

Langages du Web de données et moteurs de recherche sémantique

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Inria, I3S, CNRS

Wimmics

Agenda

1. Introduction
2. RDF
3. RDFS
4. SPARQL
5. Tools
6. Conclusion

W3C Web of Data

1. Semantic Web
2. Web of Data
3. Linked Data



WD-rdf-syntax-19980819

Resource Description Framework (RDF) Model and Syntax Specification

W3C Working Draft 19 August 1998

Newer Version Available

This Version:

<http://www.w3.org/TR/1998/WD-rdf-syntax-19980819>

Newest Version:

<http://www.w3.org/TR/WD-rdf-syntax>

Editors:

Ora Lassila <ora.lassila@research.nokia.com>, Nokia Research Center

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[Document Status](#)

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Status of This Document

This document is a minor revision of the [working draft dated 1998-07-20](#). The most significant change

Projet : ACACIA - x
raweb.inria.fr/rapportsactivite/RA99/acacia/

RaWeb 1999 / [Projet : ACACIA](#)

[AIDE](#)
[INDEX](#)

Classeur
[Mettre dans le classeur !](#)
[Afficher le classeur](#)











C. HÉBERT,
Modèle de traitement de RDF basé sur les graphes conceptuels,
Rapport de stage de DEA, I3S, université de Nice Sophia-Antipolis, 1999.

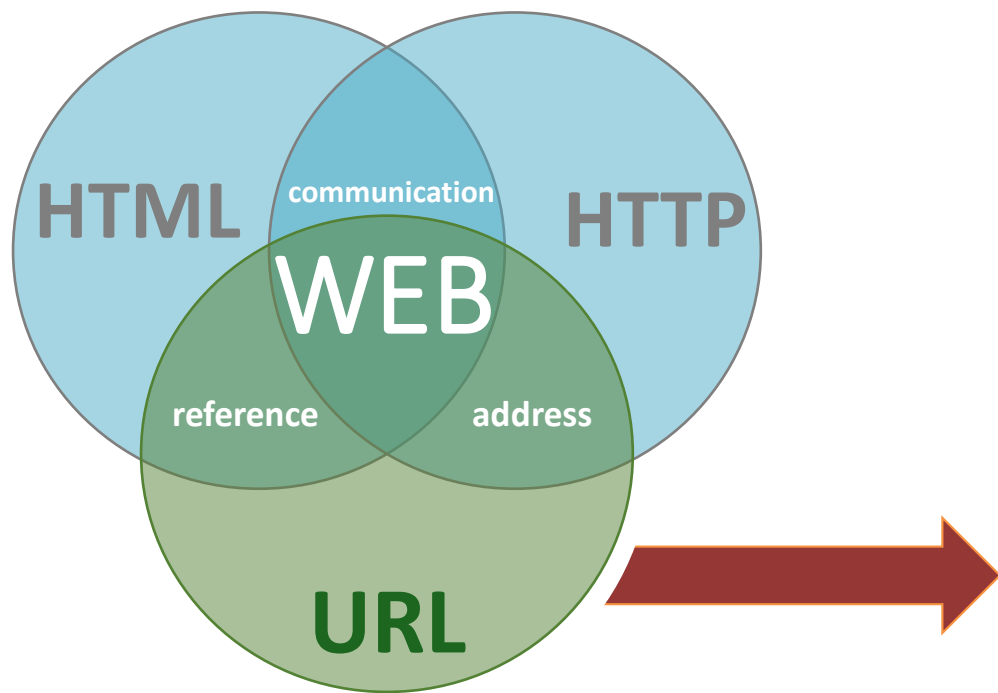
8. ICCS 2000: Darmstadt, Germany

> Home > Conferences and Workshops > ICCS

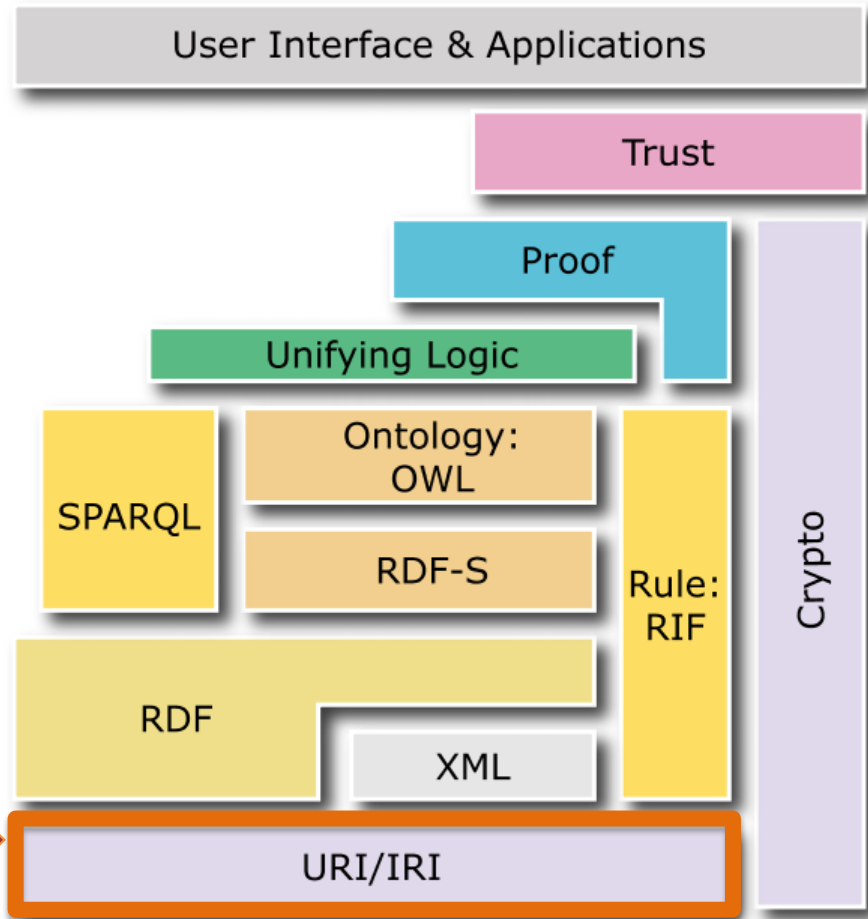
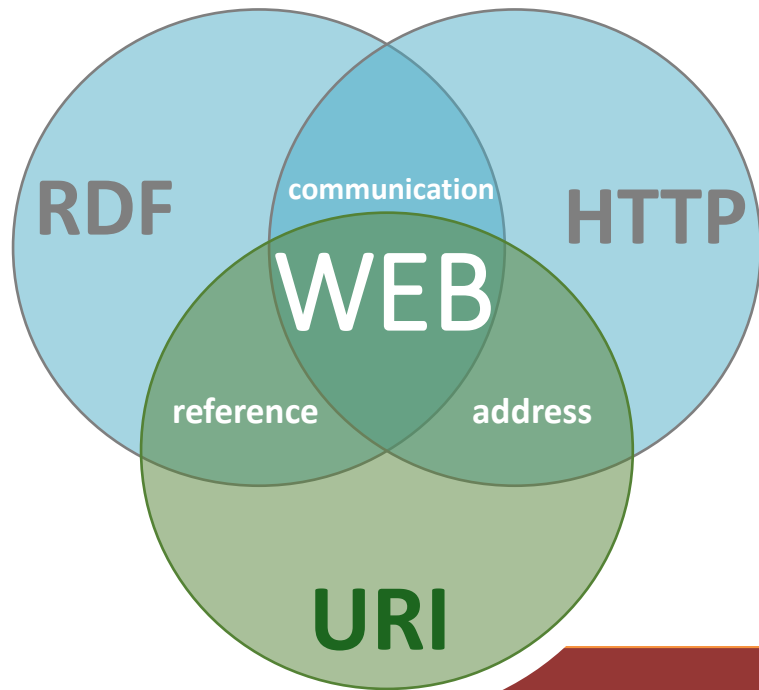
 Trier 1

-     Bernhard Ganter, Guy W. Mineau:
Conceptual Structures: Logical, Linguistic, and Computational Issues, 8th International Conference on Conceptual Structures, ICCS 2000, Darmstadt, Germany, August 14-18, 2000, Proceedings. Lecture Notes in Computer Science 1867, Springer 2000, ISBN 3-540-67859-X
-     Olivier Corby, Rose Dieng, Cédric Hébert:
A Conceptual Graph Model for W3C Resource Description Framework. 468-482

Web



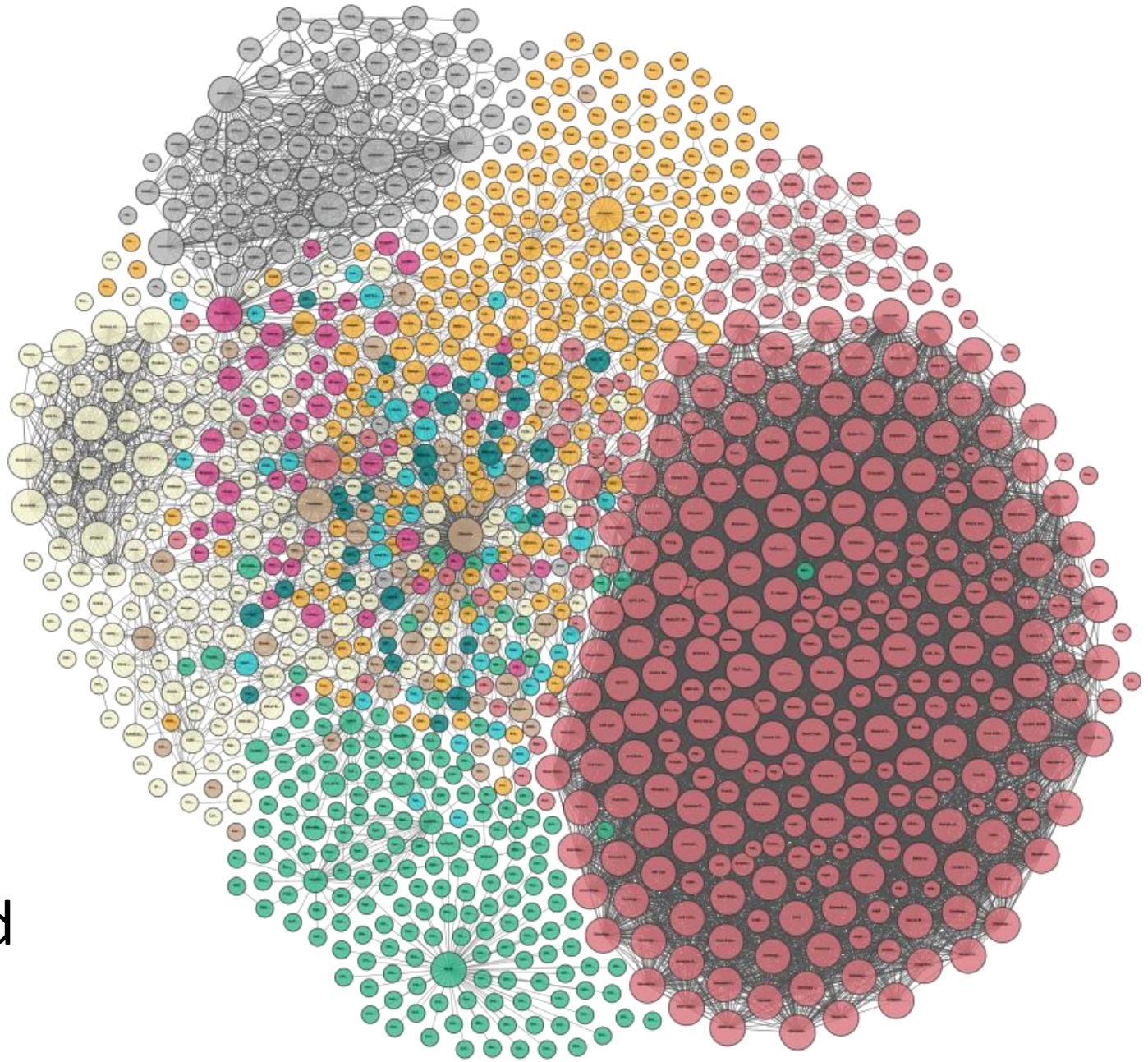
Web of Data



universal nodes and types
identification

Web of Data

- **Web:** Hypertext on top of the Internet (HTML)
- **Web of Data:** Semantic network on top of the Internet (RDF)



LOD Cloud

Semantic Web of Data

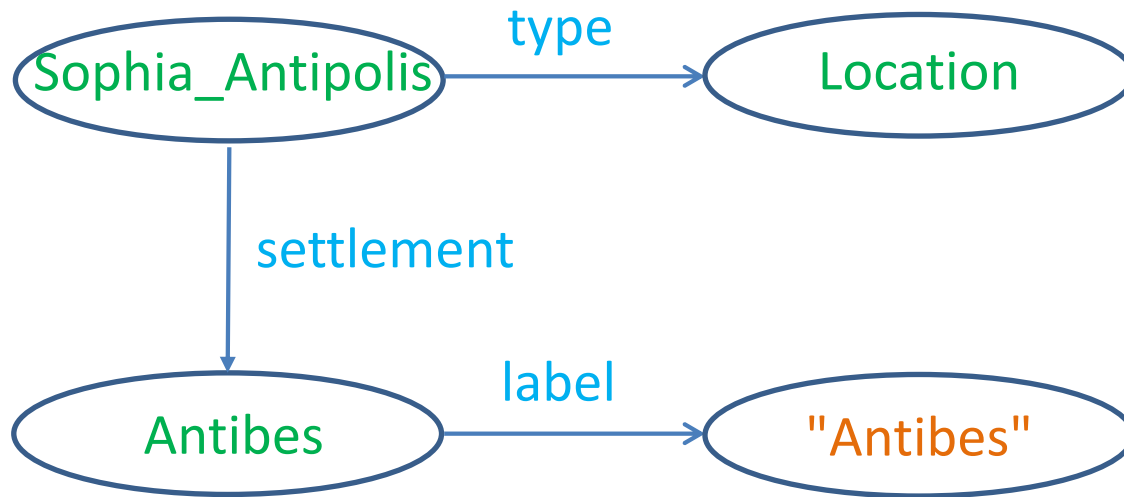
W3C Core Web of Data

- RDF: Resource Description Framework
- RDFS: RDF Schema
- SPARQL: RDF Query Language
- OWL: Web Ontology Language

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- 2. RDF**
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RDF : Labeled Oriented Graph



RDF Identifier : URI

<http://fr.dbpedia.org/resource/Sophia_Antipolis>
<<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>>
<<http://dbpedia.org/ontology/Location>>

<http://fr.dbpedia.org/resource/Sophia_Antipolis>
<<http://dbpedia.org/ontology/settlement>>
<<http://fr.dbpedia.org/resource/Antibes>>

<<http://fr.dbpedia.org/resource/Antibes>>
<<http://www.w3.org/2000/01/rdf-schema#label>>
"Antibes"@fr

RDF Identifier : URI

db:Sophia_Antipolis rdf:type onto:Location

db:Sophia_Antipolis onto:settlement db:Antibes

db:Antibes rdfs:label "Antibes"@fr

RDF Identifier : URI

URL dereferencing

Execute HTTP request

Get an RDF graph

RDF

- Triple
 - subject property object
- Binary relation
 - property(subject, object)
- Object oriented flavour
 - subject.property = object
- Type system
 - us:John rdf:type foaf:Person
 - Multi instantiation

RDF term

- URI
- Blank Node
- Literal
- XSD datatype
 - xs:int, xs:double, xs:boolean, xs:string , xs:date, etc.

RDF Syntax

- Turtle
- JSON LD
- RDF/XML
- Trig
- N3
- RDFa

Named Graph

```
graph ex:g1 {  
    ex:James a ex:Lecturer ;  
    foaf:name "James" .  
}
```

```
graph ex:g2 {  
    ex:James a ex:Musician ;  
    foaf:name "Jimmy" .  
}
```

Annotate Named Graph

```
graph ex:g1 {  
    ex:James a ex:Lecturer ;  
        foaf:name "James" .  
}
```

```
ex:g1 ex:date "1930-01-29"^^xsd:date ;  
    ex:author ex:John .
```

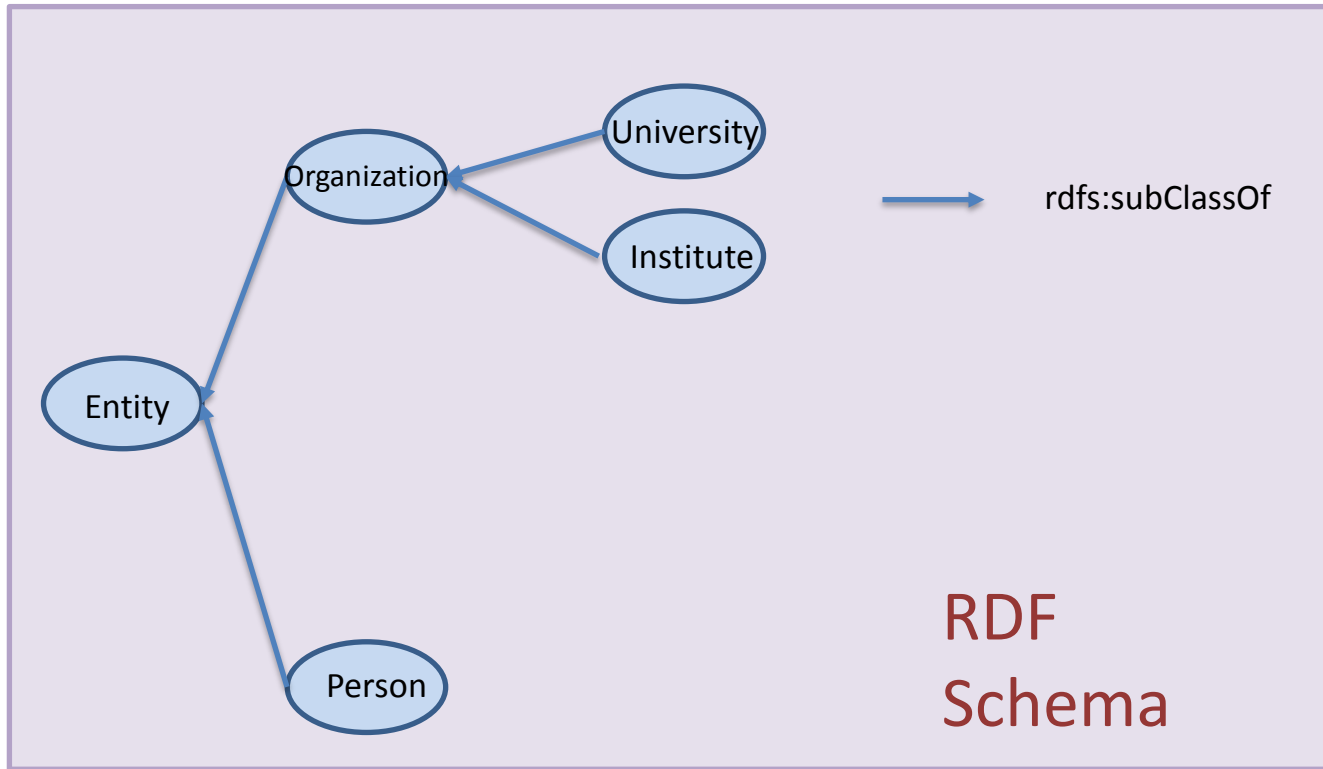
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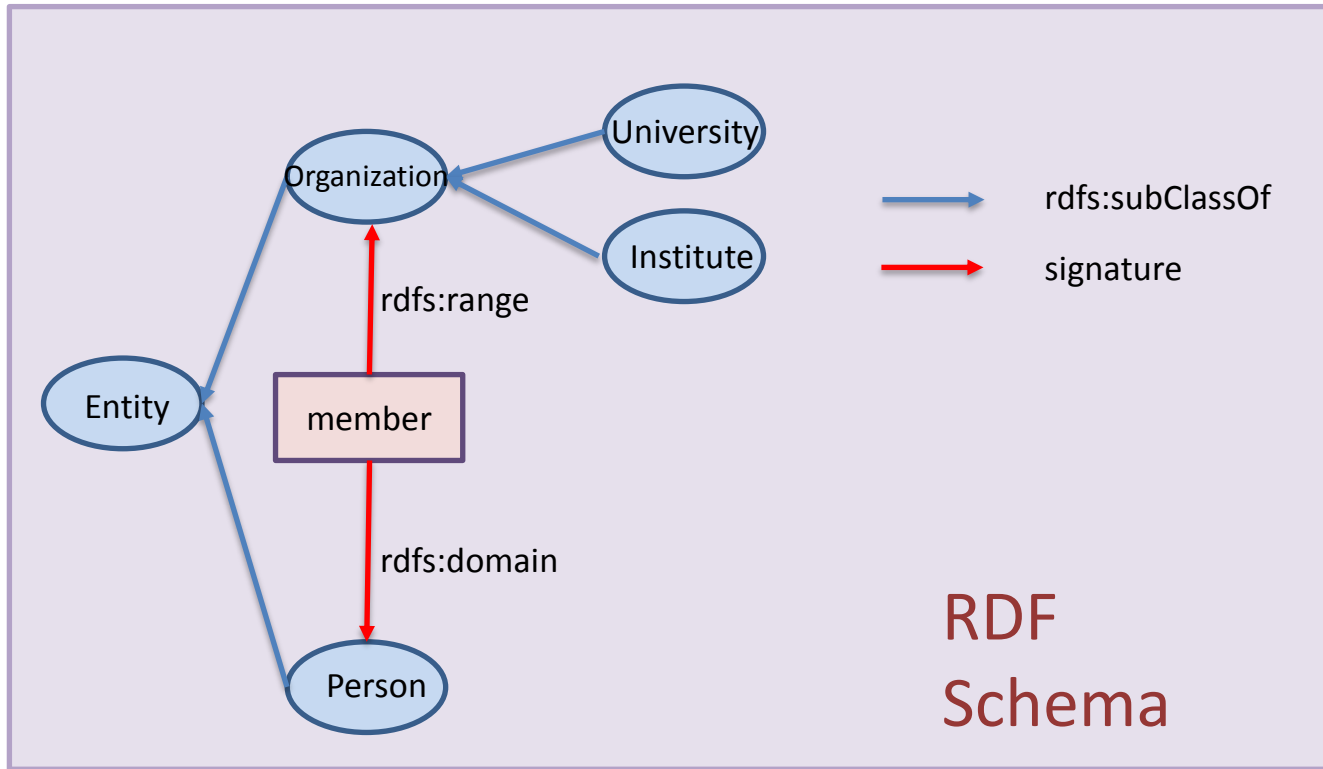
RDF Schema

- Define vocabulary for RDF
- RDF based
- Entailment oriented (not prescriptive)
- Class hierarchy: `rdfs:subClassOf`
- Multiple inheritance
- Property hierarchy: `rdfs:subPropertyOf`
- Property signature: `rdfs:domain rdfs:range`

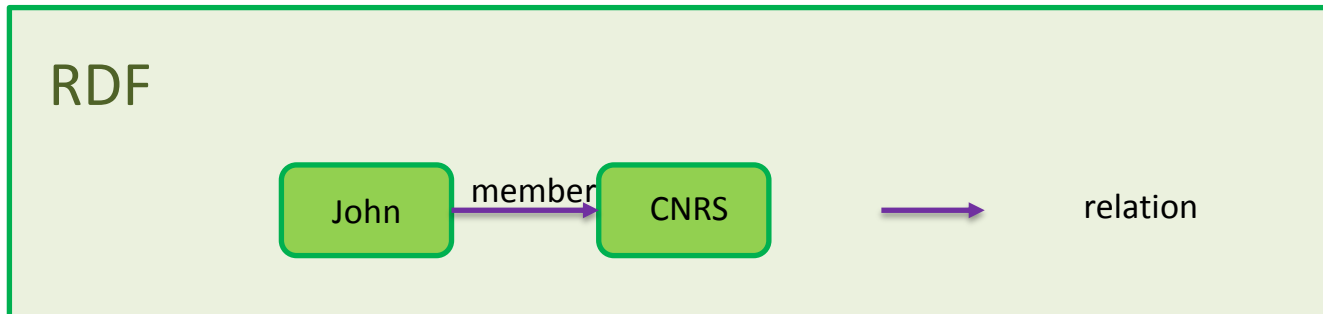
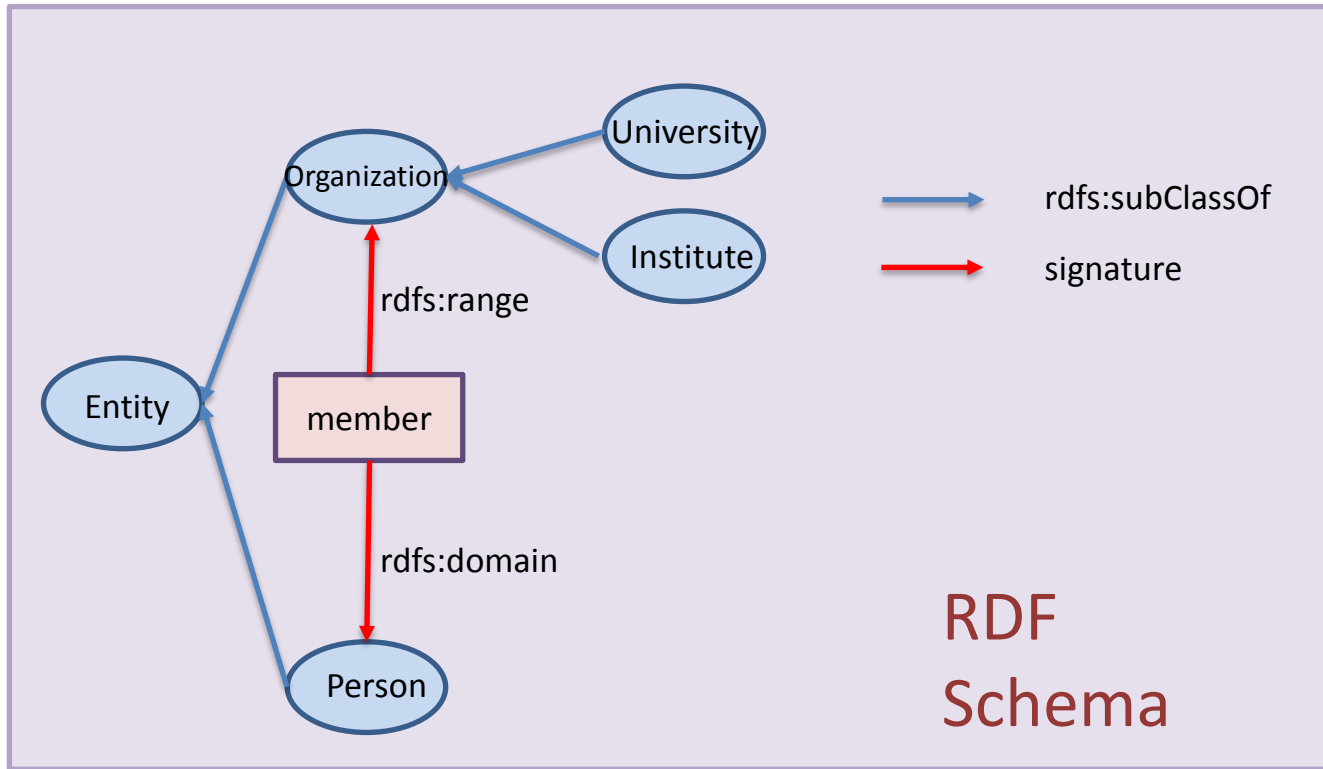
RDFS



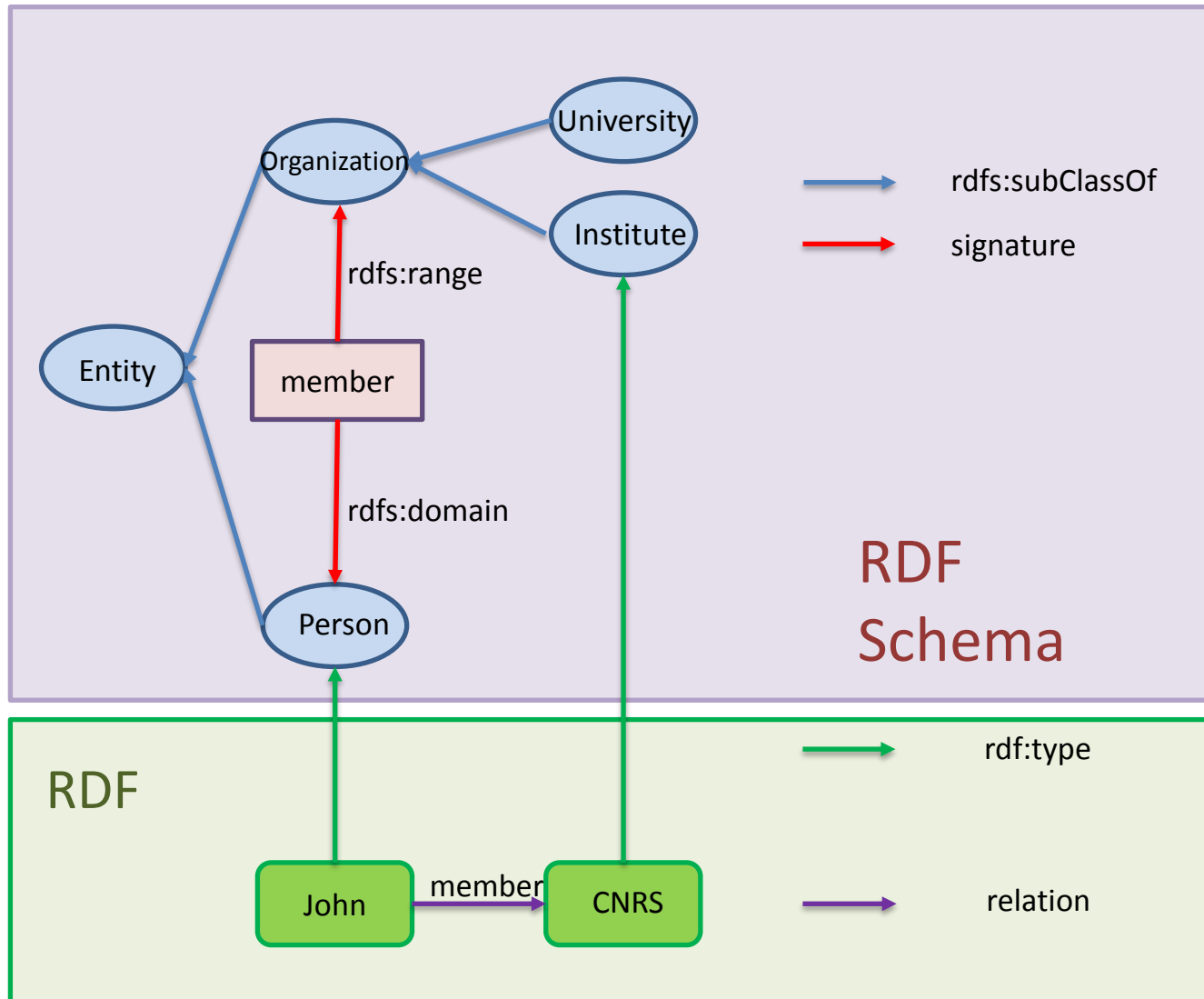
RDFS



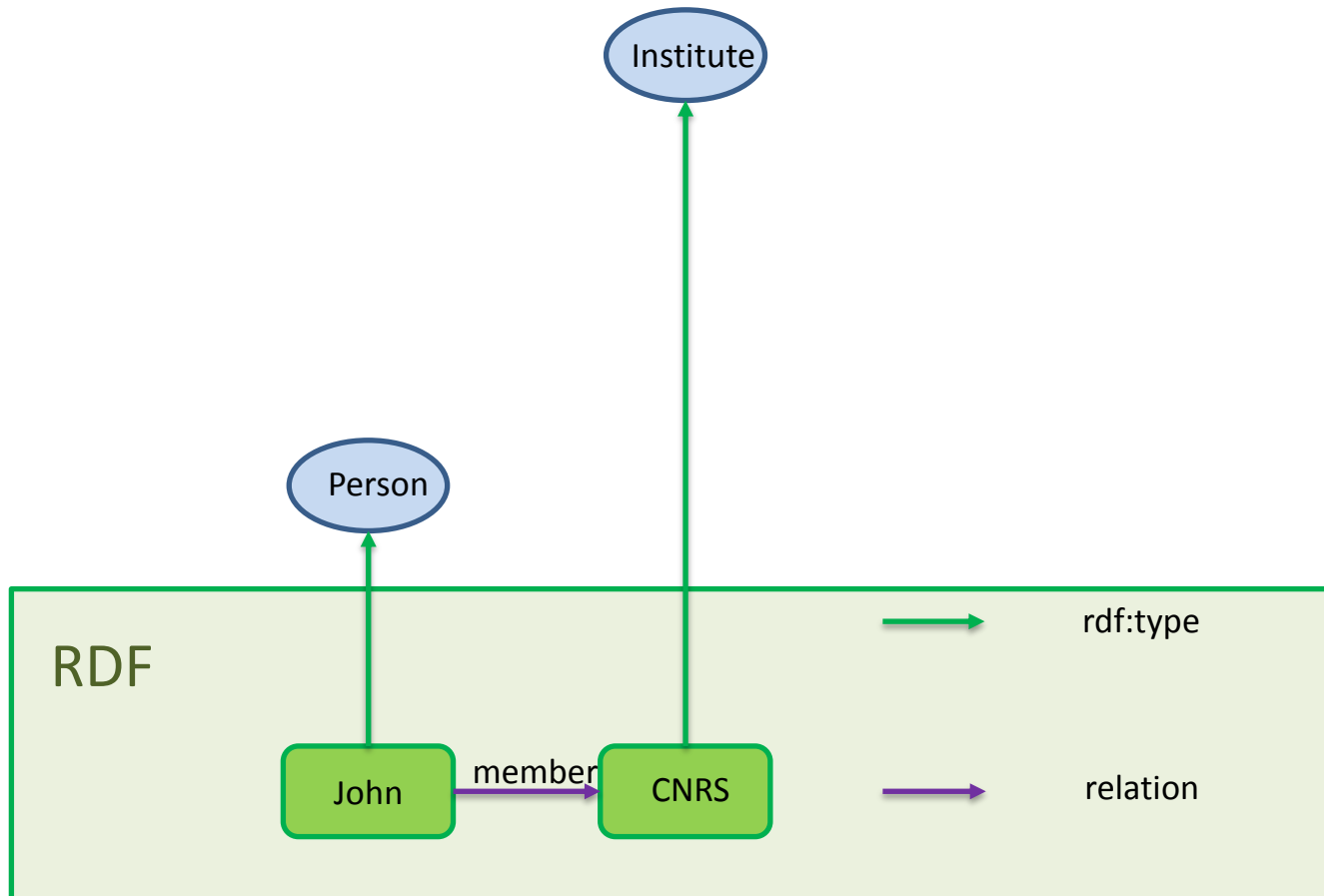
RDF & RDFS



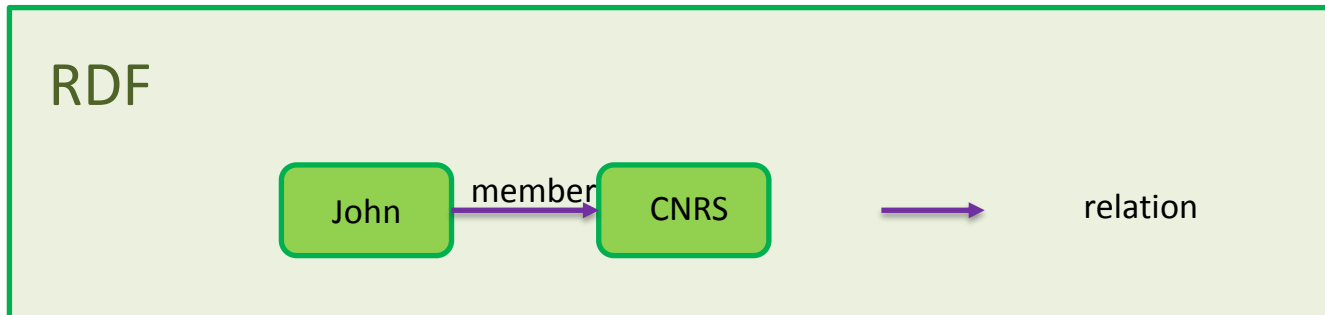
RDF & RDFS



RDF



RDF



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SPARQL

- RDF Query Language
- Query & Update
- Graph Pattern Matching

BGP: Basic Graph Pattern

```
?x a foaf:Person ;  
    foaf:name ?name ;  
    foaf:knows ?y .
```

BGP: Basic Graph Pattern

```
?x a foaf:Person ;  
    foaf:name ?name ;  
    foaf:knows ?y .
```


BGP: Basic Graph Pattern

```
?x a foaf:Person ;  
    foaf:name ?name ;  
    foaf:knows ?y .
```

(1) ?x = ex:John ; ?name = "John" ; ?y = ex:Jack

(2) ?x = ex:Jack ; ?name = "Jack" ; ?y = ex:James

Filter

```
?x a foaf:Person ;  
    foaf:name ?name ;  
    foaf:knows ?y  
filter regex(?name, "John")
```

Select Query

```
select * where {  
  ?x a foaf:Person ;  
  foaf:name ?name ;  
  foaf:knows ?y .  
}
```

SPARQL Query Form

1. select where { BGP }
2. construct { BGP } where { BGP }
3. ask { BGP }
4. describe

Statement

- Basic Graph Pattern
- Named Graph Pattern
- Property Path
- Union
- Optional
- Minus
- Service
- Nested Query
- Bind
- Values
- Filter
- Having

Modifier

1. Select distinct, select expression
2. From, from named
3. Aggregate
4. Order by
5. Group by
6. Limit
7. Offset

Property Path

```
select * where {  
  ?x rdf:type/rdfs:subClassOf* ?y  
}
```

Service

```
select * where {  
  service <http://fr.dbpedia.org/sparql> {  
    ?x rdfs:label "Antibes"@fr ;  
      geo:lat ?lat ; geo:lon ?lon  
  }  
}
```

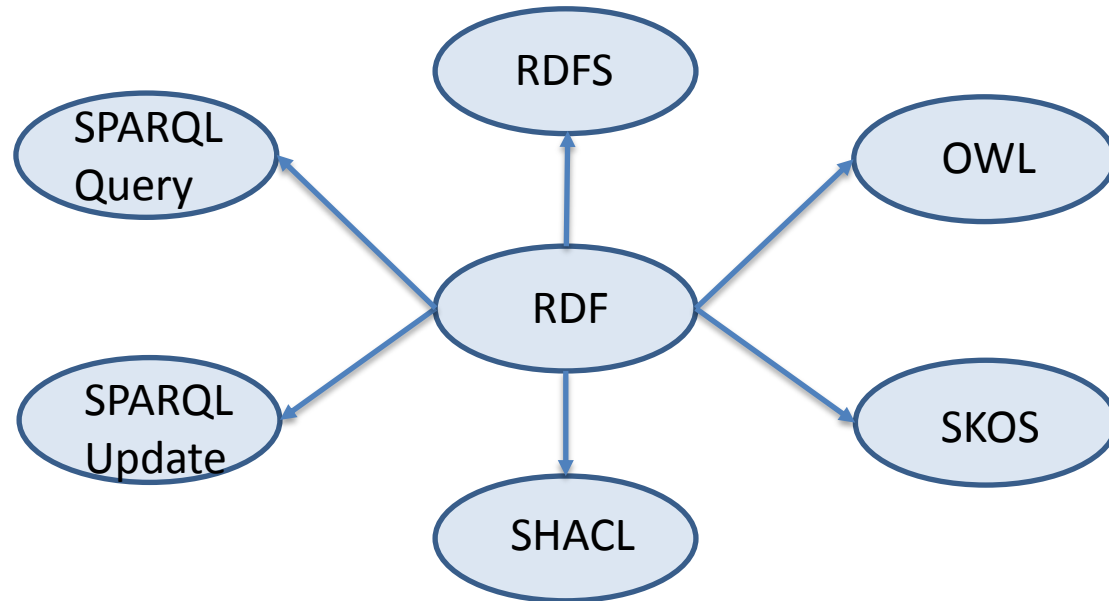

SPARQL Update

- insert data { Graph }
- delete data { Graph }

- insert { BGP } where { BGP }
- delete { BGP } where { BGP }
- delete { BGP } insert { BGP } where { BGP }

- Load, Copy, Move, etc.

Web of Data W3C Ecosystem



OWL

- Web Ontology Language
- Description Logics for RDF
- Define classes, properties and their logical relations
- Intersection, union, complement, restriction
- Transitivity, Symmetry, etc.

SKOS

- Simple Knowledge Organization System
- Thesaurus
- Natural Language
- Define terms and their linguistic relations

SHACL

- Shapes Constraint Language
- Define constraints for RDF graph
- Enables users to validate RDF graph

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Tools

- Virtuoso
- Jena
- Corese
- Sparklis

Virtuoso

- Openlink
- Data Base generic platform (relational, XML, RDF)
- SPARQL endpoint
- Linked Data
- Scale the Web of Data
- DBpedia
 - fr dbpedia: 185 404 501 triples
 - en dbpedia: 438 336 517 triples
- Manages billions of triples

<http://virtuoso.openlinksw.com/rdf/>

Virtuoso SPARQL Query Editor

[About](#) | [Namespace Prefixes](#) | [Inference rules](#)

Default Data Set Name (Graph IRI)

Query Text

```
prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
select * where {
  ?x rdfs:label "Antibes"@fr ;
  rdfs:comment ?c ;
  geo:long ?lon ; geo:lat ?lat
  filter langMatches(lang(?c), "fr")
}
```

(Security restrictions of this server do not allow you to retrieve remote RDF data, see [details](#).)

Results Format:

HTML ▼

Execution timeout:

0 milliseconds *(values less than 1000 are ignored)*

Options:

Strict checking of void variables

(The result can only be sent back to browser, not saved on the server, see [details](#))

Run Query

Reset

x	c	lon	lat
http://fr.dbpedia.org/resource/Antibes	"Antibes est une commune française située dans le département des Alpes-Maritimes en région Provence-Alpes-Côte d'Azur. Ses habitants sont appelés les Antibois ou Antipolitains. Antibes est la deuxième ville la plus peuplée du département."@fr	7.12389	43.5808



Search DBpedia...

@ http://fr.dbpedia.org

Back to old DBpedia français, langue fi

CATEGORIES

TYPES

External Links

Same As

Born Here



Antibes

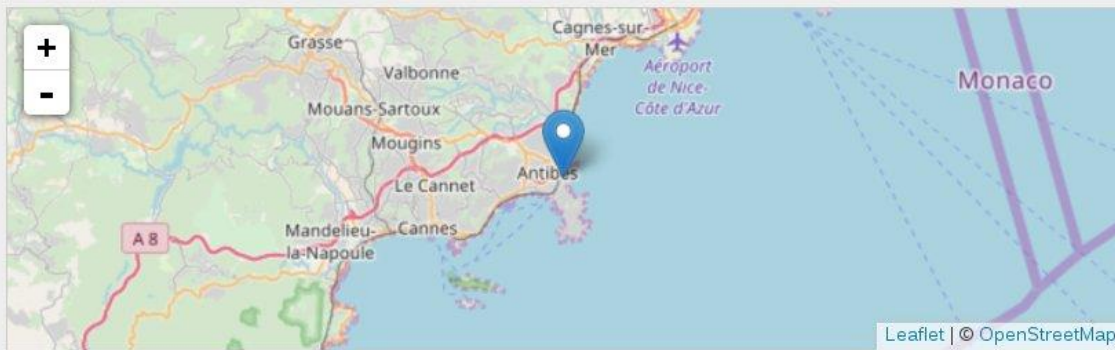
TAKE A TOUR

LEGEND

Location, lieu, lieu habité, zone peuplée

Antibes est une commune française située dans le département des Alpes-Maritimes en région Provence-Alpes-Côte d'Azur. Ses habitants sont appelés les Antibois ou Antipolitains. Antibes est la deuxième ville la plus peuplée du département.

dbpedia rdf.freebase.com/ns/m.01hh1y fr.wikipedia.org/wiki/Antibes



Property:

Value:

dbpedia-owl:abstract :

Antibes est une commune française située dans le département des Alpes-Maritimes en région Provence-Alpes-Côte d'Azur. Ses habitants sont appelés les Antibois ou Antipolitains. Antibes est la deuxième ville la plus peuplée du département. @fr

dbpedia-owl:altitude :

dbpedia-fr:Antibes__2

dbpedia-owl:arrondissement :

dbpedia-fr:Arrondissement_de_Grasse

Jena

- « Academic » reference implementation
- Apache
- Open Source
- Java
- Fuseki: SPARQL Endpoint
- TDB: persistent triple store
- Java API for RDF and OWL

<https://jena.apache.org/>

Jena

- Transitive reasoner
- RDFS rule reasoner
- OWL rule reasoners (subsets of OWL)
- Possibility to use Pellet, Racer or FaCT
- Consistency checking
- Rule based reasoner: forward, backward chaining
- Generate SPARQL algebra

<https://jena.apache.org/>

Jena Rules

```
(?p rdfs:subPropertyOf ?q), notEqual(?p,?q)  
->  
[ (?a ?q ?b) <- (?a ?p ?b) ] .
```

Corese

- Wimmics, Inria
- Inference Rule Language
- STTL: SPARQL Template Transformation Language
- LDScript: Linked Data Script Language
- SPARQL approximate search
- Web server with transformations
 - Hypertext on Linked Data

Inference Rule Language

- SPARQL based
- construct { BGP } where { BGP }
- Forward chaining inference engine
- OWL RL

STTL

- Transformation Language for RDF à la XSLT
 - SPARQL based
1. template { Text Pattern } where { BGP }
 2. transformation = set of templates
 3. st:apply-templates, st:call-template

LDScript

- Linked Data Script Language
- Define SPARQL extension functions

```
function us:fac(?n) {  
    if (?n = 0, 1, ?n * us:fac(?n - 1))  
}
```

LDScript

- Query in function
- Second order functions: map, funcall, reduce
- Lambda expression
- Pattern matching
- Statements: let, for, return
- Extension datatypes:
 - dt:graph, dt:triple, dt:mapping, dt:list

LDScript

```
function us:type(?x) {  
  let ( select * where { ?x a ?t } ) { ?t }  
}
```

Development environment

The screenshot displays the Corese/KGRAM 3.1 development environment. The window title is "Corese/KGRAM 3.1 - Wimmics INRIA I3S - 2015-05-01". The menu bar includes "File", "Edit", "Engine", "Debug", "Query", "Template", and "Explain?". The interface has a tabbed view with "System" and "Query1" tabs. Below the tabs is a toolbar with buttons for "Query", "Validate", "to SPIN", "to SPARQL", "Prove", "Trace", "Search", "Refresh stylesheet", and "Default stylesheet".

The main editor area shows a query template:

```
1 template {
2   st:apply-templates-with(st:owl)
3 }
4 where {
5 }
6
```

Below the editor is a section for the ontology, with tabs for "Graph", "XML", and "Validate". The "XML" tab is selected, showing the following ontology content:


```
Ontology(<http://example.com/owl/families>
Import(<http://example.org/otherOntologies/families.owl>)
SubClassOf(Annotation(rdfs:comment "States that every man is a person."@en)
<http://example.com/owl/families/Man> <http://example.com/owl/families/Person>)
SubClassOf(
ObjectIntersectionOf(
ObjectOneOf(<http://example.com/owl/families/Mary> <http://example.com/owl/families/Bill> <http://example.com/owl/families/Meg>) <
ObjectIntersectionOf(<http://example.com/owl/families/Parent>
ObjectMaxCardinality(1 <http://example.com/owl/families/hasChild>)
ObjectAllValuesFrom(<http://example.com/owl/families/hasChild> <http://example.com/owl/families/Female>))
)
DisjointClasses(<http://example.com/owl/families/Woman> <http://example.com/owl/families/Man>)
DisjointClasses(<http://example.com/owl/families/Mother> <http://example.com/owl/families/Father> <http://example.com/owl/families/Your
NegativeObjectPropertyAssertion(<http://example.com/owl/families/hasWife> <http://example.com/owl/families/Bill> <http://example.com/ov
NegativeDataPropertyAssertion(<http://example.com/owl/families/hasAge> <http://example.com/owl/families/Jack> "53"^^xsd:integer)
NegativeObjectPropertyAssertion(<http://example.com/owl/families/hasDaughter> <http://example.com/owl/families/Bill> <http://example.co
Declaration(Class(<http://example.com/owl/families/Account>))
```

The bottom of the window shows a status bar with "SPARQL Template Transformation Language" and a progress indicator.


CORESE Web Server

Corese is a Semantic Web Factory implementing RDF, RDFS, SPARQL and Inference Rules. This site presents demos of Semantic Web servers and Linked Data Navigators designed with [SPARQL Template Transformation Language](#).


Linked data browsers



Louis XIV de France
(1638 - 1715)



Auguste (dbpeida fr)



Auguste (dbpedia)



Emmanuel-Philibert de Savoie
(1528-1580)



Places
(Nice)



History
(XIVe Siècle)

Online services

SPARQL Query

Server

```
select * where {
  ?x ?p ?y
}
```

Query

DBpedia Query

STD

```
select * where {
  service <http://fr.dbpedia.org/sparql> {
    <http://fr.dbpedia.org/resource/Antibes> ?p ?y
  }
}
limit 10
offset 10
```

Query

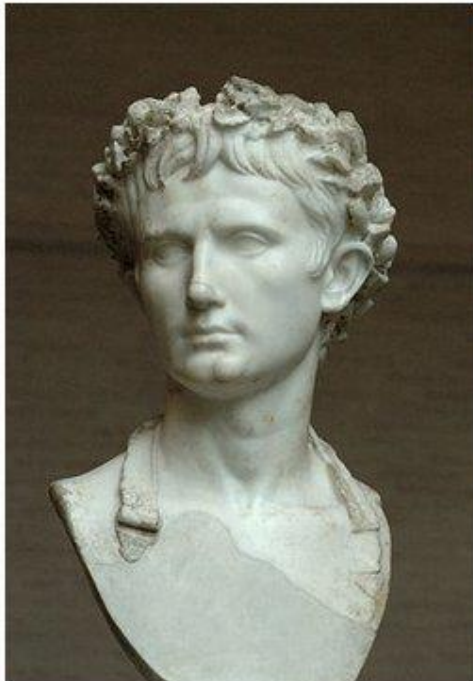
Self Service

RDF graph URI:

Format:

Transform

Auguste



Naissance -63-09-23+02:00

Décès 14-08-19+02:00

Prédécesseur Jules César

Successeur Tibère

Père Gaius Octavius

Mère Atia Balba Caesonia

Conjoints Scribonia (épouse d'Octavien) Clodia Pulchra Livie

Enfants Julia Caesaris filia

Résumé Auguste, né sous le nom de Caius Octavius le 23 septembre 63 av. J.-C. à Rome, d'abord appelé Octave puis Octavien, porte le nom de Imperator Caesar Divi Filius Augustus à sa mort le 19 août 14 ap. J.-C. à Nola. Il est le premier empereur romain, du 16 janvier 27 av. J.-C. au 19 août 14 ap. J.-C. Issu d'une ancienne et riche famille de rang équestre appartenant à la gens plébéienne des Octavii, il devient fils adoptif posthume de son grand-oncle maternel Jules César en 44 av.

Wikipedia <http://fr.wikipedia.org/wiki/Auguste>

DBpedia <http://fr.dbpedia.org/resource/Auguste>

SPARQL Sudoku Solver

1	2	3	4	5	6	7	8	9
4	5	6	7	8	9	1	2	3
7	8	9	1	2	3	4	5	6
2	1	4	3	6	5	8	9	7
3	6	5	8	9	7	2	1	4
8	9	7	2	1	4	3	6	5
5	3	1	6	4	2	9	7	8
6	4	2	9	7	8	5	3	1
9	7	8	5	3	1	6	4	2

Submit

Reset

Generated by Corese server using SPARQL Template Transformation.

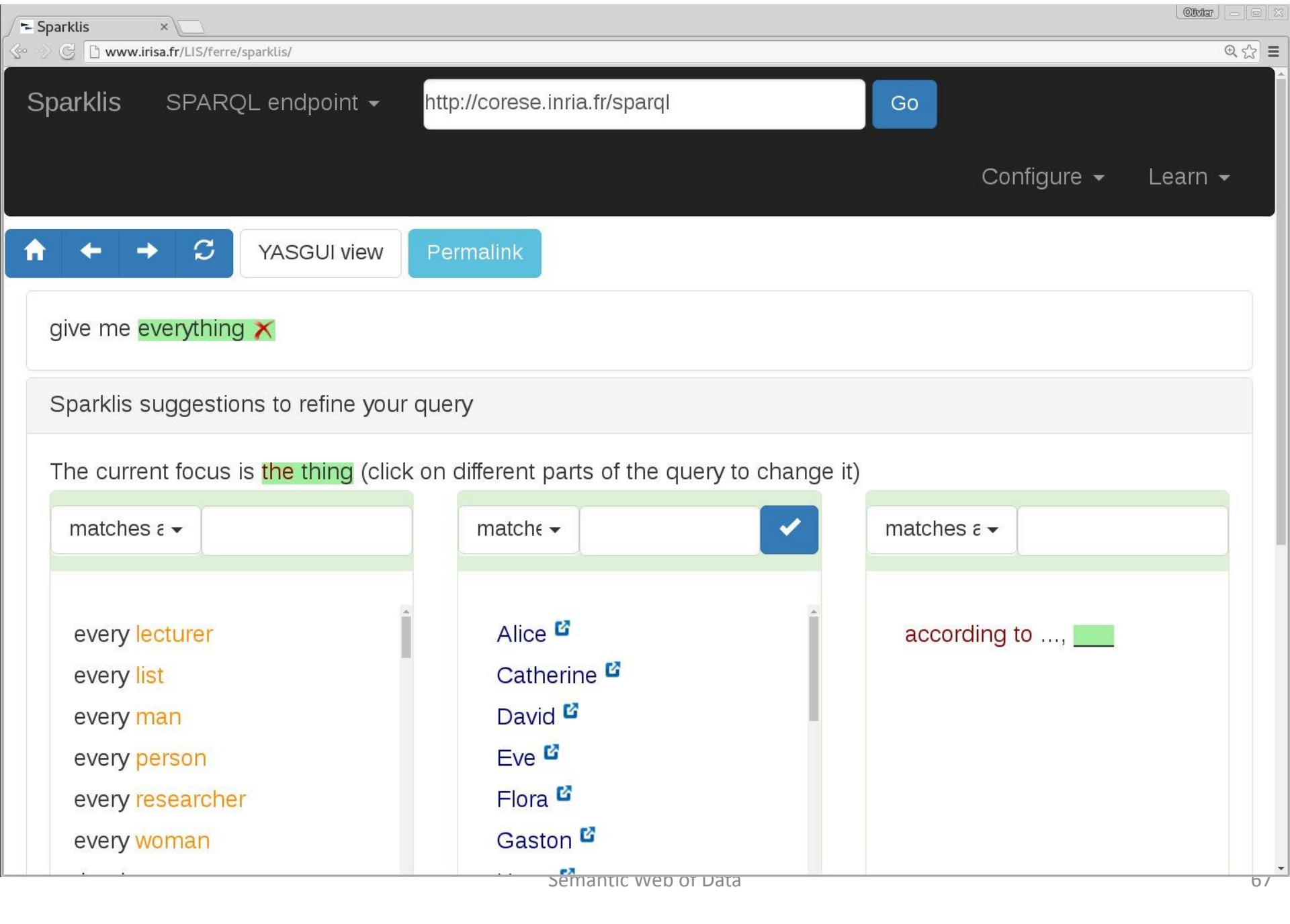
2015-06-30T16:18:58

Sparklis

- Inria Nancy, SemLIS, Sébastien Ferré
- <http://www.irisa.fr/LIS/ferre/sparklis/>
- SPARQL query structured editor
- Select a SPARQL endpoint
 - <http://fr.dbpedia.org/sparql>
- Formalized «Natural» Language

Sparklis

- Faceted search
- Browse the triple store
- Propose relevant types and properties
- Propose suggestions to refine query at given focus
- Display the SPARQL query



YASGUI view

Permalink

give me everything ✖

Sparklis suggestions to refine your query

The current focus is **the thing** (click on different parts of the query to change it)

matches ε ▾

- every lecturer
- every list
- every man
- every person
- every researcher
- every woman

matche ▾

- Alice
- Catherine
- David
- Eve
- Flora
- Gaston



matches ε ▾

according to ...,



YASGUI view

Permalink

give me every person ✘

Sparklis suggestions to refine your query

The current focus is the person (click on different parts of the query to change it)

matches ε ▾

- every person ✘ ⑧
- that has a type ⑧
- that has a name ⑦
- that has an age ④
- that has a friend ④
- that has a shirtsize ④

matche ▾

- David
- Eve
- John
- Karl
- Laura
- Mark

matches ε ▾

- and ...
- or ...
- according to ...,
- according to which there is
- ...
- that is ...
- the highest to lowest

Sparklis SPARQL endpoint Configure Learn

[Home](#) [Back](#) [Forward](#) [Refresh](#)

give me every person that has an age ✖

Sparklis suggestions to refine your query

The current focus is the age (click on different parts of the query to change it)

matches ϵ

- that is the age of ... ④
- that has a relation from ...
- that is the shoesize of ...
- that is the trouserssize of ...

matche

- 14
- 36
- 37
- 42

matches ϵ

- and
- and ...
- optionally
- not
- according to ...,
- according to which there is

Sparklis SPARQL endpoint Configure Learn

give me every person whose age is 36 ✖

Sparklis suggestions to refine your query

The current focus is **the person** (click on different parts of the query to change it)

matches ϵ

and that has a relation to ...
and that is a person
and that has an age
and that has a friend
and that has a shirtsize
and that has a shoesize

matche

and that is Karl

matches ϵ

or ...
optionally
not
according to ...,
according to which there is
...
has a relation from/to

Sparklis SPARQL endpoint Configure ▾ Learn ▾

Your query in SPARQL + results (with YASGUI)

Query

```
1 PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
2 PREFIX n1: <http://www.inria.fr/2015/humans#>
3 SELECT DISTINCT ?Person_93
4 WHERE { ?Person_93 a n1:Person .
5         ?Person_93 n1:age "36"^^xsd:integer . }
6 LIMIT 200
```

Other tools

- Oracle Spatial and RDF Semantic Graph
- AllegroGraph, FranzInc
- RDF4J (ex Sesame), Eclipse
- SWI-Prolog for the (semantic) web
 - <http://www.swi-prolog.org/web/>

SPARQL Endpoint

- <http://fr.dbpedia.org/sparql>
- <http://dbpedia.org/sparql>
- <http://data.archives-ouvertes.fr/sparql>
- <http://data.insee.fr/sparql>
- <http://data.bnf.fr/sparql>
- <http://semantic.eea.europa.eu/sparql>
- <http://data.linkedmdb.org/sparql?query=...>
- <http://geosparql.org/>

<http://www.w3.org/wiki/SparqlEndpoints>

Web of Data vs KRR and AI

- W3C provides Knowledge Representation and Reasoning with standards
- An external actor succeeded to unify a « *scattered* » research domain
- Contributes to « *industrialize* » and scale KRR
- Interoperable Knowledge Bases on the Web

Web of Data vs KRR and AI

New research problems

- Ontology design and sharing for world wide communities
- Ontology matching
- Scaling KR and entailment
- Federated query processing
- Data quality

Conclusion

- Semantic Web of Linked Data
- W3C standards
- Semantic Network at the scale of the Internet
- Distributed Knowledge Base
- Interoperable implementations

Towards the Web of Knowledge