Chapter 2
The Social Semantic Web

"You affect the world
by what you browse."
—Tim Berners-Lee

Nowadays the Web is omnipresent, reaching into almost everyone's life. More and more Web users do not switch off their devices all the time, continuously receiving and sending messages, frequently looking for information, now and then evaluating this information, and so on. The means to reach the Web do thereby not stop at personal computers, but increasingly also include mobile devices. More and more users are sharing information online, are working collaboratively on a topic, as well as maintaining their relationship in the Web (Alby, 2008). All of this is so pervasive that it feels absolutely natural. Consequently it is not surprising that topics related to the Social Web are experiencing a surge of interest, both from the scientific community as well as the industry. However, apart from this and maybe also apart from the public perception, a complementary technological revolution takes place—the rising adaption of Semantic Web technologies. The Semantic Web is a vision that the present Web will eventually include the notion of meaning and become a metadata-rich Web where presently human-readable content will contain computer-understandable semantics (Berners-Lee, Hendler, & Lassila, 2001).

Today information in the Web is raw material and currency at the same time. The possibility to extrapolate this information constitutes one of the core competencies of the future. The quest of the development ability and logistics of information is at the center of the discussion about utility and functionality of Semantic Web technologies. This discussion is controversial; skeptics of the Semantic Web dismiss the W3C standards and methods as too complex and technology-driven, as to have a chance in the grassroots-impelled Social Web. In return, the representatives of the Semantic Web community raise legitimate questions concerning alternative tools and methods to get a grip of the information overload produced by precisely the bottom-up-processes of Social Web (Blumauer & Pellegrini, 2009). Both fractions can exalt valid claims to their arguments. In the process, slowly the understanding grows that

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only combined forms of top-down with bottom-up-approaches represent a reasonable solution. Thereby this solution should include not only the technological feasibility but also social acceptance. The objective to exploit the Social Web, as well as the assignment of social media elements for collaborative enrichment of Web content with computer-understandable metadata, are impressive manifestations of a trend towards the Social Semantic Web. A denominating symptom of this development is the ongoing convergence between social media elements and Semantic Web technologies. Examples can be found in (Blumauer & Pellegrini, 2009) and (Breslin, Passant, & Decker, 2009).

This chapter should come across as a theoretical introduction in preparation for the main focus of this PhD project, the FORA framework and its YouReputation prototype implementation. It is important to grasp underlying theory in order to gain awareness of online reputation analysis problems (see Chap. 4 and 5). Thus, this chapter is intended to shine a light on the Social Web as well as the Semantic Web. As introduction, Sect. 2.1 briefly highlights the convergence of information and media sciences in the Web. Accordingly, in Sect. 2.2 the most significant elements of Social Web are revealed. Section 2.3 introduces the vision of the Semantic Web and presents its basic technologies. In Sect. 2.4 both presented parts are merged to engender the discussed Social Semantic Web. Section 2.5 closes this chapter with suggestions for further readings.

2.1 History on the Convergence of Information and Media

During the evolution of human civilization, new technologies allowed to keep evermore (semi) structured data (i.e. information) in diverse media forms. Hence, the invention of the Web, as well as the progression towards the Social Semantic Web can be pronounced by the need to get over the growing amount of information.

Indeed, the initial creation and recording of information took off with cave paintings some 32,000 years ago. One of the first expressions by letter was the Sumerian cuneiform script written on clay tablets. Caused by the papyrus rolls of the ancient Egyptians, the scrolls of Greeks and Romans, a very own dynamic evolved. The development of creation and distribution of text was even accelerated by the invention of the printing press (Portmann, 2008). The invention of photography added another key form of media, followed up by the invention of the phonograph for sound recording and the capability to effectively create movies (Manovich, 2001). This proliferation unleashed the sine qua non to collect and organize media objects. In earlier times, they were organized in libraries. These libraries were (and still are) centralized collections with categorical organization and indexing principles, whereby the knowledge organization of the stored information is mostly expert-based (Breslin et al., 2009).

About three millennia ago, the ancient Assyrians annotated clay tablets with small labels to make them easier to tell apart when they were filed in baskets or on shelves. The idea survived into the twentieth century in the form of the catalog cards that librarians used to record data (e.g. a book's title, author, subject, etc.) before library records were moved to computers (Gavirilis, Kakali, & Papatheodoro, 2008). The actual books constituted the data; the catalogue cards comprised the metadata. The term meta comes from the Greek word that denotes alongside, with, after, next. Metadata can be thought of as data about data, and it commonly refers to descriptive structured data about (Web) resources that can be used to help support a wide range of operations. To minimize information overload and consequently allow faster information access, experts manually record metadata about books on catalog cards, for example. To assign the library analogy to a Web without metadata, every word in every page in every book must be indexed. Because such indexing will lag the growth and change in the Web, it often yields poor search results. With even some basic metadata, using the library analogy again there are books with categories, titles, descriptions, ratings, yielding a much better retrieval. Unfortunately the effort for this manual indexing is not satisfactory in the growing amount of information.

Vannevar Bush was one of the first to perceive that the dissemination of information and knowledge in diverse media forms had opened up new challenges that central archives—and the manual indexing mechanisms of traditional libraries—could not fulfill. Here, information is regarded as an essential element to derive knowledge, but knowledge can additionally include facts and understanding gained through experience, education or reason. After the Second World War, Vannevar Bush suggested the Memex proto-hypertext system in which "*an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory*." (Bush, 1945). The core of his system declared a shift from a knowledge organization through experts to knowledge organization trough individuals. Later Doug Engelbart suggested the first hypertext system, what, in turn, led Ted Nelson to implement such a hypertext system with a simple Graphical User Interface (GUI). However, only Tim Berners-Lee was able to realize part of the vision: The hypertext system, alias the Web, which made global information access in the first place feasible.

The invention of the Web technically spurred new horizons for the public use of databases and networks. Innovative Web browsers subsequently allowed also laymen to access this resource. Increasingly, also organizations discovered the Web as a medium of communication between its diverse locations, departments, and stakeholders. It was therefore subsequently incorporated into part of the business.

Seen from the perspective of the producers and consumers, the Web bit by bit turned into an interactive medium. As already envisioned by (McLuhan & Nevitt, 1972; Toffler, 1980), the Web provided its prosumers, for the first time a free and easy means for interacting or collaborating with each other. Jenkins (2008) carried on McLuhan and Nevitts work and illustrated the cultural approximation of old and new media. His term convergence culture describes an emerging pattern of relations bringing together entertainment, advertising, brands, and consumers. So the burst of the dot-com bubble had no impact on the growing use of the Web. Rather improved business models and new offerings were developed. With the expansion of bandwidth and database-driven applications, it was possible to provide ever-greater amounts of information via the Web. This changed the perception of its nature to the extent that it was considered as a platform to store content.

The growing percentage of UGC challenged increasingly the exclusive state of established news portals and knowledge bases. Hence, the influence of this UGC in the pre-media space increased over time. The term pre-media space denotes the area in the verge of traditional media's news aggregation on their portals. In the context of anti-globalization movement's alternative public media projects were started. In particular, the rise of blogs and the emerging blogosphere fueled expectations for grassroots journalism. Blogs became popular as a new form of communication. Likewise the number of online communities and volunteer contributors accelerated drastically. Earlier blogs and communities were smiled at, but now they are accepted as open communication and documentation media. The same is true for social networks; end of September 2011, that is to say, the number of active Facebook users is exceeding 800 million (Olivarez-Giles, 2011). Wikipedia, as another example, occupied as a non-commercial project a crucial communication point. The blogosphere, in turn, revealed a new form of decentralized news propagation. Hence with the success of the blogosphere, social networks, and the Wikipedia project, the public, organizations, states, and established traditional (mass) media had to deal with innovative controlling models in the emerging Social Web. Apropos, at the time of writing, Wikipedia is suggested as world's first digital and global world cultural heritage site (Sooth & Schoneville, 2011).

2.2 Social Web Elements and Their Classification

The Social Web contains social media that include communication and interactive tools. Communication tools typically handle the capturing, storing and presentation of communication, usually written but increasingly including audio and video as well. Interactive tools handle mediated interactions between a pair or group of users. They focus on establishing and maintaining a connection among users, facilitating the mechanics of conversation and talk. This section showcases the Social Web from a social sciences perspective. On this ground, a classification of social media elements (and applications) is offered. Since a basic understanding of these elements is essential to understand this PhD thesis, the different social media elements are shortly characterized next. This characterization list thereby is illustrative rather than exhaustive.

The Social Web portrays the Web as social media elements and applications, and describes how people socialize or interact with each other throughout the Web. Hence the Social Web can be described as people linked and networking with engaging Web content in a conversational and participatory manner. Therefore (Ebersbach, Glaser, & Heigl, 2010) define that the Social Web is assembled of *"Web-based applications that support human information exchange, relationship building and its maintenance, communication and collaborative cooperation in a social or community context, and the data that emerge and the relationships* *between people who use these applications."* This thesis builds on this definition for the Social Web as well. The focus thereby is on social and not on technical criteria. Additionally within this thesis, a distinction between element and application is made; the former is defined as a manifestation of social media, the later as instantiation of the social media elements in the form of a practical tool. Social media applications may well consist of technical parts, but these parts are not in the center within this thesis. However, many of these applications share social software characteristics like the ability to upload information, service-oriented design, open Application Programming Interfaces (API), and Web feeds—as the Atom Publishing Protocol (APP) and Really Simple Syndication (RSS). A deeper introduction to social software can be found in (Ebersbach et al.,).

The plethora of social media elements is almost endless. That is why on nearly any area of social life an appropriate community on the Web can be found. Accordingly it is useful to determine these elements for their purpose. To categorize them, three criteria are considered:

- *Collaboration*: This comes across as gathering and production of knowledge (e.g. information, statements, findings, ratings, etc.). Here, people are grouping around a topic to collaboratively edit it.
- *Information*: Where the focus is on the dissemination of information and knowledge. This can comprise of hypertext, links, uploaded files (e.g. text, pictures, images, videos, etc.), as well as just comments (e.g. opinions, insights, ratings, etc.).
- *Relationship*: Whereby the focus is on the building and caring of a relationship of interpersonal connections. This is about meeting other people virtually to obtain information or recover connections—likewise from the real world.

Additionally, communication is an issue that is common to all elements of the Social Web in a more or less intense form. There are interactions between the different areas, but collaboration without communication, for example, is very difficult to imagine. The same applies to maintaining relationships and the exchange of information. So with communication the other three edges are kept together. Adapted from (Ebersbach et al., 2010), in Fig. 2.1 these edges (collaboration, information, and relationship) are visualized by a triangle. Since communication is concerned with all of these edges, it is visualized as a circle around the triangle. Note that this figure is not intended as an exact mapping of social media elements but rather as an overview of them that flow into one another.

Nevertheless, an ideal medium that meets all three edges would be located in the middle of the triangle. In the following sections, the classified social media elements will be presented. Section 2.2.1 starts with weblogs. These are personal journals, typically administrated by individuals and updated on a daily basis with a personal view on a current issue. Microblogs differ from traditional blogs in that the content is typically smaller. They focus on short messages that are exchanged via a central platform. They have primarily a communicative character, and usually a short date range. They are presented in Sect. 2.2.2. Section 2.2.3 introduces folksonomies (a blend of folk and taxonomy), which are systems of classification derived from the practice and method of collaboratively creating and managing tags

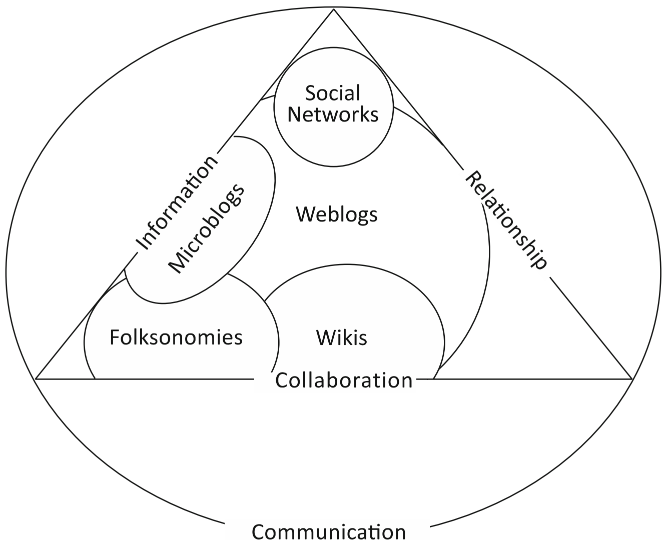

Fig. 2.1 Triangular classification model

to annotate and categorize content. Section 2.2.4 presents wikis, which focus on the collaborative creation of hypertexts, with the aim of the community to draw up content together. As a last element, in Sect. 2.2.5, social networks are explained in more detail. They center on the development and maintenance of relationship. All of these elements increasingly can appear as a combination, such as wikis, with a social network extension—the talk is then about integrated platforms.

2.2.1 Weblogs

The expression weblog originates from the words Web and log and details a type of online diary (e.g. realized with WordPress or Blogger). According to (O'Reilly, 2005) blogging is a feature of the Social Web much sought-after. He observes blogging as one of the most common activities introduced by the Social Web and spot blogs as the mightiest media of UGC. Compared to websites, blogs are easier to handle and more flexible in their utilization. Through a blog Content Management System (CMS), information can be added and administrated straightforward. This simplicity is the basis for the prodigious and tremendously fast global expansion of weblogs.

The dialogue-based communication style, inherent to blogs, is an effect of the great number of links. Many blogs are interactive, allowing visitors to leave comments and it is this interactivity that distinguishes them from static or semi-static websites. In contrast to a static or semi-static website, an interactive website is one that changes frequently and automatically, based on certain criteria. Posts are connected and referenced by a trackback function. Trackbacks lead to other blogs that have been written about the same topic. Often they are reactions to the post they are linked to, but have been published in another blog instead of a comment. In order to work, trackbacks permalinks are necessary. This technology permits each entry to have its unique Web address through which it is retrievable at any time or place. By building bridges between blogs, permalinks turned them from an ease-of-publishing phenomenon into a conversational medley of overlapping communities.

Blogs do not underlie a certain authority as the press, academia, medicine or law, which forms the interpretation of authenticity. The central characteristic of the blogosphere is that it flattens the different hierarchies; it equalizes the relationships through the fact that anyone may blog about anything (Hächler, 2010). In the blogosphere traditional hierarchies have vanished and interactivity is central to it. Other ways of control seem to be emerging. Bloggers keep an eye on their audience; their main task is to manage the interaction and to keep it going. Analyzing received attention mainly does evaluating the importance of the different bloggers. Links, hits, trackbacks and being mentioned in other (top) blogs are indicators of value. Wanting to be spread and respected in the blogosphere makes bloggers careful when marking their own opinions.

Levinson (2009) stipulates two main characteristics of blogs: Firstly and as already introduced, anyone can blog about anything and secondly, the actual impact of a blog, as well as the time of its maximum impact, is incalculable. According to (Portmann, 2008), blogs can mobilize society to bring down politicians, hold an organization to account, popularize a book or spread a video, but blogs can also continuously echo a vicious lie, for example, long after it has been debunked (Myres, 2010).

Partaking in the blogosphere involves commenting. Levinson (2009) purports that comments are the most frequent form of sustained written discourse and attribute two other functions inherent to them: Firstly, comments can be an effective promotion for one’s own blog. Secondly, and more important, comments do not solely go for the voice of the people, but also as the conveyors of the truth. They correct, if necessary, a post. Comments can therefore be a stumbling block for misuse of a blog (e.g. by competitors).

In business settings, weblogs are used either internal or external. The talk is then about corporate blogs. Such blogs are used by an organization to reach its structural goals. The benefit of corporate blogs is that posts and comments are easy to reach and follow. Corporate blogs are a connecting link between organizations and its customers.

In the subsequent section, a latest up-and-coming form of blogs will be presented: Microblogs attract additional bloggers afraid of text long entries.

2.2.2 Microblogs

Microblogs (e.g. Twitter or Tumblr[1]) are a kind of revised form of traditional weblogs, where users can post short text messages, reporting on the details of one's life. The messages are typically restricted to 140-characters for compatibility with Short Messages Services (SMS) (Comm, 2009; O'Reilly & Milstein, 2009; Sagolla, 2009).

There exists also commercial microblogs to promote websites, services or products, and to push on collaboration within an organization (Portmann & Hutter, 2011). Some microblogging services provide functionalities such as privacy settings, which permit to monitor who can read their microblogs, or other ways to promulgate post entries in addition to the Web-based interfaces, such as smartphones and Personal Digital Assistants (PDA).

Often microblogs are used to bring readers to the attention of traditional blog posts (Portmann & Hutter, 2011). However, with social bookmarking platforms, these readers can also organize their bookmark-worthy Web content in a straightforward manner. Additionally these platforms can be used to annotate the Web content—folksonomies are such an example. Anyway, different microblogging systems even allow annotating its messages with hashtags. These hashtags are means to tag underlying message and may provide a folksonomy.

2.2.3 Folksonomies

Metadata can be used to provide a structured description of characteristics such as the meaning (i.e. semantics), content, structure and purpose of a Web resource; to facilitate information sharing; to enable more sophisticated search engines on the Web; to support intelligent agents and the pushing of data (e.g. from Web feeds); to minimize data loss or repetition; and to help with the discovery of resources by enabling field-based searches.

The interactive and participative possibilities of the Social Web also have their effect on the way people organize and share their online sources. Tagging and the emerging folksonomies are the result of people describing or labeling Web content (e.g. bookmarks on Delicious or images on Flickr). (Smith, 2008) characterizes folksonomy as the popular term describing the bottom-up classification systems that emerge from collaborative tagging content. Tags can be seen as metadata about a resource. They can be used in various situations. For example, an image platform allows one to upload photos, sort them, and subsequently organize them through tags. On microblogging platforms, as another example, often the possibility to annotate content by hashtags is provided (see Sect. 2.2.2). Social bookmarking platforms, in turn, entail being able to add tags to a user's bookmarks (e.g. links,

[1] http://www.tumblr.com/

pictures, movies, etc.). By adding whatever keywords suit best, each user creates his collection of links that are being categorized through these keywords. Whenever a user finds a website that is meaningful to save or mark, he can do so by describing it through keywords or tags. This way he adds metadata to the online source, creating multiple and especially personal ways of finding it again. In addition, the tags and sources are being shared with the entire community, thus enabling to pinpoint new resources including the same or similar tags. Tagging improves the findability of resources by using individuals' vocabulary and by empowering everyone to organize a collection their own way. In tagging, keywords can be chosen freely and are treated identically with no hierarchical background.

These user-added keywords are the basis organizational objects for the emergent folksonomies. While by tradition, metadata was created primarily by experts following stringent taxonomies and pre-specified controlled vocabulary, the categories based on Web user-created metadata are more flexible (Orio, 2010). To return to the library analogy (see Sect. 2.1), experts agree on the usage of specific metadata (i.e. taxonomies) to annotate content. Web users, however, are not bound by such agreements. Hence, in contrast to taxonomies, which are hierarchical and exclusive, tags are neither exclusive nor hierarchical. The three entities tags, users, and resources constitute what is called a folksonomy (Smith, 2008).

UGC and sincerity are coevally the folksonomies' advantage and disadvantage. Its simplicity and low entry barriers comfort people to actively participate in tagging and thus inflicting metadata to the Web (Hächler, 2010). It is a very facile process that takes no ancillary capabilities because each user can use his own vocabulary. While the traditional and professional creation of metadata is time and effort consuming, folksonomies can keep up with the immense amounts of new content timelessly being created on the Web. They allow quick adaption of new terms when traditional vocabulary is missing. However, there are limitations resulting from the democratic way of labeling Web content. Tagging's nature, and therefore that of folksonomies, is fundamentally chaotic, prevalently giving rise to problems of imprecision and ambiguity because there is just no predefined vocabulary to be used.

All in all, folksonomies are transforming the creation of metadata for resources from an isolated professional activity into a shared, communicative activity by the users. This shift is of dual nature and also causes some difficulty: On one hand, tagging is a great system for individual organizations, at the same time there is an inherent compulsion to share in order to generate folksonomies and to reveal the full and useful power of the system for the user. However the dualisms should be carefully considered. Folksonomies are aggregated through vast amounts of metadata created by the users. The fundamental difference to traditional classification schemes lies in the reduced complexity. Some organizations use folksonomies to let their employees easier manage their own Intranet hyperlinks.

A further possibility for organizing information and knowledge instead of metadata, are wikis. A wiki is a website that allows the creation and editing of interlinked websites via a Web browser using a simplified markup-language.

2.2.4 Wikis

A wiki (e.g. Wikipedia or Wikitravel) is a system that allows one or more people to build up a knowledge body of interlinked webpages, using a process of creating and editing pages. With wikis, anybody can contribute equally to a joint online publication. Wikis are rooted on the convention that contributors can straightly post whatever they know about a topic for others to approve, clarify, add to, or revise rather than all content is being accepted by a Web administrator as occurs with conventional websites. Centralized production and top-down techniques of knowledge sharing are being pushed aside by the belief and the new concept that everyone together is smarter than one alone. This concept is known as collective intelligence, a shared group intelligence that emerges from the collaboration and competition of many individuals (Malone, 2006). This concept can also be found more or less in every social media element. For example, the previously introduced social bookmarking platforms, where users are collaboratively organizing Web content in a more meaningful way as only experts can do. The times when knowledge needed to be vouched for, authorized and approved by experts before it could hit the broad audience seem in some areas to fade out evermore. Wikis are characterized by arising properties in the media.

The aim of the wiki is to establish collective knowledge. Therefore, they highlight the participation, the contribution and collaboration of the users. The keyword for wikis is easy. Anyone can edit and contribute to a wiki, demanding it to be easy to handle. Wikis usually have an editing link, through which anyone can start writing and adding to the content. They tightly pursue the open-source software ideal, which implies that the quality of the collectively produced product is more crucial than owning the idea or the code. Wikis can play havoc with the conventional ideas of copyright and intellectual property (Richardson, 2010).

Whereas blogs and microblogs are good for discussions, wikis are not as optimal for carrying out discussions about conceptions. Most conversations, concerning which article and what posts need to be altered in what way, may happen parallel to it. However, this process demonstrates how the collaboration is brought to light and correspond with the ideal of open-source knowledge gathering (Hächler, 2010).

In some organizations wikis are tools successfully used to manage the organization's internal information and knowledge. Moreover, they can be used in organizational context also for project management. Through wikis newcomers to the organization or a project can gain fast access to (relevant) information (Fuchs, 2010).

The last crucial elements of the Social Web are social networks, presented in the next section. These networks are social structures made up of individuals (or organizations) called nodes, which are connected by one or more specific types of interdependency.

2.2.5 Social Networks

Social networks (e.g. Facebook or Google+) have become a significant medium for self-expression and identity generation. A vital characteristic of the present culture is the raising of individualism and the elevation of the individual experience as a guarantor of truth. The individual has increasingly evolved to the heart of social, economic and technological order. Besides, society seems to become evermore formed by an expressive culture, blurring the differentiation between private and public. Stepwise sociality is taking place in the virtual world and likewise intimacies are being carried into the virtual world. In such an environment it then becomes a critical factor as to how individuals cultivate and negotiate their own identity. Each person is responsible for drawing a suitable persona. Therefore, the resulting persona is as intimate as its public.

A definition of social network sites stems from (Humphreys, 2009), who calls them "*Web-based services that allow individuals to* [...] *construct a public or semi-public profile within a bounded system,* [...] *articulate a list of other users with whom they share a connection, and* [...] *view and traverse their list of connections and those made by others within the system.*" For (Levinson, 2009), this kind of social media has the very purpose of building and developing social networks, and thus enabling people to connect for whatever proposition. Social networks provide their members a platform from which they can engage in a wide-ranging variety of activities such as private messaging, bulletins or group messaging, blogging, posting of photos, videos or music, as well as instant messaging and groups devoted to common interests. Additionally the platform also allows tagging content (e.g. photos, links, etc.). The topic of this social medium is to bring people together. Groups and similar online activities such as forums or message boards are then fundamental elements of online life. Groups share and discuss links, texts, photos and videos. This interconnectedness connote that the most relevant component of any social network is the friend, follower or contact. They can be known solely virtually or be known in real life also.

There is one clandestine dimension to all the self-productions through social media and that is the persistence of everything once it has been published (Hächler, 2010). Publications can have an effect which might have been unintended or unforeseen at the time of publication. Users leave data trails which are being collected incessantly. This collection happens automatically, invisibly and mostly involuntarily. Users might feel that they own the social media because of the extraordinary power of production and self-projection it furnishes.

In business environments social networks can be used to promote products or brands. Yet, social networks can extend the outreach of an organization not only to promote, but also to gather information and knowledge—also through personal employees' connections.

2.3 The Vision of the Semantic Web

Although the Social Web offers an easy mode to share information, work collaboratively and maintain relationships, the capability to read, understand, and process content is limited only to humans. Computers have difficulties handling documents with natural language content, not to mention handling them automatically. Information as preferred by humans is hard to find too, as the precision of search results is low. Searching for information rests upon identifying words within websites and matching them. For example, if someone is searching for Apple, normally a Web search engine as Google[2] is consulted. Yet, based on the search term, the Web search engine will unfortunately refer to the multinational organization Apple Inc. and the fruit (and others) with no opportunity to discriminate, if there is no additional contextual information available. Acronyms can similarly be a problem, such as ANT being the insect, Apaches Another Neat Tool for automating software build processes or the acronym for Actor Network Theory. Using more than one search term can help in finding websites more precisely, but there is no control over synonyms. The same resources can be described in different ways. Distorted search results may in turn prompt frustrated Web surfers to crowdsource their questions to trusted branches of their social networks, for example. The idea is that friends and relations can steer someone toward a good answer much more reliable than today's Web search engines. Nevertheless, the Semantic Web promises a remedy.

Up until now Web search engines had difficulties to put a search query into context with the implicit user's need. It would be of great help if computers could assist users and ease the load by having computer-understandable semantics at their disposal in order to understand findings like humans can and thereby avail oneself of natural language Web content. This is exactly what the Semantic Web is conceived to establish. (Berners-Lee et al., 2001) sketched the idea as follows: *"The Semantic Web is an extension of the current Web in which information is given well-defined meaning, better enabling computer and people to work in cooperation."* This section is now concerned with the technological aspects of the Semantic Web. The extension of the present Web is made up of metadata that delineate the semantics of the content of websites. The Greek word semantic stands for the meaning of, and consequently the Semantic Web represents a Web that is able to understand its content; this is accomplished mainly by embedding further meaning to the Web. The idea of a Semantic Web implicates a move from unstructured websites (e.g. without or only with sparse computer-understandable metadata) to structured ones that cannot only be understood by humans. The semantic vocabulary is based on concepts that are defined in ontologies.

The term ontology (from the Greek words on meaning being and logos meaning to reason) was originally coined in philosophy to denote the theory or study of being as such. The use of the term ontology in computer science has a more practical meaning than its use in philosophy. The study of metaphysics is not in the foreground in computer science, but rather what properties a computer must have to enable it to process data that is being questioned within a certain domain of discourse. Ontologies are artifacts of objects and their ties. Hence ontologies provide criteria for distinguishing various types of objects (e.g. concrete and abstract, existent and non-existent, real and ideal, independent and dependent,

[2] http://www.google.com/

etc.) and their ties (relations, dependences and predication). Within computer science, the term stands for a design model for specifying the world that consists of a set of types, relationships and properties. What is provided precisely can deviate, but these properties are fundamentals of every ontology.

According to (Gruber, 1993), an ontology is a *"formal, explicit specification of a shared conceptualization"*. There is an expectation that the model bear analogy to the real world as well; however, it definitely offers a common terminology that can be used to model a domain. A domain is the type of objects and concepts that exist, and their properties and relations. In literature there is furthermore a distinction between strong and weak ontologies, whereas in this thesis only weak ontologies are used. A weak ontology is one that is not sufficiently as rigorous as a strong one and therefore allows computers to insert new details without an intervention by humans. In addition, a weak ontology converges with Description Logic (DL) and other subfields in which automatic reasoning is known to be possible.

Ontologies provide a vocabulary of terms in a given field that are needed to itemize the meaning of the annotations added to websites. Consider, for example, the domain of `organization`. This domain contains concepts such as `name`, `project`, `employee`, `store`, etc. Each `store` has for example a property `isInRegion` and a relationship `belongsToOrganization`; the latter links a `store` to the concept `organization`. Likewise an `employee` is a `person` such as Tim Cook, the Chief Executive Officer (`CEO`) of Apple Inc. It is possible to say that the ontology provides concepts, properties, and relationships with well-defined meanings such that the business information of websites can be described and annotated by relying on the elements of the ontology. So ontologies are designed to be understandable by computers as part of the Semantic Web.

In Fig. 2.2 an abstract of the Semantic Web Stack (aka Semantic Web Cake or Semantic Web Layer Cake) is presented; it is composed as a hierarchy of languages, where each layer engages capabilities of the underlying layer. The Stack is still evolving as the layers are concretized. Accordingly in this figure only the layers used within this thesis are highlighted.

The bottom layers of the Stack contain technologies such as Unicode, Uniform Resource Identifier (URI), and eXtensible Markup Language (XML). These technologies are well known from the earlier Web and, without modification, provide a root for the Semantic Web. The presented middle layers enclose technologies standardized by W3C to enable building Semantic Web applications.

In the following sections, the individual layers of the Stack will be introduced. Section 2.3.1 begins with the Resource Description Framework (RDF); a framework for creating statements in the form of triples (i.e. subject, predicate, and object). RDF presents information about resources in the form of a graph. Section 2.3.2 introduces RDF Schema (RDFS). RDFS provides basic vocabulary for RDF. Using RDFS it is possible to create hierarchies of classes and properties. The Web Ontology Language (OWL) extends RDFS by adding more advanced constructs to describe semantics of RDF statements. It allows stating additional constraints, such as cardinality, restrictions of values, or characteristics of properties such as transitivity. It adds expressiveness to the Semantic Web, described in Sect. 2.3.3. The Rule Interchange

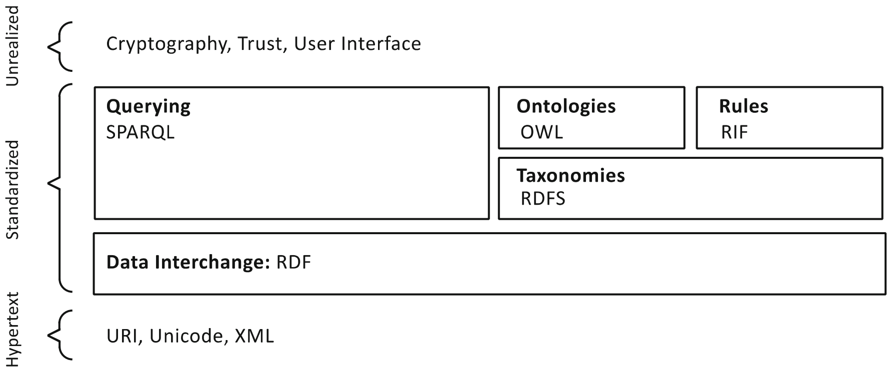

Fig. 2.2 Semantic Web Stack

Format (RIF) brings support for rules and is presented in Sect. 2.3.4. This is important to allow describing relations that cannot be directly described using DL as used in OWL, for example. Lastly, the SPARQL Protocol and RDF Query Language (SPARQL) is envisaged in Sect. 2.3.5. This is a RDF protocol and query language—it can be used to query any RDF-based data (i.e. including statements involving RDFS and OWL). Hence, SPARQL is necessary to retrieve information from the Semantic Web.

At last, the top layers contain technologies that are not yet standardized or hold just concepts, such as cryptography or a trust layer, which should be implemented in order to realize the Semantic Web. Within this PhD thesis, these layers are not further explained.

2.3.1 Resource Description Framework

RDF is used to represent entities, referred to by their unique identifiers or URIs, and a binary relationship among those entities. RDF is made of two parts: The data model specification and serialization syntax. The data model definition is the core of the specification, and the syntax is essential to convey RDF data in the Web.

Two entities and their binary relationship are termed a statement or a triple. Shown graphically, the source of the relationship is termed the subject of the statement, the labeled arc itself is the predicate (or property) of that statement, and the destination of the relationship is called the object of that statement. The data model of RDF distinguishes among entities (or resources), which have a unique URI identifier, and literals, which are solely strings. The subject and the predicate of a statement are always resources, while the object can be a resource or a literal. In RDF diagrams, resources are drawn as ovals, and literals as boxes. An illustration of a statement is given in Fig. 2.3. This statement is adapted from (Breslin et al., 2009).

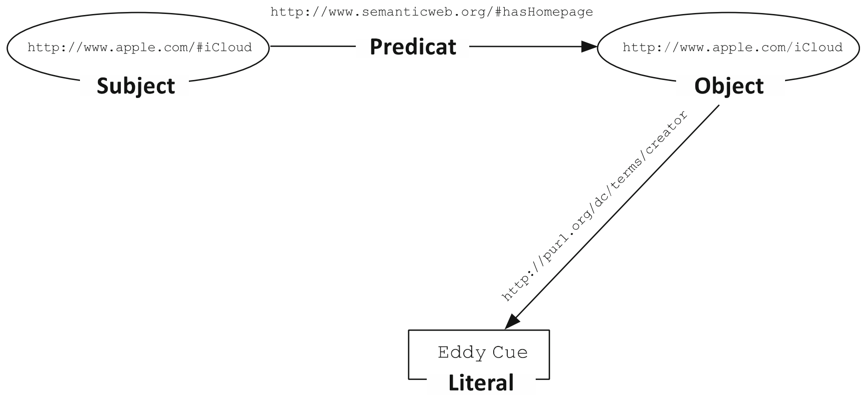

Fig. 2.3 Simple RDF graph

This can be read as that the resource `http://www.apple.com/#iCloud` has a homepage, which is `http://www.apple.com/iCloud`. At first glance it may look odd that predicates are resources too, and thus have a URI as a label. However, to prevent confusion it is essential to give the predicate a unique identifier. Simply `hasHomepage` would not meet the requirements, as different vocabularies might state different descriptions of the predicate with different meanings. The property `http://purl.org/dc/terms/creator` with value "`Eddy Cue`" (a literal) has been added to the graph to indicate that Eddy Cue (i.e. Apple's responsible for Web software and services who oversees iCloud[3] service) has created the homepage.

For a more functional data representation, further vocabularies and conventions should be established. For instance, predicate URI's are usual shortened by employing the XML-namespace syntax. Instead to write the full URI `http://www.SemanticWeb.org/#hasHomepage`, the namespace form `sw:hasHomepage` is employed with the hypothesis that the substitution of the namespace prefix `sw` with `http://www.SemanticWeb.org/#` is defined. In addition, the namespace prefix `rdf` is often used to refer to the specification declaring how metadata should be created according to the RDF model and syntax (Lassila & Swick, 1999). In this case, the `rdf` prefix would be extended to the Uniform Resource Locator (URL) of the RDF-specific vocabulary `http://www.w3.org/1999/02/22-rdf-syntax-ns#`. The same goes for RDFS model and syntax as well (see Sect. 2.3.2).

The RDF specification suggests two standard ways to serialize RDF data in XML: A shortened and a standard syntax. Both serialization possibilities use the XML namespace mechanisms to reduce URIs as already presented (Bray, Hollander, & Layman, 1999). Another option for serializing RDF is the annotation of HTML5 documents with RDF in Attributes (abbreviated as RDFa). RDFa allows

[3] http://www.apple.com/icloud/

including semantics in HyperText Markup Language (HTML), so that the data can be mapped to RDF and objects can be identified by URIs (Breslin et al., 2009; Pilgrim, 2010). This approach virtually bridges the gap between the Semantic Web for humans and for computers since a single document with RDFa can cover information for both. This also circumvents the repetition of information between a HTML and an RDF/XML document.

As presented in this section, RDF is used as a general method for conceptual description or modeling of information that is implemented in Web resources, using a variety of syntax formats. These syntax formats can be found in (Hitzler, Krötzsch, & Rudolph, 2010).

2.3.2 RDF Schema

The objective of the RDFS specification is to determine the primitives needed to describe classes, instances and relationships (Brickeley & Guha, 2004). RDFS is an RDF application, defined in RDF itself. The defined vocabulary is similar to the usual modeling primitives available in frame-based languages (where domain entities are modeled as frames that have a set of appropriate slots or properties). In this section, the vocabulary used in the stated examples is defined by RDFS. The prefix `rdfs` is thus an acronym for `http://www.w3.org/2000/01/rdf-schema#`, the RDFS namespace identifier.

Figure 2.4 depicts an RDFS-based ontology, defining the class `sw:Project` and two properties `sw:hasHomepage` and `sw:hasMember`. The class node is defined by typing the node with the resource `rdfs:Class` that represents a metaclass in RDFS. `sw:Project` is also defined as a subclass of `rdfs:Resource`, which is in the class hierarchy the most general class defined by RDFS. The `rdfs:subClassOf` property is defined as transitive and `rdfs:Literal` represents the class of XML literal values (e.g. strings and integers). The presented RDFS-based ontology is adapted from (Breslin et al., 2009).

Properties are defined with the resource `rdf:Property`, which is the class of all properties. `rdf:type` is an instance of `rdf:Property` used to state that a resource is an instance of a class. Furthermore, the domain and range of a property can be constrained by using the properties `rdfs:range` and `rdfs:domain` to define value restrictions on properties. For example, the property `sw:hasHomepage` has the domain `sw:Project` and a range `rdfs:Resource` (which is compliant with the use of `sw:hasHomepage` in Fig. 2.3). Using these definitions, RDF data can be tested with conformance in relation to a particular RDFS specification. RDFS defines even more modeling primitives, which could be found by (Hitzler et al., 2010).

It is usual for ontologies to refer only to the ontology schema (aka the ontology model or ontology meta-model). As introduced, an ontology is simply a specification of conceptualization without naming instances. If instances are annotated by ontology tags and modeled as ontology, then the talk is of a knowledge base

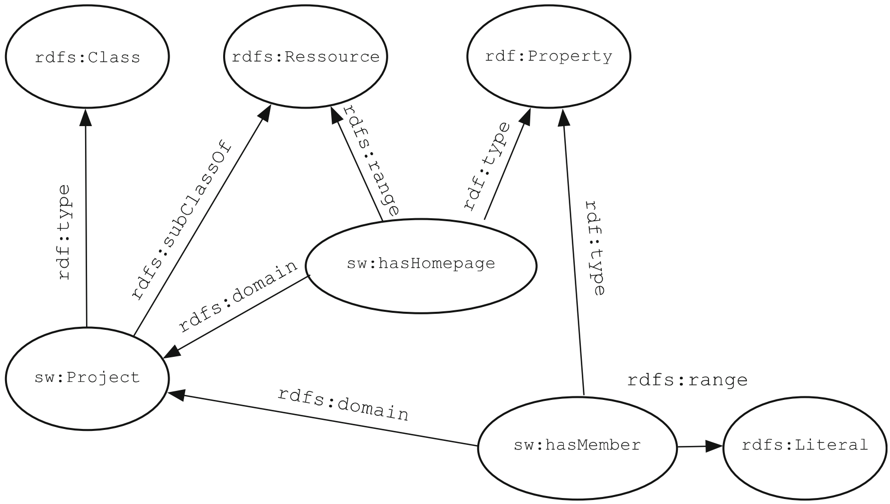

Fig. 2.4 RDFS-based ontology

(or an ontology-based knowledge base). Thus, a knowledge base is a collection of instances of the concepts defined in the ontology, and the ontology specifies the structure of the knowledge stored in the knowledge base (Kaufmann, 2007). Further terminology involves the terms ABox and TBox, which are employed to define two statement types in ontologies and knowledge bases: TBox statements describe the controlled vocabulary or the set of classes and properties of an ontology. ABox statements are TBox-compliant statements regarding the vocabulary that describe instances. For instance, a specific apple tree is an individual for the concept of tree, while it can be stated that trees as a concept are material beings that have to be positioned on some location it is possible to state the specific location that an apple tree takes at some specific time. Together, all ABox and TBox statements make up the ontology-based knowledge base.

2.3.3 Web Ontology Language

The expressiveness of RDFS is rather restricted. For instance, it cannot be used to define that a property is symmetric (e.g. `:isNeighbourOf`) or transitive (e.g. `:locatedIn`). This restricted expressiveness resulted in the necessity for a more powerful ontology modeling language—in particular, one that permitted widened computer interpretability of Web content. This led to OWL, which allows modelers to use an expressive formalism to define diverse logical concepts, and relations in ontologies to annotate Web content (McGuinness & van Harmelen, 2004). Computers can then use the strengthened content in order to assist humans in various tasks. As such, OWL performs the requirement for an ontology language that can formally describe the meaning of terminology on websites. If computers are anticipated to perform useful reasoning tasks on these Web documents, the language must transcend the semantics of RDFS. OWL has been designed to meet this necessity.

In the same fashion of RDFS, OWL can be utilized to explicitly represent the meaning of terms in vocabularies and the relationships between those terms. The ontologies are used by applications that need to process the content of information instead of just presenting it. OWL provides a more substantial vocabulary in the context of formal semantics than RDFS by permitting additional modeling primitives that result in an enhanced expressiveness for characterizing properties and classes. A complete list of OWL syntax can be found in (Hitzler et al., 2010). OWL offers three sublanguages with varying degrees of expressiveness. These are OWL Full, OWL DL, and OWL Lite (ordered by descending expressiveness). Each of these sublanguages is a syntactic extension of its simpler predecessor.

- *OWL Full*: This is the complete OWL language without any limitations and complete with maximum expressiveness, but lacking any computational guarantee. All language constructs can be used in any combination as long as the result is valid RDF.
- *OWL DL*: This limits the expressive power of OWL Full (and increases the expressive power of OWL Light). It offers all OWL constructs with certain limitations such as type separation. For example, every resource can only be a class, a property, or an individual. This means that a class cannot simultaneously be an individual. OWL DL is intended for people who want maximum expressiveness, but retain computational completeness (all conclusions can be computed) and decidability (all computations will finish in finite time).
- *OWL Light*: This further restricts the expressive power of OWL DL. It also offers hierarchies of classes and properties, and simple constraints enable the modeling of thesauri and simple ontologies. Limitations are imposed on how classes are related to each other.

The OWL family contains several species, serializations, syntaxes and specifications with similar names. This might be unclear unless a consistent approach is implemented. OWL and OWL2 are used to refer to the 2004 and 2009 specifications, respectively. Full species names will be used, including specification version. When referring more generally, the OWL family is used.

Specification in this context means an explicit representation by some syntactic means. Most approaches to ontology modeling agree on the following primitives for representation purposes: Firstly, there must be a distinction between classes and instances, where classes are interpreted as a set of instances. Classes may be partially ordered using the binary relationship `:subClassOf`, which can be interpreted as a subset relationship between two classes. The fact that an object is an element of a certain class is usually denoted with a binary relationship such as `:type`. Consider, a combination of an ontology together with a set of instances of classes constitutes a knowledge base (see Sect. 2.3.2). Secondly, a set of properties (also called attributes or slots) is required. Slots are binary relationships defined by classes, which usually have a certain domain and a range. Slots might be used to check if a certain set of instances with slots is valid with respect to a certain ontology.

Another important fact to keep in mind regarding these languages and the Semantic Web in general is that they refer to what is termed an Open-World Assumption (OWA). Consequently, if something is not defined, nothing can be anticipated about it. By way of example, if no triples bring up that `:Heather :isMarriedWith :Jony`, and if someone asks if Heather and Jony are married, the answer will not be no but rather unknown, as there are not enough facts to answer that query.

2.3.4 Rule Interchange Format

RIF is designed as a general framework for interchanging rules of various types. A possibility to converge this ambitious target is to start with a least common denominator of a set of rule languages. Such a shared core language helps to highlight the commonalities of various formalisms and can be a foundation for leading the expansion toward more meaningful languages. Although initially meant by many as a rules layer for the Semantic Web, indeed the design of RIF is based on observations that there are many rules languages in existence, and what is really needed is to exchange rules between them (Hitzler et al., 2010).

A rule is arguably one of the elementary concepts in computer science: It is collected from an `IF-THEN` construct. `IF` some condition that is testable in a dataset holds, `THEN` the conclusion is processed. Deriving anything from its DL roots, rule systems employ a notion of predicates that hold or not of some data objects. For instance, the above mentioned fact that Heather Pegg is married with Jony Ive (i.e. Apple's designer behind iPad, iPhone, and iPod) might be expressed with predicates as `:married(:Heather,:Jony)`. `:married` is a predicate that can be claimed to hold between `:Heather` and `:Jony`. Adding the notion of variables, a rule could be:

```
IF :married(?x,?y) THEN :loves(?x,?y)
```

Thereby it is expected that for every pair of `?x` and `?y` (e.g. `:Heather` and :`Jony`) for which the `:married` predicate holds, a computer that could understand this rule would deduce that the `:loves` predicate holds for that pair too.

Rules are an elementary type of encoding knowledge, and are a rigorous simplification of DL for which it is comparatively straightforward to implement reasoning engines (e.g. Bossam, FaCT++, HermiT, Pellet, RacerPro, etc.) that can handle the conditions and draw correct conclusions. A rule system is an implementation of a certain syntax and semantics of rules, which may expand the elementary notion from above to enclose existential quantification, disjunction, logical conjunction, negation, functions, non-monotonicity, and many other features. The standard RIF dialects are

RIF-Core, Basic Logic Dialect (BLD), and Production Rule Dialect (PRD) (Hitzler et al., 2010):

- *RIF Core*: This dialect is supported by a large class of rule-based systems and is defined as a restriction of the more expressive BLD, but it can similarly be considered as a sublanguage of PRD. In this meaning, RIF-Core is effectively the fundamental core of the rule languages envisioned by RIF. Semantically, RIF-Core is closely allied to DL programming without function symbols or any pattern of negation.
- *RIF BLD*: This dialect adds features to the Core dialect that are not directly available such as logic functions, equality in the `THEN`-part and named arguments. It corresponds to positive logic programs without functions or negations and has a model-theoretic semantics. From a semantic point of view, the main variation between RIF-Core and RIF-BLD is that the latter also facilitates the employ of function symbols.
- *RIF PRD*: This dialect can be used to model production rules. Features that are predominantly in PRD but not in BLD include negation and retraction of facts. These rules are order dependent, hence conflict resolution strategies are required when multiple rules fire. The PRD specification defines such a resolution structure based on forward-chaining reasoning. RIF-PRD has an operational semantics, whereas the condition formulas also have a model-theoretic semantics.

2.3.5 SPARQL Protocol and RDF Query Language

RDF(S) and OWL are effective languages for representing ontologies and metadata on the Semantic Web. However, as soon as this metadata has been published, query languages are needed to draw full benefit of it. SPARQL satisfies this aim and allocates a query language and a protocol for RDF data on the Semantic Web. By providing HyperText Transfer Protocol (HTTP) bindings for it, as well as normalized serialization of the results—in XML or JavaScript Object Notation (JSON)—it can be efficiently used to provide open access to RDF databases.

SPARQL can be thought of as the Structured Query Language (SQL) of the Semantic Web, and offers a powerful method to query RDF triples and graphs. As RDF data is elucidated as a graph, SPARQL is therefore a graph-querying language, which means that the approach is distinct from SQL where one is concerned with tables and rows. Moreover, SPARQL provides extensibility within the query patterns (based on the RDF graph model itself) and therefore advanced querying capabilities on the basis of this graph representation.

SPARQL can be used to query standalone RDF files as well as sets of RDF files, either loaded in memory by the SPARQL query engine or through the utilization of a SPARQL-conformal triplestore (a storage system for RDF data). Therefore, there is presently a need to know which files must be queried before running a query, which is a hitch in some cases and can be regarded as a hurdle to be overcome.

However, in addition to distributed SPARQL query engines in order to dynamically identify which RDF sources should be considered when querying information, four different approaches are normally used: `ASK`, to postulate a simple true-or-false result for a query on a SPARQL endpoint; `CONSTRUCT`, to abstract information from the endpoint and transform the results into valid RDF; `DESCRIBE`, to extract an RDF graph from the endpoint; and `SELECT`, to extract raw values from an endpoint. Note that each of these query forms takes a `WHERE` block to restrict the query although in the case of the `DESCRIBE` query the `WHERE` is optional (Breslin et al., 2009; Hitzler et al., 2010; Seaborne et al., 2008).

Query patterns generate an unordered collection of solutions, with each solution being a partial function from variables to RDF terms. These solutions are treated as a sequence with no specific order. Sequence modifiers can then be applied to create an order: `DISTINCT` ensures that the solutions in the sequence are unique; `LIMIT` restricts the number of solutions; `OFFSET` controls where the solutions start from in the overall sequence; and `ORDER` puts the solution in a specific order. `FILTER`s are other conditions in a query that restrict a set of matching results. Contrasting graph patterns, `FILTER`s are not only based on RDF, but may cover further requirements.

While SPARQL is obviously a key component of the Semantic Web, it has some limits. At the time of writing, SPARQL does not provide any aggregate function, hence implying a need to use external languages (e.g. PHP Hypertext Preprocessor (PHP) or JavaScript) to run aggregations, which can make the adoption of RDF technologies complicated in some cases. Furthermore, SPARQL is a read-only language, in that it does not allow one to add or modify RDF statements. Likewise also vagueness is not adequate supported by SPARQL so far (Stoilos et al., 2005b). Thus, long ways round have to be taken to overcome a vague query (Cheng, Ma, & Yan, 2010). This is occasionally quite an obstacle, which is why within this PhD project `FILTER`s are used for fuzzy querying (see Chap. 7).

2.4 Towards a Social Semantic Web

The last years have shown immense undertakings for the definition of the foundational standards supporting data interchange and interoperation. A number of Semantic Web technologies have attained broad deployment. Often these technologies are composed of ontologies, which share a property: They are small and vertical; in other words, they are member of numerous domains. Each horizontal domain (e.g. `:organization`) would typically reuse a wide range of these vertical ontologies, and when deployed the ontologies allow interacting with each other.

In a most helpful starting point, the Semantic Web attempts to make social websites interoperable by providing standards to support data interchange and interoperation between applications, empowering individuals and communities to partake in the construction of shared interoperable information. This adaption of the Semantic Web to the Social Web gives rise to either a social Semantic Web (i.e. more top-down driven) or a semantic Social Web (i.e. more bottom-up driven),

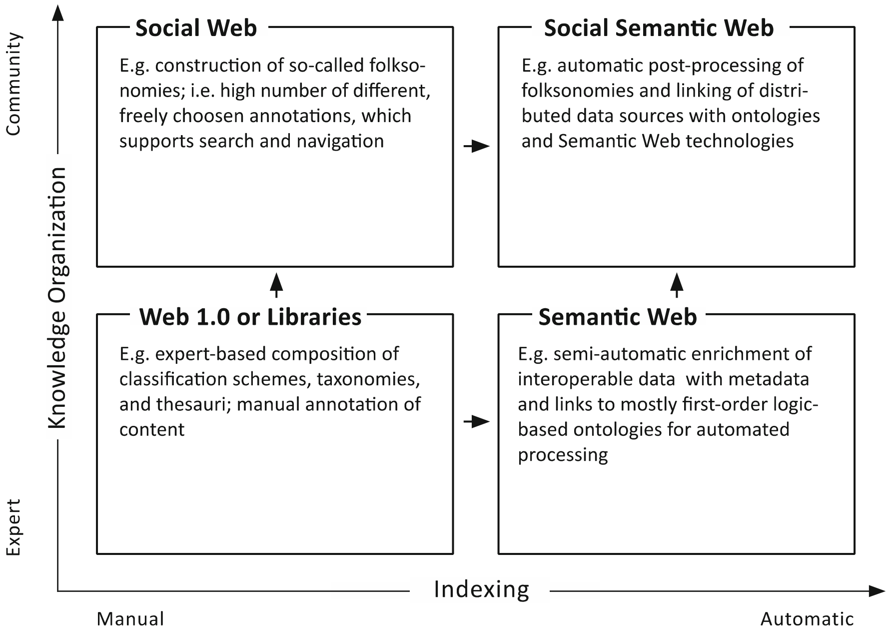

Fig. 2.5 Development of the Social Semantic Web

summarized as Social Semantic Web that is an innovative Web of interlinked and semantically-rich knowledge. This vision of the Web is made of interlinked documents, data, and even applications created by the users themselves as a consequence of all kinds of social interactions, and it is depending on computer-readable formats so that it can be used for purposes that the actual state of the Social Web cannot accomplish without difficulty (Breslin et al., 2009).

Adapted from (Blumauer & Pellegrini, 2009), Fig. 2.5 pictures prototypically the different paradigms to evolve a Social Semantic Web. Thereby the two different kinds of indexing (manual vs. automatic) are represented by the horizontal axis and the two different kind of knowledge organization (expert vs. community) by the vertical axis.

As previously discussed, the libraries were the first to use expert-based manual knowledge organization. The ideas described were either motivated by a community-based knowledge organization or by an automatic indexing of the data by computers. Nowadays the Social Semantic Web can connect these ideas and generate a symbiosis of collective intelligence between humans and computers. Through adding social features to the Semantic Web the social Semantic Web emerges, while the injection of computer-understandable semantics to the Social Web yields the semantic Social Web; within this PhD thesis the focus is rather on the latter. However, yet, in literature no distinction can be found and so, with a few exceptions, this thesis adheres to the common used term Social Semantic Web.

With the Social Semantic Web it is now feasible to harness the intelligence of vast numbers of people, connected in very different ways and on a considerably larger scale than has ever been imaginable before. As forms of collective intelligence grow in importance, as seen with crowdsourcing projects, the value of socially aware individuals is going to arise as well (Saenz, 2011).

Subsequently, by a clever linking of human and computers strengths, this can lead to an enhanced collective intelligence. The combination of the Social Web and Semantic Web can lead to something greater than the sum of its parts, where the Social Web elements can be interconnected with Semantic Web technologies, and Semantic Web elements are enhanced with the wealth of knowledge inherent in UGC. According to (Breslin et al., 2009), this goes hand-in-hand with solving the chicken-and-egg problem of the Semantic Web (i.e. it is difficult to create useful Semantic Web applications without the data to power them, and it is difficult too, to produce semantically-rich data without the interesting applications themselves). Since the Social Web entails such semantically-rich content, interesting applications powered by Semantic Web technologies can be created straightway (Blumauer & Pellegrini, 2009). In terms of the increasing integration of mobile devices and everyday objects into the Web, this is also highly favored.

For example, Social Web users are already bringing semantically-rich annotations through folksonomies into being. This PhD thesis' intention for the Semantic Web is to amend the bottom-up attempt of the Social Web in a top-down manner as (Cardoso, 2007) suggests. The fundamental aim is a stronger knowledge representation, as can be achieved with folksonomies solely, for example. Fuzziness can overcome the gap between folksonomies and ontologies because fuzziness corresponds to the way in which humans think and it is, thus, suitable for characterizing vague information and helps to more efficiently handle real-world complexities (Meier, Schindler, & Werro, 2008). One possible way to use these advantages is through fuzzy clustering algorithms, which allow modeling of the uncertainty associated with vagueness and imprecision through mathematical models (de Oliveira & Pedrycz, 2007; Bezdek, Keller, Krisnapuram, & Pal, 2008; Miyamoto, Ichihashi, & Honda, 2008). As a crucial part of this PhD thesis, folksonomies will be converted to computer-understandable ontologies adapted from fuzzy clustering algorithms. With this in mind, the next chapter introduces into the fundamentals of fuzzy clustering methods. In the end, the completely computer-produced ontology will be used to enhance online reputation analysis in the Social Semantic Web.

2.5 Further Readings

A book worth reading about libraries in ancient world is (Too, 2010). The connection to the Web and its history is given by (Banks, 2008), (Hafner & Lyon, 2008), and by (Portmann, 2008). The development of the Web to a Social Web can be extracted from (Alby, 2008) and (Ebersbach et al., 2010). In these books also descriptions of the various Social Web applications such as blogs, folksonomies, microblogs, social networks and wikis can be obtained. (Portmann & Hutter, 2011) explain the interaction of these Social Web applications, and (Jenkins, 2008; Manovich, 2001; McLuhan & Nevitt, 1972; Toffler, 1980) broadly explain the shift from traditional to interactive media; thereby their focus is on media sciences.

Information about the Semantic Web can by now be found in numerous books. Thereby (Antoniou & van Harmelen, 2008) and (Allemang & Hendler, 2008)'s focus is on practical usability of the Semantic Web, whereby (Hitzler, Krötzsch, Rudolph, & Sure, 2008) and (Hitzler et al., 2010) condense more the theoretical potential of the Semantic Web, but likewise include various examples of the power of its technologies.

The Social Semantic Web and its possibilities are explained in (Breslin et al., 2009) or by (Blumauer & Pellegrini, 2009). Thereby also other practical applications bridging the gap between Social and Semantic Web are presented. Such applications are, for example, Dublin Core,[4] DBpedia,[5] Semantic Media Wiki,[6] Friend-Of-A-Friend (FOAF) protocol,[7] Description Of A Project (DOAP)[8] or the Semantically-Interlinked Online Communities (SIOC).[9] Explanatory notes with concerning illustrations on these tools can be found in (Breslin et al., 2009; Blumauer & Pellegrini, 2009; Hitzler et al., 2010).

4 http://dublincore.org/

5 http://dbpedia.org/

6 http://semantic-mediawiki.org/

7 http://www.foaf-project.org/

8 http://trac.usefulinc.com/doap

9 http://sioc-project.org/

http://www.springer.com/978-3-0348-0556-8

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