DBIS
database & information systems group
ionian university

Linked Data and Semantic Web Ontologies (Εισαγωγή)

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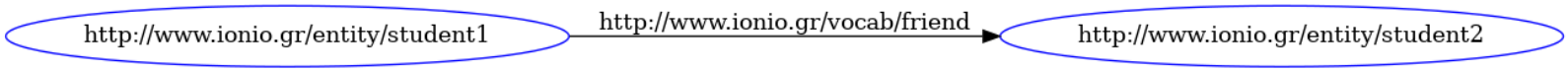
Τμήμα Αρχειονομίας, Βιβλιοθηκονομίας και Μουσειολογίας
Ιόνιο Πανεπιστήμιο

RDF Dataset (1/2)

<http://www.ionio.gr/entity/student1> <http://www.ionio.gr/vocab/friend> <http://www.ionio.gr/entity/student2> .



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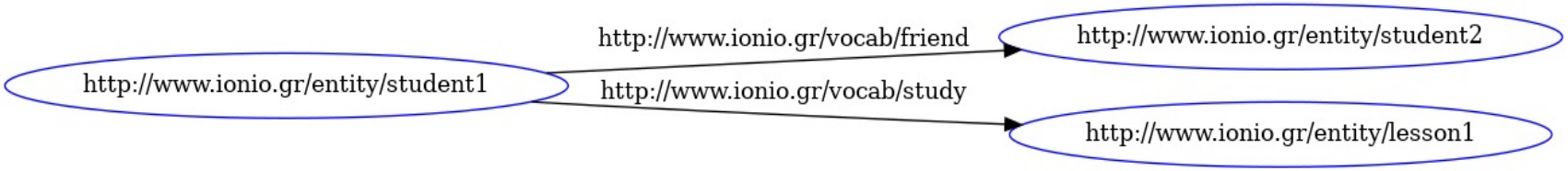

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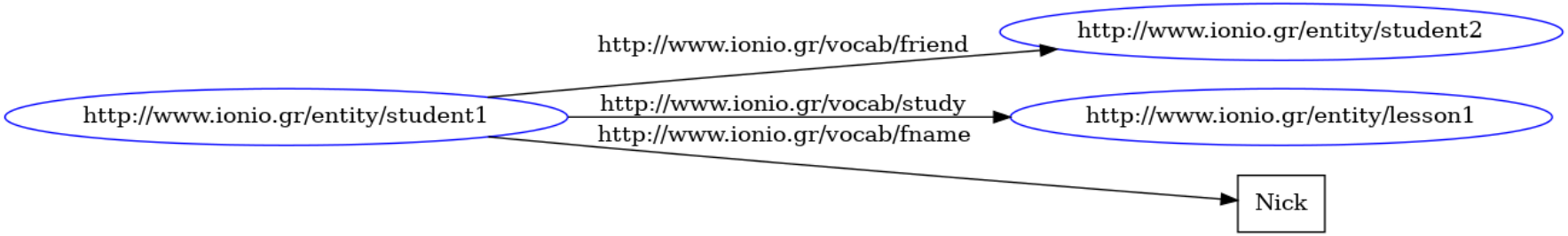
<http://www.ionio.gr/entity/student1> <http://www.ionio.gr/vocab/fname> "Nick" .



RDF Dataset (2/3)

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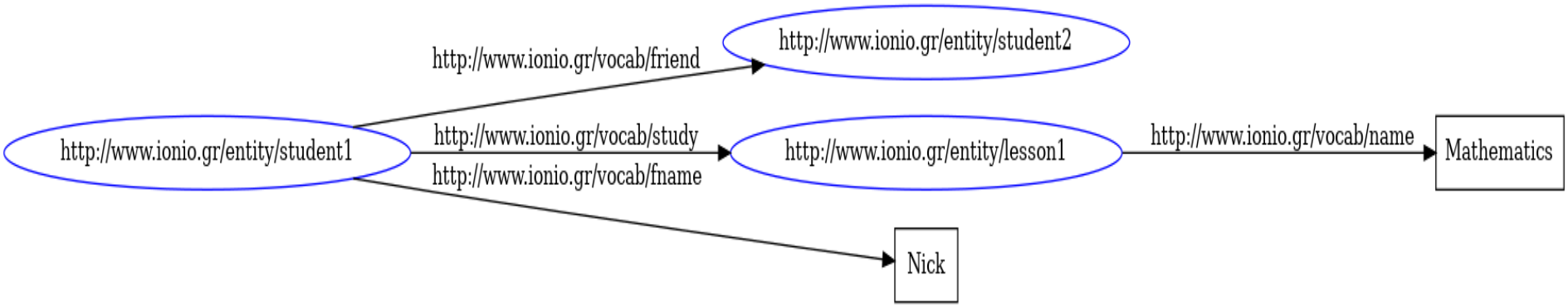
<http://www.ionio.gr/entity/student1> <http://www.ionio.gr/vocab/fname> "Nick" .

<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/name> "Mathematics" .



RDF Dataset (3/3)

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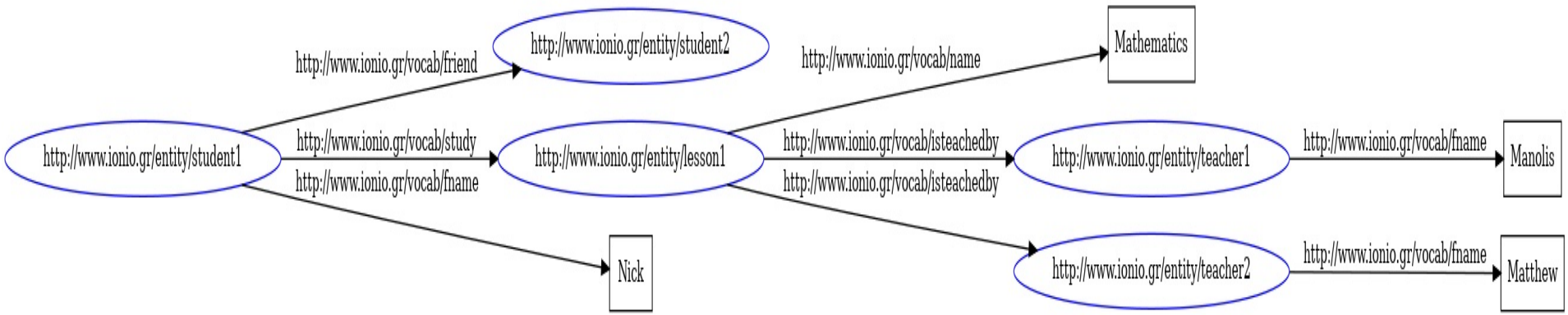
<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/isTeachedby> <http://www.ionio.gr/entity/teacher2> .

<http://www.ionio.gr/entity/teacher1> <http://www.ionio.gr/vocab/fname> "Manolis" .

<http://www.ionio.gr/entity/teacher2> <http://www.ionio.gr/vocab/fname> "Matthew" .



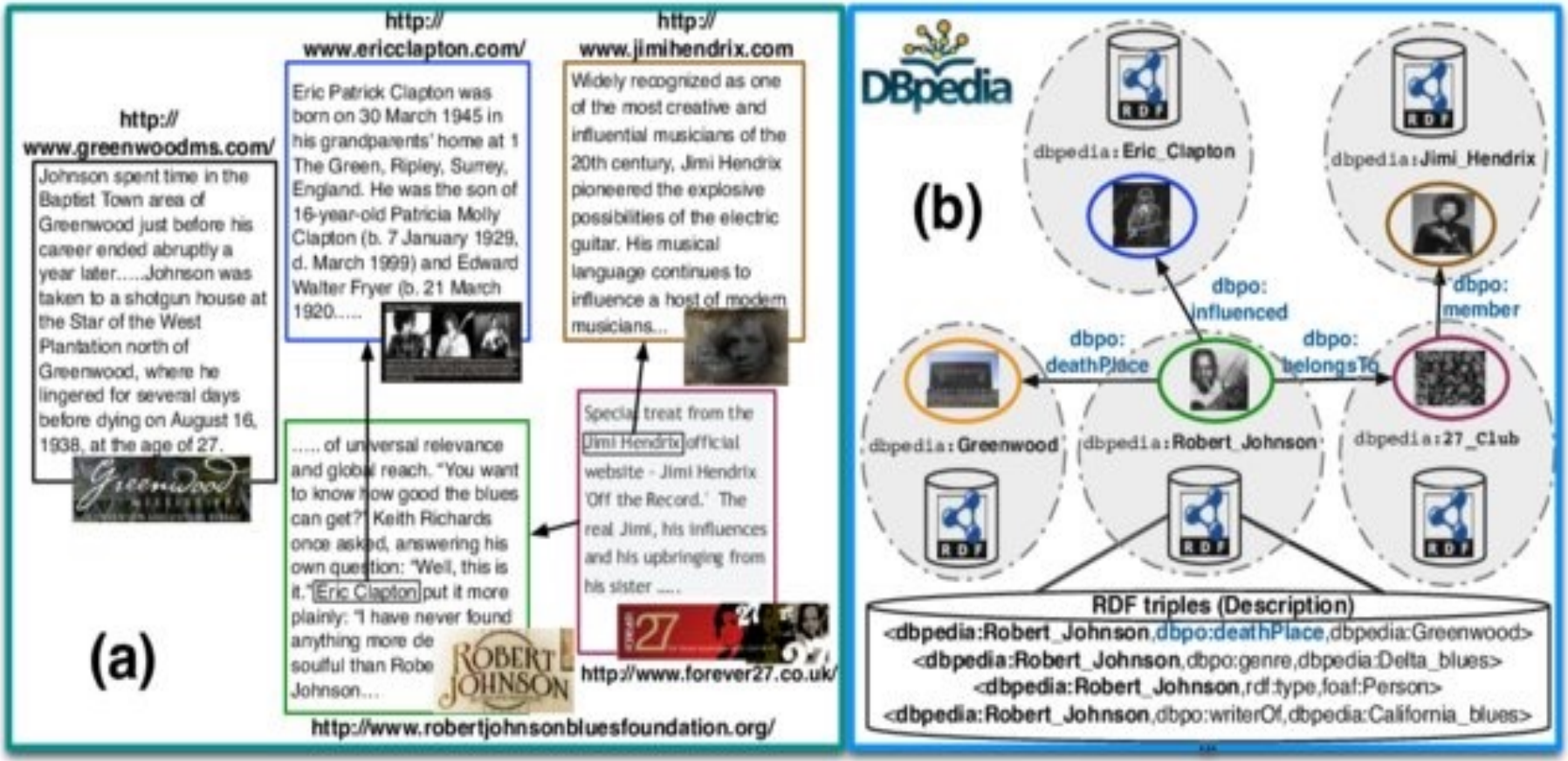
Linked Data

The term Linked Data refers to a set of best practices for publishing structured data on the Web.

The four design principles of Linked Data (by Tim Berners Lee):

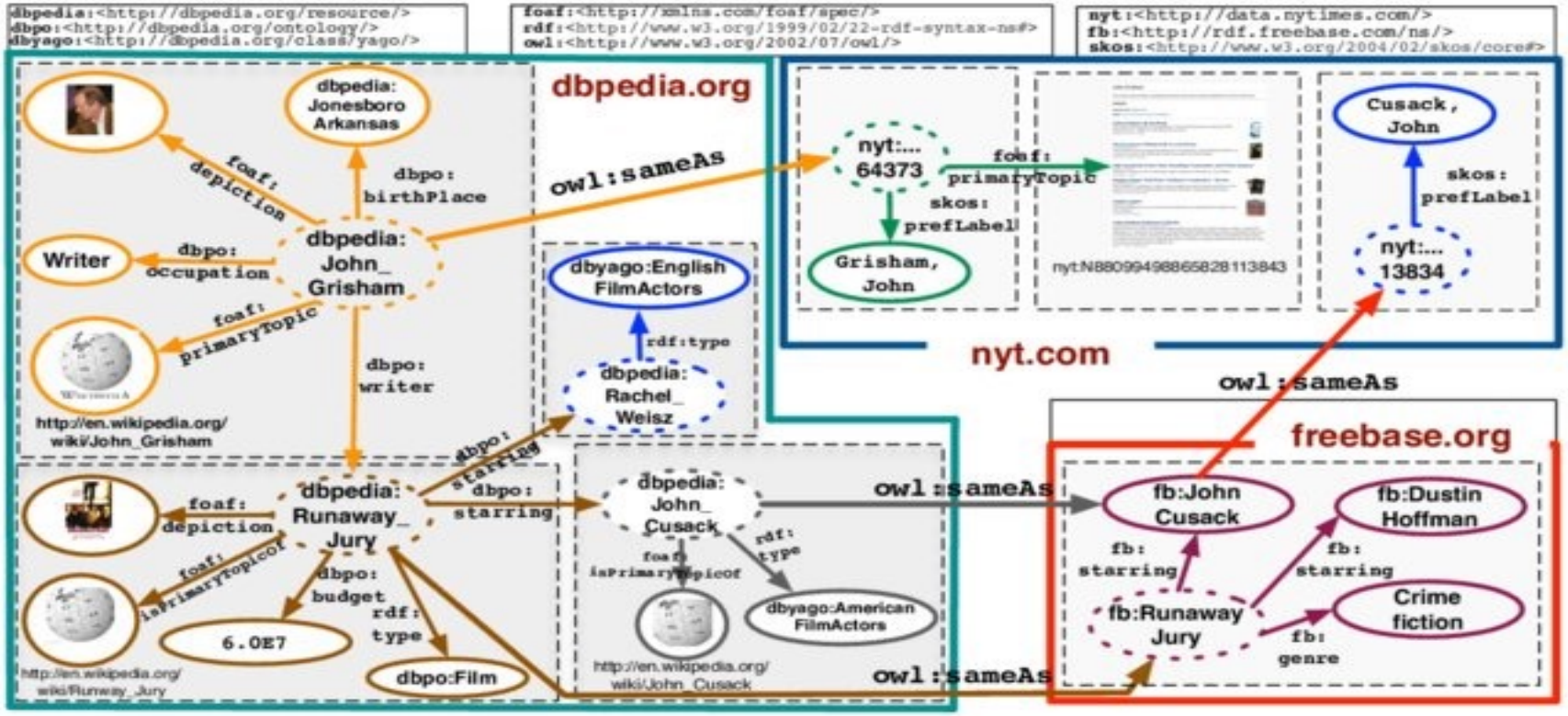
1. Use Uniform Resource Identifiers (URIs) as names for things.
2. Use HTTP URIs so that people can look up those names.
3. When someone looks up a URI, provide useful information, using the standards (RDF*, SPARQL).
4. Include links to other URIs so that they can discover more things.

Web of Documents to Web of Data (1/2)



Source of Image: NautiLOD: A Formal Language for the Web of Data Graph

Web of Documents to Web of Data (2/2)



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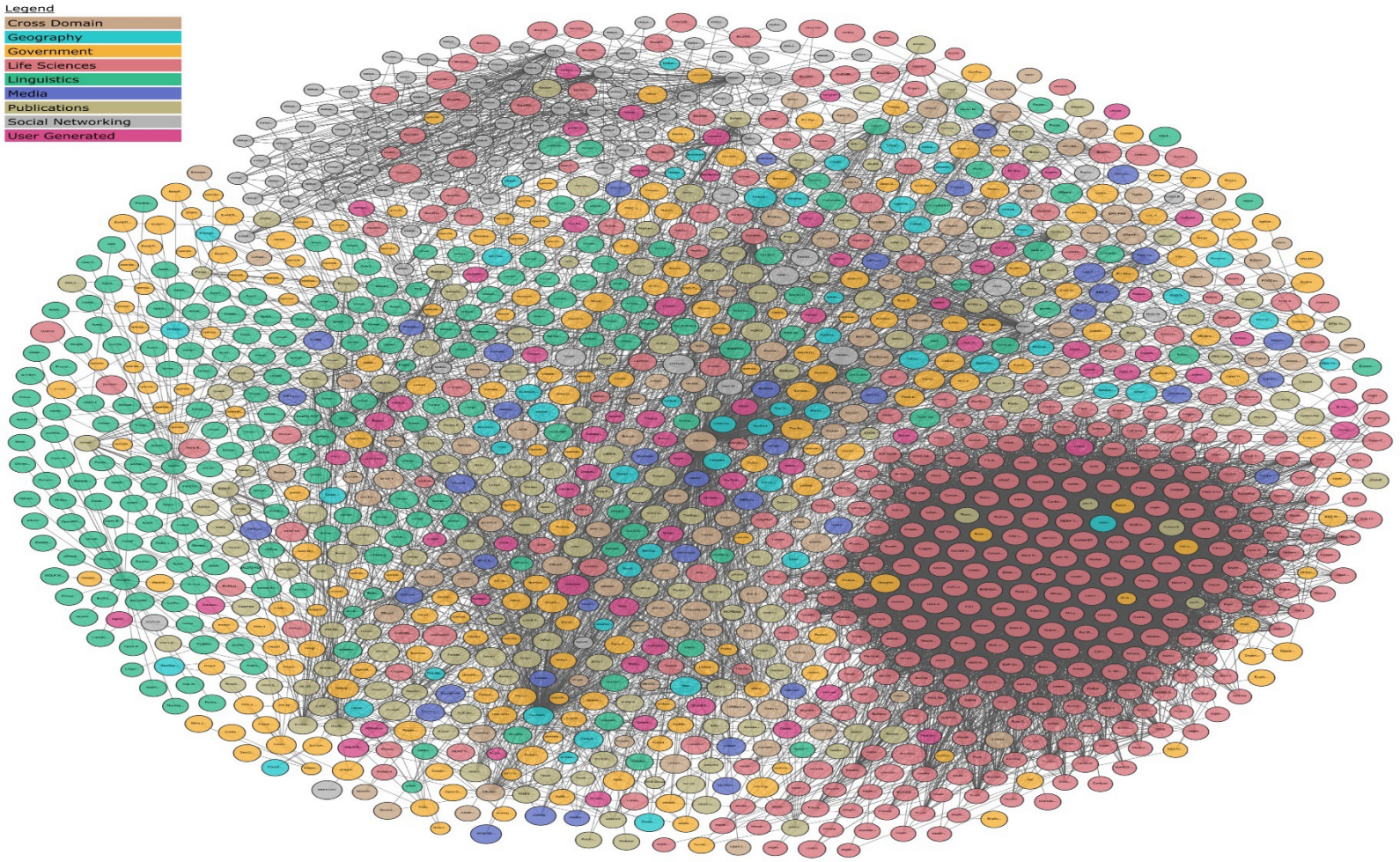
Linked Open Data Cloud (1/2)

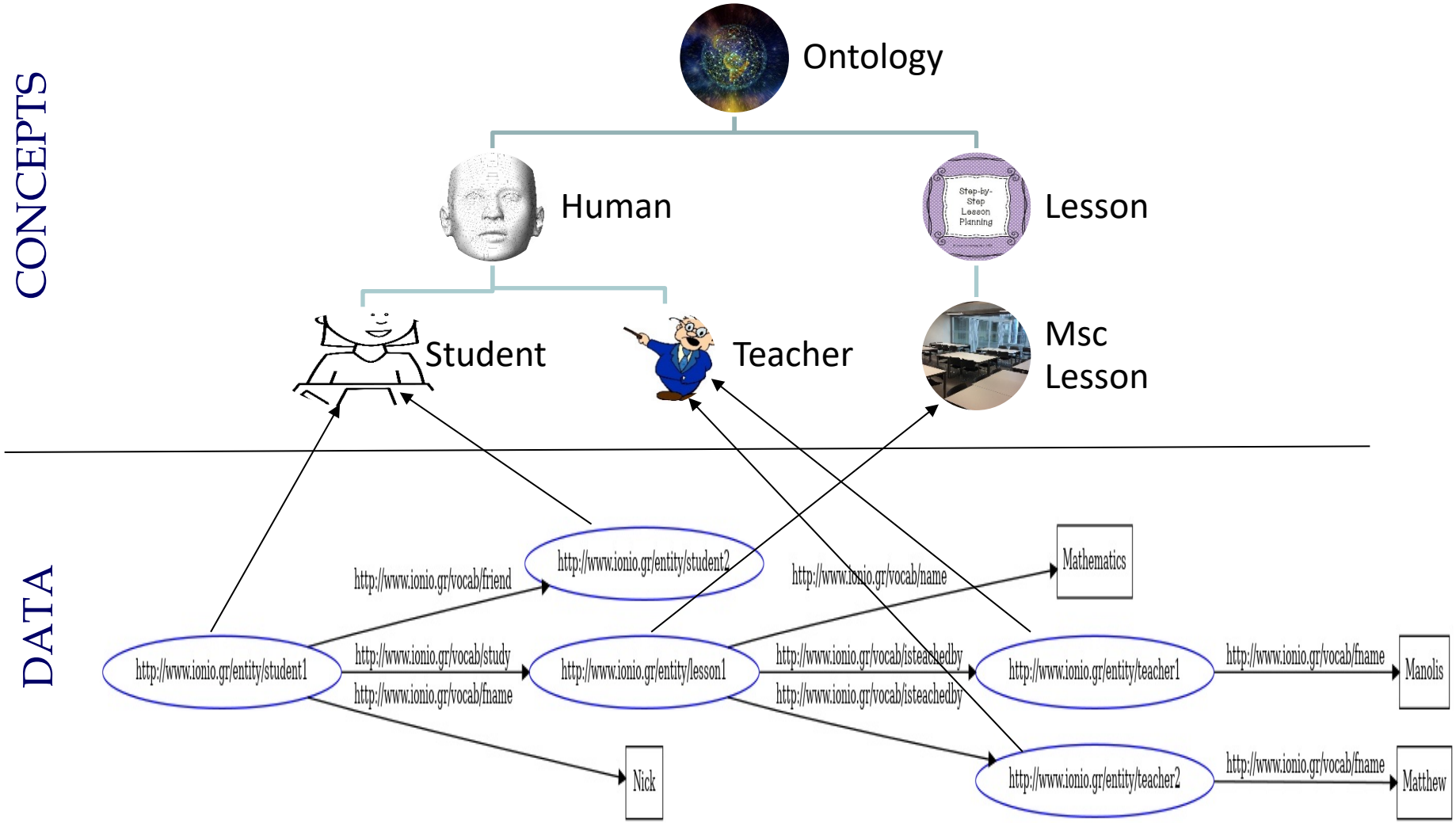


https://lod-cloud.net/clouds/lod-cloud.svg

Linked Open Data Cloud (2/2)

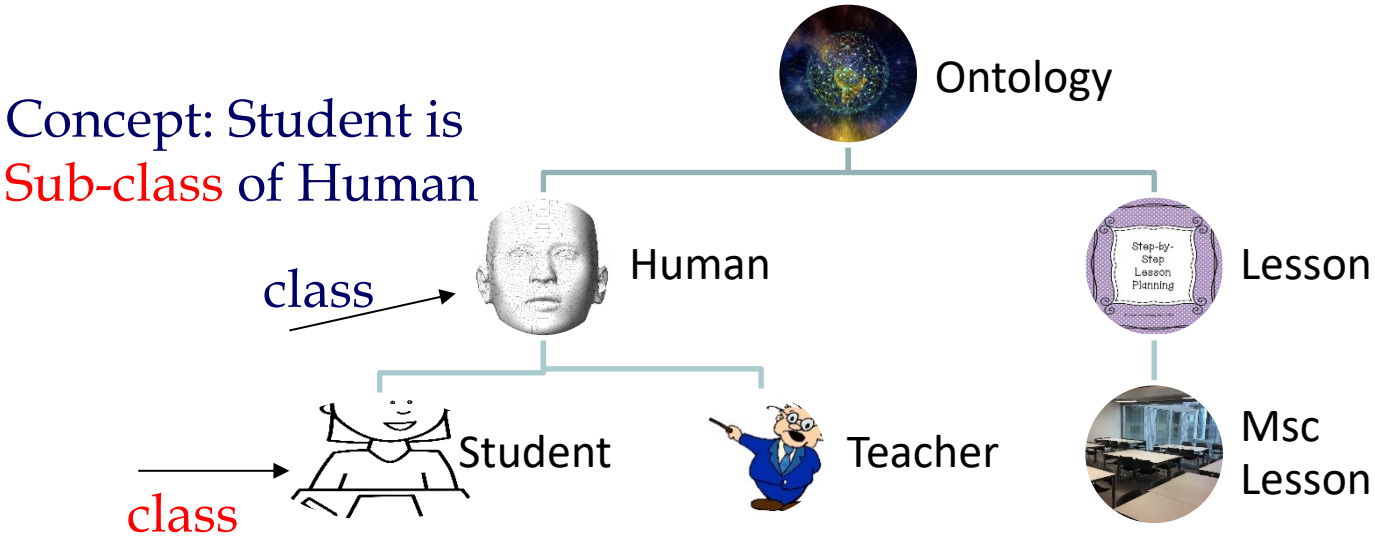
- This image shows datasets that have been published in the Linked Data format.
- The dataset currently contains **1314** datasets with **16308** links

Data + Concepts



Class Hierarchy

- Class hierarchy

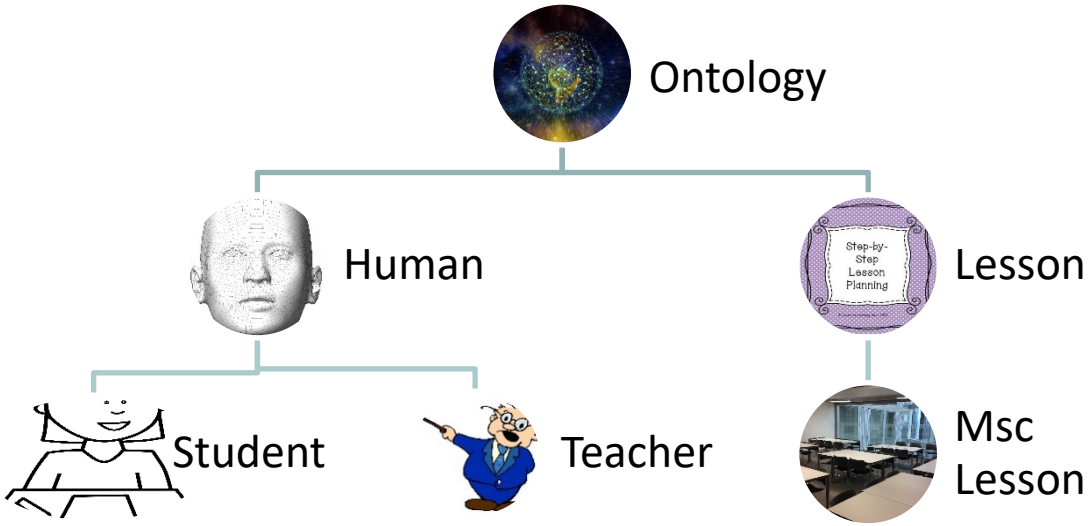


Data Entry: http://www.ionio.gr/entity/student1 is Individual or Instance of Class Student

Reasoning: Since student1 is an instance of Student and Student is subclass of Human we conclude that student1 is an instance of the class Human

Class Hierarchy

- Class hierarchy



Data Entry: http://www.ionio.gr/entity/student1 is **Individual or Instance** of Class **Student** OR **Human**?

BOTH CORRECT

BUT

If we say student1 is Student then we know that he is also Human
If we say student1 is Human then we don't know that he is also Student

Properties (Relations)

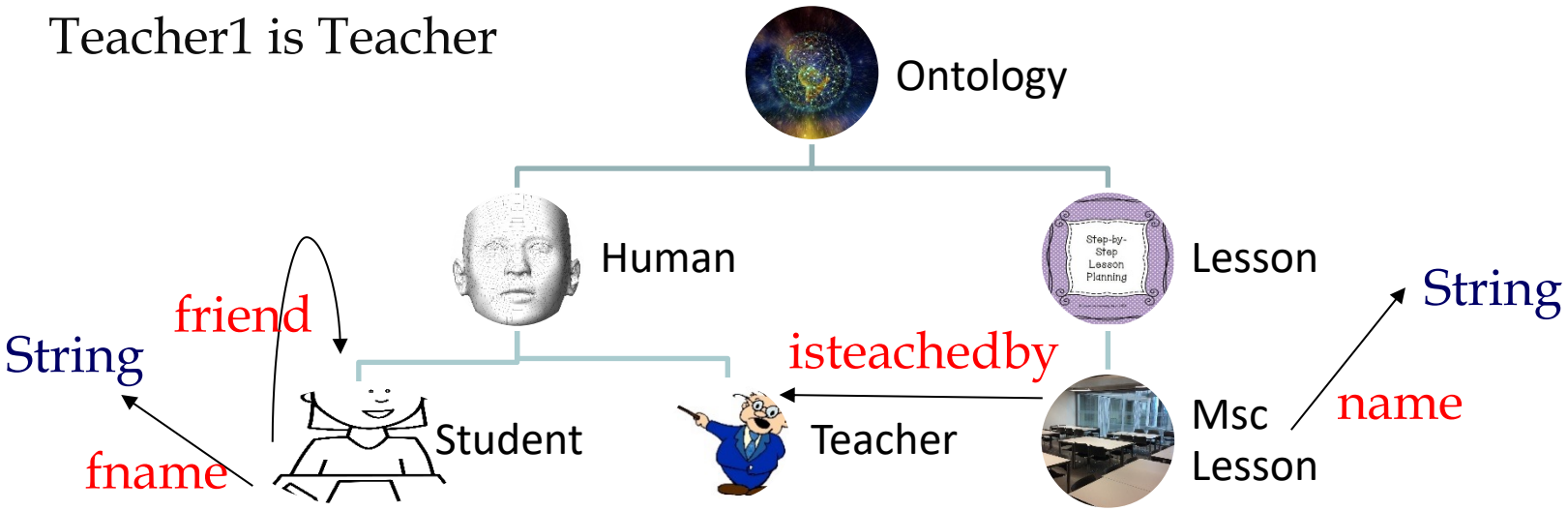
<http://www.ionio.gr/entity/student1> <http://www.ionio.gr/vocab/friend> <http://www.ionio.gr/entity/student2> .

<http://www.ionio.gr/entity/student1> <http://www.ionio.gr/vocab/fname> "Nikos" .

<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/name> "Mathimatika" .

<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/isteachedby> <http://www.ionio.gr/entity/teacher1> .

- Student1 (Instance) is Student (Class) AND also Human
- Lesson1 is Msc Lesson
- Teacher1 is Teacher



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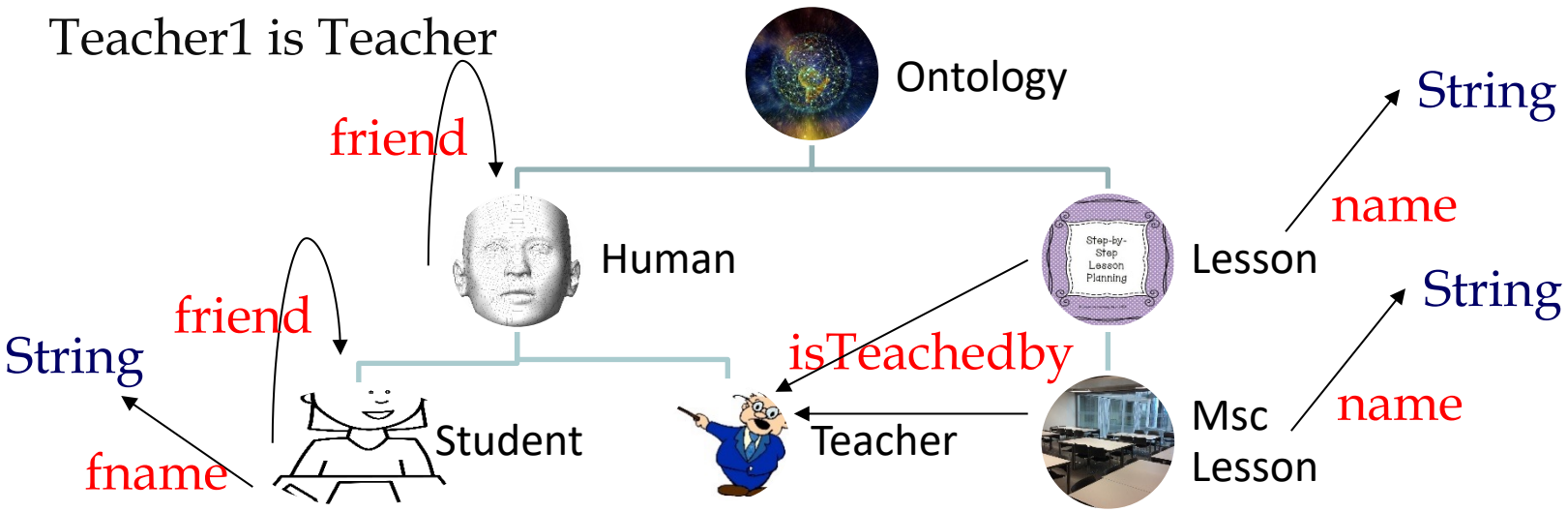
<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/isTeachedby> <http://www.ionio.gr/entity/teacher1> .

- Student1 is Student
- Lesson1 is Msc Lesson
- Teacher1 is Teacher



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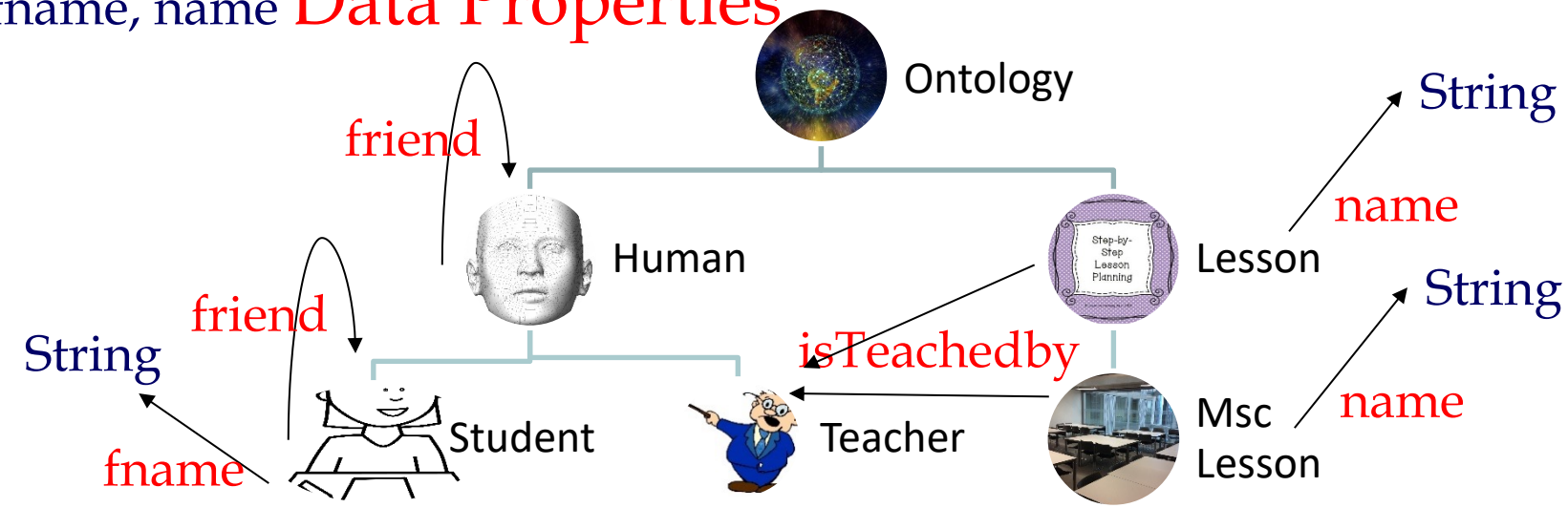
<http://www.ionio.gr/entity/lesson1> <http://www.ionio.gr/vocab/isTeachedby> <http://www.ionio.gr/entity/teacher1> .

friend, isTeachedby Object Properties

fname, name Data Properties



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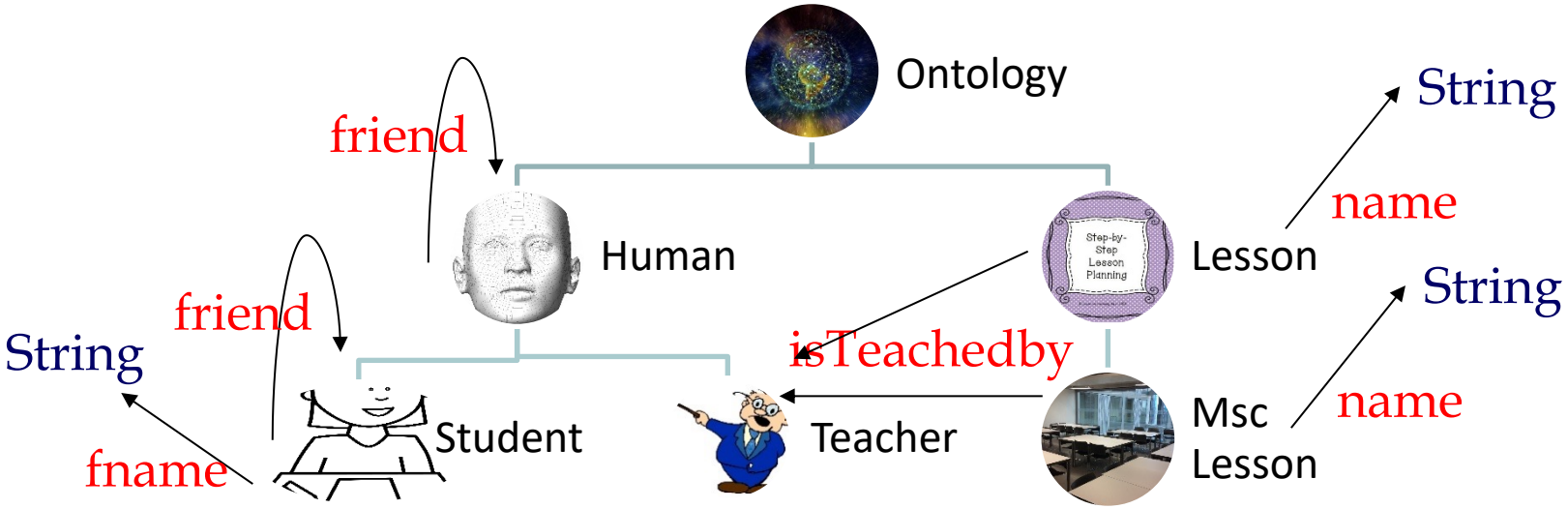
Domain – Range

IsTeachedby: Domain Lesson – Range Teacher



FULL dataset: Data + Concepts example

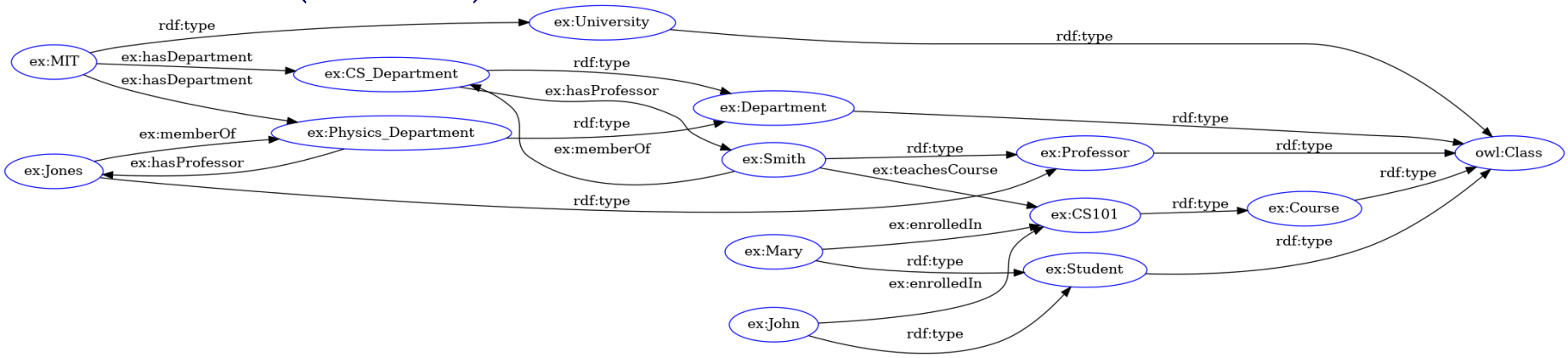
CLASSES: University, Department, Professor, Student, and Course

PROPERTIES: hasDepartment, hasProfessor, hasStudent, teachesCourse, enrolledIn, and memberOf

ontology

INDIVIDUALS (INSTANCES): MIT (a university), CS_Department and Physics_Department (departments), Smith and Jones (professors), Mary and John (students), and CS101 (a course)

Data



Namespaces:
rdf: http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs: http://www.w3.org/2000/01/rdf-schema#
owl: http://www.w3.org/2002/07/owl#
ex: http://example.org/university#

Protégé: Ontology Editor

- A free, open-source ontology editor
- https://protege.stanford.edu/
  - Webprotege
    - https://webprotege.stanford.edu/
    - Registration required
  - Desktop edition

Ontology Languages in SW (1/4)

- RDFS (Resource Description Framework Schema) and OWL (Web Ontology Language) are both languages used in the Semantic Web domain to model and define ontologies, which are formal representations of knowledge. While they serve similar purposes, they have different levels of expressiveness and are used in different contexts.

Ontology Languages in SW (2/4)

- **RDFS (Resource Description Framework Schema):**
  - RDFS is an extension of the Resource Description Framework (RDF), which is a W3C recommendation for describing resources on the web.
  - RDFS provides a basic vocabulary for describing classes and properties of resources.
  - It allows the definition of simple ontologies, including hierarchies of classes and properties, but it lacks expressive power for specifying complex constraints or relationships.

Ontology Languages in SW (3/4)

- **OWL (Web Ontology Language):**
  - OWL is a more expressive language for defining ontologies compared to RDFS.
  - It is based on Description Logics and provides constructs for defining classes, properties, individuals, and complex relationships between them.
  - OWL allows for the specification of richer constraints, such as cardinality restrictions, property characteristics (e.g., symmetry, transitivity), disjointness axioms, and more.
  - It comes in three increasingly expressive variants: OWL Lite, OWL DL, and OWL Full, with OWL DL being the most commonly used due to its balance between expressiveness and computational tractability.

Ontology Languages in SW (4/4)

- In summary, RDFS is simpler and more limited compared to OWL. It's suitable for basic ontology modelling tasks, while OWL provides more expressive power for creating complex and detailed ontologies, making it more suitable for advanced semantic web applications.