Ontology-based stereotyping in a travel support system

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Abstract

The aim of this paper is to address the problem of user profile initialization in a travel support system. In the system under consideration, ontologically demarcated data is stored in a central repository, while user profiles are functionalized as instances of travel object ontologies. Creation of an initial user profile is achieved through stereotyping. An example of utilization of this technique, in the case of restaurant stereotypes, is presented.

1. Introduction

Travel support systems are considered a paradigmatic example for utilization of software agents [1]. When such system is to utilize Internet-available data, there exist at least two ways of approaching its development. First, information can be indexed (only links to data are stored). Second, information can be actually gathered. While each approach has its advantages and disadvantages, we have decided to proceed with information gathering. In this way we are able to develop a system which locally resembles a "mini Semantic Web." The Semantic Web [2] is to consist of semantically demarcated resources available in a machine-consumable form. Unfortunately, while this vision is very appealing (and a hot research area), it is far from reaching practical usability. In particular, scarcity of ontologically demarcated data hinders its further development (a classic example of a chicken and egg problem). Therefore, to be able to experiment with semantically demarcated "travel content," we have designed our system around a central repository, where content is to be collected and stored. In particular, the proposed system consists of a *content collection subsystem*, where data for the system is gathered and semantically demarcated [3,4,5], a *content delivery subsystem* responsible for communicating with the user [6], and a *content management subsystem* where data is stored and where its quality is assured. The top-level view of the system is represented in Figure 1.

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Observe, that content is gathered from (a) *Verified Content Providers* (*VCP*), representing sources of content that are consistently available and format of which is changing rarely (e.g. website of Sofitel Hotels and Resorts) and (b) *Other Sources*, that represent the remaining available content. For more information about the system see [7,8].
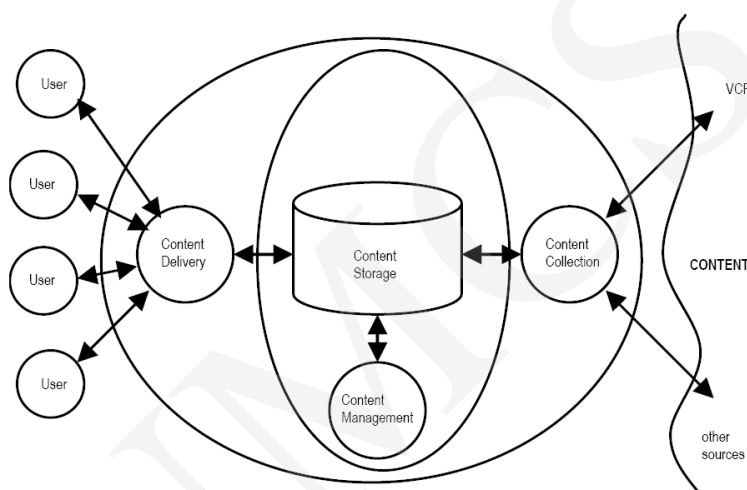

Fig. 1. Top level view of the system

In the context of this paper, we are particularly interested in the way that user profiles can be represented. Since data describing travel objects is collected in the form of instances of ontologies, it is natural to use the same approach to define user profiles. For instance, if one of properties of a hotel is its having a fitness center, we can specify that this feature is important to the user by giving it a high value of "liking." Therefore, user profile can be represented as an instance of a travel ontology, where user preferences are depicted as degrees of his liking (or disliking) of a given feature of a travel object.

Obviously, the aim of generating user profiles is to filter and to deliver content which is relevant to their context [9]. This can be achieved through variety of content personalization techniques. However, there it is usually assumed that (a) the system tracks user's behavior in order to learn her profile, and (b) user is willing to spend (some) time interacting with the system allowing it to "know her well." This generates a well known problem of *initialization of a new user profile* and finding solution to this problem is critical for both the user and the system [10-12]. To address it in our system we have adapted a well-known *stereotyping* approach (see [13]) to the Semantic Web environment that utilizes ontologically demarcated data. While our approach to user profile construction and utilization is based on ideas presented in [10,12-17], utilization

of these methods in the context of semantically demarcated information is novel and was proposed originally in [18].

In the paper we proceed as follows, in the next section we briefly describe ontologies that have been defined and are utilized in the system, and follow with a short discussion of user profile representation. In the next three sections we first, present some of the related work and follow with our proposed solution. In Appendix we present more details of proposed user stereotypes.

2. Ontologies in the system

Our original decision, to store ontologically demarcated travel-related content, resulted in search of appropriate domain ontologies. As reported in [4,19,20], while there exists a large number of attempts at designing ontologies depicting various aspects of the world (including world-of travel), we were not able to locate a complete ontology of most basic travel objects, such as a *hotel* or a *restaurant*. We had therefore to define both ontologies. In the case of hotel ontology we have constructed it on the basis of information available within Internet Travel Agencies [4,19]. For the restaurant ontology we have utilized an existing implicit restaurant ontology utilized in the ChefMoz project[1]. This ontology could not have been used directly due to the fact that data stored there is infested with bugs that make its automatic utilization impossible without pre-processing (see [4,20] for more details). Therefore, we have reverse engineered the restaurant ontology underlying the ChefMoz project and semi-automatically cleaned data related to restaurants available in Poland. As a result, we have a fully functional and ready to experiment with dataset stored in the central repository. Below we present a fragment of our restaurant ontology (in N3 notation):

```
:Restaurant      rdfs:subClassOf loc:Location.
:accepts         a  rdf:Property;
                 rdfs:label  "accepts";
                 rdfs:range   mon:MeanOfPayment;
                 rdfs:domain  :Restaurant.

:alcohol         a  rdf:Property;
                 rdfs:label  "alcohol";
                 rdfs:range   :AlcoholCode;
                 rdfs:domain  :Restaurant.

:cuisine         a  rdf:Property;
                 rdfs:label  "cuisine";
                 rdfs:domain  :Restaurant;
                 rdfs:range   :CuisineCode.
```

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[1]*ChefMoz dining guide*, http://chefdmoz.org/.

```
:dress              a   rdf:Property;
                    rdfs:label   "acceptable dress";
                    rdfs:range   :DressCode;
                    rdfs:domain  :Restaurant.

:smoking            a   rdf:Property;
                    rdfs:label   "smoking-friendlyness";
                    rdfs:range   :SmokingCode;
                    rdfs:domain  :Restaurant.
```

3. User profile representation

In order to deliver personalized content to the user we have to find a way to represent our knowledge about her, i.e. define user profile. Furthermore, its form has to make interactions happening in the system as simple as possible (user profile representation should not introduce an extra overhead). Since our system is oriented toward processing ontologically demarcated data, it is very natural to represent user preferences in the same way. Thus we adapted an overlay model of user profile, where opinions of the user are "connected" with appropriate concepts of domain ontology. This approach is also called a *student model*, since it has been found useful to describe knowledge of the student about specific topics of the domain [21].

For instance, let us consider Ann, who does not like meat and thus she eats vegetarian food and likes salad bars. In our ontology both preferences can be expressed in terms of features of the restaurant. Specifically, we assign weight to each feature (the larger the weight the more important it is to the user). In the case of Ann, vegetarian-related concepts will be assigned large weights, while other features that she does not particularly care about (e.g. disallowance of minors in a restaurant) will be assigned small weight – the lesser the interest, the closer to 0 the value will be. In the case of features for which we do not know user's preferences, no value will be assigned. Let us observe that we are mimicking the notion of probability – all assigned values are from the interval (0,1). This means that even in the case of strong counter-preference towards a given feature we will assign it value 0 (there are no negative values available). Proceeding, we will create a special instance of restaurant ontology, one that represents user-restaurant-profile. The following "code" fragment depicts Anns profile as it would be represented in our system:

```
:AnnOpinions a sys:OpinionsSet;
   sys:containsOpinion
     [sys:about res:VeganMenu;
        sys:hasClassification sys:Interesting;
        sys:hasNormalizedProbability 0.60].
```

```
[sys:about res:VegetarianDishes;
    sys:hasClassification sys:Interesting;
    sys:hasNormalizedProbability 0.93].
[sys:about res:VegetarianMenu;
    sys:hasClassification sys:Interesting;
    sys:hasNormalizedProbability 0.92].
[sys:about res:PolishCuisine ;
    sys:hasClassification sys:NotInteresting;
    sys:hasNormalizedProbability 0.11].
[sys:about res:RussianCuisine;
    sys:hasClassification sys:NotInteresting;
    sys:hasNormalizedProbability 0.31].
[sys:about res:MinorsNotAllowed,
    sys:hasClassification sys:NotInteresting;
    sys:hasNormalizedProbability 0.15].
[sys:about res:SaladBar,
    sys:hasClassification sys:Interesting;
    sys:hasNormalizedProbability 0.89].
[sys:about res:Takeout ,
    sys:hasClassification sys:Interesting;
    sys:hasNormalizedProbability 0.74].
```

Here we can find that Ann likes to eat in restaurants serving vegetarian-like food and providing take-out service; while Russian and Polish cuisines and disallowance of minors result in a "negative interest" for such restaurants.

4. Initialization of user profile – prior work

One of the important questions that all recommender systems have to address is: how to "introduce" a new user to the system [15]. This is often called a *new user problem* and is a part of a *cold start* (or *ramp-up*) problem iteRotarau2005,Burke2002. Recommendation given by the system to the new user can be irrelevant and result in breaking his cooperation with the system. Therefore, Montaner et al. [10] suggested using one of the following techniques to initialize user profile: manual initialization, training set or stereotyping. Our choice is stereotyping.

In everyday life a *stereotype* is a generalization about a person or group of persons. We develop and utilize stereotypes when we are unable or unwilling to obtain all information needed to make fair judgments about people or situations. In many cases, in absence of a "complete picture," stereotypes allow us to "fill in the blanks" [22]. It is one of the most common techniques used to create a model or an opinion about someone or something we do not know precisely. For example when we see a *judge* we can think about him as a well-educated, honest

man and when we see a *politician* we are likely to think that he is hollow and hypocritical (although this could be incorrect). One of ways in which stereotypes help to simplify the world is that they have strong effect on what characteristics of a person or a thing are attended to and remembered [13].

In recommending systems, such as our Travel Support System, stereotyping is a method for classifying users into categories and then making predictions based on stereotypes associated with particular categories. Stereotypes contain typical assumptions that one makes about members of that category [23]. Use of stereotypes in recommending systems that maintain profiles of their users was introduced by Rich in the GRUNDY system [13], where users were assigned to one or more stereotypes and when appropriate activation condition (*trigger*) occurred, corresponding stereotype was applied. In such a stereotype-based system users can be classified either (a) on the base of answers they gave during first use of the system or (b) by tracking their behavior while they interact with the system. However, we need to remember that answering to a large number of questions can be confusing and irritating. Moreover, people asked about themselves have problems with delivering accurate information [13,15] – sometimes people are over influenced by a group they belong to; sometimes they are afraid to confirm theirs interests etc. This fact forced us to collect information from only few explicit questions – to gain basic information about the user, and to update user profile later – according to her interactions with the system. Note here, that in most systems using stereotyping, it is the only method of information filtering (also called *demographic-filtering*). Therefore, classification is rigid: each user, once classified, cannot be reclassified, and it is difficult to specify exceptions, i.e. to respect individual characteristics that a specific user is known not to share with the group [16]. Since we use stereotyping only for initialization of the user profile, our system does not fall into the rigidity-trapand allows us to constantly adjust user profiles.

5. Proposed solution – stereotypes

Obviously, we use the same way of representing stereotypes as we used to represent user-profiles. The only difference is that in the case of stereotypes opinions are always "radical" and thus weight of interest in a feature are either 0 or 1. Let us illustrate this by a partial depiction of a *Conservative* stereotype (again in N3 notation) and follow by the discussion of subsequent features of that stereotype.

```
:ConservativeOpinions a sys:OpinionsSet;
   sys:containsOpinion
     [sys:about res:FullBar;
        sys:hasClassification sys:Interesting;
        sys:hasNormalizedProbability 1.0],
```

```
[sys:about res:PolishCuisine;
   sys:hasClassification sys:Interesting;
   sys:hasNormalizedProbability 1.0],
...
[sys:about res:EuropeanCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
[sys:about res:ChineseCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
[sys:about res:EclecticCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
...
[sys:about res:BrasserieCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
...
[sys:about mon:BankCard;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
...
[sys:about mon:DinersClubCard;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
[sys:about mon:Cash;
   sys:hasClassification sys:Interesting;
   sys:hasNormalizedProbability 1.0],
[sys:about res:FastFoodCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0],
[sys:about res:HamburgerCuisine;
...
[sys:about res:PizzaCuisine;
   sys:hasClassification sys:NotInteresting;
   sys:hasNormalizedProbability 0.0].
```

*Conservative*s do not like novelty. They refuse to eat meals belonging to foreign cuisines, or fast-food. They also avoid going to restaurants that accept bank cards. They love Polish national cuisine, fatty-meaty meals, combined with large amount of alcohol.

```
:ConservativeData a sys:StereotypeProfileData;
   sys:hasDressSet
      [sys:contains sys:Elegant];
   sys:hasProfessionSet
      [sys:contains sys:Handworker, sys:UnemployedJobSeeker,
          sys:PensionerAnnuitant];
   sys:hasWealthSet
      [sys:contains sys:Rich, sys:NotRich, sys:AverageRich];
   sys:hasAgeSet
      [sys:hasLeftBound 45; sys:hasRightBound 90].
```

Typically, the *Conservative* is a mature person (age of 45 or more). He or she is usually a handworker, a pensioner or annuitant. Although the *Conservative* is not rich, he or she wears elegantly.

Let us now discuss what happens when a new user logs to the system. She will be requested to fill a short questionnaire containing questions about age, gender, income level, occupation, address (matching user features defined by the user ontology), as well as questions about her travel preferences (user data: $\hat{u}$). Personal data collected through the questionnaire will be used to match a person to one of stereotypes. More precisely, a distance measure between user-specified characteristics and these appearing in stereotypes defined in the system (stereotype data: $\hat{S}$) will be calculated to find which matches her profile the closest. To achieve this, the following formula will be used:

$$d\left(\hat{S}, \hat{u}\right) = \frac{\sum_{f=1}^{k} w^f \delta_{\hat{S}\hat{u}}^f d_{\hat{S}\hat{u}}^f}{\sum_{f=1}^{k} w^f \delta_{\hat{S}\hat{u}}^f},$$

where

 – $d_{\hat{S}\hat{u}}^f$ is the distance measure between value of $\hat{S}$ and $\hat{u}$ at the dimension of *f* attribute – we can use this approach because the stereotype and user data can be represented as vectors:

$$\hat{u} = \begin{bmatrix} \hat{u}_1 \\ \hat{u}_2 \\ \vdots \\ \hat{u}_n \end{bmatrix}, \quad \hat{S} = \begin{bmatrix} \hat{S}_1 \\ \hat{S}_2 \\ \vdots \\ \hat{S}_n \end{bmatrix}$$

 – $\delta_{\hat{S}\hat{u}}^f = 0$ if there is no given value for attribute *f*, either for $\hat{S}^{(f)}$ or $\hat{u}^{(f)}$ (i.e. they have not been defined in stereotype or in user data); note, that the user is not required to enter all personal data; otherwise $\delta_{\hat{S}\hat{u}}^f = 1$,

- w^f is a significance weight of attribute f.

Note that since not all attributes have numerical values, the way that $d_{\hat{S}\hat{u}}^f$ is computed has to be modified accordingly. Therefore we use type classification proposed in [24]. Accordingly, we distinguish the following types of $\hat{u}$ attributes:

1. *nominal*, distinguishes between categories, e.g. between professions (teacher vs. manager). Elements of this type can be equal ($\hat{u}^{(f)} = \hat{w}^{(f)}$) or not ($\hat{u}^{(f)} \neq \hat{w}^{(f)}$),

2. *ordinal*, extending nominal type by possibility of ordering values according to their range ($\hat{u}^{(f)} < \hat{w}^{(f)}$, $\hat{u}^{(f)} = \hat{w}^{(f)}$, $\hat{u}^{(f)} > \hat{w}^{(f)}$). Here, possible values of the attribute are called states, for which we assign appropriate range: $r_i^f \in \left[1, 2, ..., M^f\right]$ is the range of value i of attribute f. For instance, wealth attribute can be of one of the following states: not rich ($r_0^f = 1$), average rich ($r_1^f = 2$), rich ($r_2^f = 3$), very rich ($r_3^f = 4$). Finally, M^f depicts size of the domain of attribute f (in the above example $M^f = 4$).

3. *interval*[2], which has values that belong to the linear scale and thus we can compute the distance measure directly ($\hat{u}^{(f)} - \hat{w}^{(f)}$). The age attribute is an example here.

In the case of stereotype data ($\hat{S}$) we must note, that each attribute carries only a "single value." For this purpose, we will establish sets of possible values for nominal and ordinal types

$$\hat{S}^{(f)} = \left\{\hat{s}_1^{(f)}, \hat{s}_2^{(f)}, ..., \hat{s}_n^{(f)}\right\},$$

while for the values of interval types, we will define borders of intervals considered in the system ($\hat{S}^{(f)} = \langle y_l, y_r \rangle$).

Now we can define $d_{\hat{S}\hat{u}}^f$ more precisely, depending on the type of f attribute:

- when f is nominal: $d_{\hat{S}\hat{u}}^f = 0$, if $\hat{u}^{(f)} \in \hat{S}^{(f)}$; otherwise $d_{\hat{S}\hat{u}}^f = 1$;

- when f is interval: $d_{\hat{S}\hat{u}}^f = 0$, if $\hat{u}^{(f)} \in \hat{S}^{(f)}$; otherwise $d_{\hat{S}\hat{u}}^f = \left|m - \hat{u}^{(f)}\right| / \left(\max^f - \min^f\right)$, where $m = (1/2)(y_1 + y_2)$ and $\max^f$ and $\min^f$ are possible maximal and minimal values of F, respectively.

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[2]In the cited work [24] author describes also ratio type, with values put on an absolute scale (distinguishing it from the interval type. Here we have joined both types into one.

– when f is ordinal: $d_{\hat{S}\hat{u}}^{f} = 0$, if $\hat{u}^{(f)} \in \hat{S}^{(f)}$; otherwise

$$d = \min_{\hat{s}^{(f)} \in \hat{S}^{(f)}} \left| r\left(\hat{s}^{(f)}\right) - r\left(\hat{u}^{(f)}\right) \right| \text{ and we can compute: } d_{\hat{S}\hat{u}}^{f} = d / \left(M^{f} - 1\right).$$

The same process is repeated for all stereotypes to find the one that fits the best. In the next step opinions of this stereotype are moved to the profile of the new user. The complete stereotyping process has been described in figure 2.
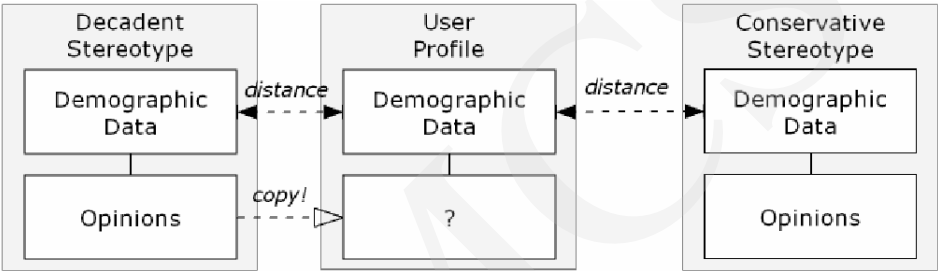

Fig. 2. The stereotyping algorithm

To illustrate in more detail how the proposed method works, in Table 1 we represent Anns profile being compared with the *Conservative* stereotype.

Table 1. Example of computing distance between Ann's profile and the *Conservative* stereotype; the only similarity is found in the wealth attribute

Attribute (f)	Conservatist's data ($\hat{S}$)	Ann's data ($\hat{u}$)	Weighted distance ($w^{f} d_{\hat{S}\hat{u}}^{f}$)
age	45-90	21	$1.04 = 2 \cdot 0.52 = 2 \cdot \dfrac{0.5(90+45) - 21}{90 - 0}$
wealth	not rich, avarage rich or rich	rich	$4 = 4 \cdot 1$
dress	elegant	natural	$0 = 1 \cdot 0$
profession	handworker, unemployed / jobseeker, pensioner / annuitant;	student / pupil	$0 = 2 \cdot 0$
Total ($d\left(\hat{S}, \hat{u}\right)$)			$0.56 = \dfrac{1.04 + 4 + 0 + 0}{2 + 4 + 1 + 2}$

6. Creating stereotypes methodological considerations

Usability and effectiveness of stereotypes depend on at least two factors: (1) quality of stereotypes themselves, and (2) quality of implications that can be drawn from the fact that someone is associated with a given stereotype [16]. The first factor is related to the number of stereotypes, correctness of selection and number of selected attributes that demarcate them, and that are used to establish

the distance between the user profile and the stereotype. Furthermore, the selection of the significance weight (w^f), which specifies importance of individual attributes also plays a very important role. The psychologists Reed and Friedman [25] have shown that using normative weights to divide people into actual categories associated with their lifestyle, may result in misclassification as individuals have different self-perceptions. What is more promising is utilization of a consumer behavior model, which takes into account not only external factors, but also the self-perception that conceptualizes the way individuals think and feel about themselves, as well as how they would like to think and feel about themselves [26]. The second factor is related to the quality of available data. For instance, the authors of the *LifeStyle Finder* system have utilized the data from a CRM system that contained, among others, US census data, magazine subscription data, purchase data and questionnaire-based data collected for about 40,000 people [27]. In the case of gastronomy, user profiles are studied only by largest restaurant chains and their data is not publicly available[3]. Separately, we were not able to find non-commercial data that would allow us to connect culinary preferences with age or income.

When data is not available, it is possible to use a questionnaire. Obviously, proceeding this way will result in a substantial expenditure of time and resources [28]. The questionnaire should consist of two parts: one related to the restaurant and one to the client. In the case of our system, features of the restaurant have to match these in our restaurant ontology. As a result, we should be able to answer the question: who (described demographically) is frequenting a given type of restaurants. Note that the described process means also, that we will be stereotyping restaurants. In other words, to be able to build a stereotype of the user and answer the question who is coming to Japanese restaurants, we need to create a stereotype of a Japanese restaurant first [29].

Obviously, it is also possible to create stereotypes on the basis of clustering of actual user behavior. As long as a large enough data sample is available, standard clustering algorithms can be applied. Similar approach was utilized, for instance in the *Doppelgänger* system [30]. The main problem with this approach is the need to possess a large quantity of data prior to creating stereotypes. Observe, however, that this approach can be used to modify stereotypes in an existing system [31].

Weighting all pros and cons we noticed, that the most important drawback of stereotyping-based approaches is substantial expenditure of time and resources while constructing stereotypes. Probably, this is the reason for preparing only

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[3]Information obtained from Joanna Ochniak from the School of Hotel and Restaurant Studies in Poznan, and from Andrzej Maslowski from the Institute of Market and Consumption in Warsaw; restaurant chains such as Starbucks, McDonalds or KFC have only provided us with basic information of limited practical value.

hand-crafted stereotypes in most of the user modeling systems [16]. However, this is usually done on the base of empirical data (e.g. purchase data), which in our case was difficult to acquire. Therefore we decided to prepare stereotypes on the base of our knowledge gathered in discussion with specialists, gastronomy literature [29] and own intuitions. We present all stereotypes in Appendix, recognizing that each generalization could be prejudicial and misleading. However stereotyping is only the first assessment about the user in the system and other user modeling technique can improve it.

7. Conclusions

In this paper we have addressed the problem of user profile initialization in a Travel Support System. We have suggested how a modified stereotyping can be used to solve this problem and presented how stereotypes can be represented and utilized in our system. Since the system is currently being implemented, in the future we will be able to report on the success of the proposed approach.

8. Stereotypes

Here we describe all stereotypes conceptualized so far within the system with the exception of the *Conservative* stereotype, which was already described above.

Youngster stereotype represents people of age below 15, whose wealth can vary (since it depends on the richness of their parents). No dress style for this stereotype is specified. *Youngster*s like hamburgers, hot-dogs and pizza (fast-food). Their favorite restaurant must offer menu dedicated to kids, serve meals outdoors and be able to handle large groups. *Youngster*s usually pay by cash.

```
[basicstyle=] :YoungsterData a sys:StereotypeProfileData;
    sys:hasProfessionSet [sys:contains sys:StudentPupil,
    sys:UnemployedJobSeeker];
    sys:hasWealthSet [sys:contains sys:Rich, sys:NotRich, sys:AverageRich];
    sys:hasAgeSet [sys:hasLeftBound 0; sys:hasRightBound 15].

:YoungsterOpinions a sys:OpinionsSet;
    sys:containsOpinion
        [sys:about res:FastFoodCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:HamburgerCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:HotDogsCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:PizzaCuisine;
            sys:hasClassification sys:Interesting],
```

```
[sys:about mon:Cash;
    sys:hasClassification sys:Interesting],
[sys:about res:KidFriendly;
    sys:hasClassification sys:Interesting],
[sys:about res:Kids;
    sys:hasClassification sys:Interesting],
[sys:about res:Kiosk;
    sys:hasClassification sys:Interesting],
[sys:about res:LargeGroupsOk;
    sys:hasClassification sys:Interesting],
[sys:about res:Outdoor;
    sys:hasClassification sys:Interesting],
[sys:about res:Family;
    sys:hasClassification sys:Interesting].
```

Young sportsman. This stereotype describes a person of age between 15 and
25 years, who wears sport-style clothing and is employed as a handworker. It
could also be a student or someone unemployed and who therefore cannot afford
expensive food. Sportsman likes entertainment (places that offer adult forms of
entertainment and music) and eats quickly. Similarly to a Decadent (s)he likes
drinking alcohol (mostly beer). Finally, he has no problem with places that are
not minority-friendly.

```
:YoungSportmanData a sys:StereotypeProfileData;
    sys:hasDressSet [sys:contains sys:SportyDress];
    sys:hasProfessionSet [sys:contains sys:Handworker,
    sys:StudentPupil, sys:UnemployedJobSeeker];
    sys:hasWealthSet [sys:contains sys:NotRich, sys:AverageRich];
    sys:hasAgeSet [sys:hasLeftBound 15; sys:hasRightBound 25].

:YoungSportmanOpinions a sys:OpinionsSet;
    sys:containsOpinion
        [sys:about res:FastFoodCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:HamburgerCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:HotDogsCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:PizzaCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:BarPubBreweryCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:MinorsNotAllowed;
```

```
            sys:hasClassification sys:Interesting],
    [sys:about res:AdultEntertainment;
            sys:hasClassification sys:Interesting],
    [sys:about mon:Cash;
            sys:hasClassification sys:Interesting],
    [sys:about res:Brewery;
            sys:hasClassification sys:Interesting],
    [sys:about res:FullBar;
            sys:hasClassification sys:Interesting],
    [sys:about res:WineBeer;
            sys:hasClassification sys:Interesting],
    [sys:about res:BeerTasting;
            sys:hasClassification sys:Interesting],
    [sys:about res:Entertainment;
            sys:hasClassification sys:Interesting],
    [sys:about res:CafeCoffeeShopCuisine;
            sys:hasClassification sys:NotInteresting],
    [sys:about res:CafeteriaCuisine;
            sys:hasClassification sys:NotInteresting],
    [sys:about res:TeaHouseCuisine;
            sys:hasClassification sys:NotInteresting].
```

Student is a person of age between 18 and 26 years old, not rich and "wearing naturally." Student prefers restaurants serving variety of foods: from pizza and Mexican cuisine to Asian food. His/her favorite restaurant should offer take-out and delivery services. Each meal should involve beer. A restaurant, a club or a pub is his/her second home and it is desirable from such a place to arrange concerts, provide Internet access and organize beer-tasting events. Students usually pay by cash.

```
:StudentData a sys:StereotypeProfileData;
    sys:hasDressSet [sys:contains sys:Natural];
    sys:hasProfessionSet [sys:contains sys:StudentPupil,
    sys:UnemployedJobSeeker];
    sys:hasWealthSet [sys:contains sys:NotRich];
    sys:hasAgeSet [sys:hasLeftBound 18; sys:hasRightBound 26].

:StudentOpinions a sys:OpinionsSet;
    sys:containsOpinion
        [sys:about res:AsianCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:ChineseCuisine;
            sys:hasClassification sys:Interesting],
```

[sys:about res:DoughnutsCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:PizzaCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:ItalianCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:SushiCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:TexNexCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:MexicanCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:VietnameseCuisine;
   sys:hasClassification sys:Interesting],
[sys:about res:BrasserieCuisine;
   sys:hasClassification sys:Interesting],
[sys:about mon:Cash;
   sys:hasClassification sys:Interesting],
[sys:about res:Delivery;
   sys:hasClassification sys:Interesting],
[sys:about res:Takeou;
   sys:hasClassification sys:Interesting],
[sys:about res:Upscale;
   sys:hasClassification sys:Interesting],
[sys:about res:Upscale;
   sys:hasClassification sys:Interesting],
[sys:about res:Brewery;
   sys:hasClassification sys:Interesting],
[sys:about res:WineBeer;
   sys:hasClassification sys:Interesting],
[sys:about res:BeerTasting;
   sys:hasClassification sys:Interesting],
[sys:about res:Entertainment;
   sys:hasClassification sys:Interesting],
[sys:about res:Outdoor;
   sys:hasClassification sys:Interesting],
[sys:about res:BeingYourOwnBeer;
   sys:hasClassification sys:Interesting],
[sys:about res:InternetAccess;
   sys:hasClassification sys:Interesting].

Snob. Snob, often dubbed as novo-rich has accumulated wealth extremely fast. (S)he is 25-40 years old and very well to do. He or she wears elegantly. The *Snob* is employed for instance as a business-person, director of start-up company or an advertising agent. *Snob* abhors fast-food and Polish national cuisine (we consider only Polish users at this moment). However, (s)he is eclectic: tries many foreign cuisines: Greek, Italian or Thai. S(he) also likes fashionable, high-value wines. (S)he pays only by a credit or debit card.

```
:SnobData a sys:StereotypeProfileData;
    sys:hasDressSet [sys:contains sys:Elegant];
    sys:hasProfessionSet [sys:contains sys:AdvertisingMarketingWorker,
        sys:ManagerDirector];
    sys:hasWealthSet [sys:contains sys:Rich, sys:VeryRich];
    sys:hasAgeSet [sys:hasLeftBound 25; sys:hasRightBound 40].

:SnobOpinions a sys:OpinionsSet;
    sys:containsOpinion [sys:about res:WineBeer;
            sys:hasClassification sys:Interesting],
        [sys:about res:WineList;
            sys:hasClassification sys:Interesting],
        [sys:about res:WineTasting;
            sys:hasClassification sys:Interesting],
        [sys:about res:Winery;
            sys:hasClassification sys:Interesting],
        [sys:about res:ExtensiveWineList;
            sys:hasClassification sys:Interesting],
        [sys:about mon:BankCard;
            sys:hasClassification sys:Interesting],
        [sys:about mon:ChargeCard;
            sys:hasClassification sys:Interesting],
        [sys:about mon:CreditCard;
            sys:hasClassification sys:Interesting],
        [sys:about mon:AmericanExpressCard;
            sys:hasClassification sys:Interesting],
        [sys:about mon:MasterCardEuroCard;
            sys:hasClassification sys:Interesting],
        [sys:about mon:DinersClubCard;
            sys:hasClassification sys:Interesting],
        [sys:about res:EuropeanCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:ChineseCuisine;
            sys:hasClassification sys:Interesting],
        [sys:about res:EclecticCuisine;
```

```
        sys:hasClassification sys:Interesting],
    [sys:about res:ItalianCuisine;
        sys:hasClassification sys:Interesting],
    [sys:about res:GreekCuisine;
        sys:hasClassification sys:Interesting],
    [sys:about res:BrasserieCuisine;
        sys:hasClassification sys:Interesting],
    [sys:about res:BeingYourOwnWine;
        sys:hasClassification sys:Interesting],
    [sys:about res:InternetAccess;
        sys:hasClassification sys:Interesting],
    [sys:about res:PrivateRoomAvailable;
        sys:hasClassification sys:Interesting],
    [sys:about res:FastFoodCuisine;
        sys:hasClassification sys:NotInteresting],
    [sys:about res:HamburgerCuisine;
        sys:hasClassification sys:NotInteresting],
    [sys:about res:HotDogsCuisine;
        sys:hasClassification sys:NotInteresting],
    [sys:about res:PolishCuisine;
        sys:hasClassification sys:NotInteresting],
    [sys:about res:KidFriendly;
        sys:hasClassification sys:NotInteresting],
    [sys:about res:Kids;
        sys:hasClassification sys:NotInteresting].
```

Decadent is person of age between 20 and 50 years old. In the case of the *Decadent*, financial status is of no particular importance. They can be students, academicians, or free-lancers. *Decadent*s wear naturally or elegantly. They go to restaurants serving coffee, tea and wines. Places where wine could be tasted (and over-indulged) are of special interest. Fast food is disgusting for the *Decadent*.

```
:DecadentData a sys:StereotypeProfileData;
    sys:hasDressSet [sys:contains sys:NaturalDress, sys:ElegantDress];
    sys:hasProfessionSet [sys:contains sys:StudentPupil, sys:ScientistTeacher,
    sys:SpecialistFreeLancer, sys:UnemployedJobSeeker];
    sys:hasWealthSet [sys:contains sys:NotRich, sys:AverageRich];
    sys:hasAgeSet [sys:hasLeftBound 20; sys:hasRightBound 50].

:DecadentOpinions a sys:OpinionsSet;
    sys:containsOpinion
        [sys:about res:CafeCoffeeShopCuisine;
            sys:hasClassification sys:Interesting],
```

```
[sys:about res:CafeteriaCuisine;
    sys:hasClassification sys:Interesting],
[sys:about res:TeaHouseCuisine;
    sys:hasClassification sys:Interesting],
[sys:about res:WineBeer;
    sys:hasClassification sys:Interesting],
[sys:about res:WineList;
    sys:hasClassification sys:Interesting],
[sys:about res:WineTasting;
    sys:hasClassification sys:Interesting],
[sys:about res:Winery;
    sys:hasClassification sys:Interesting],
[sys:about res:ExtensiveWineList;
    sys:hasClassification sys:Interesting],
[sys:about res:Entertainment;
    sys:hasClassification sys:Interesting],
[sys:about res:FastFoodCuisine;
    sys:hasClassification sys:NotInteresting],
[sys:about res:HamburgerCuisine;
    sys:hasClassification sys:NotInteresting],
[sys:about res:HotDogsCuisine;
    sys:hasClassification sys:NotInteresting],
[sys:about res:PizzaCuisine;
    sys:hasClassification sys:NotInteresting].
```

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