



Introduction to Ontologies

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EHS Workshop
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Anschutz Medical Campus

Hello!

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Resources



Slides:

bit.ly/ehsworkshop



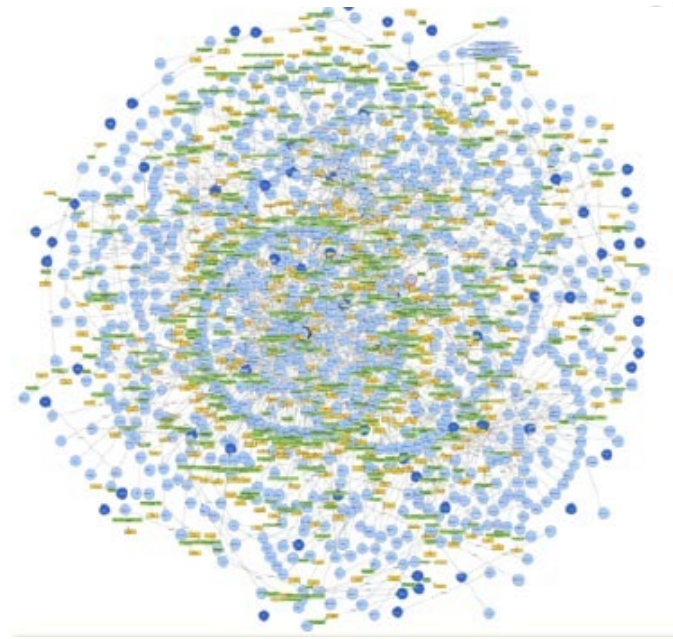
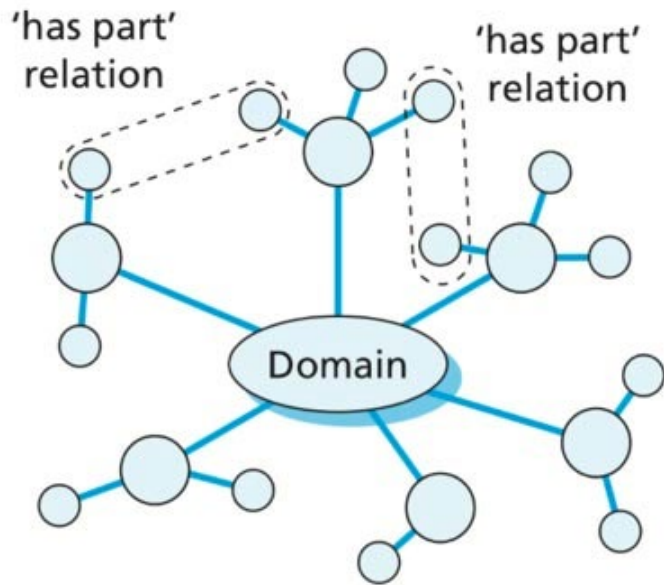
Ontology Resources:

<http://obofoundry.org/resources>



1. Introduction to Ontologies

Ontologies are **systematic representations of knowledge** that can be used to **integrate and analyze** large amounts of heterogeneous data



Terminology vs Ontology

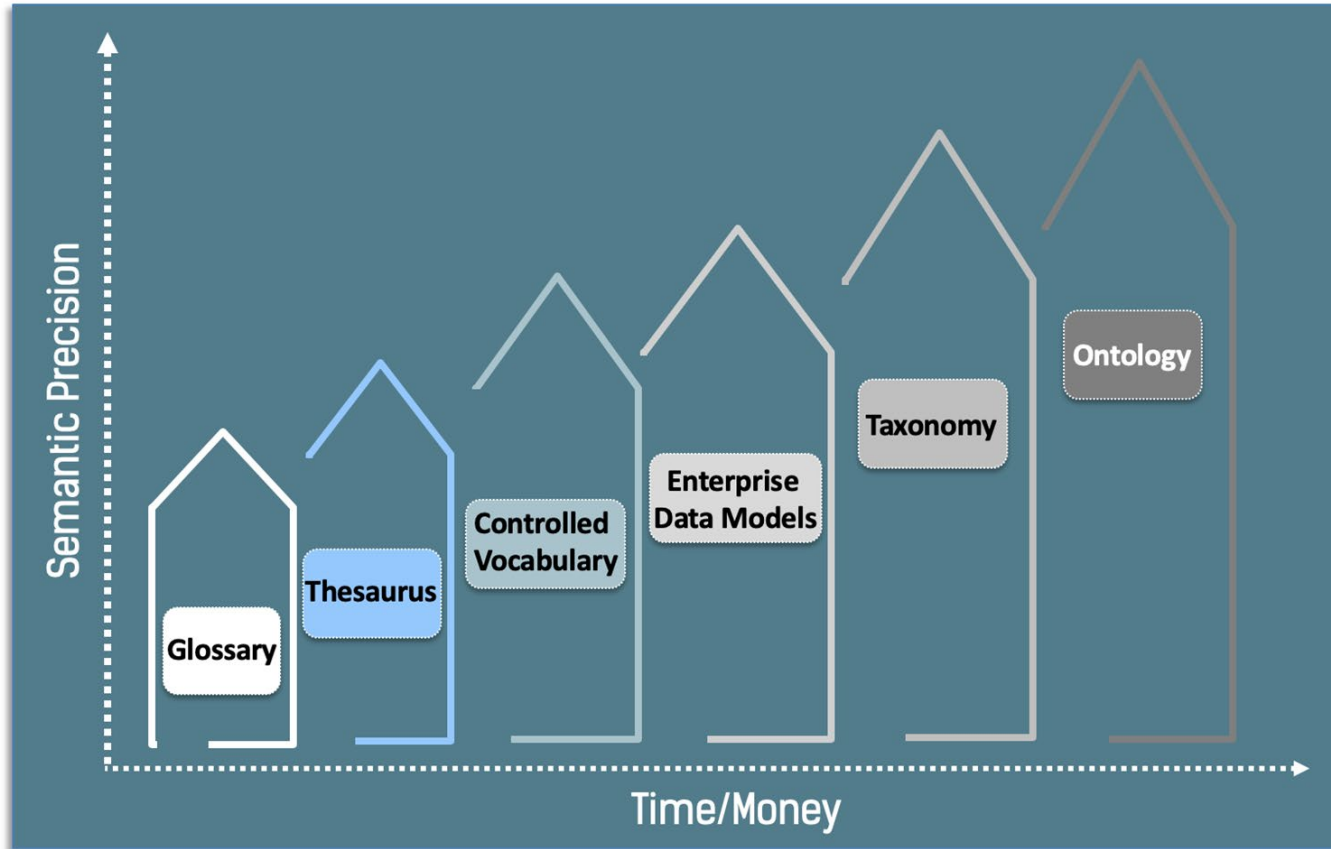
Terminology

A collection of terms, may include synonyms, definitions.

Ontology

A classification of knowledge in which terms are textually and logically defined. Provides *semantics* or *meaning* to terms.

Complexity of Vocabulary Types



Ontology use case

Query

Where can I buy light beer?




Website says sells
light beer



Website says sells
**pilsner, lager, pale
ale, etc.**

Elements of an Ontology

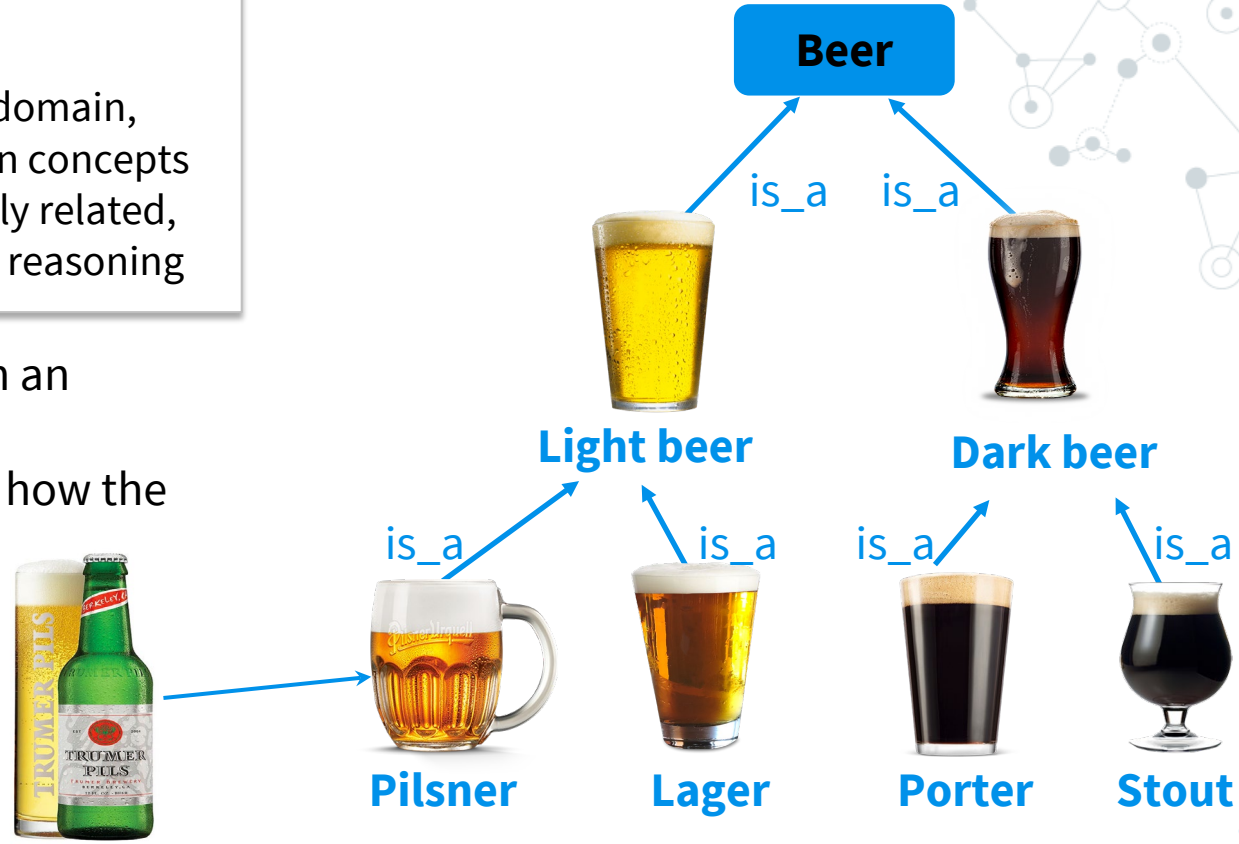
on·tol·o·gy
/än'täləjē/ 

A knowledge classification of a domain, where the relationships between concepts are formally defined and logically related, which allows for computational reasoning

Classes (terms) - concepts in an ontology

Relationships (properties) - how the classes relate to each other

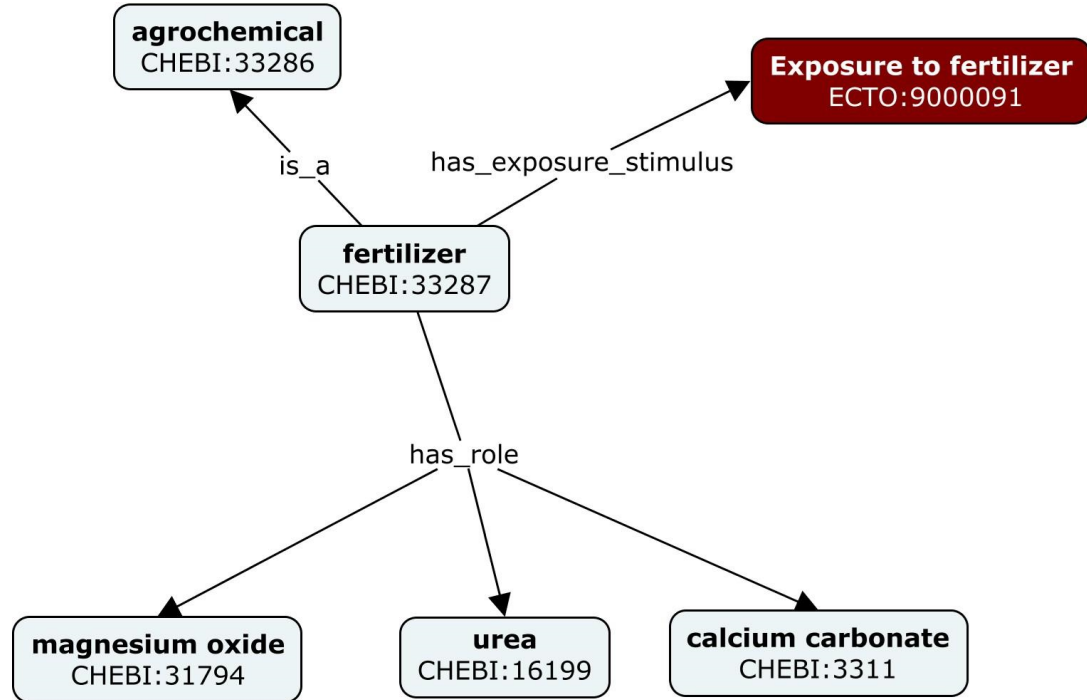
Instances - individuals



Ontology use case

Query

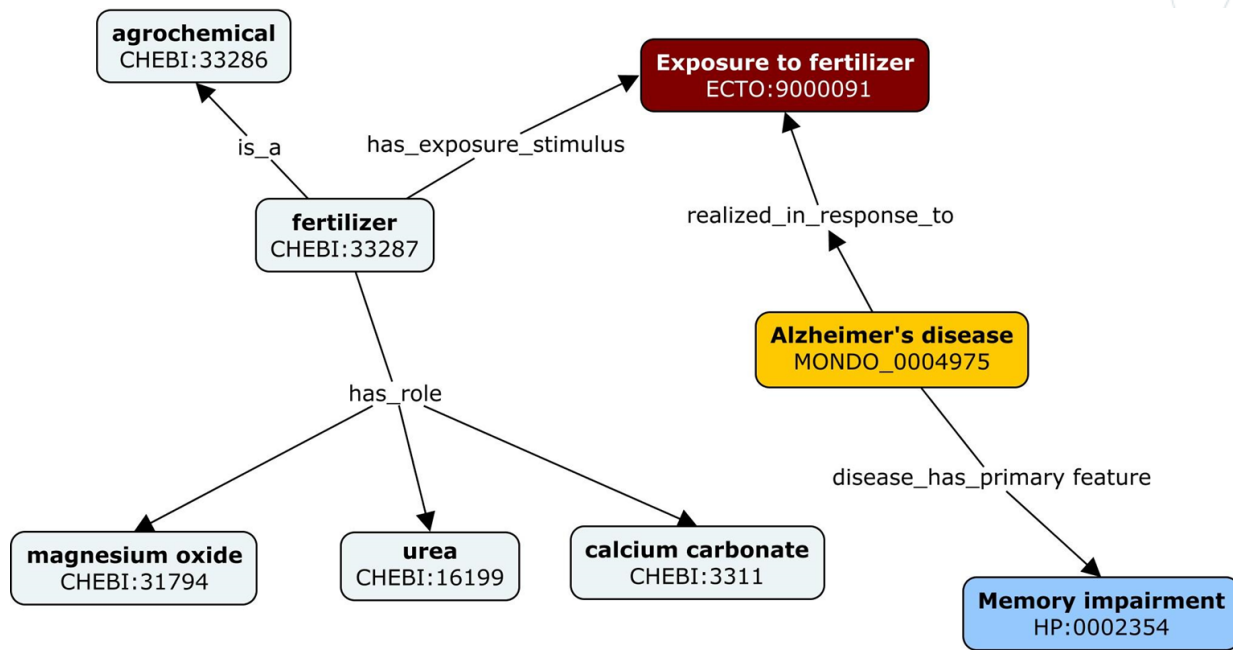
I want to find symptoms when someone was exposed to fertilizer.



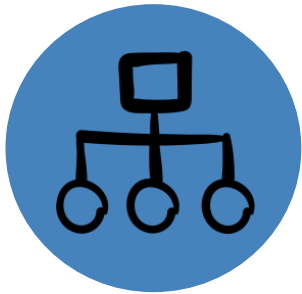
Ontology use case

Query

I want to find symptoms when someone was exposed to fertilizer.



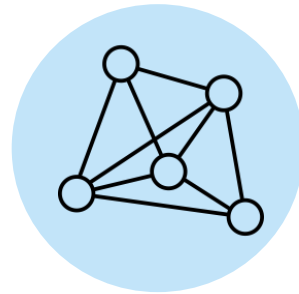
What can you do with an ontology?



**Organizing
data**



**Filtering
data**

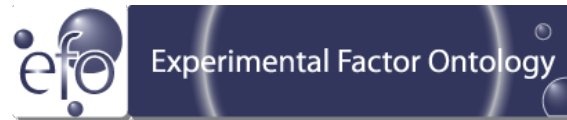


**Connecting
data**



**Suggesting
data**

Examples



Ontologies in Everyday Life



SHOW RESULTS FOR

Movies & TV

- Prime Video
- Blu-ray
- DVD
- Movies
- Kids & Family
- [See more](#)

Toys & Games

- Action & Toy Figures
- Toy Building Sets

Novelty & More

- Movie & TV Fan T-Shirts
- Women's Novelty Tops & Tees
- Men's Novelty Shirts
- Movie & TV Fan Accessories

Books

- Marvel Comics & Graphic Novels
- Superhero Comics & Graphic Novels
- Comics & Graphic Novels
- Teen & Young Adult Books
- Teen & Young Adult Literature & Fiction
- [See more](#)

CDs & Vinyl

- Soundtracks
- Pop
- Movie Scores
- Movie Soundtracks

Prime Video

- Movies
- TV

Digital Music

- Soundtracks
- [See All 24 Departments](#)



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Guardians Of The Galaxy

\$19.64 Blu-ray prime
FREE Delivery by Fri, Oct 12
Or FREE One-Day Pickup

More Buying Choices
\$13.69 (18 used & new offers)



Guardians of the Galaxy (

Prime Video
\$3.99 – **\$17.99** Rent or Buy



[Play trailer](#)

Guardians of the Galaxy :

A group of intergalactic criminals at control of the universe.

Cast



Chris Pratt
Peter Quill



Vin Diesel
Groot



Bra
Cox
Roc



Chris Pratt

American actor

facebook.com/PrattPrattPratt

Christopher Michael Pratt is an American actor. Pratt came to prominence with his television roles, particularly for his role as Andy Dwyer in the NBC sitcom Parks and Recreation, for which he received ...
[Wikipedia](#)

Born: June 21, 1979 (age 39 years), Virginia, MN

Height: 6' 2"

Spouse: Anna Faris (m. 2009–2018)

TV shows: Parks and Recreation, The O.C., Everwood, MORE

Children: Jack Pratt

Movies

[View 25+ more](#)



Guardians of the Galaxy
2014



Jurassic World: Fallen Ki...
2018



Avengers: Infinity War
2018



Passengers
2016



Guardians of the Galaxy V...
2017

A decorative network diagram in the top-left corner, consisting of various sized nodes (some solid, some hollow) connected by thin lines, forming a complex web-like structure.

2.

Ontology Structure

Ontologies are expressed in formal language like Web Ontology Language (OWL)

OWL is a semantic web computational logic-based language, designed to represent rich and complex knowledge about things and the relations between them. It also provides detailed, consistent and meaningful distinctions between classes, properties and relationships.

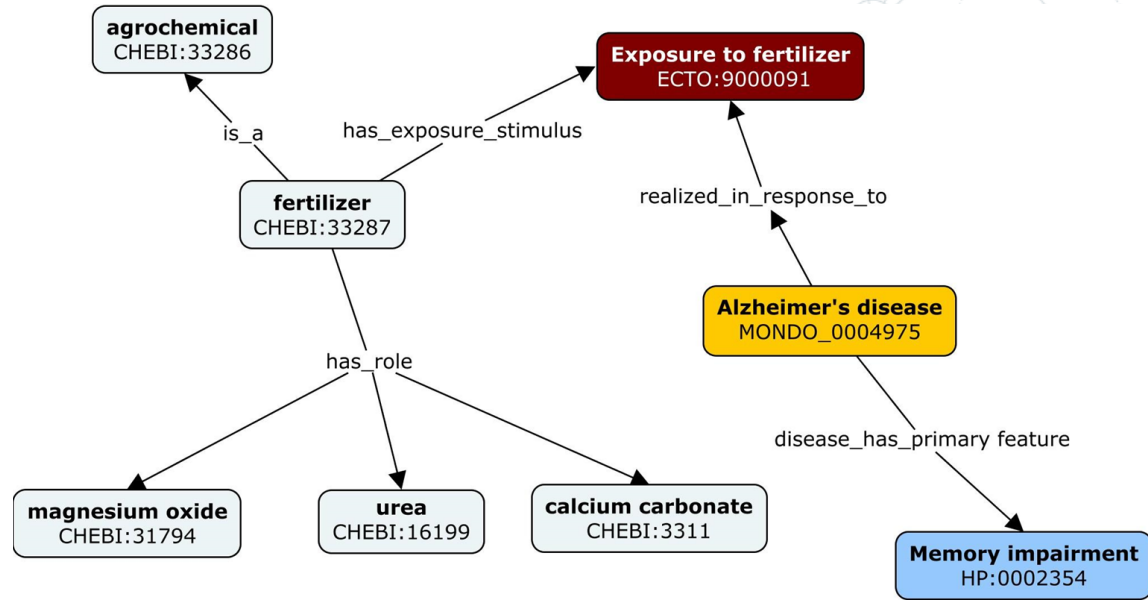
“Why not be inconsistent in at least one aspect of a language which is all about consistency?”

- *Guus Schreiber, Why OWL and not WOL?*



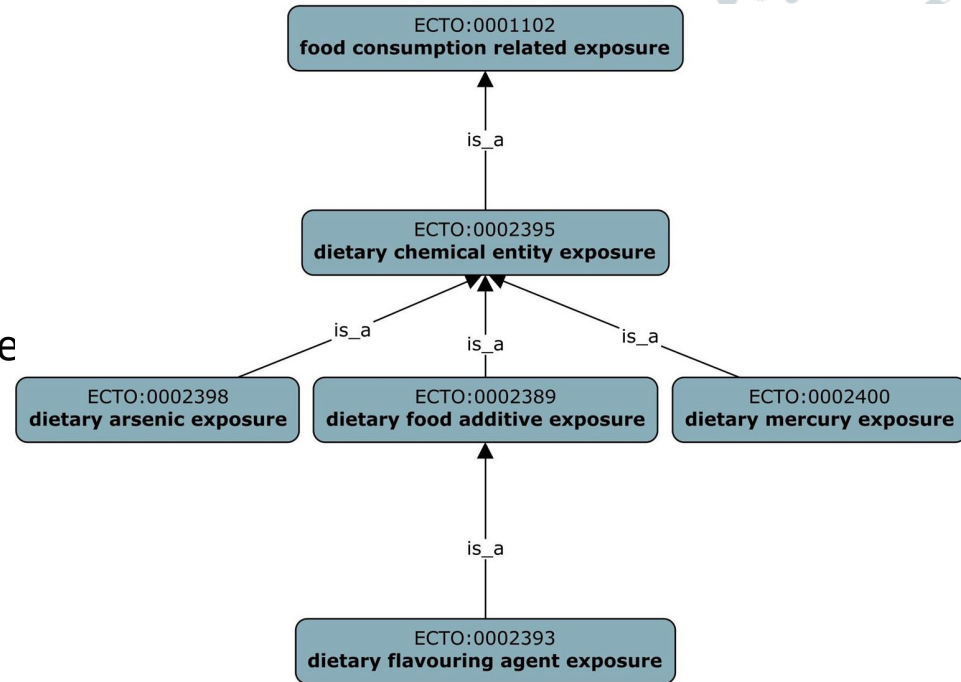
Key Features

- **Hierarchical classification:** Terms are arranged in a hierarchy
- **Text definitions:** Terms are defined
- **Synonyms:** alternative terms
- **Logical definitions:** Semantics - relationships between terms are defined, allowing logical inference and sophisticated data queries



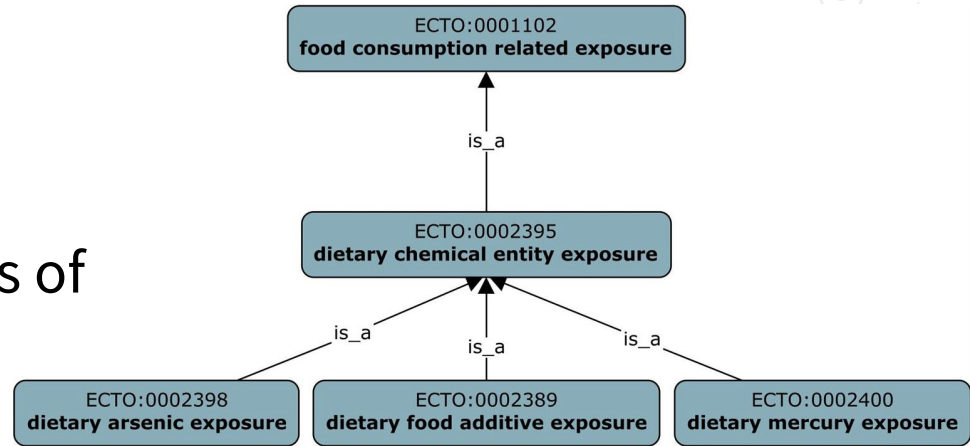
The is_a relationship

- Terms (classes) in an ontology are often classified via an 'is_a relationship
- What is a subsumption hierarchy?
- Which class is a superclass of 'dietary food additive exposure'?
- Which class is a subclass of 'food consumption related exposure'?
- Is 'dietary flavouring agent exposure' a type of 'dietary chemical entity exposure'?
- What is the relationship of 'dietary arsenic exposure' to 'dietary chemical entity exposure'?



The is_a relationship

- The **is_a** relation is like inheritance
- Children terms inherit the properties and relationships of the parent term



Dietary chemical entity exposure

An exposure event arising as a result of ingestion in food of chemical entity.

Dietary arsenic exposure

An exposure event arising as a result of ingestion in food of arsenic.

Ontologies textually and logically define the relationships between classes

Text (human readable) definition

An exposure event arising as a result of ingestion of food containing chemicals with the role of flavouring agent.

Logical (machine readable) definition

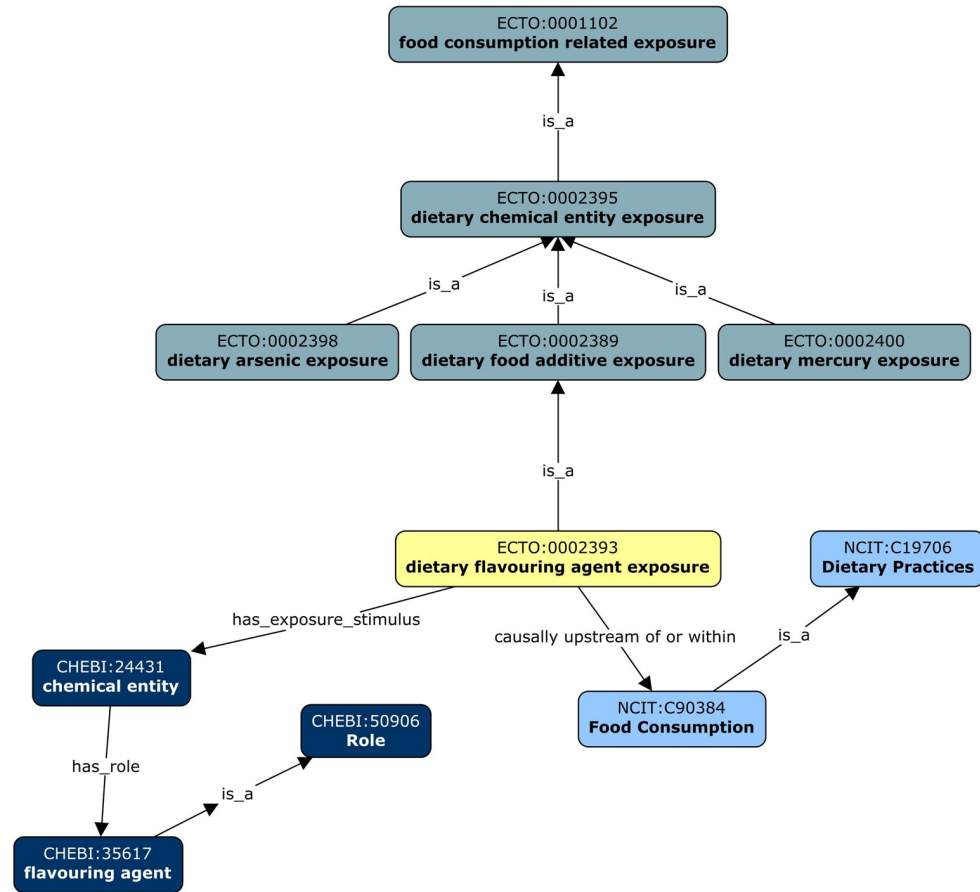
'exposure event'

and ('has exposure stimulus' some

('chemical entity'

and ('has role' some 'flavouring agent'))

and ('causally upstream of or within' some 'Food Consumption'))



A decorative network diagram in the top-left corner, consisting of various sized grey circles (nodes) connected by thin grey lines (edges). Some nodes are solid, while others are hollow with a dashed border. The network is dense and irregular, extending from the top-left towards the center of the slide.

3.

How to look up ontology terms/hierarchies



ONTOLOGY SEARCH

Home

Ontologies

Documentation

About

Welcome to the EMBL-EBI Ontology Lookup Service

Search

Examples: [diabetes](#), [GO:0098743](#)[Looking for a particular ontology?](#)

About OLS

The Ontology Lookup Service (OLS) is a repository for biomedical ontologies that aims to provide a single point of access to the latest ontology versions. You can browse the ontologies through the website as well as programmatically via the OLS API. OLS is developed and maintained by the [Samples, Phenotypes and Ontologies Team \(SPOT\)](#) at EMBL-EBI.

Related Tools

In addition to OLS the SPOT team also provides the OxO, Zooma and Webulous services. [OxO](#) provides cross-ontology mappings between terms from different ontologies. [Zooma](#) is a service to assist in mapping data to ontologies in OLS and [Webulous](#) is a tool for building ontologies from spreadsheets.

Report an Issue

For feedback, enquiries or suggestion about OLS or to request a new ontology please use our [GitHub issue tracker](#). For announcements relating to OLS, such as new releases and new features sign up to the [OLS announce mailing list](#)

Data Content

Updated 19 Jul 2021 06:38

- 264 ontologies
- 6,496,664 terms
- 32,638 properties
- 498,030 individuals

Tweets by @EBIOLS



We are looking for a software developer to join our team. You can apply at embla.org/jobs/position/ ... if you are interested. [#softwareengineer](#) [#java](#) [#semanticweb](#) [#hiring](#)



Jun 8, 2021



Are you interested in deploying OLS, Zooma and OxO in your own environment? If so, please checkout our documentation in this regard github.com/EBISPOT/ontoto.... Many thanks to [@_jmcl](#) and [@NicoMatentzogl](#)

<https://www.ebi.ac.uk/ols/index>

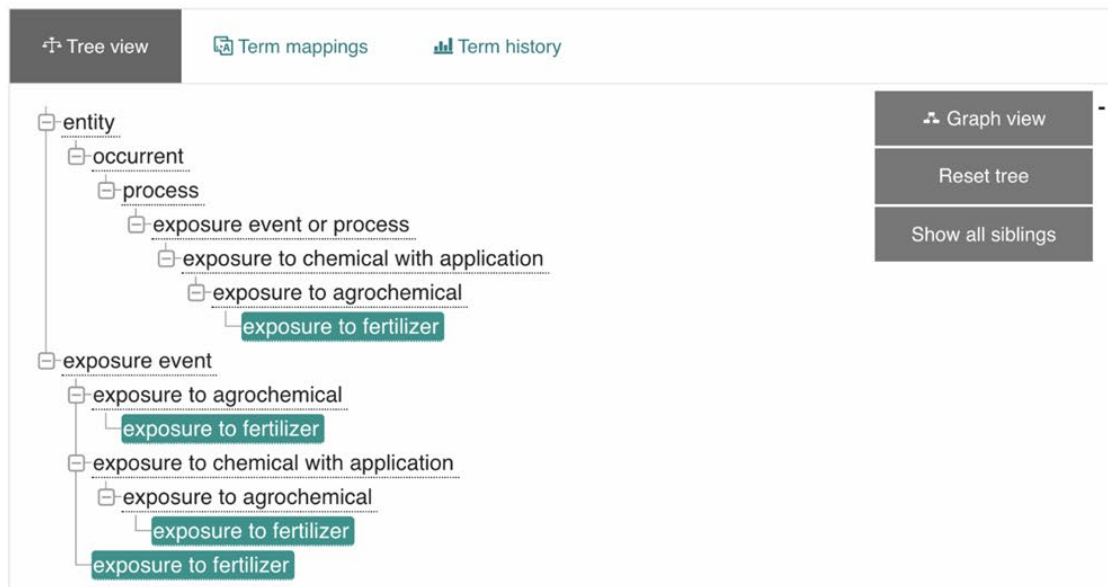


exposure to fertilizer

 http://purl.obolibrary.org/obo/ECTO_9000091  Copy

An exposure to fertilizer.

Synonyms:



-  Graph view
- Reset tree
- Show all siblings

Term information

Term relations

Equivalent to:

- [exposure event](#) and *has exposure stimulus some* [fertilizer](#)

Subclass of:

- [exposure event](#)
- [exposure to agrochemical](#)
- *has exposure stimulus some* [fertilizer](#)

Welcome to BioPortal, the world's most comprehensive repository of biomedical ontologies

Search for a class

Enter a class, e.g. Melanoma



[Advanced Search](#)

Find an ontology

Start typing ontology name, then choose from list



[Browse Ontologies](#)

Ontology Visits (September 2018)



BioPortal Statistics

Ontologies	729
Classes	9,594,071
Resources Indexed	48
Indexed Records	39,537,360
Direct Annotations	95,468,433,792

A library of ontologies and ontology related services

<http://bioportal.bioontology.org/>

Welcome to Ontobee!















Ontobee: A [linked data](#) server designed for ontologies. Ontobee is aimed to facilitate ontology data sharing, visualization, query, integration, and analysis. Ontobee dynamically [dereferences](#) and presents individual ontology term URIs to (i) *HTML web pages* for user-friendly web browsing and navigation, and to (ii) *RDF source code* for [Semantic Web](#) applications. Ontobee is the default linked data server for most [OBO Foundry library ontologies](#). Ontobee has also been used for many non-OBO ontologies.

Please select an ontology (optional)

Keywords:

Jump to <http://purl.obolibrary.org/obo/>

Currently Ontobee has been applied for the following ontologies:

No.	Ontology Prefix	Ontology Full Name	OBO ?	List of Terms
1	AEO	Anatomical Entity Ontology	L	 
2	AGRO	Agronomy Ontology	L	 
3	APO	Ascomycete phenotype ontology	L	 
4	APOLLO_SV	Apollo Structured Vocabulary	N	 
5	ARO	Antibiotic Resistance Ontology	L	 
6	BCGO	Beta Cell Genomics Ontology	L	 
7	BCO	Biological Collections Ontology	L	 

Query ontologies, and provides RDF supporting remote query of each ontology term and the Semantic Web
<http://www.ontobee.org>

Which is the right ontology to use?

- There are multiple ontologies that exist, start by selecting the appropriate ontology, then search and restrict your search to that ontology.
- Recommend using ontologies that are open and interoperable. Focusing on OBO foundry ontologies are a good place to start
- Make informed decision about which ontology to use
- Maybe the ontology you want to use does not have the term you want, so make a term request to that ontology



About ▾

Principles ▾

Ontologies ▾

Resources ▾

Citation ▾

Participate ▾

FAQ ▾

Search Ontobee

Submit

The Open Biological and Biomedical Ontology (OBO) Foundry

Community development of interoperable ontologies for the biological sciences

Learn about OBO best practices and community resources

- [More about the OBO Foundry](#)
- [OBO Foundry principles](#)
- [OBO tutorial](#)
- [Ontology browsers, tutorials, and tools](#)

Participate

- [Join the OBO mailing list](#)
- [OBO Foundry Operations and Working Groups](#)
- [Submit bug reports or suggestions for improvement via GitHub](#)
- [Submit your ontology to be considered for inclusion in the OBO Foundry](#)

OBO Library: find, use, and contribute to community ontologies

The table below lists current OBO ontologies (in alphabetical order, but with the ontologies that have been manually reviewed by the OBO Foundry listed first, and obsolete ontologies listed last).

Download table as: [[YAML](#) | [JSON-LD](#) | [RDF/Turtle](#)]

A community of ontologists committed to a shared set of principles to build open biomedical ontologies.

<http://obofoundry.org/>

A decorative network diagram in the top-left corner, consisting of various sized circles (nodes) connected by thin lines (edges). Some nodes are solid grey, while others are hollow white with a grey border. The connections form a complex, branching structure.

3.

Managing Ontologies in GitHub



- Free, open-source online platform for hosting for software development projects
- Provides version control using Git
- Widely used in the ontology development community to:
 - store ontology files
 - version control
 - issue tracker

Sign up for free at: www.github.com

Ontology issue trackers



A tracker is a place to put a formal ontology request

1



Trackers have long been used in the software community for keeping track of bugs, feature requests, etc

2



Advantages:

- Open
- Documentation
- Community can comment

3



Tracker IDs can be referenced in ontology metadata, such as in an editor note or definition annotation

4



master 12 branches 17 tags

Go to file

Add file

Code

laurenechan Make sure pipeline fails when duplicate ids in patterns (#193) 08dcac3 on Jun 11 524 commits

.github/workflows	Make sure pipeline fails when duplicate ids in patterns (#193)	last month
imports	merge fork (#151)	4 months ago
mappings	Mappings 2021 (#169)	3 months ago
patterns	Release	4 months ago
reports	merge fork (#151)	4 months ago
src	Make sure pipeline fails when duplicate ids in patterns (#193)	last month
subsets	new release	3 years ago
.gitignore	Make sure pipeline fails when duplicate ids in patterns (#193)	last month

About

Modular environmental exposures ontology

- environment
- health
- owl
- ontology
- obo
- exposure
- obofoundry

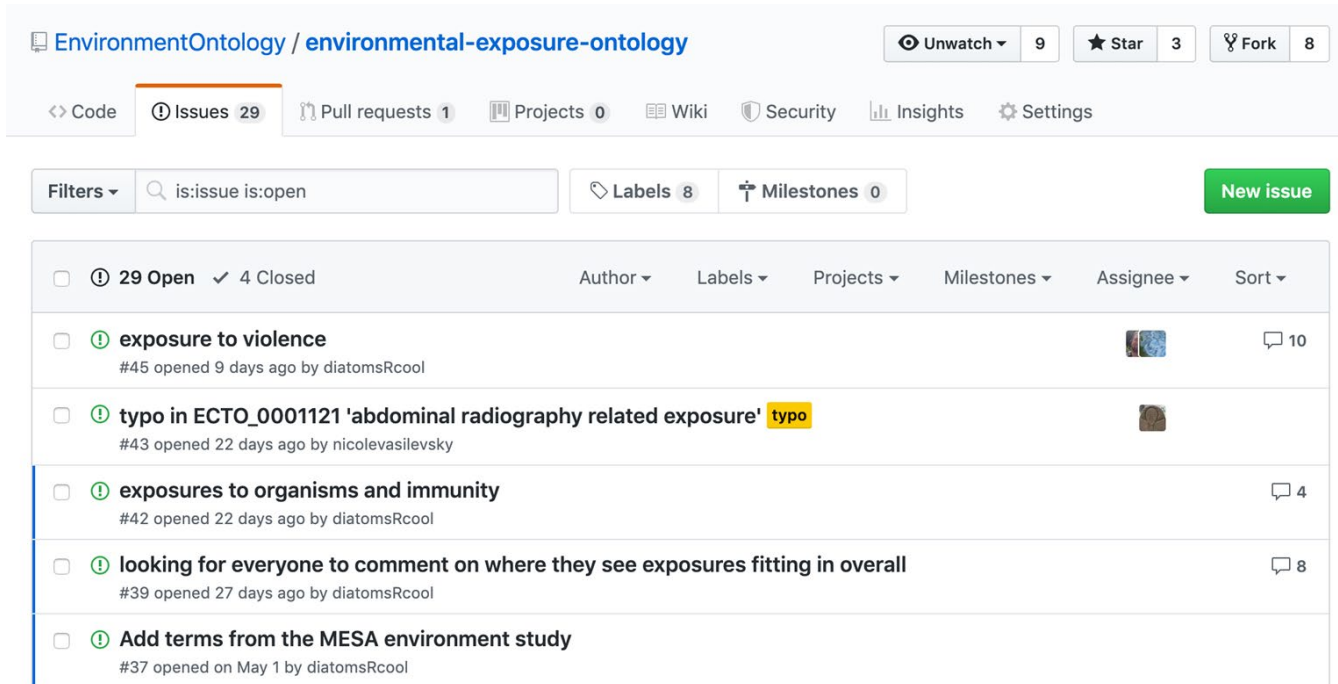
Readme

View license

Releases 17

v2021-03-17 Latest on Mar 18

ECTO GitHub Issue Tracker





EnvironmentOntology / environmental-exposure-ontology

Unwatch 9 Star 3 Fork 8

Code Issues 29 Pull requests 1 Projects 0 Wiki Security Insights Settings

Filters is:issue is:open Labels 8 Milestones 0 New issue

<input type="checkbox"/>	29 Open	4 Closed	Author	Labels	Projects	Milestones	Assignee	Sort
<input type="checkbox"/>	exposure to violence							10
	#45 opened 9 days ago by diatomsRcool							
<input type="checkbox"/>	typo in ECTO_0001121 'abdominal radiography related exposure'			typo				
	#43 opened 22 days ago by nicolevasilevsky							
<input type="checkbox"/>	exposures to organisms and immunity							4
	#42 opened 22 days ago by diatomsRcool							
<input type="checkbox"/>	looking for everyone to comment on where they see exposures fitting in overall							8
	#39 opened 27 days ago by diatomsRcool							
<input type="checkbox"/>	Add terms from the MESA environment study							
	#37 opened on May 1 by diatomsRcool							

<https://github.com/EnvironmentOntology/environmental-exposure-ontology/issues>

How do you write a tracker request?

- ◎ Provide as much information as possible, in order to facilitate the change you are requesting and for future reference
- ◎ For new terms, or term rearrangements, provide the intended hierarchy – both parent/subclass as well as any other relations required
- ◎ Provide text definitions for all new or edited terms
- ◎ Provide attribution for the definitions
- ◎ Provide suggested synonyms

A decorative network diagram in the top-left corner, consisting of various sized circles (nodes) connected by thin lines (edges). Some nodes are solid grey, while others are hollow white with a grey border. The network is dense and irregular.

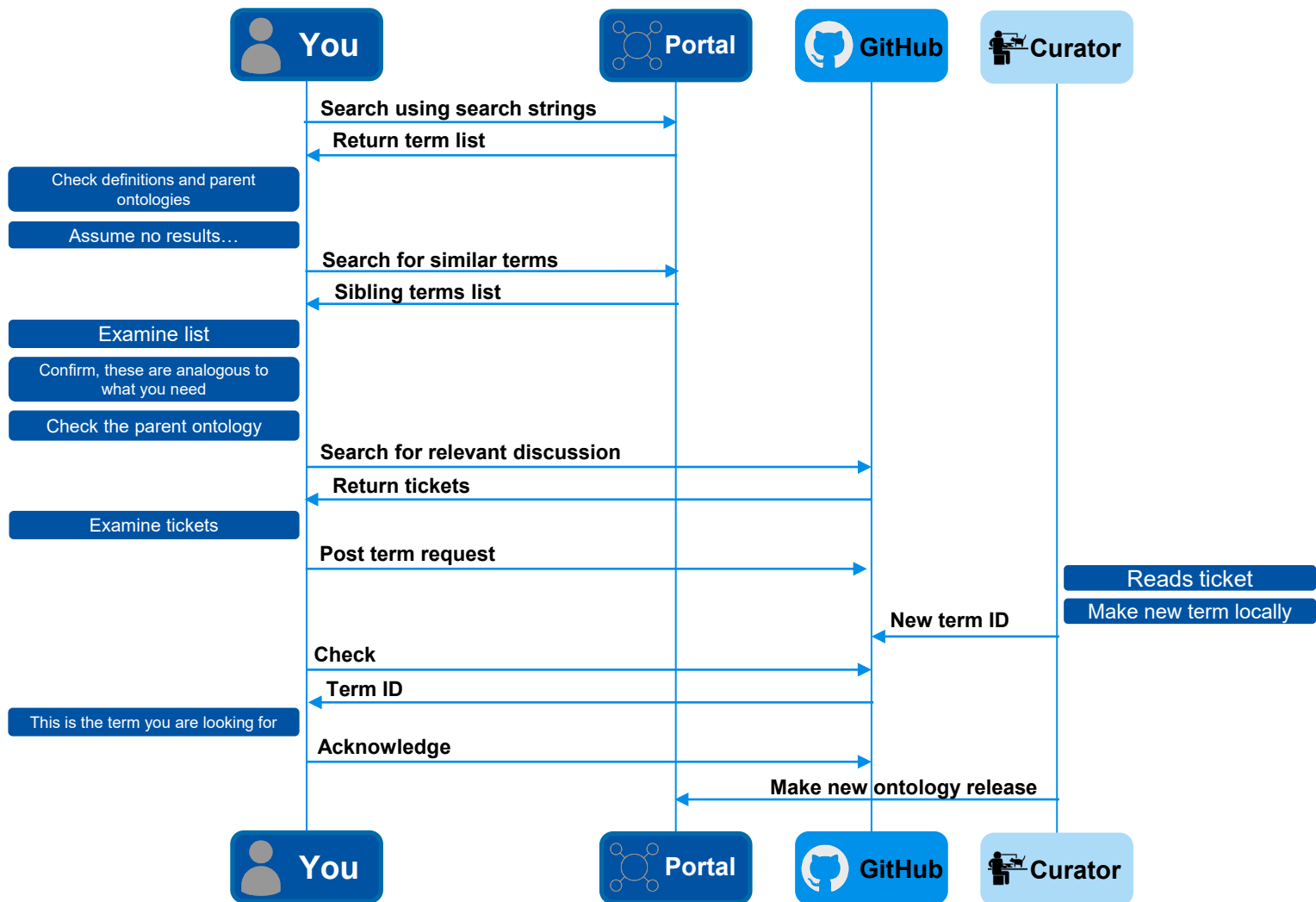
4.

Participate in Ontology Communities

**Expert
contributions
to ontologies**



Term search and request workflow





Summary

- Add value to your data by annotating your data with external ontologies
- Semantic enrichment aids in computational analysis
- Participate in ontology communities, your contributions are appreciated and valued
- Join OBO Foundry Slack: obo-communitygroup.slack.com

Acknowledgements



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University of Colorado



Chris Mungall
Lawrence Berkeley National Lab



David Osumi-Sutherland
European Bioinformatics Institute



Nico Matentzoglou
Semanticy



Anne Thessen
University of Colorado

Some content was adapted from:

BDK14: Introduction to OWL2 and data reasoning | <https://github.com/OHSUBD2K/BDK14-Ontologies-101>

Thanks!

You can find me at:

✉ nicole@tislabs.org

🐦 [@n_vasilevsky](https://twitter.com/n_vasilevsky)