

## **Portal Ontology**

Semantic Web Portal Project

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DERI Research Report

June 2004

**Deliverable:**

**D1**

**Version:**

**0.9**

**Date:**

**17-Jun-04**

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## ***Abstract***

This document explains the design objectives and the modeling decisions for an ontology which explicitly describes and acts as the skeleton for a Semantic Web driven community portal. The Semantic Web Portal is intended to be used as a platform for the exchange between all kinds of people working in a common scientific area. Hence, we model concepts within domains such as information exchange and cooperative research, which are relevant for a Semantic Web Portal. Included are concepts like ***Person, Publication, Conference, Meeting*** and the like. The aim is to showcase Semantic Web technology by building a web portal based on these technologies. The first prototype of such a portal will target the area of Semantic Web research itself, and therefore help to bring together research groups, research projects, software developers and user communities interested in that area.

The current version of our ontology is not a static and final version. Instead, we intend to extend and improve it in the future. This process should be driven by the community's needs and suggestions.

## ***Acknowledgements***

This deliverable is based on previous work by Jos de Bruijn and Holger Lausen.

We would like to thank Jos and Holger, as well as all members of the Semantic Web Portal Working Group for their contributions and support, and all other members of DERI who helped us during the writing of this document.

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## 1 Introduction

This ontology defines the concepts and classes (we will treat the two terms as synonyms for the remainder of this document) and relations within the context of a scientific Semantic Web Portal (SWPortal). According to Lausen et. al. [1] a Semantic Web Portal is defined as a web portal

- for a community to share and exchange information
- developed based on Semantic Web technologies

Our ontology shall capture common sense knowledge and enable interoperability. The current version should not be seen as a static and final version. Instead, we intend to extend and improve the ontology in the future. This process should be driven by the community's needs and suggestions.

In the current version the ontology is restricted to domain specific classes, e.g. *Agent*, *Document*, ... Other aspects like application specific ones are currently not modeled, but may be objective of future efforts. For example, another ontology could describe application specific aspects such as different means of presenting information (pages, cells, dropdown lists, etc.). The combination of both ontologies could provide a declarative specification of the portal.

Also, the ontology tries to cover the domain of a generic research focused SWPortal, and not necessarily a specific one focused on research within the area of the Semantic Web. As a result, concepts specific to the domain of the Semantic Web (e.g. URI, formal language, RDF, etc.) are not included.

## 2 General Structure and Design Principles

### 2.1 Flat vs. Hierarchical Structure

As opposed to the flat ontology structure in the previous version of this document, we are generally in favor of a more nested and therefore hierarchical structure. One of the advantages of this approach is the fact that it allows for a better exploitation of polymorphism. E.g. the *authors* attribute of a *Document* instance could have the range of *Agent*. In that way, any instance of *Person*, *Organization* or *Initiative* (which are all subclasses of *Agent*) could act as the author. Along the same lines, we favour the use of complex datatypes (e.g. objects) for the ranges of properties over the use of atomic datatypes (e.g. strings) whenever possible<sup>1</sup>.

A related issue is the question of whether or not it is justified to introduce new subclasses under certain conditions. More specifically, should one introduce subclasses *B* and *C* to a class *A*, when *B* and *C* do not differ formally in terms of

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<sup>1</sup> in OWL terms, this would translate to object properties vs. datatype properties



properties or restrictions? While some people would argue that subclassing in such situations tends to make the class hierarchy unnecessarily complicated and bloated, we argue that it would in fact make the ontology more concise. As an example, the previous version of the SWPortal ontology (v0.3) made use of a *type* slot to distinguish instances of the same class to avoid subclassing and thus reduce the number of classes and make the ontology easier to comprehend. However, we argue that *type* is actually an inherent feature of every class. Therefore, adding a *type* slot to a class - which, by virtue of being a class, already has a *type* - contradicts the basic principles of object orientation and ontology building. Instances of such classes would effectively end up with two types. Furthermore, we feel that introducing subclasses such as *MasterThesis* and *PhDThesis* to a *Thesis* class doesn't make an ontology more complicated or less comprehensible than introducing an additional *type* slot to *Thesis*, even if the two subclasses have no further differences. On the contrary, it allows for a much greater generality in using the ontology - a query for all master theses could be subsumed by a more general query for all instances of a certain class, instead of having to write an extra query for all instances of class *Thesis*, which also have the value "MasterThesis" for their *type* slot.

## 2.2 Cardinality

Another fundamental question is whether or not to impose any cardinality restrictions on the properties defined for an ontology. There are several options:

- Don't define any restrictions in the ontology itself. This will keep the ontology very general and allow for a broader audience to use it. If any restrictions are needed in a specific case, they can be moved into the domain of individual applications.
- Define the restrictions very loosely. E.g. don't define any restrictions of type "required" (1 : 1 or 1 : \*), but instead define all restrictions as "optional" (0 : 1). This will allow for incomplete data or underspecified instances, which may actually be desirable in some cases. A user might e.g. want to create an instance of class *Presentation*. However, she knows only that the presentation will have the title "Minimalist Program and Parsing", but knows neither the precise date nor who will give the presentation. Leaving the restrictions "optional" will allow that.
- Define the restrictions in a very strict and precise way. This will clearly increase the descriptive power of the ontology, since it will e.g. be possible to express that (in reality) every instance of *Presentation* has a presenter and will take place at some specific point in time (so these properties would be required). Similarly, every instance of *Person* has a name (required), but only some have publications (optional).

Another question in this context is how the restrictions would be interpreted. Here, one has to differentiate between the *closed world assumption* and the *open world assumption*. Informally, the closed world assumption states that all relevant facts are contained in a given knowledge base (KB). Everything that cannot be proven or falsified through the facts in the KB is defined as *false*. As a result, instances that are not specified for their required properties will lead to inconsistencies in the KB. On the other hand, the open world assumption simply defines everything that cannot be proven or falsified through the facts in the KB as *unknown*. As a result, there will never be any inconsistencies deriving from underspecified instances.

In the situation that would be desirable from our point of view, the ontology would have precise cardinality restrictions. However, the application which would use the ontology (i.e. the SWPortal) would interpret it under the open world assumption, thus allowing the users to add incomplete data. At the same time, the restrictions could be used by the portal to inform the users about underspecified instances, if so desired ("Warning - you still haven't specified a presenter for the presentation!"). This is how we intend the cardinality restrictions defined in chapter 3 to be interpreted.

## 2.3 Integration of External Ontologies

A further principle in the design of our ontology is reuse of existing ontologies. I.e. if the concepts in our ontology have equivalent concepts in existing ontologies, it would be desirable to make use of these instead of reinventing the wheel. This will facilitate the exchange of data between the knowledge base of the Semantic Web Portal and other knowledge bases. In the following sections we will briefly present the external ontologies we decided to integrate into the SWPortal ontology.

### 2.3.1 FOAF - Friend of a Friend

The FOAF ontology (see [3]) is used to express metadata about persons: their names, addresses, depictions of them, etc. FOAF has been developed by Dan Brickley and Libby Miller and is formally specified in in RDFS/OWL. A typical way to make use of this ontology is to define one's own FOAF description and publish it somewhere on the web, thus making it possible for software agents to access and make use of the description. An interesting and unique feature of FOAF then is the possibility to express whom a person knows, by referring to that person's FOAF description (using a URI). In this way, a large and decentralized web of FOAF descriptions is created.

The decision to integrate FOAF into the SWPortal ontology came quite natural, mainly because of the large intersection between the domains of both ontologies. The central concept in FOAF - the person - plays an equally central role in any SWPortal. Other important objects in SWPortals are also already covered by FOAF, e.g. documents or projects. Furthermore, integrating FOAF will help to increase the acceptance of our own ontology, since FOAF is already relatively well accepted and





widespread. People could register to a portal based on our ontology by simply providing the URL to their FOAF description.

A possible disadvantage of integrating FOAF is the fact that the ontology is still under development. As a result, many of the concepts and properties defined are classified as "unstable" or "testing" and may change in the future.

There are a number of other ontologies for persons available. However, we decided not to use these for a number of reasons. Most importantly, and as we already mentioned above, FOAF seems to be the ontology in this domain which is best known and has the widest acceptance. Also, FOAF is more general than its competitors by abstracting from the concept *Person* to a more general concept of *Agent*. This allows the design of our ontology to be more dynamic. However, for completeness sake, we will give a short overview over other person ontologies here:

- A DAML Ontology by LiDing describing a person<sup>2</sup>. The properties listed in this ontology are a subset of the vCard ontology.
- A Person Ontology developed by Ontoprise as part of the Bizon project<sup>3</sup>.
- A W3C Note that specifies a Resource Description Framework (RDF) encoding<sup>4</sup> of the vCard profile defined by RFC 2426<sup>5</sup>:

### 2.3.2 BibTex

Our *swportal:Publication* subontology is modeled closely after the definition of the BibTex Entry types defined in [2]. These types were introduced in 1985 and are meanwhile widely used and accepted<sup>6</sup>. BibTeX is a program and file format designed by Oren Patashnik and Leslie Lamport in 1985 for the [LaTeX](#)<sup>7</sup> document preparation system. Detailed rationalization for the concepts can be found in the literature [2][4]. In the following we will have a more detailed look at how this file format can be translated into an ontology with concepts and properties.

There are currently two public ontologies based on the bibtex format:

- **DARPA/DAML BibTex Ontology** (2001)  
<http://www.daml.org/ontologies/115>

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<sup>2</sup> <http://www.daml.org/ontologies/206>

<sup>3</sup> [http://www.ontoprise.de/documents/bizon\\_person.rdf](http://www.ontoprise.de/documents/bizon_person.rdf)

<sup>4</sup> <http://www.w3.org/TR/2001/NOTE-vcard-rdf-20010222/>

<sup>5</sup> <ftp://ftp.isi.edu/in-notes/rfc2426.txt>

<sup>6</sup> Example of pages providing bibliographic information as Bibtex Entry: <http://citeseer.nj.nec.com/>, <http://portal.acm.org/>

<sup>7</sup> <http://tex.loria.fr/english/index.html>



- **KAON BibTEX Ontology**

[http://kaon.semanticweb.org/ontos/bibtex.kaon/ontology\\_view](http://kaon.semanticweb.org/ontos/bibtex.kaon/ontology_view)

The DARPA/DAML BibTex ontology is a one-to-one mapping to the BibTex types and fields, as defined in [5]. But it is only an enumeration of classes and properties with comments. There exist no local restrictions for the properties on the classes, even though [2] defines them. Also the ranges of the properties are not defined. We took this ontology as a starting point, converted it to OWL and added restrictions.

The KAON BibTex Ontology is loosely based on BibTex (some concepts removed) but EU Project specific (e.g. Concept Deliverable) were added. This Ontology is only available in the KAON format and could therefore not be examined in detail. Also no related documentation was published.

Patshnik [2] implies some cardinality restrictions. All attributes defined in [4] are classified into: required, optional and ignored. In our ontology, this is translated to 0 : 1, 1 : 1 and no statement.

While the BibTex implementation in the previous version of the SWPortal was more or less a flat mapping from BibTex types to ontology concepts, we decided to follow a different approach in this version (as already discussed in 2). The purpose of the BibTex types is to classify entries in a bibliography - ideas such as inheritance, relations or hierarchical structuring, which are powerful and central aspects of ontology design, have not been considered at all when designing these types. We felt that, even though we would start the design of the *swportal:Publication* sub-ontology from the BibTex types, we should not slavishly stick to them. Instead, we introduced a number of subclasses, where we thought it reasonable.

### 2.3.3 RSS - RDF Site Summary

The family of RSS vocabularies is used to publish channels or feeds (i.e. lists) of news items in some machine-readable format. These news items can represent articles, forum entries, blog entires, etc. - basically any kind of textual data that can be referred to by a URI. News items in RSS normally contain a title, a description (typically a summary or short excerpt) and a link to the referred piece of text. In a typical RSS scenario, the publisher of a website that provides textual information which is updated regularly (such as a newspaper, a page with product news, etc.) would publish an RSS feed. Users could then subscribe to different feeds with the help of a news aggregator client. The aggregator would periodically check the RSS feed for updates and inform the user of any new news items, thus making it easier to follow what is going on on a number of different pages.



There are currently a number of competing RSS formats<sup>8</sup>, the most important ones being RSS 0.91 (Rich Site Summary), RSS 1.0 (RDF Site Summary, see [7]) and RSS 2.0 (Really Simple Syndication, see [8]). The version numbers are quite confusing, because higher numbers actually don't indicate that the corresponding version is newer or an elaboration of a version with a lower number. On the contrary, all three formats are independent developments. While RSS 0.91 and RSS 2.0 are currently in wider usage and provide a richer and more expressive vocabulary than RSS 1.0, the latter is based on RDF. Since this makes RSS 1.0 easier to integrate into an RDFS/OWL based ontology, we decided to chose this format.

## 2.4 Other Ontologies

### 2.4.1 Time

Time-related concepts are of central importance in any kind of web portal. Documents have publication dates, presentations are given on a specific date, at a specific time and last for a specific period of time. Phone conferences with participants from different countries might have to take time zones into account. As a result, a sufficiently fine-grained time ontology is needed. Simple approaches like the *dc:date* property defined by the Dublin Metadata Initiative<sup>9</sup> are inappropriate here, as they simply take string values with no specific syntax. This might be sufficient to specify publication dates (which in fact is the original intent). However, it is restricted to dates and does not facilitate reasoning for overlapping periods of time, time zones, etc. On the other hand, elaborate ontologies like DAML-Time<sup>10</sup> provide a complete specification of a theory of time, but might be too complex for most applications. A simpler but still sufficiently expressive approach like the one presented in a paper by Pan and Hobbs [9] might provide a good compromise.

For the time being, we have decided not to include a fine-grained time ontology like the ones mentioned above. This was done due to time constraints and not a design decision. In a future version of this ontology, we will explore this area further.

## 2.5 Representation Language

When choosing a language for the formal representation of our ontology, we basically had to decide between RDF Schema (RDF/S) and OWL, since these two are the current standards of Semantic Web Ontology Languages. It quickly became clear that RDF/S was not really an option, because the level of expressivity it offers clearly isn't

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<sup>8</sup> for an overview over the differences in vocabulary between the various formats, see <http://www.intertwingly.net/stories/2002/08/31/rssQuickSummary.html>

<sup>9</sup> <http://dublincore.org/>

<sup>10</sup> <http://www.cs.rochester.edu/~ferguson/daml/>



high enough. E.g., RDF/S does not offer cardinality restrictions, disjointness of classes, special characteristics of properties, etc.

Currently, the SWPortal ontology is almost completely restricted to OWL Lite. The only feature used that is outside of OWL Lite is disjointness of classes. In future versions of our ontology, we will have to decide whether this feature is actually necessary or if we require other OWL features not covered by OWL Lite. If the answer to any of these questions is positive, we will move our ontology over to OWL DL. Otherwise it might be beneficial to stay within the boundaries of OWL Lite. We decided not to choose OWL Full, in order to guarantee decidability and tractability of our ontology.

### 3 Ontology Description

This chapter contains a detailed definition of the concepts or classes in the SWPortal ontology. For each class, we define its superclass<sup>11</sup> and subclasses, give a human-readable, non-normative description and list the properties which have this class within their domain. Note that, in order to save space and make the document less cluttered, we chose to list only those properties in a class description that have not been listed in any of that class' superclasses. E.g., because *swportal:Publication* lists the property *swportal:title*, this property will not be listed again in any of the subclasses of *swportal:Publication*.

Furthermore, for each of the integrated ontologies and vocabularies we will only list those classes and properties which are directly relevant to the SWPortal ontology. For a complete definition of the respective ontology, please refer to the corresponding specifications.

The SWPortal ontology currently comprises six main concepts, some of which are taken from the FOAF ontology: *foaf:Agent*, *foaf:Project*, *swportal:Event*, *swportal:Location*, *swportal:Publication* and *swportal:Tool*. All main concepts inherit directly from *owl:Thing*. The following figure gives an overview over the class hierarchy.

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<sup>11</sup> or in some instances superclasses, since we make use of multiple inheritance





Figure 1

### 3.1 *foaf:Agent*

Extends: -

Direct Subclasses: *foaf:Group*, *foaf:Organization*, *foaf:Person*, *foaf:Initiative*

#### Class Documentation:

We adopted this concept partially from the FOAF ontology [3]. However, in our ontology the agent concept does not comprise the subclasses *software* and *physical artifact*. We decided to introduce this main concept in order to make the range of e.g. the attribute *author* of a publication more general.

#### Slots:

Slot name	Documentation	Type	Cardinality
<i>foaf:name</i>	"The name of some thing". In this case the name of an agent.	<i>String</i>	1 : 1
<i>swportal:hasAdress</i>	This property relates an agent to its address.	<i>swportal:PostalAdress</i>	1 : *
<i>foaf:mbox</i>	"This property describes a personal mailbox: A personal mailbox, ie. an Internet mailbox associated with exactly one owner, the first owner of this mailbox. This is a 'static inverse functional property', in that there is (across time and change) at most one individual that ever has any particular value for foaf:mbox."	<i>String</i>	1 : 1
<i>foaf:made</i>	This property relates an agent to something made by it. The inverse property is <i>foaf:maker</i> ."	<i>swportal:Tool, foaf:Document</i>	0 : *
<i>foaf:publications</i>	This property relates an agent to its publications. The inverse property is <i>swportal:author</i> .	<i>foaf:Document</i>	0 : *
<i>foaf:currentProject</i>	This property relates an agent to the projects it is currently involved in. The inverse property is <i>swportal:drivenBy</i> .	<i>foaf:Project</i>	0 : *
<i>foaf:pastProject</i>	"This property relates an agent to its past projects."	<i>foaf:Project</i>	0 : *
<i>swportal:organizes</i>	This property relates an agent to the events it organizes. The inverse property is <i>swportal:organizedBy</i> .	<i>swportal:Event</i>	0 : *



<b><i>swportal: givesPresentations</i></b>	This property relates an agent to the presentations it gives. The inverse property is <b><i>swportal: presenter</i></b> .	<b><i>swportal: Presentation</i></b>	0 : *
<b><i>swportal: givesTutorials</i></b>	This property relates an agent to the tutorials it gives. The inverse property is <b><i>swportal: tutoredBy</i></b> .	<b><i>swportal: Tutorial</i></b>	0 : *

### 3.1.1 *foaf:Group*

Extends: *foaf:Agent*

Direct Subclasses: none

Class Documentation:

"A class of Agents. The *foaf:Group* class represents a collection of individual agents (and may itself play the role of a *foaf:Agent*, i.e. something that can perform actions)."

Slots:

Slot name	Documentation	Type	Cardinality
<b><i>foaf: member</i></b>	"Indicates a member of a Group." This property relates a set of agents to a group. These are the members of that group.	<b><i>foaf:Agent</i></b>	1 : *

### 3.1.2 *foaf:Organization*

Extends: *foaf:Agent*

Direct Subclasses: *swportal:Company*, *swportal:ResearchInstitute*,  
*swportal:University*

Class Documentation:

This class represents an organization with a formal legal status.

Slots:

Slot name	Documentation	Type	Cardinality
<b><i>swportal: leader</i></b>	This property defines the leader of an organization, i.e. its director, chairman, etc.	<b><i>foaf: Person</i></b>	0 : 1

#### 3.1.2.1 *swportal:Company*

Extends: *foaf:Organization*

Direct Subclasses: *swportal:publisher*, *swportal:SoftwareDeveloper*

Class Documentation:



This class represents all kinds of companies. Currently only publishers and software developers are modelled.

**Slots:**

no additional slots

**3.1.2.1.1 *swportal:Publisher***

**Extends:** *swportal:Company*

**Direct Subclasses:** none

**Class Documentation:**

This class models companies that publish documents.

**Slots:**

no additional slots

**3.1.2.1.2 *swportal:SoftwareDeveloper***

**Extends:** *swportal:Company*

**Direct Subclasses:** none

**Class Documentation:**

This class models companies that develop software and sell it.

**Slots:**

no additional slots

**3.1.2.2 *swportal:ResearchInstitute***

**Extends:** *swportal:Organization*

**Direct Subclasses:** none

**Class Documentation:**

This class represents research institutes. These organizations have special research areas.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:researchAreas</i>	The areas of research some research institute is involved in. NOTE: at the moment, the range of this property is a simple String. We should look into extending this to something more elaborate.	<i>String</i>	1 : *





### 3.1.2.3 *swportal:University*

**Extends:** *swportal:University*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of universities.

**Slots:**

no additional slots

### 3.1.3 *foaf:Person*

**Extends:** *swportal:Agent*

**Direct Subclasses:** *swportal:Developer*, *swportal:Layman*, *swportal:Researcher*

**Class Documentation:**

"A person. The *foaf:Person* class represents people. Something is a *foaf:Person* if it is a person. We don't nitpic about whether they're alive, dead, real or imaginary."

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>foaf:firstName</i>	"The first name of a person." NOTE: the naming substructure of foaf is currently quite unstable.	<i>String</i>	1 : *
<i>foaf:surname</i>	"The surname of a person." NOTE: the naming substructure of foaf is currently quite unstable.	<i>String</i>	1 : 1
<i>swportal:interests</i>	The fields of interest of a person. NOTE: at the moment, the range of this property is a simple String. We should look into extending this to something more elaborate.	<i>String</i>	0 : *

### 3.1.3.1 *swportal:Developer*

**Extends:** *swportal:Person*

**Direct Subclasses:** none

**Class Documentation:**

This class represents persons that are software developers.

**Slots:**

no additional slots



### 3.1.3.2 *swportal:Researcher*

**Extends:** *swportal:Person*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of persons who are researchers. Each may have research areas, to which they already contributed.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:researchArea</i>	The areas of research some research institute is involved in. NOTE: at the moment, the range of this property is a simple String. We should look into extending this to something more elaborate.	<i>String</i>	1 : *

### 3.1.4 *swportal:Initiative*

**Extends:** *swportal:Agent*

**Direct Subclasses:** *swportal:BusinessInitiative*, *swportal:RnDInitiative*, *swportal:StandardizationInitiative*

**Class Documentation:**

This class represents an initiative. As opposed to an organization, an initiative is rather loosely defined.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:goal</i>	A description of the goal or goals of an initiative or a project as a human-readable text. NOTE: <i>foaf:theme</i> provides a similar functionality.	<i>String</i>	1 : *
<i>foaf:theme</i>	"A theme. The <i>foaf:theme</i> property is rarely used and under-specified. The intention was to use it to characterize interest / themes associated with projects and groups. Further work is needed to meet these goals." NOTE: this property is only listed for comparison with <i>swportal:goal</i> .	<i>String</i>	1 : *
<i>swportal:leader</i>	The director, chairman, etc. of an organization or initiative.	<i>foaf:Person</i>	1 : 1



<b><i>swportal:startdate</i></b>	The starting date of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<b><i>String</i></b>	1 : 1
<b><i>swportal:enddate</i></b>	The ending date of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<b><i>String</i></b>	1 : 1

#### ***3.1.4.1 swportal:BusinessInitiative***

**Extends:** *swportal:Initiative*

**Direct Subclasses:** none

**Class Documentation:**

This class represents an initiative that has a business goal, i.e. is trying to commercialize the results of its activities.

**Slots:**

no additional slots

#### ***3.1.4.2 swportal:RnDInitiative***

**Extends:** *swportal:Initiative*

**Direct Subclasses:** none

**Class Documentation:**

This class represents an initiative that has a research and development goal. I.e. developing something new and selling it afterwards.

**Slots:**

no additional slots

#### ***3.1.4.3 swportal:StandardizationInitiative***

**Extends:** *swportal:Initiative*

**Direct Subclasses:** none

**Class Documentation:**

This class represents an initiative that has as a goal to standardize something, e.g. some modeling language, a protocol or something similar.

**Slots:**

no additional slots



### 3.2 *foaf:Project*

**Extends:** -

**Direct Subclasses:** none

**Class Documentation:**

"A project (a collective endeavour of some kind)." NOTE: this must not be confused with *swportal:Initiative*. Initiatives *have* projects. Projects are *driven by* agents (e.g. initiatives).

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>foaf:name</i>	"The name of some thing." In this case, the name of this project.	<i>String</i>	1 : 1
<i>swportal:drivenBy</i>	The <i>foaf:Agent</i> this project is driven by. This is the inverse to <i>foaf:currentProject</i> . NOTE: How do we deal with the relation between <i>drivenBy</i> and <i>foaf:pastProject</i> ?	<i>foaf:Agent</i>	0 : *
<i>swportal:goal</i>	A description of the goal or goals of an initiative or a project as a human-readable text. NOTE: <i>foaf:theme</i> provides a similar functionality.	<i>String</i>	0 : 1
<i>foaf:theme</i>	"A theme. The <i>foaf:theme</i> property is rarely used and under-specified. The intention was to use it to characterize interest / themes associated with projects and groups. Further work is needed to meet these goals." NOTE: this property is only listed for comparison with <i>swportal:goal</i> .	<i>rdfs:Resource</i>	0 : *
<i>swportal:startdate</i>	The starting date of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<i>String</i>	1 : 1
<i>swportal:enddate</i>	The ending date of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<i>String</i>	1 : 1
<i>swportal:deliverables</i>	The deliverables for this project. The inverse is <i>swportal:forProject</i> .	<i>swportal:deliverable</i>	0 : *



### 3.3 *swportal:Event*

**Extends:** -

**Direct Subclasses:** *swportal:Conference*, *swportal:Presentation*, *swportal:Tutorial*, *swportal:Workshop*

**Class Documentation:**

This class represents events relevant for the area of research and business, i.e. conferences, presentations, tutorials and workshops.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>foaf:name</i>	The name of the conference.	<i>String</i>	1 : 1
<i>swportal:startdate</i>	The starting date and maybe even the starting time of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<i>String</i>	1 : 1
<i>swportal:enddate</i>	The ending date and maybe even the ending time of a project, initiative and the like. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<i>String</i>	1 : 1
<i>swportal:hasLocation</i>	The <i>swportal:Location</i> of an <i>swportal:Event</i> .	<i>swportal:Location</i>	1 : 1
<i>swportal:organizedBy</i>	The organizers of an event. At least one agent has to organize an event. The inverse property is <i>swportal:organizes</i> .	<i>foaf:Agent</i>	1 : *

#### 3.3.1 *swportal:Conference*

**Extends:** *swportal:Event*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of conferences in the area of the Semantic Web or even in the area of Computer Science.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:hasTutorials</i>	The tutorials that are offered at the conference. At least one tutorial has to be given.	<i>swportal:Tutorial</i>	1 : *



<b><i>swportal:hasPresentations</i></b>	The presentations that are offered at the conference. At least one presentation has to be given.	<b><i>swportal:Presentation</i></b>	1 : *
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### 3.3.2 *swportal:Presentation*

**Extends:** *swportal:Event*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of presentations.

**Slots:**

Slot name	Documentation	Type	Cardinality
<b><i>swportal:presenter</i></b>	The presenter of the presentation. At least one presenter has to be inserted into this slot.	<b><i>foaf:Agent</i></b>	1 : *

### 3.3.3 *swportal:Tutorial*

**Extends:** *swportal:Event*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of tutorials.

**Slots:**

Slot name	Documentation	Type	Cardinality
<b><i>swportal:tutoredBy</i></b>	The tutor of a tutorial. There has to be at least one tutor.	<b><i>foaf:Agent</i></b>	1 : *

### 3.3.4 *swportal:Workshop*

**Extends:** *swportal:Event*

**Direct Subclasses:** none

**Class Documentation:**

This class represents all kinds of workshops.

**Slots:**

Slot name	Documentation	Type	Cardinality
<b><i>swportal:hasTutorials</i></b>	The tutorials that are offered at the workshop. At least one tutorial has to be given.	<b><i>swportal:Tutorial</i></b>	1 : *



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<b><i>swportal: hasPresentations</i></b>	The presentations that are offered at the workshop. At least one presentation has to be given.	<b><i>swportal: Presentation</i></b>	1 : *
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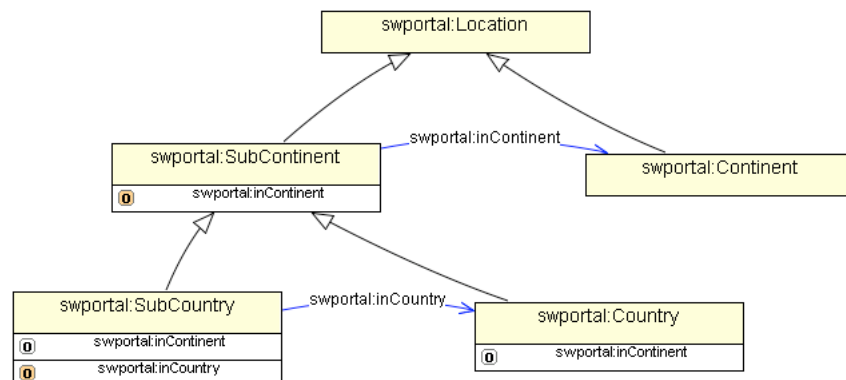
### 3.4 *swportal:Location*

**Extends:** -

**Direct Subclasses:** *swportal:Continent*, *swportal:SubContinent*

**Class Documentation:**

This class is the superclass for all classes defining geographical locations. The approach for this subontology is to have a hierarchy of location classes, such that instances of the classes further down in the hierarchy can be contained in instances of the classes higher up in the hierarchy. On each level, there exist two sister classes: class *L* defines a certain type of location, while class *SubL* defines locations which can be contained in instances of *L*. *SubL* then defines a property *inL*, to express which instance of *L* an instance of *SubL* is contained in. E.g. for a class *Continent*, there exists a class *SubContinent*. All children of *SubContinent* (either direct or transitive) define locations that can be contained in a continent, such as countries, regions, cities, etc. By virtue of inheritance, all these location classes then have a property *inContinent*, to express that they are contained in some continent. In a simpler, flat structure, *inContinent* would have to be defined explicitly for all kinds of locations that can be contained in a continent.



**Figure 2**

The interpretation of the *inL* predicates should be as follows: if, for a particular instance *K*, *inL* has a value, this value is valid. If *inL* has no value, the value of *inL* in the next location *K* is contained in valid, and so forth. E.g. an instance "Hawaii" has the value "Oceania" defined for *swportal:inContinent* and "USA" for *swportal:inCountry*. "Delaware" has no value for *swportal:inContinent*. "USA" has the value "North America" for *swportal:inContinent*. The interpretation would be that "Hawaii" is located in "Oceania", while "Delaware" is located in "North America".

We are aware of the fact that this approach is idealized and can therefore conflict with reality in some situations. E.g., the exact borders of continents are not always





defined (there are contradicting opinions on where exactly Europe begins or ends). Countries could be contained in more than one continent (Turkey belongs to both Europe and Asia). However, we think that these situations are marginal and have little or no impact on the intended use of this ontology.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>foaf:name</i>	A human-readable name.	<i>String</i>	1 : 1

**3.4.1 *swportal:Continent***

**Extends:** *swportal:Location*

**Direct Subclasses:** none

**Class Documentation:**

This class defines geographical bodies that are continents.

**Slots:**

no additional slots

**3.4.2 *swportal:SubContinent***

**Extends:** *swportal:Location*

**Direct Subclasses:** *swportal:Country*, *swportal:SubCountry*

**Class Documentation:**

This class defines geographical bodies that can be contained in continents.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:inContinent</i>	The instance of <i>swportal:Continent</i> in which some <i>swportal:SubContinent</i> is contained in.	<i>swportal:Continent</i>	1 : 1

**3.4.2.1 *swportal:Country***

**Extends:** *swportal:SubContinent*

**Direct Subclasses:** none

**Class Documentation:**

This class defines geographical bodies that are countries.

**Slots:**

no additional slots



### 3.4.2.2 *swportal:SubCountry*

**Extends:** *swportal:SubContinent*

**Direct Subclasses:** *swportal:Region*, *swportal:SubRegion*

**Class Documentation:**

This class defines geographical bodies that can be contained in countries.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:inCountry</i>	The instance of <i>swportal:Country</i> in which some <i>swportal:SubCountry</i> is contained in.	<i>swportal:Country</i>	1 : 1

### 3.4.2.2.1 *swportal:Region*

**Extends:** *swportal:SubCountry*

**Direct Subclasses:** none

**Class Documentation:**

This class defines geographical bodies that are regions, with the intended meaning "sub-division of a country".

**Slots:**

no additional slots

### 3.4.2.2.2 *swportal:SubRegion*

**Extends:** *swportal:SubCountry*

**Direct Subclasses:** *swportal:City*, *swportal:SubCity*

**Class Documentation:**

This class defines geographical bodies that can be contained in continents.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:inRegion</i>	The instance of <i>swportal:Region</i> in which some <i>swportal:SubRegion</i> is contained in.	<i>swportal:Region</i>	1 : 1

### 3.4.2.2.2.1 *swportal:City*

**Extends:** *swportal:SubRegion*

**Direct Subclasses:** none

**Class Documentation:**



This class defines geographical bodies that are cities.

**Slots:**

no additional slots

### 3.4.2.2.2 *swportal:SubCity*

**Extends:** *swportal:SubRegion*

**Direct Subclasses:** *swportal:PostalAddress*

**Class Documentation:**

This class defines geographical bodies that can be contained in cities.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:inCity</i>	The instance of <i>swportal:City</i> in which some <i>swportal:SubCity</i> is contained in.	<i>swportal:City</i>	1 : 1

### 3.4.2.2.2.1 *swportal:PostalAddress*

**Extends:** *swportal:SubCity*

**Direct Subclasses:** none

**Class Documentation:**

Instances of this class represent exact postal addresses. Note that either *swportal:postbox* or *swportal:streetAddress* should be given.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:postbox</i>	The postbox of some address.	<i>String</i>	0 : 1
<i>swportal:streetAddress</i>	The street address of some address. This is simply a string with no prescribed syntax. Could contain, street, house number, building number, room number, etc.	<i>String</i>	0 : 1

### 3.5 *swportal:Publication*

**Extends:** -

**Direct Subclasses:** *foaf:Document*, *swportal:PublicationContainer*

**Class Documentation:**

Publications are both individual documents and collections of documents such as series, journals, etc.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:title</i>	This publication's title, typed as explained in [4].	<i>String</i>	1 : 1
<i>swportal:note</i>	Any additional information that can help the reader.	<i>String</i>	0 : 1
<i>rss:link</i>	If this publication can be accessed in electronic form, the corresponding URL can be using the <i>rss:link</i> property. NOTE: this definition is a slightly extended version of the definition in the RSS 1.0 specification (see [7]).	<i>String</i>	0 : 1
<i>foaf:topic</i>	"A topic of some page or document. The <i>foaf:topic</i> property relates a document to a thing that the document is about. As such it is an inverse to the <i>foaf:page</i> <sup>12</sup> property, which relates a thing to a document about that thing."	<i>rdfs:Resource</i>	0 : *

#### 3.5.1 *foaf:Document*

**Extends:** *swportal:Publication*

**Direct Subclasses:** *swportal:DatedPublication*, *swportal:Inbook*,  
*swportal:Inproceedings*, *swportal:NewsItem*

**Class Documentation:**

Similar to the *Agent* concept, we have again decided to include a concept from the popular FOAF ontology. *foaf:Document* will serve as another root concept within the SWPortal ontology. The FOAF Vocabulary Specification [3] currently defines *Document* in a very loose way: "The foaf:Document class represents those things which are, broadly conceived, 'documents'. ... We do not (currently) distinguish between physical and electronic documents, or between copies of a work and the abstraction those copies embody."

<sup>12</sup> Not mentioned otherwise in this document.



The intended use of this concept within the SWPortal ontology is to subsume everything that contains some sort of information and has been produced by some agent (see 1.1). An instance of Document can either refer to an electronic or physical thing, as long as it is addressable by means of a URI. Examples are a book written, or a picture taken by a person, but also a log file generated by a machine.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:authors</i>	The author or authors of a document. For multiple authors, use either an instance of <i>foaf:Group</i> , or multiple values. This property is similar to <i>foaf:maker</i> , but more specific. The inverse is <i>foaf:publications</i> .	<i>foaf:Agent</i>	1 : *

**3.5.1.1 swportal:DatedPublication**

**Extends:** *foaf:Document*

**Direct Subclasses:** *swportal:Article*, *swportal:Book*, *swportal:Booklet*, *swportal:Misc*, *swportal:Proceedings*, *swportal:Techreport*, *swportal:Thesis*, *swportal:Unpublished*

**Class Documentation:**

The instances of this class comprise all publications which have a specific publication date. If a publication P is contained within an *swportal:PublicationContainer*, and this container has a publication date, then P is not an *swportal:DatedPublication*. Example: an *swportal:Inbook* publication is not an *swportal:DatedPublication* because its publication date can be inferred from the *swportal:Book* which contains it.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:publicationDate</i>	Bibtex defines <i>year</i> and <i>month</i> . These are here combined to <i>publicationDate</i> .	<i>String</i>	1 : 1

**3.5.1.1.1 swportal:Article**

**Extends:** *swportal:DatedPublication*

**Direct Subclasses:** none

**Class Documentation:**

An article from a journal or magazine.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:inJournal</i>	The journal or magazine which contains this article.	<i>swportal:Journal</i>	1 : 1
<i>swportal:pages</i>	One or more page numbers or range of numbers, such as 42--111 or 7,41,73--97 or 43+ (the '+' in this last example indicates pages following that don't form a simple range). To make it easier to maintain Scribe-compatible databases, the standard styles convert a single dash (as in 7-33) to the double dash used in TeX to denote number ranges (as in 7--33).	<i>String</i>	1 : 1
<i>swportal:number</i>	The number of a journal, magazine, techreport, or of a work in a series. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number; and sometimes books are given numbers in a numbered series. Deliverables for a project may also be given numbers.	<i>Int</i>	1 : 1
<i>swportal:volume</i>	The volume of a journal or a multi-volume book.	<i>Int</i>	1 : 1

#### 3.5.1.1.2 *swportal:Book*

Extends: *swportal:DatedPublication*, *swportal:PublicationContainer*

Direct Subclasses: none

#### Class Documentation:

A book with an explicit publisher. NOTES: - Either Author or Editor must be given - Either volume or number may be given.



**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:edition</i>	The edition of a book---for example, ``Second". This should be an ordinal, and should have the first letter capitalized, as shown here; the standard styles convert to lower case when necessary.	<i>String</i>	1 : 1
<i>swportal:publishedby</i>	The instance of <i>swportal:Publisher</i> which published this document.	<i>swportal:Publisher</i>	0 : 1
<i>swportal:inSeries</i>	The instance of <i>swportal:Series</i> in which this document was published.	<i>swportal:Series</i>	0 : 1
<i>swportal:number</i>	The number of a journal, magazine, techreport, or of a work in a series. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number; and sometimes books are given numbers in a numbered series. Deliverables for a project may also be given numbers.	<i>Int</i>	0 : 1
<i>swportal:volume</i>	The volume of a journal or a multi-volume book.	<i>Int</i>	0 : 1

**3.5.1.1.3 swportal:Booklet****Extends:** *swportal:DatedPublication***Direct Subclasses:** none**Class Documentation:**

A work that is printed and bound, but without a named publisher or sponsoring institution.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:howPublished</i>	How something strange has been published.	<i>String</i>	1 : 1



#### 3.5.1.1.4 *swportal:Misc*

Extends: *swportal:DatedPublication*

Direct Subclasses: none

#### Class Documentation:

Some sort of publication which doesn't fit into any of the other concepts.

#### Slots:

Slot name	Documentation	Type	Cardinality
<i>swportal:howPublished</i>	How something strange has been published.	<i>String</i>	1 : 1

#### 3.5.1.1.5 *swportal:Proceedings*

Extends: *swportal:DatedPublication*, *swportal:PublicationContainer*

Direct Subclasses: none

#### Class Documentation:

The proceedings of a conference.

#### Slots:

Slot name	Documentation	Type	Cardinality
<i>swportal:publishedby</i>	The instance of <i>swportal:Publisher</i> which published this document.	<i>swportal:Publisher</i>	1 : 1
<i>swportal:inSeries</i>	The instance of <i>swportal:Series</i> in which this document was published.	<i>swportal:Series</i>	0 : 1
<i>swportal:number</i>	The number of a journal, magazine, techreport, or of a work in a series. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number; and sometimes books are given numbers in a numbered series. Deliverables for a project may also be given numbers.	<i>Int</i>	0 : 1
<i>swportal:volume</i>	The volume of a journal or a multi-volume book.	<i>Int</i>	0 : 1
<i>swportal:fromOrganization</i>	The organization that sponsors a conference or that publishes a manual or techreport.	<i>foaf:Organization</i>	0 : 1



**3.5.1.1.6 *swportal:Techreport*****Extends:** *swportal:DatedPublication***Direct Subclasses:** none**Class Documentation:**

A report published by a school or other organization, usually numbered within a series (*swportal:Series*). This concept has been merged from BibTex's *techreport* and *manual* types, since both are described very similar.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:number</i>	The number of a journal, magazine, techreport, or of a work in a series. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number; and sometimes books are given numbers in a numbered series. Deliverables for a project may also be given numbers.	<i>Int</i>	0 : 1
<i>swportal:fromOrganization</i>	The organization that sponsors a conference or that publishes a manual or techreport.	<i>foaf:Organization</i>	1 : 1

**3.5.1.1.7 *swportal:Thesis*****Extends:** *swportal:DatedPublication***Direct Subclasses:** *swportal:MasterThesis*, *swportal:PhDThesis***Class Documentation:**

Any kind of thesis produced to receive some sort of university degree.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:atSchool</i>	The school where a thesis was written.	<i>swportal:University</i>	1 : 1

**3.5.1.1.7.1 *swportal:MasterThesis*****Extends:** *swportal:Thesis***Direct Subclasses:** none**Class Documentation:**

A thesis written to receive a Master degree.

**Slots:**

no additional slots

**3.5.1.1.7.2 *swportal:PhDThesis***

**Extends:** *swportal:Thesis*

**Direct Subclasses:** none

**Class Documentation:**

A thesis written to receive a PhD degree.

**Slots:**

no additional slots

**3.5.1.1.8 *swportal:Unpublished***

**Extends:** *swportal:DatedPublication*

**Direct Subclasses:** *swportal:Deliverable*

**Class Documentation:**

A document which does have an author and title, but hasn't been formally published.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:version</i>	The version number of a document which is still under development.	<i>String</i>	1 : 1

**3.5.1.1.8.1 *swportal:Deliverable***

**Extends:** *swportal:Unpublished*

**Direct Subclasses:** none

**Class Documentation:**

A document which is produced as part of a project. Deliverables are not formally published. NOTE: This concept was not derived from any of the BibTex types, but considered useful anyway.

## Slots:

Slot name	Documentation	Type	Cardinality
<i>swportal:forProject</i>	The project for which this deliverable is produced. The inverse is <i>swportal:deliverables</i> .	<i>foaf:Project</i>	1 : 1
<i>swportal:Number</i>	The number of a journal, magazine, techreport, or of a work in a series. An issue of a journal or magazine is usually identified by its volume and number; the organization that issues a technical report usually gives it a number; and sometimes books are given numbers in a numbered series. Deliverables for a project may also be given numbers.	<i>Int</i>	1 : 1

3.5.1.2 *swportal:Inbook*

Extends: *foaf:Document*

Direct Subclasses: none

## Class Documentation:

A part of an *swportal:Book*, which may be a chapter (or section or whatever) and/or a range of pages. Because the BibTeX types *inCollection* and *inBook* are very similar, we decided to keep the ontology as simple as possible and merge them both into *swportal:Inbook*. NOTE: Either *pages* or *chapter* must be given.

## Slots:

Slot name	Documentation	Type	Cardinality
<i>swportal:containedInBook</i>	The <i>swportal:Book</i> in which an <i>swportal:Inbook</i> is contained.	<i>swportal:Book</i>	1 : 1
<i>swportal:pages</i>	One or more page numbers or range of numbers, such as 42--111 or 7,41,73--97 or 43+ (the '+' in this last example indicates pages following that don't form a simple range). To make it easier to maintain Scribe-compatible databases, the standard styles convert a single dash (as in 7-33) to the double dash used in TeX to denote number ranges (as in 7--33).	<i>String</i>	0 : 1
<i>swportal:chapter</i>	A chapter (or section or whatever) number.	<i>Int</i>	0 : 1

### 3.5.1.3 *swportal:Inproceedings*

**Extends:** *foaf:Document*

**Direct Subclasses:** none

**Class Documentation:**

An article in a conference proceedings (i.e. *swportal:Proceedings*).

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:pages</i>	One or more page numbers or range of numbers, such as 42--111 or 7,41,73--97 or 43+ (the '+' in this last example indicates pages following that don't form a simple range). To make it easier to maintain Scribe-compatible databases, the standard styles convert a single dash (as in 7-33) to the double dash used in TeX to denote number ranges (as in 7--33).	<i>String</i>	1 : 1

### 3.5.1.4 *swportal:NewsItem*

**Extends:** *foaf:Document*

**Direct Subclasses:** *rss:item*<sup>13</sup>

**Class Documentation:**

This class is the super-class for any kind of news item.

**Slots:**

no additional slots

#### 3.5.1.4.1 *rss:item*

**Extends:** *swportal:NewsItem*

**Direct Subclasses:** none

**Class Documentation:**

This class is taken directly from the RSS 1.0 Specification [7]. An instance of this class describes a piece of news or any other kind of information, usually by giving its title and some sort of textual description (a summary, an excerpt, etc.). According to the specification, it "can be just about anything: discussion posting, job listing, software patch -- any object with a URI". The only required attribute is *rdf:about*, so that the item can be referenced (e.g. by an *rss:channel*).

<sup>13</sup> *rss:item* is currently the only sub-class of *swportal:NewsItem*. More could be added, to support other RSS-dialects or other news syndication formats.



NOTE: The *rss:link* property has been moved to *swportal:Publication*. For instances of this class, it should be required.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>rss:title</i>	A human readable title for this item.	<i>String</i>	1 : 1
<i>rss:description</i>	A human readable description for this item, usually something a bit more explanatory than just its title.	<i>rdf:Resource</i>	0 : 1

### 3.5.2 *swportal:PublicationContainer*

Extends: *swportal:Publication*

Direct Subclasses: *swportal:Book*, *swportal:Journal*, *swportal:Proceedings*, *swportal:Series*

**Class Documentation:**

This class comprises all kinds of publications which contain other publications, such as journal, proceedings, series, etc. An instance of *swportal:PublicationContainer* has an editor.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:editedBy</i>	The instance of <i>foaf:Agent</i> which publishes a publication.	<i>foaf:Agent</i>	1 : 1

#### 3.5.2.1 *rss:channel*

Extends: *swportal:PublicationContainer*

Direct Subclasses: none

**Class Documentation:**

"An RSS information channel."

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>rss:items</i>	"Points to a list of <i>rss:item</i> elements that are members of the subject channel."	<i>rdf:Seq</i>	1 : 1

#### 3.5.2.2 *swportal:Book*

see 3.5.1.1.2.

#### 3.5.2.3 *swportal:Journal*

Extends: *swportal:PublicationContainer*

Direct Subclasses: none



**Class Documentation:**

A scientific journal or magazine. The instances of this class are not individual issues or volumes of a journal, but the journal as such.

**Slots:**

no additional slots

**3.5.2.4 *swportal:Proceedings***

see 3.5.1.1.5.

**3.5.2.5 *swportal:Series***

**Extends:** *swportal:PublicationContainer*

**Direct Subclasses:** none

**Class Documentation:**

A series or set of books.

**Slots:**

no additional slots

### 3.6 *swportal:Tool*

**Extends:** -

**Direct Subclasses:** none

**Class Documentation:**

This class represents any kind of software tool. At the moment, this class is clearly underspecified.

**Slots:**

Slot name	Documentation	Type	Cardinality
<i>swportal:version</i>	The version number of a software tool which is still under development.	<i>Float</i>	1 : 1
<i>foaf:name</i>	The name of the software tool	<i>String</i>	1 : 1
<i>swportal:publishdate</i>	The date on which the tool was published. If the tool is too old, then it may not support a new technology which is may be needed for a project. NOTE: at the moment, the range of this property is a simple String. We should import a time ontology to specify the date more accurately.	<i>String</i>	1 : 1
<i>swportal:toolDescription</i>	The description of the capabilities and features of the tool.	<i>String</i>	0 : 1

## 4 Future Work

For future versions of this ontology, a number of issues should be addressed:

- An appropriate and sufficient time sub-ontology should be integrated or designed.
- The question of cardinality restrictions should be discussed in more detail.
- Some of the main concepts are currently underspecified and should be re-designed more elaborately (*swportal:Tool* and *foaf:Project*).



## 5 References

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