

LINKED SPATIOTEMPORAL DATA AND INTEROPERABILITY*

- *1. INTRODUCE LINKED DATA
- 2. OUTLINE NEW FRONTIERS
- 3. RELATE TO SeCoGIS 2012 PAPERS
- 4. FOCUS ON EXAMPLES

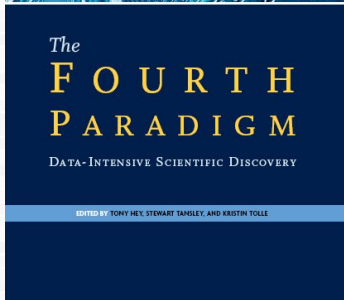
Krzysztof Janowicz

STKO Lab
University of California, Santa Barbara, USA

SeCoGIS 2012



THE 4TH PARADIGM AND THE SEMANTIC WEB



<http://research.microsoft.com/en-us/collaboration/fourthparadigm/>

- 1 Empirical
- 2 Theoretical
- 3 Computational
- 4 **Explorational**

Value Proposition of the Semantic Web

- Publishing and **Retrieving**
- **Interacting** and Accessing
- Reusing and **Integrating**

LINKING DATA AS NEXT-GENERATION INFRASTRUCTURE

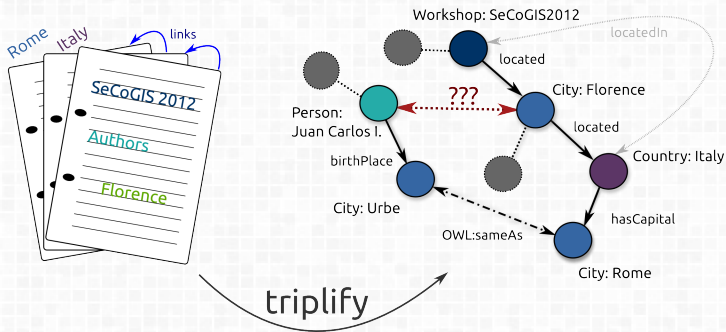


by drewdomkus, flickr.com (CC BY-NC-SA 2.0)

Data Silos

- Web services
- Databases
- Web pages
- hinder ad-hoc combination
- enforce data models
- limit re-usability

FROM LINKED DOCUMENTS TO LINKED DATA



Use Uniform Resource Identifiers (**URI**) to identify **entities**, **link** them to other entities, encode information about these entities using the **machine-understandable RDF**, and make them available on the **Web**.

EXPLORING LINKED DATA RELATED TO FLORENCE, ITALY

RelFinder

URL

between **examples**

(1)

(2)

Filter by: relations: (15/15)

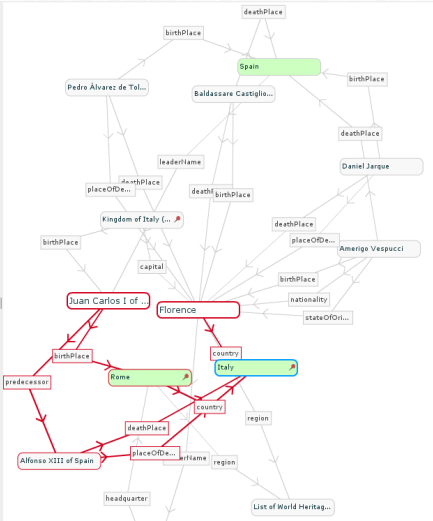
length class link conn...

number of objects	num	vi
1	1/1	
2	14/14	

Italy

More info: dbpedia.org
www.italia.it


Italy Listen·tali, officially the Italian Republic or the Republic of Italy, is a unitary parliamentary republic in south-central Europe. To the north, it borders France, Switzerland, Austria and Slovenia along the Alps. To the south, it consists of the entirety of the Italian Peninsula, Sicily, Sardinia—the two largest islands in the Mediterranean Sea—and many other smaller islands. The independent states of San Marino and the Vatican City are enclaves within Italy, while Camionese d'Italia is an Italian enclave in



Explore information related to Florence using the **Linked Data (DBpedia)**.

SEARCHING THE WEB OF DOCUMENTS

+You Search Images Maps Play YouTube Gmail Documents Calendar Translate More ▾



Search About **20,600,000 results** (0.35 seconds)

Web

Images

Maps

Videos

News

Shopping

More

Search near...

Show search tools

[Illinois - Wikipedia, the free encyclopedia](#)
en.wikipedia.org/wiki/Illinois
 ,il'i, נכח' / IL-I-NOY) is the 25th most extensive and the 5th most **populous** of the 50 United In 1957, Argonne National Laboratory, **near Chicago**, activated the first ...
 The Quad **Cities** region, located along the **Mississippi River** in northern Illinois, lists seven other **cities with populations of over 100000** within Illinois.

[Largest cities in the United States by population by decade ...](#)
en.wikipedia.org/.../Largest_cities_in_the_United_States_by_populati...
 For further research **on** year 2000 urban **population**, the County and City Data Book ... Philadelphia had been the most **populous** city in the United States prior to any rapid growth shows the increasing importance of **Mississippi River** trade. The Census Bureau provides a list of all **cities with populations over 100000**.

[Natural Earth](#)
www.naturalearthdata.com/
 Park units **over 100000** acres (~40000 hectares) appear as **areas**, park units under **100000** acres as points, and linear parks, including **rivers**, trails, and ... We favor regional significance **over population** census in determining our selection of **places**. ... The minus 200 meter bathymetry layer is buffered slightly **around** all ...

[Illinois - New World Encyclopedia](#)
www.newworldencyclopedia.org/entry/Illinois

SEARCHING THE WEB OF DATA



search powered by neofonie

[About Neofonie](#)[About DBpedia](#)[Imprint](#)[Help](#)[First](#) | [Previous](#) | [Next](#) | [Last](#)▼ **Item type**

City (7)

Place (7)

Populated Place (7)

[more](#)▼ **is city of**

Mississippi River (8)

Fort Snelling State Park (2)

Central High School (Memphis,

Tennessee) (1)

[more](#)▼ **leader title**

Mayor (7)

▼ **latitude**from... to... **Your Filters**[Reset Filters](#) ✕

Results 1 to 6 of 7

Item type [Populated Place](#) ✕ [population total 100000 and up](#) ✕ [is city of Mississippi River](#) ✕**New Orleans**

New Orleans is a major United States port and the largest city and metropolitan area in the state of Louisiana. The city is named after Philippe II, Duc d'Orléans, Regent of France, and is well known for its distinct French architecture, as well as its cross cultural and multilingual heritage. New Orleans is also famous for its cuisine, music (particularly as the birthplace of jazz), and its annual celebrations and festivals, most notably Mardi Gras.

**St. Louis, Missouri**

St. Louis is an independent city in the U.S. state of Missouri. The city itself has an estimated population of 354,361 and is the principal municipality of Greater St. Louis, population 2,879,934, the largest urban area in Missouri and 16th-largest in the United States. The city was founded in 1764 just south of the confluence of the Missouri and Mississippi rivers by colonial French traders Pierre Laclède and René Auguste Chouteau, who named the settlement after King Louis IX of France.

- **Populated places** have a population, are located, occupy a certain area,...

SEMANTICS-ENABLED GEO-INFORMATION RETRIEVAL



Reference routes

Suedkante
Bellissima
Nordostpfeller
Suedkurve

1

Search for routes within map extent

Region, Country	Mountain range
Tyrol, Austria	Wettersteingebirge
Difficulty	Climbing length
VII	350
Protection	Route Character
discontinuous (Bolt)	Crack, Chimney, Wall, Slab
Number of pitches	
9	

Map controls: Map, Satellite, Hybrid. Navigation: << back, next >>. Map data ©2008 Tele Atlas - Terra of Usa.

2

Route recommendations

Overall Ranking

Erdenkaeuffer Sigi
Mon Cheri
Bayerischer Traum
Schober
Pfellerisse

Siemens Wolf Variante 1
 Siemens Wolf Variante 2
 Siemens Wolf
 Aquaplaning
 Peters Haringer

Length Ranking [show ranking](#)Difficulty Ranking [hide ranking](#)**Schober**

Compared to reference routes

Bayerischer Traum
Erdenkaeuffer Sigi
Pfellerisse
Peters Haringer
Aquaplaning

Siemens Wolf Variante 1
 Siemens Wolf Variante 2
 Siemens Wolf

Rock Ranking [show ranking](#)

■ **Query-by-example**, exploratory search & browsing, **analogy-based search**

E.g., 'Deepwater Horizon oil spill of the 1980s?', 'Riviera of the United States?', etc.

GOOGLE'S KNOWLEDGE GRAPH





Search

About 1,050,000 results (0.12 seconds)

Web

Images

Maps

Videos

News

Shopping

More

Show search tools

March 9, 1454, Florence

Amerigo Vespucci, Born

[In 1512 Amerigo Vespucci died of malaria. - Library](#)

library.thinkquest.org/3002678F/vespucci.htm

Hello my name is **Amerigo Vespucci**. I was born March 18, 1454 in **Florence**, Italy. When I was a boy I was interested in astronomy and the study of the universe.

[Amerigo Vespucci - Wikipedia, the free encyclopedia](#)

en.wikipedia.org/wiki/Amerigo_Vespucci

Amerigo Vespucci was born and raised in **Florence**, Italy. He was the third son of Ser Nastagio (Anastasio), a Florentine notary, and Lisabetta Mini. Amerigo ...

[Amerigo Vespucci - Biography of Amerigo Vespucci](#)

geography.about.com > ... > [Geography](#) > [History of Geography](#)

Learn all about the explorer for whom America is named - **Amerigo Vespucci**, from your ... Vespucci was born in 1454 to a prominent family in **Florence**, Italy.

[Amerigo Vespucci - NNDB](#)

www.nndb.com/people/438/000085183/

... who gave his name of **Amerigo** to the new world as America, was born at **Florence** on the 9th of March 1451. His father, Nastagio (Anastasio) **Vespucci**, was a ...

Amerigo Vespucci



iberapedia.wikia.com

Amerigo Vespucci was an Italian explorer, financier, navigator and cartographer who first demonstrated that Brazil and the West Indies did not represent Asia's eastern outskirts as initially conjectured ...

Wikipedia

Born: March 9, 1454, [Florence](#)

Died: February 22, 1512, [Seville](#)

People also search for



Christopher Columbus



Ferdinand Magellan



John Cabot



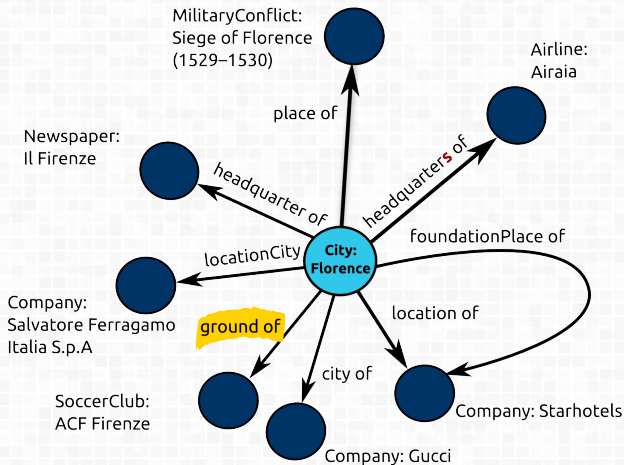
Martin Waldsee...



Vasco da Gama

[Feedback](#)

SOME DBPEDIA FACTS ABOUT FLORENCE, ITALY



A GLIMPSE AT THE DBPEDIA ONTOLOGY

About: [ground](#)

An Entity of Type : [ObjectProperty](#), from Named Graph : <http://dbpedia.org/classes/>, within Data Space : [dbpedia.org](#)

Property	Value
rdf:type	■ owl:ObjectProperty
rdfs:domain	■ dbpedia-owl:SoccerClub
rdfs:isDefinedBy	■ http://dbpedia.org/ontology/
rdfs:label	■ ground
rdfs:range	■ dbpedia-owl:Place

About: [soccer club](#)

An Entity of Type : [Class](#), from Named Graph : <http://dbpedia.org/resource/>, within Data Space : [dbpedia.org](#)

Property	Value
rdf:type	■ owl:Class
rdfs:isDefinedBy	■ http://dbpedia.org/ontology/
rdfs:label	■ club de football ■ soccer club
rdfs:subClassOf	■ dbpedia-owl:SportsTeam
is rdfs:domain of	■ dbpedia-owl:chairmanTitle ■ dbpedia-owl:clubsRecordGoalscorer ■ dbpedia-owl:managerTitle ■ dbpedia-owl:firstGame ■ dbpedia-owl:fansgroup ■ dbpedia-owl:largestWin ■ dbpedia-owl:worstDefeat ■ dbpedia-owl:dissolved ■ dbpedia-owl:ground ■ dbpedia-owl:capacity ■ dbpedia-owl:manager ■ dbpedia-owl:season ■ dbpedia-owl:honours
is rdfs:range of	■ dbpedia-owl:soccerTournamentMostSteady ■ dbpedia-owl:soccerTournamentLastChampion ■ dbpedia-owl:soccerTournamentMostSuccessful
is rdfs:subClassOf of	■ dbpedia-owl:NationalSoccerClub

A GLIMPSE AT THE SCHEMA.ORG

Thing > Place > Landform > Mountain

A mountain, like Mount Whitney or Mount Everest

Property	Expected Type	Description
Properties from <u>Thing</u>		
<u>additionalType</u>	URL	An additional type for the item, typically used for adding more specific types from external vocabularies in microdata syntax. This is a relationship between something and a class that the thing is in. In RDFa syntax, it is better to use the native RDFa syntax - the 'typeof' attribute - for multiple types. Schema.org tools may have only weaker understanding of extra types, in particular those defined externally.
<u>description</u>	Text	A short description of the item.
<u>image</u>	URL	URL of an image of the item.
<u>name</u>	Text	The name of the item.
<u>url</u>	URL	URL of the item.
Properties from <u>Place</u>		
<u>address</u>	<u>PostalAddress</u>	Physical address of the item.
<u>aggregateRating</u>	<u>AggregateRating</u>	The overall rating, based on a collection of reviews or ratings, of the item.
<u>containedIn</u>	<u>Place</u>	The basic containment relation between places.
<u>event</u>	<u>Event</u>	Upcoming or past event associated with this place or organization.
<u>events</u>	<u>Event</u>	Upcoming or past events associated with this place or organization (legacy spelling; see singular form, event).
<u>faxNumber</u>	Text	The fax number.
<u>geo</u>	<u>GeoCoordinates</u> or <u>GeoShape</u>	The geo coordinates of the place.

Most of the ontologies/vocabularies used to annotate popular Linked Data sets are **too lightweight**; they fail to restrict the interpretation of terms towards their intended **meaning**.

SEMANTICS-ENABLED PERSONAL INFORMATION MANAGEMENT

Activity Journal 7:35 PM jingie

KAYAK - Cheap Flights, Hotels, Airline Tickets, Cheap Tickets, Cheap Travel Deals - Compare Hundreds of Travel Sites At Once - Mozilla

KAYAK Flights Hotels Cars Deals More

Round-trip One-way Multi-city

From Santa Barbara, CA - Santa Barbara (SB)

Sunday 10/07/2012 Yesterday 10/06/2012

1 Event name: ESWC 2012
 Start Date: May 27, 2012
 End Date: May 31, 2012
 Location: Heraklion, Greece
 Abstract due: Dec 05, 2011
 Fullpaper due: Dec 12, 2011
 Link: <http://2012.eswc-conferences.org>
 Conference description:
 CFP: 9th Extended Semantic Web Conference (ESWC12)
 CFP ESWC12 - 9th Extended Semantic Web Conference May 27 - 31, 2012
 Info at: <http://2012.eswc-conferences.org/>

2 People:
 Mark Sandier
 Yves Raimond
 Boris Motik
 Despoina Magka
 Ian Horrocks
 Milan Stankovic
 Philippe Laubie
 Matthew Rowe
 Jose Borbinha
 Nuno Freire
 David Carral
 Pascal Hitzler
 José Luis Ambler
 Parag Mallick
 Isabelle Augens
 Sebastian Padgug

3 Papers:
 Semantic Content Management with Sgvizler: A JavaScript Wrapper for RDFaCE-Lite: a WYSIWYM editor for ParkJam: Crowdsourcing Parking Allocation: Nobody Wants to Live in a Cold City

4 My activities:
 Paper Writing
 Travel Arrangement
 Conference Participation

5 Applications:
 Adobe Reader 9
 Thunderbird Mail
 Firefox Web Browser
 Text Editor

6 Files:
 OpenStreetMap
 Google Maps
 KAYAK - C...kets
 Triplt | On...ip p

7 Name: Pascal Hitzler
 Position: Assistant Professor
 Affiliation: Dept of Computer Science & Engineering, Wright State University
 Address: Dept of Computer Science & Engineering, Wright State University, 3640 Colonel Glenn Hwy, Dayton, OH 45435, USA

8 People he/she knows:
 Matthias Wendt
 Stefan Schlobach
 Adila Krisnadhi
 Vivit Natase
 Guenther Palm
 Krishnaprasad Thirunarayan
 Maithilee Kunda
 Barbara Hammer
 Gregory Provan
 York Sure

Papers he/she published:
 Type-elimination-based reasoning for the description logic
 Integrating OWL and Rules: A Syntax Proposal for Nominal
 Reasoning Description Logic Rules.: ESWC: 345-359
 ODBASE 2011 PC Co-chairs' Message.: OTM Workshops :
 Representation of Parsimonious Covering Theory in OWL
 Mathematical Aspects of Logic Programming Semantics
 Contextual Ontology Alignment of LOD with an Upper Or
 What's Happening in Semantic Web - ... and What FCA Co
 Computing inconsistency measure based on paraconsistent
 Local Closed World Semantics: Grounded Circumscription

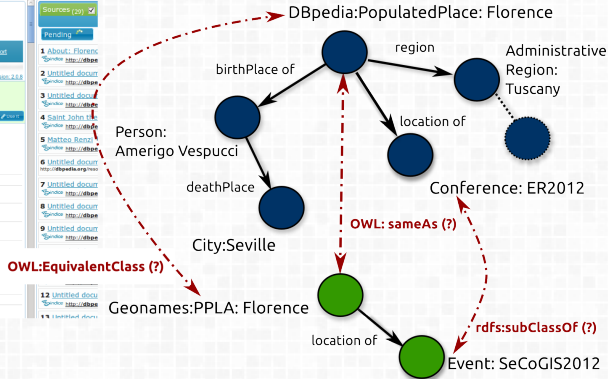
Queries and integrates Linked Data from Freebase, Semantic Web Dog Food, GFPWiki, Arnetminer, Bibsonomy, and Delicious.

INTEGRATION AND QUERY FEDERATION

The screenshot shows the SIG.MA Semantic Information Mashup interface. The search results for 'Florence' include:

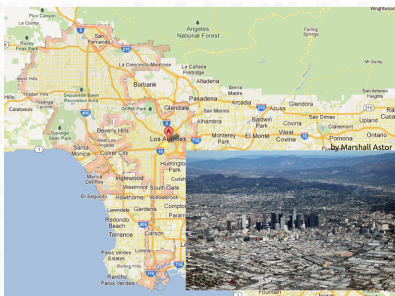
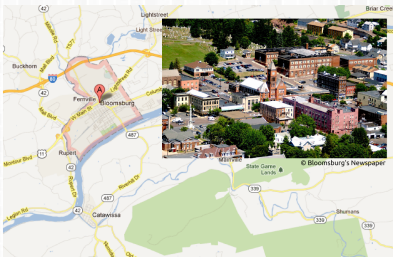
- picture:** A grid of images showing Florence, Italy.
- comment:** [SHOW 32 VALUES](#)
- is alma mater of:** http://dbpedia.org/resource/University_of_Florence [1]
- area total:** 1024 10000 000000 [1]
- area code:** 05 [1]
- area total km:** 102 [1]
- is battles of:** http://dbpedia.org/resource/Battle_of_Florence [1]
- is battle of:** http://dbpedia.org/resource/Battle_of_Florence [1]
- is body of:** http://dbpedia.org/resource/Body_of_Florence [1]
- is before of:** http://dbpedia.org/resource/Before_of_Florence [1]
- is birth place of:** [Matteo Renzi](http://dbpedia.org/resource/Matteo Renzi) [1] [SHOW 320 MORE VALUES](#)

The screenshot shows a SPARQL query results table with 12 rows. The first row is 'About: Florence'. The second row is 'Untitled document'. The third row is 'Untitled document'. The fourth row is 'Saint John the Baptist'. The fifth row is 'Matteo Renzi'. The sixth row is 'Untitled document'. The seventh row is 'Untitled document'. The eighth row is 'Untitled document'. The ninth row is 'Untitled document'. The tenth row is 'Untitled document'. The eleventh row is 'Untitled document'. The twelfth row is 'Untitled document'.

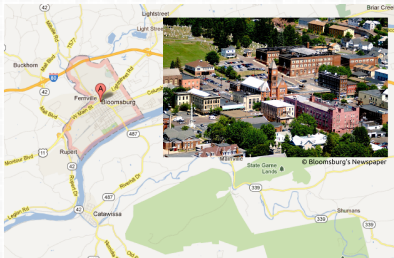


Integration by searching **equivalent classes** or/and **same features** in data sets. This requires **ontology** matching and **alignment**.

WHY NOT JUST STANDARDIZE MEANING?



WHY NOT JUST STANDARDIZE MEANING?



- **California:**
City \equiv *Town*
- **Utah:**
Town \equiv $<$ (population, 1000)
- **Pennsylvania:**
Town \equiv {*Bloomsburg*}

SEMANTIC INTEROPERABILITY – MEANINGFUL LINKS



- Unfortunately, our data sources use exactly the **same terminology** (e.g., *connection*) to talk about totally different and **contradicting facts** (e.g., *separation*)
- While we can still **syntactically integrate** and reuse information, the results may be misleading or even **meaningless**

- We need **heterogeneity preserving** semantic interoperability methods

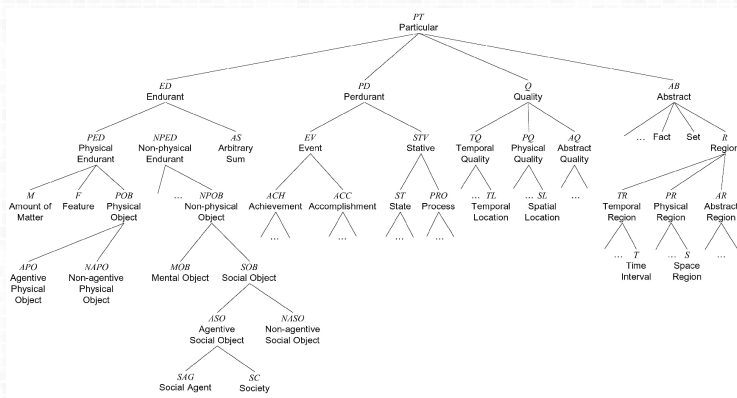
SEMANTIC INTEROPERABILITY – MEANINGFUL LINKS



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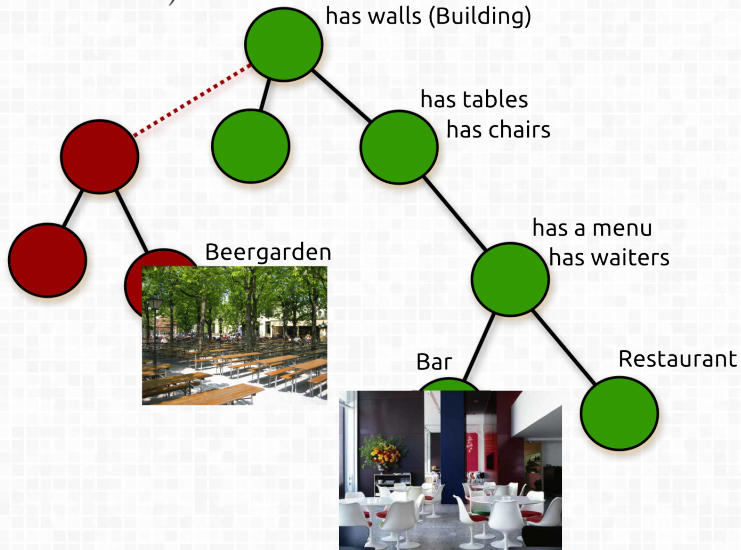
- We need **heterogeneity preserving** semantic interoperability methods

RESTRICTING MEANING VIA FOUNDATIONAL ONTOLOGIES

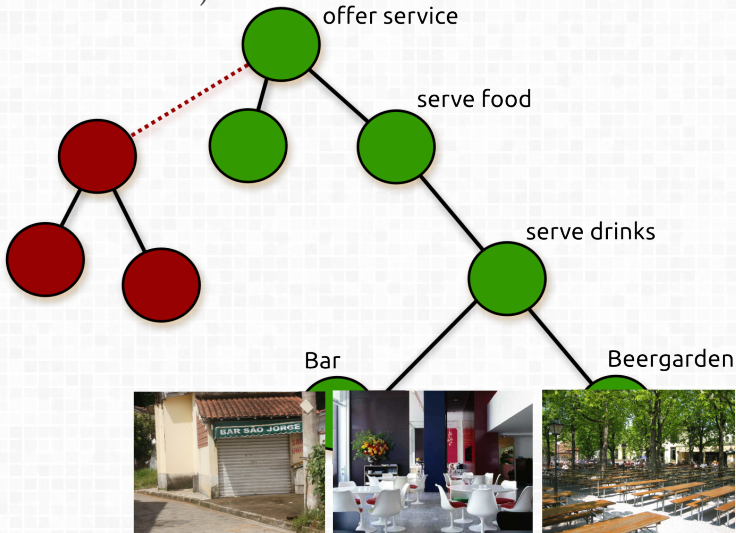


- Arrive at a **common agreement** on how to **partition** the world and define it in a **machine readable** way
- The **Semantic Web** offers formal **languages** and **reasoning** support

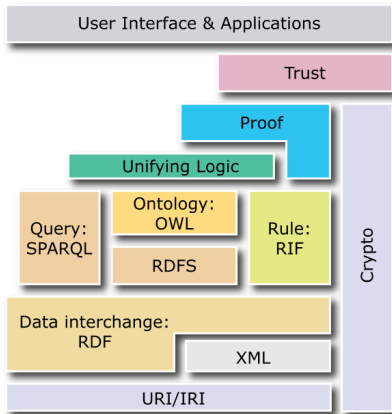
DIFFICULTIES WITH GLOBAL TOP-DOWN ONTOLOGIES (ATTRIBUTE VIEW)



DIFFICULTIES WITH GLOBAL TOP-DOWN ONTOLOGIES (FUNCTIONAL VIEW)

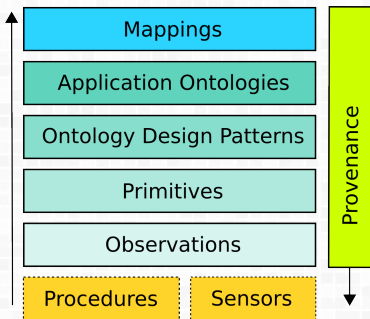


THE SEMANTIC WEB IS A TECHNOLOGY STACK



- Almost all Semantic Web layer cakes are **technology stacks**
- They tell us which languages to use, not **how to model**

OBSERVATION-DRIVEN ONTOLOGY ENGINEERING



- Local and crisp **microtheories** instead of global ontologies
 - Mine ontological primitives out of real **observation data**
 - Assist domain experts in becoming knowledge engineers by developing reusable **patterns**
 - **Defer** the introduction of classes that are heavy on ontological **commitments** (e.g., forest)
- Ontologies should be about **communication** not about replacing **numerical models**. We should **not** try to develop an **universal ontology** for rivers, mountains, forests, and so forth, but work on the **alignment** and translation between local ontologies.

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

- | | | | |
|--|-----|--|-----|
| $a:\text{flowsInto} \sqsubseteq a:\text{IsConnected}$ | (1) | $b:\text{flowsInto} \sqsubseteq b:\text{IsConnected}$ | (6) |
| $a:\text{IrrigationCanal} \sqsubseteq a:\text{Canal}$ | (2) | $b:\text{Canal} \sqsubseteq (\geq 2 b:\text{IsConnected}.b:\text{Waterbody})$ | (7) |
| $\exists a:\text{flowsInto}.a:\text{AgriculturalField} \sqsubseteq a:\text{IrrigationCanal}$ | (3) | $b:\text{IrrigationCanal} \equiv (=1 b:\text{IsConnected}.b:\text{Waterbody})$ | |
| $a:\text{Waterbody} \sqcap a:\text{Land} \sqsubseteq \perp$ | (4) | $\sqcap (=1 b:\text{flowsInto}.b:\text{AgriculturalField})$ | (8) |
| $a:\text{AgriculturalField} \sqsubseteq a:\text{Land}$ | (5) | | |

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

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$a:\text{AgriculturalField} \equiv b:\text{AgriculturalField}$

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

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$a:\text{Canal} \equiv b:\text{Canal} [\dots]$

$a:\text{AgriculturalField} \equiv b:\text{AgriculturalField}$

$b:\text{IrrigationCanal} \sqsubseteq a:\text{IrrigationCanal}$

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

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$a:\text{flowsInto} \sqsubseteq a:\text{IsConnected}$	(1)	$b:\text{flowsInto} \sqsubseteq b:\text{IsConnected}$	(6)
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$a:\text{AgriculturalField} \sqsubseteq a:\text{Land}$	(5)		

$a:\text{AgriculturalField} \equiv b:\text{AgriculturalField}$

$b:\text{IrrigationCanal} \sqsubseteq a:\text{IrrigationCanal}$

$\text{AgriculturalField} \equiv \text{Waterbody}$

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

$a:\text{flowsInto} \sqsubseteq a:\text{IsConnected}$	(1)	$a:\text{Canal} \equiv b:\text{Canal} [\dots]$	
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$a:\text{AgriculturalField} \equiv b:\text{AgriculturalField}$

$b:\text{IrrigationCanal} \sqsubseteq a:\text{IrrigationCanal}$

$\text{AgriculturalField} \equiv \text{Waterbody}$

$a:\text{Canal}(x) \wedge \neg a:\text{IrrigationCanal}(x) \rightarrow b:\text{Canal}(x)$

ALIGNING, MATCHING, AND TRANSLATING ONTOLOGIES

- $a:\text{flowsInto} \sqsubseteq a:\text{IsConnected}$ (1)
 $a:\text{IrrigationCanal} \sqsubseteq a:\text{Canal}$ (2)
 $\exists a:\text{flowsInto}. a:\text{AgriculturalField} \sqsubseteq a:\text{IrrigationCanal}$ (3)
 $a:\text{Waterbody} \sqcap a:\text{Land} \sqsubseteq \perp$ (4)
 $a:\text{AgriculturalField} \sqsubseteq a:\text{Land}$ (5)

$a:\text{Canal} \equiv b:\text{Canal} [\dots]$

- $b:\text{flowsInto} \sqsubseteq b:\text{IsConnected}$ (6)
 $b:\text{Canal} \sqsubseteq (\geq 2 b:\text{IsConnected}. b:\text{Waterbody})$ (7)
 $b:\text{IrrigationCanal} \equiv (=1 b:\text{IsConnected}. b:\text{Waterbody})$
 $\sqcap (=1 b:\text{flowsInto}. b:\text{AgriculturalField})$ (8)

$a:\text{AgriculturalField} \equiv b:\text{AgriculturalField}$

$b:\text{IrrigationCanal} \sqsubseteq a:\text{IrrigationCanal}$

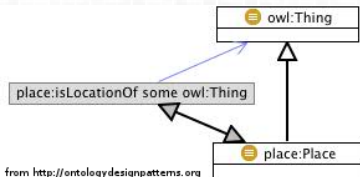
$\text{AgriculturalField} \equiv \text{Waterbody}$

$a:\text{Canal}(x) \wedge \neg a:\text{IrrigationCanal}(x) \rightarrow b:\text{Canal}(x)$

$a:\text{Canal}(x) \wedge a:\text{Vessel}(y) \wedge \text{builtIn:navigable}(x, y) \rightarrow c:\text{NavigableCanal}(x)$

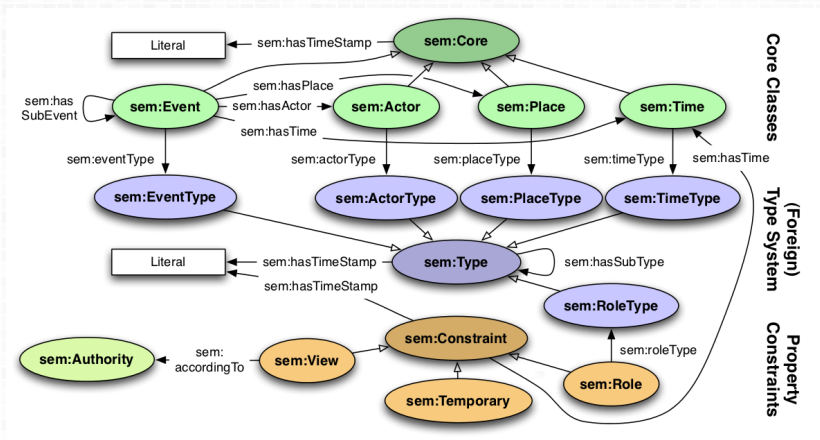
ONTOLOGY DESIGN PATTERN

- **Modular** but **self-contained** building blocks/strategies
- **Reusable** and **extendible**
- Even huge ontologies can be modularized using ODP (for example **DOLCE**)
- **No need** to import **full** ontology and **all ontological commitments**
- Different **types** of patterns, e.g. **content** vs. **logical**



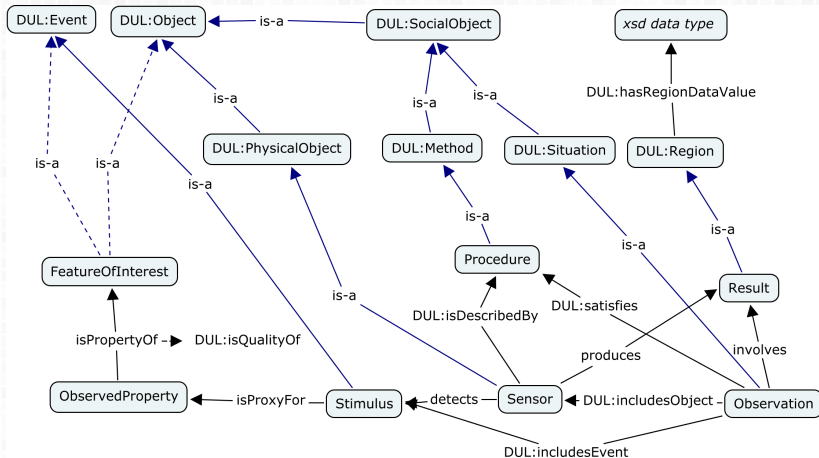
- What are the major **geo-ontology** design patterns?

ANATOMY OF (COMPLEX) PATTERNS



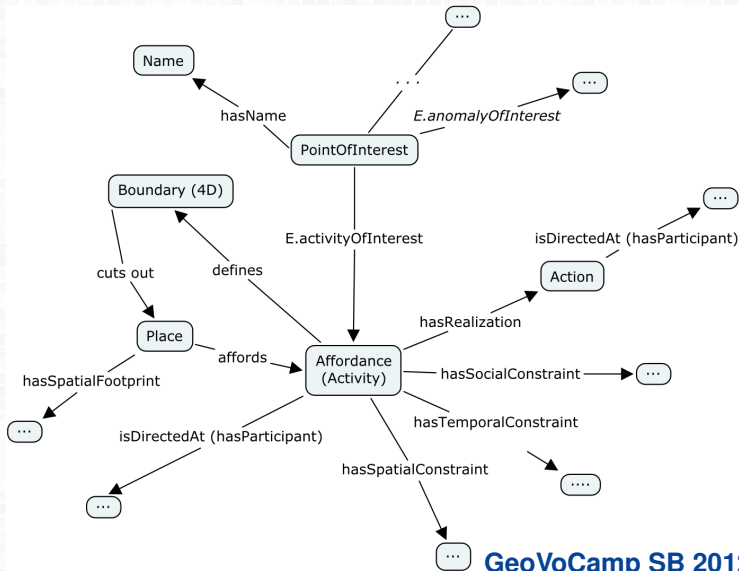
Simple Event Model

STIMULUS SENSOR OBSERVATION PATTERN



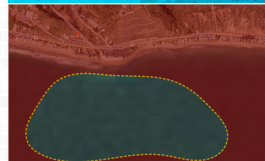
W3C XG SSN Pattern + DOLCE alignment

POINTS OF INTEREST PATTERN

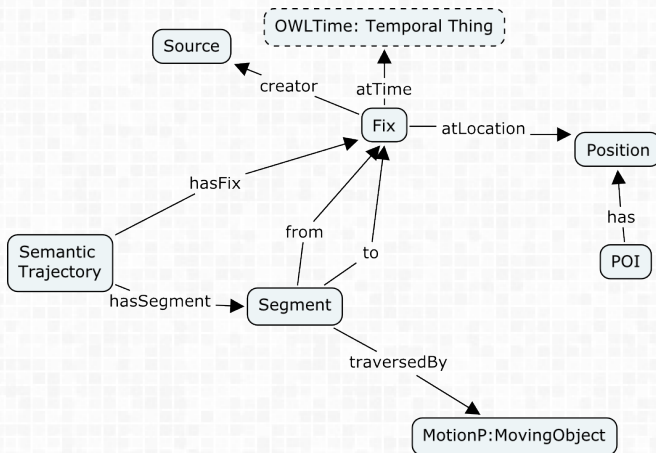


SCUBA DIVING PLACE(S) EXAMPLE

- **Field**/surface of water depth **observation**
- ScubaDiving**Activity**
 - **Constraints** (> 3m water depth)
 - ...
- **Boundary** (GIS clip operation)
- bounded **region(s)** on the surface of the Earth
- **named** places (for those of **interest**).



(SEMANTIC) TRAJECTORY PATTERN



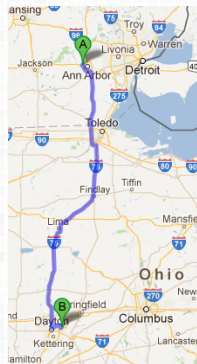
GeoVoCamp Dayton 2012

MIKE'S TRIP TO THE GEOVOCAMP DAYTON 2012


```

:mikestrip a :SemanticTrajectory ;
  :hasSegment
    [a :Segment;
      :from :fix1; // mikeshome
      :to :fix2; // rest stop
      :traversedBy :fordFocus],
    [...]
    [a :Segment;
      :from :fixn; // WrightStateUniversity
      :to :fixm], // Knoesis
      :traversedBy :mike],
    [...]
:time1 a time:Instant;
  :inXSDDateTime "2012-09-15T11:26:22Z".
:pos1 a :Position;
  :geo:astWKT "Point(-83.XYZ45348 42.XYZ53678)";
:mikesHome a :POI;
  :has :pos1;
  [...]

```



GEO-VOCABULARY CAMPS

 Krzysztof Janowicz

[page](#) [discussion](#) [edit](#) [history](#) [move](#) [unwatch](#)

GeoVoCampSB2012

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 - 9.1 Organizers
 - 9.2 Participants
 - 9.3 Not sure
 - 9.4 Would like to, but can't
- 10 Outcomes
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 - 10.2 Observed Event Geo-Pattern
 - 10.3 A possible approach to a Motion and Path design pattern based on the PATH image schema
- 11 GeoVoCampMadrid2012
- 12 Workshop on GIScience in the Big Data Age 2012

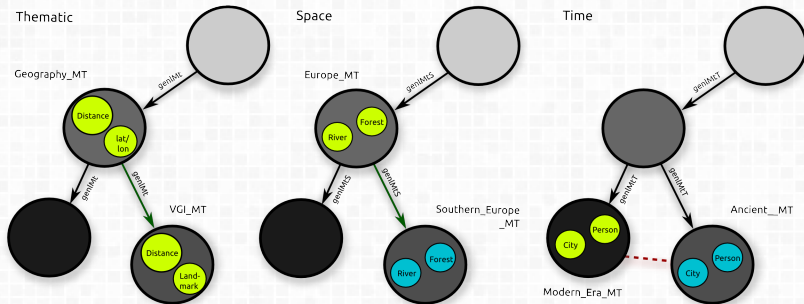
General

We are currently planning a GeoVoCamp as follow-up to the [2009](#) and [2011](#) Vocamps in Washington D.C. and the 2011 GeoVoCamp in **Southan Santa Barbara, California** to bring the events to the West Coast as well.

NEW: There will be a **workshop event** in Dayton, OH in September 2012.

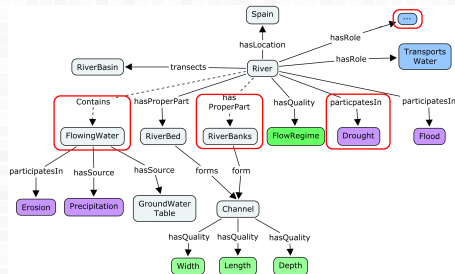
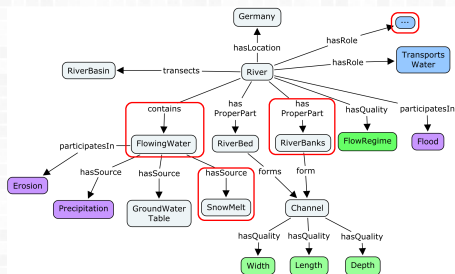
What

HANDLING SEMANTIC HETEROGENEITY BY MICROTHEORIES



- Employ **space** and **time** as fundamental **structuring principles** for the development of **ontologies**.

INSPIRE EXAMPLE– COMPUTING A COMMON GROUND



■ **INSPIRE Watercourse:** 'A natural or man-made **flowing water** course or stream.'

■ **Instead** of a **top-down ontology** for the EU that violates local definitions, **compute** a top-level based on **local definitions** of the member states.

*INSPIRE: Infrastructure for Spatial Information in the European Community

PRESERVING LOCAL CONCEPTUALIZATIONS

The screenshot shows the Protege interface for the ontology `RiversReasoning.owl`. The left pane displays the class hierarchy, where `GermanRiver` is a subclass of `INSPIREWatercourse`, which is a subclass of `ENVORiver`. The right pane shows the description of `GermanRiver`, which is defined as a subclass of `EuropeanRiver` and `INSPIREWatercourse`. The description includes several restrictions:

- `or AquaticRecreationArea`
- `or Navigable`
- `or TransportsWater`
- `or WaterBody`
- `or WaterSupply`
- `and (hasSource some GroundWaterTable)`
- `or (hasSource some Precipitation)`
- `or (hasSource some SnowMelt)`
- `and contains some FlowingWater`
- `and hasDestination some WaterBody`
- `and hasLocation some Germany`
- `and hasPart some RiverBanks`
- `and hasPart some RiverBed`
- `and hasQuality some FlowRegime`
- `and transects some RiverBasin`

The INSPIRE definition is **too restrictive**

A FINAL THOUGHT...

We assume that **ontology standardization** is less difficult and more persistent than **aligning** and translating local application-centric ontologies.

What if standardization is the more difficult task?

SPECIAL ISSUE ON LINKED SPATIOTEMPORAL DATA

