

# The TW Wine Agent: A Social Semantic Web Demo

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## ABSTRACT

The Tetherless World (TW) Wine Agent extends the original Stanford Knowledge Systems Laboratory (KSL) Wine Agent to support collective recommendations on food-wine pairings. This is done to (1) demonstrate the advance of Semantic Web technologies, including OWL DL reasoning, SPARQL, provenance explanation, and semantic wikis, and (2) show how the Semantic Web can be integrated into Social Web applications. A live demo is available at <http://onto.rpi.edu/wiki/wine>, which is designed for use on mobile phones as well as standard browsers.

## Categories and Subject Descriptors

D.2.11 [Software Engineering]: Software Architectures-*Patterns*  
I.2.11 [Artificial Intelligence]: Distributed Artificial Intelligence-*Intelligent agents*

## Keywords

Social Semantic Web, Intelligent Agent, Architecture

## 1. INTRODUCTION

Since its inception, the World Wide Web has emerged as an effective medium for individuals to publish and share opinions, especially in the Web 2.0 era. In this paper, we investigate how the Social Web can be improved by Semantic Web technologies that offer powerful information organization, integration, and analysis functions. To this end, we developed the Tetherless World (TW) Wine Agent, which aggregates web user recommendations on food-wine pairings, using cutting-edge semantic web technologies.

In contrast with the Stanford Knowledge Systems Laboratory (KSL) Wine Agent [1], the TW Wine Agent architecture (see Figure 1) is highlighted by three key features:

(1) Collecting input from web users by using a Semantic Wiki. Instead of storing all domain knowledge in pre-defined ontologies (like the KSL Wine Agent did), the TW Wine Agent integrates an OWL-based wine ontology with the Semantic Wiki [2] knowledge base that maintains web user recommendations.

(2) Finding and recommending wines using SPARQL [3] and the Pellet OWL DL reasoner [4], both of which are current generation Semantic Web technologies. This contrasts with the KSL Wine Agent, which utilized the Java Theorem Prover (<http://ksl.stanford.edu/software/JTP/>) along with the OWL-QL query language (<http://ksl.stanford.edu/projects/owl-ql/>).

(3) Providing detailed explanations for socially-aggregated recommendations. The TW Wine Agent now extends the Inference Web [5] application to explain why certain wines were recommended and rated via recommendation aggregation.

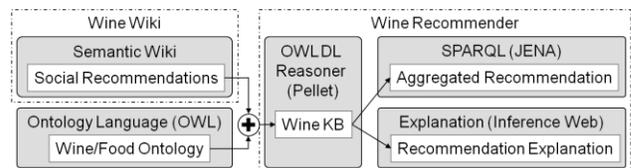


Figure 1. TW Wine Agent architecture and SW technologies

In addition to these feature highlights, the TW Wine Agent is designed to provide a functional user experience on both standard web browsers and mobile devices. To achieve this, an AJAX-based client program (which handles all user interaction) is used to call a backend server for handling computationally intensive work (such as OWL DL reasoning).

## 2. SEMANTIC DOMAIN KB: WINE WIKI

Since the currently used wine ontology can list wine instances based on specified wine properties, the TW Wine Agent lets web users contribute domain specific data (i.e. wine recommendations based on specified wine properties) and in turn records applicable provenance metadata (e.g. the name of the author).

To handle user contributions, the TW Wine Agent relies upon Semantic MediaWiki - a wiki extension that lets users encode semantic web knowledge on wiki pages. This tool was chosen for the following reasons: (1) it is a ready-to-use Web 2.0 platform with components such as user management, online editing and storage, and provenance tracking; and (2) it offers many useful semantic knowledge management components, such as semantic MediaWiki syntax, semantic querying, and semantic forms/templates. Figure 2a shows a form-based semantic knowledge input interface and Figure 2b shows RDF data generated from the input interface.

(2a) Recommendation Form

(2b) RDF data

Figure 2. Submitting a wine recommendation to the wiki

### 3. THE WINE RECOMMENDER

The TW Wine Agent uses the following procedure to obtain wine recommendations:

(1) Present a hierarchy of foods (based on a listing of foods stored on the Semantic MediaWiki) to help users select the food instance that is the main ingredient of their desired meal.

(2) Using the selected food, the TW Wine Agent searches the Pellet enabled Wine KB (based on the Semantic Wiki and wine ontology, as well as added triples through OWL DL inference) for applicable user-submitted wine recommendations using SPARQL queries. Recommendations on more general types of the selected food are also considered applicable according to OWL DL inference. Note that each applicable recommendation is encoded as a set of preferred wine property-value restrictions.

(3) For each recommendation, the wine KB is queried using SPARQL to obtain a list of matching wines. We then aggregate these listed wines and rank each wine using the percentage of endorsing recommendations (see Figure 3).

### 4. EXPLANATION / CUSTOMIZATION

Depending on the wine listings returned by the TW Wine Agent, users could want to modify parameters used to obtain the listings (such as excluding some wine recommendations). Furthermore, users may be more inclined to trust wine listings by knowing how they were derived. For these reasons, the TW Wine Agent provides users the ability to both view explanations of its decision making process and to filter wine listings based on recommendation provenance which is tracked by Wine wiki (e.g. the author from Figure 2a).

In order to explain the result wine listings (see Figure 3), TW Wine Agent keeps track of the steps taken to generate wine listings (see Figure 4), which can be viewed by clicking the applicable “?” button in Figure 3. In Figure 4, the TW Wine Agent explains why the wine Bancroft Chardonnay was rated as 75% for the food Swordfish: (1) the properties of the wine are listed in the same row; (2) four recommendations are found applicable on swordfish and its generalized food categories (non-bland fish, and fish); and (3) one recommendation is found not matching the wine properties of Bancroft Chardonnay, and thus 3 out of 4 applicable recommendations endorse the wine. Moreover, TW Wine Agent also allows users to filter recommendations by provenance. As shown in Figure 4, each recommendation comes



Figure 3. Aggregated wine listing (mobile viewer)

from a certain recommender, and TW Wine Agent allows users to filter recommendations by certain properties, including authorship and specified food. Note that Inference Web is used here to represent the provenance annotation for recommendations and workflow that integrates social recommendations to final results.

**Selected food: Swordfish Wine: BancroftChardonnay**

REC. ID	MADE BY	FOR FOOD
Rec-2Dhendler	James Hendler	Swordfish
RecDLM Swordfish	Deborah L. McGuinness	Swordfish
RecNonBlandFish	Li Ding	Non Bland Fish
RecFish	James Michaelis	Fish

SUPPORTING RECS: 3 CONFLICTING RECS: 1 SCORE: 3/4 = 75%

**Why this is the case:**

WINE	COLOR	BODY	FLAVOR	SUGAR
<b>BancroftChardonnay</b>	White	Medium	Moderate	Dry
REC. ID				
Rec-2Dhendler	Red <input checked="" type="checkbox"/>	Light <input checked="" type="checkbox"/>		Dry
RecDLM Swordfish	White	Medium	Moderate	Dry
RecNonBlandFish	White		Moderate	
RecFish	White		Moderate	Dry

Figure 4. Explanation of why “Bancroft Chardonnay” was listed for “Swordfish” Here, each rectangle with X indicates that a property of one recommendation (i.e. Rec-2Dhendler) is conflicting with that of the recommended wine (i.e. Bancroft Chardonnay).

### 5. CONCLUSION

TW Wine Agent extends the original KSL wine agent into a socially-based application, using the best in class semantic web technologies (such as Semantic Wiki, OWL DL inference, SPARQL querying, Inference Web) and Web 2.0 technologies (such as AJAX and mobile user interfaces). This effort has yielded a lightweight Social Semantic Web application providing both a demonstration and an example that others may wish to leverage.

### 6. ACKNOWLEDGMENTS

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