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Integrating Heterogeneous Data Sources in the Web of Data

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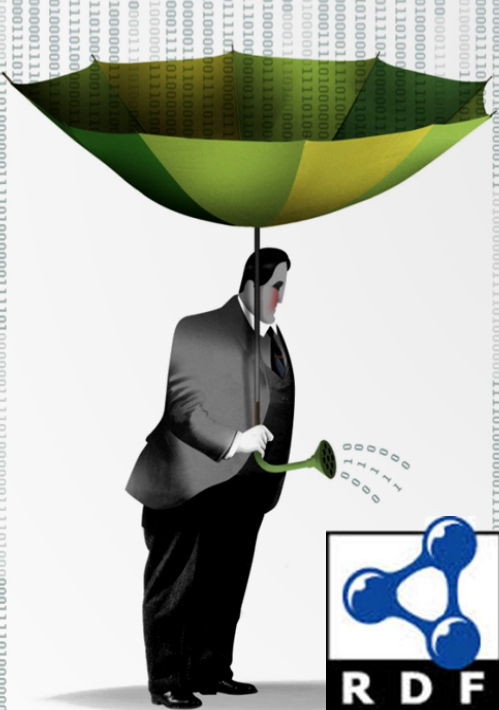
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Integrating Heterogeneous Data Sources in the Web of Data

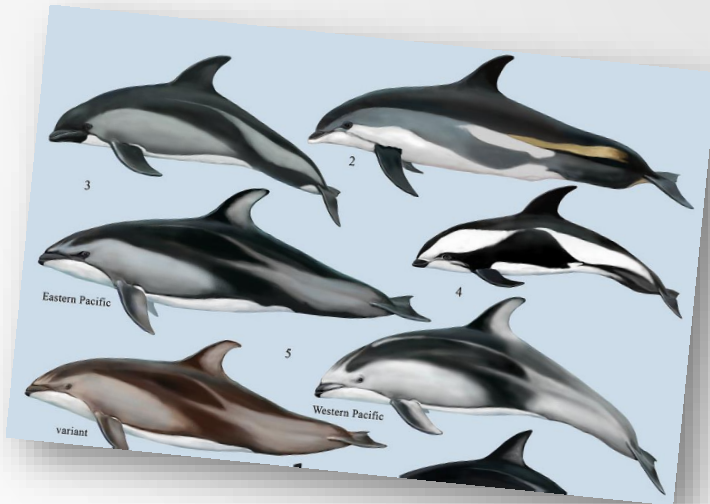
JDEV²⁰¹⁷

Franck Michel

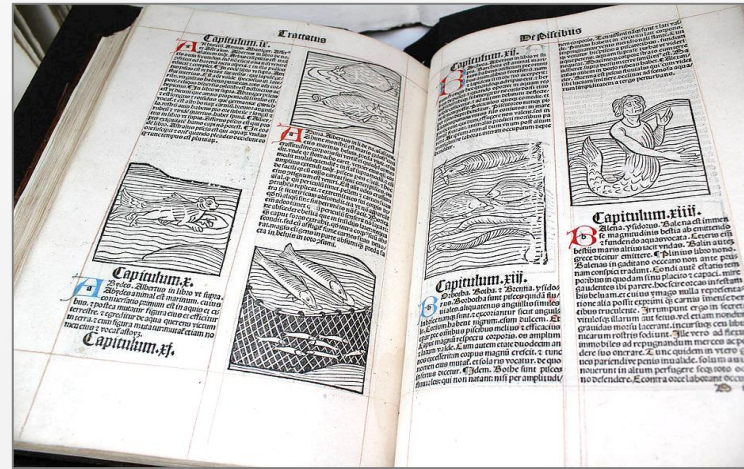
UNIVERSITÉ
CÔTE D'AZUR



More data sources \Rightarrow More opportunities



Example: study history of zoological knowledge



First Natural History Encycloedia, 1485.



Conservation biology*



Archaeological excavation

Example: study history of zoological knowledge

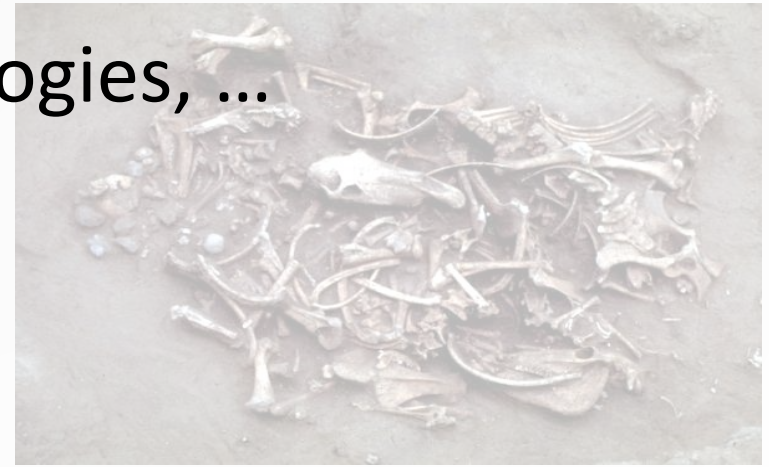


Knowledge formalizations

Controlled vocabularies,
taxonomies
domain ontologies, ...

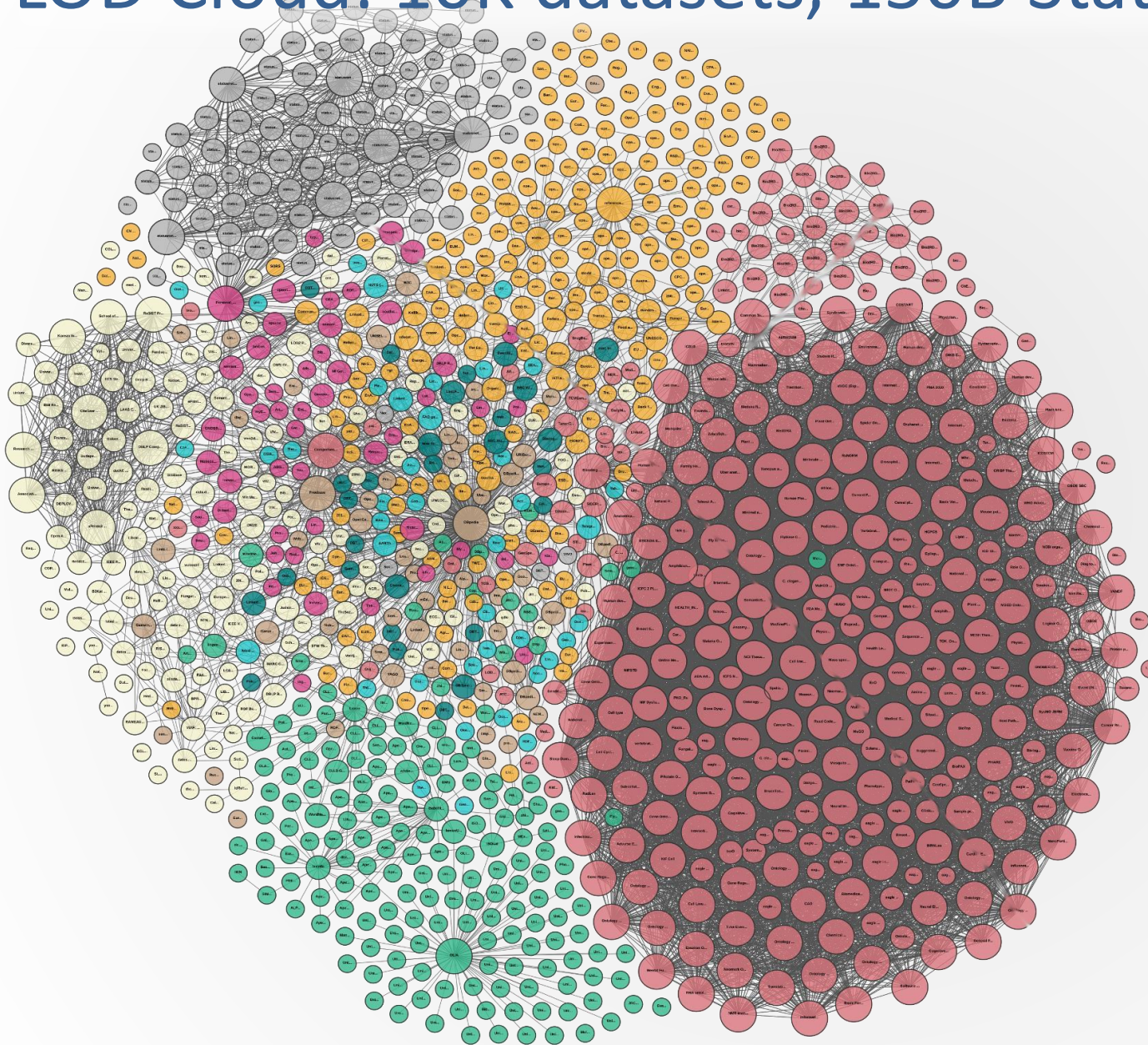


Conservation biology*



Archaeological excavation

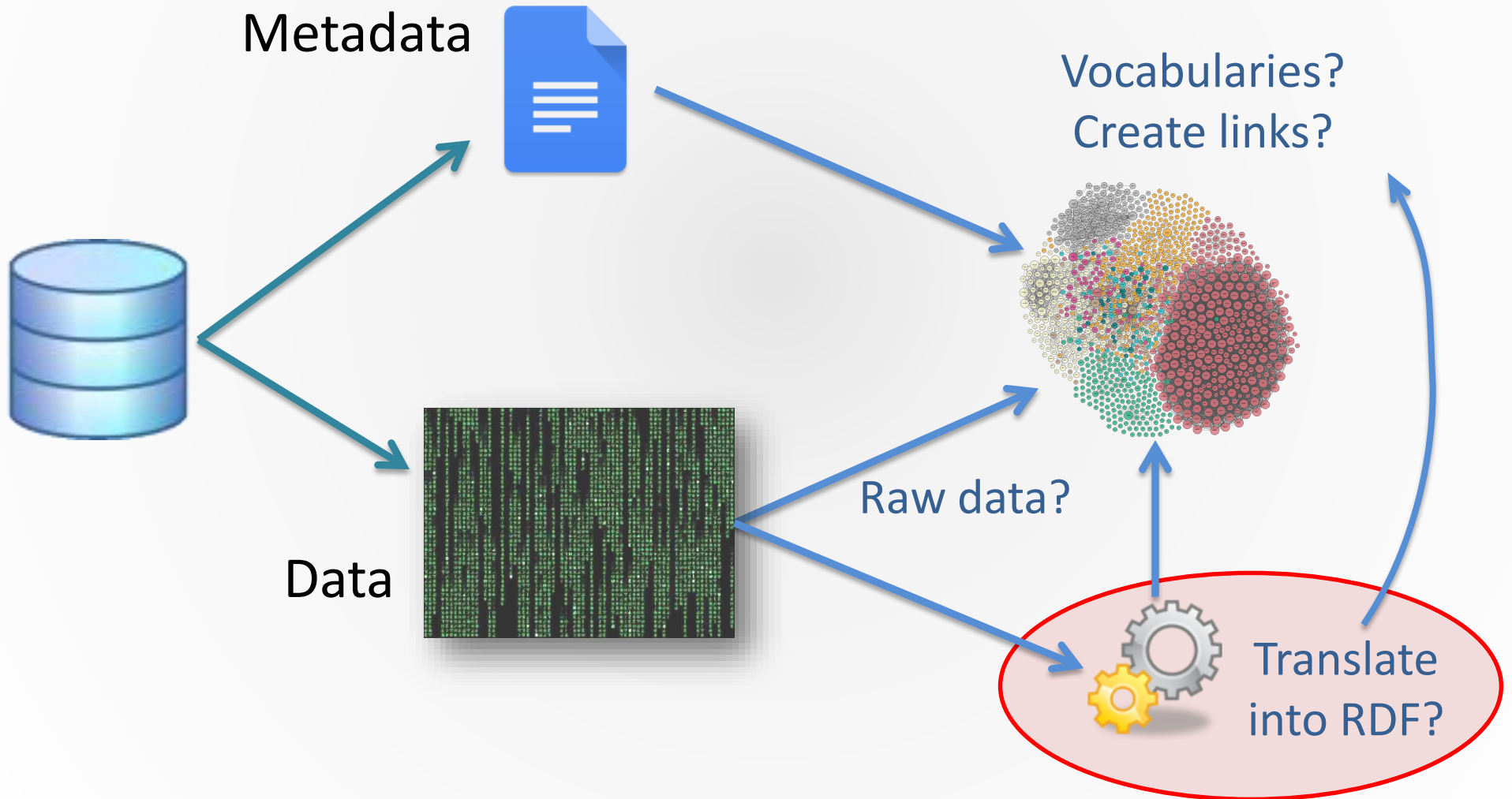
LOD Cloud: 10K datasets, 150B Statements



- ✓ On the Web
- ✓ In RDF
- ✓ Under open licences
- ✓ Interlinked



Publishing legacy data in RDF raises tricky questions



Agenda



Describe the translation of heterogeneous data into RDF

Choose vocabularies to represent RDF data

Access the RDF data produced

The key importance of metadata

Agenda



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Data Sources Have Heterogeneous Data Models

Documents



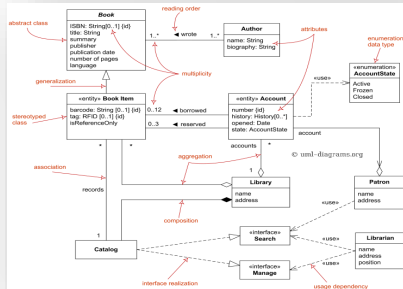
Relational DB

ID	NAME	

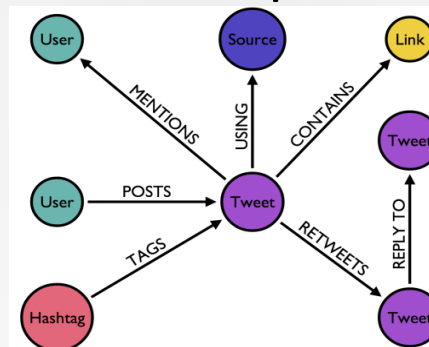
Native XML DBs

```
<Books>
  <Book ISBN="0553212419">
    <title>Sherlock Holmes: Complete Novels...</title>
    <author>Sir Arthur Conan Doyle</author>
  </Book>
  <Book ISBN="0743273567">
    <title>The Great Gatsby</title>
    <author>F. Scott Fitzgerald</author>
  </Book>
  <Book ISBN="0684826976">
    <title>Undaunted Courage</title>
    <author>Stephen E. Ambrose</author>
  </Book>
  <Book ISBN="0743203178">
    <title>Nothing Like It In the World</title>
    <author>Stephen E. Ambrose</author>
  </Book>
</Books>
```

Object-Oriented



Graph



Agenda



Describe the translation of heterogeneous data into RDF

- HTML data with RDFa

- CSV data

- Relational data

- NoSQL data

Choose vocabularies to represent RDF data

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Describe the translation of heterogeneous data into RDF

HTML data with RDFa

CSV data

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<http://devlog.cnrs.fr/>



```
<body vocab="http://schema.org/">
  <div resource="/jdev2017" typeof="Event">
    <h2 property="title">JDEV 2017</h2>
    <p>Date: <span property="startDate">2017-07-04</span></p>
    ...
    <p>T2 - Ingénierie et web des données.
      <a property="url" href="http://devlog.cnrs.fr/jdev2017/t2">More...</a>
    </p>
  </div>
</body>
```



```
prefix sch: <http://schema.org/>
<http://devlog.cnrs.fr/jdev2017>
  rdf:type sch:Event ;
  sch:title "JDEV 2017";
  sch:startDate "2015-10-20" ;
  sch:url <http://devlog.cnrs.fr/jdev2017/t2> .
```

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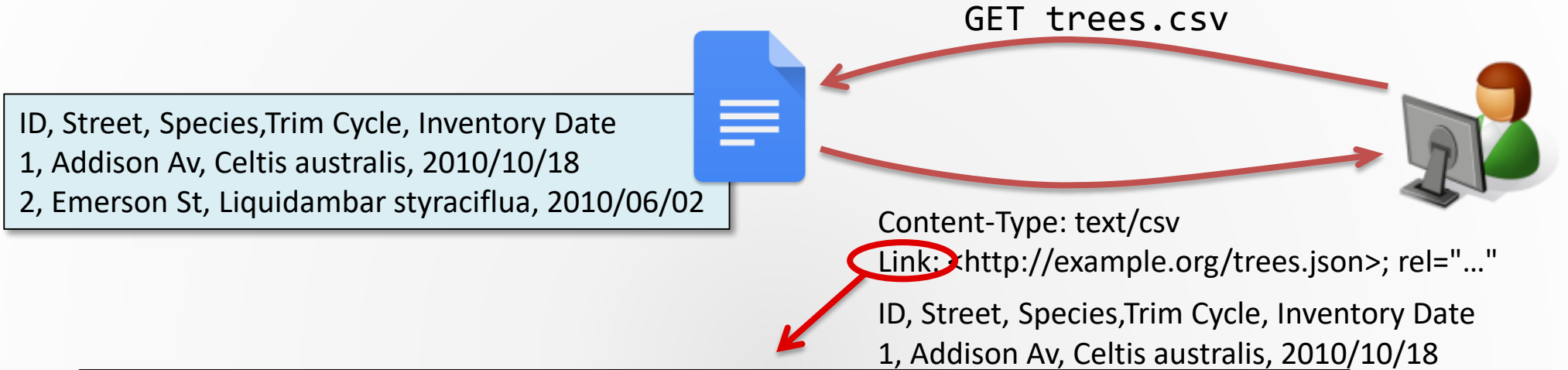
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CSVW: CSV on the Web



<https://www.w3.org/2013/csvw/>



```
{ "@context": ["http://www.w3.org/ns/csvw", {"@language": "en"}],  
  "url": "trees.csv", "dc:title": "Trees",  
  "dc:license": { "@id": "http://.../..cc-by/" },  
  "dc:modified": { "@value": "2010-12-31", "@type": "xsd:date" },  
  "tableSchema": {  
    "columns": [  
      { "name": "ID", "titles": ["ID", "Identifier"], "datatype": "string", "required": true },  
      { "name": "Street", "titles": "On Street", "dc:description": "...", "datatype": "string" }, ...  
    ],  
    "primaryKey": "ID", "aboutUrl": "#id-{ID}" } }
```

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Direct Mapping of a RDB to RDF

Table: PEOPLE		
ID	FNAME	WROTE (<i>FK BOOK/ID</i>)
7	Catherine	22
8	Olivier	22
...

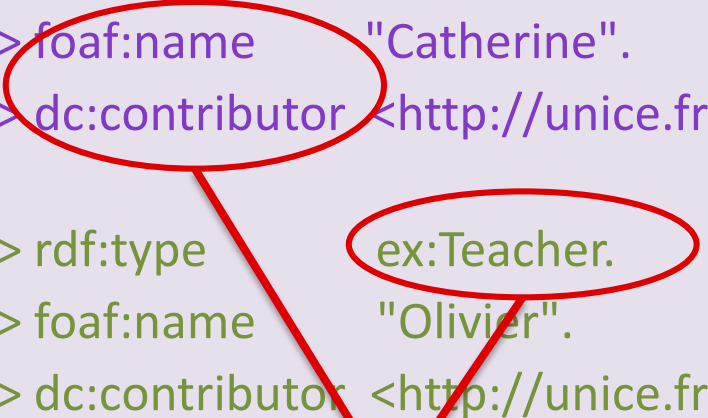
```
<PEOPLE/ID=7> rdf:type          <PEOPLE> .
<PEOPLE/ID=7> <PEOPLE#FNAME> "Catherine" .
<PEOPLE/ID=7> <PEOPLE#WROTE> <BOOK/ID=22> .

<PEOPLE/ID=8> rdf:type          <People> .
<PEOPLE/ID=8> <PEOPLE#FNAME> "Olivier" .
<PEOPLE/ID=8> <PEOPLE#WROTE> <BOOK/ID=22> .
```


Custom Mapping of a RDB to RDF

Table: PEOPLE		
ID	FNAME	WROTE (FK BOOK/ID)
7	Catherine	22
8	Olivier	22
...

```
<http://unice.fr/staff/7> rdf:type          ex:Teacher.  
<http://unice.fr/staff/7> foaf:name      "Catherine".  
<http://unice.fr/staff/7> dc:contributor <http://unice.fr/book/22>.  
  
<http://unice.fr/staff/8> rdf:type          ex:Teacher.  
<http://unice.fr/staff/8> foaf:name      "Olivier".  
<http://unice.fr/staff/8> dc:contributor <http://unice.fr/book/22>.
```



Existing vocabularies

```
<#MapPeople>
  rr:logicalTable [ rr:tableName "PEOPLE" ];
  rr:subjectMap [
    rr:template "http://unice.fr/staff/{ID}";
    rr:class ex:Teacher;
  ];
  rr:predicateObjectMap [
    rr:predicate foaf:name;
    rr:objectMap [ rr:column "FNAME" ];
  ].
```



```
<http://unice.fr/staff/7> rdf:type ex:Teacher.
<http://unice.fr/staff/7> foaf:name "Catherine".
<http://unice.fr/staff/8> rdf:type ex:Teacher.
<http://unice.fr/staff/8> foaf:name "Olivier".
```

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Mapping of a NoSQL DBs to RDF with xR2RML

```
{ "id": 106,  
  "firstname": "John",  
  "emails": [ "john@foo.com", "john@example.org" ]  
}
```



```
<#MapMbox> xR2RML  
xrr:logicalSource [ xrr:query "db.people.find({'emails':{$ne: null}})" ];  
rr:subjectMap [ rr:template "http://example.org/member/{$.id}" ];  
rr:predicateObjectMap [  
  rr:predicate foaf:mbox;  
  rr:objectMap [ xrr:reference "$.emails.*"; rr:termType rr:Literal ]  
].
```

```
<http://example.org/member/106> foaf:mbox "john@foo.com".  
<http://example.org/member/106> foaf:mbox "john@example.org".
```

Many methods for many types of data sources

HTML

RDFa, Microformats

XML

AstroGrid-D, SPARQL2XQuery, XSPARQL

CSV/TSV/Spreadsheets

XLWrap, Linked CSV, CSVW, RML

JSON

TARQL, JSON-LD, RML

Relational Databases

D2RQ, R₂O, Ultrawrap, Triplify, SM
R2RML: Morph-RDB, ontop, Virtuoso

NoSQL

xR2RML (MongoDB), ontop (MongoDB),
[Mugnier et al, 2016]

Multiple formats

RML, TARQL, Apache Any23, DataLift,
SPARQL-Generate

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Direct mapping: create my own vocabulary

Can be derived from an existing schema

May seem easier: “*I do whatever I want*”

But no added semantics, need to link my vocabulary with other ones

Custom Mapping: reuse existing vocabularies

Large variety of existing vocabularies

But may be difficult to find the appropriate one

Partial coverage of the domain

Granularity: too high (cumbersome), too low (useless)

Different points of view

Frequently, a mixed approach is used

Agenda



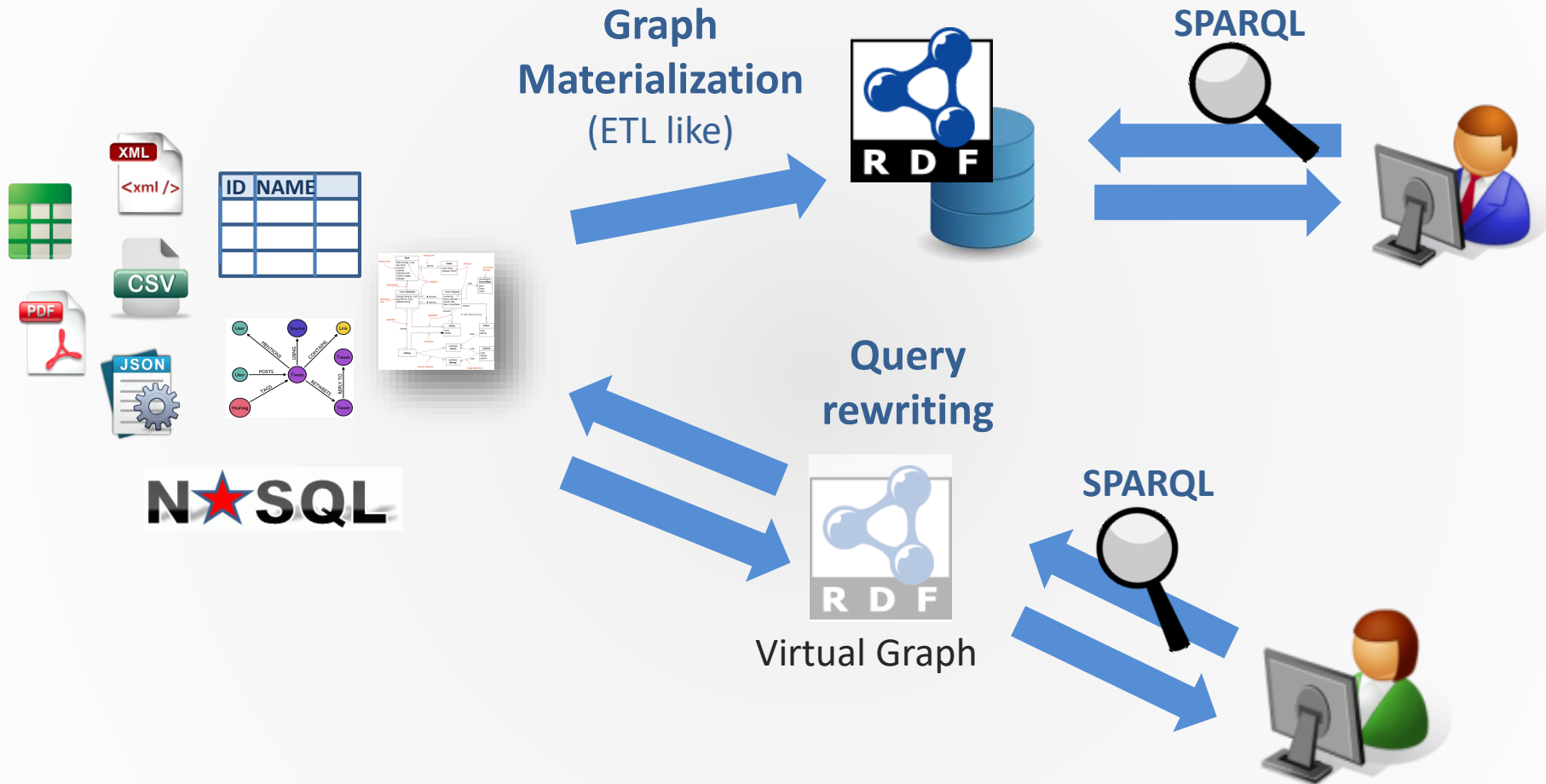
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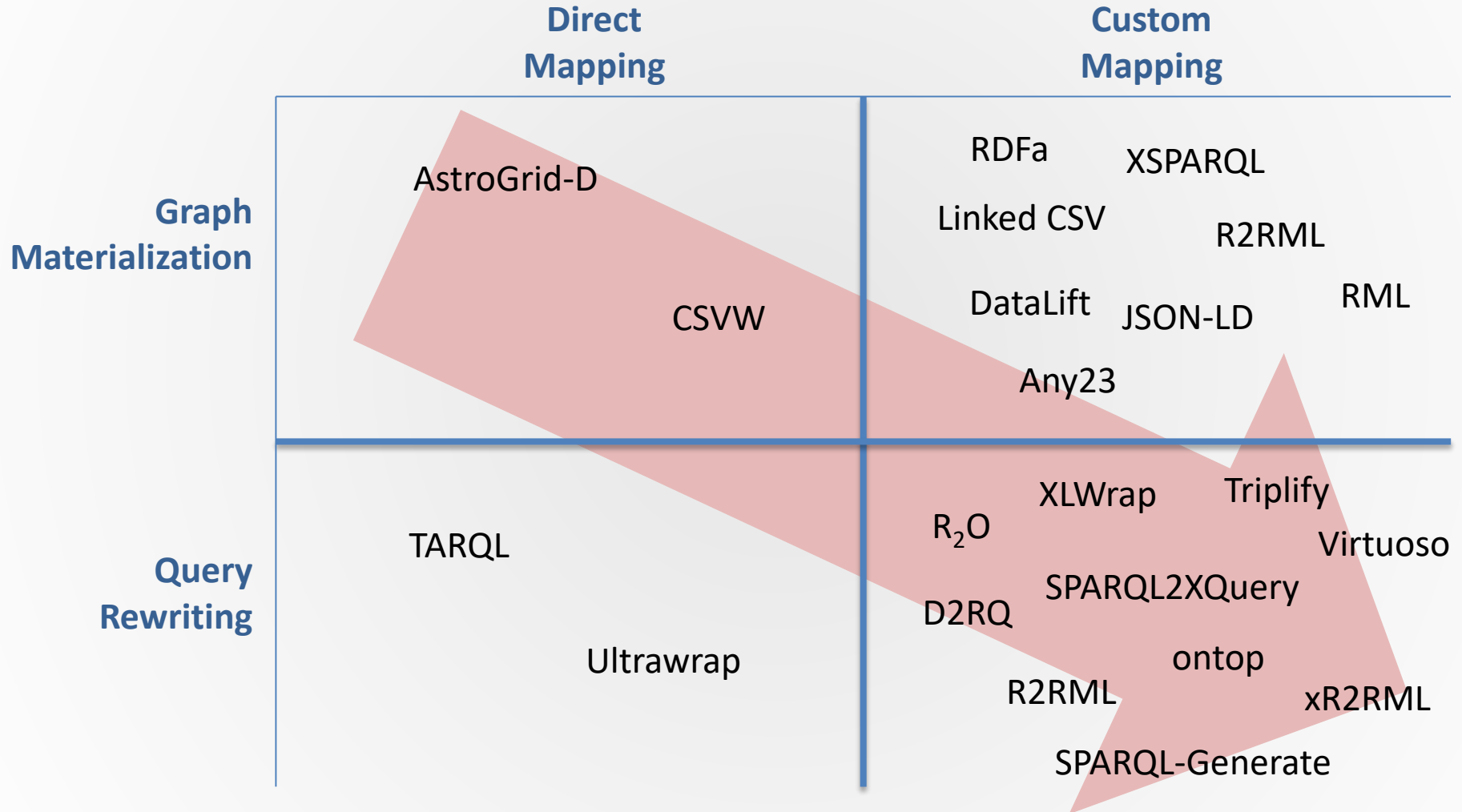
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Two approaches to translate existing data sources in RDF



A large variety of approaches



Agenda



Describe the translation of heterogeneous data into RDF

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Making datasets **discoverable** and **reusable**

requires


high-quality, comprehensive metadata

 Recherche

Thématiques



CONTRIBUEZ !

 / Jeux de données 1 à 20 sur 27346

Trier par



Population

Ce jeu de données permet d'accéder aux résultats des recensements de la population, à des séries chronologiques de la Banque de Données Macro-économiques de l'Insee sur le thème de la population et à d'autres données...

 01/1901 à 07/2015  Mensuelle  France  Commune française  23  32



Indicateur Avancé Sanitaire IAS® - SYNDROME GRIPPAL

L'objectif de l'Indicateur Avancé Sanitaire (IAS®) "Syndrome Grippal" est de contribuer à la surveillance des syndromes grippaux en France en apportant des informations complémentaires à celles du réseau Sentinelles

Metadata are the key to enable dataset reuse

Context	Identification, authors, dates, license, version, reference articles
Access	Format, structure, location (dwld), query method
Meaning	What do the data represent? What concepts, entities, semantics?
Interpretation	Units (cm or inches, left/right)...
Provenance	Acquired with which equipment, parameters, protocols? Derived from which dataset? With which processing? Dataset-level or entity-level provenance
Statistics	Number of triples per property of class, links to other datasets...
...	

Several works normalize metadata descriptions and how to use metadata

- CSVW: CSV on the Web
- DCAT: Data Catalog Vocabulary
DCAT extensions, application profiles
W3C Dataset Exchange Working Group
- VoID: Vocabulary of Interlinked Datasets
- HCLS: Health Care & Life Sciences Dataset Profile
- ...



Thank
you!