

# The Social Semantic Server

## A Framework to Provide Services on Social Semantic Network Data

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**Abstract.** This paper presents work-in-progress on the *Social Semantic Server*, an open framework providing applications and their users with a growing set of services of different granularity that utilize social and artifact network data. The *Social Semantic Server* forms a novel approach to store, query and update semantically enriched social data in order to exploit its relations within. The use of its services will be demonstrated in an exemplary use case in the health care domain.

**Keywords:** social semantics, semantic networks, social networks, artifact-actor networks

## 1 Introduction

During the last years, the popularity of social networks, such as Facebook<sup>1</sup> and Twitter<sup>2</sup>, has drastically grown and much research has been performed in the field of social network analysis (an adapted combination of graph theory and network science [1] [2]). Moreover, structured and semantically enriched data have become increasingly important since, combined with social network data, they provide valuable supplementary information and make additional analysis possible [6].

The *Social Semantic Server* (*SSS*) presented in this paper is based on Artifact-Actor Networks (AANs) [5] that combine both, the classic social network and the artifact network approaches (e.g., Wikipedia<sup>3</sup>). It can establish more meaningful connections between artifacts and actors [5], which in turn can be further used in the respective systems (e.g., to determine topics that an author is interested in based on the articles he/she has read in order to recommend further references).

<sup>1</sup> <http://www.facebook.com/>

<sup>2</sup> <http://twitter.com/>

<sup>3</sup> <http://de.wikipedia.org/>

However, AANs neither explain exactly how these relations emerge nor how they can be exploited meaningfully. To address these issues, we introduce the *SSS* framework implementing services that utilize semantic technologies in dealing with social data from user-to-user interactions and/or user interactions with digital artifacts, such as texts or multimedia documents (e.g., pictures or videos).

To the best of our knowledge, the *SSS* is a novel approach to an open and extensible back-end framework equipping applications with services for exploiting and enriching social data using semantic relations.

## 2 Approach

The *SSS* is realized as a Java framework and can provide services of various degrees of complexity. It is accessible from within lightweight HTML applications via WebSockets or REST and from server-side applications capable of socket-based communication strategies. To increase interoperability, services that receive the application input and/or deliver the results to the requesting application use JSON for data encoding and transmission.

Together with the *SSS* framework, REST and JavaScript libraries based on WebSockets could be included in applications directly, which facilitates tying the framework to custom applications. As the set of services is supposed to grow and being extended, the core implementation of the *SSS* allows to easily register new services to its dedicated service registry. Generally, the server provides two types of services that are described below:

**Low-Level Services** are used to generate and enhance the semantic structures of an AAN. On the one hand, they allow to store and query semantically structured data in the form of RDF triples [3] [4] that are instantiated and further processed within the respective services. Low-level services are designed to access and update the semantic data structures in an RDF triple store (e.g., Virtuoso<sup>4</sup>). As users and digital artifacts are central concepts within an AAN, designated services make it possible to work with their respective representations (e.g., Java objects) that are directly mapped to the data base. This way, users and digital artifacts can be interlinked and used together with common features of social networks. On the other hand, low-level services provide functionalities, including:

- support sharing and subscribing processes of artifacts or groups of artifacts
- annotate/tag entities of the AAN with metadata and discuss digital artifacts
- handle collaborative work on digital artifacts with regard to read/write restrictions
- allow (re-)structuring of hierarchical and ordered collections of digital artifacts
- authenticate users and broadcast updates to connected applications

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<sup>4</sup> <http://virtuoso.openlinksw.com>

- deal with digital artifacts, such as texts and multimedia documents (e.g., pictures and videos), uploaded via the respective services to an integrated Apache WebDAV<sup>5</sup> repository

**High-Level Services** use the given semantic structures formed by low-level services. They exploit explicit and implicit (social) relations to provide functions that support a personalized reflection of an AAN in order to:

- support (self-)reflection and increase the awareness of specific topics
- recommend various types of AAN entities, such as users (e.g., experts, novices), digital artifacts (e.g., discussions, collections of digital artifacts) and meta-data (e.g., tags, ratings, descriptions)
- search within several entities and their relations via tags or content-based keywords (Apache Solr<sup>6</sup> is used for full-text indexing of all uploaded digital artifacts)

With regard to social semantic data, high-level services perform filtering, inferring and modeling tasks utilizing metadata from digital artifacts/users, usage paths or even more complex data from artifact/user models based on semantic relations. Additional services are available, such as calculating certain indicators (e.g., the maturity of digital artifacts within an application) from the social data and the usage histories. Their results can be used by other high-level services (e.g., for searching within the AAN).

### 3 Applications

The *SSS* framework is currently being extended in the context of a big FP7 EU project, Learning Layers<sup>7</sup> (LL). The overall goal of the framework and its services is to help the participants from the health care and construction domains to build a large-scale social semantic knowledge repository that can easily be extended and used to scaffold learning episodes. In the following paragraphs we present a work-in-progress application scenario from the health care domain in the UK and elaborate on the related *SSS* service administration.

In the UK, the National Health Service establishes guidelines for General Practitioners (GPs), Diabetes Specialist Nurses, etc., for managing particular situations and diseases (e.g., diabetes) and deliver best care to locals with corresponding needs. However, the guidelines do not cover all issues encountered by GPs in practice. This triggers seeking support and related discussions, which can be facilitated via meaningful scaffolding with appropriate experts, documents, videos, pictures, etc.; e.g., up-to-date research results and worthwhile insights of GPs who face similar challenges, may help to reduce or eliminate the guidelines' ambiguities with regard to certain treatments or medications. Therefore, a tool is required that will enable GPs to state clearly defined questions for a chosen

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<sup>5</sup> <http://www.webdav.org>

<sup>6</sup> <http://lucene.apache.org/solr>

<sup>7</sup> <http://learning-layers.eu/>

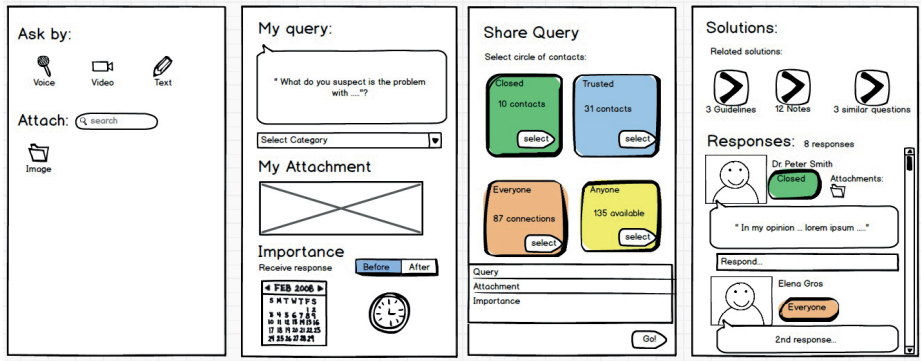


Fig. 1. Application scenario for supporting discussion and search tasks with recommendations based on AAN data (LL Design Team 'Pandora').

group of people. By discussing and answering respective questions with the help of trusted networks and by taking advantage of the inherent knowledge from this specific kind of AAN, mentioned ambiguities can be addressed via a meaningful service instrumentation (see a dedicated application scenario sketch in Figure 1).

The *SSS* framework will support both, the basic and advanced features of the application using its low- and high-level services. The application will enable the user to enter problem statements into well-structured search queries. High-level services will deliver suitable recommendations (e.g., specialists or notes of related discussions) by exploiting the semantic structures of the knowledge base formed by low-level services. Thereby the following basic services will be used, as illustrated in the different screens of Figure 1:

The first screen shows various ways to enter problem statements (e.g., ask a question using voice, video or text) and the upload of documents as attachments to the post. The second screen contains the available annotation options (e.g., adding metadata) for classifying the question into a certain category and assigning it a certain importance based on an urgency value. Moreover, the question can be shared among different contact circles to start a discussion in the personal/trusted or extended/public social networks as demonstrated in screen three. Furthermore, the fourth screen displays the recommendation filtering in different categories and possible privacy levels (e.g., closed or everyone). The recommendation categories can be users, digital artifacts or metadata (e.g., tags), as stated in section 3.

The application scenario above describes 1 out of about 20 use cases generated by four design teams of the LL project. All of the use cases (or at least specific parts thereof) will be realized using applications based on the *SSS* services.

## 4 Conclusions and Future Work

This work presents the *SSS*, an open framework that enables applications to generate and use semantically enriched AAN data by integrating a growing set of dedicated services. One of the next steps will be to evaluate the framework's feasibility with regard to its services by testing the functional application prototypes in realistic field settings. For future work we plan to extend the available set of functionalities by services that provide meaningful assistance to various kinds of learners in performing their actual work tasks.

Additionally, services will be developed, which seamlessly integrate different types of vocabularies as ontologies to form a basis of semantic structures for the server. On the one hand, they could represent emerging vocabularies that are generated and utilized by users of applications via the *SSS* and on the other hand, they could represent vocabularies on a higher level of formality (e.g., not directly extendable disease classification vocabularities, such as the ICD<sup>8</sup>). As a result, applications could utilize metadata from different vocabularies upon various AAN entities that are needed in the respective contexts. Furthermore, we will attempt to distribute our ideas via SourceForge<sup>9</sup> as open-source software under the Apache License v2.

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<sup>8</sup> <http://www.who.int/classifications/icd/en/>

<sup>9</sup> <https://sourceforge.net/p/learning-layers/code/HEAD/tree/trunk/SocialSemanticServer/>