Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

A Model of Building Ontologies for a Tourism Portal in Description Logic

Anriette BISHARA*

Abstract

In this paper, we present a model of building ontologies for Semantic Web Portal, based on the Description Logics. Semantic Web Portal is a web page, based on Semantic Web Technologies, since the traditional current web programming only allows for describing the layout of Web pages, but not their semantic content, therefore the main reason for using Semantic Web Technologies that is human readable information is accompanied by machine-readable information, usually written in ontologies, for building Web Ontology Languages (OWL) we chose Protégé. The topic of our web portal is tourism in Georgia, where the user can automatically plan trips (the places to visit in Georgia), and this portal can be applied to any country in the world but we chose Georgia as an example.

Keywords: Description Logics (DL), Georgian Tourism Application, Protégé, Semantic Web Portal, Semantic Web Technologies, Web Ontology Languages (OWL)

Introduction

The Internet as we know it today is a successful stand but does not keep pace with the rapid development taking place in the world.

Search engines of the traditional current web programming, have a big problem for retrieving the data, it is most of the time return a huge number of answers, some of them they do not have any relation to the search, other times they do not have answers at all.

The design of the traditional current web, is human-readable information more than machine-readable information, since the HTML standard only allows for describing the layout of Web pages, but not their semantic content. (Eiter, Ianni, Lukasiewicz, Schindlauer, & Tompits, 2008). New technology is changing the way we use the net that is future internet will have to change (Pandey, 2012; Bishara, 2015). The scientists are working and preparing for a web of things which will allow all electronic devices for actively participating in the future internet, and this thought led the scientists to the Semantic Web (Pandey, 2012; Bishara, 2015) Semantic Web is considered to be the next generation web. It is a combination of various technologies, usually referred as the Semantic Web Stack. The name itself, Semantic Web, was introduced by Tim Berners - Lee, who was a founder of this scientific direction (Berners-Lee, Hendler, & Lassila, 2001) Semantic Web is a collection of different technologies, where most of them are already standardized (Shadbolt, Berners-Lee, & Hall, 2006). Nowadays, the main research is concentrated on the ontology, logic, and proof layers (Janjua & Hussain, 2010; Maedche & Staab, 2012).There are a lot of portals and applications whatever depends on Semantic Web Technology or other technologies, which offers different services for internet users, but each portal or application is providing one service without compiling all services in one application. For example, there are many applications which can help the users to book travel tickets, hotels, etc. (like, e.g., TripAdvisor, Booking.com, etc.).Our portal will combine all services which the user will need during his travel. The purpose of this study and research is to describe building ontologies for a Tourism Web Portal based on Semantic Web Technologies, represented in the form of Web Ontology Languages (OWL), by using Protégé. Since the traditional current web programming only allows for describing the layout of Web pages, but not their semantic content, therefore the main reason for using Semantic Web Technologies that is human readable information is accompanied by machine-readable information, usually written in ontologies which are called machine-processable formalisms for knowledge description, their purpose is to describe objects according to the domain of interests, Ontology can be represented on the web in the form of Web Ontology Languages (OWL) which are standardized by World Wide Web Consortium (W3C) (Antoniou & Harmelen, 2004). The advantages which can be achieved by using ontologies, more efficiently than by using traditional web programming approaches, is that we can add machine-readable meaning to Web pages, by defining the shared terms in Web resources, to make use of knowledge Representation (KR) technology for automated reasoning from Web resources, and to apply cooperative agent

* Ph.D. Student, Faculty of Computer Technologies and Engineering, International Black Sea University, Tbilisi, Georgia.
E-mail: anriettehazem@yahoo.com

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

technology for processing the information of the Web (Horrocks, Patel-Schneider, & Harmelen, (2003); McGuinness & Harmelen, 2004). For building Web Ontology Languages (OWL) we chose Protégé, free open-source ontology editor, and framework for building intelligent systems, Protégé's architecture can be adapted to build both simple and complex ontology-based applications (Knublauch, Fergerson, Noy, & Musen, 2004; Gennari, et al., 2003). Web Ontology Languages (OWL) is derived from a well-known family of logic called Description Logics (DL), which is a family of logics for knowledge representation, they are usually decidable fragments of first-order predicate logic and closely related to propositional modal logics (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003; Hitzler, Krötzsch, & Rudolph, 2009). We chose our Web Portal to represent Georgia as an example, but the model developed is general enough to be used for any other country. We provide a model of an ontology that can be filled in with a data representing any country of interest.

The rest of the paper is organized as follows: next section describes preliminaries, where we present the Web Ontology Languages (OWL) and its Components, the Description Logics, and its Components, the syntax for OWL DL, besides to an overview of Protégé. Then follows the main section, describing our contribution – the model of the ontology. The final section is the Practical Part and Results, Conclusion.

Preliminaries

Web Ontology Languages (OWL) which are standardized by World Wide Web Consortium (W3C) (Antoniou & Harmelen, 2004), can add machine-readable meaning to web pages, by defining the shared terms in web resources, to make use of knowledge Representation (KR) technology for automated reasoning from Web resources, and to apply cooperative agent technology for processing the information of the Web (Horrocks, Patel-Schneider, & Harmelen, (2003); McGuinness & Harmelen, 2004). The language OWL provides three increasingly expressive sublanguages, namely OWL Lite, OWL DL, and OWL Full.

In this research paper, we will use OWL DL.

An OWL Ontology Components consists of Individuals represent objects in the domain that we are interested in.

Properties are binary relations on individuals - i.e. properties link two individuals together.

Classes are interpreted as sets that contain individuals. They are described using formal (mathematical) descriptions that state precisely the requirements for membership of the class.

(Horrocks, Patel-Schneider, & Harmelen, (2003); McGuinness & Harmelen, 2004)

Description Logics (DL) is a family of logics for knowledge representation. They are usually decidable fragments of first-order predicate logic and closely related to propositional modal logics. There are various description logics, such as ALC, SHOIN(D), SHIF(D) and the like (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003; Hitzler, Krötzsch, & Rudolph, 2009).

Description Logics (DL) Components

Concept names are equivalent to unary predicates and concepts to formulae with one free variable.

Role names are equivalent to binary predicates and roles to formulae with two free variables.

Individual names are equivalent to constants.

Operators restricted so that the language is decidable: ∀ and ∃ directly corresponds to □ and ◇

In modal logics □ can be read as necessarily and ◇ as possibly (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003; Hitzler, Krötzsch, & Rudolph, 2009).

Knowledge is represented as a knowledge base, K = (A, T) where:

– A is a set of assertions about named individuals, called the ABox (e.g. GeorgianCity (Tbilisi), isCaptialOf (Tbilisi, Georgia))

– T is a set of terminology definitions (i.e. complex descriptions of concepts or roles), called the TBox (e.g. Religious Tourism ⊆ Tourism) (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003; Hitzler, Krötzsch, & Rudolph, 2009).

DL	OWL
⊤ (top concept)	owl:Thing
⊥ (bottom concept)	owl:Nothing
Concept name	Class
Role name	Object property
¬C (concept negation)	ObjectComplementOf(C)
C U D (concept disjunction)	ObjectUnionOf(C D)
C ∩ D (concept conjunction)	ObjectIntersectionOf(C D)
∀R.C (universal quantification)	ObjectAllValuesFrom(r C)
∃R.C (existential quantification)	ObjectSomeValuesFrom(r C)
(≥ n r .C)	ObjectMinCardinality(n r C)
(≤ n r .C)	ObjectMaxCardinality(n r C)
(= n r .C)	ObjectExactCardinality(n r C)

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

Protégé free open-source ontology editor and framework for building intelligent systems, Protégé's architecture can be adapted to build both simple and complex ontology-based applications, Protégé developed at Stanford Medical Informatics. It has a community of thousands of users. Although the development of Protégé has historically been mainly driven by biomedical applications, the system is domain-independent and has been successfully used for many other application areas as well specifically for

- A Java-based application (multi-platform)

- A graphical user interface (GUI) to help the editing of ontologies creation, modification, reasoning, debugging (Knublauch, Fergerson, Noy, & Musen, 2004; Gennari, et al., 2003).

The model

The purpose of this study and research is to describe a model of building ontologies for a Tourism Web Portal, based on the Description Logics (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003; Hitzler, Krötzsch, & Rudolph, 2009). Semantic Web Portal is a web page, based on Semantic Web Technologies (Berners-Lee, Hendler, & Lassila, 2001), since the traditional current web programming only allows for describing the layout of web pages, but not their semantic content (Eiter, Ianni, Lukasiewicz, Schindlauer, & Tompits, 2008). Therefore the main reason for using Semantic Web Technologies that is human readable information is accompanied by machine-readable information, usually written in ontologies.

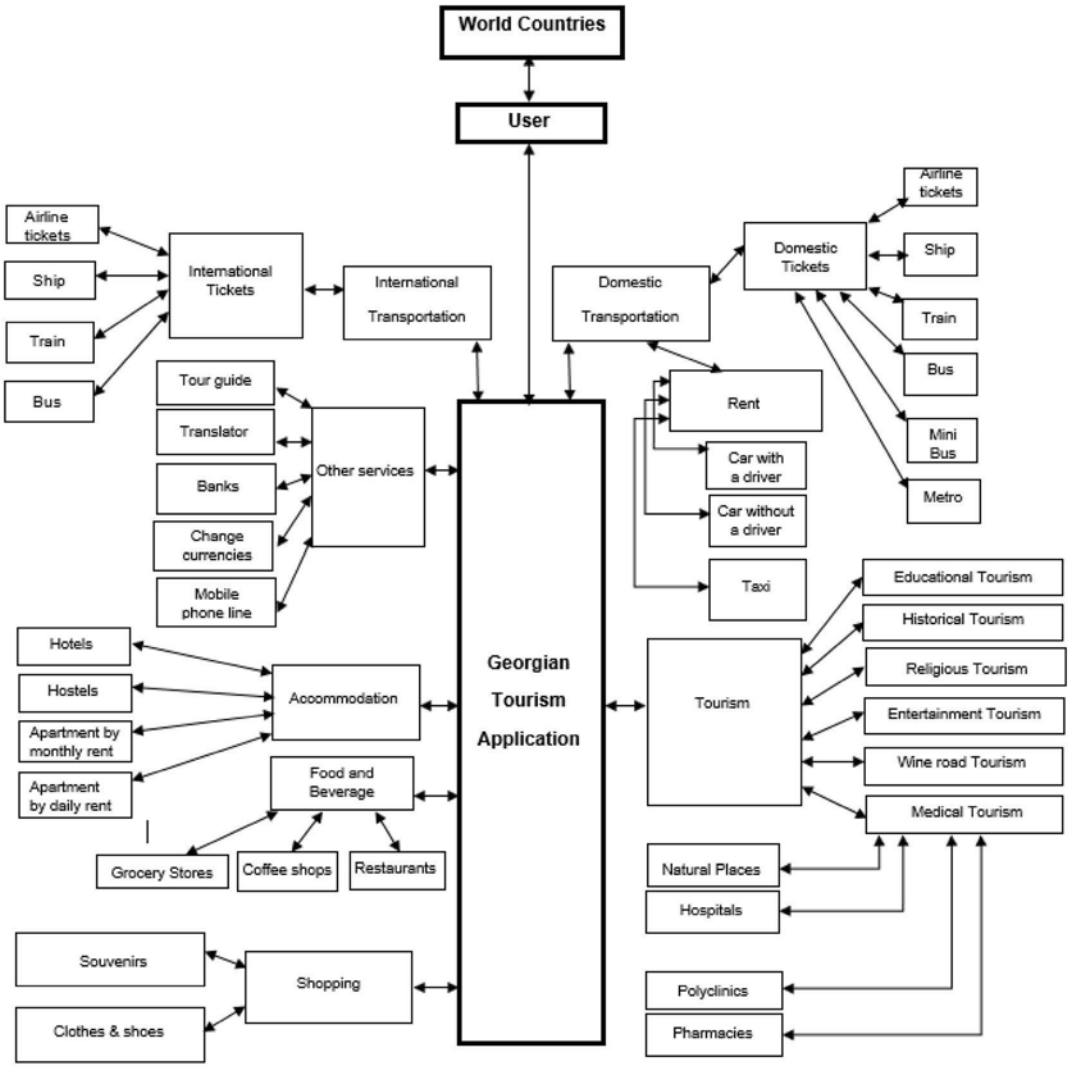

Fig. 1. *The model for a Tourism Portal*

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

The advantages which can be achieved by using ontologies, more efficiently than by using traditional web programming approaches.

When adding machine-readable meaning to Web pages, by defining the shared terms in Web resources, to make use of knowledge Representation (KR) technology for automated reasoning from Web resources. (Horrocks, Patel-Schneider, & Harmelen, (2003); McGuinness & Harmelen, 2004). For building Web Ontology Languages (OWL) (Antoniou & Harmelen, 2004). We chose Protégé, although there are many editors for developing ontologies (like, e.g., Web ODE, ICOM, etc.), but for our work it is the most suitable free open-source ontology editor, and framework for building intelligent systems, because Protégé's architecture can be adapted to build both simple and complex ontology-based applications (Knublauch, Fergerson, Noy, & Musen, 2004; Gennari, et al., 2003). There are a lot of portals and applications whatever depends on Semantic Web Technology or other technologies, which offer different services for internet users, but each portal or application is providing one service without compiling all services in one application. For example, there are many applications which can help the users to book travel tickets, hotels, etc. (like, e.g., TripAdvisor, Booking.com, etc.). (Fig. 1.)

Our portal will combine all services which the user will need during his travel. We chose our Web Portal to represent Georgia as an example, but the model developed is general enough to be used for any other country. We provide a model of an ontology that can be filled in with a data representing any country of interest. As we can see in Figure.1. The model for a Tourism Portal.

Practical Part and Results

- For the practical work, last year was devoted to collecting data, we were concentrated to collect data for Georgian country, from different and trusted resources, and transfer the data in form of ontology which based on the Description Logic, and we started building our ontology by using Protégé

Fig. 2. *Class Hierarchy for All Countries*

- As we can see from the figure 2. Class Hierarchy for All Countries which represented the classes and subclasses, for any country in general.

As we mentioned several times in this research paper, that we chose our Web Portal to represent Georgia as an example.

But we provide a model of an ontology that can be filled in with a data representing any country of interest, as the following

- Apartment by daily rent ⊆ Accommodation
- Apartment by monthly rent ⊆ Accommodation
- Hostels ⊆ Accommodation
- Hotels ⊆ Accommodation
- Coffee shops ⊆ Food and Beverage
- Grocery Stores ⊆ Food and Beverage
- Restaurants ⊆ Food and Beverage
- Clothes & shoes ⊆ Shopping
- Souvenirs ⊆ Shopping
- Education Tourism ⊆ Tourism
- Entertainment Tourism ⊆ Tourism
- Historical Tourism ⊆ Tourism
- Medical Tourism ⊆ Tourism
- Religious Tourism ⊆ Tourism
- Wine road ⊆ Tourism
- Domestic Transportation ⊆ Transportation
- International Transportation ⊆ Transportation

- We provided a model of an ontology, based on Description Logic, using the Tbox axioms, but we do not give any kind of Abox axioms, because they represent actual data that depend on the country itself.

- And we must note that we will present only samples of

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

a general structure of the work.

For presenting the whole general structure of the ontology, will be very difficult as it is a huge amount of data

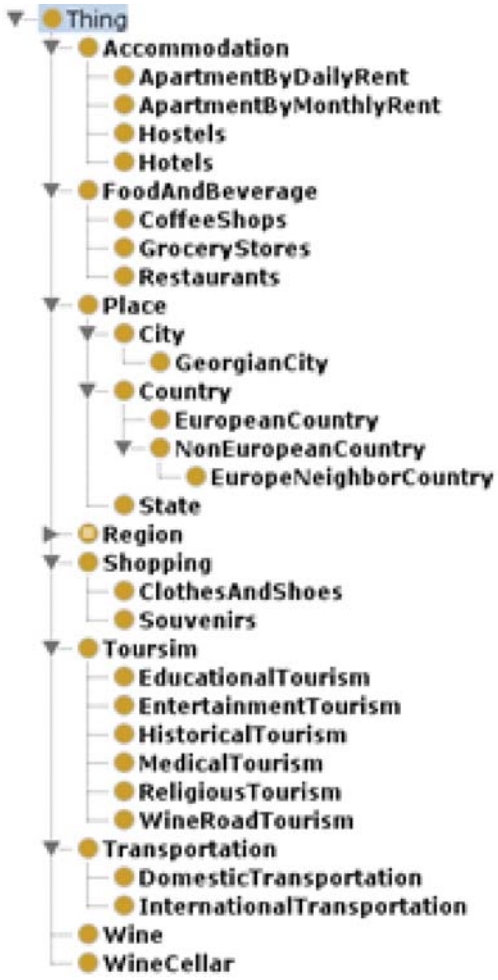

Fig. 3. *Class Hierarchy for Georgia*

- As we can see from the figure 3. Class Hierarchy for Georgia which represented the classes and subclasses, but this figure is different from the previous one, as this figure shows that Georgia has been applied for the model, as an example for the Country, in this step we used both Tbox axioms and Abox axioms, (but it does not show clearly the used of Abox axioms, we will show it clearly in the next figure, as the next step we will add the individuals

Fig. 4. *Individuals by type*

- In figure 4. Individuals by type Shows the cities of Georgia.

Fig. 5. *Property assertions*

Journal of Technical Science & Technologies; ISSN: 2298-0032; e-ISSN: 2346-8270; Volume 7, Issue 1, 2018

- When we press on Tbilisi it shows its properties in other icon which represented in figure 5. Property assertions.

As it shows by very clear way how the ABox axioms was used for the individual (Tblisi).

Fig. 6. *Individuals by type*

- In figure 6. Individuals by type shows the regions of Georgia.

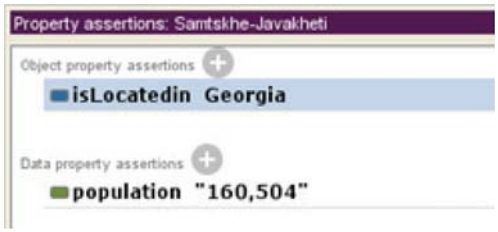

Fig. 7. *Property assertions*

- When we press on Samtskhe–Javakheti region, it shows its properties in another icon which represented in figure7. Property assertions it shows by the very clear way in another example, how the ABox axioms were used for the individual (Samtskhe–Javakheti).

Conclusion

We presented a model of building ontologies for Semantic Web Portal, based on the Description Logics, by using Protégé, we chose our Web Portal to represent Georgia as an example, but the model developed is general enough to be used for any other country.

References

Antoniou, G., & Harmelen, F. v. (2004). Web Ontology Language: OWL .In Handbook on Ontologies. Springer Berlin Heidelberg.

Baader, F., Calvanese, D., McGuinness, D. L., Nardi, D., & Patel-Schneider, P. F. (2003). THE DESCRIPTION LOGIC HANDBOOK. New York: Cambridge University Press.

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The Semantic Web. Scientific American, pp.34-43.

Bishara, A. (2015). Reasoning Techniques in Semantic Web. Tbilisi, Georgia.

Eiter, T. S., Ianni, G. B., Lukasiewicz, T., Schindlauer, R., & Tompits, H. (2008). Combining answer set programming with description logics for the Semantic Web. Artificial Intelligence, 1495-1539.

Gennari, J., Musen, M., Fergerson, R., Grosso, W., Crubézy, M., Eriksson, H., . . . Tu, S. (2003). The evolution of Protégé: an environment for knowledge-based systems development. International Journal of Human-Computer Studies, 89-123.

Hitzler, P., Krötzsch, M., & Rudolph, S. (2009). Foundations of Semantic Web Technologies. Chapman and Hall/CRC.

Horrocks, I., Patel-Schneider, P. F., & Harmelen, F. v. ((2003)). From SHIQ and RDF to OWL: The Making of a Web Ontology Language. Journal of Web Semantics, 7–26.

Janjua, N. K., & Hussain, F. K. (2010). Development of a Logic Layer in the Semantic Web: Research Issues. In proceedings of the Sixth International Conference on Semantics Knowledge and Grid (SKG10), (pp. 367-370). IEEE Computer Society.

Knublauch, H., Fergerson, R. W., Noy, N. F., & Musen, M. A. (2004). The Protégé OWL Plugin: An Open Development Environment for Semantic Web Applications. Third International Semantic Web Conference. Hiroshima, Japan.

Maedche, A., & Staab, S. (2012). Maedche, Alexander ; Staab, Steffen (Vol. 665). Springer Science & Business Media.

McGuinness, D., & Harmelen, F. v. (2004, February 10). OWL Web Ontology Language. Retrieved from W3C: https://www.w3.org/TR/2004/REC-owl-features-20040210/

Náufel do Amaral, F. (2010). Usability of a Visual Language for DL Concept Descriptions. In Proceedings of the Fourth international conference on Web reasoning and rule systems (pp. 27- 41). Bressanone/Brixen, Italy: Springer, Berlin, Heidelberg.

Pandey, G. (2012). The Semantic Web: An Introduction and

Issues. International Journal of Engineering Research and Applications, pp.780-786.

Shadbolt, ,. N., Berners-Lee, T., & Hall, W. (2006). The Semantic Web Revisited. IEEE Intelligent Systems, pp. 96-101.