

# SINUX - Ubuntu spiced up with Semantic Web

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**Abstract**—In this paper we propose SINUX, a Linux distribution especially created for those who want to learn and use the currently existing Semantic Web technologies. It has integrated many important instruments and references to online informations, making it easy for the users to have a proper development environment without any hassle.

**Index Terms**—Ubuntu, Semantic Web, Linux distribution

## I. INTRODUCTION

In recent years, Semantic Web (Web 3.0) [1] is a research and development field, both in the industrial and in academia environment. There are many instruments available to communities with interests in the direction of the Semantic Web, but whose installation may bring difficulties to the end user. Therefore, in this paper we propose SINUX (Semantic Linux) [2], a linux distribution based on Ubuntu 10.10 created for those who want to learn and use the currently Web 3.0 (Semantic Web) [3] tools and technologies. SINUX gathers in one place multiple (development) tools and tutorials that are useful both for experienced users and beginners. We also remark that SINUX is not a proposal for a semantic desktop (e.g. Nepomuk) [4]–[6], but may help to the adoption of Semantic Web technologies.

## II. SINUX ENVIRONMENT

The development in the field of Semantic Web implies the use of various standards and technologies. Every person who wants to be part of the Web 3.0 must have a development environment installed, containing various tools and references to specifications and technologies. The configuration of such an environment might be a time consuming task, especially for beginners, having to find and install many tools, to create a personal collection of links for online resources etc. To assist with this, we have created SINUX, a linux distribution which is pre-loaded with the most important tools and online resources, helping users to focus directly on the development part, saving the time needed for the installation and configuration phase. Also, SINUX is based on Ubuntu, which is the most user friendly linux distribution.

We based our classification of the resources installed on the main concepts in Semantic Web and on Tim Berners-Lee’s Semantic Web Stack (fig. 1) [7]. Taking into account all these, we created a special menu, *Semantic Web*, which contains the following submenu:

- Microformats
- RDF - Resource Description Framework

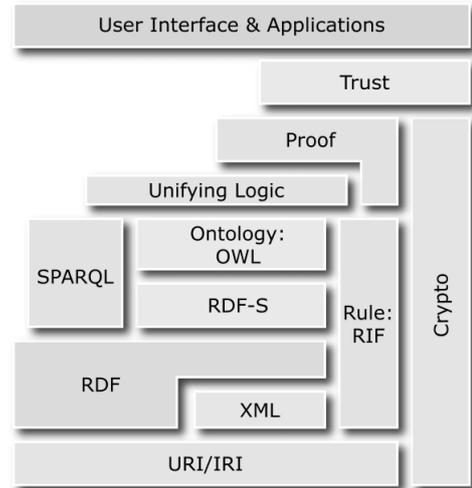


Fig. 1. Tim Berners-Lee’s Semantic Web Stack [7]

- RDF Schema
- OWL - Web Ontology Language
- SPARQL - RDF Query Language

Because this menu was necessary to be accessible for all users, it was added by editing the main menu’s (*Applications*) configuration file, */etc/xdg/menus/applications.menu*:

```
<!-- Semantic Web-->
<Menu>
  <Name>Semantic Web</Name>
  <Directory>
    SemanticWeb.directory
  </Directory>
  <Include>
    <And>
      <Category>SemanticWeb</Category>
    </And>
  </Include>
</Menu>
<!--microformats -->
<Menu>
  <Name>Microformats</Name>
  <Directory>
    SemanticWebMicroformats.directory
  </Directory>
  <Include>
```

```

<And>
  <Category>
    SemanticWebMicro
  </Category>
</And>
</Include>
</Menu>

```

Submenus were created by adding directory files on `/usr/share/desktop-directories/`:

```
SemanticWebRDF.directory
```

```

[Desktop Entry]
Name=RDF - Resource Description Framework
Comment=Resource Description Framework
Icon=/usr/share/icons/SemanticWeb/rdf.ico
Type=Directory
X-Ubuntu-Gettext-Domain=gnome-men

```

The entry was created by adding shortcut files on `/usr/share/applications/`:

```
protege.desktop
```

```

[Desktop Entry]
Version=4.1
Name=Protege OWL Editor
Comment=Edit and create ontologies
Exec=/opt/Protege_4.1_beta/Protege
Terminal=false
Type=Application
Icon=/opt/Protege_4.1_beta/Protege.ico
Categories=SemanticOwl
StartupNotify=true

```

Some tools were installed directly from Ubuntu Repository (Eclipse, NetBeans, etc.), while others were downloaded from the Internet and installed manually (Protege, Twinkle, etc.). In the last case, the tools were placed under `/opt` partition. Some of these applications already offered the binary (executable file), and in this situation, it was necessary only to create the appropriate entry in the menu. Also, there were other tools that came as an archive file (like Java archive), and for these applications launcher scripts were created, with menu shortcuts to them.

Keeping these tools updated raises some problems, because many of them do not offer automatic updates or even a version control system (SVN, CVS etc.) and all are based on Java, any attempt to create an update system for any of these tools will not provide stability for the system. It is enough that only one update modifies the installed Java version for the other tools to stop working. For the tools installed directly from Ubuntu Repositories, the updates are made through Ubuntu Update manager. For Mozilla Firefox Plug-ins, any request for a plug-in installation is redirected to the last version of that plug-in and the Add-ons Manager takes care of future updates.

### III. SINUX DEPLOYMENT AND USE

#### A. Deployment

SINUX DVD has some dedicated graphics, with semantic web and Ubuntu logos (login screen and wallpaper). Also the SINUX boot menu and loading theme were specially designed according to this.

SINUX DVD was created with Remastersys [8] from an installed Ubuntu version, “spiced up” with resources and tools for Semantic Web. One advantage of having Remastersys already installed is that anyone can add other tools and make desired changes to SINUX, and then can redistribute (creating a new DVD version, life or ready to install).

#### B. Launch/Install

SINUX can be used both as a live environment (ideal for testing) and installed on your personal PC. To start, it is necessary that the system can boot from the DVD-DRIVE. The SINUX DVD needs to be inserted into the DVD-DRIVE and, after a possible “Press any key to continue ...” message, it opens a menu with multiple choices. The user may select one of the two major options: “Boot Sinux Live” or “Install it”.

On Live environment, SINUX creates a user “sinux” which is capable to take root rights (sudo). For the installation version, the customer is asked to create his own user (standard installation procedure from Ubuntu). The Semantic Web tools are available on SINUX for all users, no matter the type of usage.

#### C. Semantic integrated tools

To use the full potential of SINUX it is recommended to have an Internet connection because there are several tools that are running online. After launching/installing SINUX, there will be an icon on Desktop, *Getting Started*, having the SINUX logo (a harmonious combination between the Ubuntu logo and the RDF logo). This icon opens a window that guides the user to the specific menu and also allows him also to access the documentation. This specific menu is called *Semantic Web* and was added to the standard *Applications Menu* from Ubuntu. Semantic Web menu is easily found because of the associated logo.

This menu contains a link to a frameworks collection, *Advanced Semantic Web Frameworks*, an *About* window and, according to the classification made in section II, the specified submenus, which group the following tools:

1) *Microformats submenu*: SINUX provides tools for working with Microformats, an emerging standard for injecting semantics into HTML. These tools are grouped in the Microformats submenu as follows:

- **Documentation (online)** - a link to “Tutorials on Microformats - Making Web Content Smarter” page;
- **hCalendar Creator (online)** - a link to “hCalendar Creator”, an online tool for generating the HTML code corresponding to a hCalendar microformat (a simple, open, distributed calendaring and events format, using

a 1:1 representation of standard iCalendar VEVENT properties and values in semantic HTML or XHTML) [9];

- **hCard Creator (online)** - online tool for generating a hCard (a simple, open, distributed format for representing people, companies, organizations, and places, using a 1:1 representation of vCard properties and values in semantic HTML or XHTML) [10];
- **hReview Creator (online)** - online tool for generating a hReview (a simple, open, distributed format, suitable for embedding reviews of products, services, businesses, events etc. in HTML, XHTML, Atom, RSS and arbitrary XML [11];
- **Install Operator** - this submenu allows direct installing of “Operator”, a Firefox extension that leverages microformats and other semantic data that are already available on many web pages to provide new ways to interact with web services. With “Operator” it is possible to combine pieces of information on Web sites with applications in ways that are useful. For instance, Flickr + Google Maps, Upcoming + Google Calendar, Yahoo! Local + your address book, and many more possibilities and combinations [12];
- **Install Tails** - for downloading and installing Tails, a Firefox extension for showing and exporting microformats. Currently it supports the following formats: hCard (export to .vcf file), hCalendar (export to .ics file), hReview, xFolk, Rel-license [13];
- **Optimus (online tool)** - a link to Optimus page, which is a microformats transformer. It easily transforms microformatted content to nice, clean, easily digestible, XML, JSON or JSON-P [14].

2) *OWL - Web Ontology Language submenu*: The OWL Web Ontology Language is an ontology language for the Semantic Web with formally defined meaning [15]. OWL 2 ontologies provide classes, properties, individuals, and data values and are stored as Semantic Web documents. OWL 2 ontologies can be used along with information written in RDF and OWL 2 ontologies themselves are primarily exchanged as RDF documents. SINUX provides tools for working with ontologies in the **OWL - Web Ontology Language submenu**:

- **Protege OWL Editor** - Protege is a free, open source ontology editor and knowledge-base framework. [16] The Protege platform supports two main ways of modeling ontologies via the Protege-Frames and Protege-OWL editors. Protege ontologies can be exported into a variety of formats, including RDF(S), OWL and XML Schema. Also, it offers support for OWL-S used to compose Web services [17]. Protege is supported by a strong community of developers and academic, government and corporate users, who are using it for knowledge solutions in different areas, as biomedicine, intelligence gathering and corporate modeling;
- **Public ontologies (online)** - a link to [http://protegewiki.stanford.edu/wiki/Protege\\_Ontology\\_Library](http://protegewiki.stanford.edu/wiki/Protege_Ontology_Library), a page that

is organized into the following groupings: OWL ontologies, Frame-based ontologies, Ontologies in other formats (e.g., DAML+OIL, RDF Schema etc.). We also mention Semantic Media Wiki. Semantic MediaWiki is an extension of MediaWiki [18]. MediaWiki is the wiki engine for Wikipedia. Its extension Semantic MediaWiki turns MediaWiki into a semantic wiki, as the one used on semanticweb.org which is an important resource for the Semantic Web;

- **Smore** - a tool for creating OWL Markup for HTML Web Pages [19]. It is a MINDSWAP (Maryland Information and Network Dynamics Lab Semantic Web Agents Project) project. Primary goals include:
  - To allow the user to markup web documents with limited knowledge of OWL terms and syntax;
  - To provide a way to use Classes, Properties, and Individuals from existing ontologies, do limited ontology editing or even create a new ontology from scratch using terms from web documents;
  - To provide a flexible environment for creating simple web pages simultaneously with markup.
- **Swoop** - a tool for creating, editing, and debugging OWL ontologies [20]. It was produced by the MIND lab at University of Maryland, College Park, but is now an open source project with contributors from all over the world;
- **Tutorial (online)** - a link to “OWL 2 Web Ontology Language Quick Reference Guide” - W3C Recommendation [21].

3) *RDF - Resource Description Framework submenu*: Resource Description Framework or RDF is a family of specifications for a metadata model that is often implemented as an application of XML. The RDF family of specifications is maintained by the World Wide Web Consortium (W3C). RDF extends the linking structure of the Web to use URIs to name the relationship between things as well as the two ends of the link (this is usually referred to as a triple). Using this simple model, it allows structured and semi-structured data to be mixed, exposed, and shared across different applications. This linking structure forms a directed, labeled graph, where the edges represent the named link between two resources, represented by the graph nodes. This graph view is the easiest possible mental model for RDF and is often used in easy-to-understand visual explanations.

RDF dedicated tools are organized by SINUX in three submenus: *RDF - Resource Description Framework*, *RDF Schema and SPARQL - RDF Query Language*.

The *RDF - Resource Description Framework* submenu on SINUX contains:

- **Documentation** - three links to online information referring to RDF presentation, RDF Schema [22] and a RDF tutorial;
- **Dublin Core metadata editor (online)** - This service will retrieve a Web page and automatically generate Dublin Core metadata, either as HTML `<meta>...</meta>` tags or as RDF/XML, suitable for embedding in

the <head>...</head>section of the page. The generated metadata can be edited using the form provided and converted to various other formats (USMARC, SOIF, IAFA/ROADS, TEI headers, GILS, IMS or RDF) if required. Optional, context sensitive, help is available while editing [23];

- **GRDDL Service (online)** GRDDL is a markup format for **Gleaning Resource Descriptions from Dialects of Languages**. It is a W3C Recommendation and enables users to obtain RDF triples out of XML documents, including XHTML [24];
- **IsaViz** - IsaViz is a visual environment for browsing and authoring RDF models represented as graphs [25]. It features:
  - a 2.5D user interface allowing smooth zooming and navigation in the graph;
  - creation and editing of graphs by drawing ellipses, boxes and arcs;
  - RDF/XML, Notation 3 and N-Triple import;
  - RDF/XML, Notation 3 and N-Triple export, but also SVG and PNG export.
- **RDFa parser (online)** an online tool for RDFa fragment parsing provided by W3C [26];
- **RDFPic** - is a tool to embed a RDF description of a picture into the picture itself. Only the .jpeg format is currently supported [27];
- **Sindice (online)** - a link to “Sindice Inspector” [28], a tool that takes anything with structured data on (RDF, RDFa, Microformats) and provides several handy ways: in a “Sigma” based view, a novel card/frame based view, a SVG based interactive graph view (like Google Map), sortable triples, with “prettyprint” namespace support, full ontology tree view for Online Data Reasoning debugging. Also it does live Online Data Reasoning: allows a data publisher to see which ontologies are implicitly or explicitly (directly or indirectly, via other ontologies) and visualizes the full closure of inferred statements using different colors. It also provides a tree of the ontologies in use and their dependencies.
- **Triplr (online)** [29];
- **W3.org - RDF Validation Service (online)** - a tool for checking and visualizing RDF documents (both triples and graph mode) [30].

4) *RDF Schema submenu*: RDF Schema (variously abbreviated as RDFS, RDF(S), RDF-S, or RDF/S) is an extensible knowledge representation language, providing basic elements for the description of ontologies, otherwise called Resource Description Framework (RDF) vocabularies, intended to structure RDF resources. Many RDFS components are included in the more expressive language Web Ontology Language (OWL).

- **Intro** - a link to a wikipedia site that describe RDF Schema and it’s main specifications [22];
- **Nasa taxonomy** the NASA taxonomy [31] provides first steps towards the unification of the NASA information

space by documenting a high level set of terms that can be used for mapping together varying data structures. Reconciliation of terms and topics is essential to understanding NASA discoveries in a larger context. Current version of the NASA Taxonomy: Taxonomy Facets (or branches) and Terms, Definitions, Synonyms, Relationships;

- **RDFs Representations** - Online tutorial about RDFs representations;
- **SKOS** (Simple Knowledge Organisation System) provides a model for expressing the basic structure and content of concept schemes such as thesauri, classification schemes, subject heading lists, taxonomies, folksonomies and other types of controlled vocabulary [32], [33]. As an application of the Resource Description Framework (RDF) SKOS allows concepts to be documented, linked and merged with other data, while still being composed, integrated and published on the World Wide Web. In basic SKOS, conceptual resources (concepts) can be identified using URIs, labelled with strings in one or more natural languages, documented with various types of notes, semantically related to each other in informal hierarchies and association networks and aggregated into distinct concept schemes. In advanced SKOS, conceptual resources can be mapped to conceptual resources in other schemes and grouped into labelled or ordered collections. Concept labels can also be related to each other. Finally, the SKOS vocabulary itself can be extended to suit the needs of particular communities of practice;
- **ThManager** - is an Open Source Tool for creating and visualizing SKOS RDF vocabularies, a W3C initiative for the representation of knowledge organization systems such as thesauri, classification schemes, subject heading lists, taxonomies, and other types of controlled vocabulary [34]. ThManager facilitates the management of thesauri and other types of controlled vocabularies, such as taxonomies or classification schemes. The tool has been implemented in Java and has the following features:
  - Multi-platform (Windows, Unix). As it has been developed in Java and the storage of metadata records is managed directly through the file system, the application can be deployed in any platform with the minimum requirement of having installed a Java virtual machine;
  - Multilingual. The application has been developed following the Java internationalization methodology. Nowadays, there are Spanish and English versions. With little effort, other languages could be supported;
  - Selection and filtering of the thesauri stored in the local repository;
  - Description of thesauri by means of metadata in compliance with a Dublin Core based application profile for thesaurus (see application profile). These metadata can be either visualized in HTML or edited through a form;
  - Visualization of thesaurus concepts. The visualiza-

tion interface includes the following widgets:

- \* **Alphabetic viewer:** It provides the list of thesaurus concepts alphabetically ordered in the selected language;
  - \* **Hierarchical viewer:** It provides a tree showing the hierarchical structure of thesaurus concepts;
  - \* **Concept viewer:** For a selected concept it shows all the properties allowing additionally the navigation to the related concepts by means of hyperlinks;
  - \* **Search tool:** It facilitates search of concepts. The searching process is based on preferred labels allowing the following criteria: “equals”, “starts with” and “contains”.
- Edition of thesaurus content. The tool provides an edition interface to modify the content of a thesaurus: creation of concepts, deletion of concepts and update of concept properties;
  - Exchange of thesauri according to SKOS format. The export operation includes the export of thesaurus metadata;
  - Extraction of related concepts in WordNet. It generates an automatic mapping of thesaurus concepts against the concepts of Wordnet lexical database;
  - On-line help by means of PDF visualization.
- **Visual Thesaurus** is an interactive dictionary and thesaurus which creates word maps that blossom with meanings and branch to related words [35]. Its innovative display encourages exploration and learning. You’ll understand language in a powerful new way. Say you have a meaning in mind, like “happy.” The VT helps you find related words, from “cheerful” to “euphoric”. The best part is the VT works like your brain, not a paper-bound book. You’ll want to explore just to see what might happen. You’ll discover, and learn, naturally and intuitively. You’ll find the right word, write more descriptively, free associate and gain a more precise understanding of the English language.

5) *SPARQL RDF Query Language submenu:* RDF is a directed, labeled graph data format for representing information in the Web. This specification defines the syntax and semantics of the SPARQL query language for RDF. SPARQL can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware. SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions. SPARQL also supports extensible value testing and constraining queries by source RDF graph. The results of SPARQL queries can be results sets or RDF graphs.

- **DBpedia (online)** - Accessing the DBpedia Data Set over the Web [36]. DBpedia is a community effort to extract structured information from Wikipedia and to make this information available on the Web. DBpedia allow to ask sophisticated queries against Wikipedia, and to link other data sets on the Web to Wikipedia data. We hope this will

make it easier for the amazing amount of information in Wikipedia to be used in new and interesting ways and that it might inspire new mechanisms for navigating, linking and improving the encyclopaedia itself;

- **Install Semantic Radar** - Semantic Radar [37] recognizes all RDF content (pointed to by autodiscovery links) and displays custom icons to indicate presence of the following data:
  - FOAF (Friend-Of-A-Friend);
  - SIOC (Semantically-Interlinked Online Communities);
  - DOAP (Description Of A Project);
  - RDFa (RDF embedded in XHTML).
- **SPARQL Endpoints (online)** - a link to a webpage who provide a list with current alive SPARQL Endpoints [38];
- **SPARQL Query Validator** - online tool for validation of SPARQL Queries provided by <http://www.sparql.org/>;
- **SPARQL RDF Data Validator** - online tool for validation of RDF data provided by <http://www.sparql.org/>;
- **SPARQL Update Validator** - online tool for validation of RDF data updates provided by <http://www.sparql.org/>;
- **Twinkle** - is a simple GUI interface that wraps the ARQ SPARQL query engine [39]. The tool should be useful both for people wanting to learn the SPARQL query language, as well as those doing Semantic Web development. With Twinkle it is possible to interrogate a conceptual model that is stored locally as a RDF document or online SPARQL endpoints; the defaults are DBpedia, revyu.com and GovTrack, but the tool also permits adding other external endpoints through configuration files.

#### IV. CONCLUSION AND FUTURE WORK

In recent years the Semantic Web has seen an increasing interest from the communities involved, many instruments being developed and being accessible to end users. For those, the setup of an environment containing all the necessary tools may bring difficulties. To assist with this, we proposed in this paper SINUX, a Linux distribution which has integrated multiple (development) tools and tutorials about microformats, OWL, RDF, RDF Schema and SPARQL. In the next version of the distribution we plan to further integrate more tools [40]. Also, regarding the management of updates, taking into account the problem identified, we are focusing now on implementing a mechanism for solving this. Currently, we take into consideration two ways of managing updates, both of which require a permanent maintenance of the project:

- 1) Creating a dedicated repository for SINUX through which to deliver updates to users only after verifying that these updates do not lead to instability of the system (creating .deb packages from projects sources, which is not always feasible);
- 2) Developing a system that will control SINUX versions. New updates mean a new SINUX version. When the system starts, SINUX will compare its own version with the latest version stored on server. If the server version is higher, it will notify that to the user.

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