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Semantic web and conceptual modelling

Summary: The notion of the Semantic Web has become an oft alluded to concept in the context of many introductory texts since Tim Berners-Lee tried to develop a new extension of the actual WWW. The Semantic Web, to be understood by everyone and to be easy to use needs a well defined model. An attempt to make the conceptual model of SW system cannot be considered to be complete after just specifying the structure and behaviour of the Web. It is also necessary to specify how end users will interact with the resources available on Internet. The problems, the solutions and the architecture of the Semantic Web will be explained in the first part of this research. The next section presents ontologies and their role in the creation of the Semantic Web, how they are created and used as a specification of a conceptualization (Tom Gruber).

Keywords: Semantic Web, Conceptual Modelling, Ontologies, SW architecture, SW model

Sieć semantyczna i modelowanie konceptualne

Streszczenie: Pojęcie Sieci semantycznej stało się często używanym zagadnieniem w kontekście wielu wstępów artykułów od momentu gdy Tim Berners-Lee stworzył nowe rozszerzenie rzeczywistej www. Sieć semantyczna, aby była zrozumiana przez każdego i łatwa w obsłudze, musi mieć bardzo dobrze opracowany model. Próbujemy stworzyć model konsceptualny systemu SW (semantic web). Nie można jednak uznać prac za skończone jedynie określając strukturę oraz działanie sieci. Bradzo istotnym aspektem jest sprecyzowanie w jaki sposób użytkownicy będą nawiązywać interakcję z zasobami dostępnymi w Internecie. Problemy, rozwiąznia i architektura sieci semantycznej zostanie omówiona w części pierwszej tego badania. Kolejna część prezentuje ontologie i ich role w tworzeniu sieci semantycznej, jak są one tworzone i wykorzystywane jako opis szczegółowy konceptualizacji (Tom Gruber).

Słowa kluczowe: Sieć semantyczna, modelowanie konceptualne, ontologie, architektura sieci semantycznej, model sieci semantycznej

1. Introduction

The Semantic Web is an innovative way to access, search and find information on the Internet. The World Wide Web is continuously updated and the quantity of information is increasing every year, but the quality is different for each new data item. The information is understood only by humans and only those users can access and use the content of the Web pages [3]. The Semantic Web comes with the innovation in the www area, using the software programs, to allow computers to use the data in this field to achieve the objectives required for users. The main importance of this extension of WWW is that it allows everyone who has no specialist technical knowledge to access information in the easiest way and faster. The formal description of the existing resources on the Internet (web pages, text documents, multimedia, databases, services etc.) is also a part of Semantic Web [2]. The idea of this approach is that the Web contains data and not documents, turning them into a huge database understood by both people and computers.

Conceptual modelling is the process that develops a semantic description of a system to be reflected (modelled) by the general structure and implementation of a Database application [13]. Conceptual modelling is independent of the Database, it involves analysing system requirements and developping a general semantic structure. This will create a Database with a high level structure of the content and application-specific restrictions. The restrictions define rules to ensure the validity of the content in the Database. On the other hand, conceptual data modelling involves the building of model data to ensure accurate transposition on the analysed reality. A conceptual model consists of intermediate models that are used in support of design methodologies. A conceptual model is a set of concepts and the rules of combining of these concepts allow representation of reality within the area subject to computerization. The models used are called semantic models and aim at ensuring that the concepts offered allow representation of the real world. Correctly designing a relational database structure designed in modelling is critical for writing application programs and their operation without the anomalies that can appear at a wrong structure.

The idea of the Semantic Web in addition to having meaning for humans, also has meaning for machines (computers) in such a way that they can searched, found, interpreted, shared and reused among applications, organizations and communities [4]. This Semantic Web, seen as a huge database, needs a well-defined structure and therein comes conceptual modelling. The main use of conceptual modelling is relational database structure design. This area that research had evolved to the development of the software tools that provides a high degree of normalization schemes relationships, avoiding anomalies due to unsystematic elements and eliminating the subjectivity of the designer with the accuracy of the method [13]. Without conceptual modelling, the Semantic Web would be based on a database that consists of a collection of interrelated tables and associations between which would be difficult to read even for people. The connection between conceptual modelling and the Semantic web involves developing schemes intelligible to computers, even if it is a complex database.

This paper presents a set of aspects that we discovered by modelling the Semantic Web. The model can be used to create a comprehensive conceptual model of a Web application that most application domain users can relate to. We want to create a model for the Semantic Web according the structure of its developer, Tim Berners Lee, by replacing links between documents with links between data (called RDF links). We are more interested in the way that semantic technologies can bring traffic to his Web and what it can contribute to archive so that the users are able to accomplish the objective of monetization and in this way they can also get value and extra earnings for their businesses. Once the model is established, we need a logical architecture using concepts in an implementation domain. In this domain these concepts could be an access control module, view generator, workflow engine, object or data model, which can be implemented using technology available in the computer domain. The next step is to develop a physical architecture model using concepts such as algorithms, flow charts and database schemas to realise the concept used for the logical architecture model.

The first part of this paper is dedicated to the conceptions of the Semantic Web and Conceptual Modelling , understanding the problems and, from some reviews, to discover the usage and the need to make the Internet a better source of information. After familiarising with those concepts, the architecture of the Semantic Web is the next step in this research. In the end, the conceptual model for the SW, using the capabilities and the thinking of humans is developed after emphasizing the link between the SW and the CM. Conclusions, acknowledgements and references will close as usual the work. The main idea of this paper is to introduce a new concrete and detailed model for the SW.

2. The Semantic Web and Conceptual Modelling – Review

Some researchers discuss trends and future prospects of the Semantic Web and its applications related to a conceptual model, a model used by machines to understand the information available on the Internet. Ştefan Trăuşan-Matu speaks about the Semantic Web and provides us with some knowledge about it. The Semantic Web is the new generation of the World Wide Web. It is used not only to be covered by users using “browsers”, but also by the programs with various properties. To mention a few of them, first: “Do a selective access of the web pages (searches and filters)”, this is about how to access a web page with the appropriate content, the content that is useful for the person who searches for information on the Internet. Secondly we can “Process the Web resources”, meaning that before the information is available on the web, it is taken over and, after some processes, it is displayed for users. The third property is “Generating another Web resources”, the resources can be cited or used for another paper or data.

The Semantic Web has requirements for any kind of resources: "Addnotation and meta-description of the Web resources using XML (Extensible Markup Language)" for data transfer between applications on the Internet, XML was designed to carry data - with focus on what data is; "Representation and processing of the knowledge (using logic terminology and description) – Ontology" and "Processing of the Web resources by multi-agent system" using various languages like SGML, HTML, XML or LaTex [15].

Some researchers are focused on analysis of the current state of SW applications in academic communities and on usage of ontologies which are discussed in one of their dimensions because it is a key technology for all SW applications and introduces 9 types of usage of ontology: (1) Usage as a Common Vocabulary, (2) Usage for Search, (3) Usage as an Index, (4) Usage as a Data Schema, (5) Usage as a Media for Knowledge Sharing, (6) Usage for a Semantic Analysis, (7) Usage for Information Extraction, (8) Usage as a Rule Set for Knowledge Models, (9) Usage for Systematizing Knowledge. Fundamental features of the SW include enabling computers to process semantics on various resources of WWW annotated by metadata, which is in turn defined by ontology. Since ontology is a fundamental and important technology for SW applications, this paper analyzes it from the viewpoint of ontology [9]. This scientific paper will serve to explain how we can use the ontologies for a model.

Some concepts, problems, solutions and architecture about the SW are described by Jun Cai, Vladimir Eske and Xueqiang Wang in their document. They defined the essence of the Semantic Web (SW) as "a mesh of information linked up in such a way as to be easily processable by machines, on a global scale" and "The Semantic Web approach develops languages for expressing information in a machine processable form", two sentences which are completed by a third expression, "It's information in machine processable form, however at the same time first one defines the SW as a global scale information mesh and the second sentences defines it as a framework for expressing information". In this case both citations demonstrate the main principle of the SW: information in Web should be more machine processable and understandable. In this case the SW can be the goal as well as a tool (language for expressing). It seems to be the main paradox of the SW: to be an egg and a chicken in the same time [7]. We will use their book to point out the use of the SW and the architecture of the conceptual model, as they showed in the first part of their work: we use Web as a global database first of all for searches. Today's search engines cannot search more precisely than they do now. Maybe the same reason is that the structure and size of the current Web do not facilitate making searches more precise and efficient. The second reason can be eliminated: Web contains now a huge number of documents and this number has a strong tendency to double each one or two years. The structure of documents and Web itself, probably, can be changed in "a better – machine processable way" [7].

Conceptual modelling makes a process by which representations of the world get translated into IS objects, a prominent aspect of IS development and use (Kung and Soelvberg, 1986; John Mylopoulos, 1998; Rossi and Siau, 2000; Wand and Weber, 2002). J. Mylopoulos said also that conceptual modelling refers to the “activity of formally describing some aspects of the physical and social world around us for the purposes of understanding and communication”. Arturo Castellanos, in his research, said that conceptual modelling involves documenting knowledge about a domain, defining its scope, and outlining constraints. Once developed, conceptual models typically guide database and application design and often become legally binding documents that contain information specifications of the IS. Conceptual models depict information about the kinds of objects that an IS needs to represent. Major conceptual modelling grammars, such as UML and ER Diagrams, organize domain objects into classes (e.g., similar to concepts, categories, kinds, or entity types) [1].

About conceptual modelling and conceptual models Bernhard Thalheim says that conceptual modelling is one of the central activities in Computer Science. Conceptual models are mainly used as intermediate artifacts for system construction. They are schematic descriptions of a system, a theory or a phenomenon concepts of an origin thus forming a model. A conceptual model is a model enhanced by concepts. The process of conceptual modelling is ruled by the purpose of modelling and the models [5]. His research differentiates between “Model”, “To Model” and “Modelling” and we will use “Conceptual Modelling” to define and analyse the process.

In this paper we want to explain the connection and the meaning between the Semantic Web and Conceptual Modelling. We see the Semantic Web as a database of a system and we need a model to create it to be understood by both humans and machines. This is the main propose of this paper, to create a model for the SW, but first we should define the purpose of a Model, the proprieties, the function, and the type of this Model. Bernhard Thalheim says also in other research that the range of models spans from elementary to matured models. Depending on the goal, purpose and function of the model within a deployment story (‘Gebrauchsspiel’), we may use the most appropriate model. If goals, purposes and functions are changing then we need to change the model [6]. This is the reason that we will make a model for the extension of WWW, the Semantic Web.

3. Semantic Web discussions

3.1 Problems

Nowadays the SW is mostly a future concept and an innovation for WWW and it’s in the central circle of interest for many people. This term is not so known by everyone and the necessity to explain it is because it is a part of our life and we use it even though many of us don’t know that. For example, when we search something on Google, even if it’s a simple document, we write only some words and we receive all the documents which contain that group of words, sometimes not what we needed. This is one of the situations when we need the Semantic Web but there are more reasons.

First of all, not all parts of the SW are developed yet. Perhaps the most important parts like agent, trust and retrieval techniques are developed very poorly which has strongly restricted the real usability of the SW and should be improved by IT specialists. Most of it has been developed and there are many concepts of every part but is not a final concept, it can be improved and it is still in progress. The idea is in the focus of IT developers and they try to structure user-centred contextual information to facilitate agent-based (inter)operations on the network and to demonstrate how agents understand semantic resources in a context-aware manner in real practices.

A second reason can be that the technological base does not allow us to use the SW in a good way. This issue concerns the current level of hardware and software that cannot support all SW features ("We believe that performance in terms of speed is not as important in this case as performance in terms of what is retrieved" from OWLIR – Information Retrieval On The Semantic Web report). The technical capabilities of hardware acquisition devices are improved but their acquisition is not so easy to do for most people. Using some very technologically advanced approaches of the Semantic Web gives users more opportunities to work with data, but they require specific knowledge of developers and administrators and place higher requirements on hardware equipment.

(3) People have no resolution to change the Web and to spend a lot of money. After all IT crises people are very careful with all the new technologies which require a lot of money. It is mostly a psychological problem, but maybe it is the most important problem in making the SW really a system on a global scale. They need especially long-term preservation of data, quality and range of their semantic description, and data sharing itself and they do not want to allocate more money for this than they already have . And another problem for the scientific community is that (4) many people do not believe in the Semantic Web. Poor theoretical foundations and the absence of good news and evaluation results make people, and especially computer experts, more and more pessimistic. [7]

3. 2 Solutions

For those problems some researchers have found practical solutions. The core of the SW are already developed (some languages appeared to describe the parts of the architecture of the Semantic Web and we have as description Languages: RDF (The Resource Description Framework), DAML (DARPA Agent Markup Language) + OIL (Ontology Inference Layer or Ontology Interchange Language), ontology and interface, the basic concepts of agents and proof is taken from AI (Artificial Intelligence).

There is a clear plan for the future. It seems the group of developers has a clear plan how to make Web Semantic start from its architecture and finish with a conceptual model. It gives the hope that all other problems are only technical. Work at the semantic web level includes libraries of reusable components for knowledge-intensive systems; ontology editors and servers; next-generation, ontology-based annotation tools; and site and interface ontologies to support knowledge-based generation and filtering of web pages. While the Semantic Web is about semantic infrastructure, tools and resources, processes and organisations and about the integration of 'smart' technology into work-processes.

Industry makes the computer faster and faster every minute. Thousands of unemployed, but highly qualified, programmers are ready to develop a new software agent for the SW. The revolution of industry, especially automation for a better quality of life gives us the need to develop new areas of Computer Sciences. A semantic web solution is one where it is possible to meet all functional requirements with SWS Also SWS is very helpful in data management and putting semantic in data and relations

Another solution for humans is that it is always possible to add rules in the system in future so that new meanings could be possibly given to existing data. and minimum input. is required during data creation (i.e. for example by only giving city names during newsitem creation like Copenhagen, the system is able to infer the country that is Denmark and region that is Europe).

Wide use has created a good foundation for the Semantic Web together with already developed software tools for the creation of Semantic Web applications allowing to reduce the cost of Semantic Web building. That is a good reason to put up money right now. The Service Model is a detailed description of the service in which it is modelled as a process. This description is further sub-divided into a process model, which describes the sub-components of the service and a process control model, which provides a runtime framework to monitor the execution of the service. The active position of the Scientific Community made people believe in the SW. The problem of the SW is not a technology but philosophy of future Web existance. You trust the technology, but you believe the philosophy. Technology gives the answer, philosophy teaches us to find the answer [7]. Those are only some solutions given by Jun Cai, Vladimir Eske and Xueqiang Wang, but there are more solutions which haven't been discovered yet.

4. The architecture of The Semantic Web

Tim Berners-Lee organised the Semantic Web effectively in a pyramid known as the Layer Cake, illustrated in Figure 1. To summarize the key components of the semantic stack models represented in Figure 1, one can categorize them generally into semantic and syntactical components, or more specifically in the following manner: ontologies and taxonomies (OWL), mark up languages and formats (XML, XML namespaces, XHTML, RDF, RDF Schema), query languages (SPARQL), language text representation (Unicode), user interfaces, rules (Rule Interchange Format - RIF), SWRL - A Semantic Web Rule Language, addressing and identifying (HTTP, URI, Internationalized Resource Identifier - IRI), abstract layer (Trust and Logic) [12].

In the semantic web architecture, Web ontology languages are built on top of RDF(S). However, serious difficulties have arisen when trying to layer expressive ontology languages, like OWL, on top of RDF-Schema. Although these problems can be avoided, OWL (and the whole Semantic Web architecture) becomes much more complex than it should be. A possible simplification of the semantic web architecture is suggested. The paper is organized as follows: it reviews the main features of RDF(S) model theory and of standard description logics formalisms. The main design principles followed in the design of the Semantic Web languages are enumerated. Also the layer of OWL are on top of RDF(S), while the next part summarizes other proposals for layering the Semantic Web. Finally, in this figure a possible simplification of the Semantic Web layering is suggested and its main features and advantages are discussed.[1]

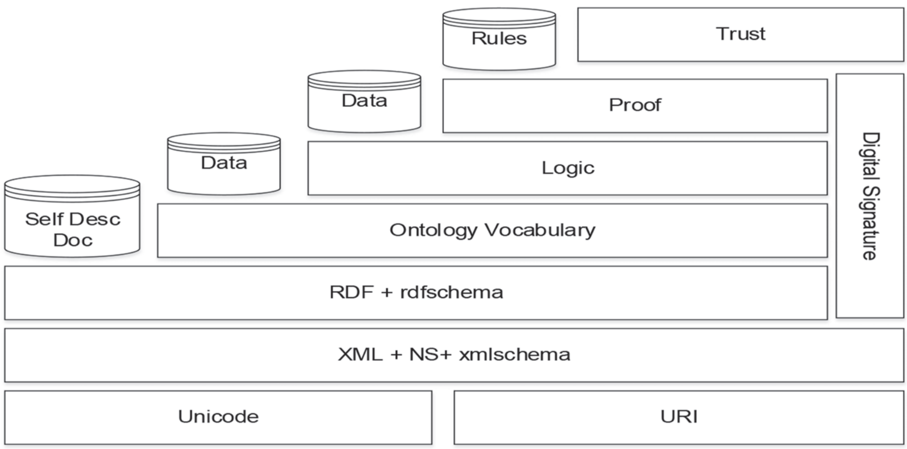

Figure 1. Semantic Web architecture. [7]

It may be seen as a suite of technologies and at the pyramid base stands the Unicode standard and the Uniform Resource Identifier (URI). The Unicode is used for manipulating and representing the text in various languages and it is a formatted string that serves as a means of identifying abstract or physical resource. URI which is useful for identifying the resources published on the Web (multimedia, files, web pages, blogs, etc.), referring to the subset of URI that identifies resources via a representation of their primary access mechanism [10].

[1] Bernardo Cuenca Grau, "A Possible Simplification of the Semantic Web Architecture", Online on: https://pdfs.semanticscholar.org/fa60/231f40d70e1087dee1a8f7f58356b5541486.pdf

Nowadays, XML (Extensible Markup Language) is standard for data exchange on the web and it represents description and transfer on the web but it has a series of limitations [2]. One of those limitations is the lack of formal semantics of the XML Schemas, which burdens the communication between applications and services that do not share the same schema or the same interpretation of a schema. As a certain level of semantics was indeed to be added to the XML language, the RDF (Resource Description Framework) language was born, which describes the resources using triples such as "Research, Property, Value", arranged in structures similar to graphs [2]. The RDF standardizes the definition and use of metadata. RDF uses XML and it is at the base of the semantic Web, is graph-based, not hierarchical like XML and other data description formats, single pieces of information are graph nodes and the relationships between them are graph edges [10].

The RDF Schema is used in a hierarchy of types in order to organise the resources and the proprieties. The OWL language extends the RDF(S) language introducing a series of more advanced constructors that allow more expensive descriptions than the possible ones using RDF(S) triplets. OWL also allows defining constraints upon properties such as cardinal constraints, value restrictions or predefined characteristic constraints for properties (i.e. transitivity, symmetry, etc.) [2]. Ontology vocabulary agrees that provides a set of well-founded constructs to build meaningful higher level knowledge for specifying the semantics of terminology systems in a well-defined and unambiguous manner. It enhances the semantics of terms by providing richer relationships between the terms of a vocabulary and express them in a logic-based language, so that detailed and meaningful distinctions can be made among the classes, properties, and relations. It also increases communication either between humans and computers. The three major uses of ontologies are to assist in communications between humans; to achieve interoperability and communication among software systems; and to improve the design and quality of software systems [10]. It should be noted that RDF(S) and OWL languages are based on the theory of descriptions logistics, which guarantees a non-ambiguous semantic interpretation of the declarations made in those languages [2].

Logic, Proof and Trust are some layers which are not well standardized. Their purpose is to provide similar features to the ones that can be found in First Order Logic (FOL). The idea is to state any logical principle and allow the computer to reason by inference using these principles.

5. Ontologies

The ontology is composed of classes and properties that are divided into four blocks, each one of which includes the classes that are directly related to the following points of the contract: (1) the object, which is the supply that the contract covers; (2) the parts, which are the agents that participate in the procurement process and, when appropriate, in the contract – the contracting authority, tender, awarded tender, etc.; (3) the procedure, composed of the steps taken until the end of the contract; and (4) the fulfilment, which includes actions that must be taken after the contract formalization [8]. Basically, it means that an ontology formally describes concepts and relationships which can exist between them in some community. In other words, an ontology describes a part of the world. A concept in an ontology can represent a variety of things. A concept can be an object of any sort: person, car, building, it can describe an activity or state: swimming, being busy or available, abroad. It can represent abstract concepts like time or value. There is no strict restriction what it can express as a concept in our ontology. The only restriction is the real world which our ontology tries to reflect [11].

Ontologies are defined independently from the actual data and reflect a common understanding of the semantics of the domain of discourse. Ontology is an explicit specification of a representational vocabulary for a domain; definition of classes, relations, functions, constraints and other objects. Programmatically, a common ontology defines the vocabulary with which queries and assertions are exchanged among software entities. Ontologies are not limited to conservative definitions, which in the traditional logic sense only introduce terminology and don't add any knowledge about the world.To specify a conceptualization we need to state axioms that put constraints on the possible interpretations for the defined terms. [7]

The ontologies are repertoires of terms and vocabulary for meta-descriptions. They are data knowledge declarative and they are shared by communities of agents (ACL is provided which is the ontology used in communication). The ontologies contain: the categories and fundamental concepts, the properties concepts, the relations and the differences between concepts, axioms.

6. Conceptual Modelling for Understanding the World That Is Coming

Over the past fifteen years, the term 'human information interaction' has been widely used in the literatures of information searching, seeking and retrieval, human computer interaction, and information architecture [12].

The paper provides a conceptual model of the Semantic Web that encompasses four key strata, namely, the body of human users, the body of software applications facilitating creation and consumption of documents, the body of documents themselves and a proposed layer that would improve automated manipulation of Web-based data by the software applications [12].

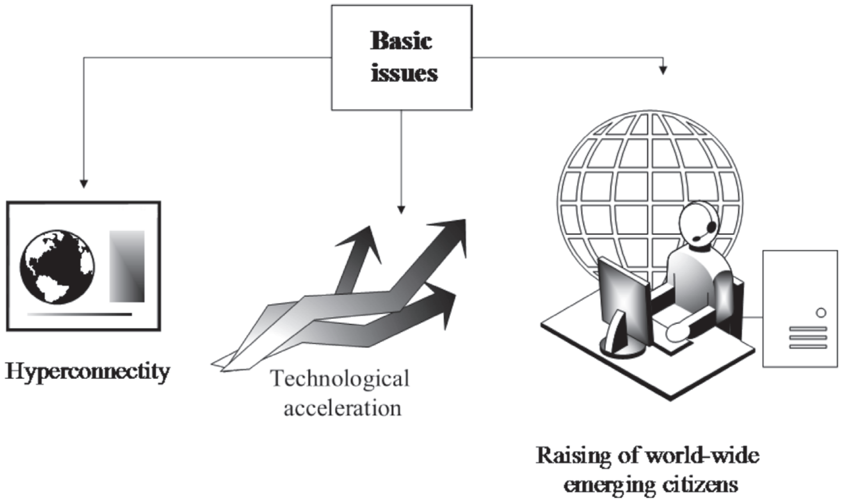

Figure 2. The context for the new world (O. Pastor, 2015)

After emphasizing the link between the SW and the CM we will explore in this section how a model for SW can be made for machines using a model from real life. Our computer will be seen as a human with conventional rational capabilities for understanding the information. CM should be the basic tool of a future, evolved human being, able to use a level of knowledge never reached before, based on the rational use of universal information and advanced technologies [2]. Many researchers are interested in the continuous development of the context for the new world to come. As O. Pastor says in his paper, we should concentrate on the basic issues that appear nowadays (Figure 2).

Hyperconnectity means that the global net platform that has been created gives a big power to individuals and it allows the whole world to be more and more connected, having immediate access to any information and knowledge on the planet. This also blurs geographical barriers and it creates a world of total, open competition. Technological acceleration is about the technological improvement with its exponential growth. This technological explosion opens the way for a technological revolution whose intensity and social implications have never been seen before. The raising of world-wide emerging citizens, coming potentially from any country of the world, are ready to consume and compete. The emergence of this new actor will impact economics and politics.

When considering the current manifestation of the Web, a simplified model of information interaction can be posited involving three key universally present collectives:

a) The body of users that create and consume digital content (based on a given context)
b) The body of software applications that facilitate creation and consumption of the content
c) The body of digital documents whose content is created and consumed

Proof and trust appear largely to express the presumed necessity of dual safeguards against either faulty logical constructions and/or deliberate misalignments of third stratum documents to inappropriate or incorrect archetype documents [12].These three collectives can be seen as constituting three interoperating strata or regions, where the users are situated in the first stratum, the software applications in the second, and the digital documents in the third.

As stated earlier, the software applications that foster the interaction between user and document are currently limited in their capacity to manipulate and employ data embedded within the documents. This is in part an unintended consequence of the content being largely produced for the user's consumption, and not for the software application [12].

The conceptual model (Figure 3) for SW is a new approach of the model for humans. Every human characteristic of their conceptual model may be transposed in a software model with the same meaning for machines.

The model for SW is understood by both parts in the same way, even if it uses different blocks, abstracts elements or codes.

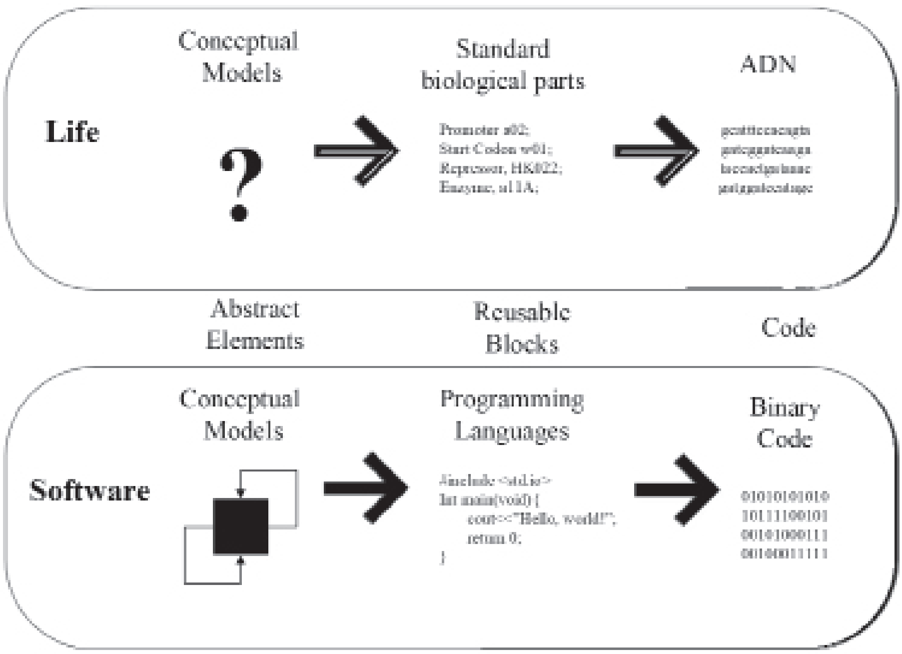

Figure 3. Conceptual models for software versus conceptual models for life (O. Pastor, 2016)

Understanding the world to come can be seen as a challenge whose solution should be CM-based. The sequence of social and technological advances that we are witnessing in the last decades is the source of a new era for humanity. A CM-based exercise is required to understand those big changes and their immediate consequences. Once more, conceptualization is the key activity to guide adequately this new world that comes. This conceptualization process should be oriented to identify the basic issues that lead the change, to understand how they affect the current social context and to develop strategies to implement an accurate transformation [14].

For our model we need only three central elements or functions which are critical in the construction of a viable Semantic Web, namely: structure, which occurs when concepts occurring in the third stratum are demarcated through URI and then connected with archetype documents via XML; meaning, which occurs when various archetype documents begin to be constructed and connected through RDF triples; and ontologies, which emerge from the intersection of multiple RDF triples and serve as platforms of subsequent inference as guided by the rules and definitions offered by both RDFS and OWL that govern domains [12].

7. Conclusion

The Semantic Web is a new concept, a dream introduced by Tim Berners-Lee, a new Web full of surprises, with sites for everybody, and at anytime. They can listen to music (the most popular site is YouTube), search for information or definitions (Wikipedia), learn using virtual lessons from virtual schools (W3Schools) and many more things that have been the true strength of the web for the public. The search engines were developed in ways that facilitated that public growth and that can be understood by machines. The information access based on the SW has made it easy to find, present and maintain the information required by a wide variety of users, specialised or not. The solution for this problem is the Semantic Web; it will provide intelligent access to heterogeneous, distributed information, enabling software products to mediate between user needs and the information sources available.

The Web is a collection of information, as a database, but it doesn't provide support in processing this information. For any person it will be difficult to understand how the Semantic Web works without a model. Conceptual modelling tries to make processing the data of the SW easy using a model. Any modelling process has a conceptual model. The best conceptual model does exist, but we are extremely unlikely to find it. We try to identify the most appropriate model given the constraints of knowledge, time and resource. We can conclude that conceptual modelling is not a science, but an art or craft which continues the need for a more concerted effort to develop the field of conceptual modelling in both research and practice. The importance of CM is whether all the simulation modellers follow a formal process or not in creating a simulation model.

This paper emphasizes the intended importance of conceptualizing from two perspectives: from an Information Systems/Software Engineering perspective on the one side, for machines as computers and for AI, and from a social, human being-oriented perspective on the other side because of social and technological challenges which should be based on CM. The CM is an essential discipline to develop where technology and information were properly used, focusing on the ontological background that such a sound definition requires. There are few steps to follow, the hardest part being to know how to design this complex system. Here, the CM can provide the answers and tools, and can help us to understand and manage life going beyond the capabilities traditionally attached to human beings and opening the door to an improved version for machines. The challenge is to improve the world that is already coming, with a sound CM background as the essential strategy to make it viable and real and make use of the web as a large information environment for offering information services.

The overarching goal of this paper has been to provide a general conceptualization of the Semantic Web and of Conceptual Modelling for a better understanding of the current digital information environment. The key for our model were the ontologies, Semantic Web construction and Semantic Web architectures. Future research within this field may perhaps expand upon this model, serving as nodal elements in the creation of larger dynamic ontologies, to incorporate both technical and conceptual components in generating a more holistic representation for the concept of the Semantic Web.

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