Databases

Graph Databases

Motivation

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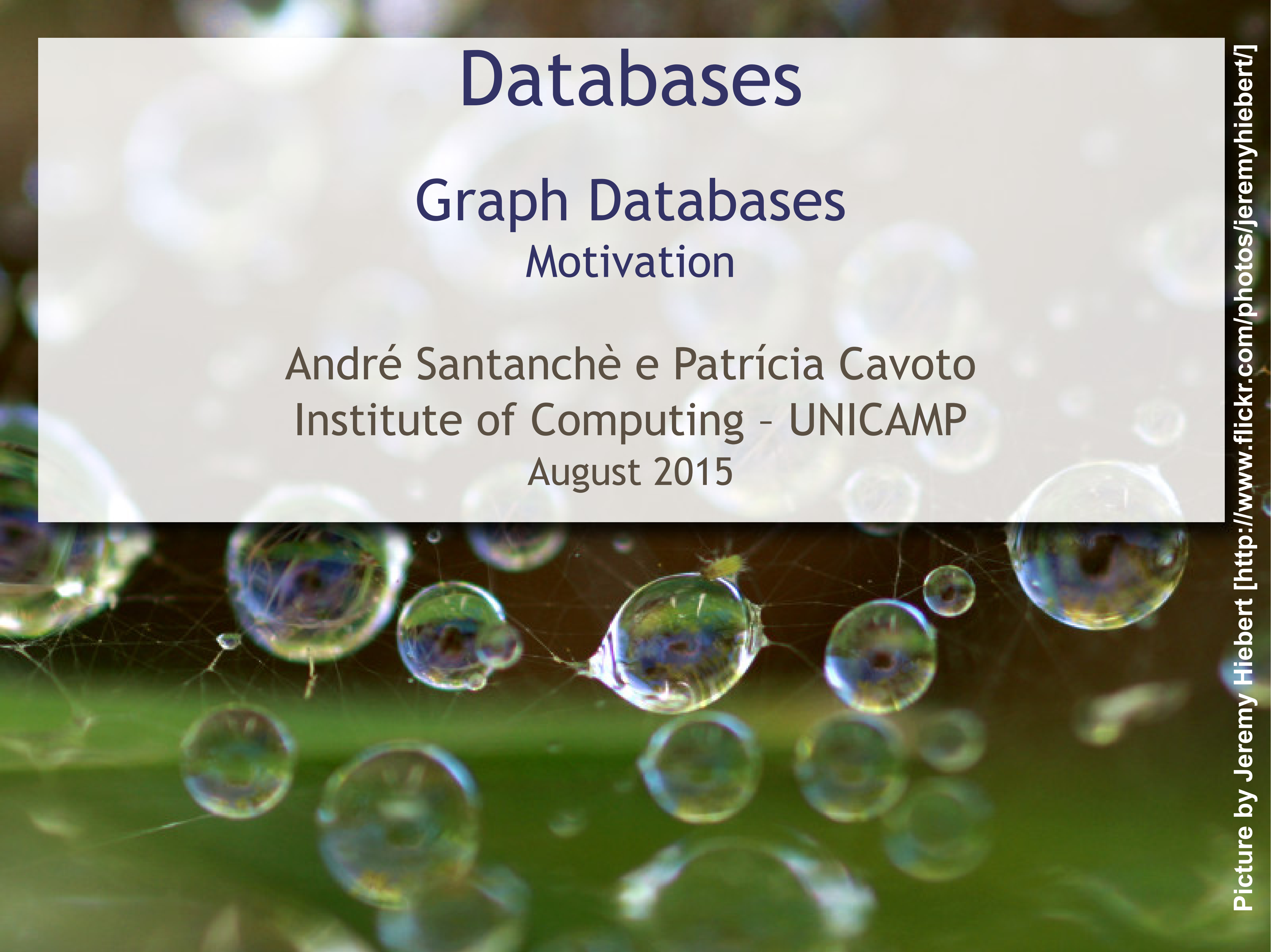
Institute of Computing – UNICAMP

August 2015



Picture by Jeremy Hiebert [http://www.flickr.com/photos/jeremyhiebert/]

Graph Database

Graph as the basic data model of a database

Why Graphs?

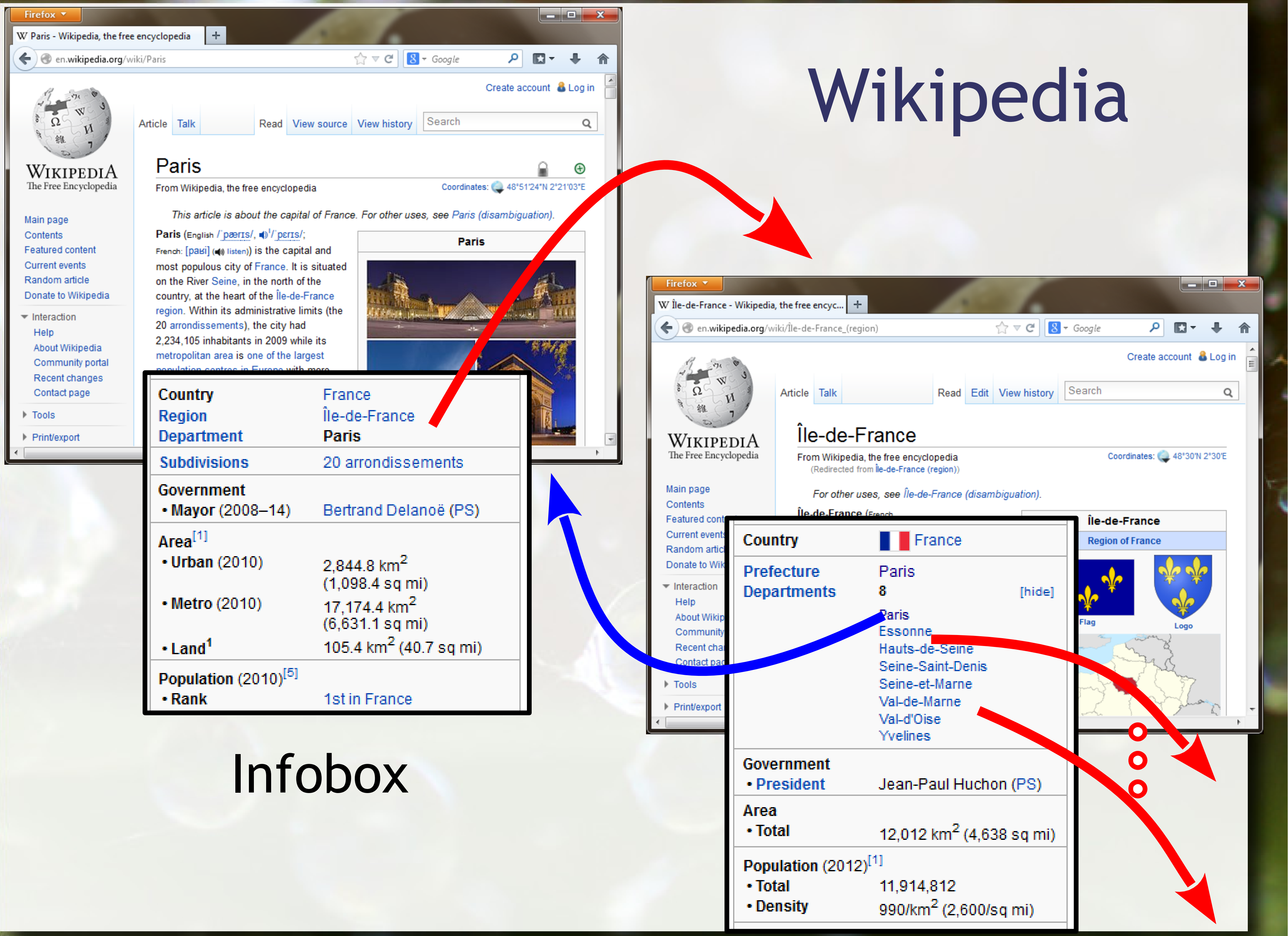
Why Graphs?

- The Web Effect
  - Linked Data
  - Social Networks and Social Content
- Sharing and interconnecting
- Complex Networks

Why Graphs?

Linked Data

Wikipedia



Paris

From Wikipedia, the free encyclopedia

Coordinates: 48°51′24″N 2°21′03″E

This article is about the capital of France. For other uses, see Paris (disambiguation).

Paris (English /ˈpærɪs/, /ˈpɛrɪs/; French: [paʁi] (listen)) is the capital and most populous city of France. It is situated on the River Seine, in the north of the country, at the heart of the Île-de-France region. Within its administrative limits (the 20 arrondissements), the city had 2,234,105 inhabitants in 2009 while its metropolitan area is one of the largest population centres in Europe with more

Paris	
Country	France
Region	Île-de-France
Department	Paris
Subdivisions	20 arrondissements
Government	
• Mayor (2008–14)	Bertrand Delanoë (PS)
Area[1]	
• Urban (2010)	2,844.8 km^2 (1,098.4 sq mi)
• Metro (2010)	17,174.4 km^2 (6,631.1 sq mi)
• Land[1]	105.4 km^2 (40.7 sq mi)
Population (2010)[5]	
• Rank	1st in France

Île-de-France

From Wikipedia, the free encyclopedia

(Redirected from Île-de-France (region))

Coordinates: 48°30′N 2°30′E

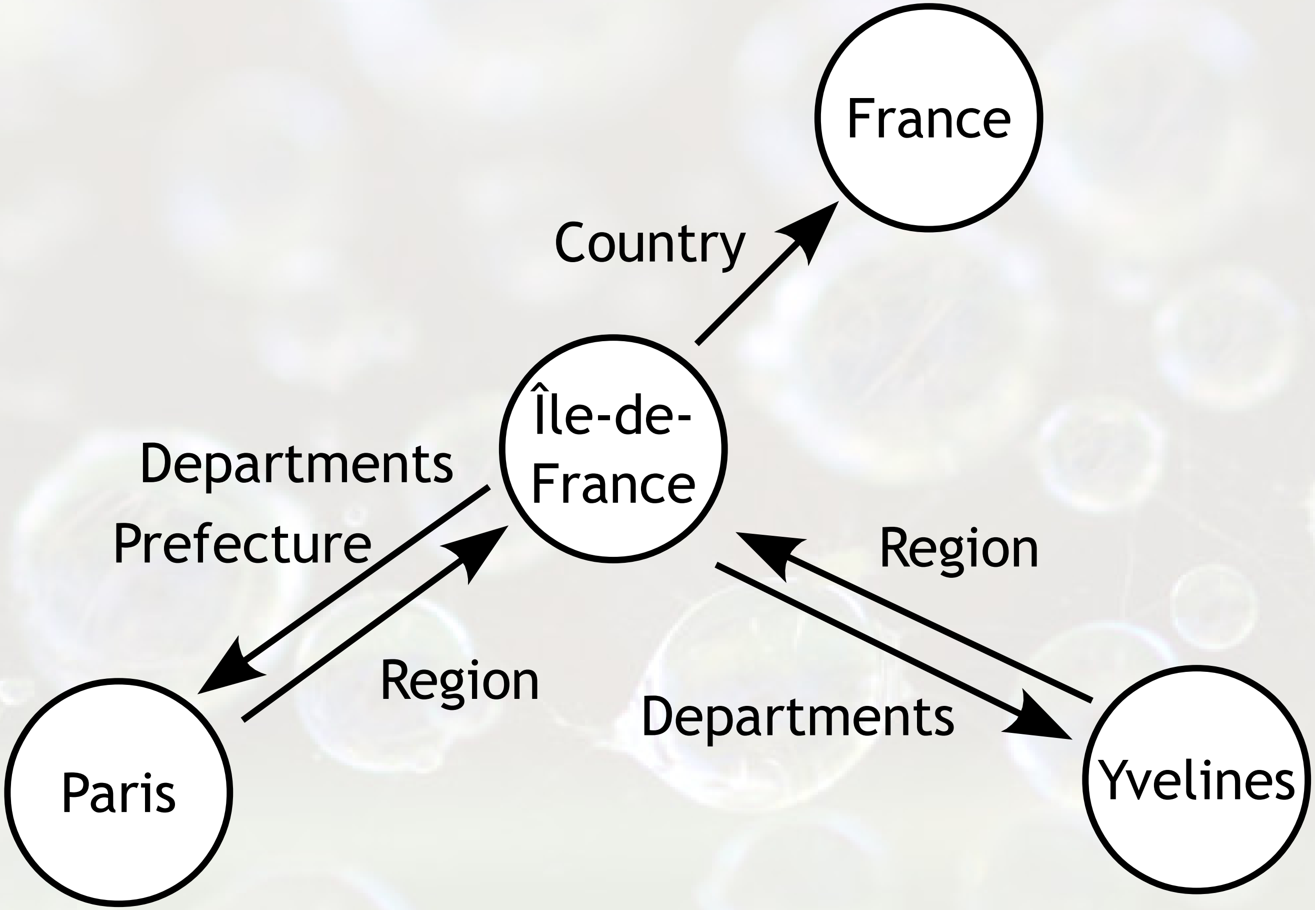
For other uses, see Île-de-France (disambiguation).

Île-de-France (French

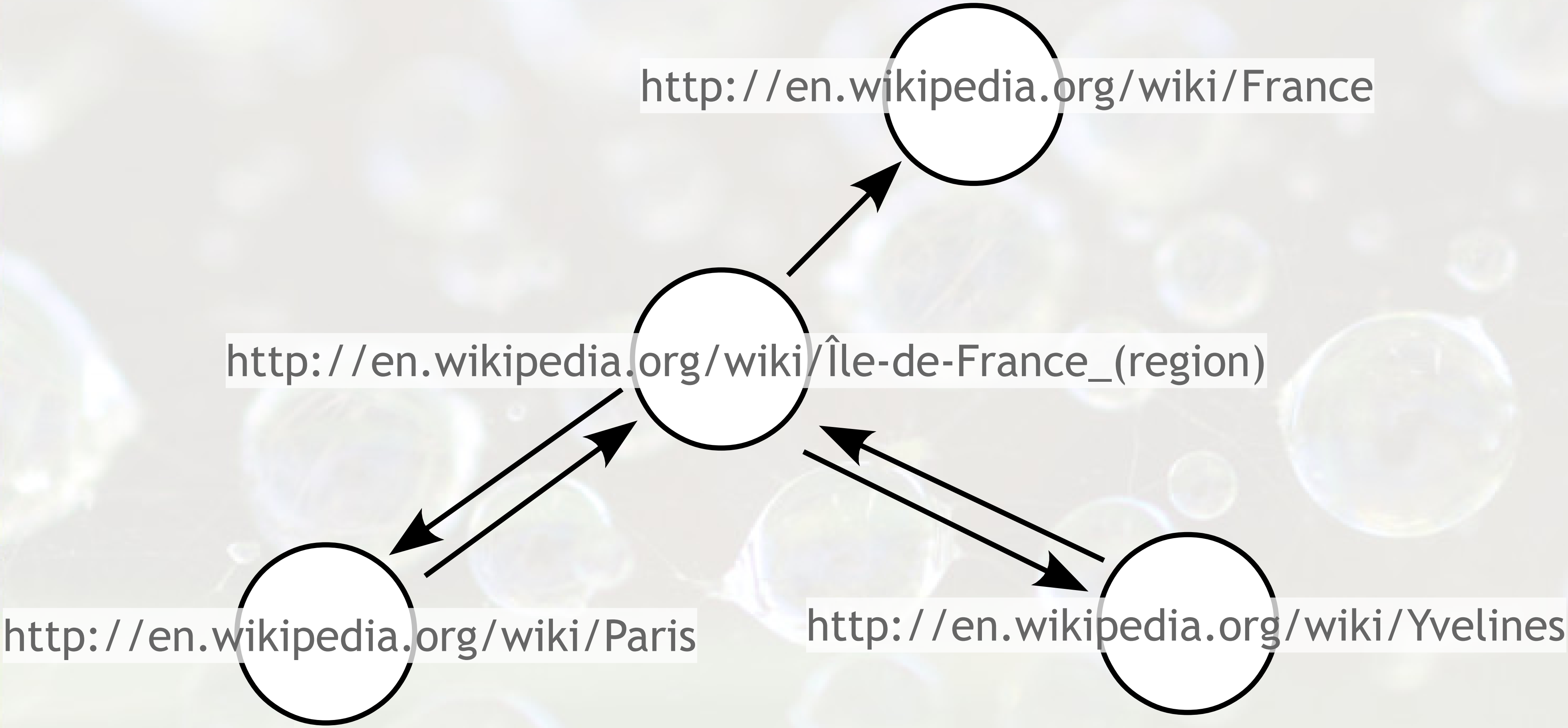
Île-de-France	
Region of France	
Country	France
Prefecture	Paris
Departments	8 [hide]
	Paris Essonne Hauts-de-Seine Seine-Saint-Denis Seine-et-Marne Val-de-Marne Val-d'Oise Yvelines
Government	
• President	Jean-Paul Huchon (PS)
Area	
• Total	12,012 km^2 (4,638 sq mi)
Population (2012)[1]	
• Total	11,914,812
• Density	990/km^2 (2,600/sq mi)

Infobox

DBPedia


France
Country
Île-de-France
Departments
Prefecture
Region
Region
Departments
Paris
Yvelines

DBPedia (URIs)



http://en.wikipedia.org/wiki/France

http://en.wikipedia.org/wiki/Île-de-France_(region)

http://en.wikipedia.org/wiki/Paris

http://en.wikipedia.org/wiki/Yvelines

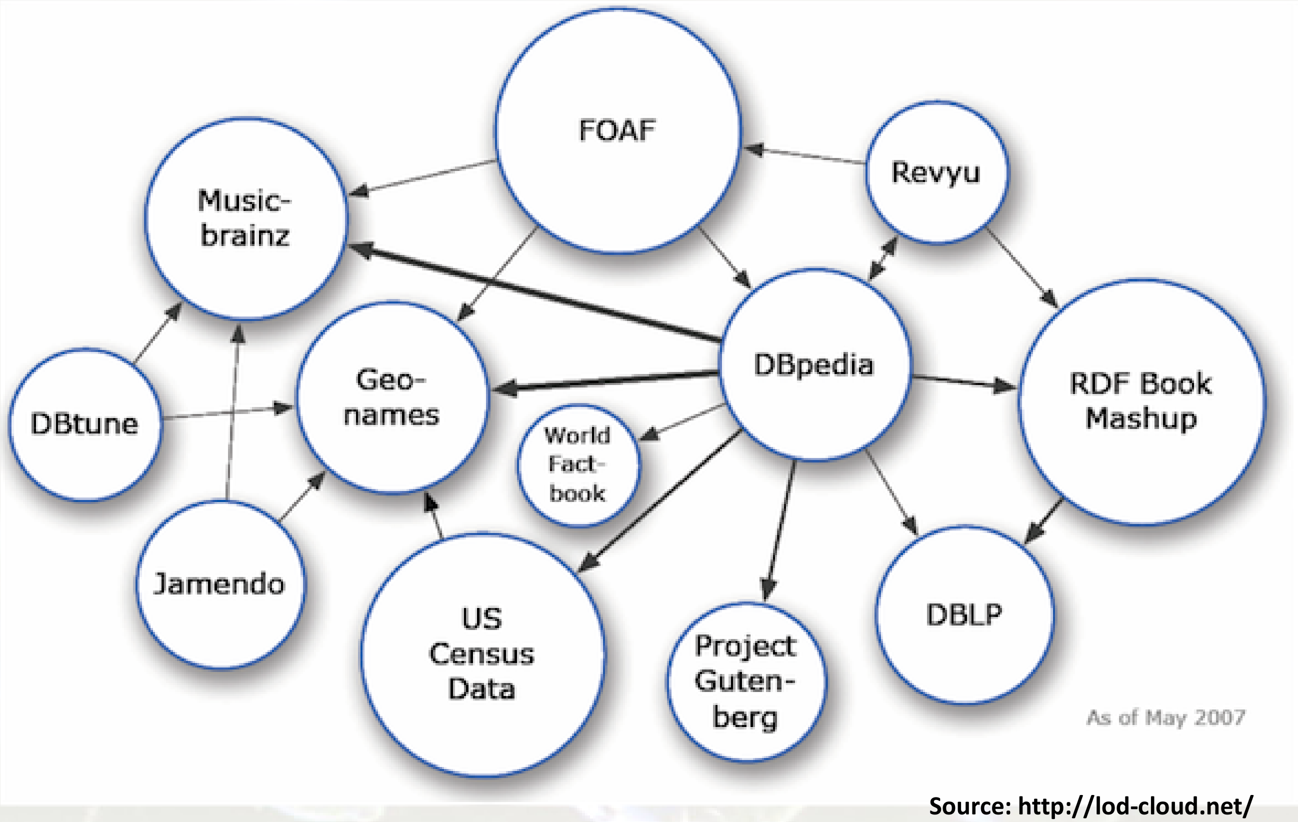
DBPedia – English

- **4 million things**
- 3.22 million classified in a consistent ontology
  - 832,000 persons
  - 639,000 places (427,000 populated)
  - 372,000 creative works
    - 116,000 music albums; 78,000 films; 18,500 video games
  - 209,000 organizations
  - 226,000 species
  - 5,600 diseases.

DBPedia – International

- 119 languages
- 24.9 million things
- 16.8 million interlinked with English
- 12.6 million unique things

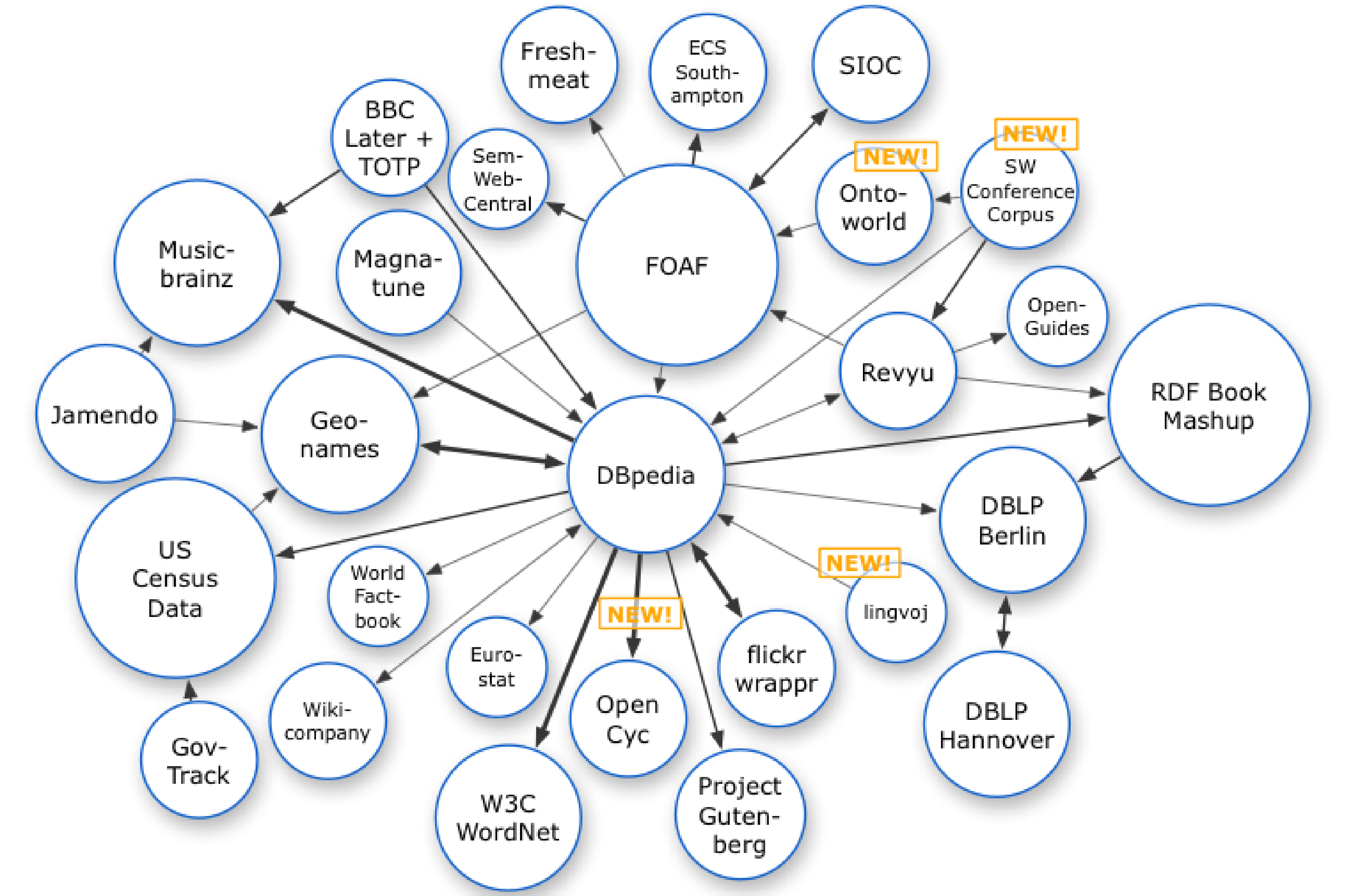
Linked Data



Source: http://lod-cloud.net/

Datasets published following Linked Data ‘format’: **05/2007**

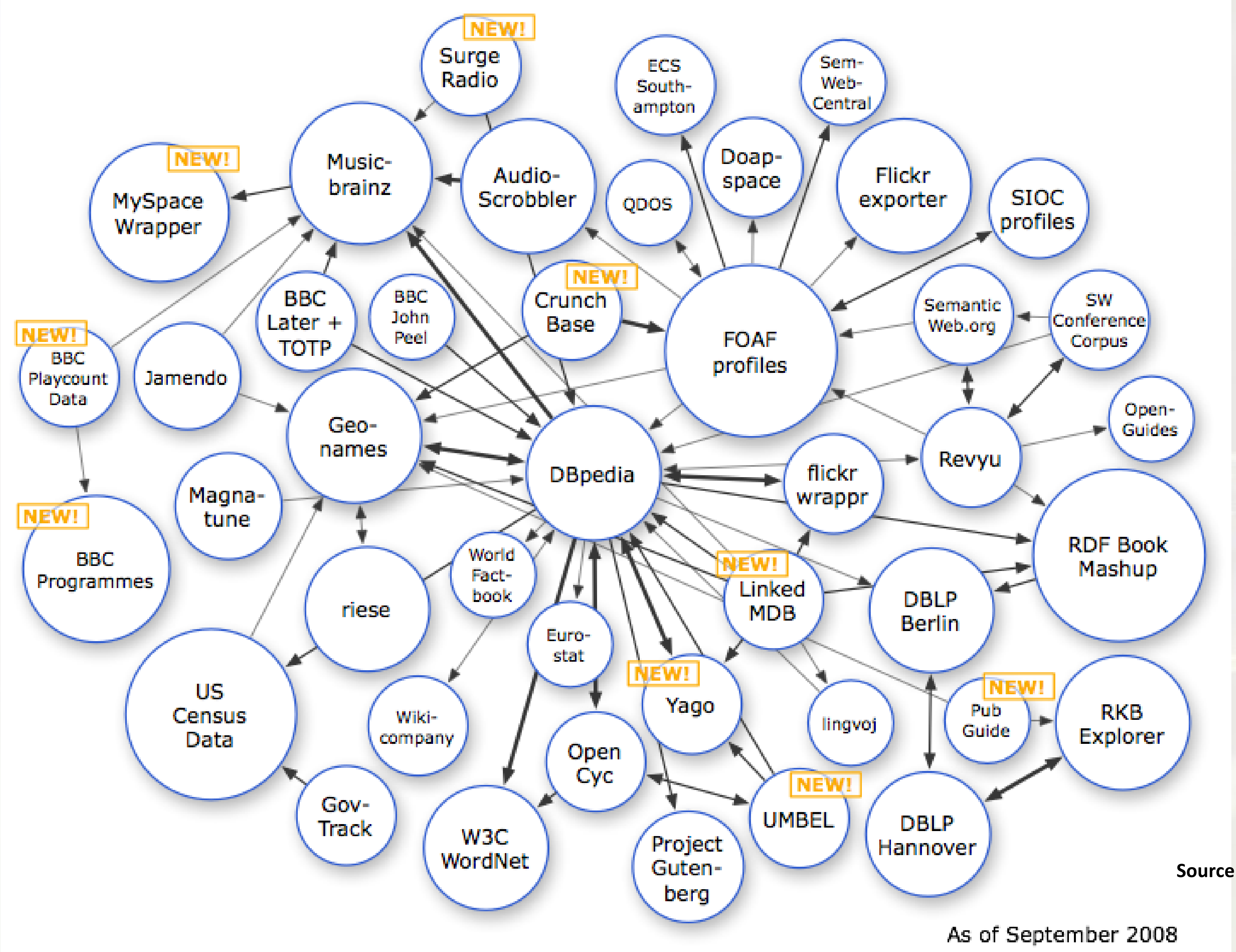
Linked Data



Source: http://lod-cloud.net/

Datasets published following Linked Data ‘format’: **11/2007**

Linked Data

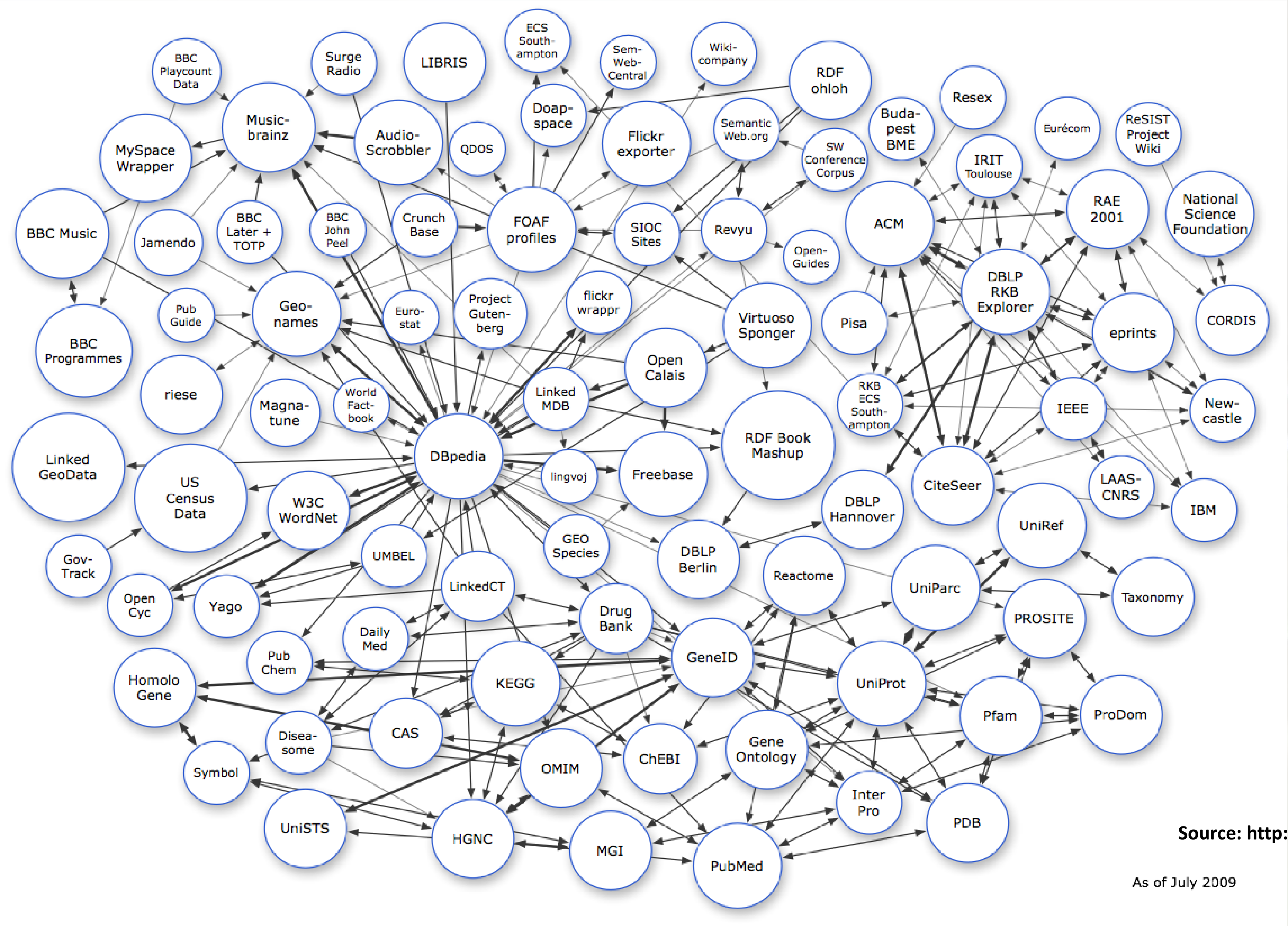


As of September 2008

Source: http://lod-cloud.net/

Datasets published following Linked Data ‘format’: **2008**

Linked Data

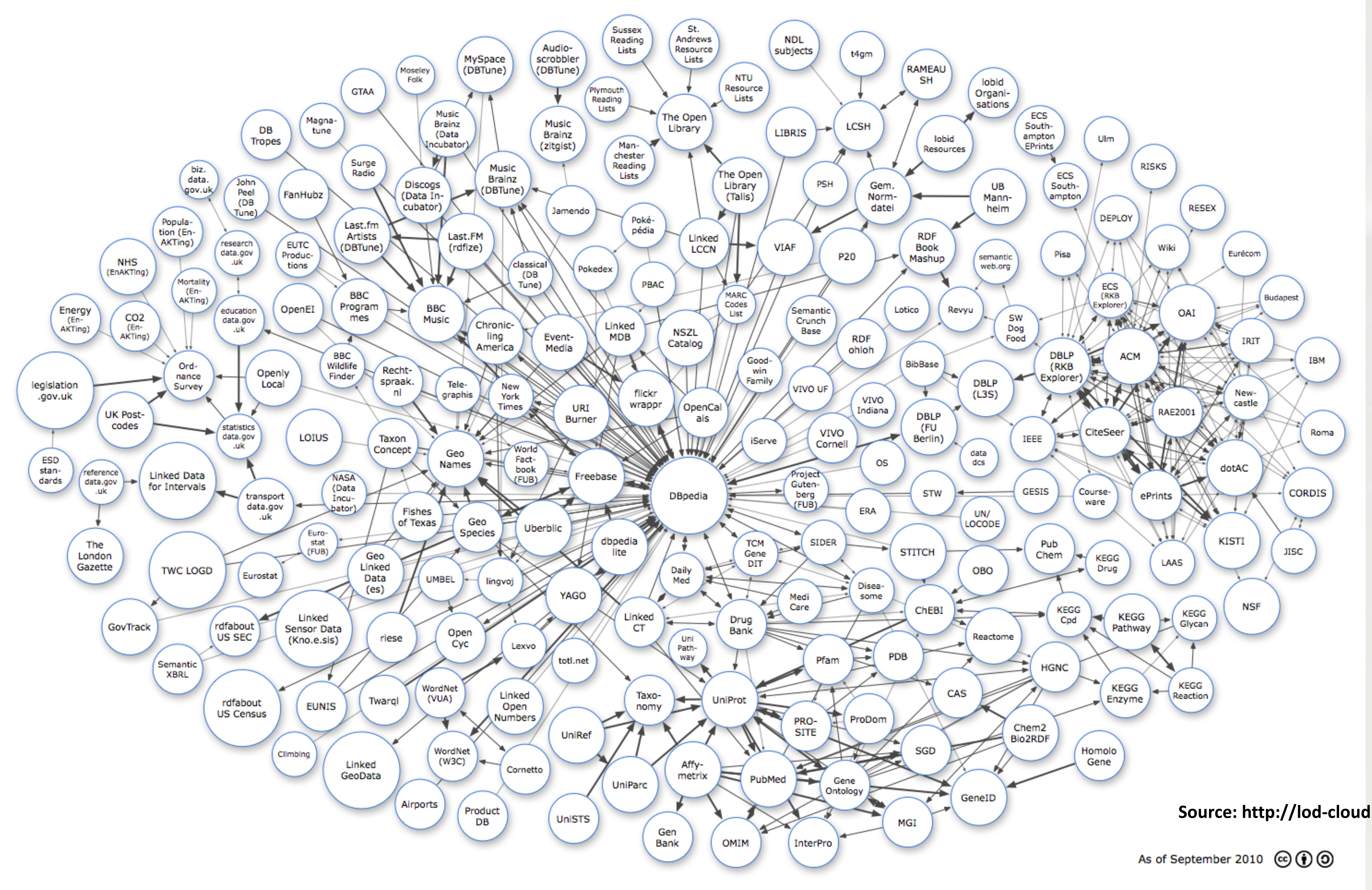


Source: http://lod-cloud.net/

As of July 2009

Datasets published following Linked Data 'format': **2009**

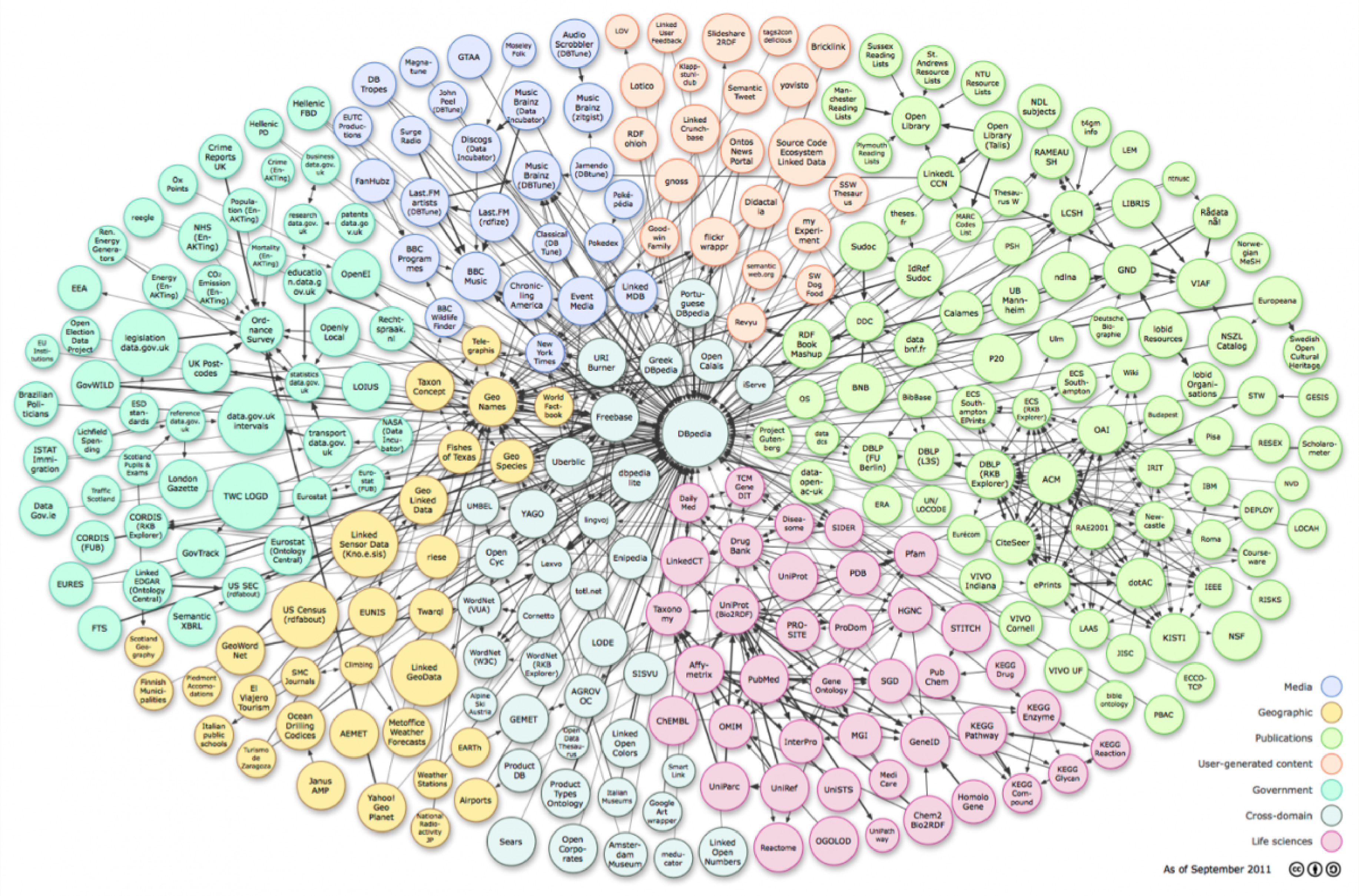
Linked Data



Source: http://lod-cloud.net/

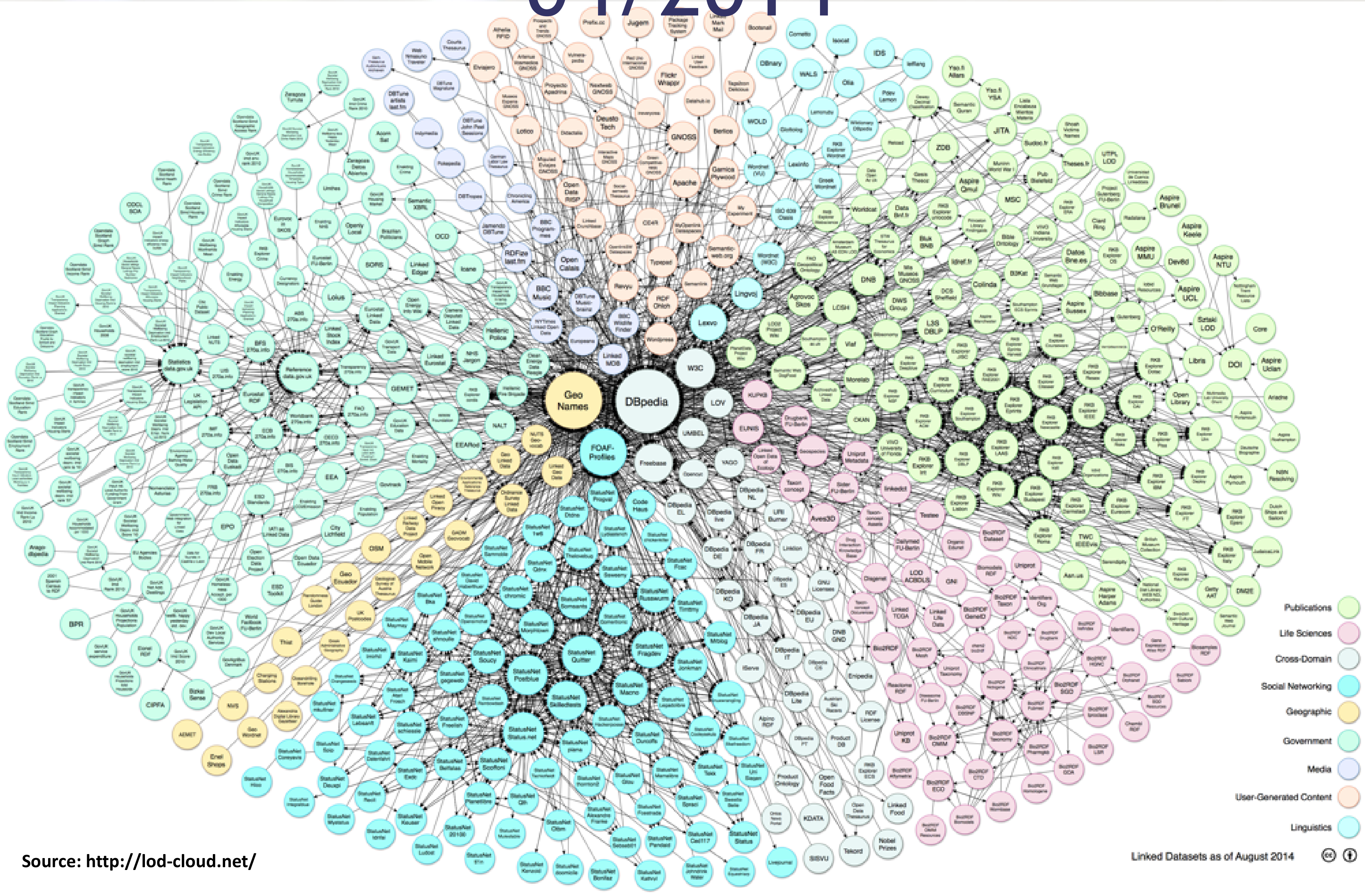
Datasets published following Linked Data 'format': **2010**

Linked Data



Datasets published following Linked Data 'format': **2011**

Linked Data 04/2014



Source: http://lod-cloud.net/

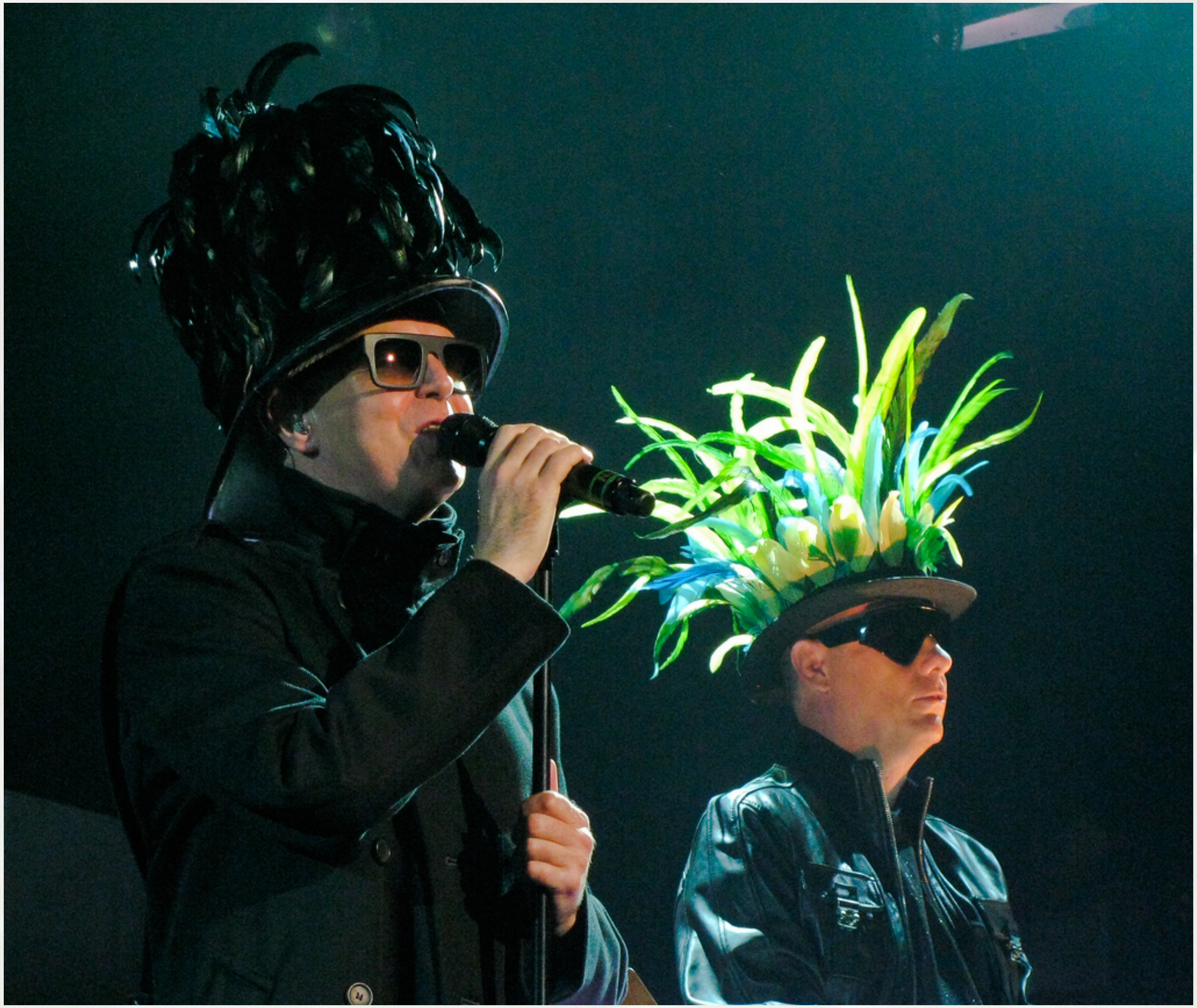
Why Graphs?

Social Networks and Social Content

Searching **Pet**

Pet Shop Boys

Anirudh Koul



pet shop boys, pet, concert, tour

cat, kittens, eyes, ears, pet, animal

dog, pet, alaskan malamute

dog, pet, animal, funny, glasses

cat, kitty, eyes, pretty

cat, kitten, garden, pet

recycle, pet, plastic bottle, polyethylene terephthalate

recycle, pet, plastic bottle, polyethylene terephthalate

wine, pet, bottle

sfroehlich1121

cat, kittens, eyes, ears, pet, animal

shorty_nz_2000

dog, pet, animal, funny, glasses

Edward Corpuz

dog, pet, alaskan malamute

sfroehlich1121

cat, kitty, eyes, pretty

Jay Woodworth

cat, kitten, garden, pet

Nemo's great uncle

recycle, pet, plastic bottle, polyethylene terephthalate

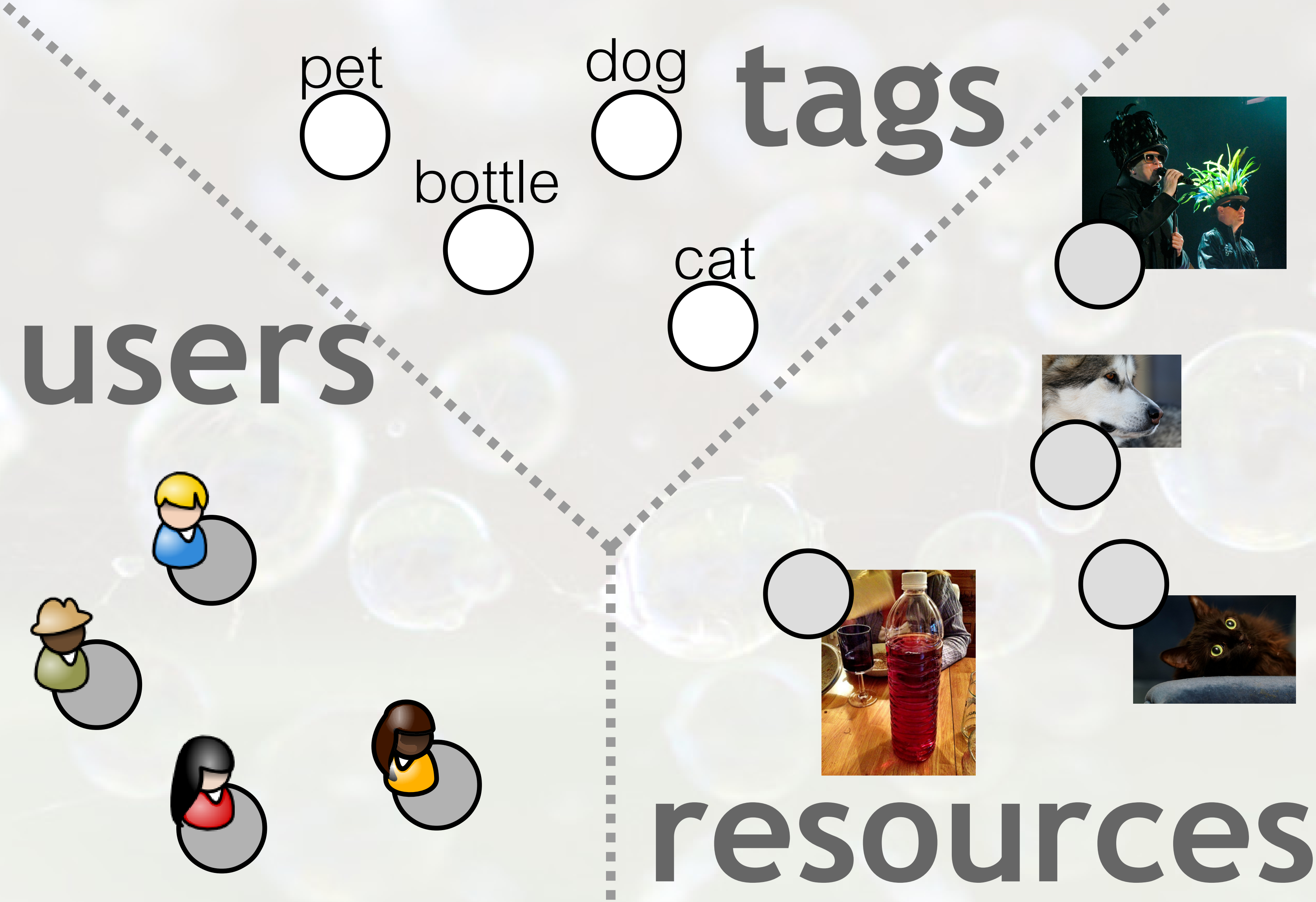
Karl Baron

wine, pet, bottle

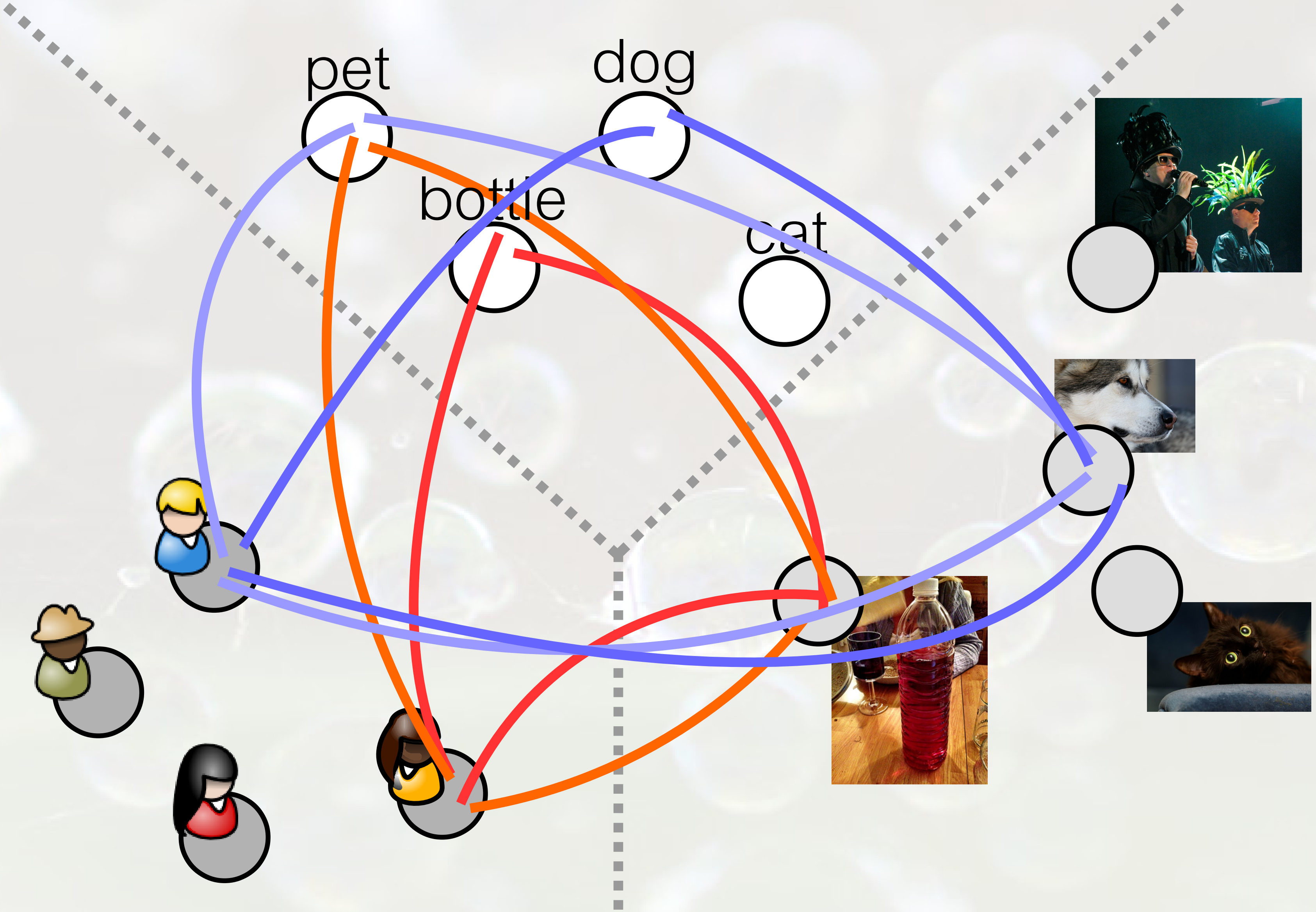
FaceMePLS

recycle, pet, plastic bottle, polyethylene terephthalate

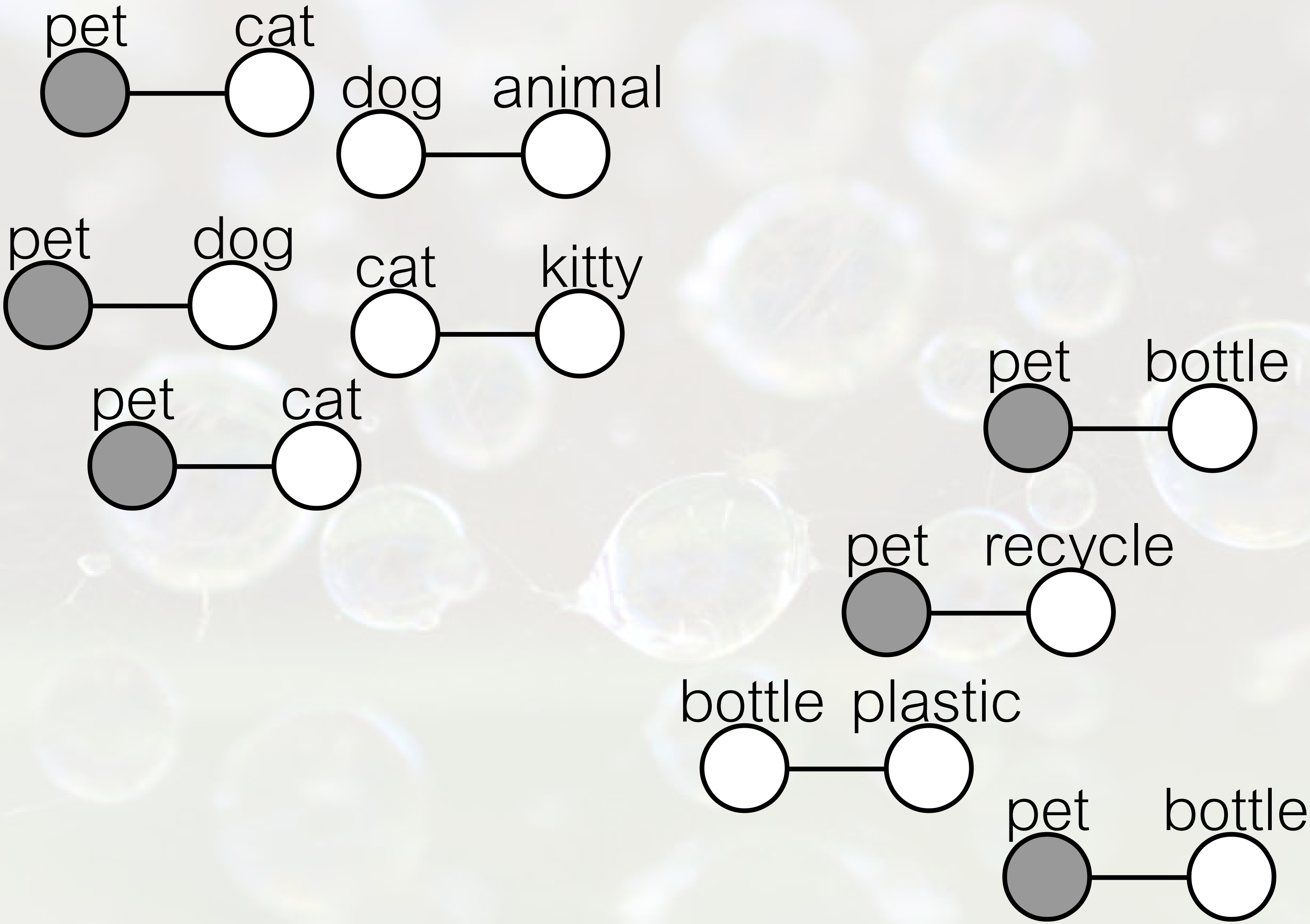
Graph users/tags/resources



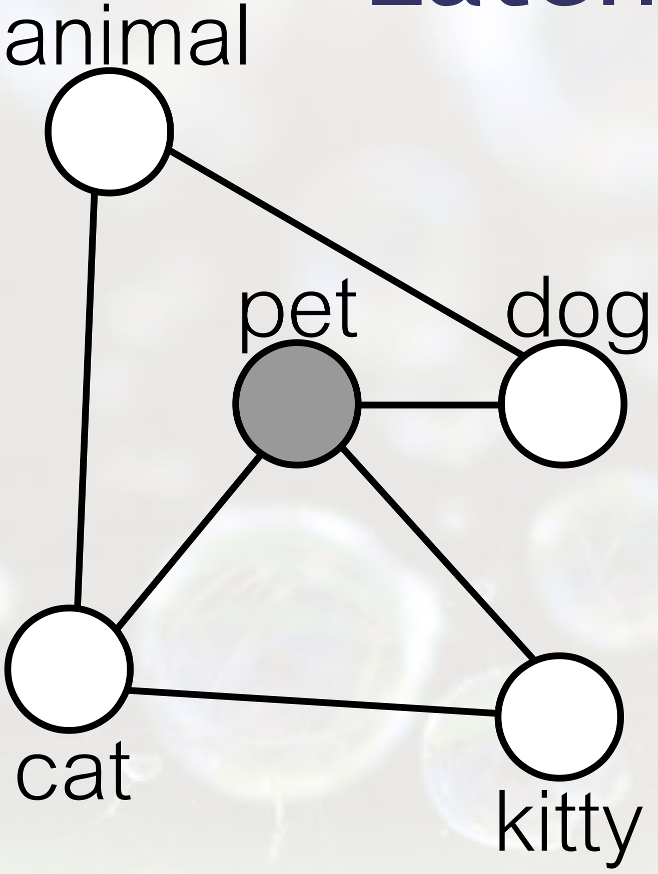
Graph users/tags/resources

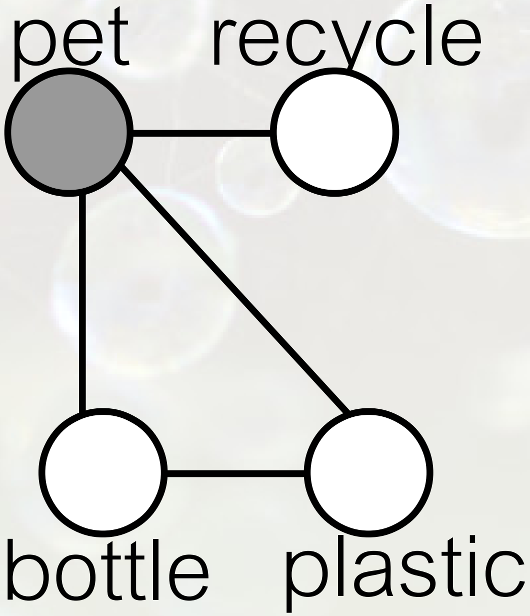


Co-ocurrences and Latent Semantics

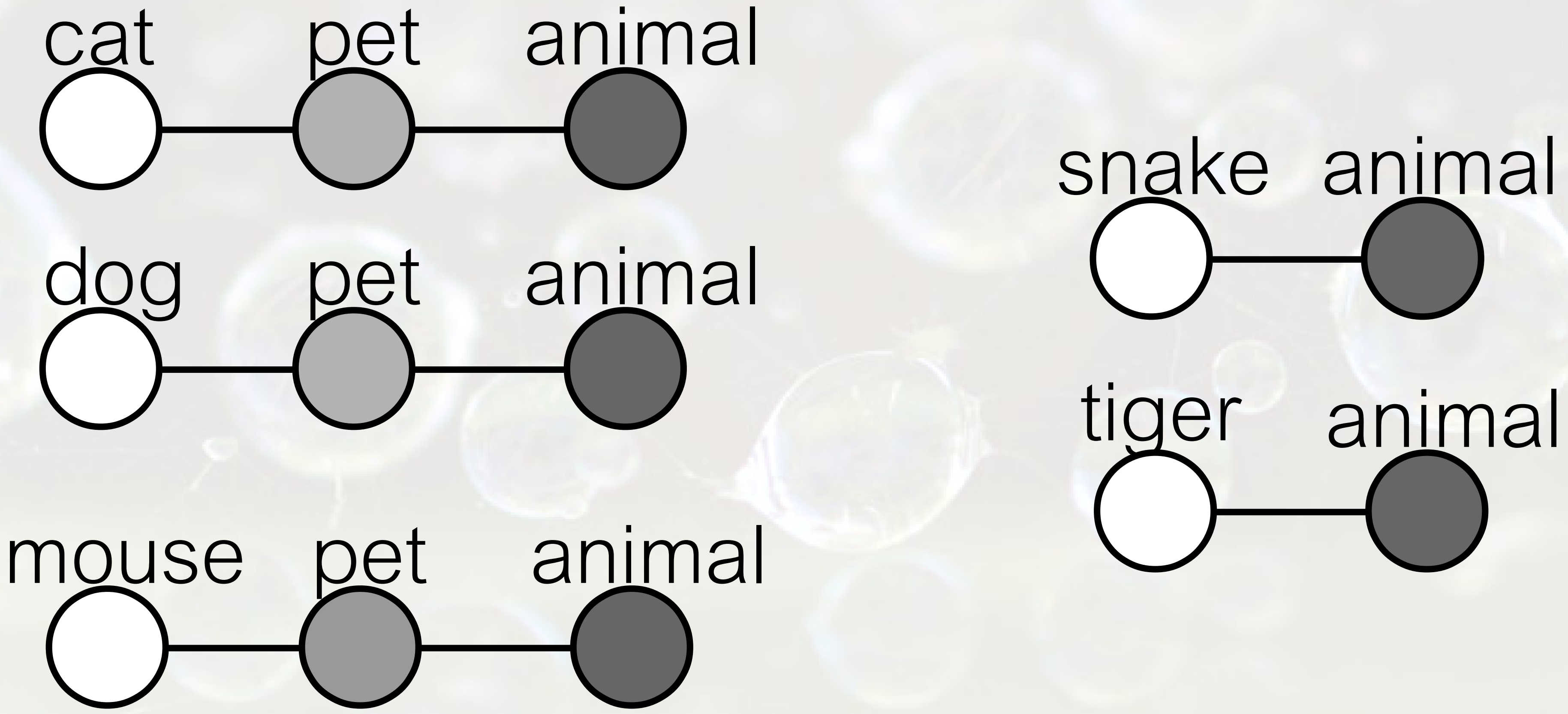


Co-ocurrences and Latent Semantics

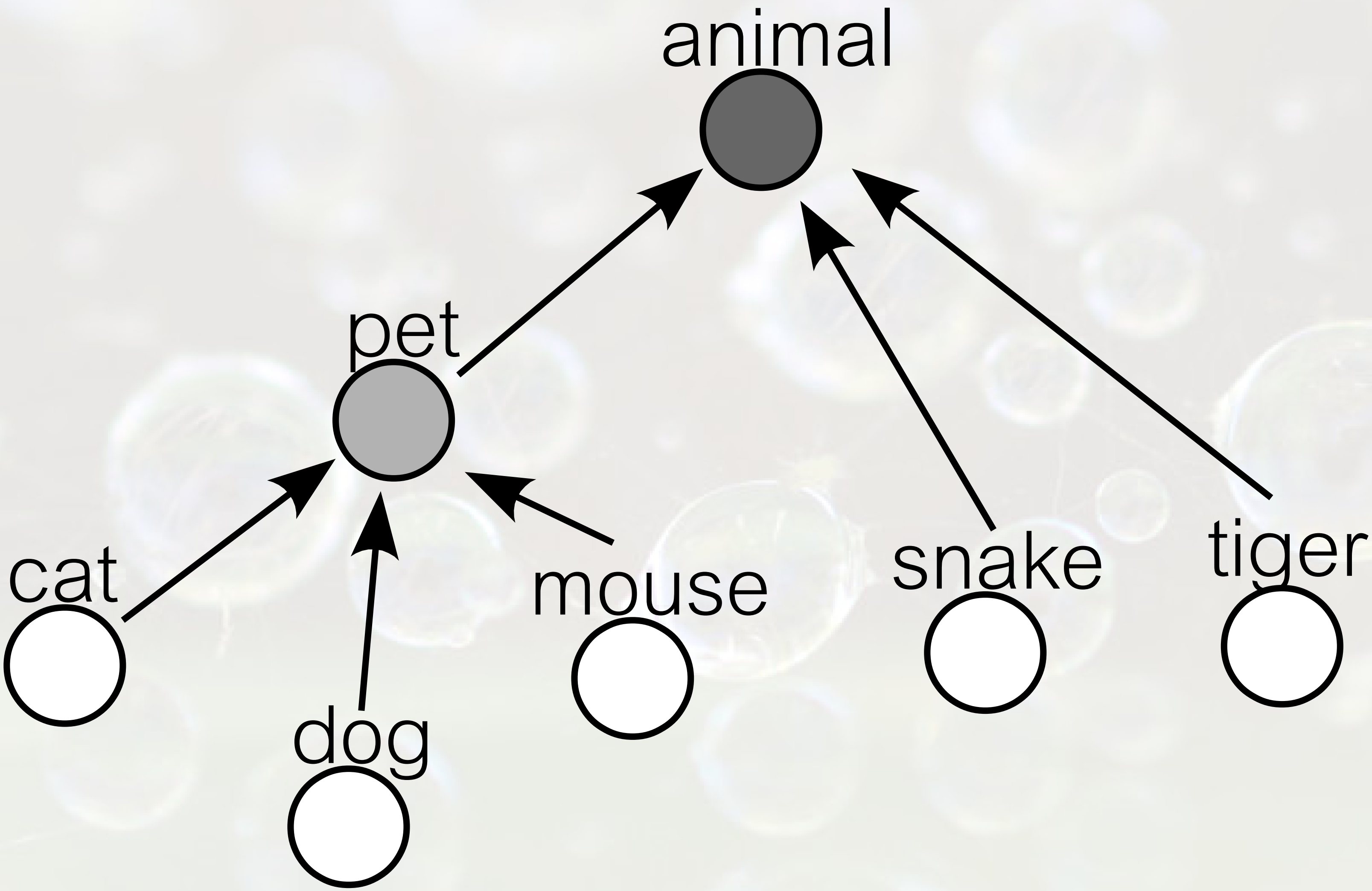




Co-ocurrences and Latent Semantics

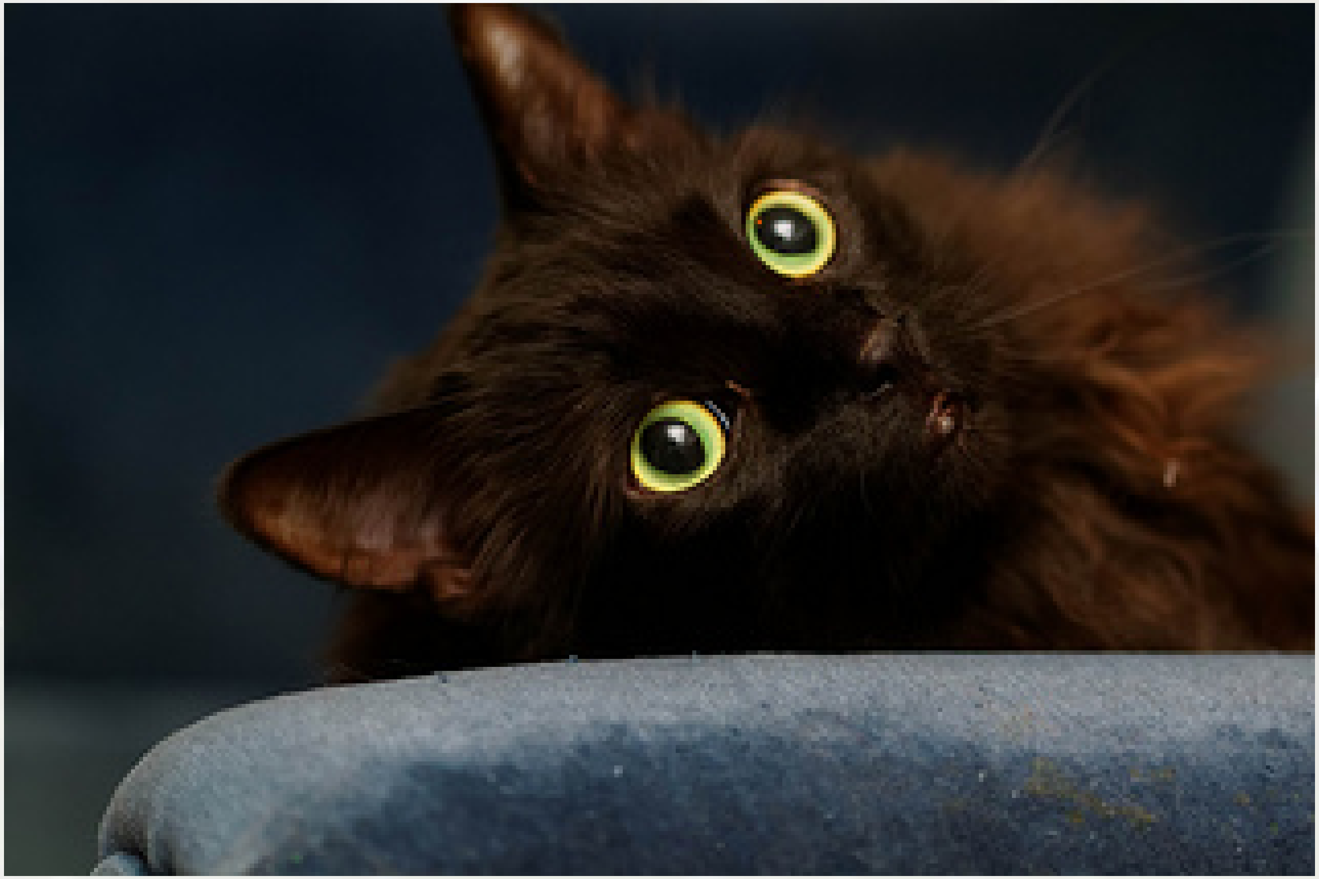


Co-ocurrences and Latent Semantics



Social Effect
Suggested/Reinforced Tags

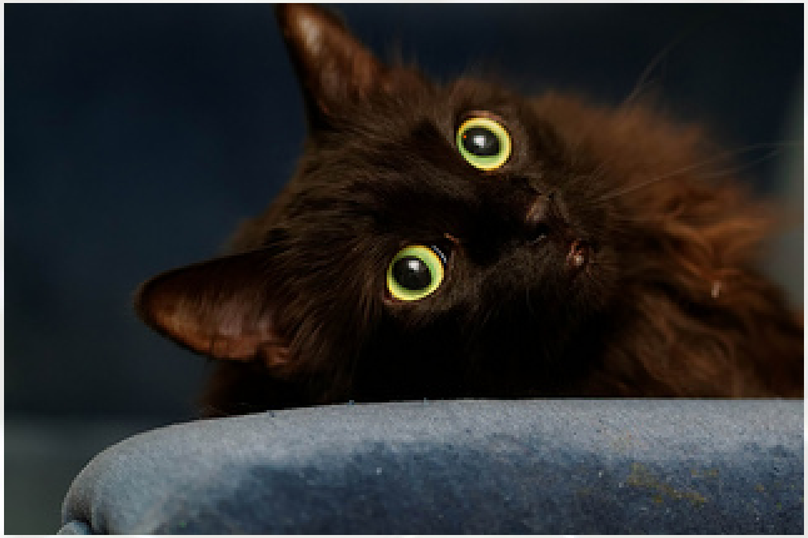
sfroehlich1121



black, cat, kitty, katze, long, hair, blue, eyes, pretty, canon, t1i, 500d, ef 100mm f/2.8 usm macro

Social Effect
Suggested/Reinforced Tags

sfroehlich1121



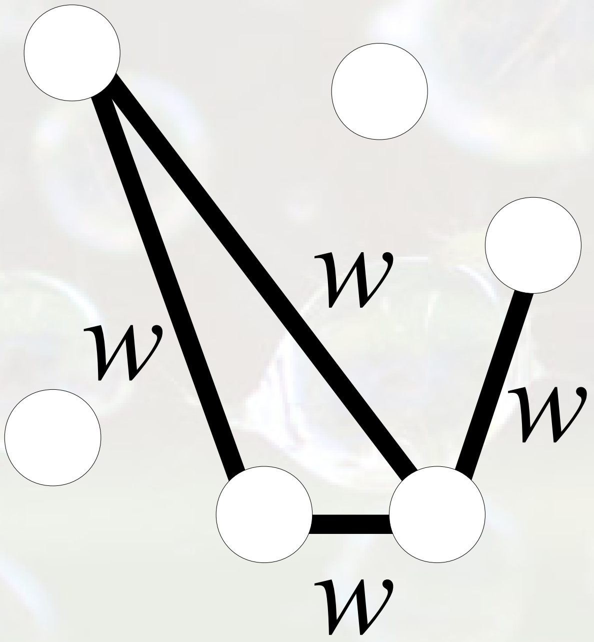
black, cat, kitty, katze, long,

hair, blue, eyes, pretty,

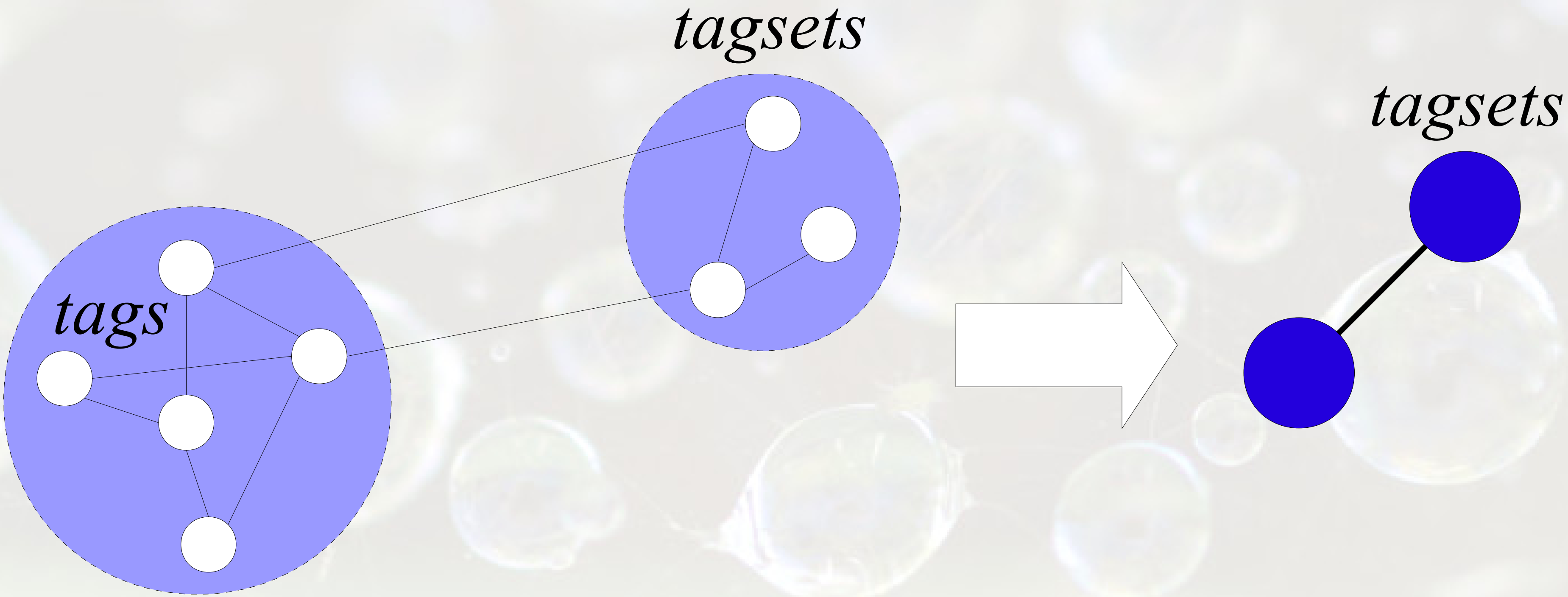
canon, t1i, 500d, ef 100mm f/2.8 usm macro

M1
co-occurrences in a folksonomy

tags / co-occurrences

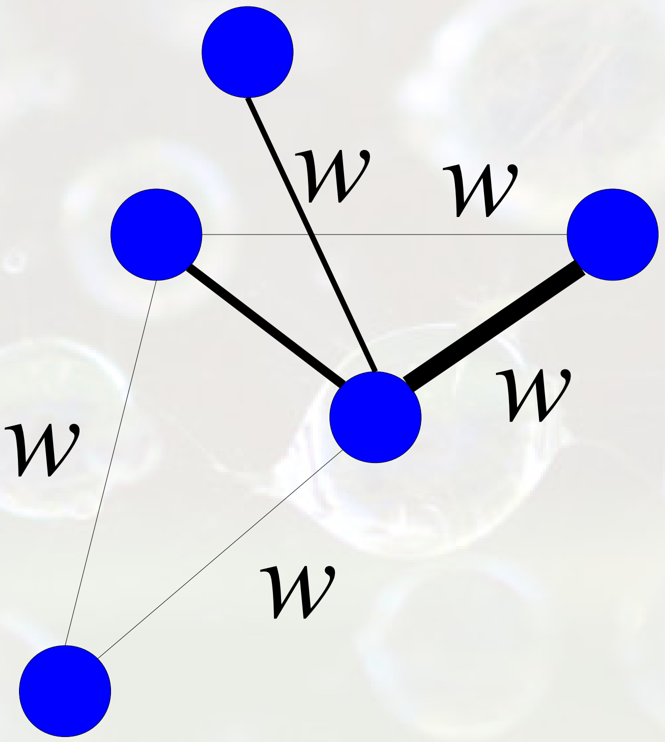


Tagsets



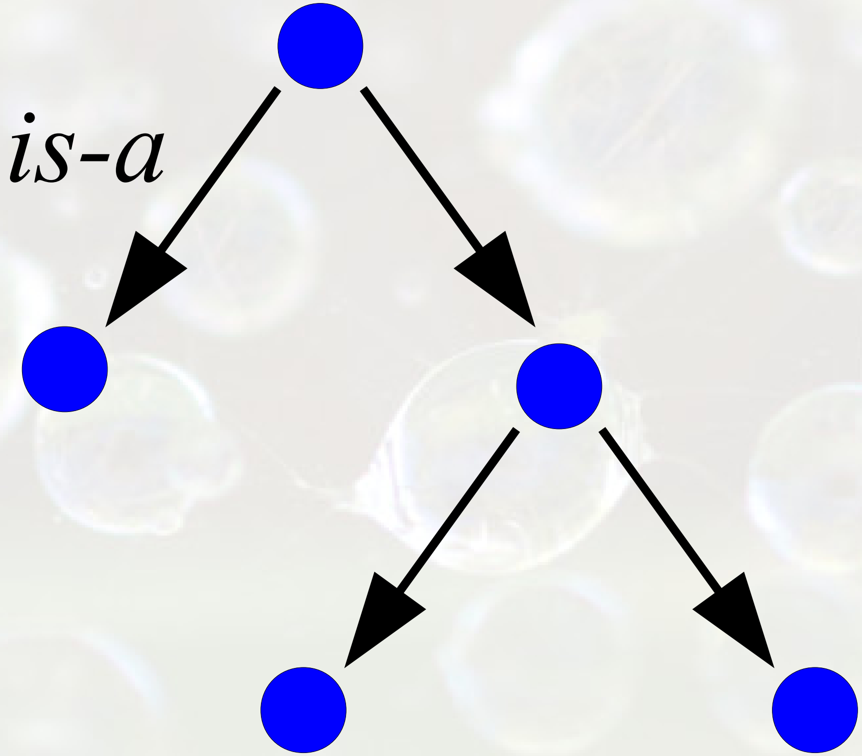
M2
tagsets and their co-occurrences

tagsets/co-occurrences



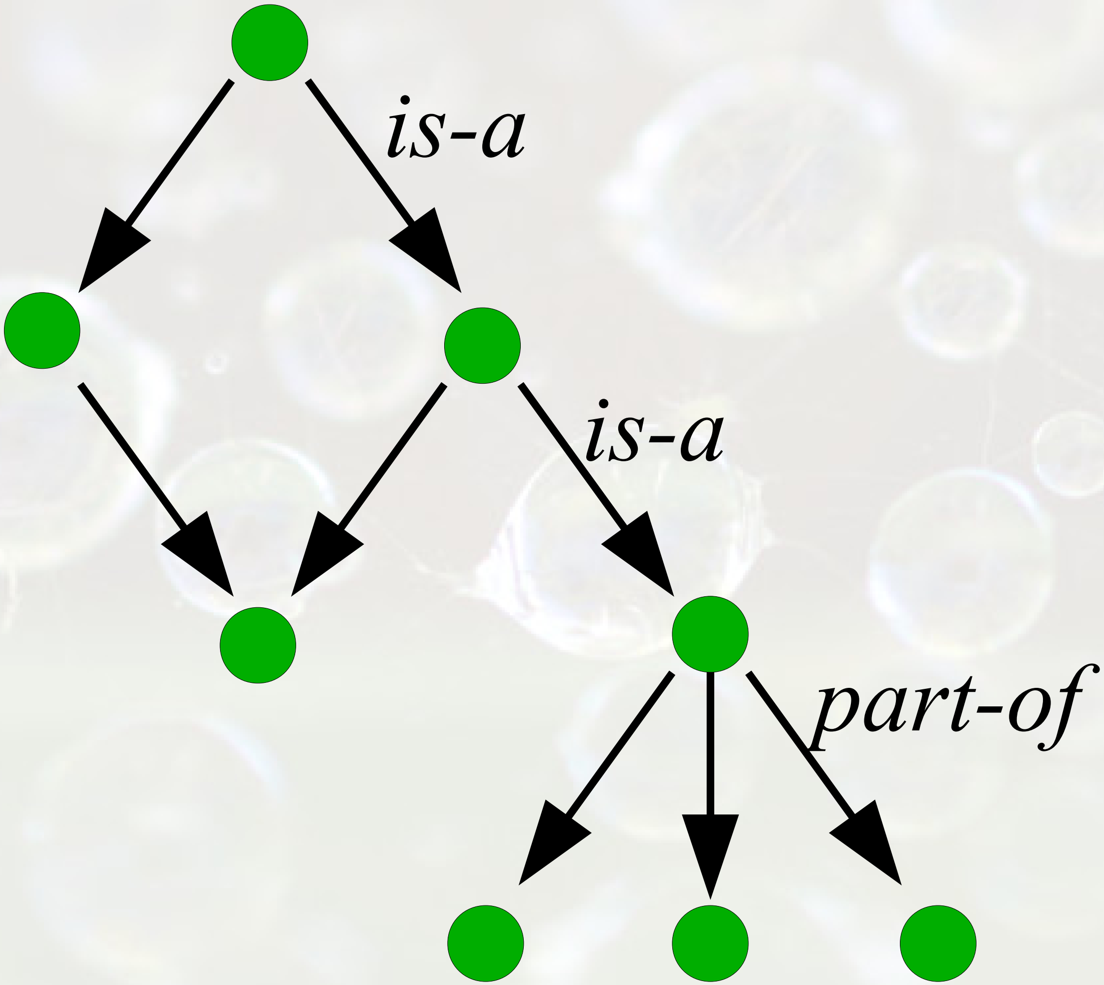
M4
Social Ontology

tagsets / typed relations



M3
simplified model of an ontology

concepts/relations

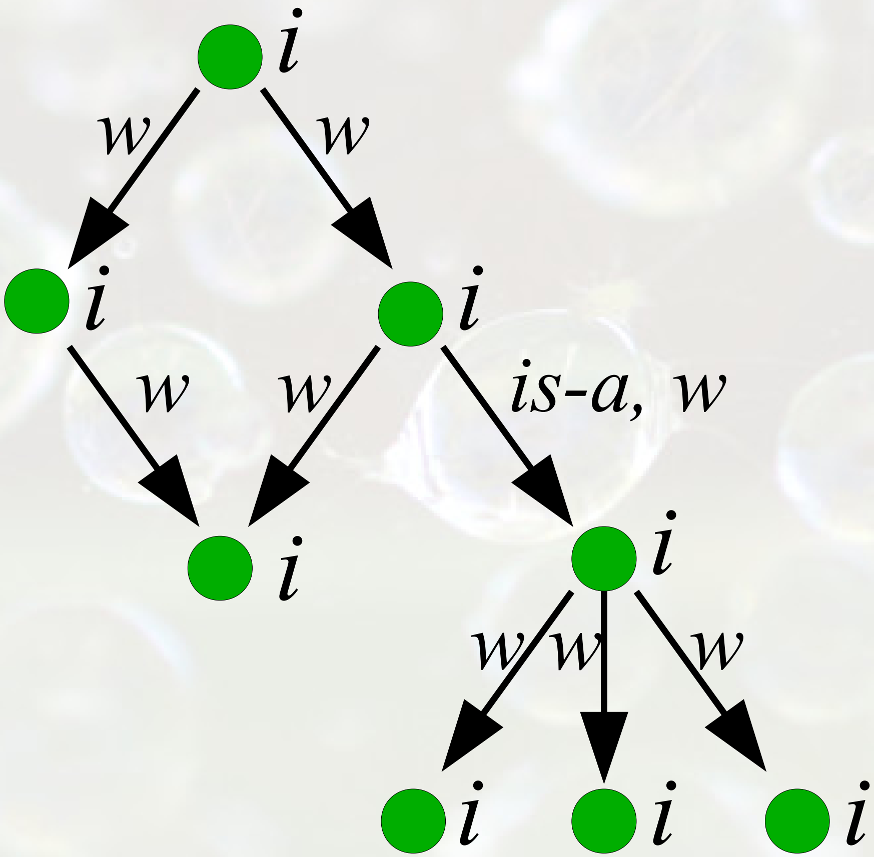


M5
Folksonomized Ontology (FO)

concepts / typed relations (ontology)

+

information content / co-occurrences (folksonomy)



Meaning of Pet
needs
meaning of other tags?

Matrix

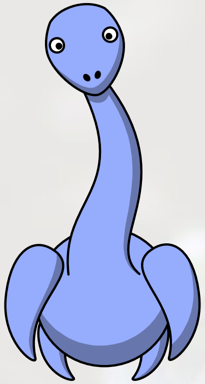
What is the meaning of the word Love?

Why Graphs?

Sharing and Interconnecting

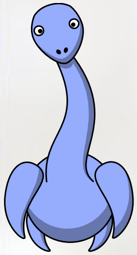
Models to Describe

Describing Prehistoric Animals



MNHN A. C. 8592		
Is a	Plesiosaurus dolichodeirus	
Origin	Lyme Regis	England
Recognized	1824	
Size	5	

Describing Prehistoric Animals



SIPB R 90

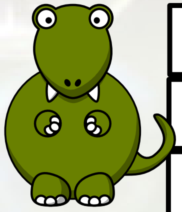
Is a	Plesiosaurus dolichodeirus	
Origin	Lyme Regis	England
Recognized	1830	
Size	5	

STC223

Is a	Plesiosaurus gurgitis	
Origin	St. Croix	Switzerland
Recognized	1964	
Size	3.5	

MNHN 1912.20

Is a	Triceratops horridus	
Origin	Lance Creek	EUA
Recognized	1889	
Size	9	



Sue

FMNH PR2081

Is a	Tyrannosaurus rex	
Origin	Hell Creek	EUA
Recognized	1990	
Size	12.3	

Table

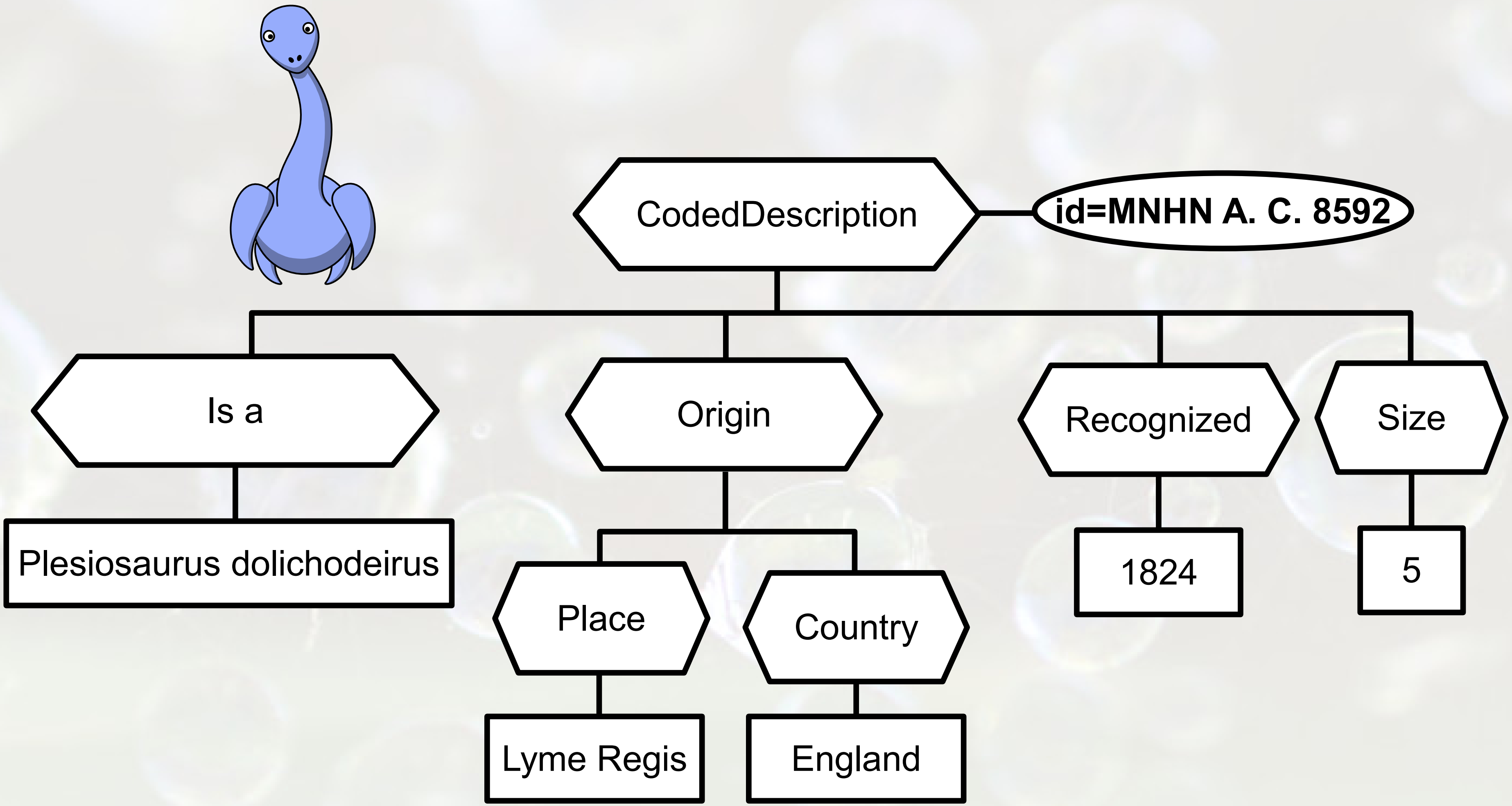
Id	Is a	Origin Place	Origin Country	Recognized	Size
MNHN A. C. 8592	Plesiosaurus dolichodeirus	Lyme Regis	England	1824	5
SIPB R 90	Plesiosaurus dolichodeirus	Lyme Regis	England	1830	5
STC223	Plesiosaurus gurgitis	St. Croix	Switzerland	1964	3.5
MNHN 1912.20	Triceratops horridus	Lance Creek	EUA	1889	9
FMNH PR2081	Tyrannosaurus rex	Hell Creek	EUA	1990	12.3

Table

Excellent to Manage Data with Predictable Static Schema

Sharing?

Documents and XML



CodedDescription

id=MNHN A. C. 8592

Is a

Plesiosaurus dolichodeirus

Origin

Place

Lyme Regis

Country

England

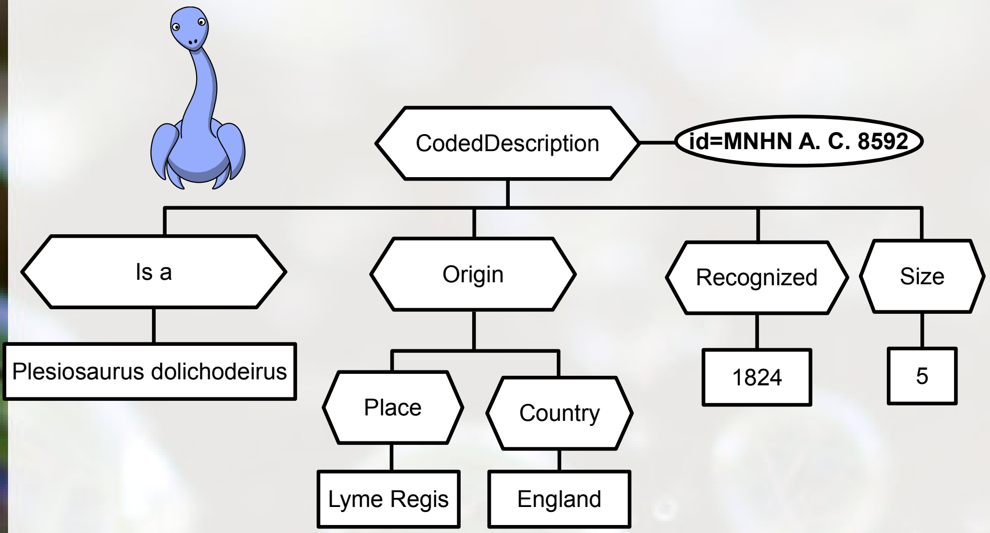
Recognized

1824

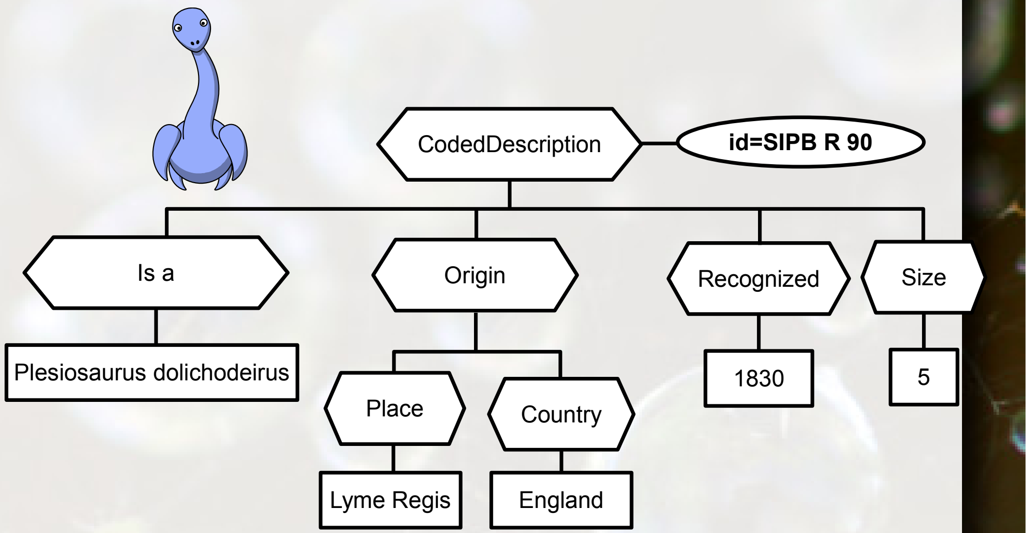
Size

5

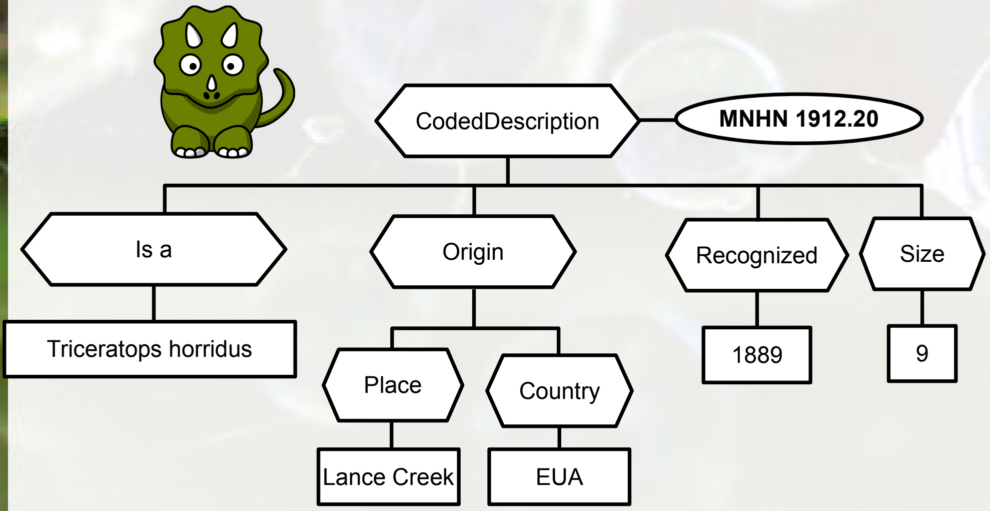
Documents and XML



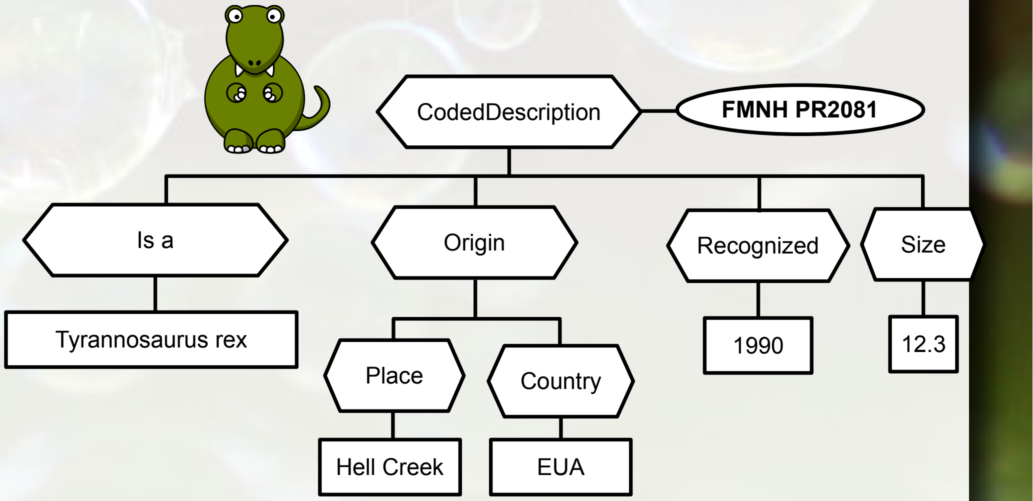
- CodedDescription — id=MNHN A. C. 8592
  - Is a
    - Plesiosaurus dolichodeirus
  - Origin
    - Place
      - Lyme Regis
    - Country
      - England
  - Recognized
    - 1824
  - Size
    - 5



- CodedDescription — id=SIPB R 90
  - Is a
    - Plesiosaurus dolichodeirus
  - Origin
    - Place
      - Lyme Regis
    - Country
      - England
  - Recognized
    - 1830
  - Size
    - 5



- CodedDescription — MNHN 1912.20
  - Is a
    - Triceratops horridus
  - Origin
    - Place
      - Lance Creek
    - Country
      - EUA
  - Recognized
    - 1889
  - Size
    - 9



- CodedDescription — FMNH PR2081
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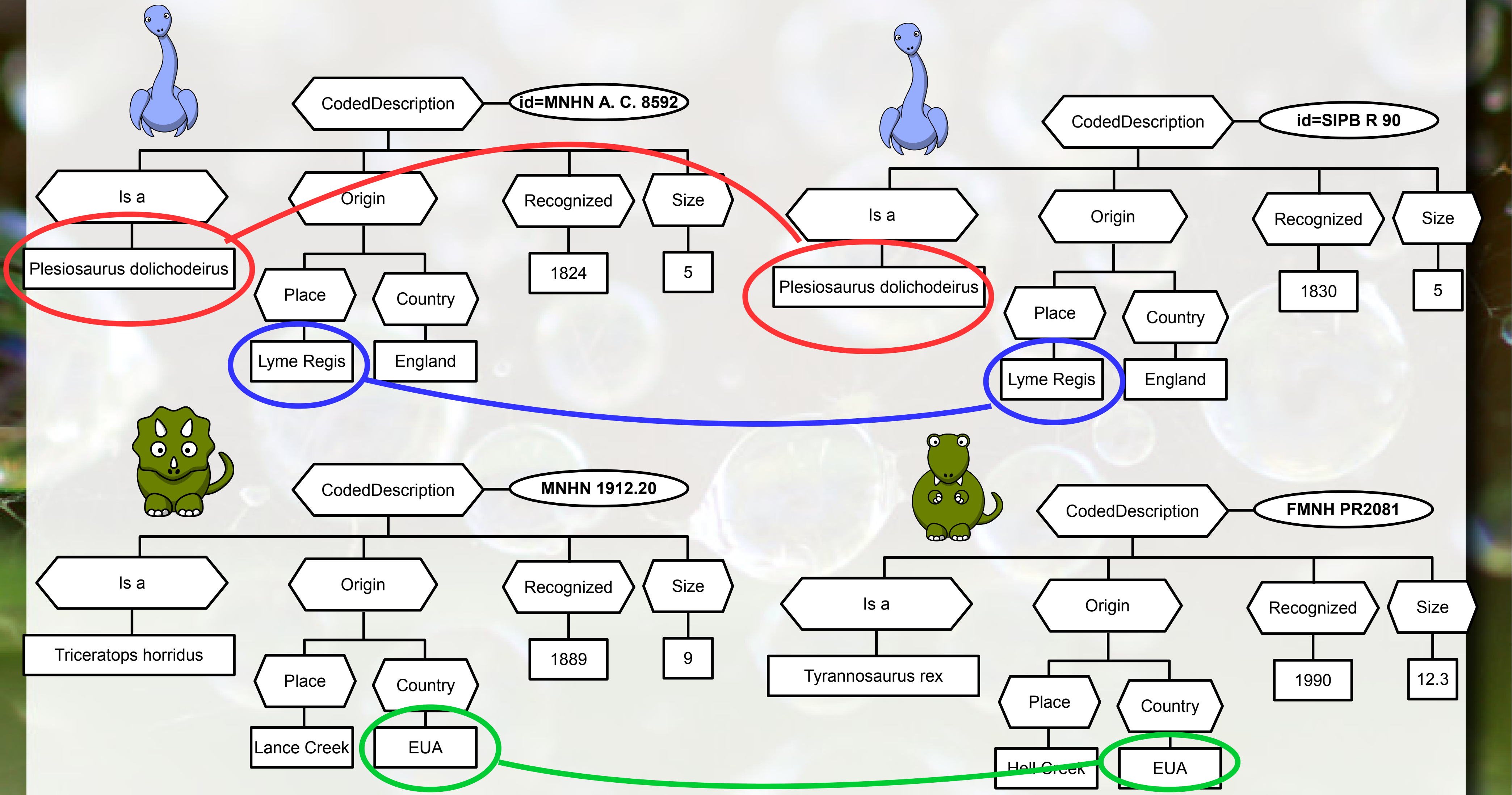
    - Tyrannosaurus rex
  - Origin
    - Place
      - Hell Creek
    - Country
      - EUA
  - Recognized
    - 1990
  - Size
    - 12.3

Documents and XML



CodedDescription
id=MNHN A. C. 8592
Is a
Plesiosaurus dolichodeirus
Origin
Place
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Country
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1824
Size
5

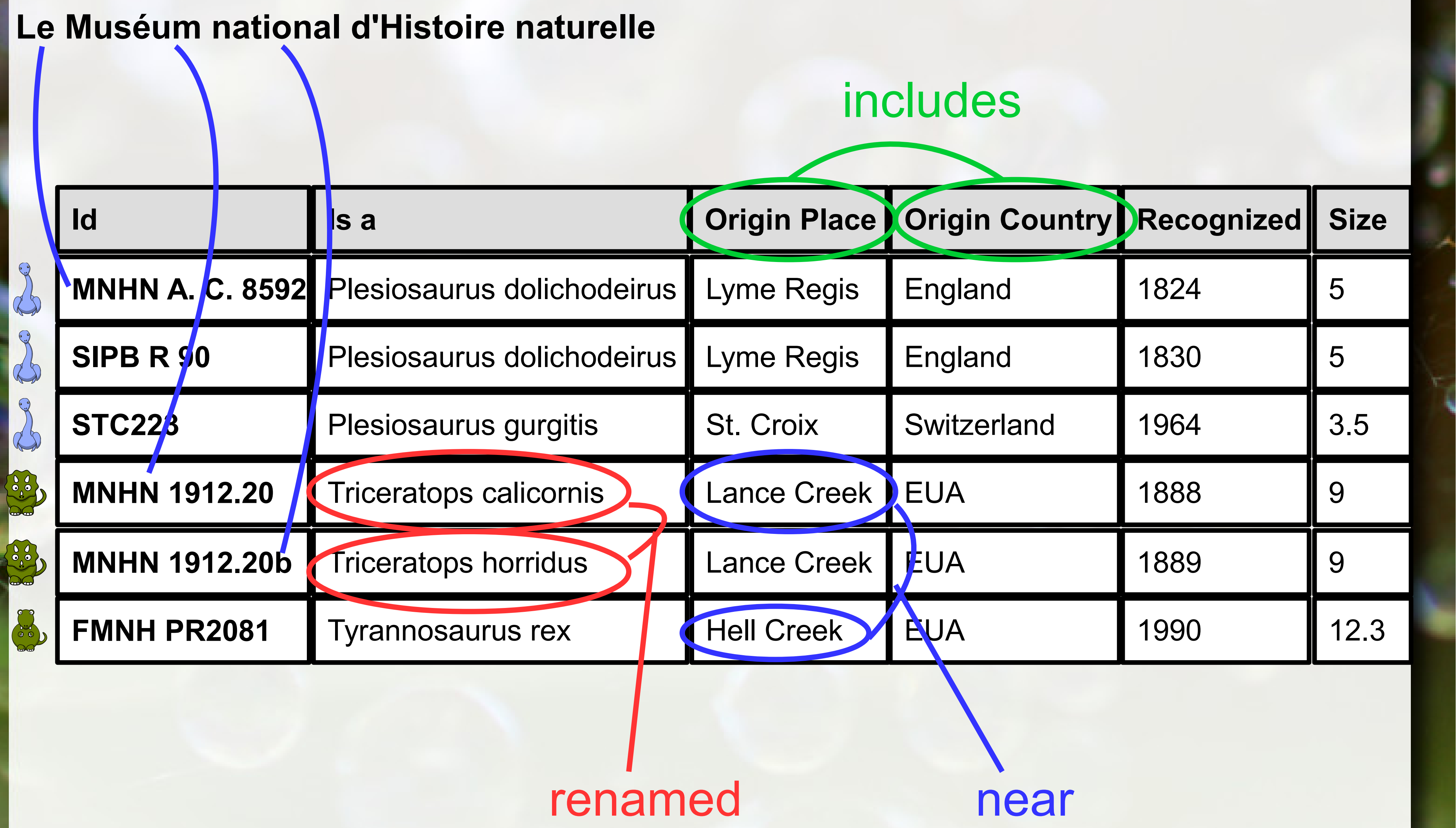
CodedDescription
id=SIPB R 90
Is a
Plesiosaurus dolichodeirus
Origin
Place
Lyme Regis
Country
England
Recognized
1830
Size
5

CodedDescription
MNHN 1912.20
Is a
Triceratops horridus
Origin
Place
Lance Creek
Country
EUA
Recognized
1889
Size
9

CodedDescription
FMNH PR2081
Is a
Tyrannosaurus rex
Origin
Place
Hell Creek
Country
EUA
Recognized
1990
Size
12.3

How much hierarchical is your data?

Back to the Table



Le Muséum national d'Histoire naturelle

includes

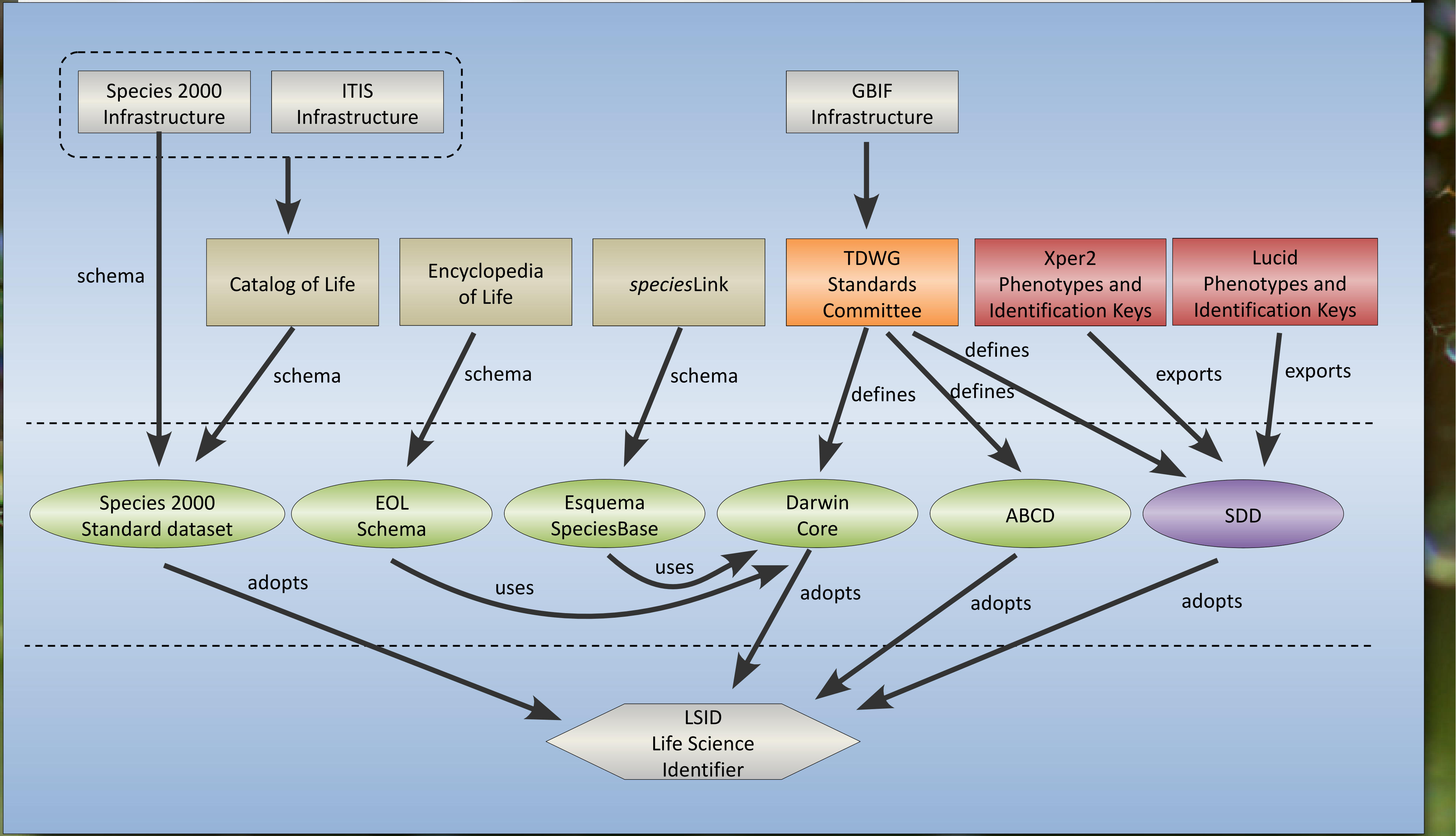
Id	Is a	Origin Place	Origin Country	Recognized	Size
MNHN A. C. 8592	Plesiosaurus dolichodeirus	Lyme Regis	England	1824	5
SIPB R 90	Plesiosaurus dolichodeirus	Lyme Regis	England	1830	5
STC223	Plesiosaurus gurgitis	St. Croix	Switzerland	1964	3.5
MNHN 1912.20	Triceratops calicornis	Lance Creek	EUA	1888	9
MNHN 1912.20b	Triceratops horridus	Lance Creek	EUA	1889	9
FMNH PR2081	Tyrannosaurus rex	Hell Creek	EUA	1990	12.3

renamed

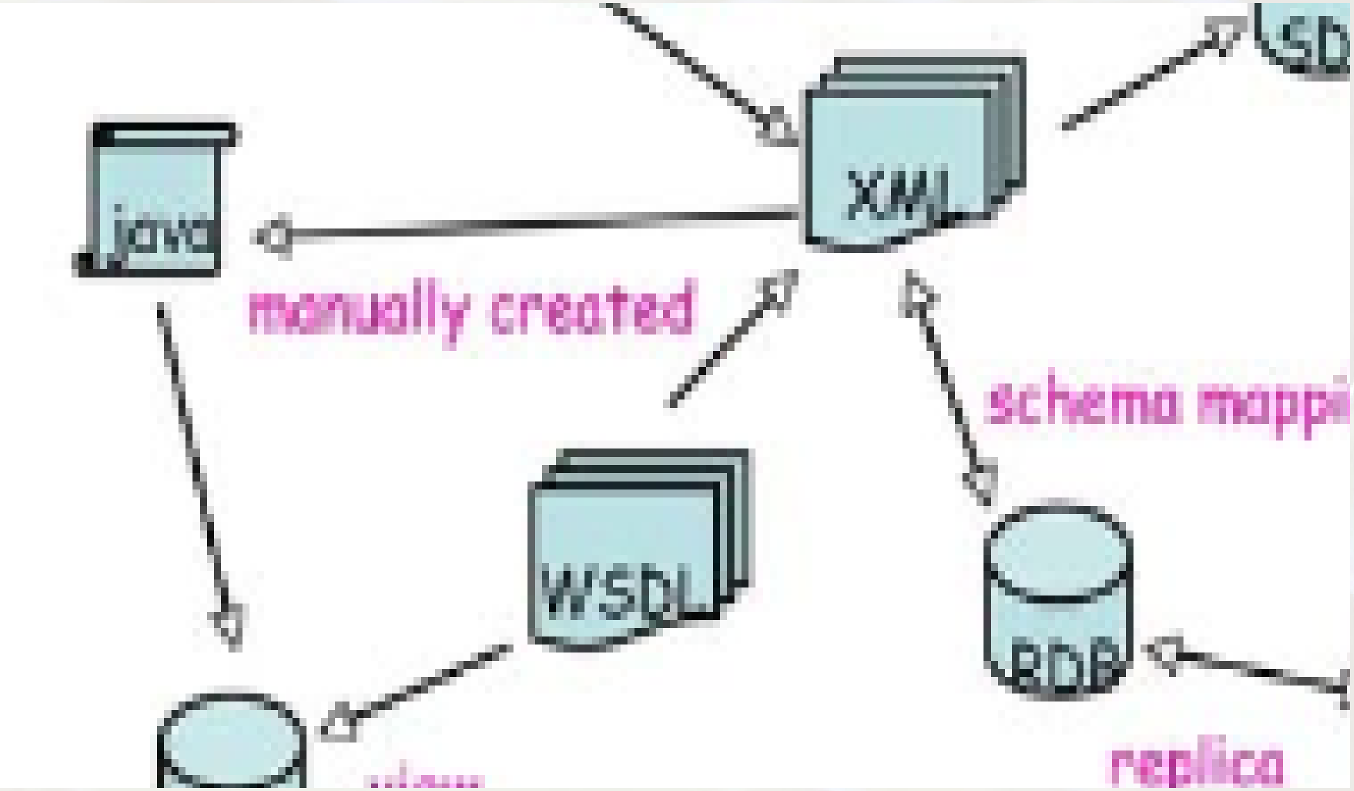
near

The tradeoff of Static Schemas

XML Schema
Not designed to mix



DataSpaces
Pay-as-you-go Integration



Franklin, M., Halevy, A., & Maier, D. (2005). From databases to dataspaces: a new abstraction for information management. SIGMOD Rec., 34(4), 27–33.

DataSpaces and Linked Data

Why Graphs?

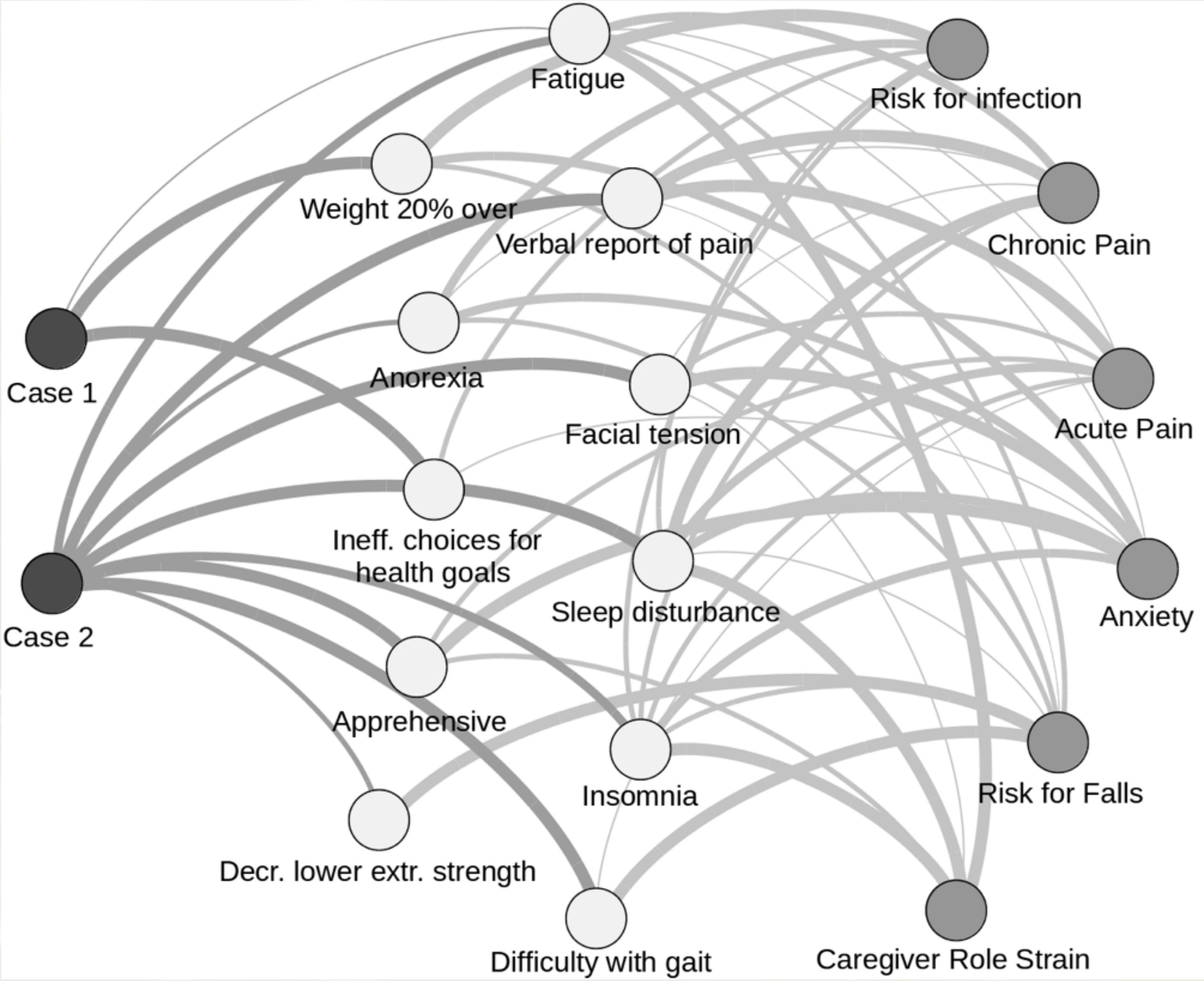
Complex Networks

Complex Networks

- Developed steadily since 1999
- Discrete systems are represented in terms of entities and relationships

(Luciano da F. Costa, 2013)

Patient x Diagnosis



(Gomes-Jr, 2013)

Complex Networks

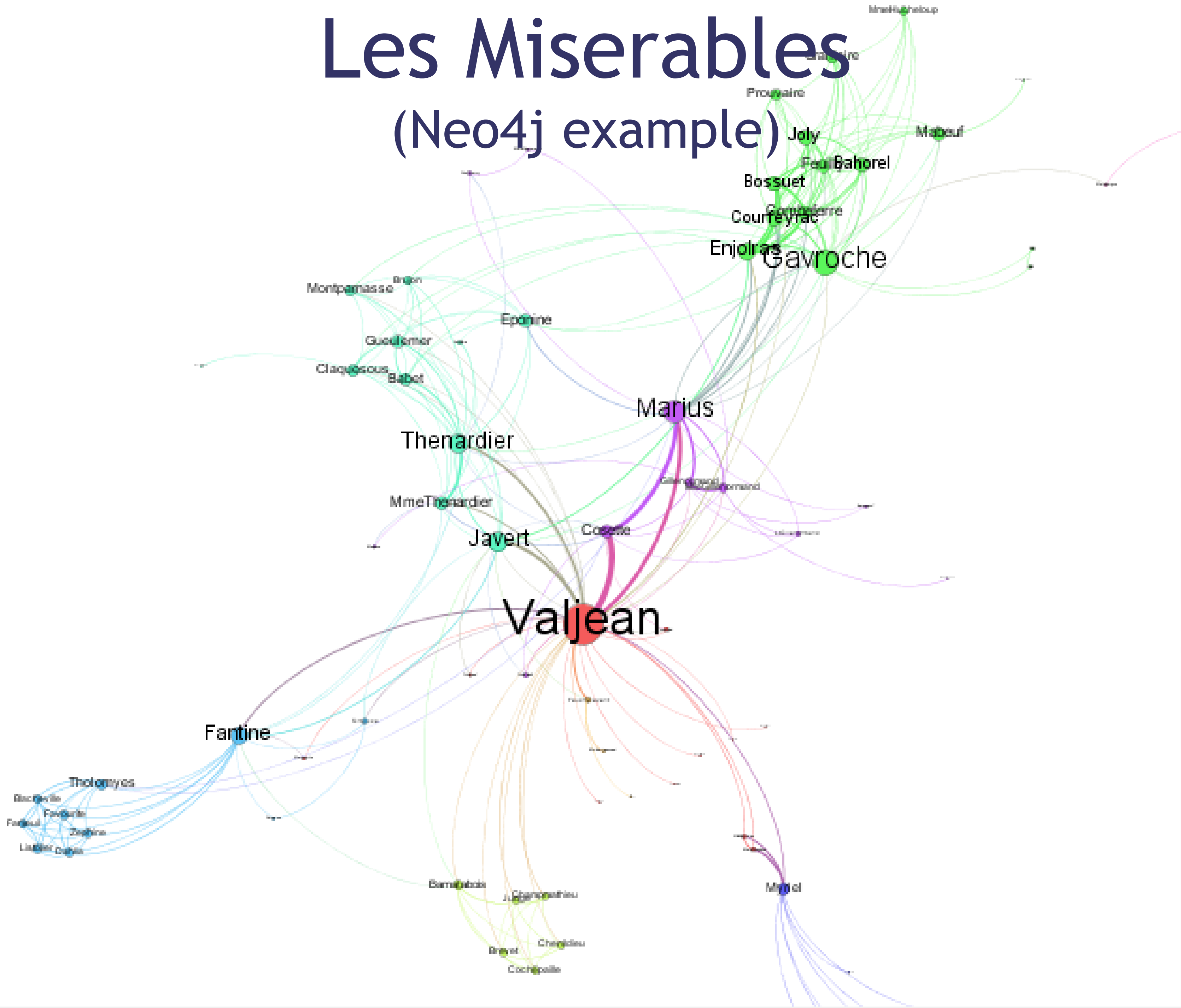
- Physical relationships
  - neurons – nodes; connections – edges
- Force relationships
  - grains – nodes; force vectors – edges
- Social relationships
- Conceptual relationships

Complex Networks Examples

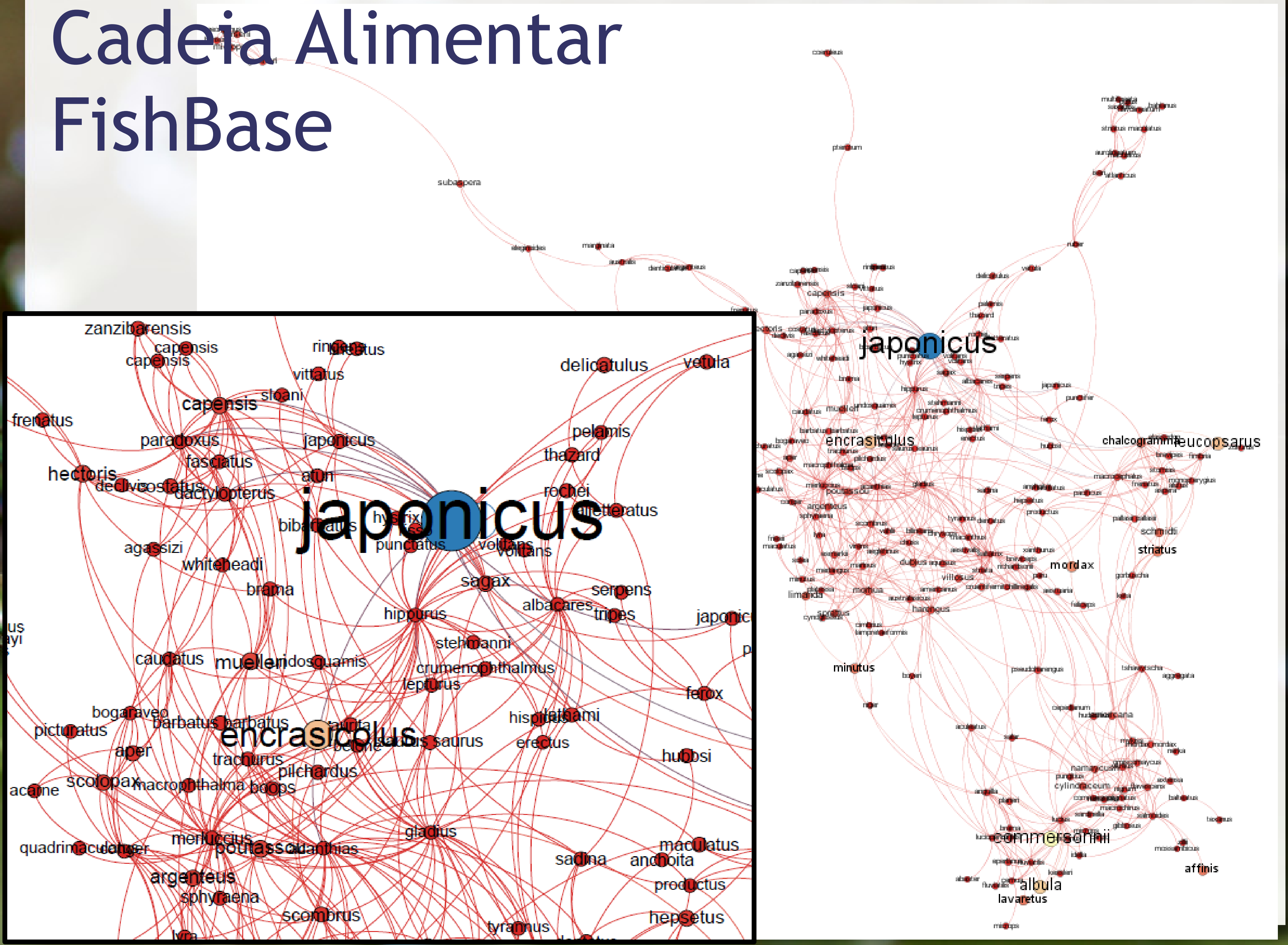
http://www-personal.umich.edu/~mejn/networks/

Les Miserables

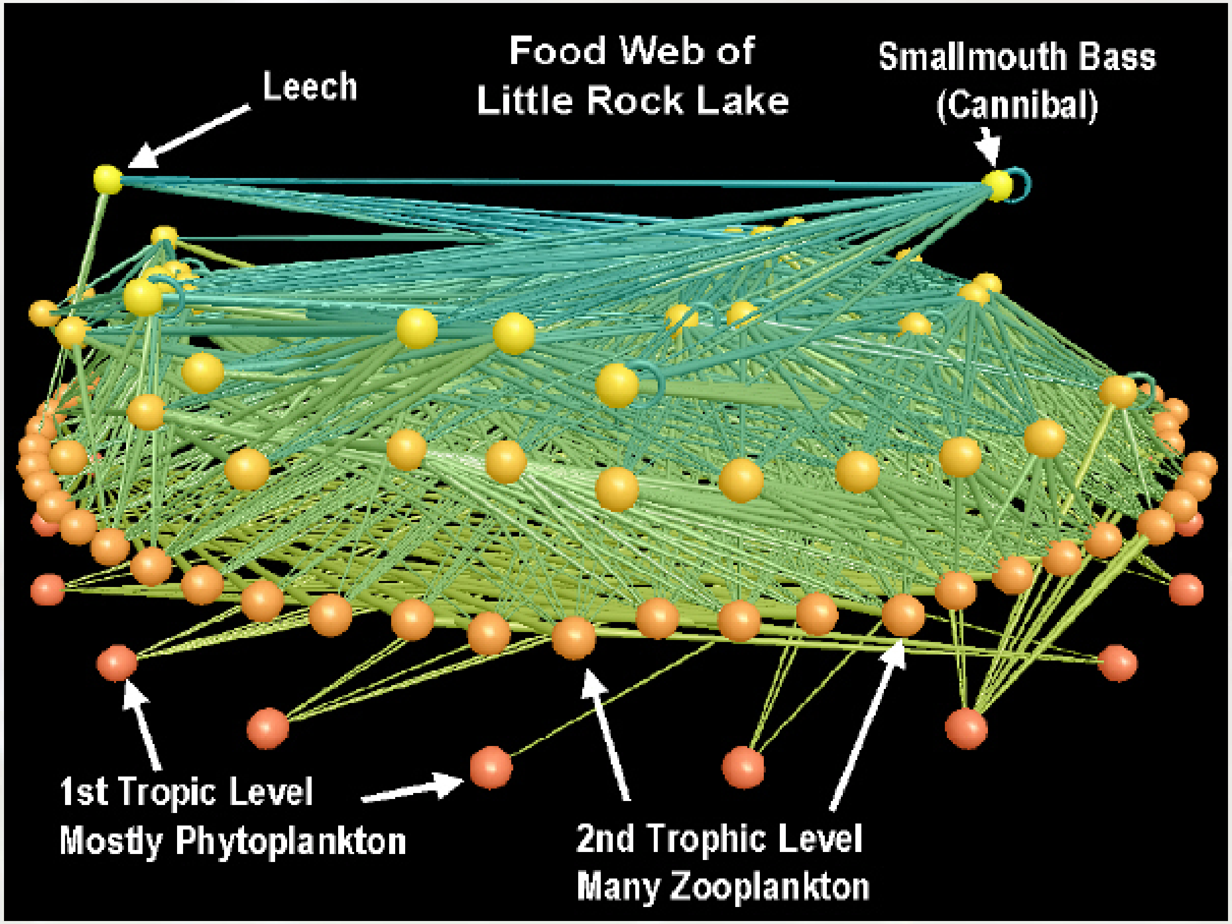
(Neo4j example)



Cadeia Alimentar FishBase

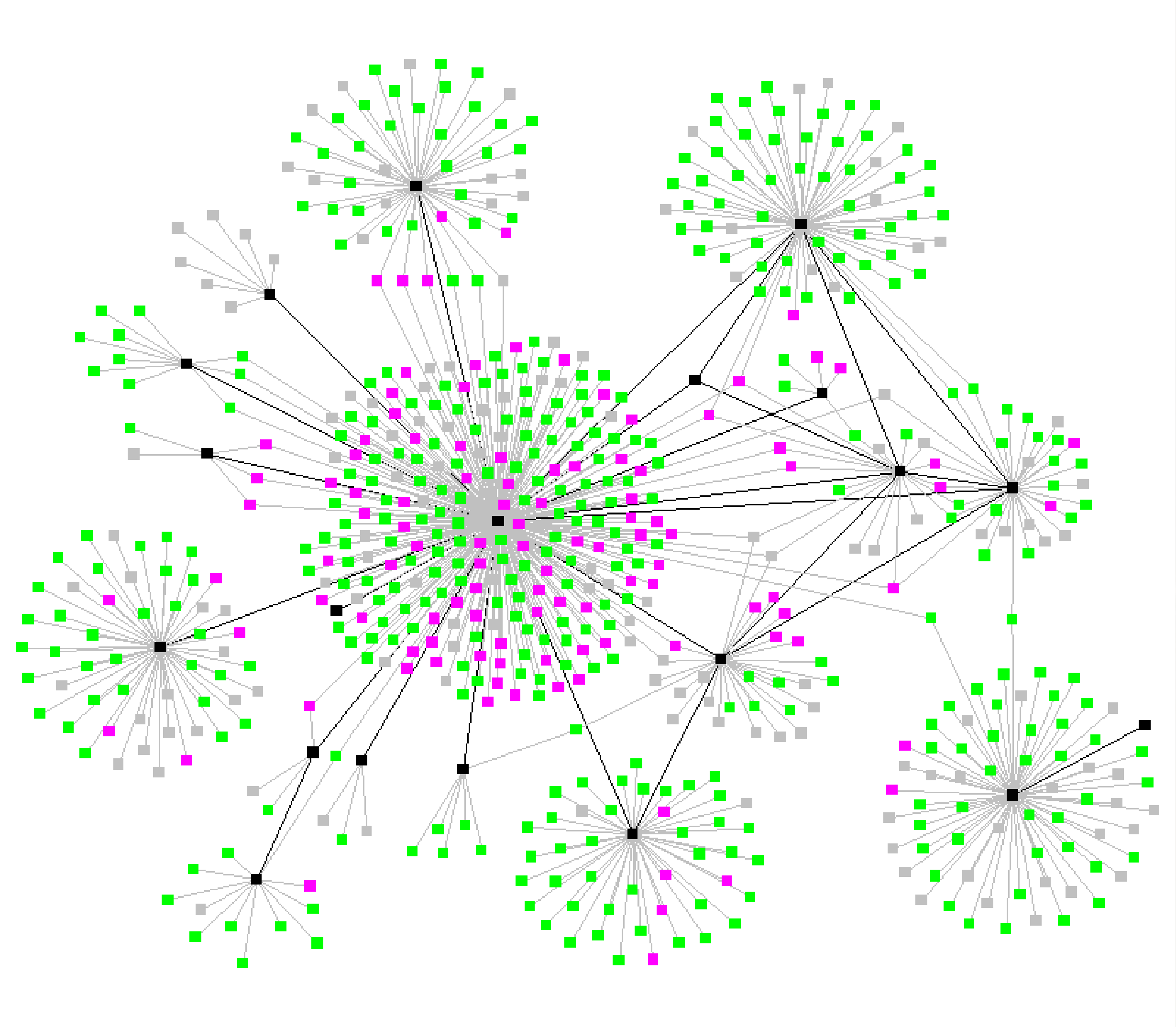


Freshwater food web



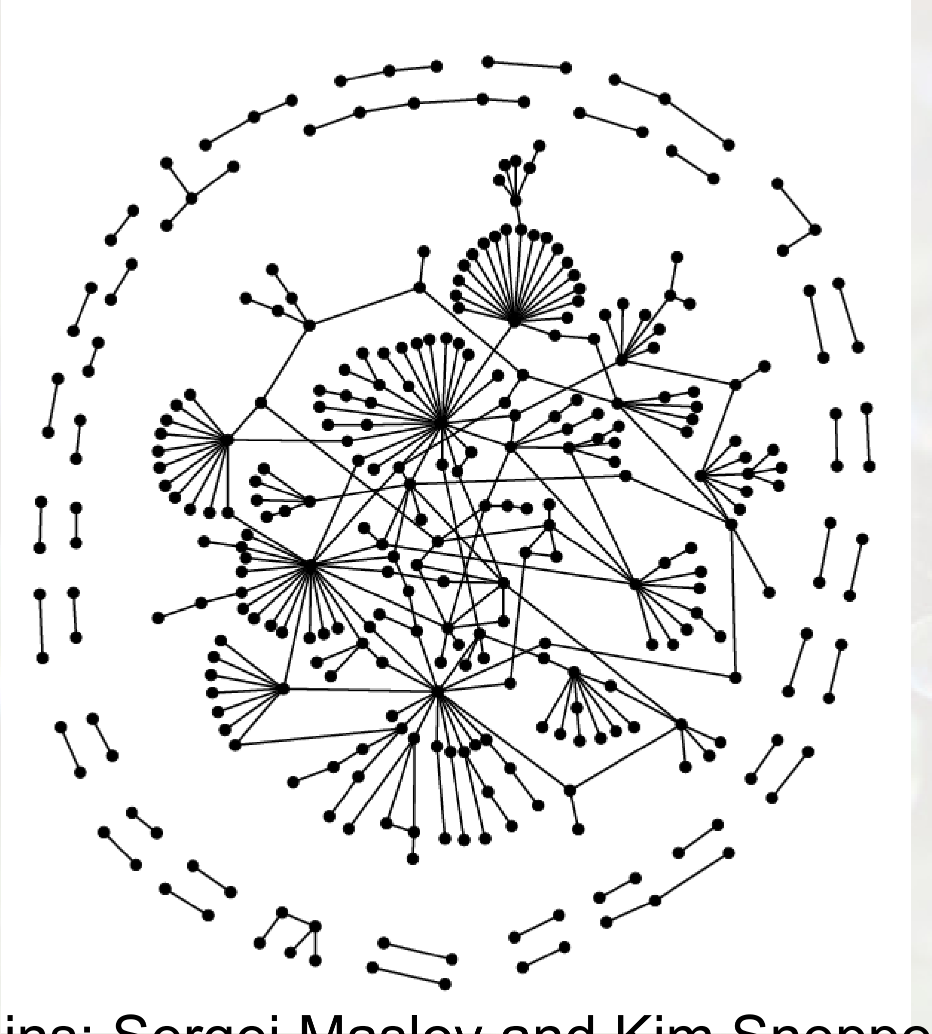
Freshwater food web: Neo Martinez and Richard Williams.

Contagion of TB



Contagion of TB, books on politics: Valdis Krebs, www.orgnet.com.

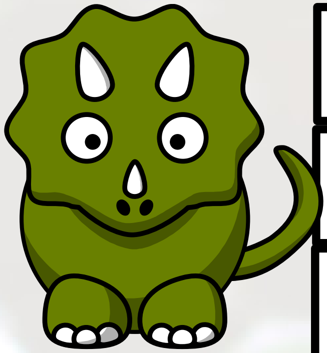
Yeast proteins



Yeast proteins: Sergei Maslov and Kim Sneppen, Specificity and stability in topology of protein networks, Science 296, 910-913 (2002).

What can I ask to a Graph?

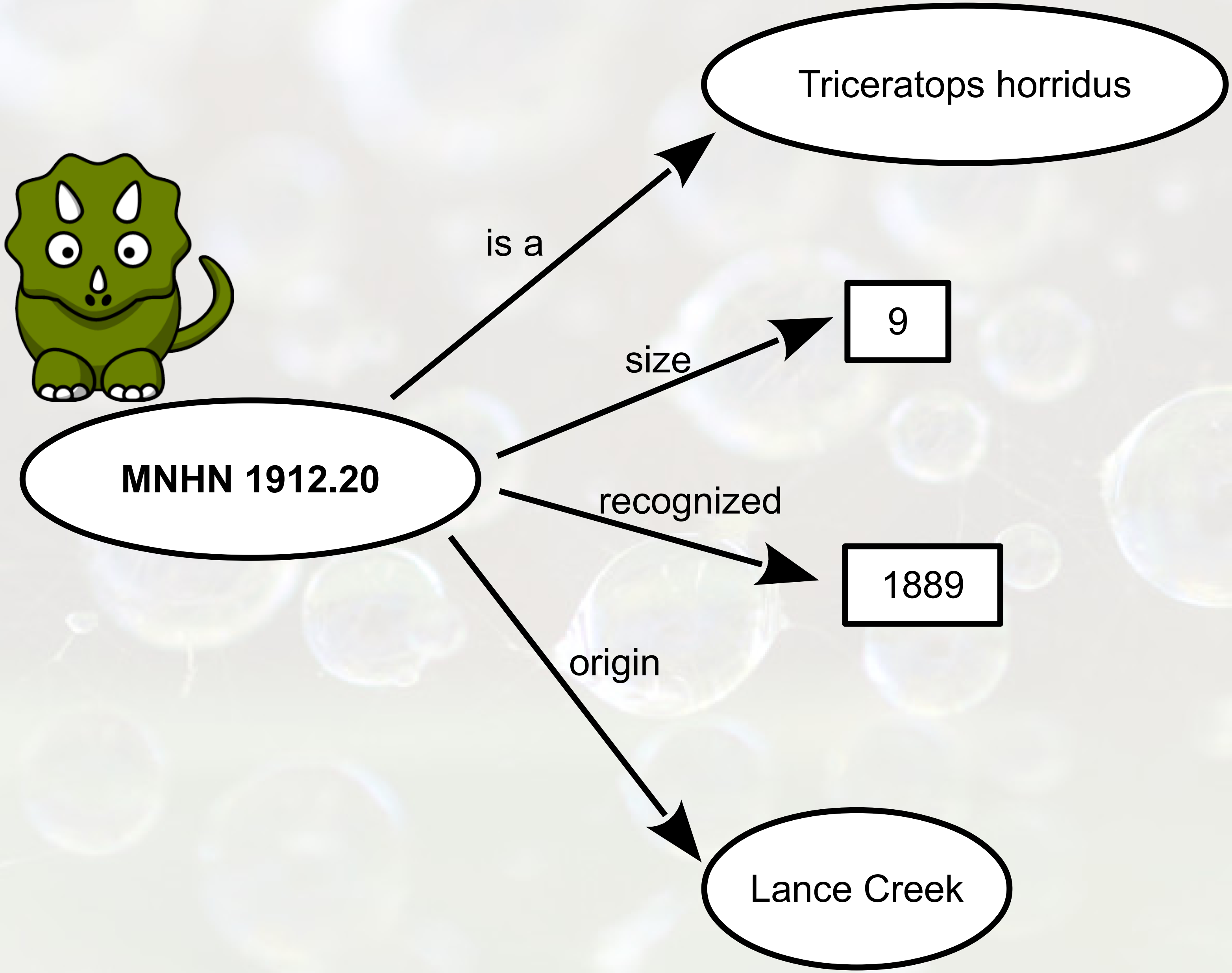
Triceratops in a Graph



MNHN 1912.20

Is a	Triceratops horridus	
Origin	Lance Creek	EUA
Recognized	1889	
Size	9	

Triceratops in a Graph



MNHN 1912.20

is a

Triceratops horridus

size

9

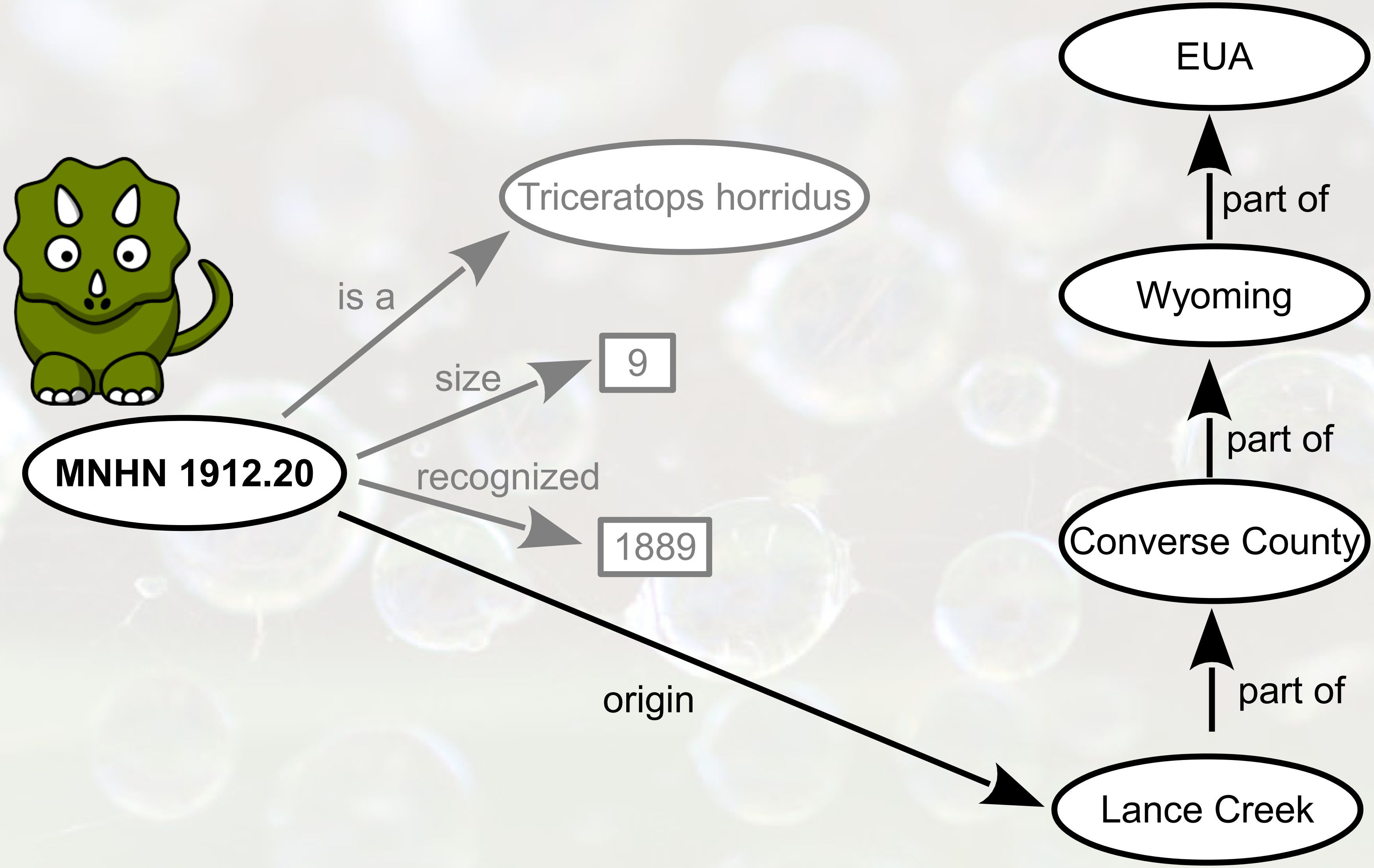
recognized

1889

origin

Lance Creek

Triceratops in a Graph



MNHN 1912.20

is a

Triceratops horridus

size

9

recognized

1889

origin

Lance Creek

part of

Converse County

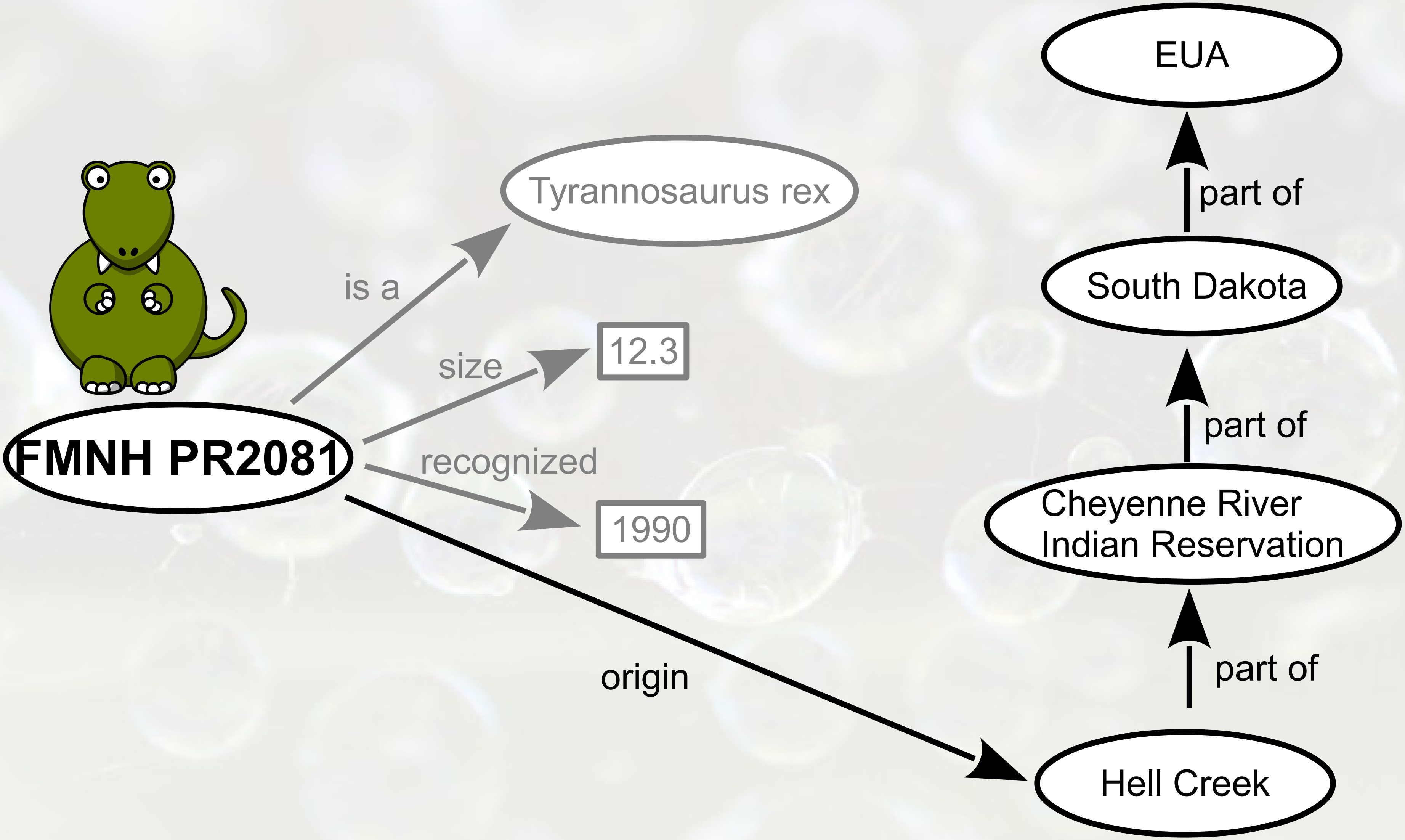
part of

Wyoming

part of

EUA

Tyrannosaurus in a Graph


FMNH PR2081

is a

Tyrannosaurus rex

size

12.3

recognized

1990

origin

Hell Creek

part of

Cheyenne River Indian Reservation

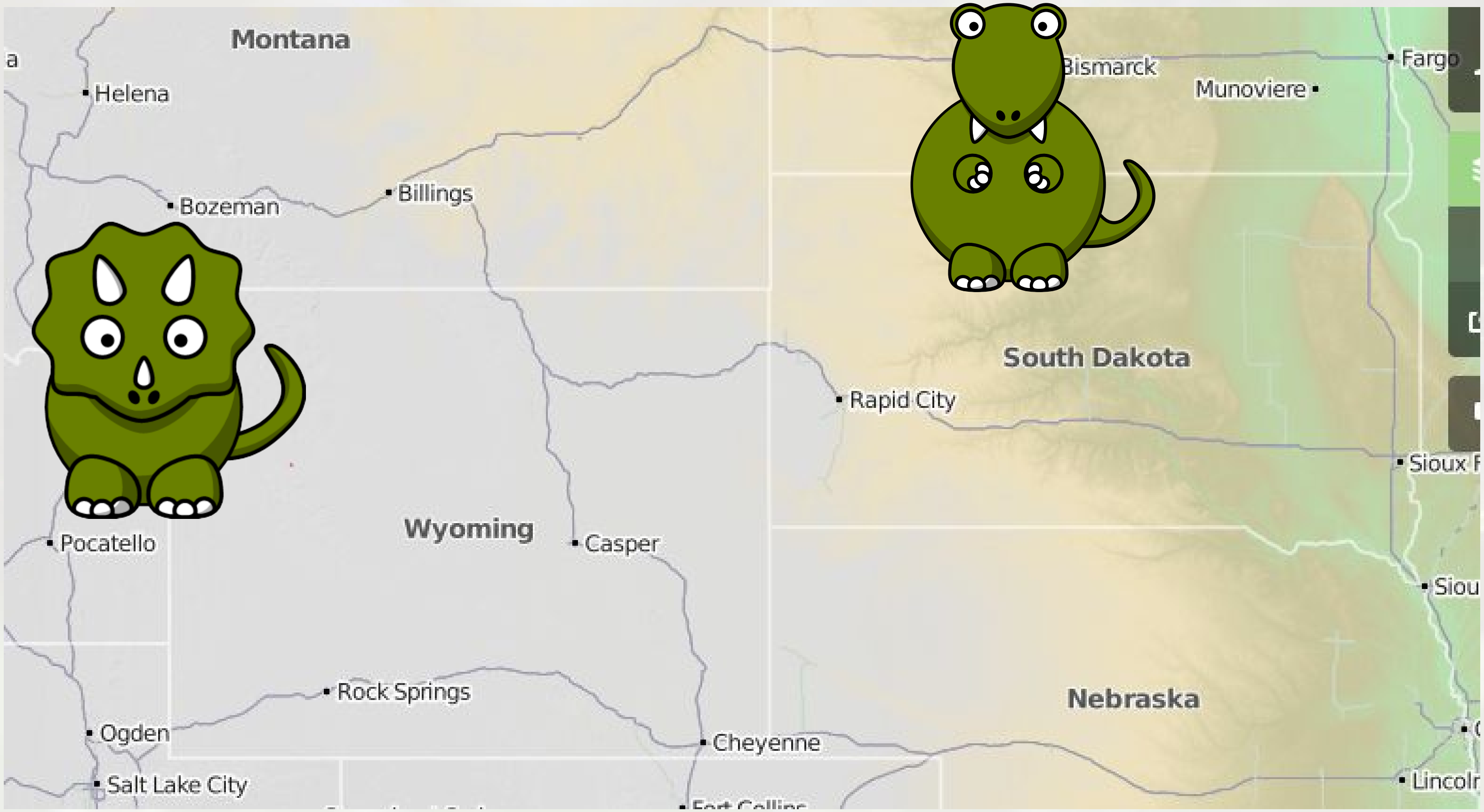
part of

South Dakota

part of

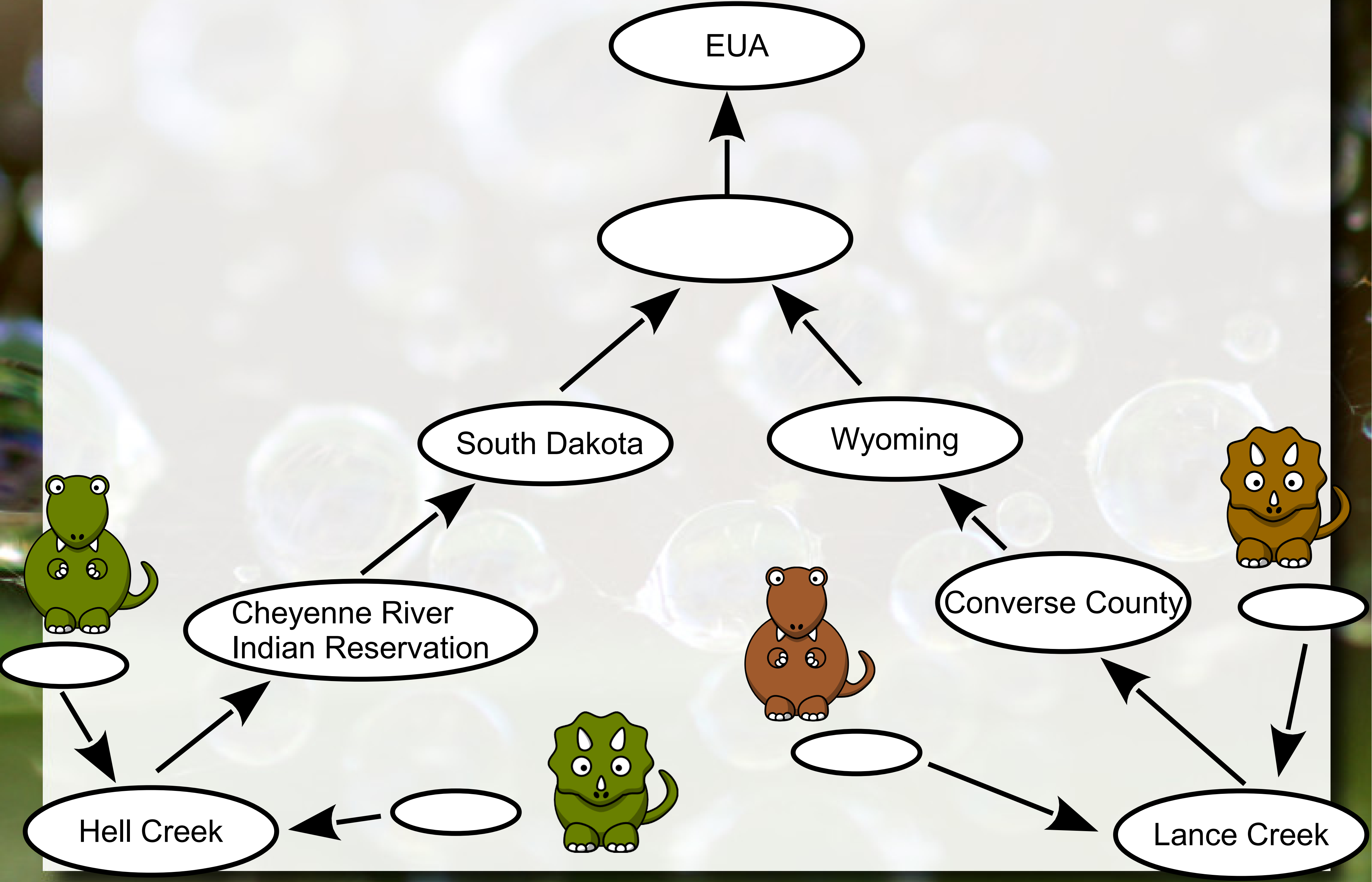
EUA

Analyzing in the Space

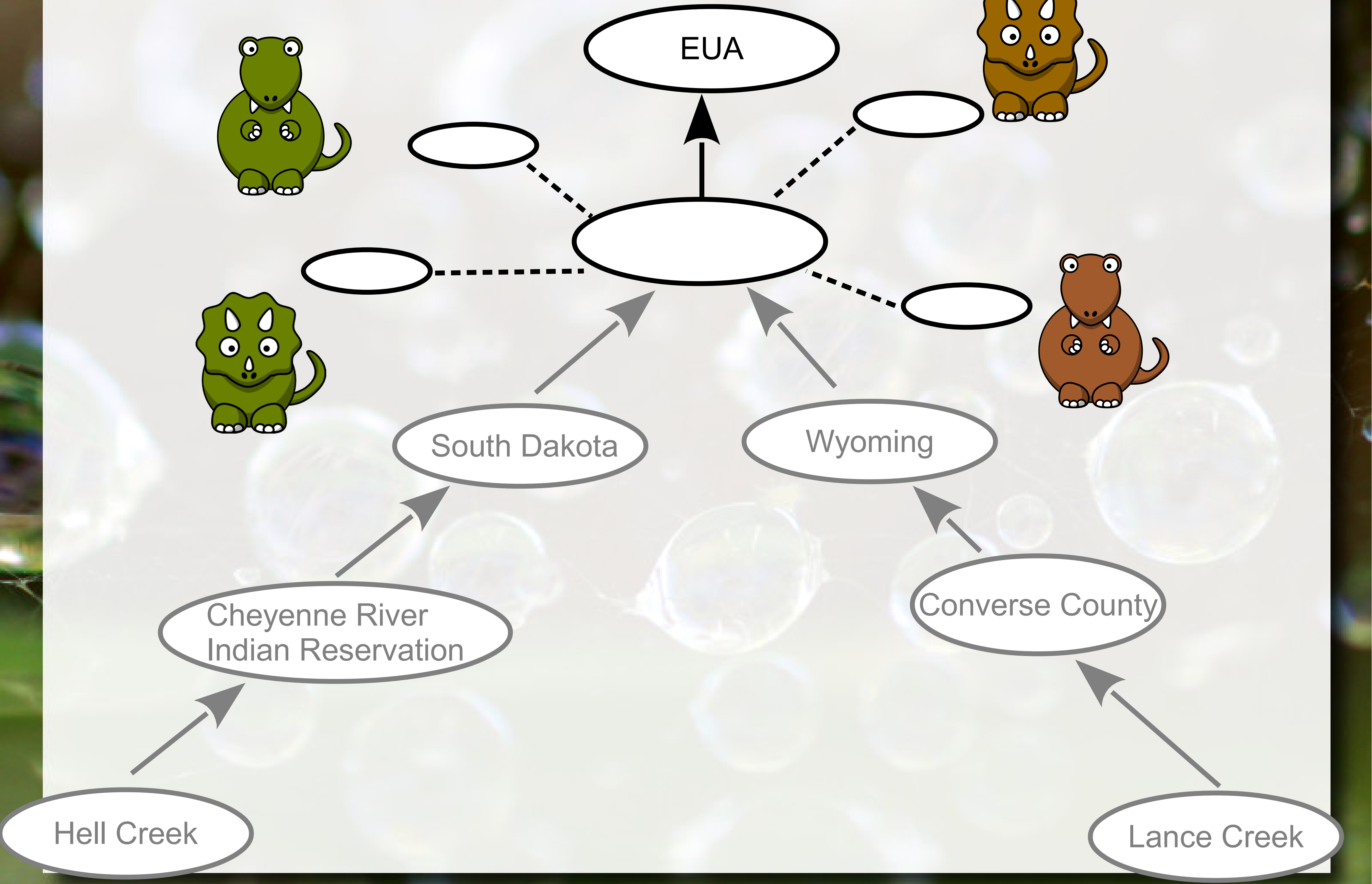


OpenStreetMap

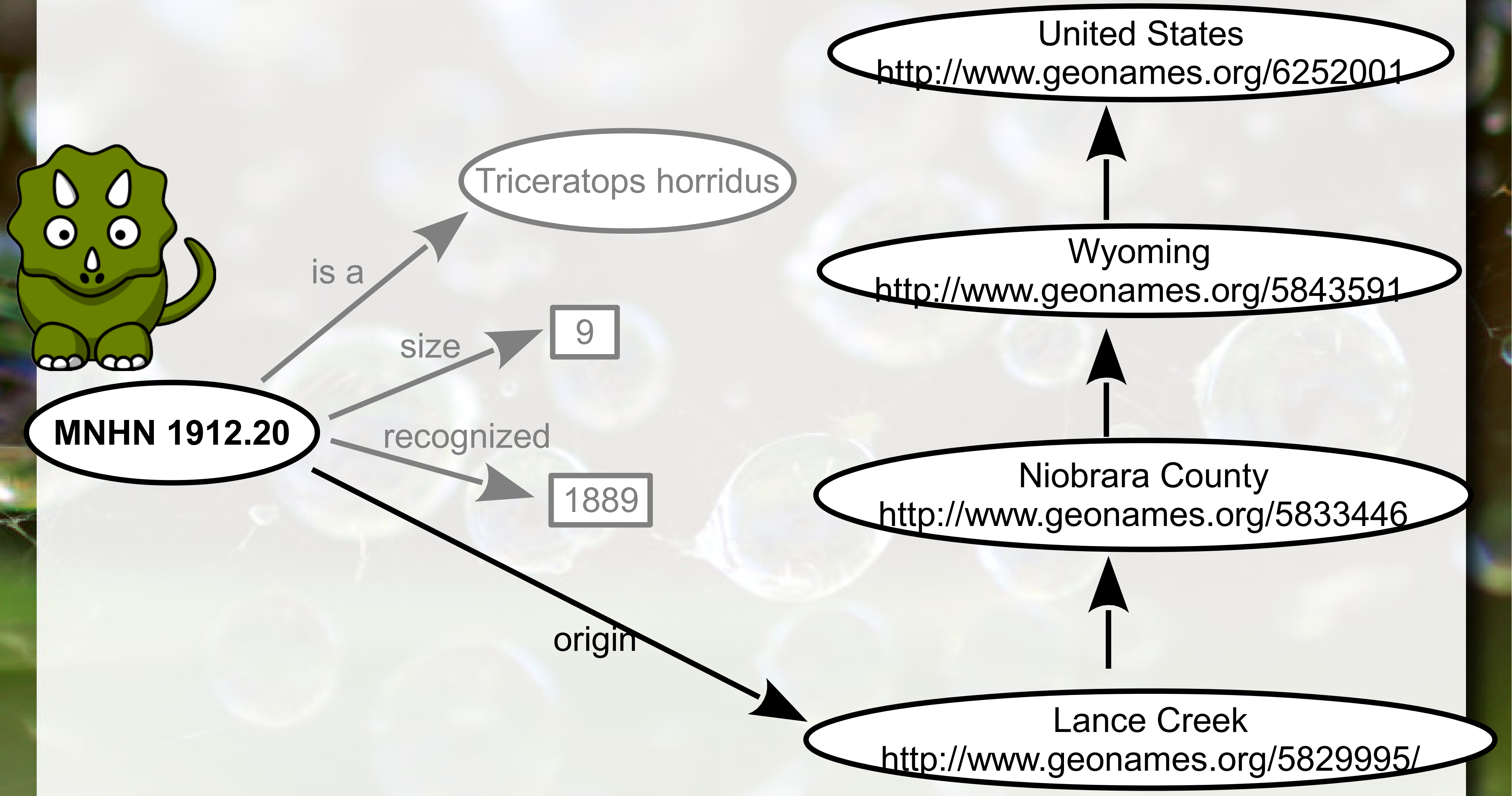
Analyzing in the Space



Analyzing in the Space



GeoNames



MNHN 1912.20

is a

Triceratops horridus

size

9

recognized

1889

origin

Lance Creek
http://www.geonames.org/5829995/

Niobrara County
http://www.geonames.org/5833446

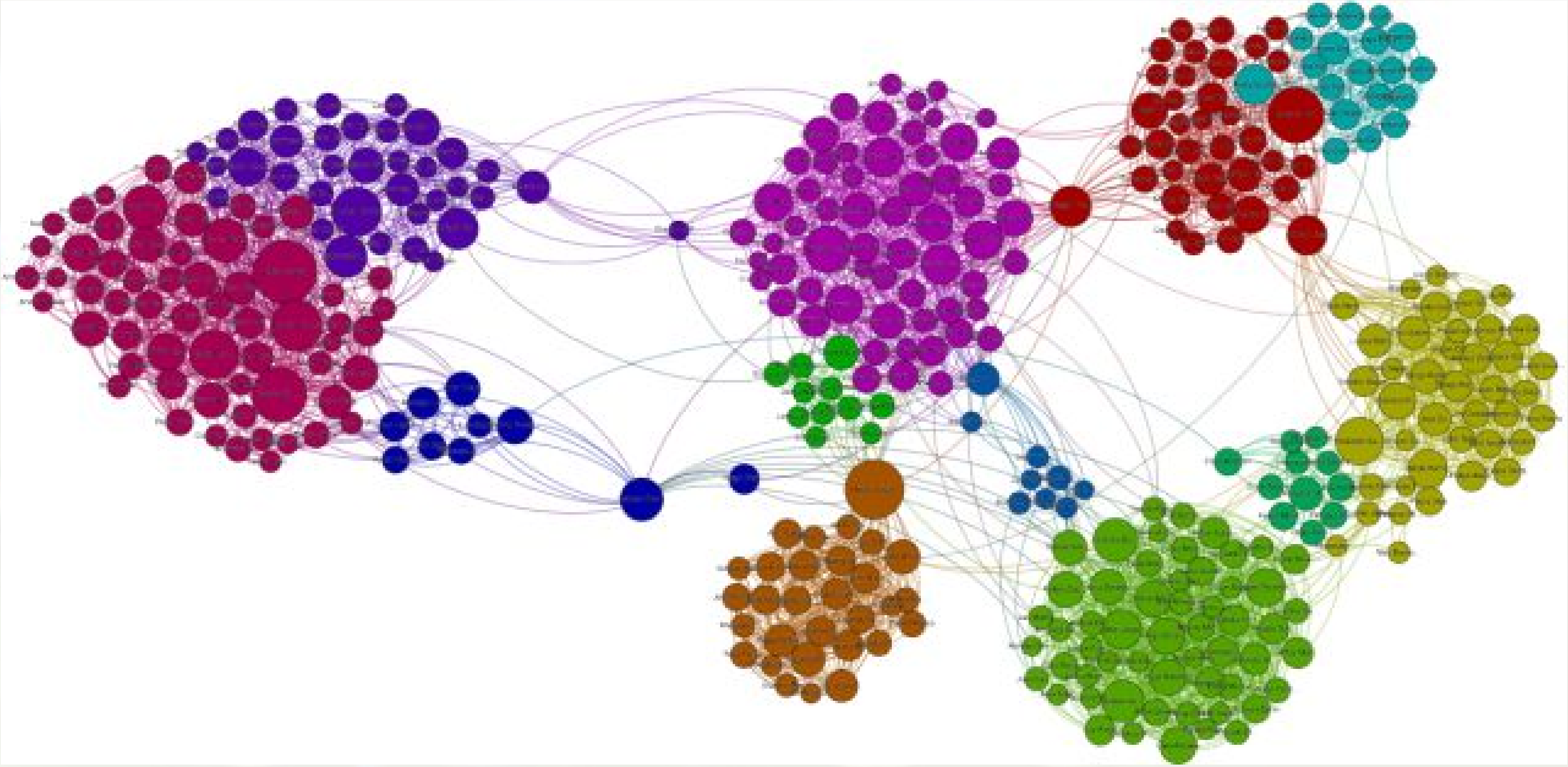
Wyoming
http://www.geonames.org/5843591

United States
http://www.geonames.org/6252001

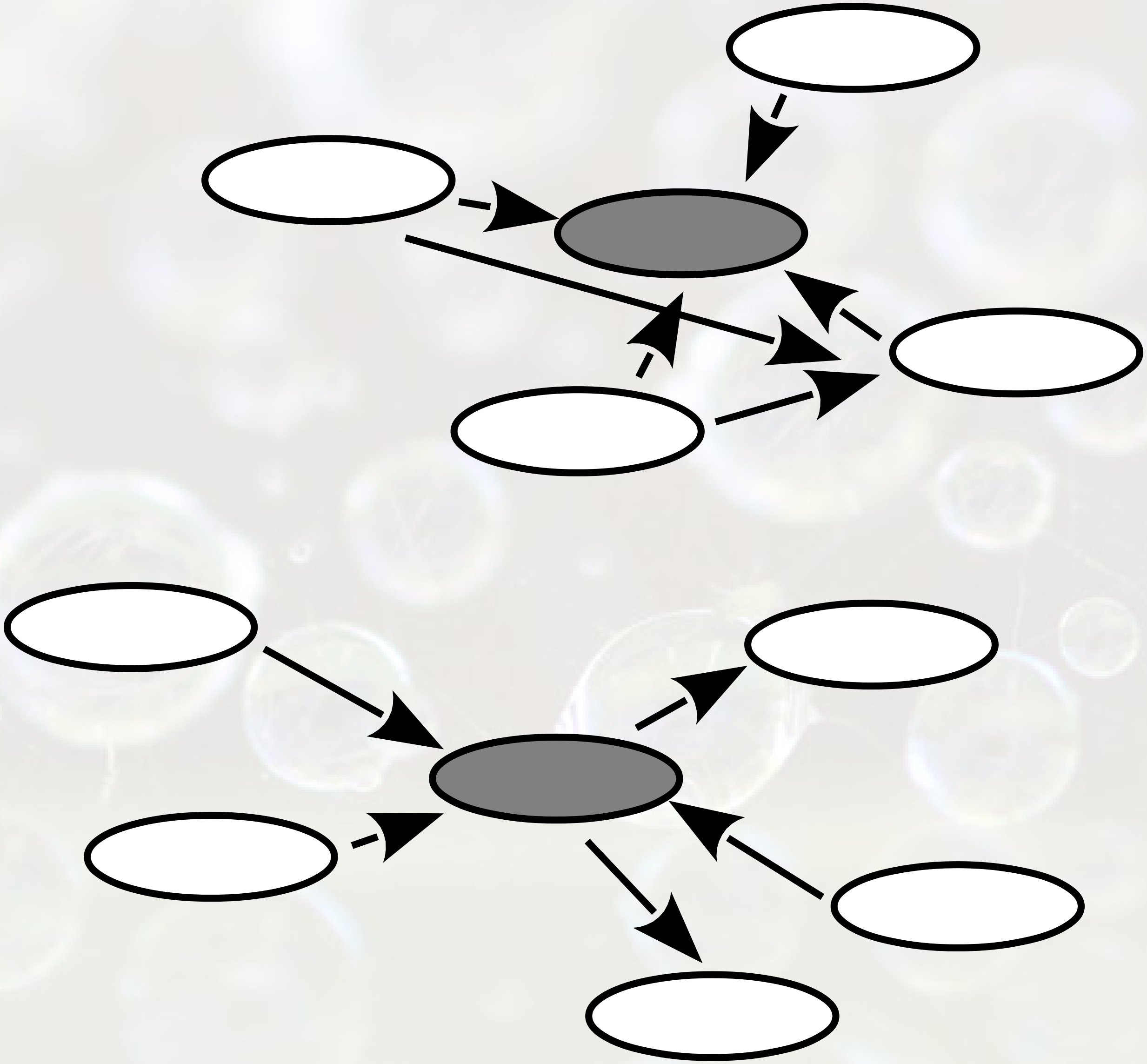
Processing the Query

- Process by pattern
  - Find [species] whose [origin] → (0..*) part of → EUA
- Process by inference
  - Find [species] whose [origin] → EUA
  - Rules:
    - If (A) origin (B) and (B) part of (C) => (A) origin (C)
    - If (A) part of (B) and (B) part of (C) => (A) part of (C)

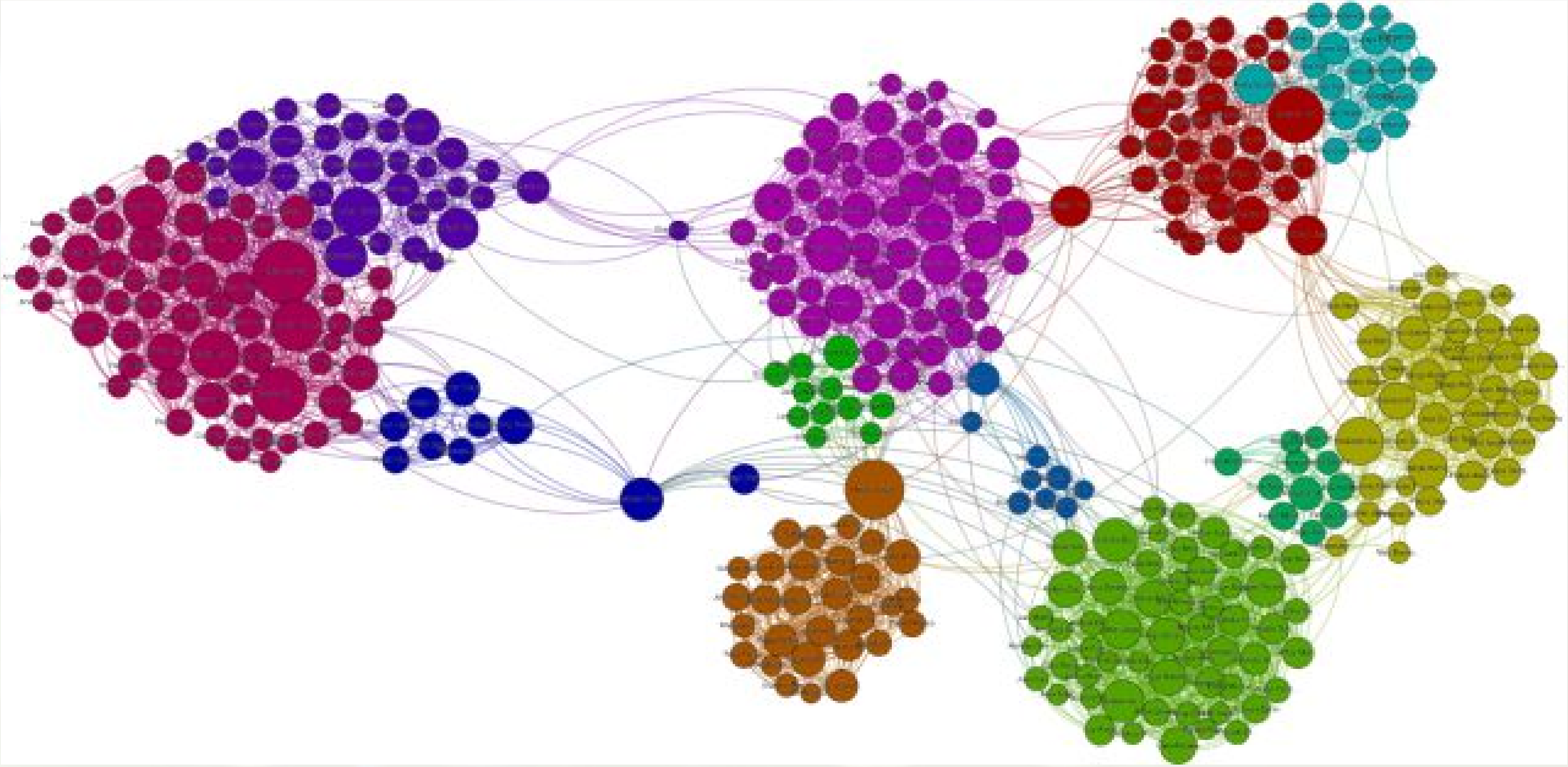
Looking the Topology



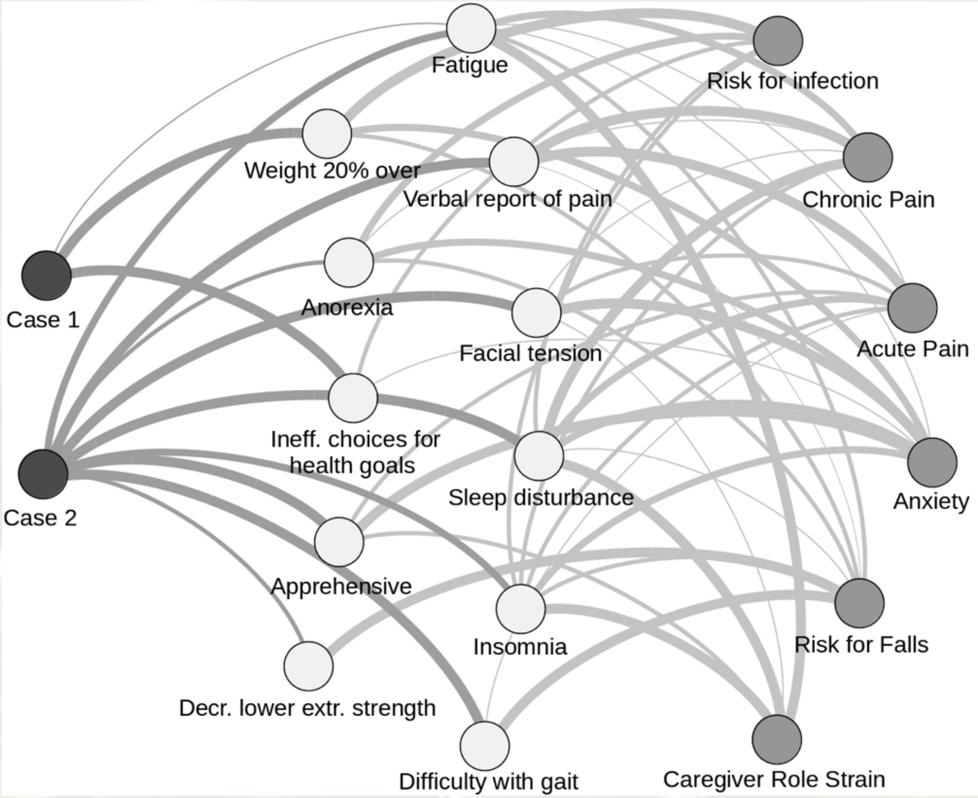
Graph Topology



Graph Topology



Patient x Diagnosis

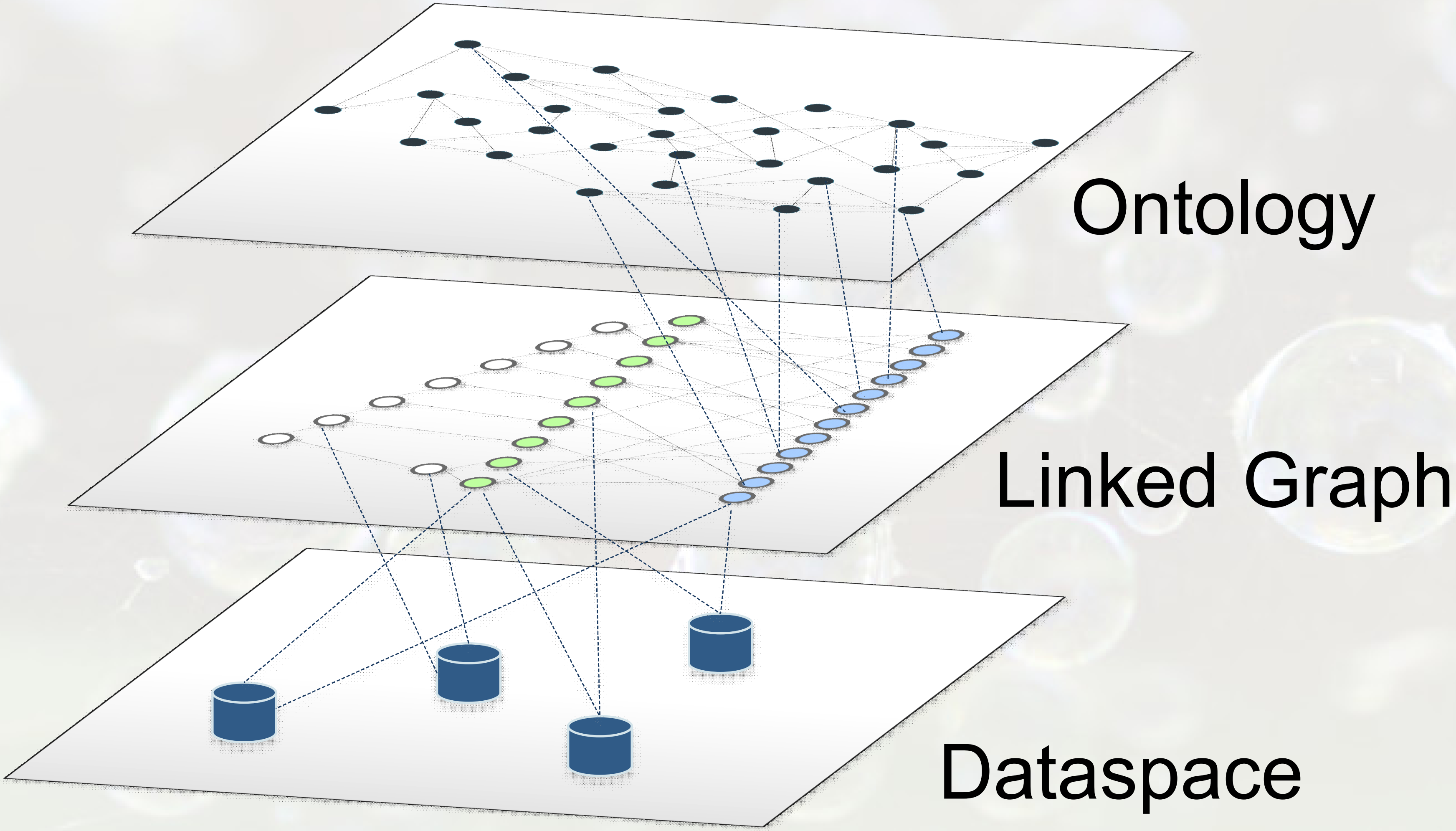


- Retrieve candidate **diagnosis** relevant to a given **patient** based on her **symptoms** and correlations with other similar patients.

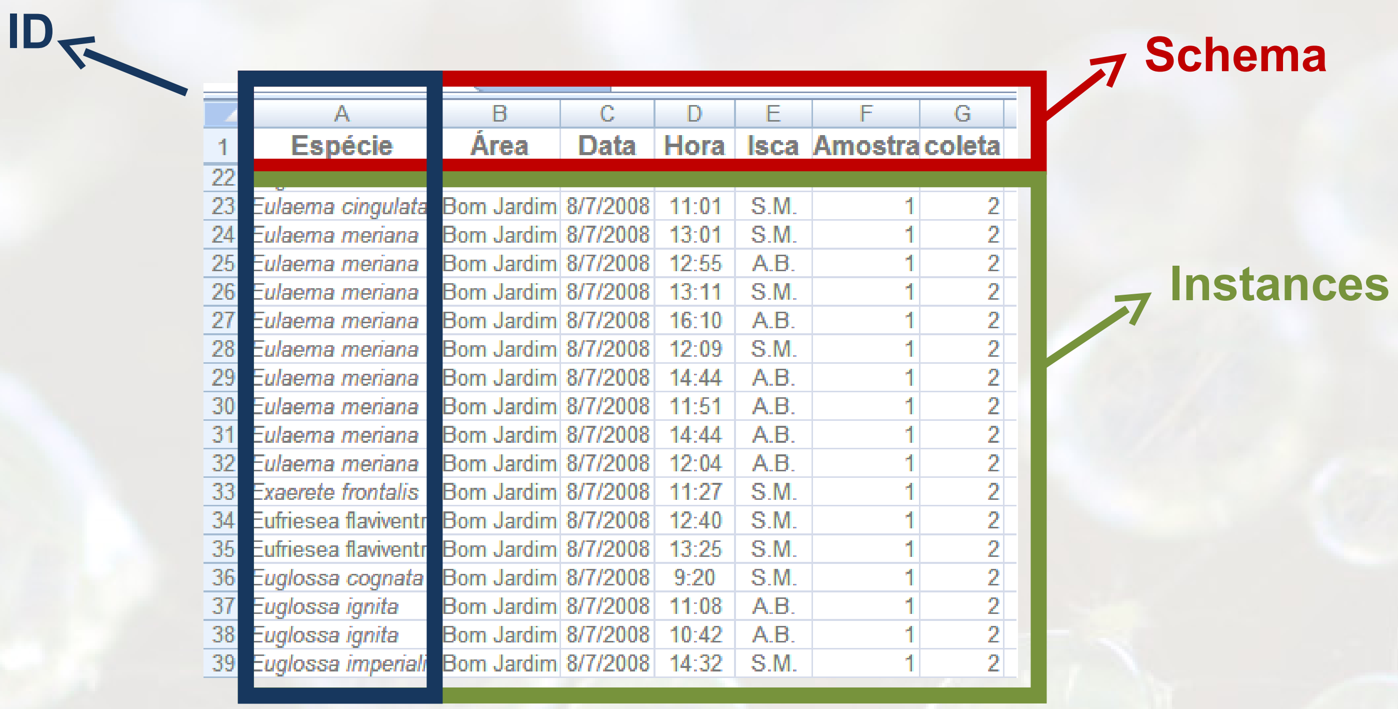
(Gomes-Jr, 2013)

From Dataspaces to Ontologies

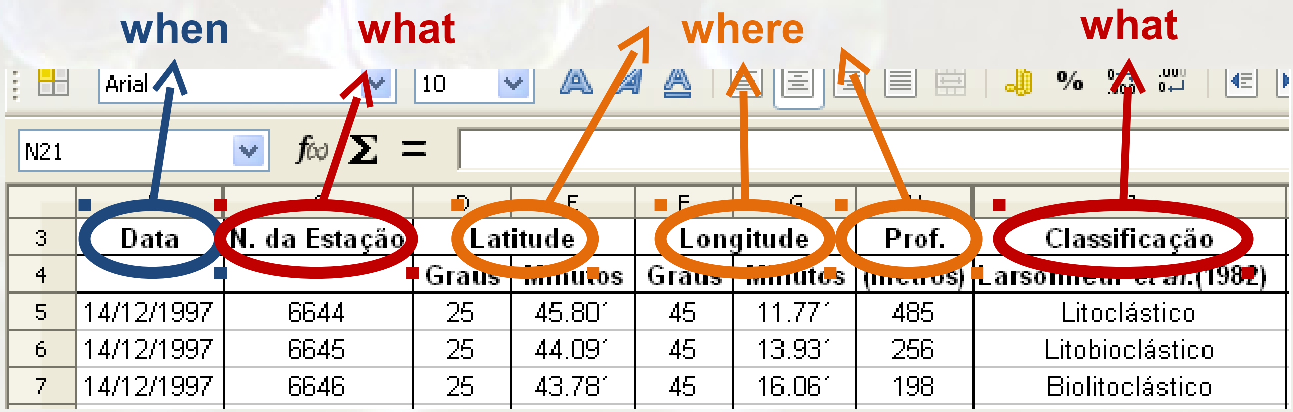
From Dataspaces to Ontologies



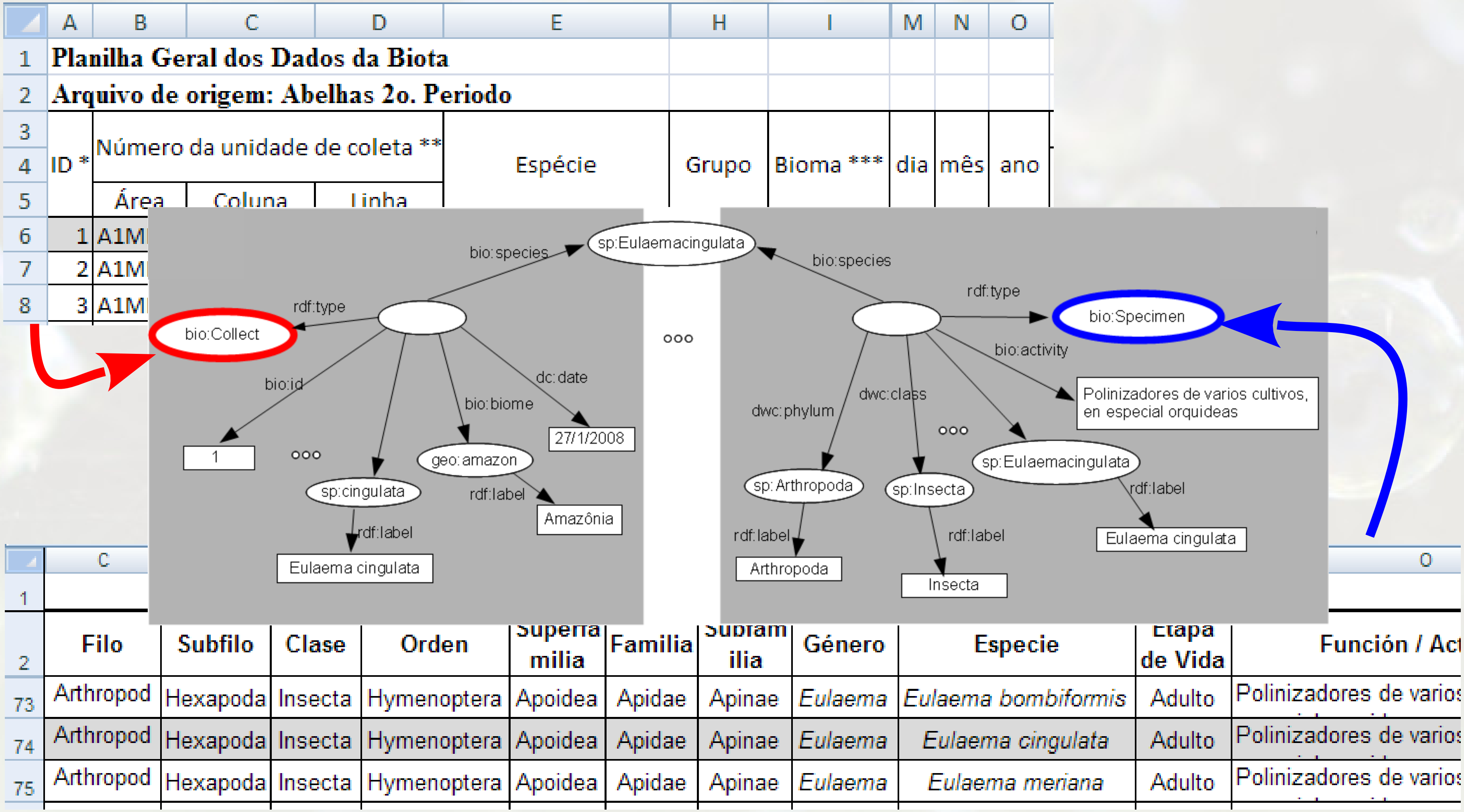
Building Patterns



	A	B	C	D	E	F	G
1	Espécie	Área	Data	Hora	Isca	Amostra	coleta
22							
23	*Eulaema cingulata*	Bom Jardim	8/7/2008	11:01	S.M.	1	2
24	*Eulaema meriana*	Bom Jardim	8/7/2008	13:01	S.M.	1	2
25	*Eulaema meriana*	Bom Jardim	8/7/2008	12:55	A.B.	1	2
26	*Eulaema meriana*	Bom Jardim	8/7/2008	13:11	S.M.	1	2
27	*Eulaema meriana*	Bom Jardim	8/7/2008	16:10	A.B.	1	2
28	*Eulaema meriana*	Bom Jardim	8/7/2008	12:09	S.M.	1	2
29	*Eulaema meriana*	Bom Jardim	8/7/2008	14:44	A.B.	1	2
30	*Eulaema meriana*	Bom Jardim	8/7/2008	11:51	A.B.	1	2
31	*Eulaema meriana*	Bom Jardim	8/7/2008	14:44	A.B.	1	2
32	*Eulaema meriana*	Bom Jardim	8/7/2008	12:04	A.B.	1	2
33	*Exaerete frontalis*	Bom Jardim	8/7/2008	11:27	S.M.	1	2
34	Eufriesea flaviventr	Bom Jardim	8/7/2008	12:40	S.M.	1	2
35	Eufriesea flaviventr	Bom Jardim	8/7/2008	13:25	S.M.	1	2
36	*Euglossa cognata*	Bom Jardim	8/7/2008	9:20	S.M.	1	2
37	*Euglossa ignita*	Bom Jardim	8/7/2008	11:08	A.B.	1	2
38	*Euglossa ignita*	Bom Jardim	8/7/2008	10:42	A.B.	1	2
39	*Euglossa imperiali*	Bom Jardim	8/7/2008	14:32	S.M.	1	2



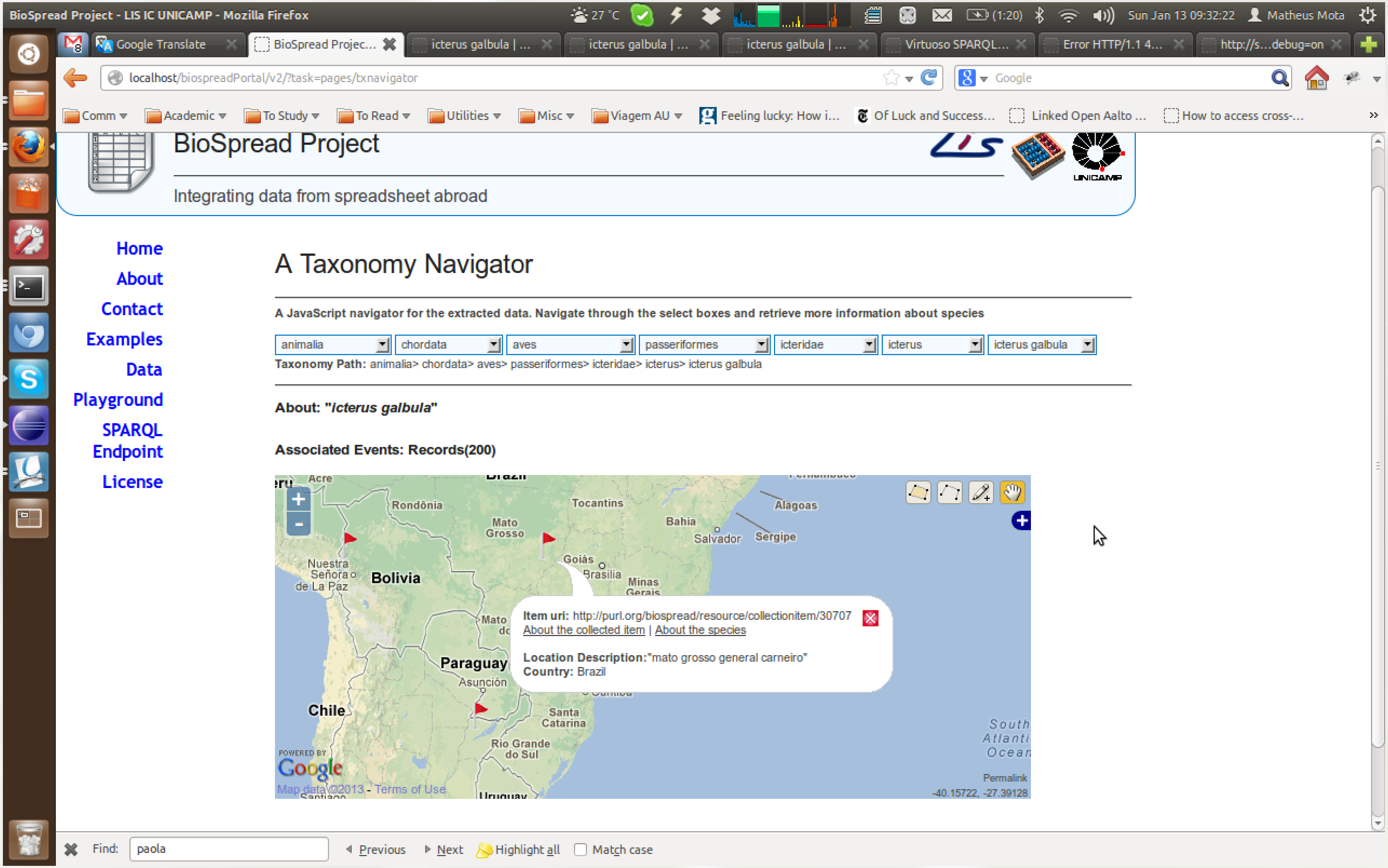
			D	E	F	G	H	
3	Data	N. da Estação	Latitude		Longitude		Prof.	Classificação
4			Graus	Minutos	Graus	Minutos	(metros)	Larsonneur et al.(1982)
5	14/12/1997	6644	25	45.80´	45	11.77´	485	Litoclástico
6	14/12/1997	6645	25	44.09´	45	13.93´	256	Litobioclástico
7	14/12/1997	6646	25	43.78´	45	16.06´	198	Biolitoclástico



	A	B	C	D	E	H	I	M	N	O
1	**Planilha Geral dos Dados da Biota**									
2	**Arquivo de origem: Abelhas 2o. Periodo**									
3	ID *	Número da unidade de coleta **			Espécie	Grupo	Bioma ***	dia	mês	ano
4										
5		Área	Coluna	Linha						
6	1	A1M								
7	2	A1M								
8	3	A1M								

	C										O
1											
2	**Filo**	**Subfilo**	**Clase**	**Orden**	**Superfamilia**	**Familia**	**Subfamilia**	**Género**	**Especie**	**Etapa de Vida**	**Función / Act**
73	Arthropod	Hexapoda	Insecta	Hymenoptera	Apoidea	Apidae	Apinae	*Eulaema*	*Eulaema bombiformis*	Adulto	Polinizadores de varios
74	Arthropod	Hexapoda	Insecta	Hymenoptera	Apoidea	Apidae	Apinae	*Eulaema*	*Eulaema cingulata*	Adulto	Polinizadores de varios
75	Arthropod	Hexapoda	Insecta	Hymenoptera	Apoidea	Apidae	Apinae	*Eulaema*	*Eulaema meriana*	Adulto	Polinizadores de varios

Data Exploration Prototype



BioSpread Project

Integrating data from spreadsheet abroad

A Taxonomy Navigator

A JavaScript navigator for the extracted data. Navigate through the select boxes and retrieve more information about species

animalia | chordata | aves | passeriformes | icteridae | icterus | icterus galbula

Taxonomy Path: animalia> chordata> aves> passeriformes> icteridae> icterus> icterus galbula

About: "*icterus galbula*"

Associated Events: Records(200)

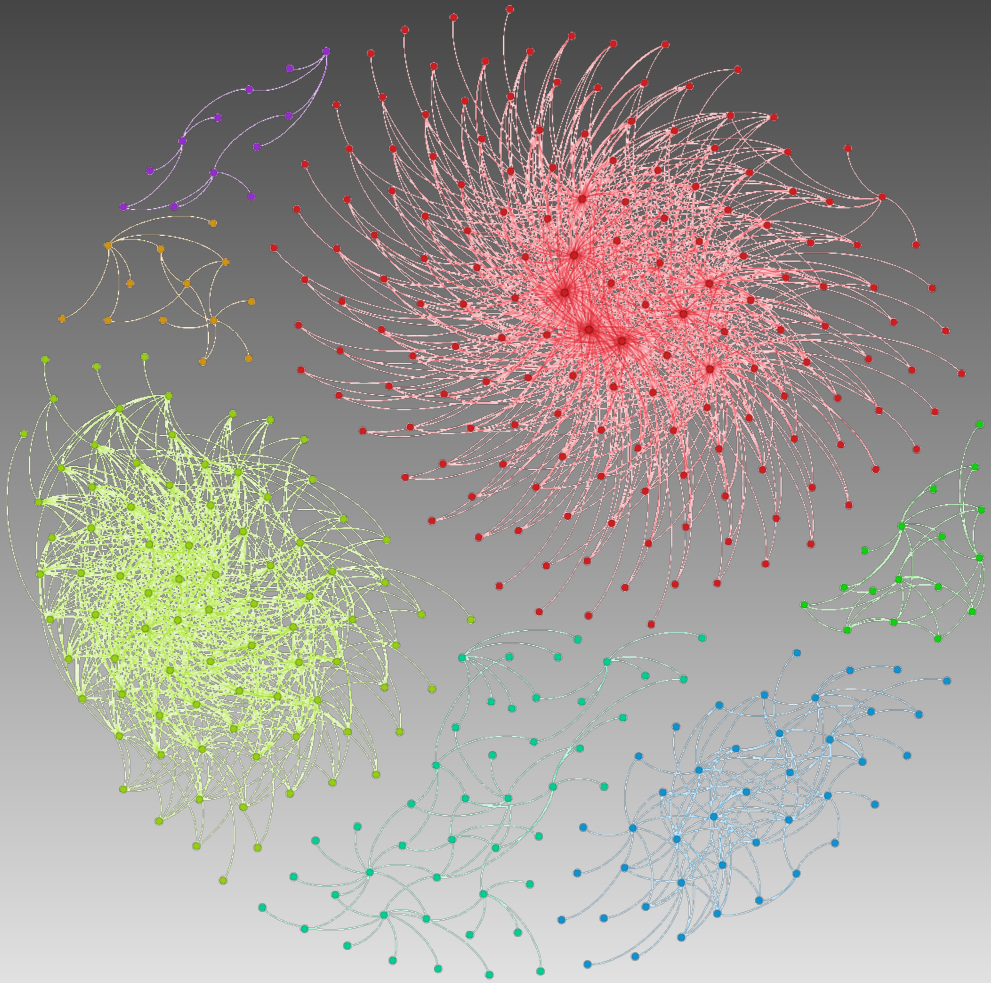
Item uri: http://purl.org/biospread/resource/collectionitem/30707
About the collected item | About the species

Location Description:"mato grosso general carneiro"
Country: Brazil

Integrating phenotypes

7 distinct morphological descriptions:

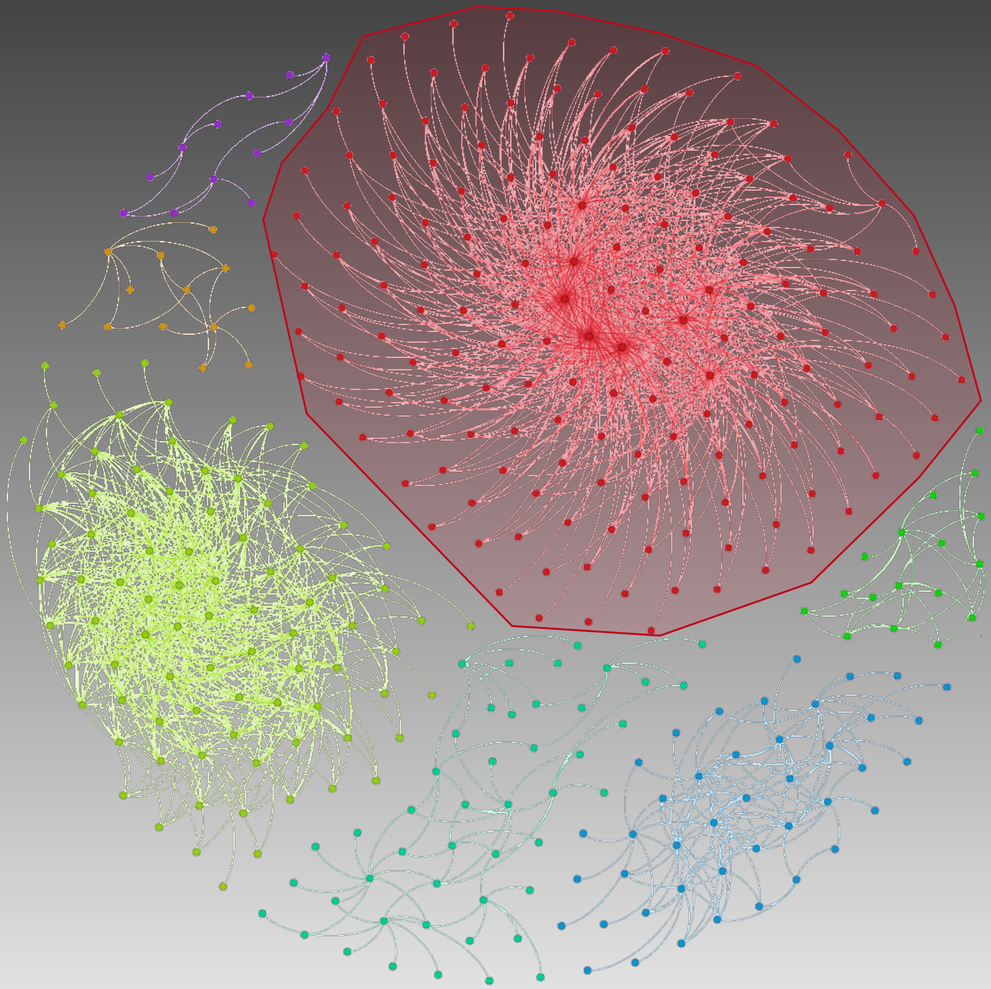
- genus Varanus
- *Varanus gouldii*
- *Varanus indicus*
- *Varanus prasinus*
- *Varanus salvator*
- *Varanus spiny*
- *Varanus timorensis*



Our approach

7 distinct morphological descriptions:

- genus Varanus
- *Varanus gouldii*
- *Varanus indicus*
- *Varanus prasinus*
- *Varanus salvator*
- *Varanus spiny*
- *Varanus timorensis*



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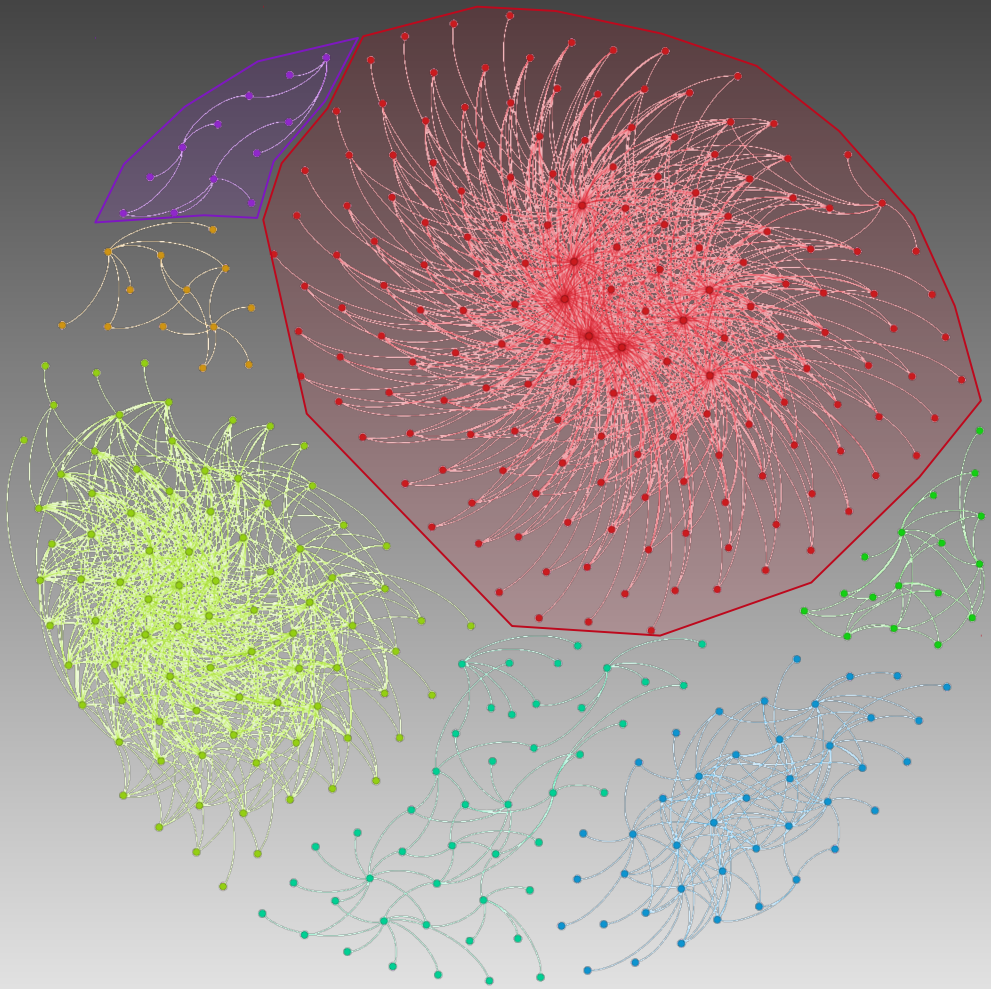

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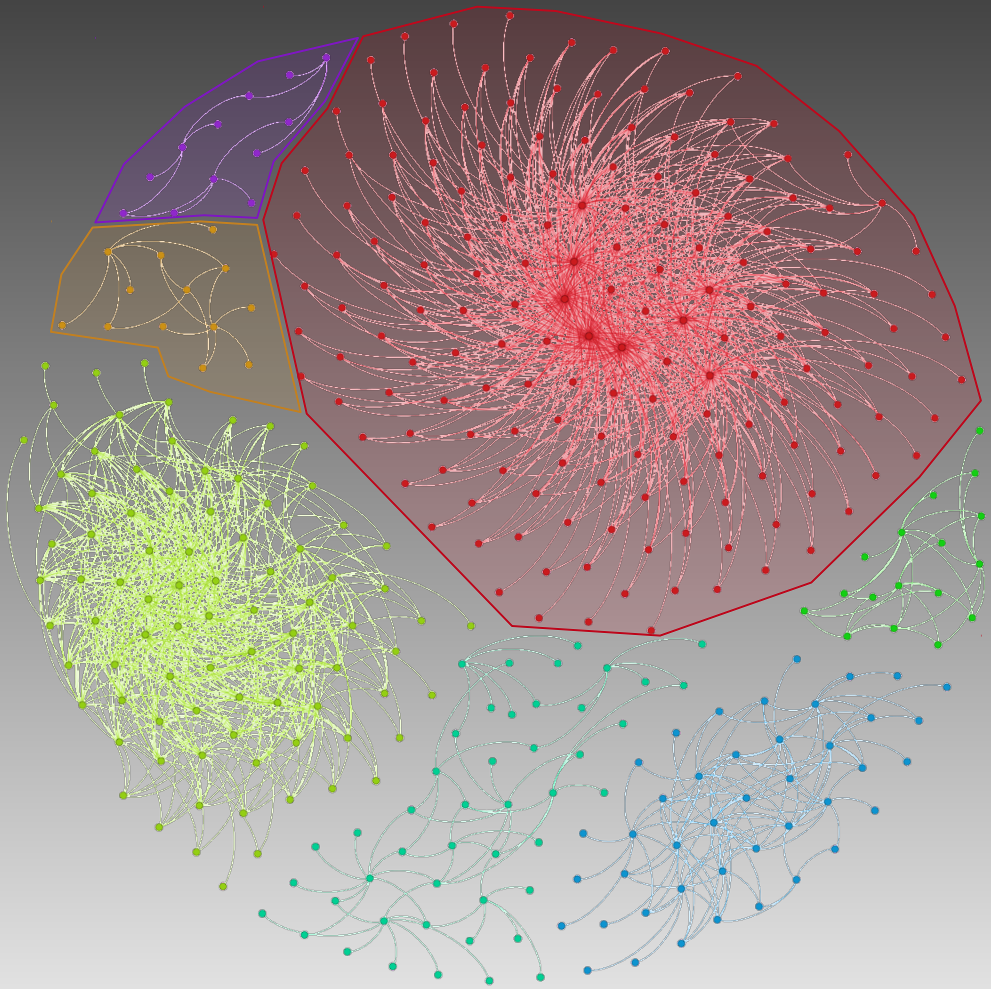

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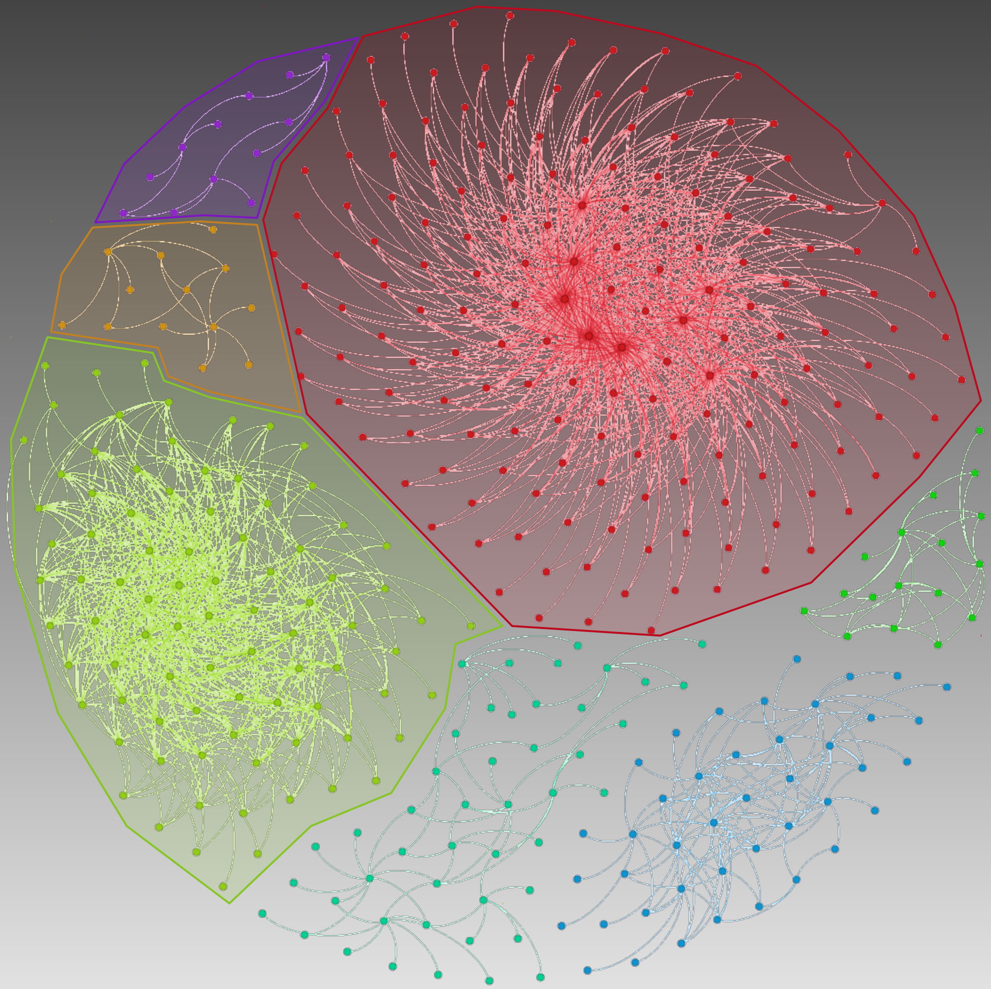

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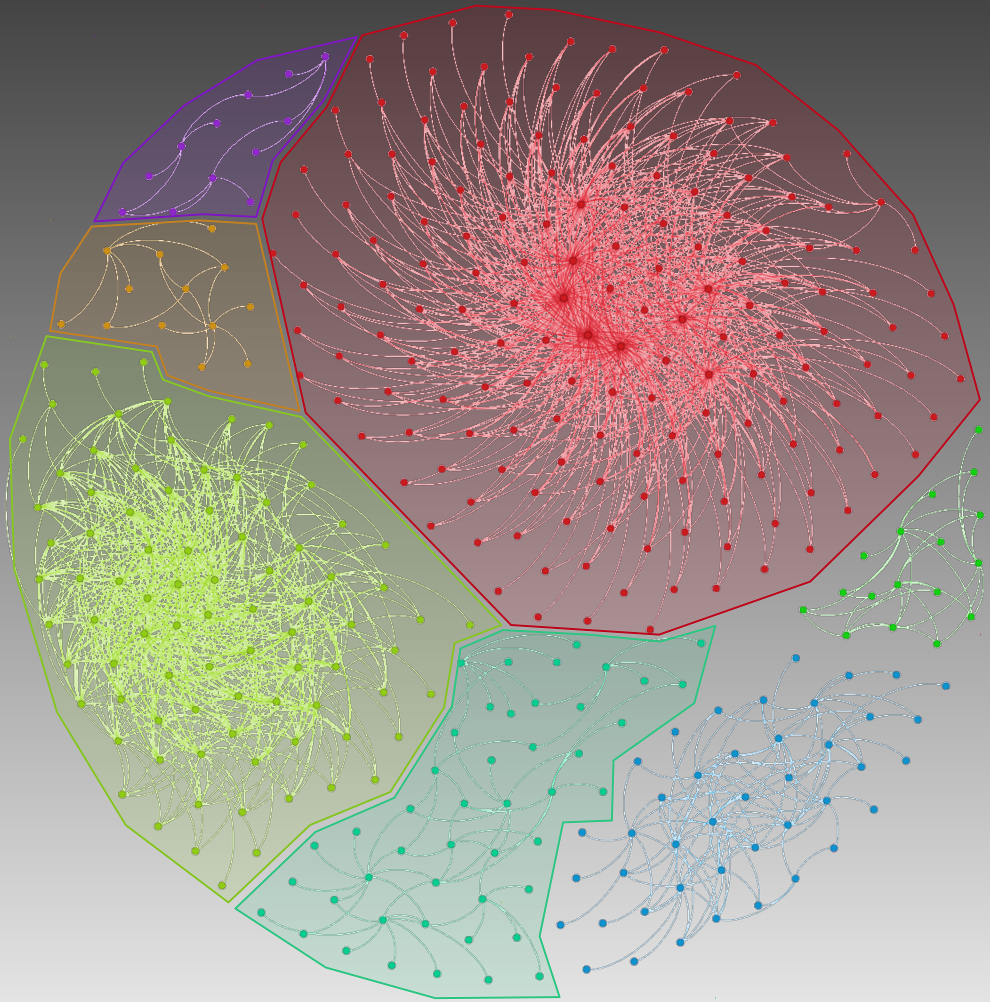

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- *Varanus salvator*
- *Varanus spiny*
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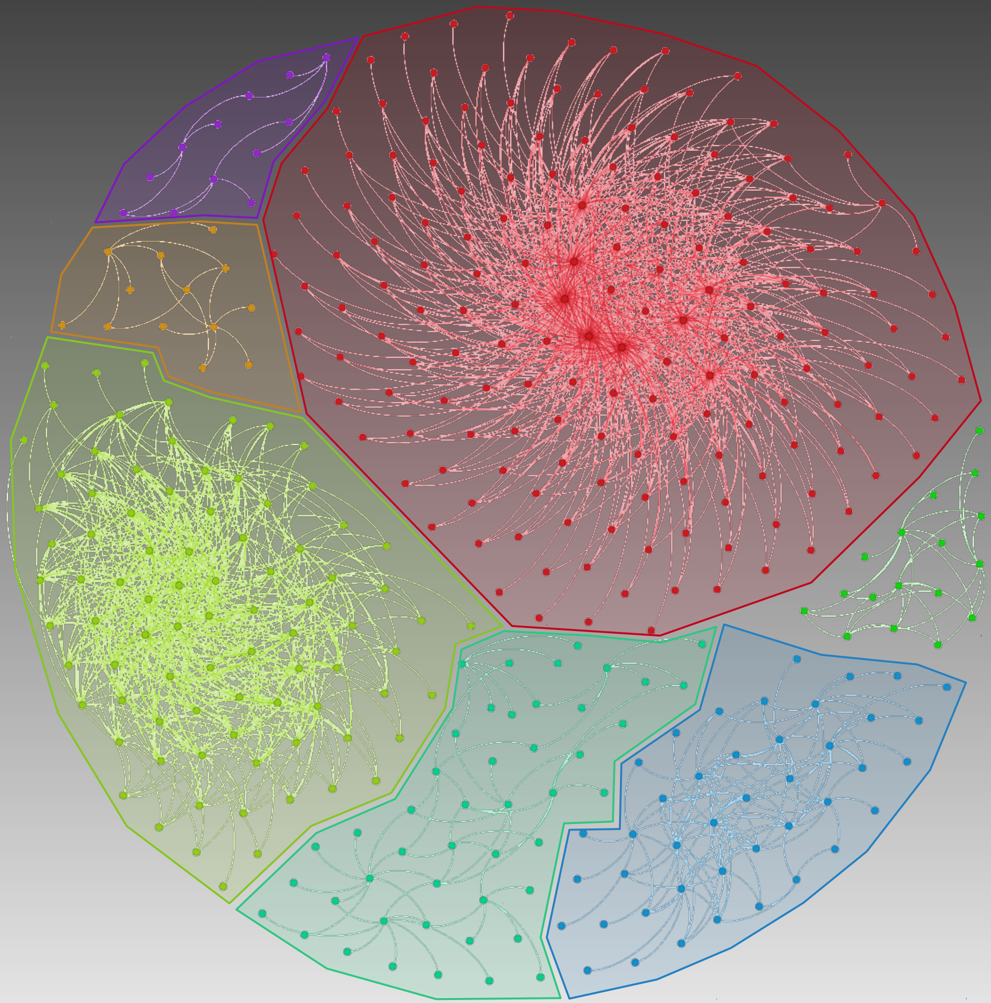

Our approach

7 distinct morphological descriptions:

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- *Varanus indicus*
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- *Varanus salvator*
- *Varanus spiny*
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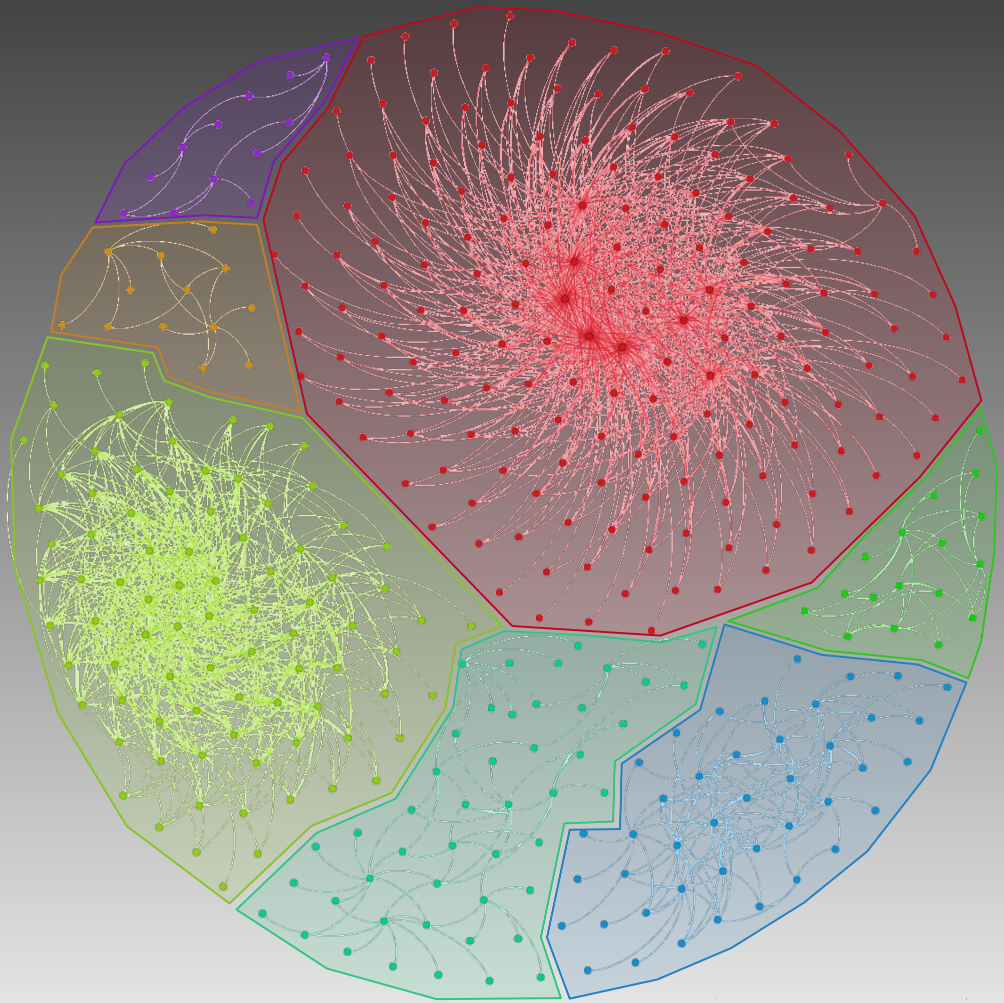

Our approach

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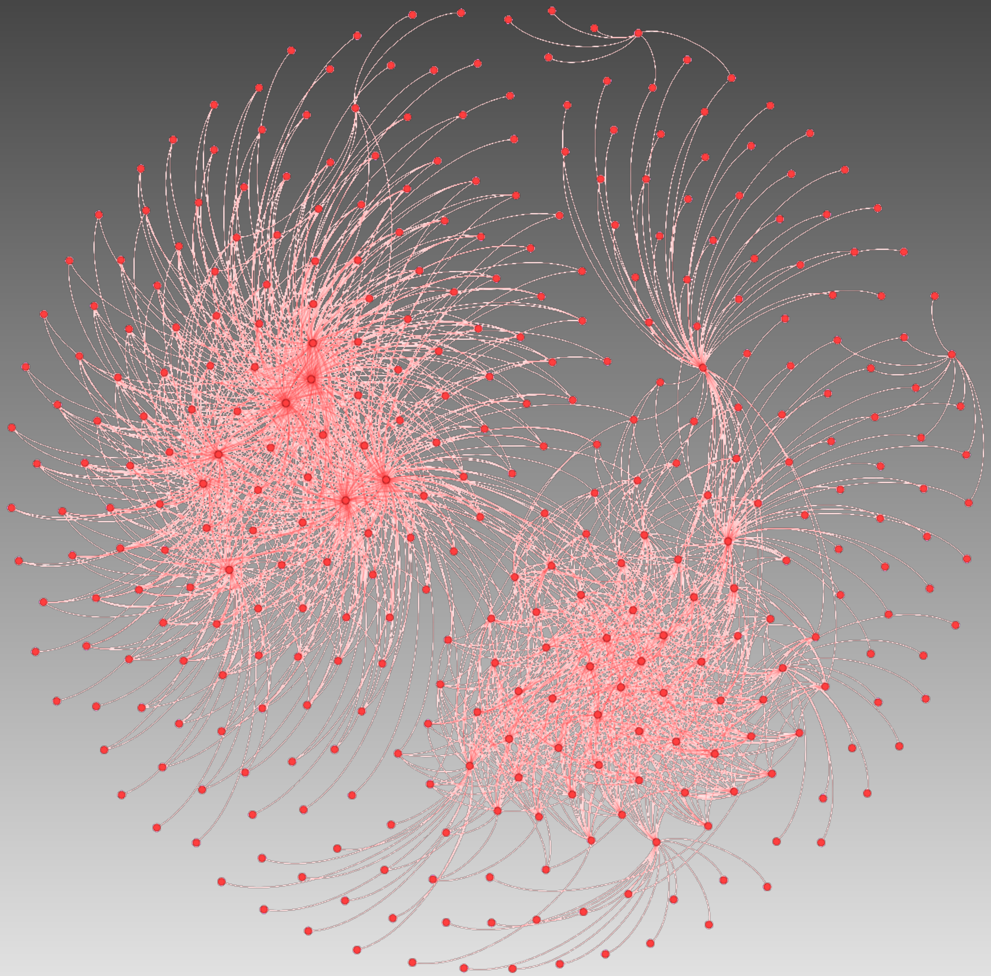
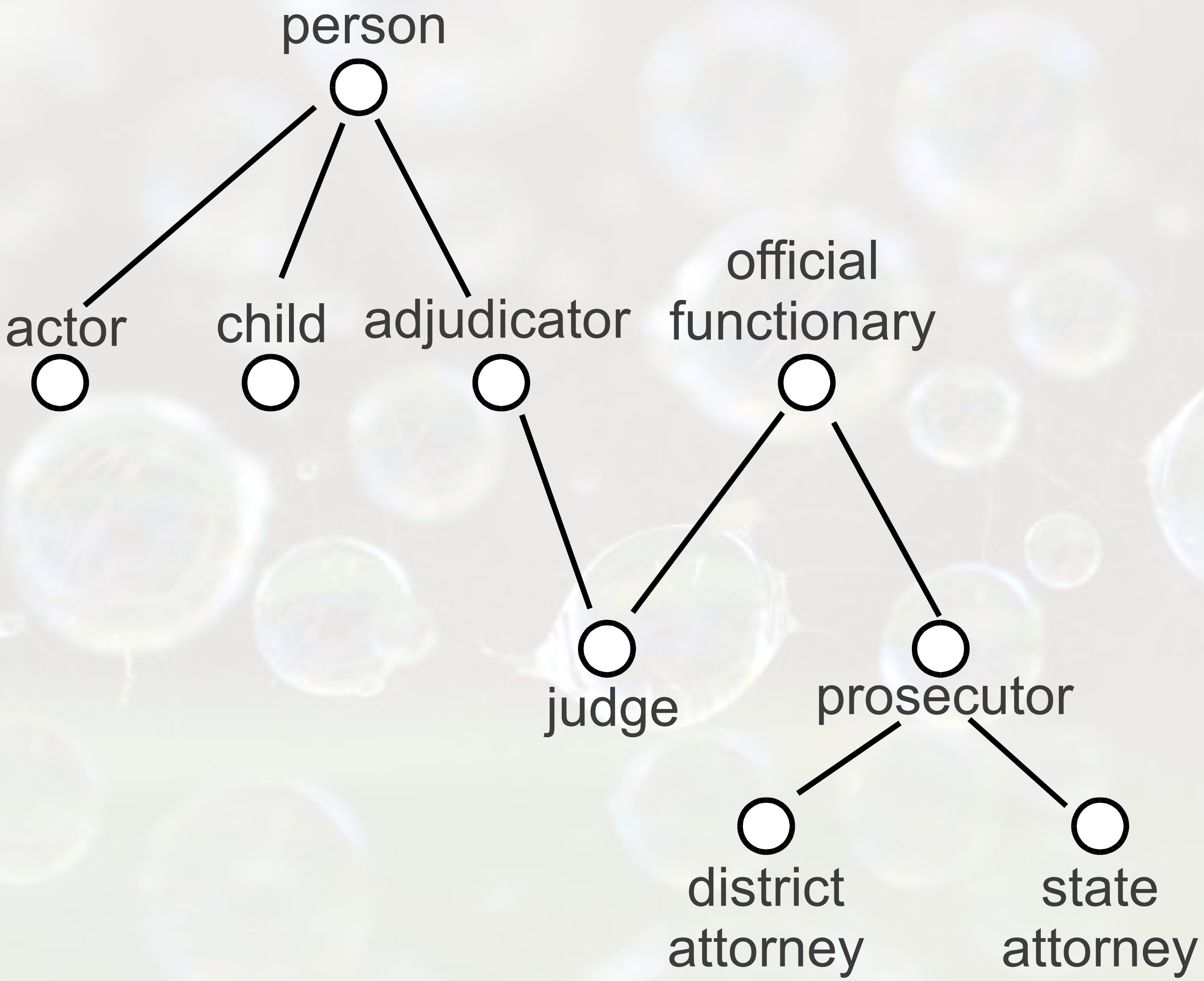
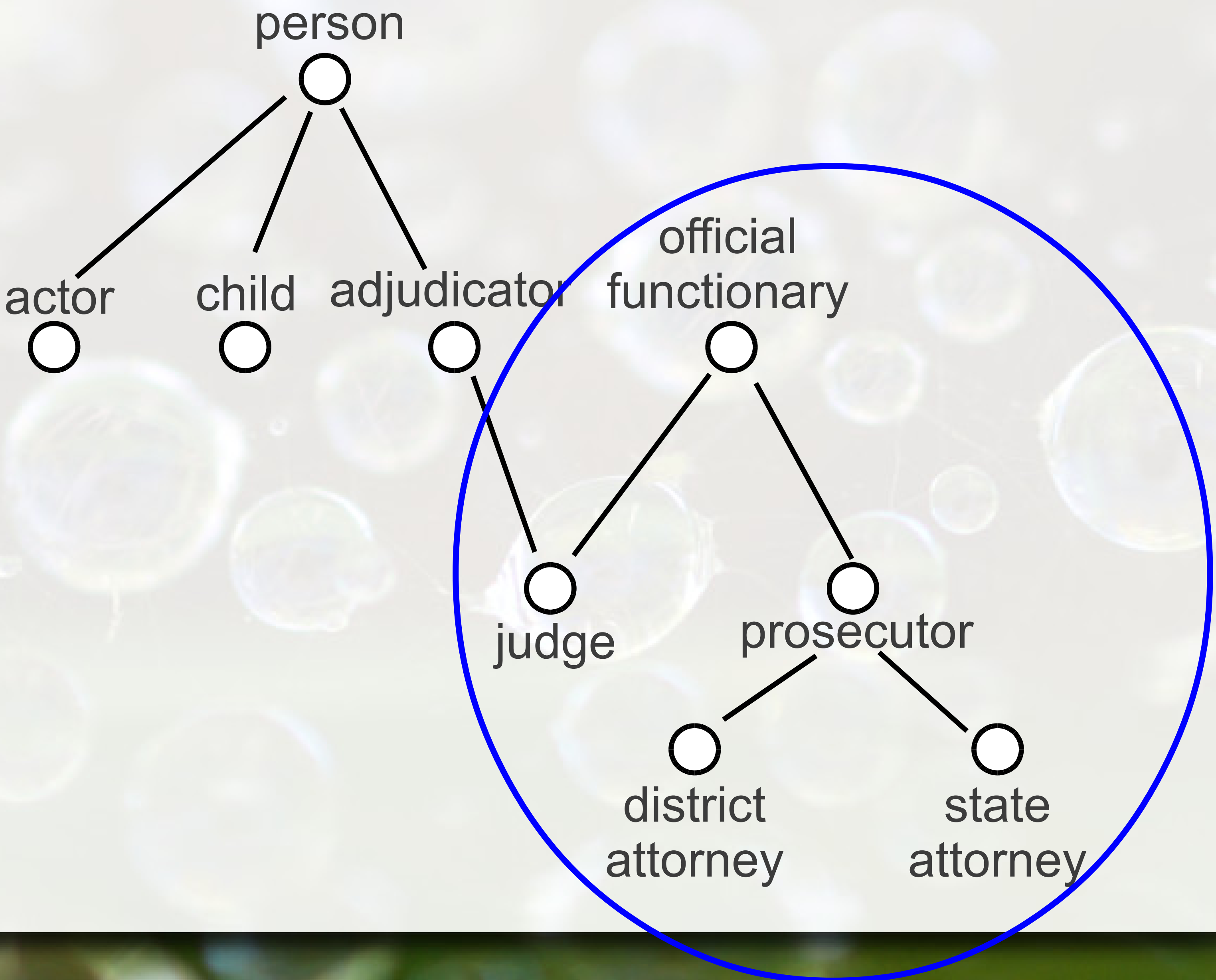


Evaluating Similarity

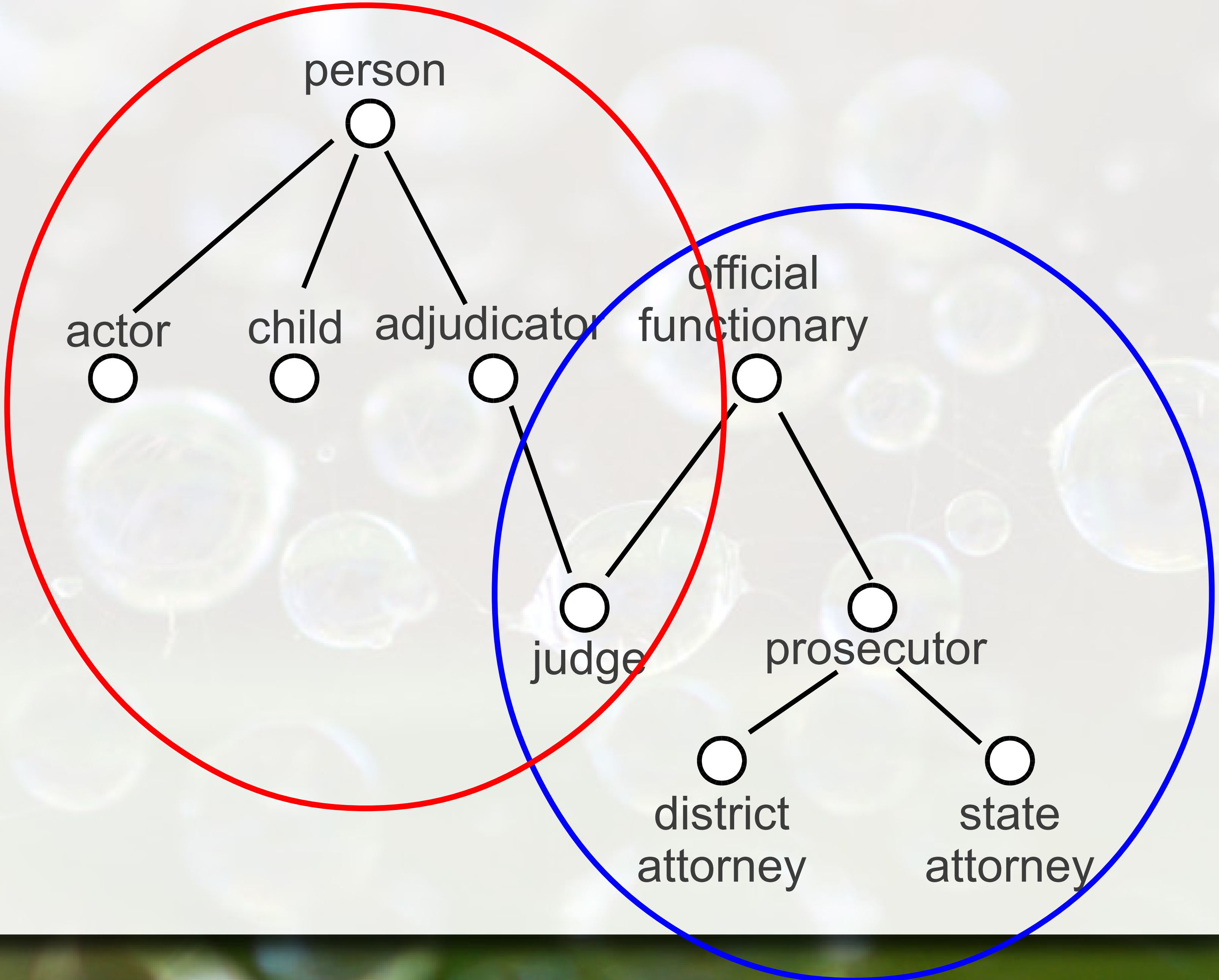
Size of the Shared Universe



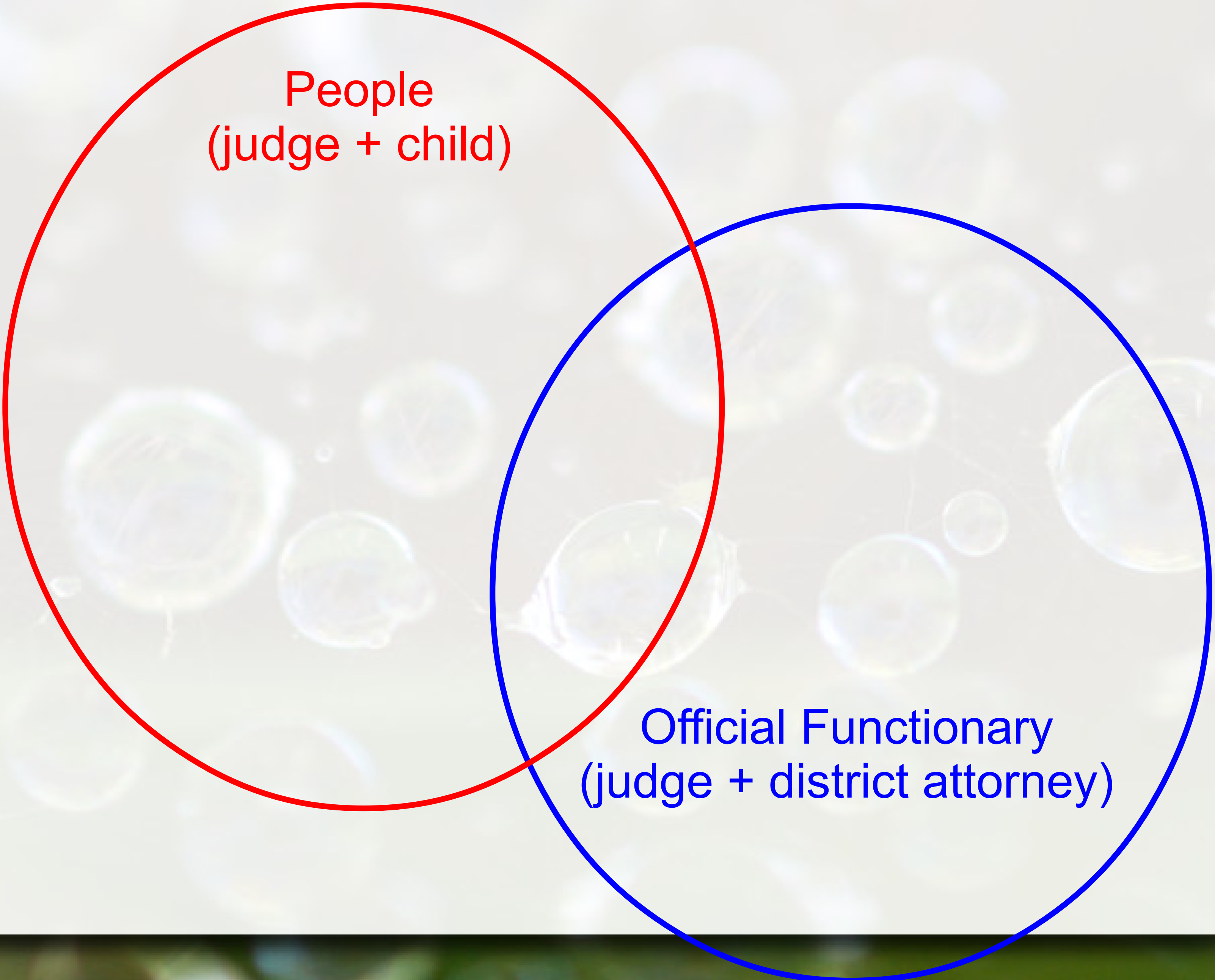
Size of the Shared Universe



Size of the Shared Universe



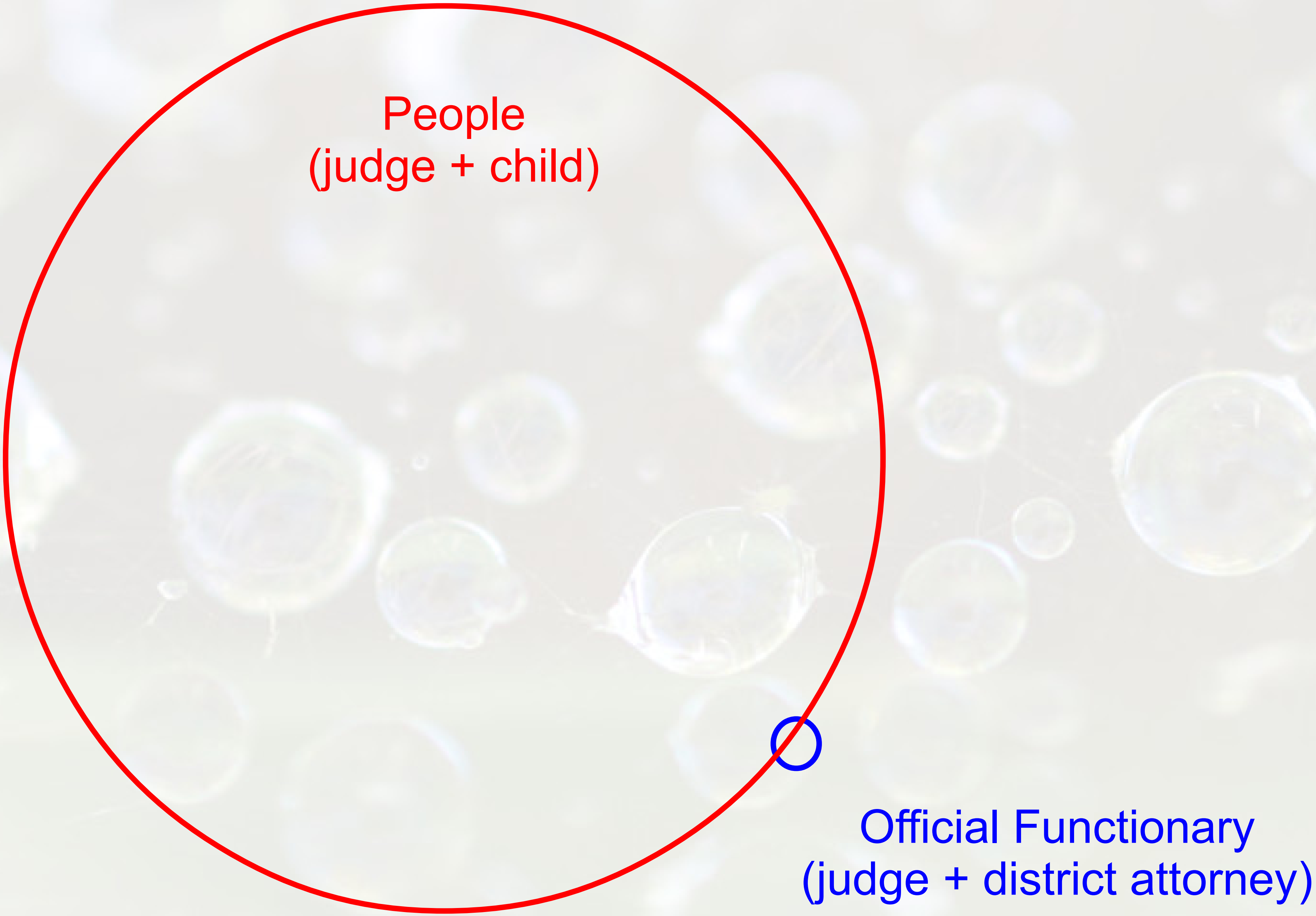
Size of the Shared Universe



People
(judge + child)

Official Functionary
(judge + district attorney)

Size of the Shared Universe



People
(judge + child)

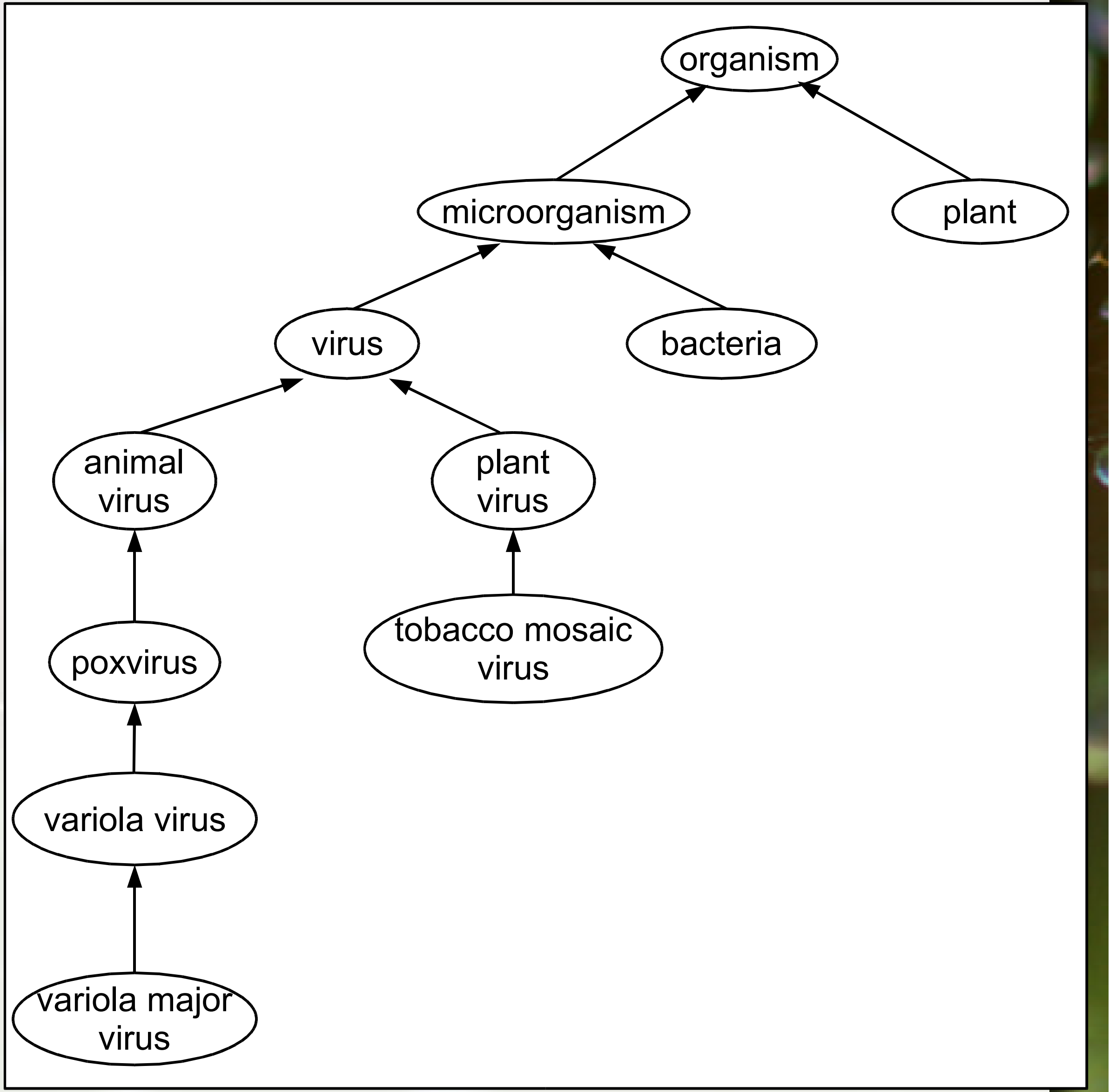
Official Functionary
(judge + district attorney)

Similarity

- What is more similar of a **tobacco mosaic virus?**

  a) variola major virus

  b) plant



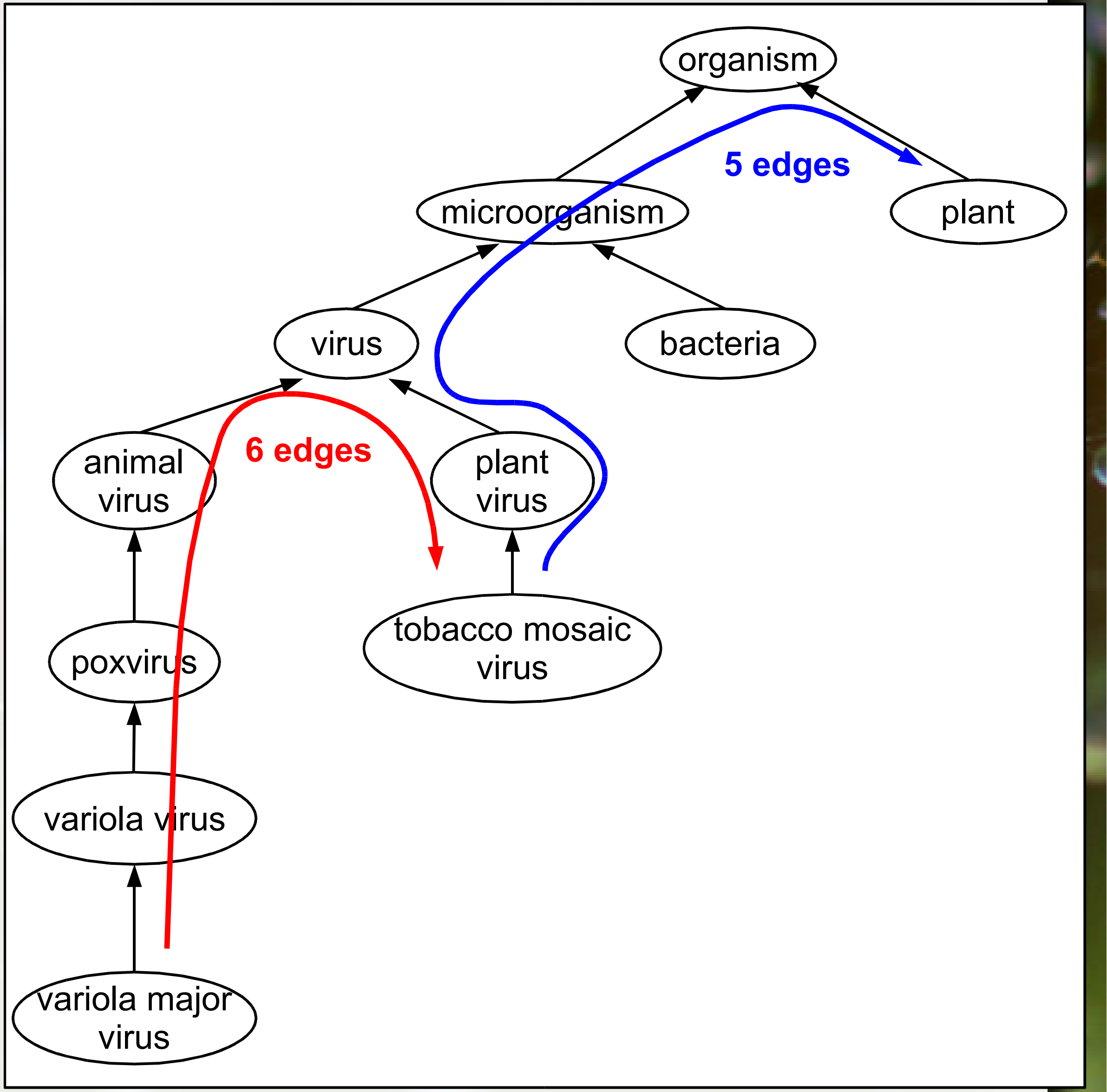
Similarity

Minimum path length

- What is more similar of a tobacco mosaic virus?

  a) variola major virus

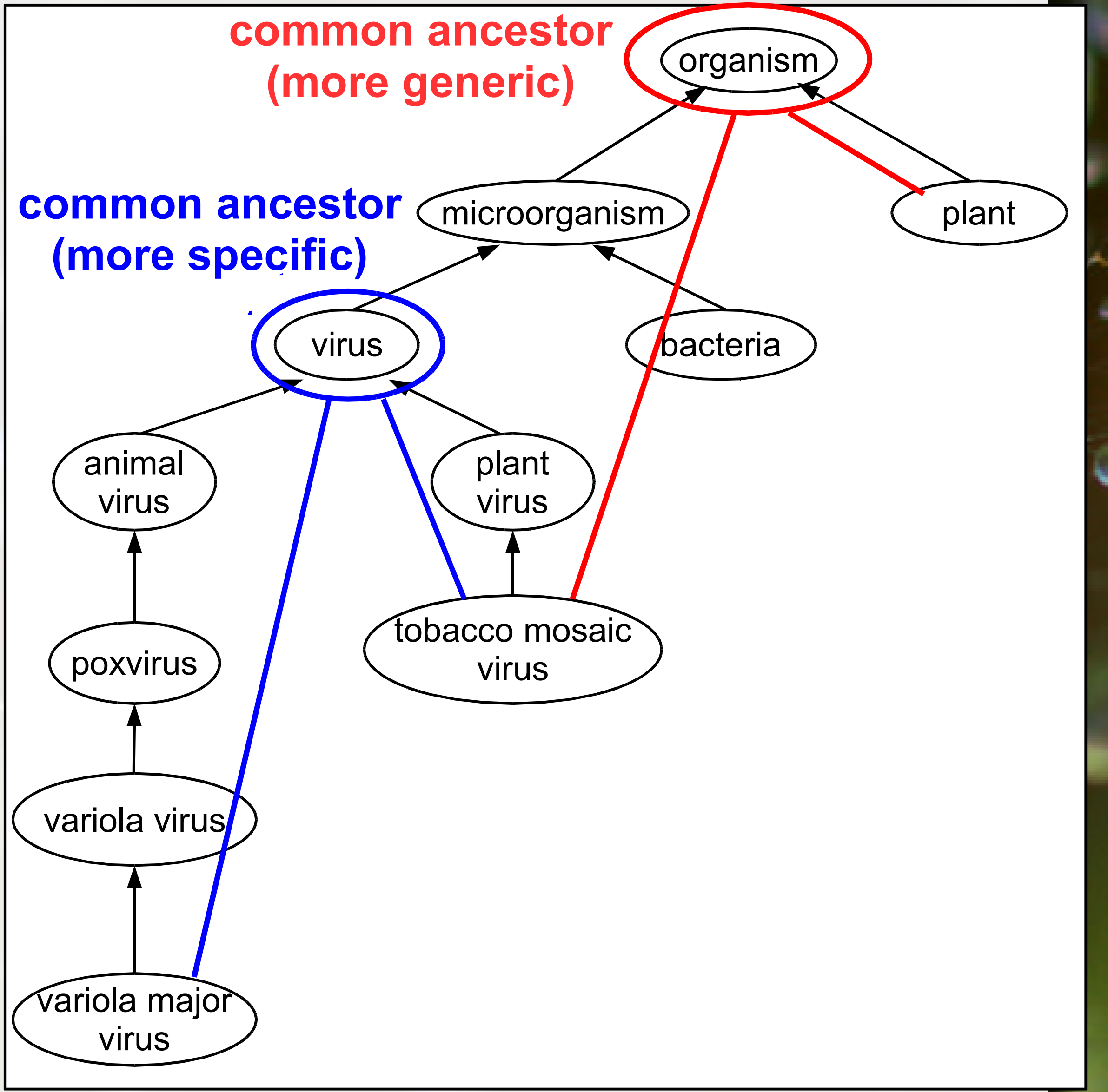
  b) plant (?)



Similarity

More specialized common ancestor

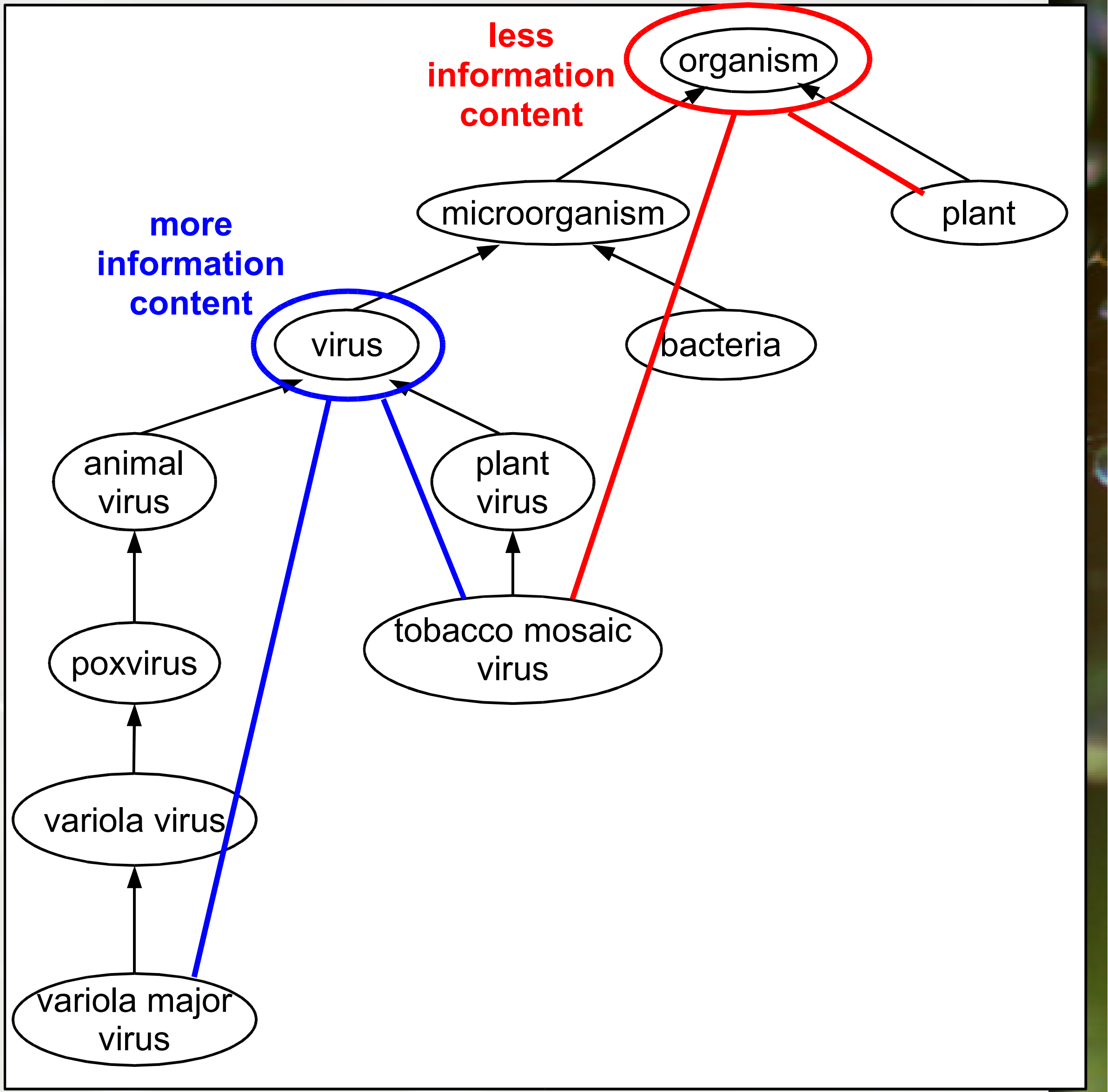
- What is more similar of a tobacco mosaic virus?
  a) variola major virus
  b) plant



Similarity

Maximum information content

- What is more similar of a tobacco mosaic virus?
  a) variola major virus
  b) plant



Similarity

Maximum information content

- What is more similar of a tobacco mosaic virus?
  - a) variola major virus
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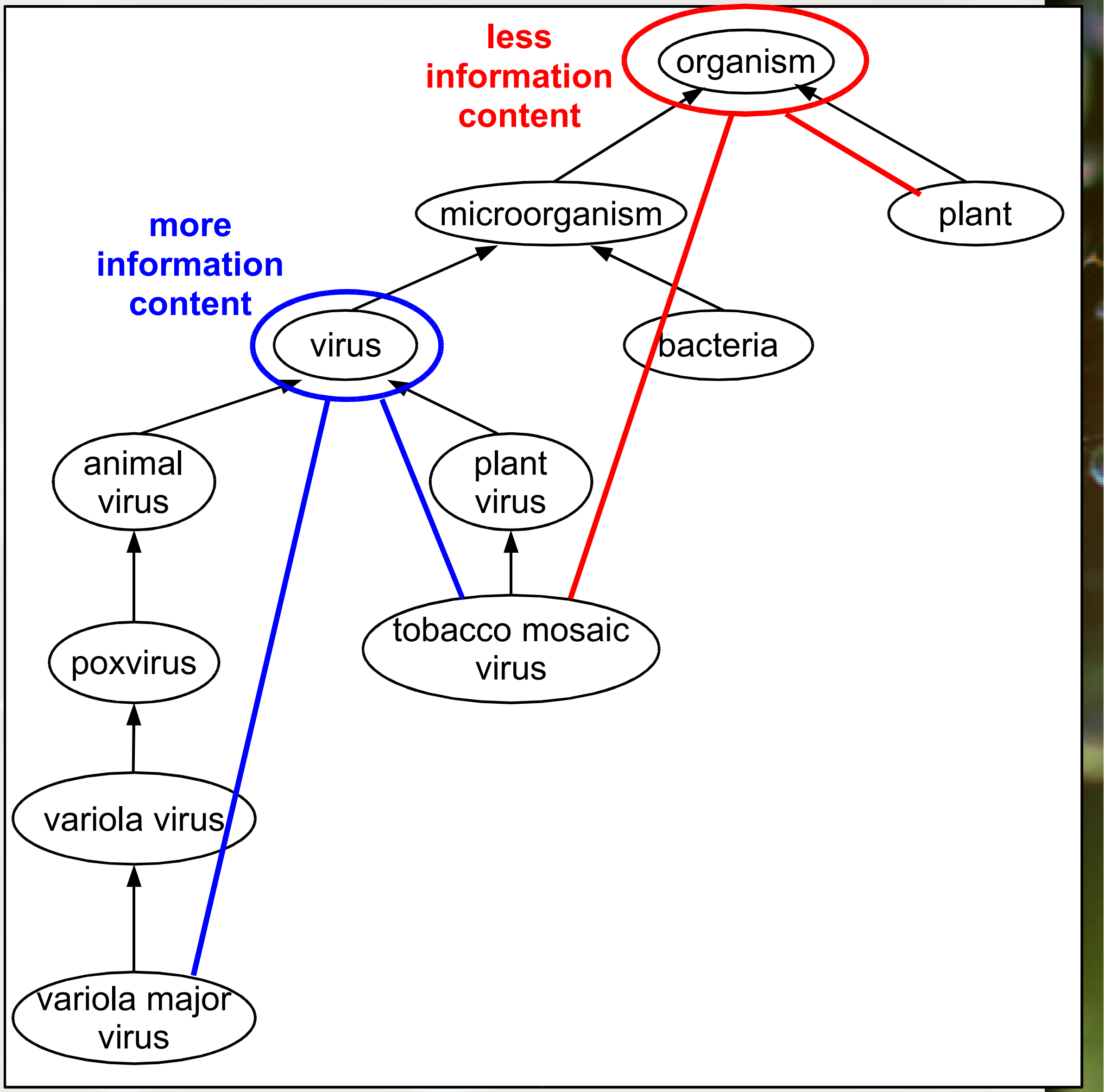


Graph Databases

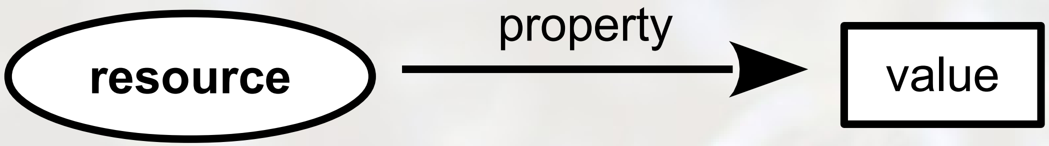
Graph Model

Graph Model

RDF Graph

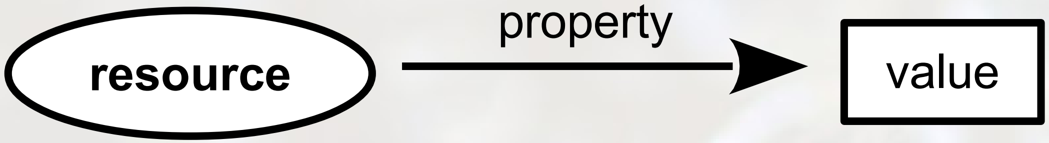
RDF Graph

- Triple model: resource, property, value

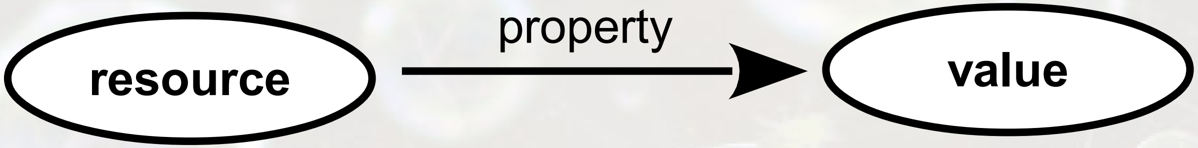


RDF Graph

- Triple model: resource, property, value

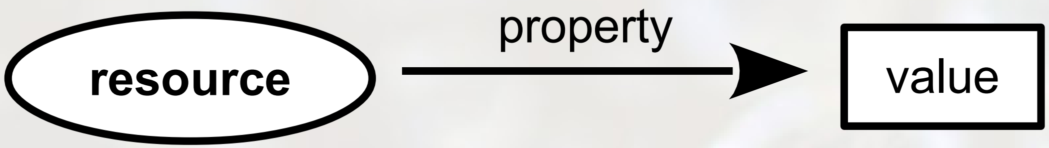


- The value can be another resource

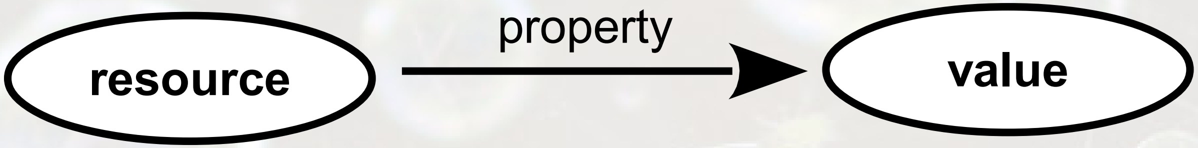


RDF Graph

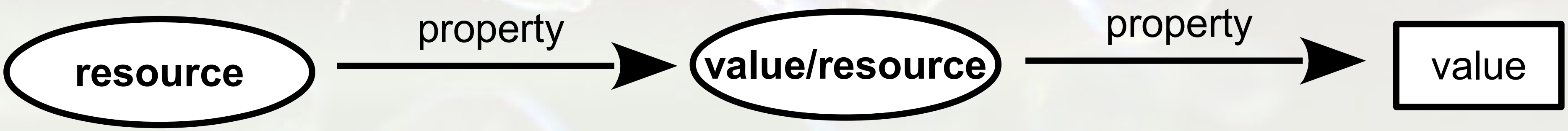
- Triple model: resource, property, value



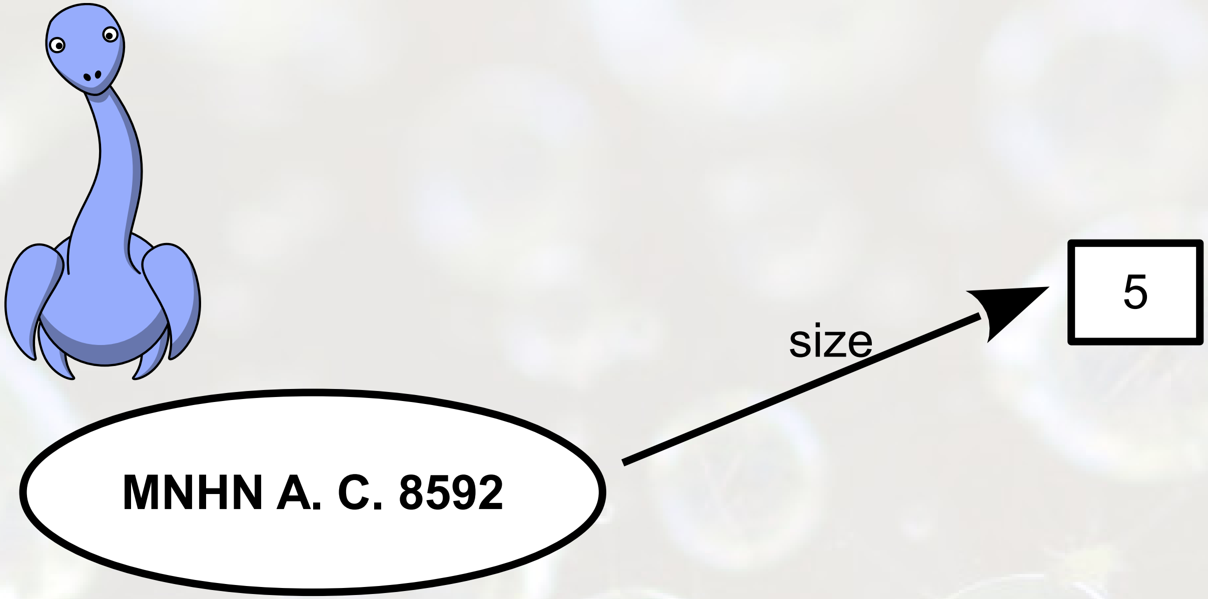
- The value can be another resource



- ... described by a property,value

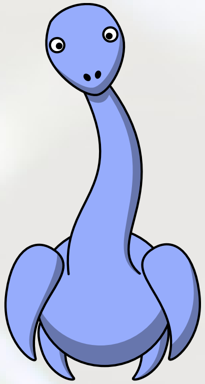


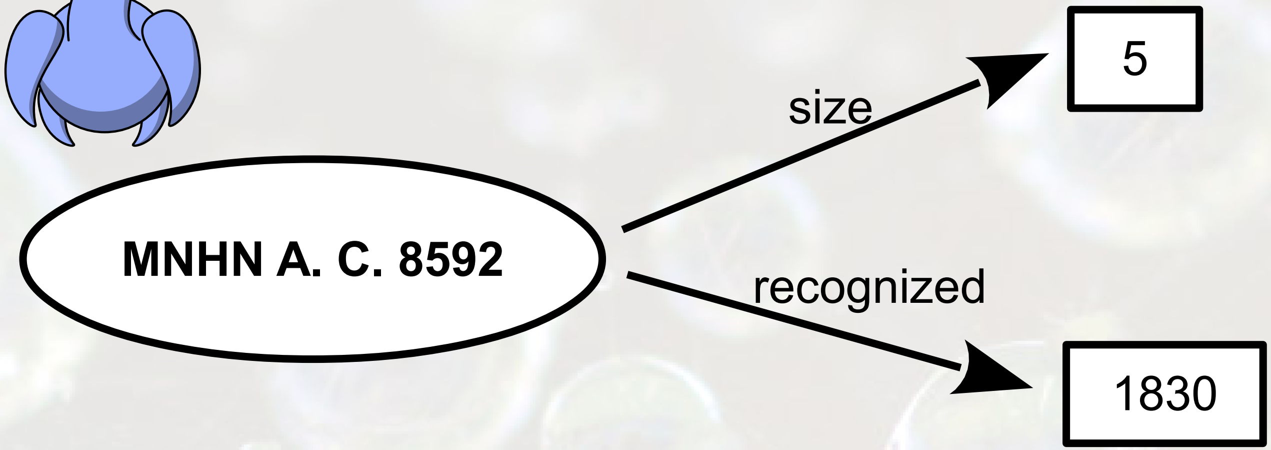
Plesiosaurus dolichodeirus in RDF



- Triple: <MNHN A. C. 8592>, size, 5

Plesiosaurus dolichodeirus in RDF





MNHN A. C. 8592

size

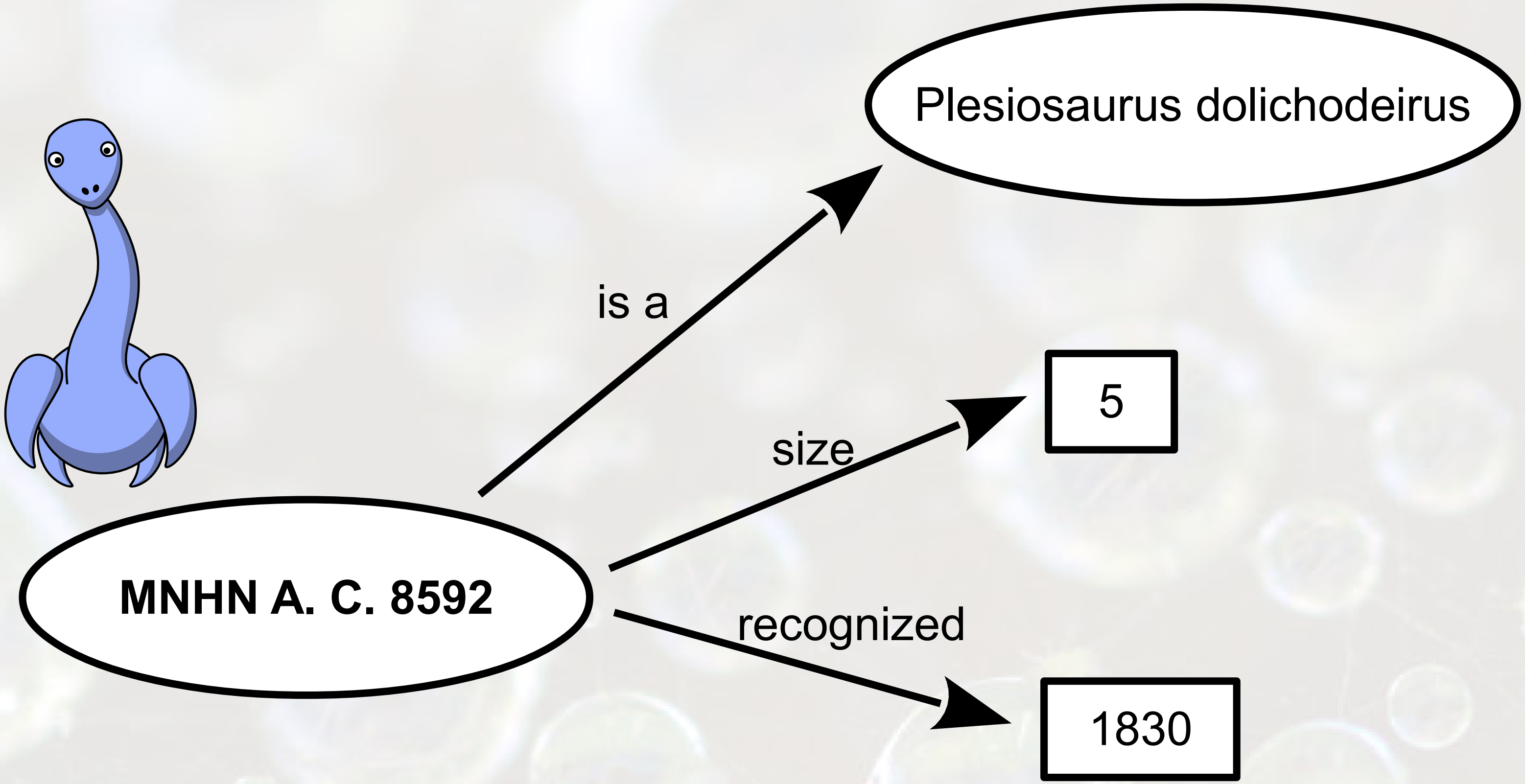
5

recognized

1830

- Triple: <MNHN A. C. 8592>, size, 5
- Triple: <MNHN A. C. 8592>, recognized, 1830

Plesiosaurus dolichodeirus in RDF



Plesiosaurus dolichodeirus

is a

5

size

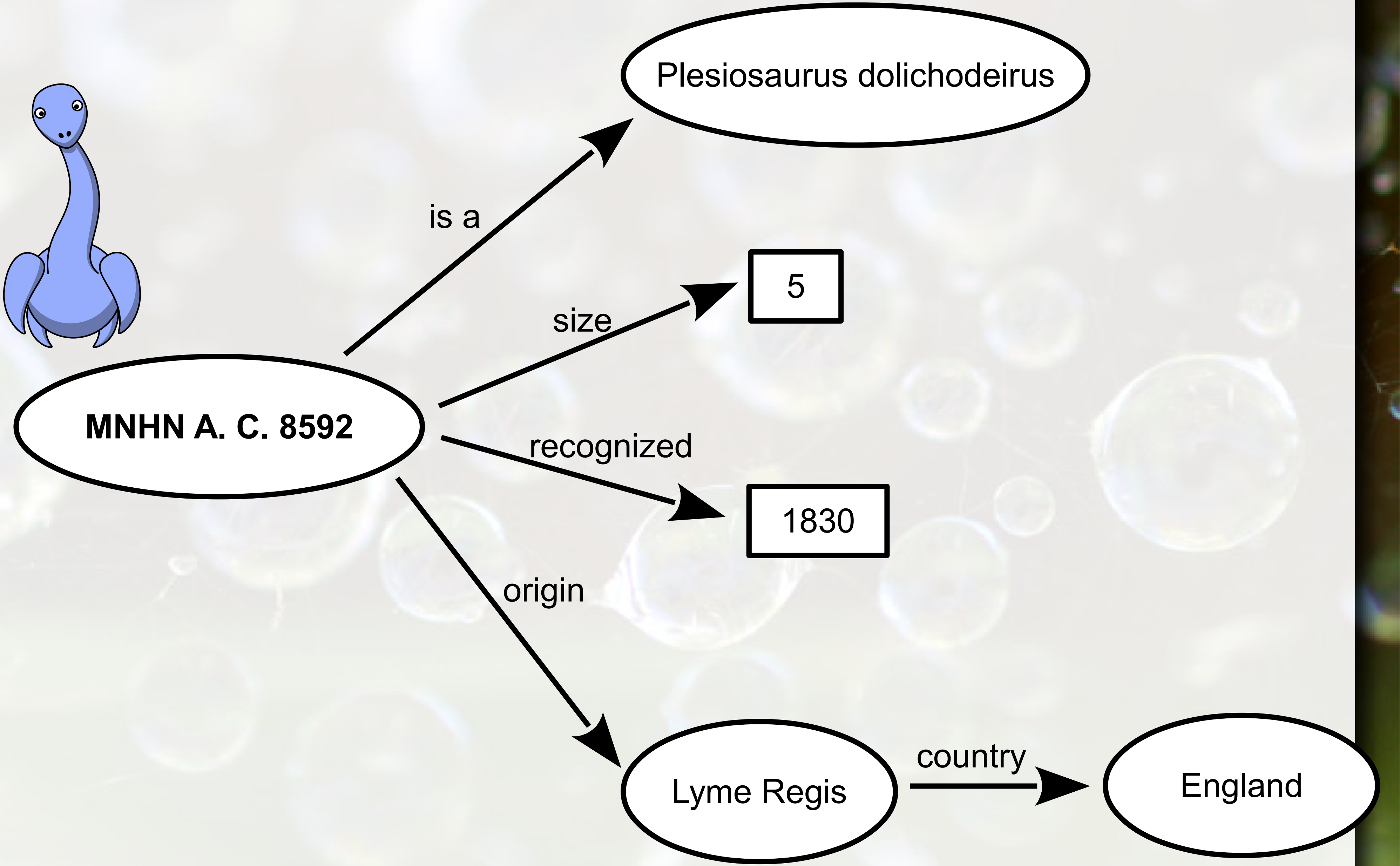
MNHN A. C. 8592

recognized

1830

- <MNHN A. C. 8592>, is_a, <Plesiosaurus dolichodeirus>

Plesiosaurus dolichodeirus in RDF



MNHN A. C. 8592

is a

Plesiosaurus dolichodeirus

size

5

recognized

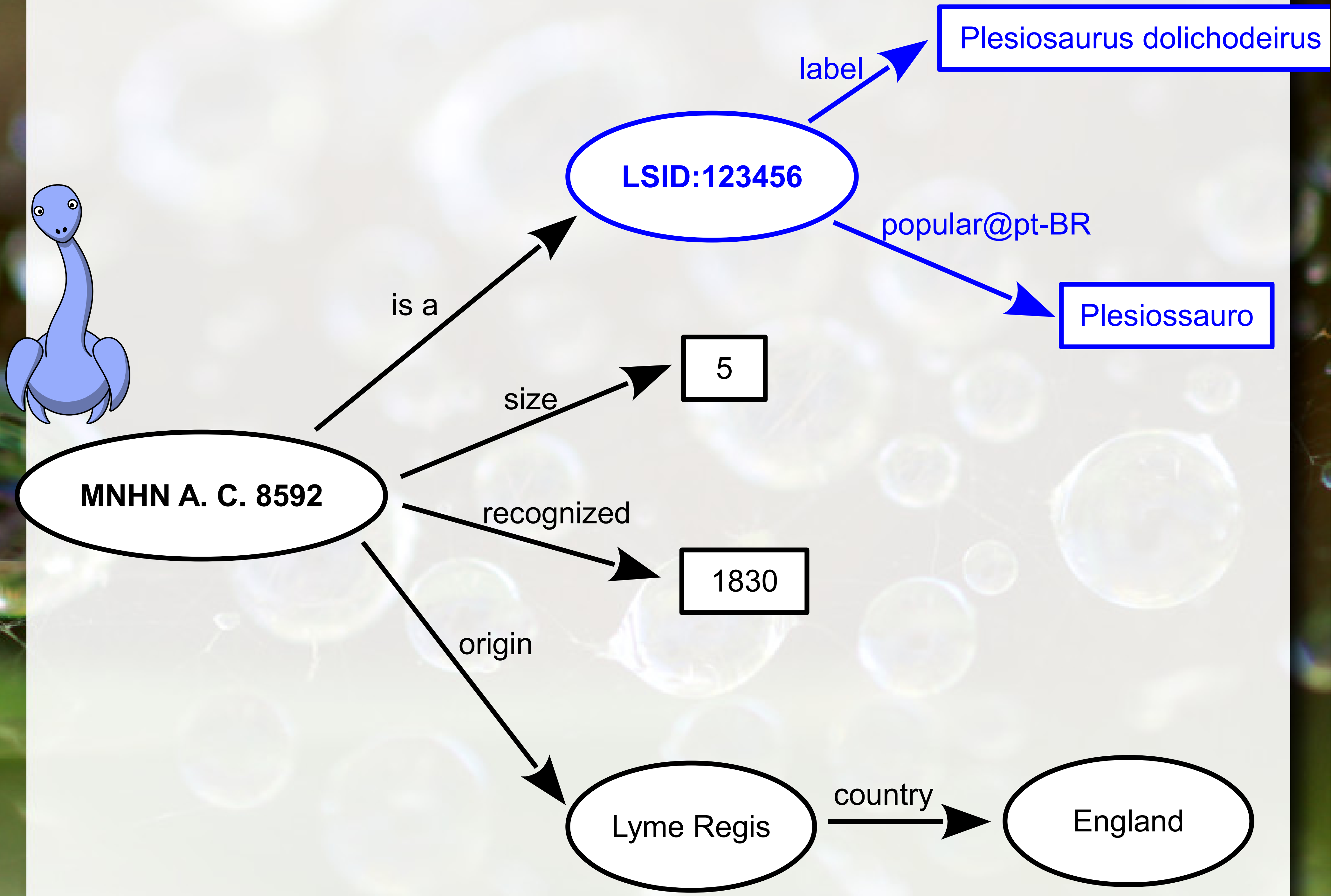
1830

origin

Lyme Regis

country

England



label

Plesiosaurus dolichodeirus

LSID:123456

popular@pt-BR

Plesiossauro

is a

5

size

MNHN A. C. 8592

recognized

1830

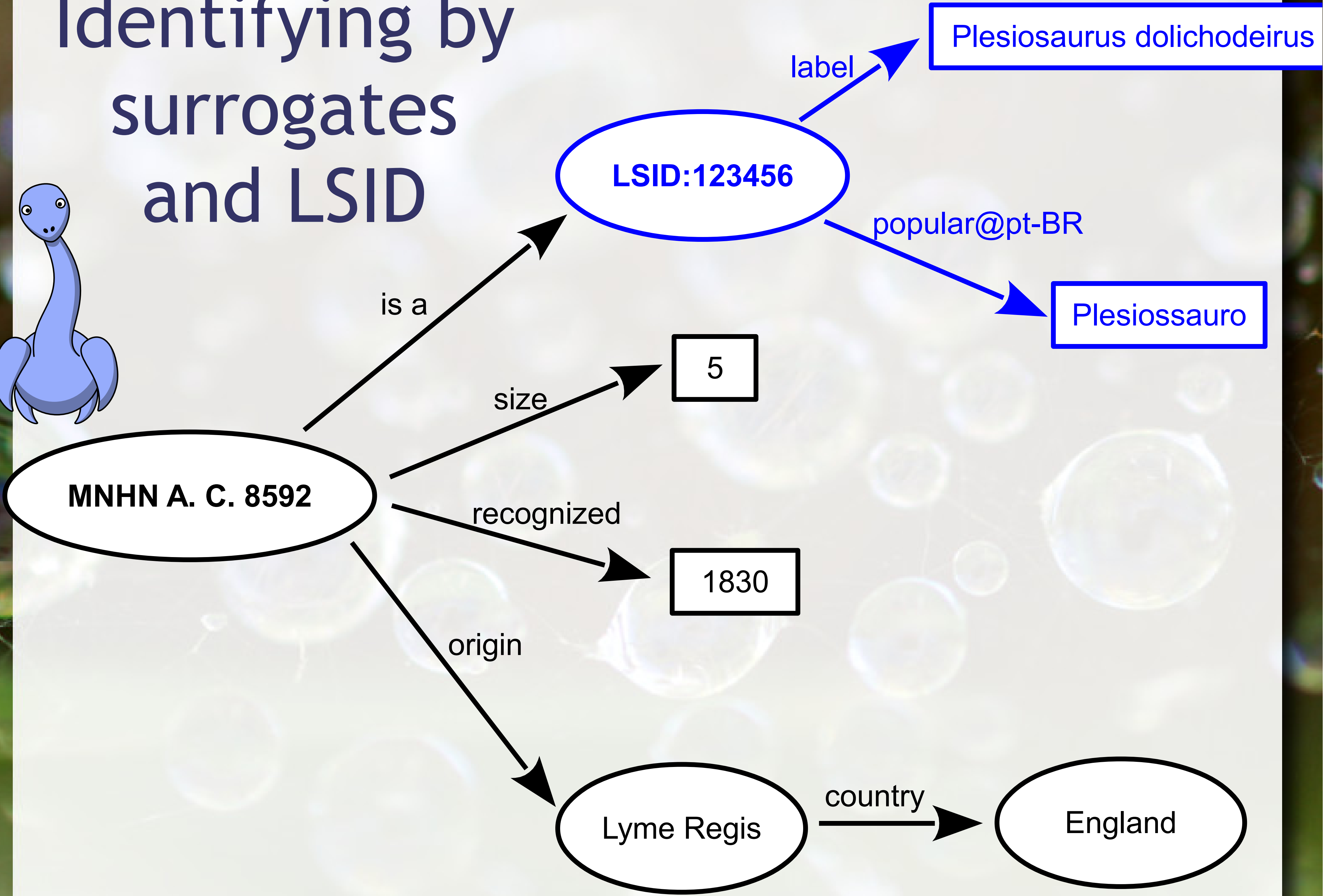
origin

Lyme Regis

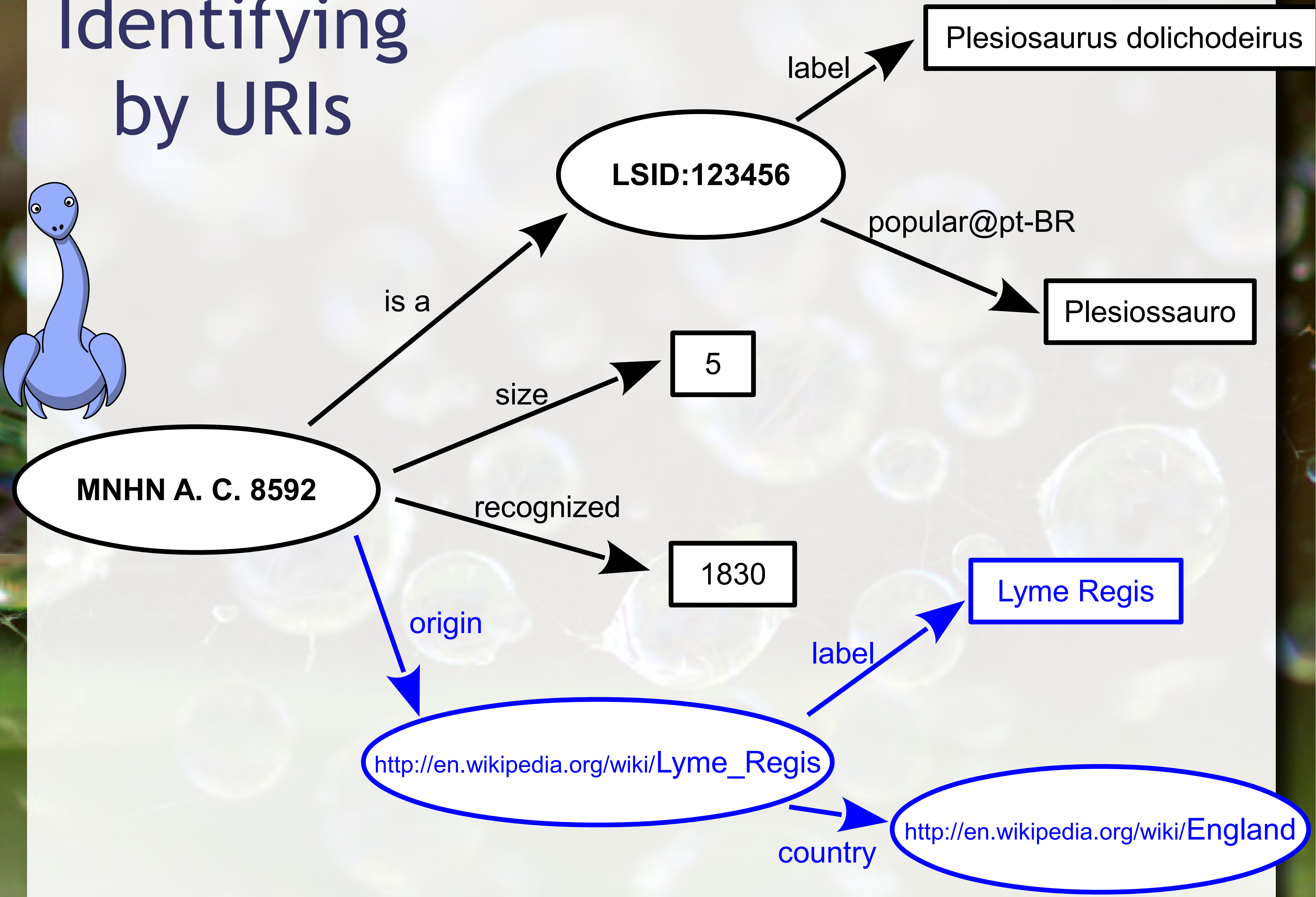
country

England

Identifying by surrogates and LSID



Identifying by URIs



LSID:123456

label

Plesiosaurus dolichodeirus

popular@pt-BR

Plesiossauro

is a

size

5

MNHN A. C. 8592

recognized

1830

origin

label

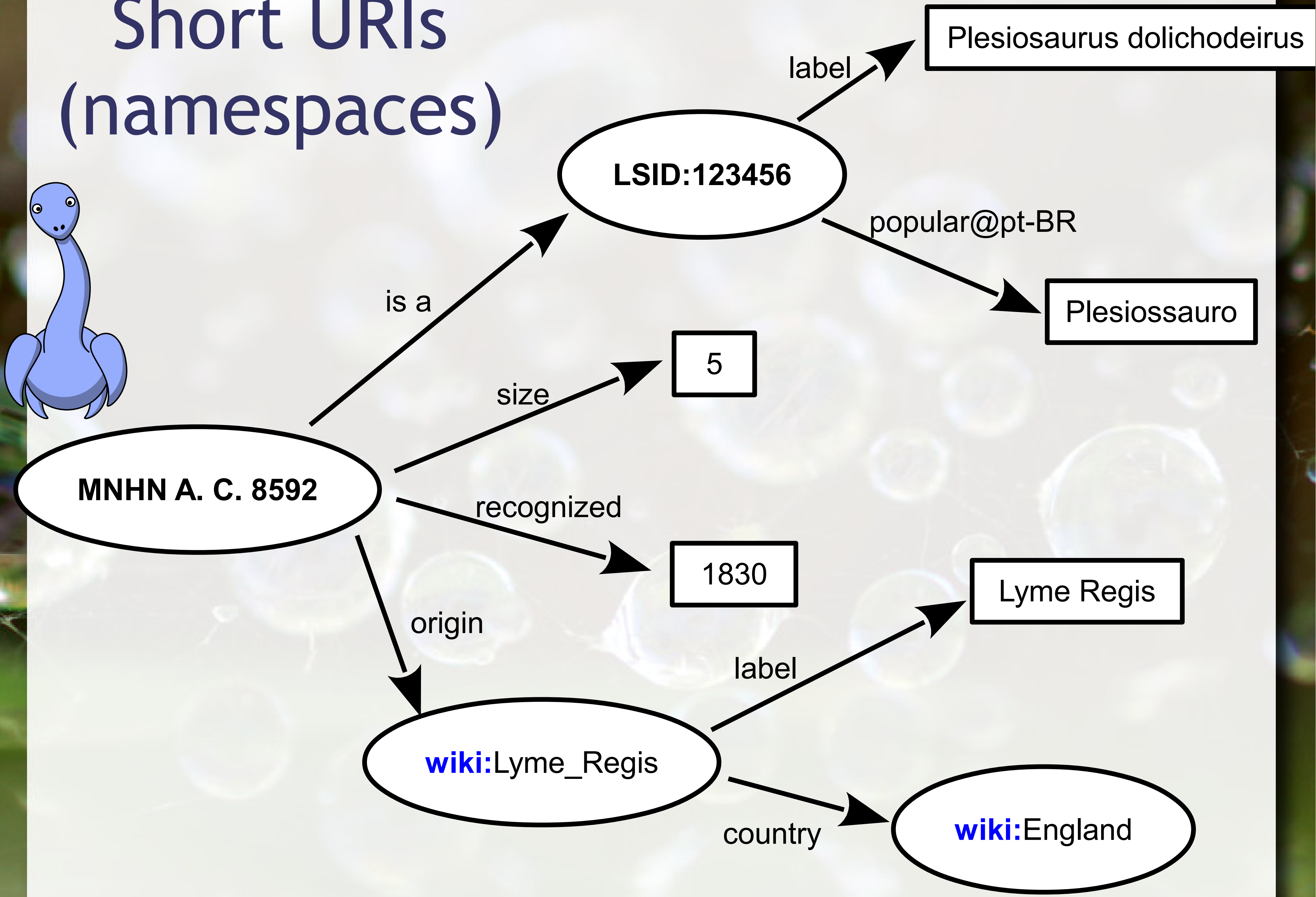
Lyme Regis

http://en.wikipedia.org/wiki/Lyme_Regis

country

http://en.wikipedia.org/wiki/England

Short URIs (namespaces)



LSID:123456

label

Plesiosaurus dolichodeirus

popular@pt-BR

Plesiossauro

is a

MNHN A. C. 8592

size

5

recognized

1830

origin

wiki:Lyme_Regis

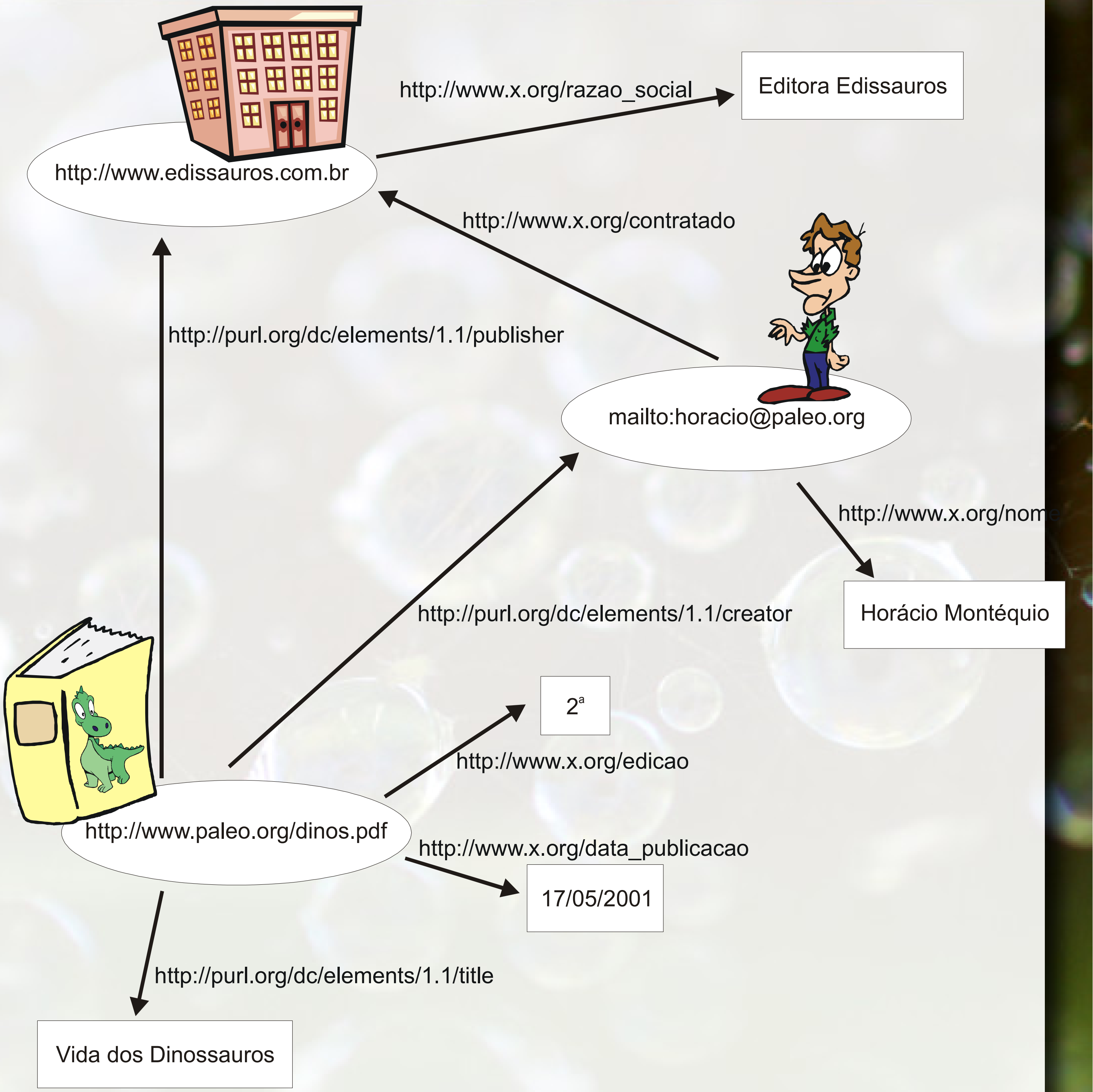
label

Lyme Regis

country

wiki:England

RDF Graph



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http://purl.org/dc/elements/1.1/title

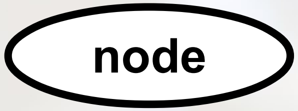
Vida dos Dinossauros

Graph Model

Property Graph

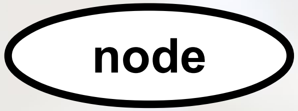
Property Graph

- (node)

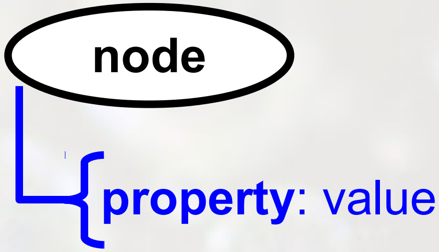


Property Graph

- (node)

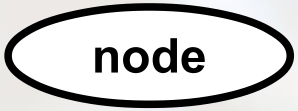


  - Nodes can have properties (node { property: value })

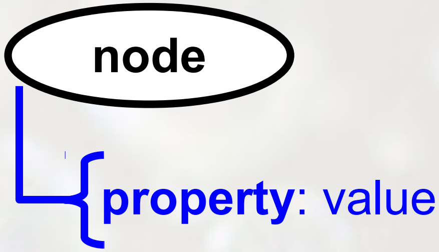


Property Graph

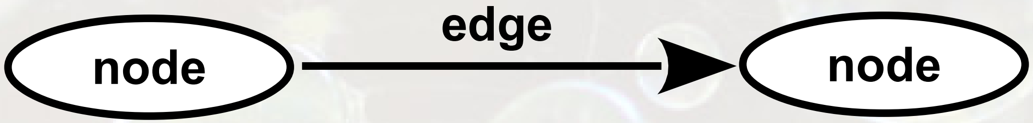
- (node)



  - Nodes can have properties (node { property: value })

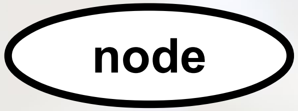


- (node)-[edge]->(node)

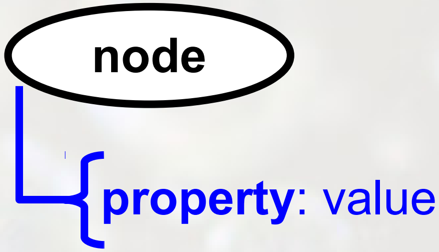


Property Graph

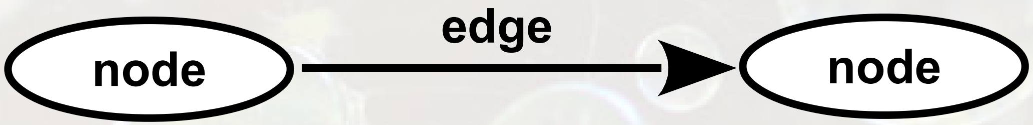
- (node)



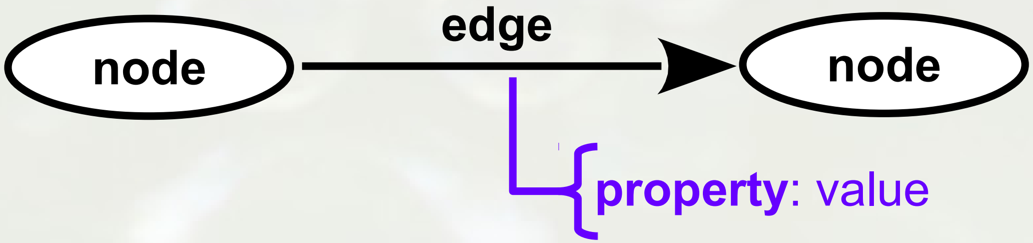
  - Nodes can have properties
    (node { property: value })



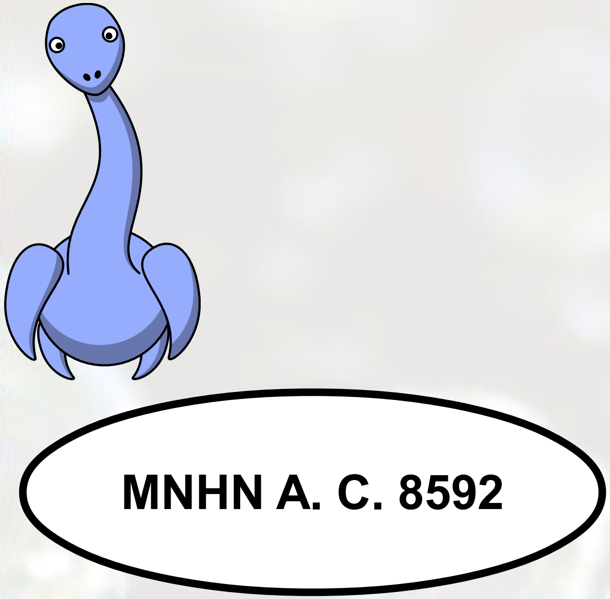
- (node)-[edge]->(node)



  - Edges can have properties
    (node)-[edge {property:value}]->(node)

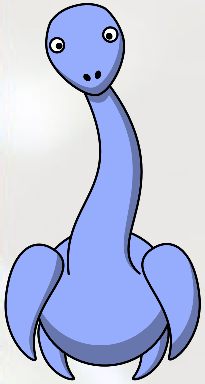


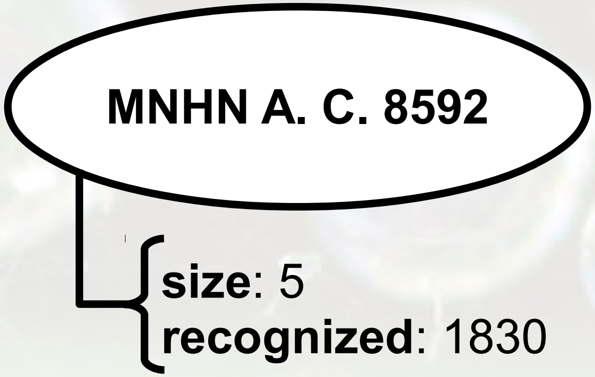
Plesiosaurus in a Property Graph



MNHN A. C. 8592

Plesiosaurus in a Property Graph

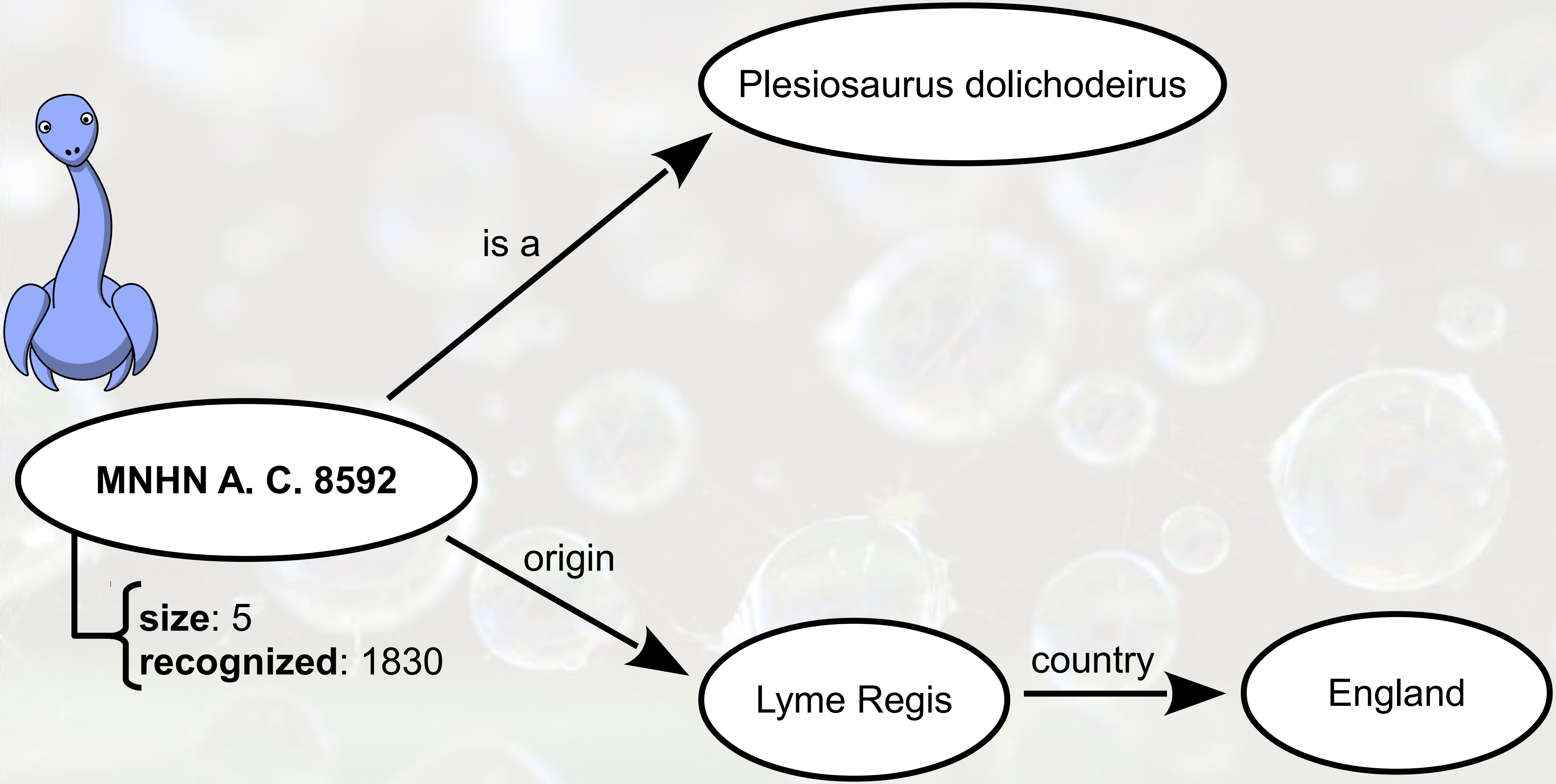




MNHN A. C. 8592

size: 5
recognized: 1830

Plesiosaurus in a Property Graph



Plesiosaurus dolichodeirus

is a

MNHN A. C. 8592

size: 5
recognized: 1830

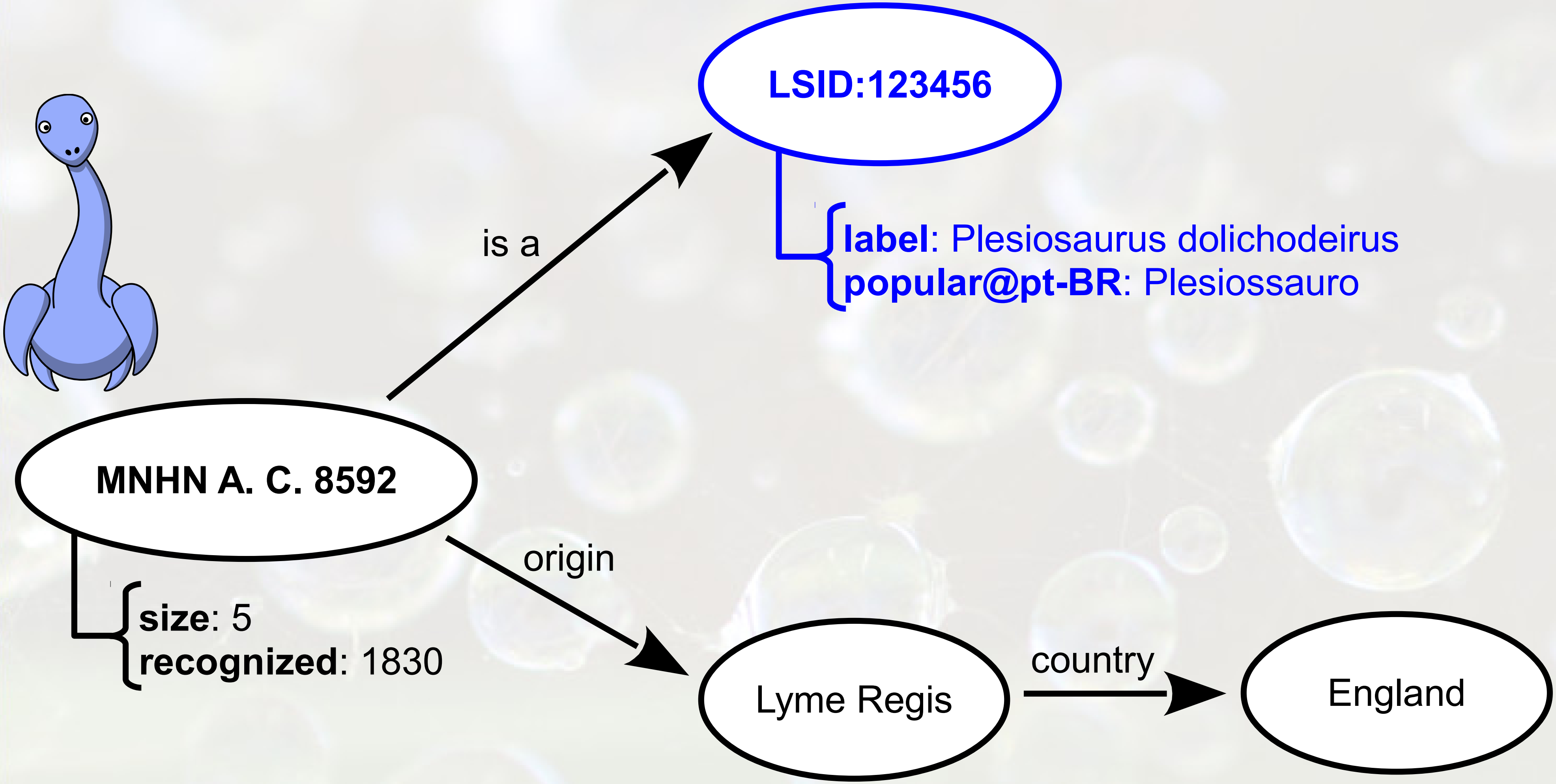
origin

Lyme Regis

country

England

LSID Surrogate



LSID:123456

label: Plesiosaurus dolichodeirus
popular@pt-BR: Plesiossauro

is a

MNHN A. C. 8592

size: 5
recognized: 1830

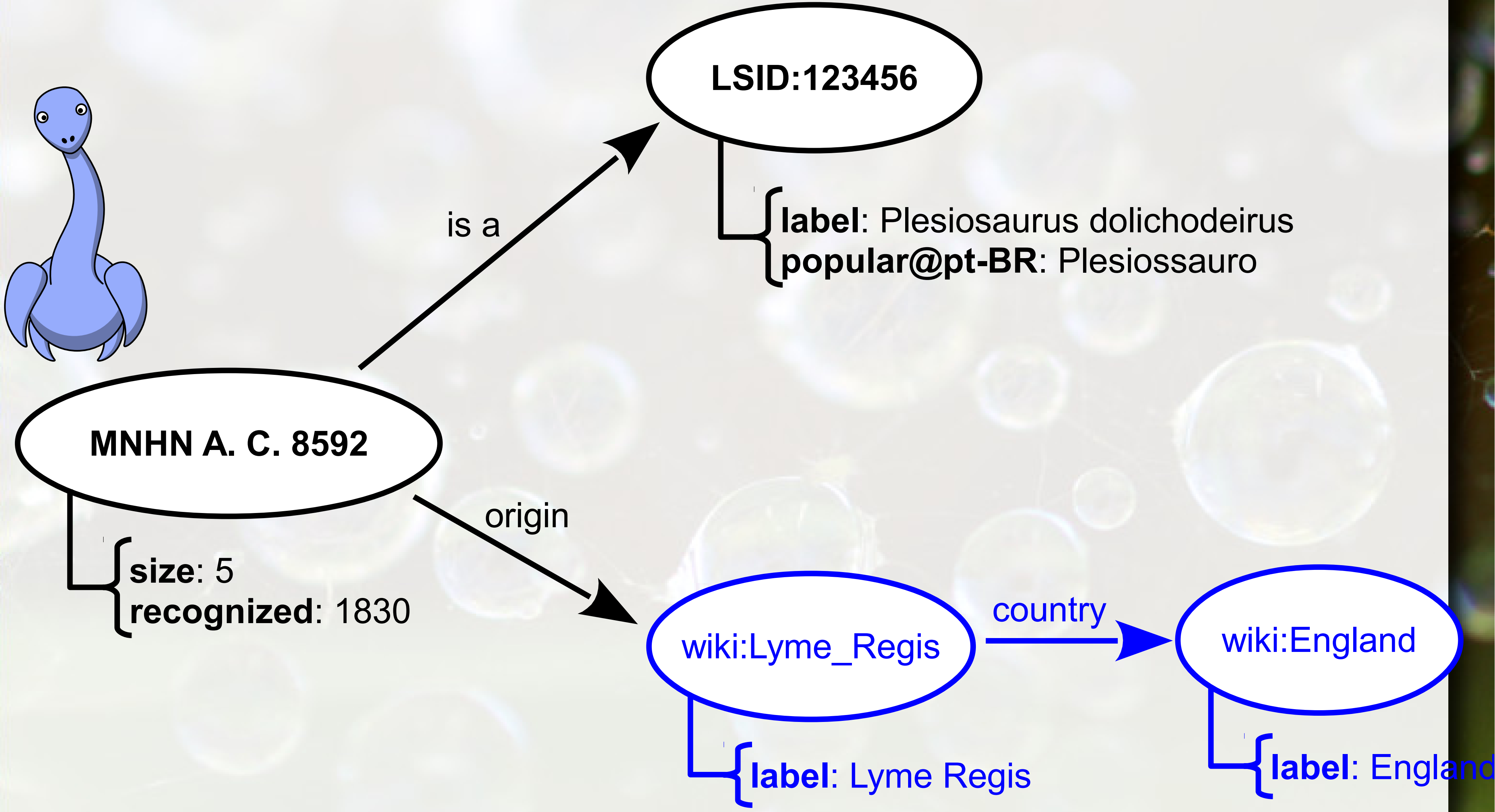
origin

Lyme Regis

country

England

URI Identifiers



LSID:123456

label: Plesiosaurus dolichodeirus
popular@pt-BR: Plesiossauro

is a

MNHN A. C. 8592

size: 5
recognized: 1830

origin

wiki:Lyme_Regis

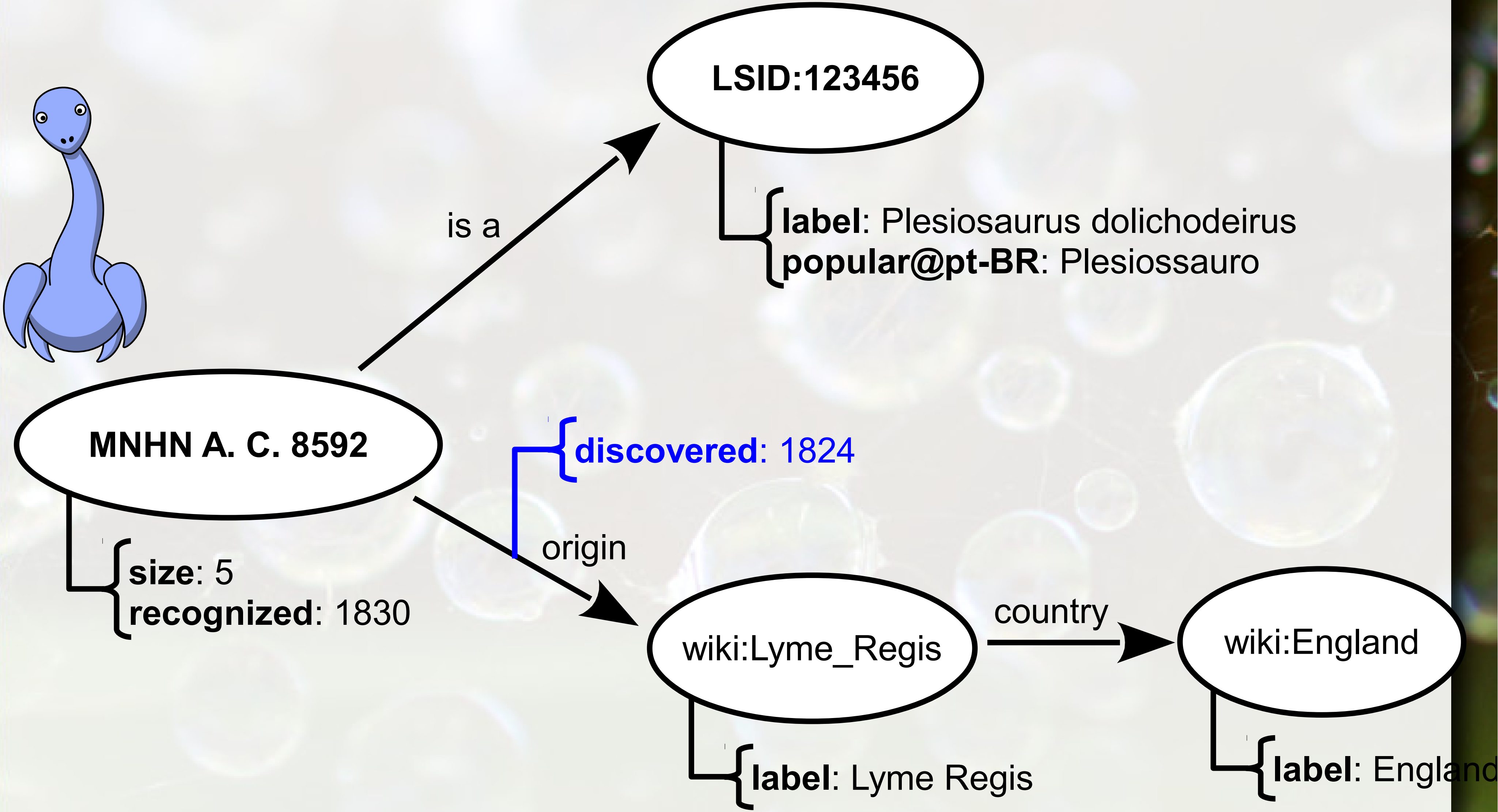
label: Lyme Regis

country

wiki:England

label: England

Property in the `origin` edge



LSID:123456

label: Plesiosaurus dolichodeirus
popular@pt-BR: Plesiossauro

is a

MNHN A. C. 8592

size: 5
recognized: 1830

discovered: 1824

origin

wiki:Lyme_Regis

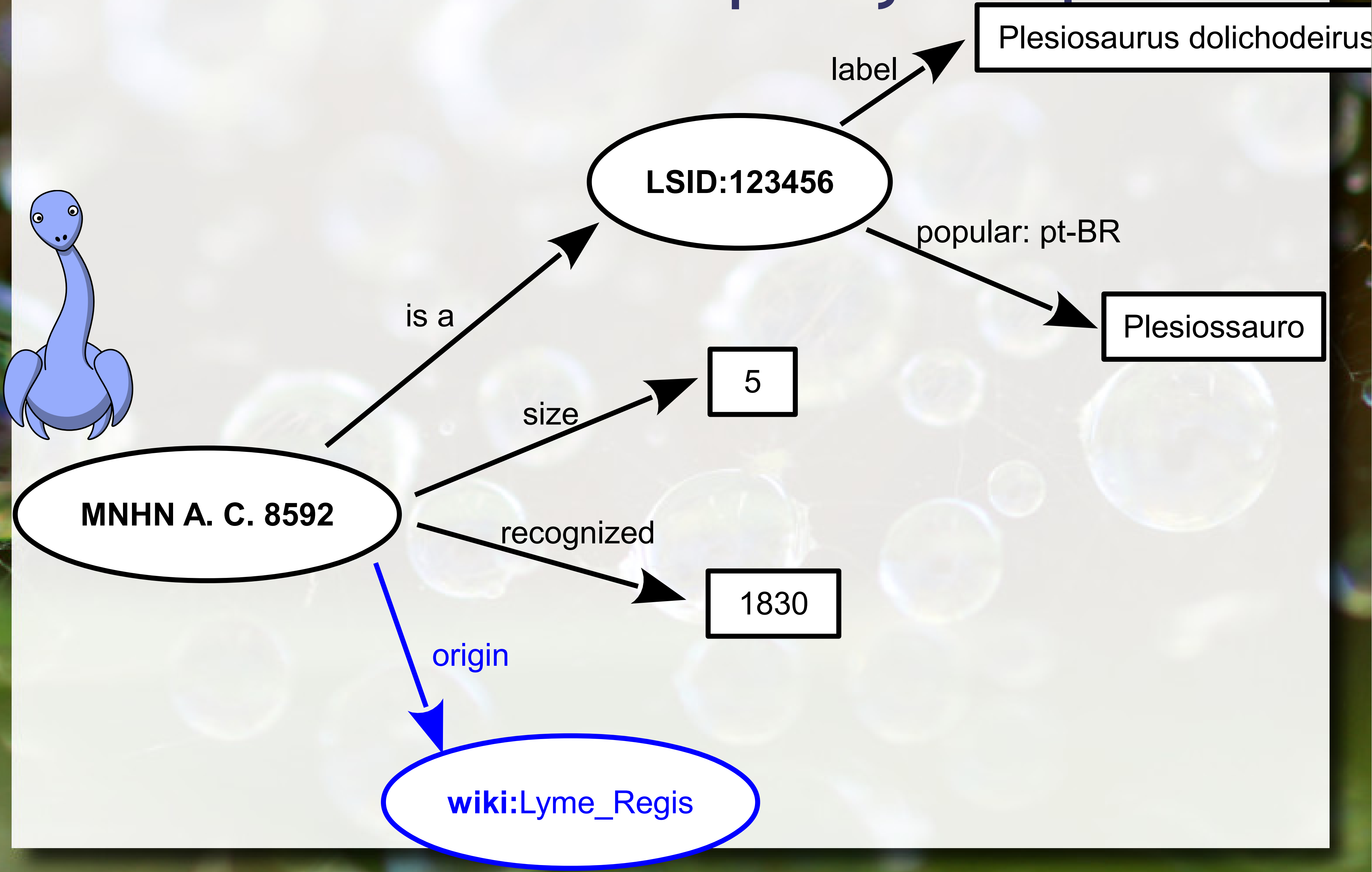
label: Lyme Regis

country

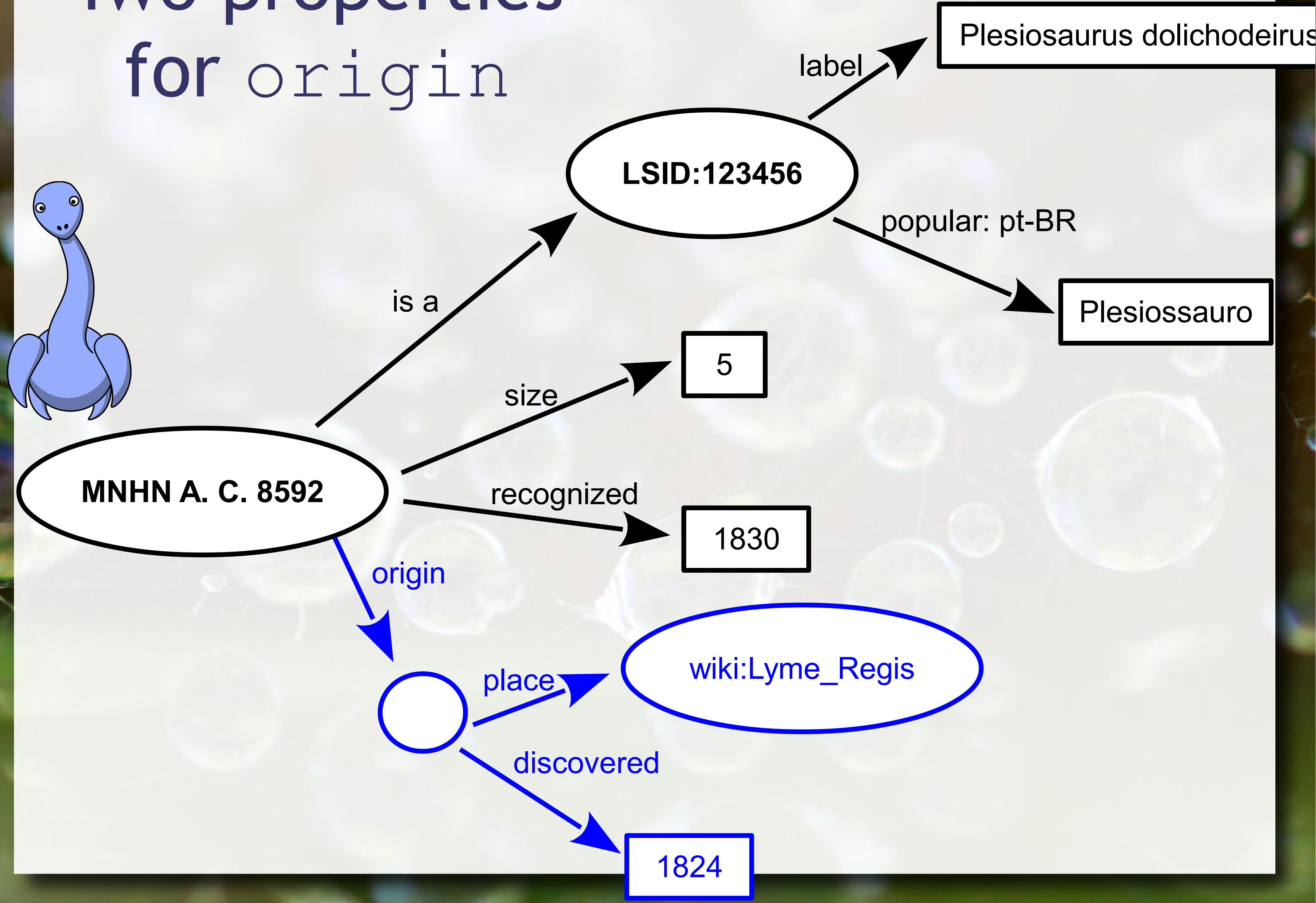
wiki:England

label: England

Back to the Property Graph



Two properties for `origin`



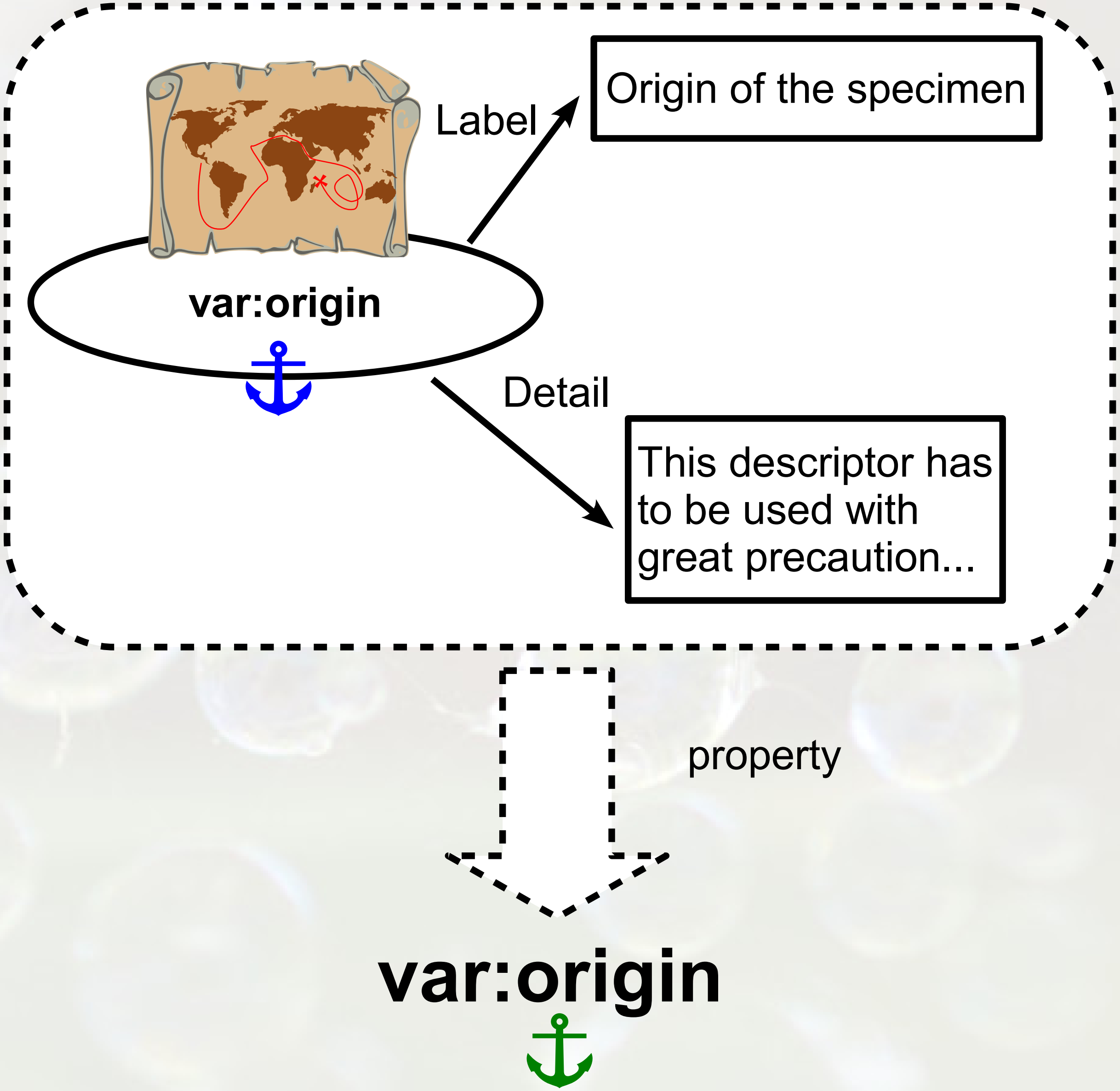
References

- GOMES-JR, L. C.; JENSEN, R.; SANTANCHÈ, A. (2013) Towards Query Model Integration: Topology-aware, IR-inspired Metrics for Declarative Graph Querying, II Workshop on Querying Graph Structured Data 2013, Genoa.

André Santanchè

http://www.ic.unicamp.br/~santanche

Property



Label

Origin of the specimen

var:origin

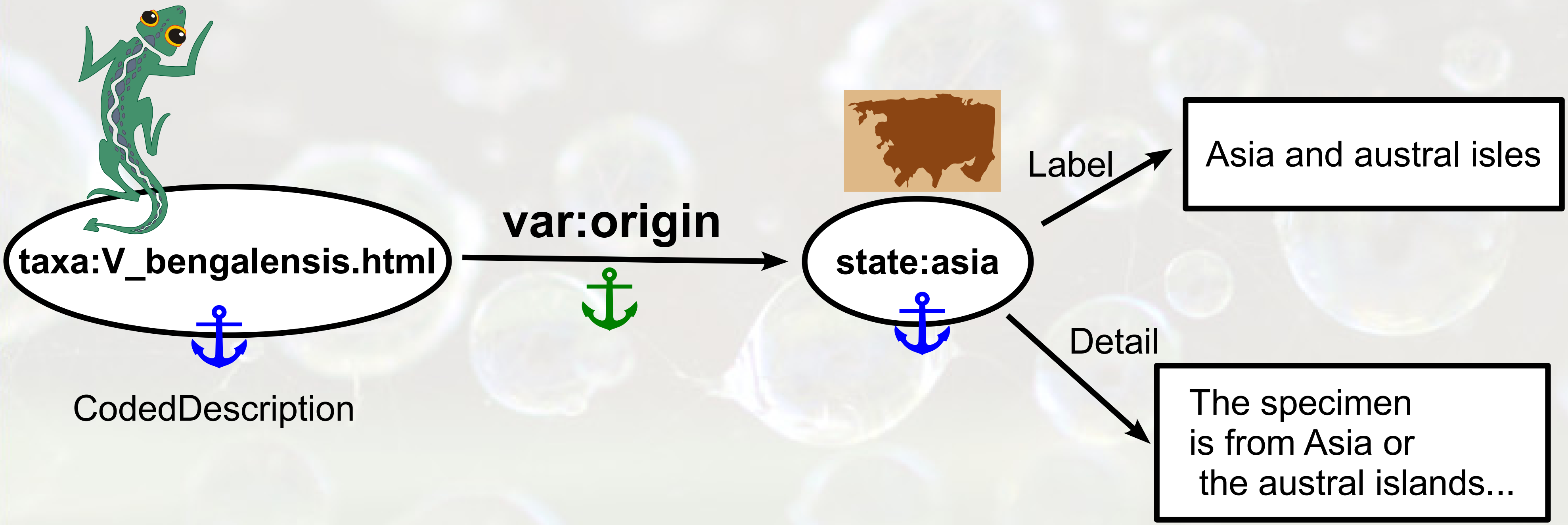
Detail

This descriptor has to be used with great precaution...

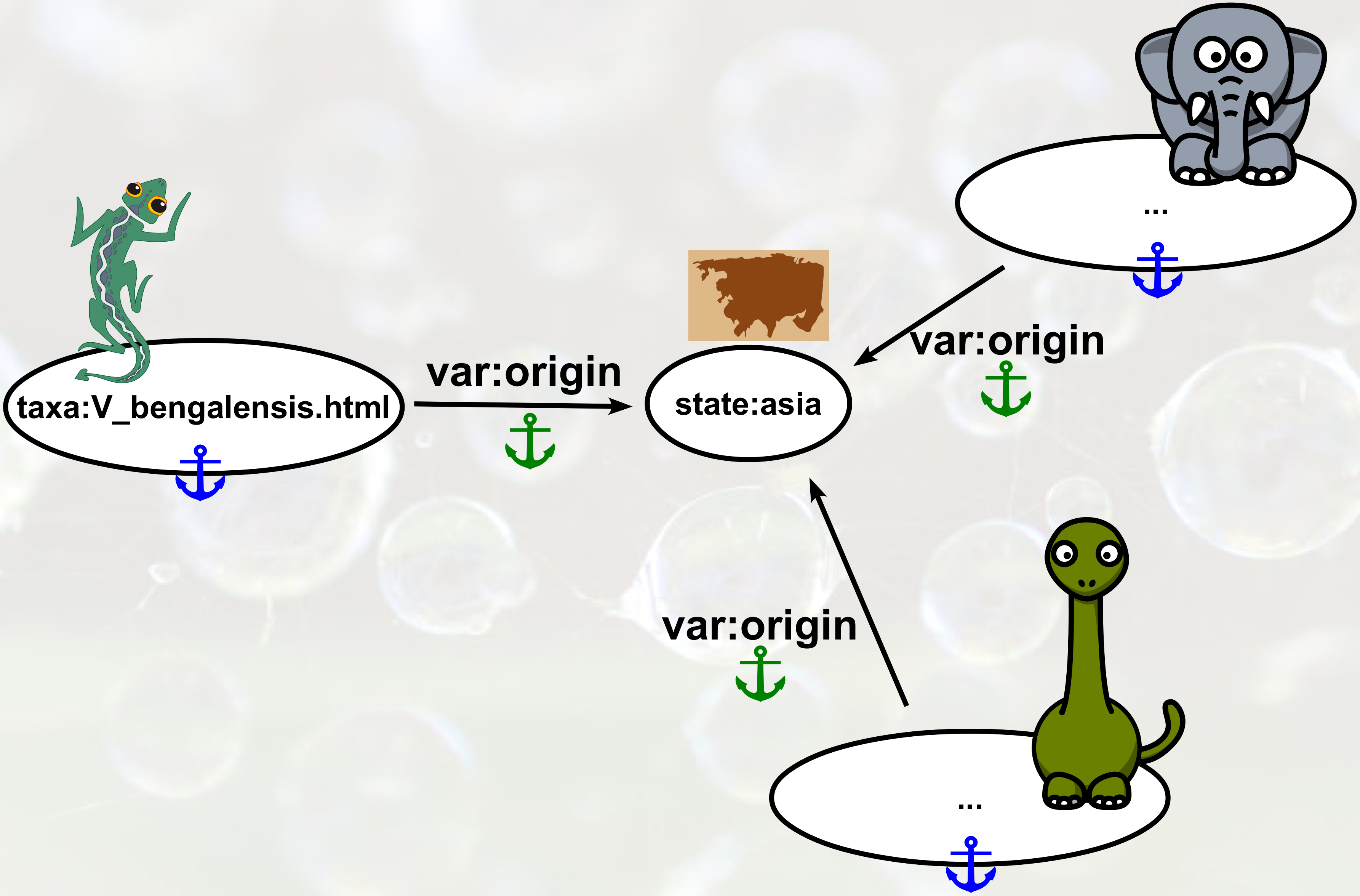
property

var:origin

Using the Property



Connected Graph



taxa:V_bengalensis.html

var:origin

state:asia

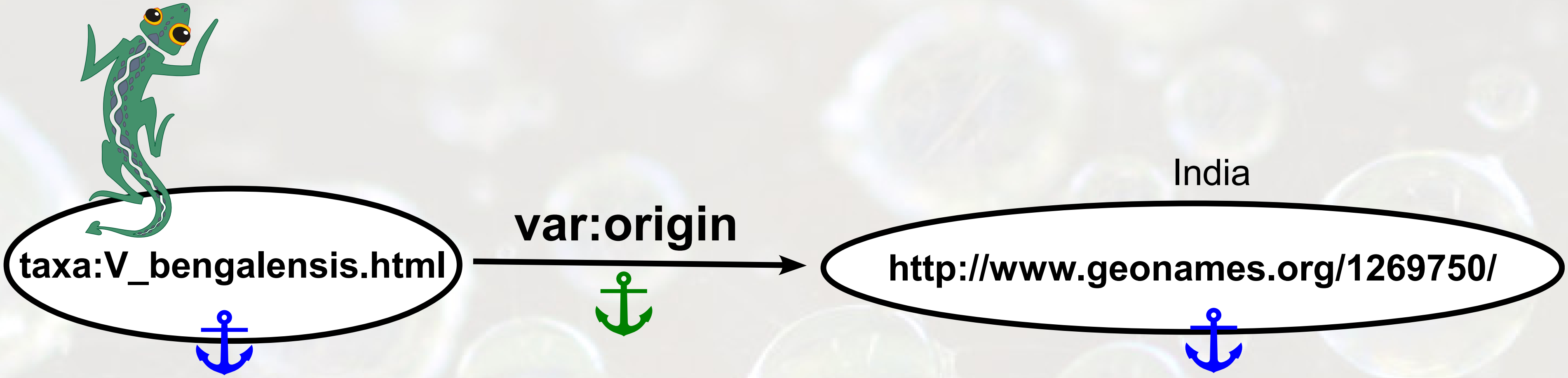
var:origin

...

var:origin

...

Origin in GeoNames



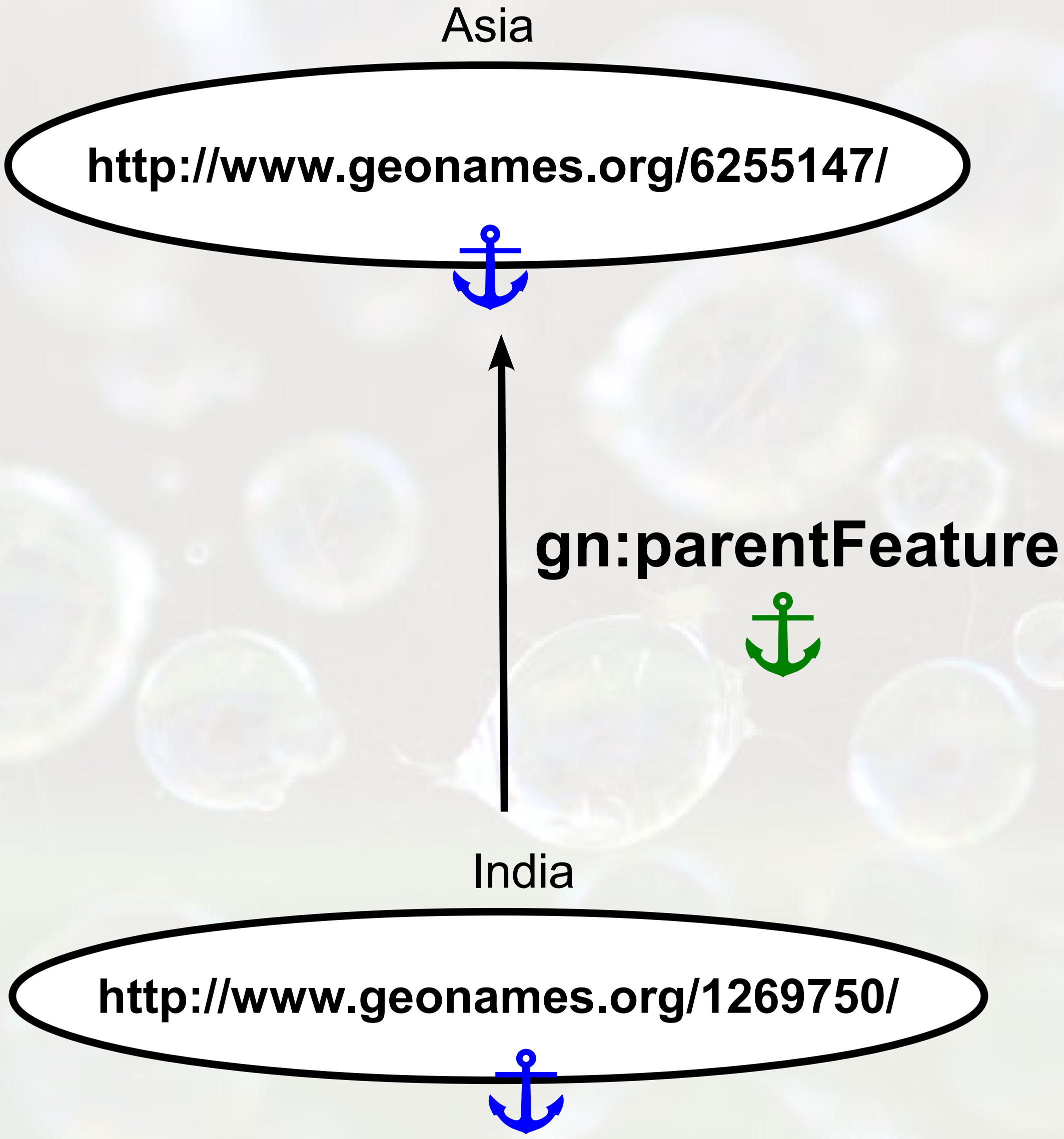
taxa:V_bengalensis.html

var:origin

India

http://www.geonames.org/1269750/

Geo Tree



Asia

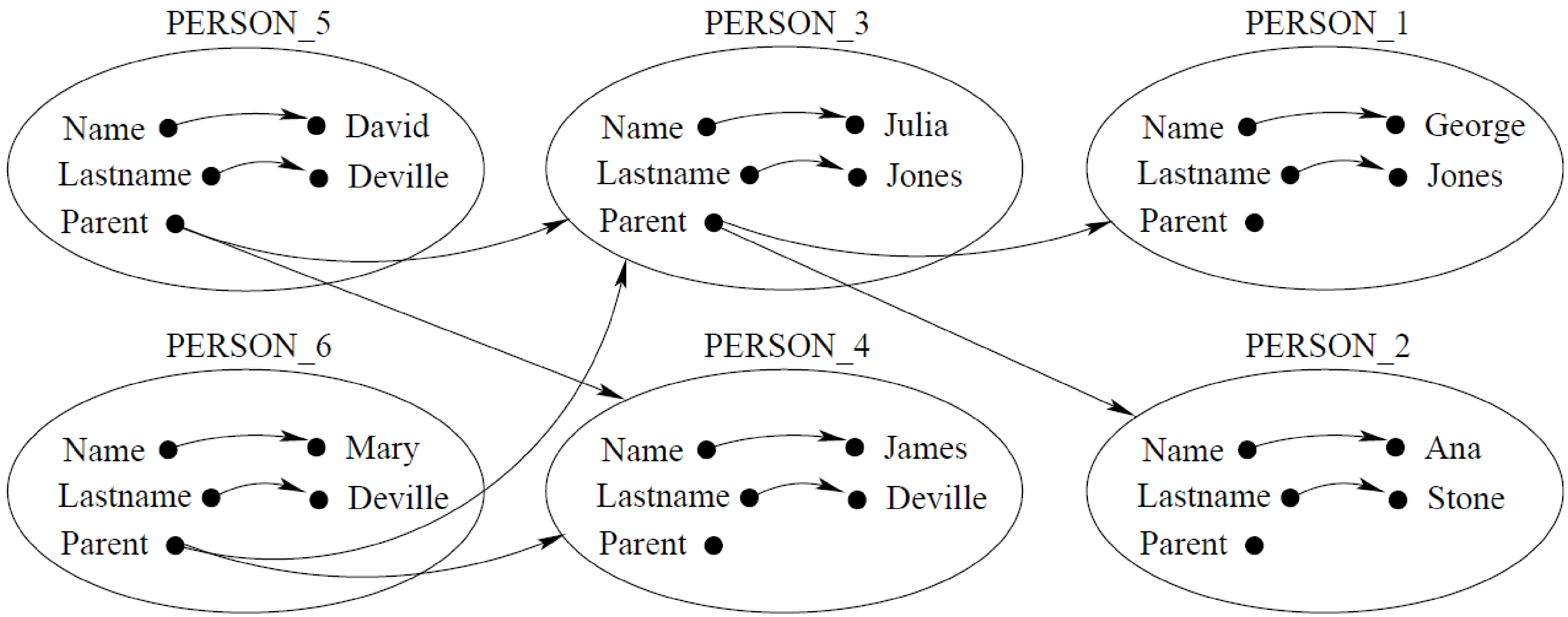
http://www.geonames.org/6255147/

gn:parentFeature

India

http://www.geonames.org/1269750/

Hypergraph



(Jaudete Daltio, 2013)

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