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Ontology Engineering

Seminar 2010 / 2011
Dec 10, 2010

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Administrative issues

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- The course is structured in 3 blocks.
  - Di 12.10.2010 14.00 - 16.00 3W03
  - **Fr 10.12.2010 08.00 - 18.00 3W03**
  - Fr 28.01.2011 08.00 - 18.00 3W03
- First session: experiment, topic assignment.
- **Second session: presentation of theoretical topics, submission of short papers, ontology project assignment.**
- Third session: ontology project assignment final presentations (teams).
- **Send slides of the 2nd session to carmen.brenner@sti2.at providing title, your name(s) and PDF**

Assignment: Linked Open Innsbruck

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- Make Innsbruck and relevant data a part of the LOD cloud
- Imagine various services on top of that data, such as events close to a certain location combined with transportation information or restaurants recommended by friends etc.
- Choose one area and build the vocabulary for this.
- However: keep the data in mind! Think about possible data sources that are already available.
- Develop at least one usage scenario for your ontology.

Assignment: Linked Open Innsbruck

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- Build a team of 4
- Choose topic + send me an email with group members + topic (first come, first serve)
- Download + install Protégé OWL (4.x?) (alternatively you can set up collaborative Protégé) (http://protégé.stanford.edu)
- Build ontology collaboratively
- Document well!
- Competency questions! (ALSO for evaluation)
- Instances!
- Visualize!
- Presentation incl. ontology project, online version of ontology
  - Explain your choice of tool
  - Visualize ontology (MEANINGFUL!)
  - Explain at least 1 usage scenario
  - Explain which data sources could be used for creating this part of the data set

Mandatory reading

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- Read about Ontology 101, Stanford University (Google)
- Christian Bizer, Tom Heath and Tim Berners-Lee. Linked Data - The Story So Far. International Journal on Semantic Web and Information Systems, Special Issue on Linked Data.

Topics: „Linked Open Innsbruck“

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- Building vocabularies to present Innsbruck in the LOD cloud
  - Accommodation
  - Transport
  - Gastronomy
  - Sight seeing
  - Outdoor activities
  - Other?

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How to build an ontology

Natalya F. Noy and Deborah L. McGuinness. ``Ontology Development 101: A Guide to Creating Your First Ontology''. Stanford Knowledge Systems Laboratory Technical Report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880, March 2001.

Step 1: Determine the domain and scope of the ontology

- What is the domain that the ontology will cover?
- For what we are going to use the ontology?
- For what types of questions the information in the ontology should provide answers?
- Who will use and maintain the ontology?

Competency Questions

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- A set of queries which place demands on the underlying ontology.
- Ontology must be able to represent the questions using its terminology and the answers based on the axioms
- Ideally, in a staged manner, where consequent questions require the input from the preceeding ones.
- A rationale for each competency question should be given.

Step 2: Consider reusing existing ontologies

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- Reuse ensures interoperability and reduces costs
- VOCAMP initiative

- Ontology libraries and tools for customization are required for this step

- Sub-steps
  - Discover potential reuse candidates
  - Evaluate their usability
  - Customize ontologies to be reused
  - Integrate and merge to the target ontology

- Dr. Watson (Open University, Knowledge Media Institute)
- SWOOGLE

Step 3: Enumerate important terms in the ontology

- What are the terms we would like to talk about?
- What properties do those terms have?
- What would we like to say about those terms?

Step 4: Define classes and class hierarchy

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- A top-down development process starts with the definition of the most general concepts in the domain and subsequent specialization of the concepts.
- A bottom-up development process starts with the definition of the most specific classes, the leaves of the hierarchy, with subsequent grouping of these classes into more general concepts.
- Middle-out approach: define the more salient concepts first and then generalize and specialize them appropriately.

Step 4: Define classes and class hierarchy (ii)

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- From the list created in Step 3, select the terms that describe objects having independent existence rather than terms that describe these objects.
  - These terms will be classes in the ontology.
- Organize the classes into a hierarchical taxonomy by asking if by being an instance of one class, the object will necessarily (i.e., by definition) be an instance of some other class.
  - *If a class A is a superclass of class B, then every instance of B is also an instance of A.*
- Classes as unary predicates—questions that have one argument. For example, "Is this object a wine?"
  - Later: binary predicates (or slots)—questions that have two arguments. For example, "Is the flavor of this object strong?" "What is the flavor of this object?"

- Concepts (classes)
- Datatype properties (string, int etc.)
  - Domain and range
  - Person hasBirthdate int
- Object properties (2 classes)
  - Person isMarried Person
- Instances
- Cardinality
- Templates

How to find classes

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- Interview: talk to subject matter experts.
- Documentation: read what experts have written about the subject matter, read the requirements documentation, read proposals and invitations to tender.
- Observation and reflection.

- Typical candidates for classes: NOUNS.
  - But: actors of use cases do not necessarily correspond to classes.

- Other terms as well
  - Verbs: an association which starts to take on attributes and associations of its own turns into an entity: „Officer arrests suspect“.
  - Verbs: events: „Illness episode“.
  - Passive form: re-formulate in active form.

Class hierarchy

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- A subclass of a class represents a concept that is a “kind of” the concept that the superclass represents.
- Classes represent concepts in the domain and not the words that denote these concepts. Synonyms for the same concept do not represent different classes.
- All the siblings in the hierarchy (except for the ones at the root) must be at the same level of generality.
- If a class has only one direct subclass there may be a modeling problem or the ontology is not complete.
- If there are more than a dozen subclasses for a given class then additional intermediate categories may be necessary.
- Subclasses of a class usually (1) have additional properties that the superclass does not have, or (2) restrictions different from those of the superclass, or (3) participate in different relationships than the superclasses.

Examples

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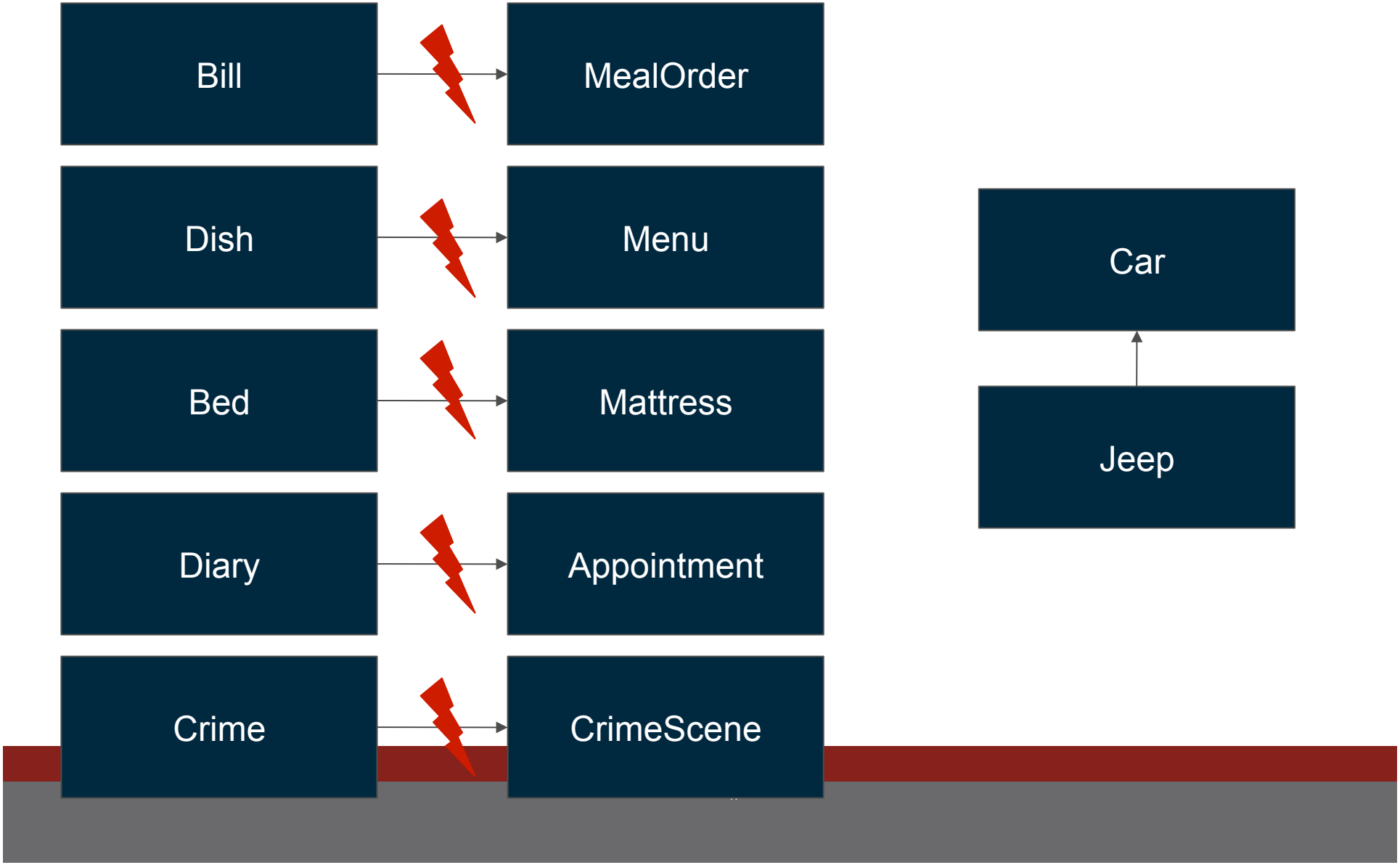

Step 5: Define attributes and relationships

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- Step 4 selected classes from the list of terms we created in Step 3.
  - Most of the remaining terms are likely to be properties of these classes.
  - For each property in the list, we must determine which class it describes.
- Types of properties
  - Attributes (Data properties, OWL)
  - Relationships (Object properties, OWL)
- Properties are inherited and should be attached to the most general class in the hierarchy.

Characterizing classes

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- Two types of principal characteristics:
  - Measurable properties: attributes.
  - Inter-class connections: relationships.

  - Color of an image as attribute vs. class.

How to find attributes

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- Interview: talk to subject matter experts.
- Documentation: read what experts have written about the subject matter, read the requirements documentation, read proposals and invitations to tender.
- Observation and reflection.

- Nouns in „-ness“
  - Velocity-ness, job-ness, arrested-ness…

- „How much, how many“ test.
  - If you evaluate this, then it is probably an attribute.
  - If you enumerate these, it is probably an entity.

Relationships

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- Are defined on sets of instances.
- Properties: reflexivity, cardinality, many-to-many, all values from, some values of, transitivity, symmetry etc.
- Arity.

How to find relationships

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- Interview: talk to subject matter experts.
- Documentation: read what experts have written about the subject matter, read the requirements documentation, read proposals and invitations to tender.
- Observation and reflection.

- Verbs, verbal phrases and things that could have been verbs.
  - „*The buttler murdered the duchess*“

Step 6: Define the restrictions of the properties

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- Refine the semantics of the properties
  - Cardinality
  - Domain and range
    - When defining a domain or a range for a slot, find the most general classes or class that can be respectively the domain or the range for the slots .
    - Do not define a domain and range that is overly general
- Example
  - Class Dog
  - Attribute Age
  - Relationship hasOwner
  - Dog hasAge Integer
  - Dog hasOwner Person
  - Domain: Dog in both cases
  - Range: XML data type: integer; Class Person

Step 7: Create instances

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- Define an individual instance of a class requires
  - choose a class
  - create an individual instance of that class
  - filling in the values of the properties

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Protege and Collaborative Protege

Overview*

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- Protege is a free, open-source platform to construct domain models and knowledge-based applications with ontologies.
- Go to http://protege.stanford.edu/doc/owl/getting-started.html to download Protege (version 4.x)

* Based on the Protege OWL Tutorial on the Protege website

Features

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- Protege supports the following ways of OE:
  - Frame-based
  - OWL
- Protege Frames editor: enables users to build and populate ontologies that are frame-based, in accordance with OKBC (Open Knowledge Base Connectivity Protocol).
  - Classes
  - Slots for properties and relationships
  - Instances for class
- Protege OWL editor:
  - Classes
  - Properties
  - Instances
  - Axioms

Interface

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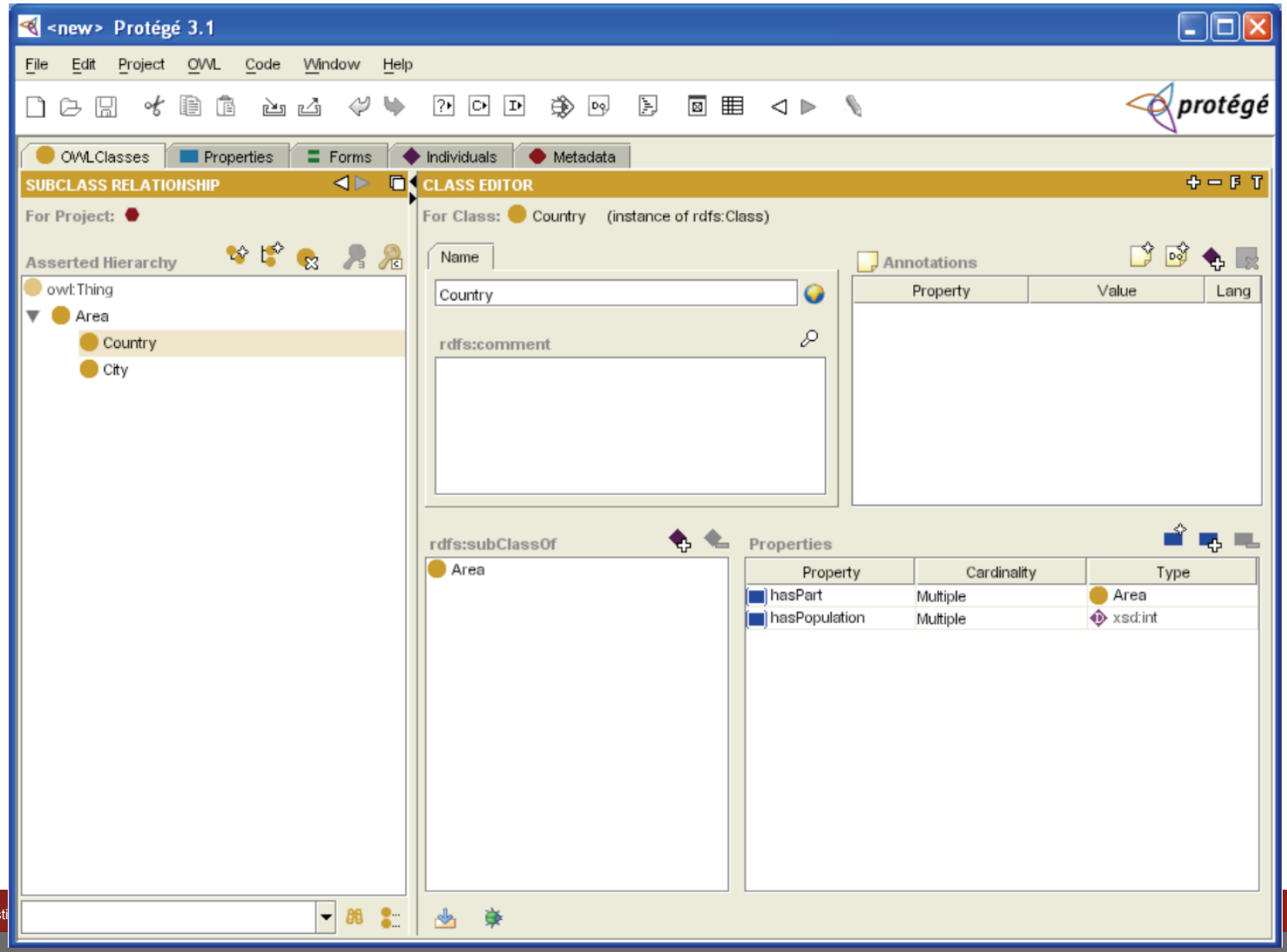

Properties tab

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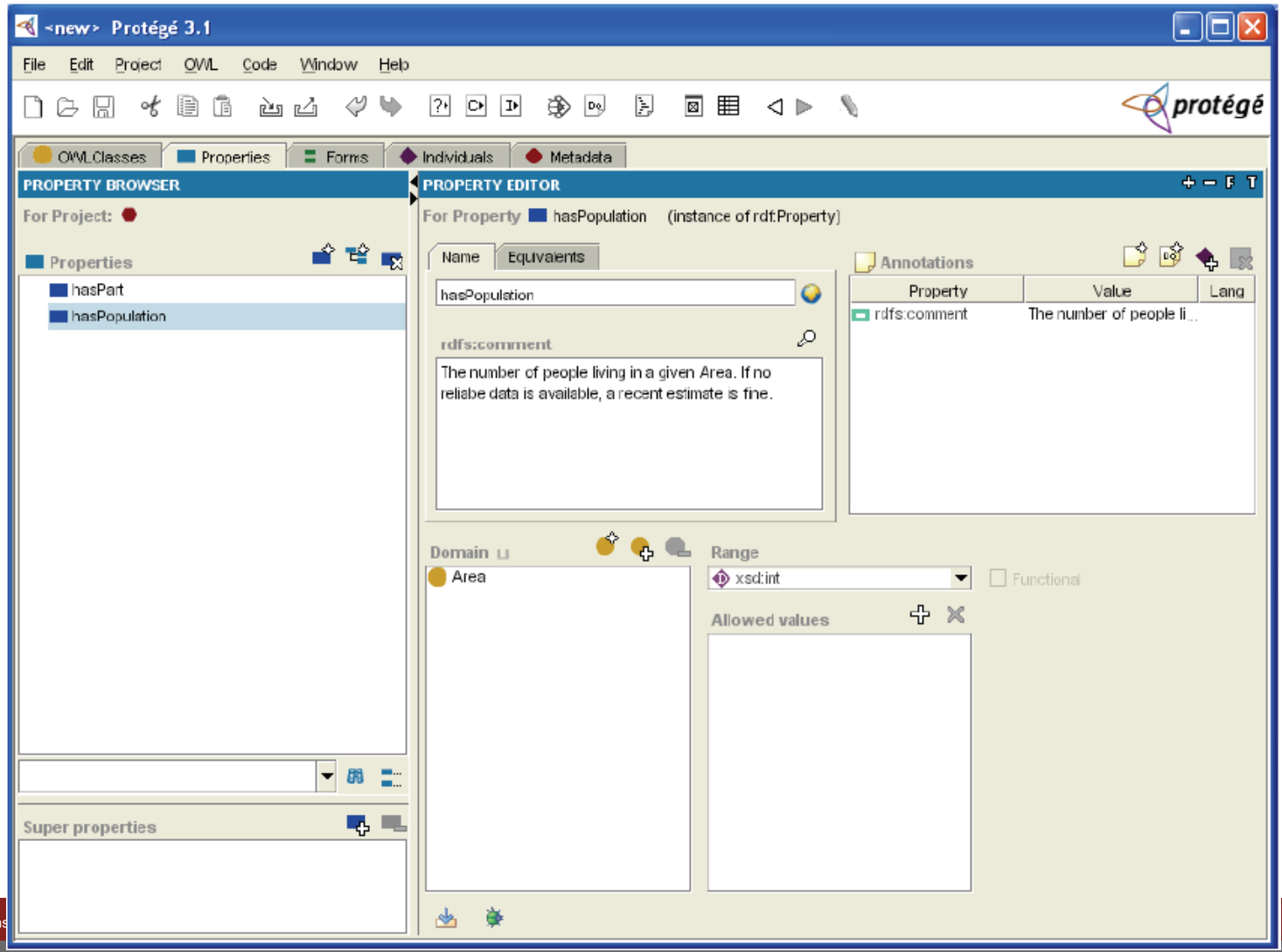

Properties

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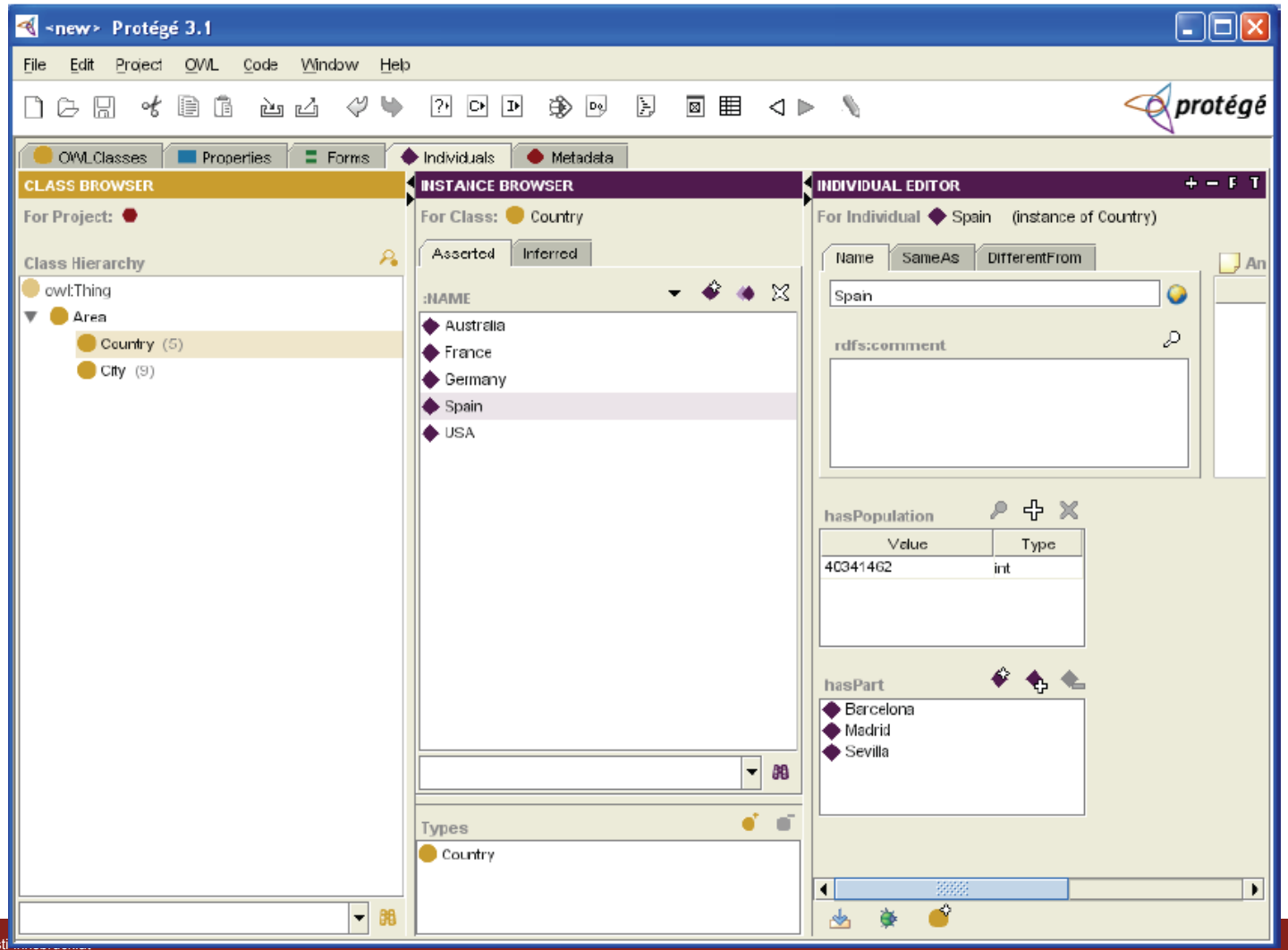
- Object properties
  - Domain: Class
  - Range: Class
  - E.g.: Dog hasOwner Person
- Datatype properties
  - Domain: Class
  - Range: Datatype
  - E.g. Dog hasBirthyear integer
- Property hierarchies

Individuals tab



Forms tab

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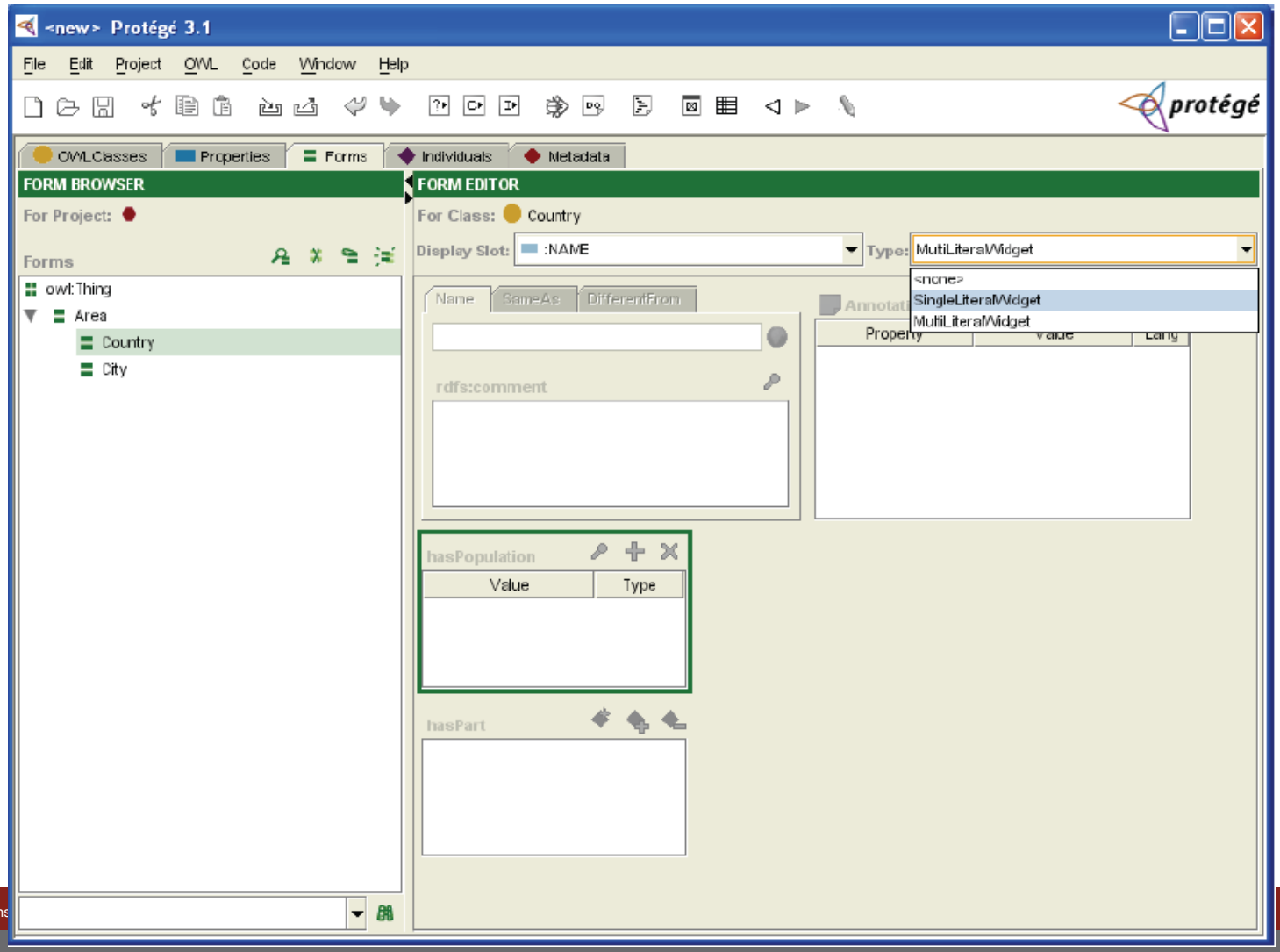

Importing ontologies

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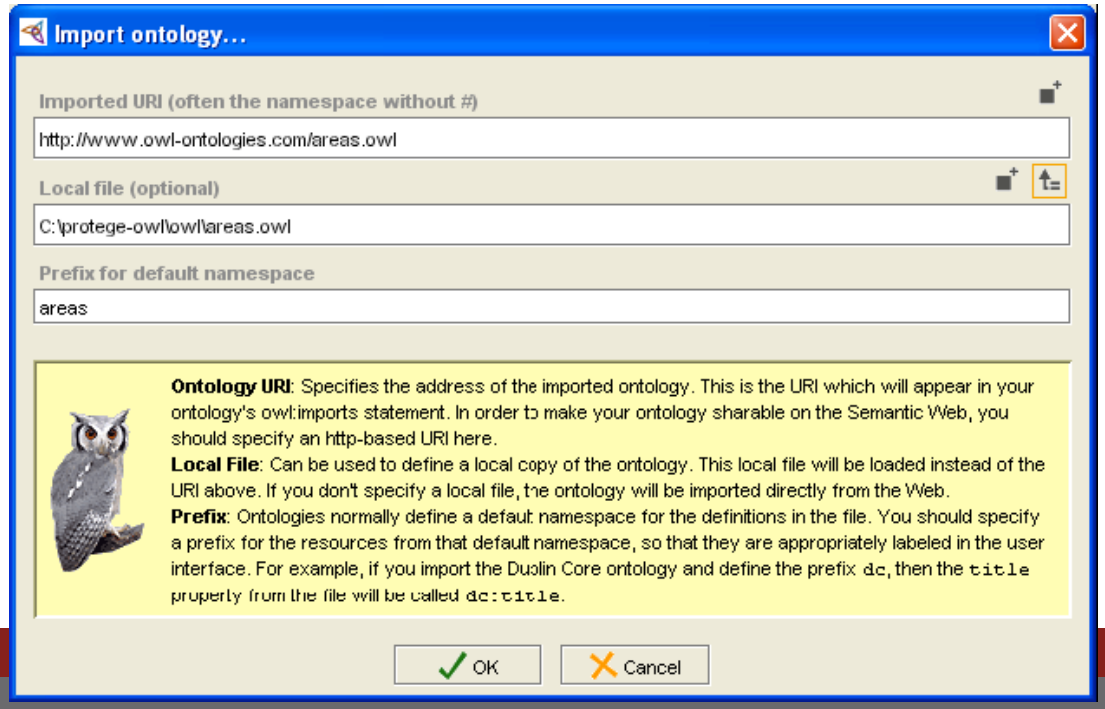
- Re-use of ontologies
- Local or on the Web



Collaborative Protege

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- Extension of Protege
- Supports:
  - Annotating ontology components and changes in the ontology
  - Dicussion threads (live chat)
  - Proposal and voting
  - Searching and filtering
  - Defining users, groups, policies
- Works with Protege OWL and Frames
- http://protege.stanford.edu/doc/collab-protege/

Collaborative Protege

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