characteristics criteria. The latter is deduced from the *static* representation and/or the *dynamic* representation. The *dynamic* representation includes the tagging behaviour, which is used to construct and update the tag-based user's profile. Finally, the social user is an active entity and his interests may change several times in a short period. That's why, updating a user's interest is important to improve quality of recommendation context. The *user interest update* criteria, contributes then to improve the quality of recommendation by knowing the user's interest as they change over time.

Table 3: Comparison of researches of modelling a tag-based user profile for recommendation

Criteria / Reference	Tag			User					
				Representation			Characteristics		
	Weight of tag	Semantic aspect of tag	Filtering tag	Vector	Graph	Other	Static	Dynamic	User interest update
De Meo *et al.*, [1]	✓		✓		✓				
Kim *et al.*, [20]	✓					✓			
Nauerz *et al.*, [25]						✓	✓	✓	✓
Xu *et al.*, [31]				✓	✓				
Pan *et al.*, [27]			✓			✓		✓	
Carmagnola *et al.*, [7]		✓				✓		✓	✓
Carmagnola *et al.*, [8]		✓				✓		✓	✓
Huang *et al.*, [18]			✓			✓			

5. CONCLUSION AND PERSPECTIVES

In this paper, we have shown characteristics of the social user, techniques and ontology of representing a tag-based profile, and techniques for updating it in a recommendation and enrichment context. We have also shown the limits associated with tags and respective solutions to the problems associated with these limits. Finally, the use of a tag-based profile in a social recommendation systems and the comparing of recommendation approaches in table 3. From table 3, we observe that no approach considers most of the criteria, which are useful in a recommendation process. Form this comparison; we plan to construct a tag-based profile which takes into consideration the weight, the semantic aspect, and the filtering of tags and both the static and dynamic aspect of user profile representation, in order to improve the quality of social recommenders systems. Our idea is to gather information from the FOAF user's profile and from the tags assigned by the user. The motivation of combining these two pieces of information is that the FOAF profile contains the interest of a user which is related to a resource representing by its URL. Also, a tag is reflecting the user's interest in a resource. The combination of the *foaf:interest* information and the tag information is based on semantic analysis and semantic distance. The update of the user's interest should take into considerations the social behaviour of the user including his tagging behaviour and social elements like "similar" users. Finally the tag's ambiguity problem is treated through a semantic way, by extracting meaningful tags and by filtering the insignificant ones.

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