

# Learning from the Masters: Understanding Ontologies found on the Web

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## 1 Overview

One identified critical success factor of the Web is the ability to “view [the] source” of a web page, examine the HTML, and borrow either explicit bits of code or patterns for doing things. The viral nature of HTML made it easy for people to build web pages without a lot (or any) formal training which substantially lowered the barrier to entry long before sophisticated tools (such as graphical HTML editors or content management systems) became available. Even for experienced designers and webmasters, the radically open source nature of the Web was a boon for understanding not just the meaning of various tags, but how to use them *effectively*.

The W3C OWL Web Ontology Language has been a W3C recommendation since 2004. Although OWL was initially designed for use in (the development of) the Semantic Web, it has rapidly become a de facto standard for ontology development in general, and is playing an important role in an increasing number and range of applications. The open source nature of the Web is an essential part of OWL and the OWL community. However, given the nature of OWL (a fairly complex logic) and real OWL ontologies (which tend to be large and complex) it is harder to *exploit* the openness.

OWL ontologies are now in use in areas as diverse as e-Science, medicine, biology, geography, astronomy, defence, and the automotive and aerospace industries (to name but a few). OWL is also the focus of much research into reasoning, language extensions, modeling techniques, and perhaps most importantly, tool support that makes these various extensions and techniques accessible to users. A wide range of tools is already available that make it significantly easier to work with ontologies. However, many people are not away of these new features, or just lack the experience to be able to use them successfully to navigate through a novel ontology with an eye to understanding it well enough to pick up useful tips and tricks, or even to understand it well enough, as a domain expert, to correct or otherwise modify it.

The purpose of this tutorial is to help attendees gain sufficient experience of working with OWL and tools to allow them to fruitfully explore new ontologies

that they may encounter. In other words, they should be able to do the equivalent of “view source” on an ontology. Also, they will get better fluency in the use and abuse of OWL by examining features, limitations, and workarounds in real contexts, as well as gaining an understanding of the impact of future extensions of OWL, in particular of rules and the proposed revision of the language called OWL 1.1.

## 2 Goals

After the tutorial, the attendees should be able to:

- understand OWL and be able to use it in practice for developing or modifying ontologies;
- be able to systematically analyze new ontologies to some degree;
- be familiar with OWL ontologies and OWL-based tools;
- understand the services that OWL-based tools provide for assisting the modeler;
- be aware of the state of the art of OWL-based technologies;
- understand the usage of OWL in applications; and
- be aware of the limitations of OWL and understand various proposed extensions (such as OWL 1.1 and rules)

## 3 Outline

The times below sum to only six hours. These are contact hour times, excluding lunch and breaks.

Only the major hands-on activities have been mentioned in this outline. There will be several other small hands-on activities during the other parts of the tutorial.

### 1. *Basic OWL: 0.5h*

- Brief introduction to the features and semantics of OWL.
- Installation of the software.

### 2. *Dealing with Simple Ontologies: 1h*

The goal is to become familiar with simple OWL ontologies. We will use an existing OWL ontology (such as the Wine ontology) as a working example and show how to manipulate it and perform basic operations using an ontology development tool; in particular, we will:

- show how to search for, load and browse an ontology;
- discuss basic style issues and some intricancies of the semantics;
- perform basic reasoning tasks such as classification and query answering;
- demonstrate how to identify and debug errors in the ontology; and
- perform some advanced analysis services, such as segmentation.

### 3. *First Major Hands-On Activity: 1h*

The attendees will be asked to:

- load, browse and navigate through an ontology;
  - modify the ontology; and
  - use a reasoner.
4. *Dealing with real-world ontologies: 1h*  
 The goal is to learn how to handle serious ontologies with actual applications, and understand how they have been modeled.  
**Ontologies for Web Services:** We will discuss the OWL-S ontologies and their uses for service matchmaking. We will show an application in which OWL-S is used for Web Service composition.  
**Biomedical Ontologies:** We will discuss the design and use of an ontology describing protein phosphatases (a family of proteins), and a medical terminology ontology (derived from the well known GALEN ontology).  
**Advanced Issues and Design Patterns:** We will present and discuss various issues that arise when building large ontologies, including nominals vs pseudo-nominals, qualified vs unqualified number restrictions, and binary vs n-ary relations.
5. *Second Major Hands-On Activity: 0.5h*  
 The attendees will be asked to:
  - load, browse and navigate through a large, existing ontology;
  - identify portions of the ontology relevant to a given task; and
  - extend the ontology.
6. *Reducing formalisms to OWL: 1h*  
 OWL is a very expressive language. An interesting application of OWL is to provide formal semantics for other representations. Prominent examples are Policy Languages (such as WS-Policy), Web Service languages and conceptual modelling formalisms, such as UML. We will demonstrate how, in practice, one can take advantage of OWL semantics for performing interesting reasoning tasks on these languages. In particular, we will show how Policy documents can be represented as ontologies and how relevant tasks such as policy containment can be solved using a reasoner.
7. *Overview of extensions: 1h*  
 The final part of the tutorial will address the limitations of OWL and, in particular, which expressive means requested by users are missing in the language. We will provide real examples that stress the representational power of the language. Finally, we will describe how some of these limitations have been overcome by various proposed revisions of OWL, such as OWL 1.1 and rules.

## 4 Importance

OWL is a major Semantic Web language, so a tutorial on its use is of current interest and importance. There are a number of large scale and complex ontologies out there (for example, consider the Open Biological consortium ontologies), but it is relatively difficult for people not involved in their development to even peruse them, much less learn or use them. When OWL was released, one could

argue that relatively poor tools support was the main barrier. But this is no longer true. We believe that encouraging a culture of examining existing ontology is a systematic way will increase the general level of “OWL savvy”, as well as increasing feedback to ontology maintainers.

## 5 Audience

We expect that the tutorial will be useful for a wide audience; in particular, we expect that current and potential users of OWL (both in industry and academia), as well as graduate students willing to learn or better understand OWL through applications will benefit highly from the tutorial.

## 6 Hands-on Activities

As indicated in the outline, attendees will be asked to perform basic tasks on several ontologies available on the Web.

The organizers will show how to download and install the open-source ontology editor SWOOP, which bundles the reasoner Pellet. All the software to be used is open-source, available online, and runs on modern Windows, Linux, and MacOS laptops.

## 7 Support Material and Special Requirements

Attendees (or small groups of attendees) are expected to have a suitable laptop running Windows, MacOS, or Linux. Attendees will be encourage to load the course software on their machines before the workshop, and instructions will be provided, but it will also be possible to perform this task during the workshop.

We need a projector in the room and sufficient networking so that the attendees can connect to the Web to search for and download ontologies.

## 8 Organizers

- **Bernardo Cuenca Grau** is a Postdoctoral Research Fellow in the Information Management Group at the University of Manchester. His current research activities are focused on new reasoning services needed to support key tasks in Ontology Engineering, such as ontology merging, design, maintenance and integration. He has been involved in the design of the OWL 1.1 extension of the Web Ontology Language.
- **Ian Horrocks** is a Professor in the School of Computer Science at the University of Manchester. He was (jointly) responsible for the development of both the OIL and DAML+OIL semantic web ontology languages, was a member of the W3C WebOntology working group that developed the OWL language (now a W3C recommendation). He (jointly) designed the logics and

algorithms underpinning the above languages, designed and implemented the FaCT system, and has been involved in the development of other ontology tools. He has been involved in the design of the OWL 1.1 extension of the Web Ontology Language.

- **Bijan Parsia** is a Lecturer in the School of Computer Science at the University of Manchester. His current research activities include various aspects of ontology-based technologies, such as reasoning, knowledge representation, services for ontology development, and tool design. He has been involved in the design of the OWL 1.1 extension of the Web Ontology Language, and is also working on other areas relevant for the Semantic Web community, such as non-monotonic reasoning and belief revision.
- **Peter F. Patel-Schneider** is a Member of Technical Staff in Bell Labs Research. Dr. Patel-Schneider's research interests center around ontology languages and Description Logics, in particular in making description logics useful in applications. He was involved the creation of languages suitable for representing ontology information; he was a member of the project advisory board of the DARPA DAML project and created and edited several portions of the DAML+OIL ontology language; he participated in the W3C Web Ontology Working Group, which resulted in the development of OWL. He has been involved in the design of the OWL 1.1 extension of the Web Ontology Language.
- **Ulrike Sattler** is a Reader in the Information Management Group within the School of Computer Science at the University of Manchester. Dr. Sattler's general research interests are in logics for knowledge representation and automated deduction. She has been involved in the design of the logics *SHIQ* and *SHOIQ*, which lie at the basis of modern ontology languages, such as OWL. She has been involved in the design of the OWL 1.1 extension of the Web Ontology Language.