Semantic Web Technologies

Semantic Web Vocabularies and Applications

Jos de Bruijn
debruijn@inf.unibz.it

KRDB Research Group
Free University of Bolzano, Italy

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Outline

RDF Vocabularies

- Use existing vocabularies whenever possible!
- Dublin Core: document metadata
- vCard: business cards
- RSS: news feeds
- FOAF: social links between people

Dublin Core

- The Dublin Core Metadata Set
  - standard vocabulary for describing resources
  - originates from library domain
  - RDF syntax
  - keywords
    - title
    - description
    - author
    - creator
    - format
    - date
    - type
    - relation
    - ...

Dublin Core Example

view-source: - Source of: http://www.w3.org/Overview-about.rdf

File Edit View Help

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:dc = "http://purl.org/dc/elements/1.1/">
   <rdf:Description rdf:about="http://www.w3.org/">
      <dc:subject>World Wide Web Consortium, W3C, World Wide Web, Web,
        WWW, Consortium, computer, access, accessibility, semantic,
        worldwide, W3, HTML, XML, standard, language, technology, link,
        CSS, RDF, XSL, Berners-Lee, Berners, Lee, style sheet, cascading,
        schema, XHTML, mobile, SVG, PNG, PICS, DOM, SMIL, MathML, markup,
        Amaya, Jigsaw, free, open source, software</dc:subject>
      <dc:description>The World Wide Web Consortium (W3C) is about 400
        organizations leading the World Wide Web to its full potential.
        Founded by Tim Berners-Lee, the Web's inventor. The W3C Web site
        hosts specifications, guidelines, software and tools. Public
        participation is welcome. W3C supports universal access, the
        Semantic Web, trust, interoperability, evolvability,
        decentralization, and cooler multimedia.</dc:description>
      <dc:date>2003-03-13</dc:date>
      <dc:format>text/html</dc:format>
      <dc:language>en-US</dc:language>
      <dc:creator>W3C Communications Team</dc:creator>
      <dc:publisher>W3C - World Wide Web Consortium -
         http://www.w3.org/</dc:publisher>
      <dc:rights rdf:resource="http://www.w3.org/Consortium/Legal/copyright-documents"/>
      <rdfs:seeAlso rdf:resource="http://www.w3.org/2000/08/w3c-synd/home.rss"/>
   </rdf:Description>
</rdf:RDF>
```

RSS

- RDF Site Summary
- Basic RSS:
  - channel
  - title
  - link
  - description
  - items
    - title
    - link
    - description
    - ...

RSS (Cont'd)

- RSS 1.0 is RDF-based
  - Module mechanism for extension; a number of modules is standardized (e.g. Dublin Core)
  - Allows integration with other RDF-based vocabularies
  - Allows structured content
  - Allows reuse of RDF vocabulary
- RSS 2.0 is XML-based
  - Extension via namespaces
  - Limited reuse of vocabulary
  - More convenient to write

RSS Example

view-source: - Source of: http://www.w3.org/2000/0

File Edit View Help

```
<?xml version="1.0" encoding="us-ascii"?><?xml-stylesheet href="http://www
<rdf:RDF xmlns="http://purl.org/rss/1.0/"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xmlns:dc="http://purl.org/dc/elements/1.1/"
         xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:h="http://www.w3.org/1999/xhtml"
         xmlns:hr="http://www.w3.org/2000/08/w3c-synd/#">
   <channel rdf:about="http://www.w3.org/2000/08/w3c-synd/home.rss">
      <title>World Wide Web Consortium</title>
      <description>Leading the Web to Its Full Potential...</description>
      <link>http://www.w3.org/</link>
      <dc:date>2006-05-29</dc:date>
      <items>
         <rdf:Seq>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item94"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item93"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item92"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item87"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item89"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item91"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item90"/>
            <rdf:li rdf:resource="http://www.w3.org/News/2006#item85"/>
         </rdf:Seq>
      </items>
```

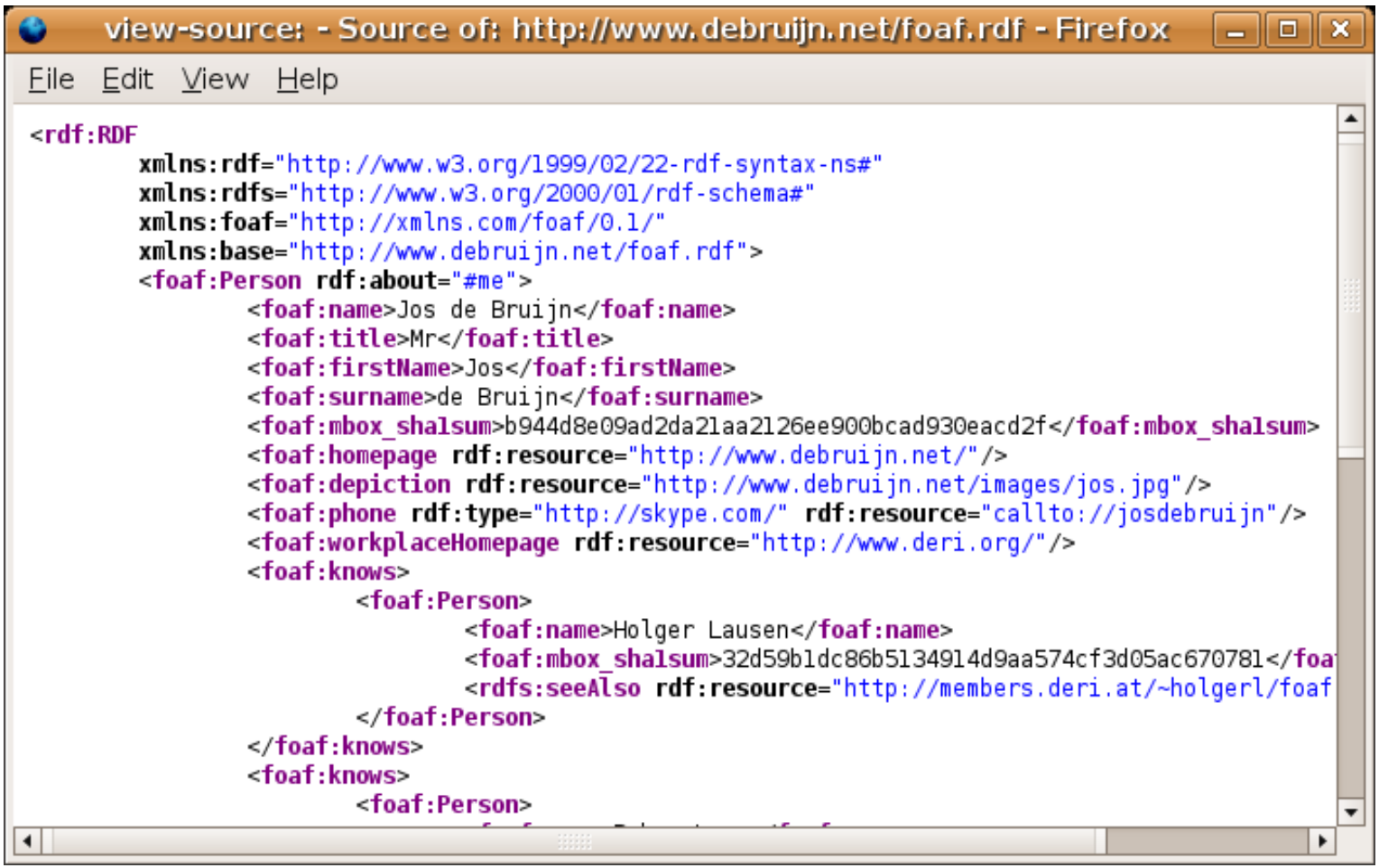
Modules in RSS

- Dublin core
- Syndication
- Content
- `http://web.resource.org/rss/1.0/modules/`

FoaF

- FoaF: Friend of a Friend
- Establishing social links between people using RDF
- Person
  - name
  - surname
  - firstName
  - homepage
  - **mbox**
  - **knows**
  - ...

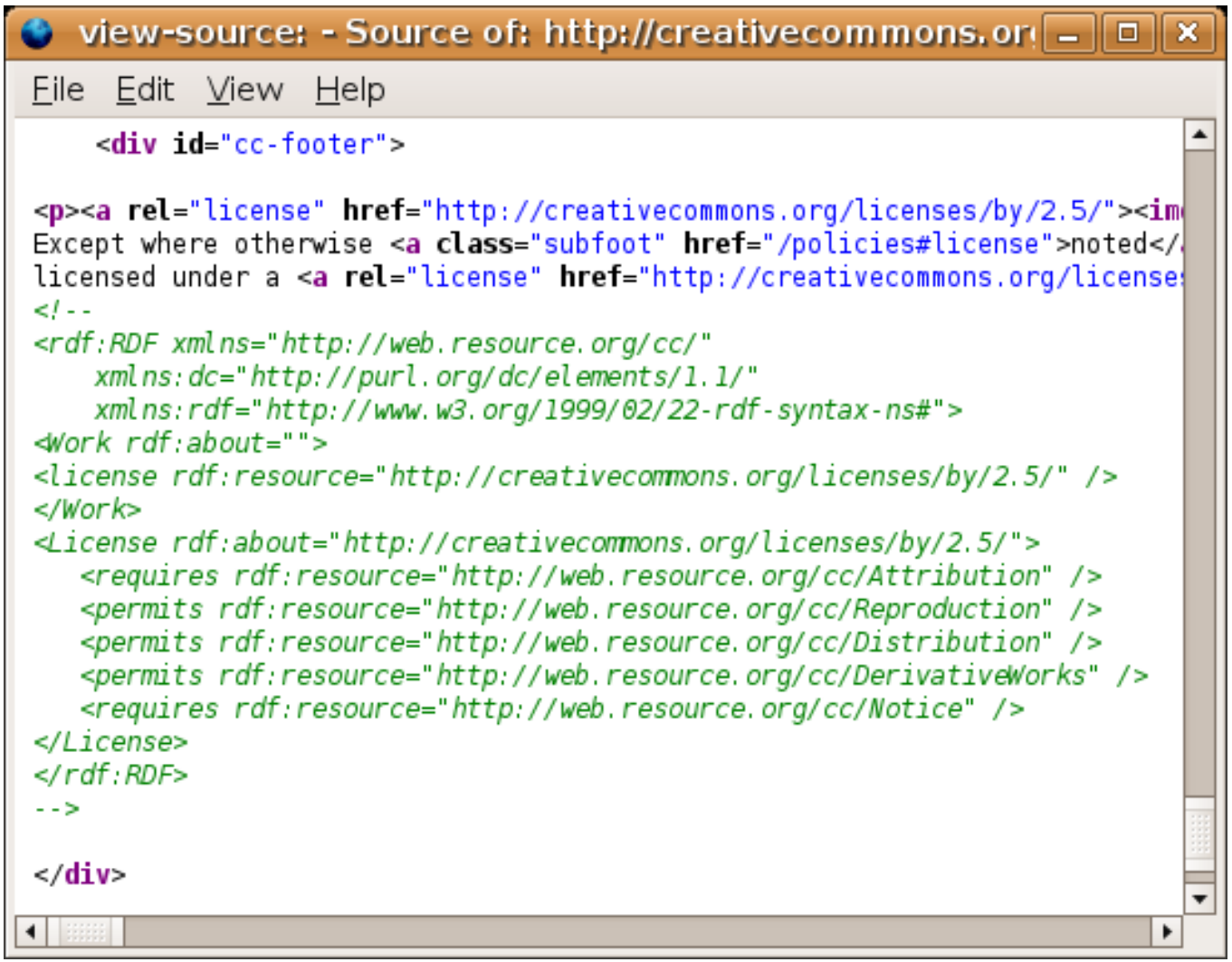
FoaF Example



Ways of Annotating Web Pages

- Including RDF as Comments
  - Hard to using existing XML tools
  - Easy for user (in case of small annotations)
  - **A comment is a comment**
- Extending XHTML to include RDF
  - Simply embed RDF in XHTML
  - Two approaches:
    1. Invalidate XHTML
    2. Use extended DTD
  - Embedding is non-standard
- Using <link> tag to connect to external RDF file
  - Need to maintain additional file

Including RDF as Comments



Extending XHTML to include RDF (I)

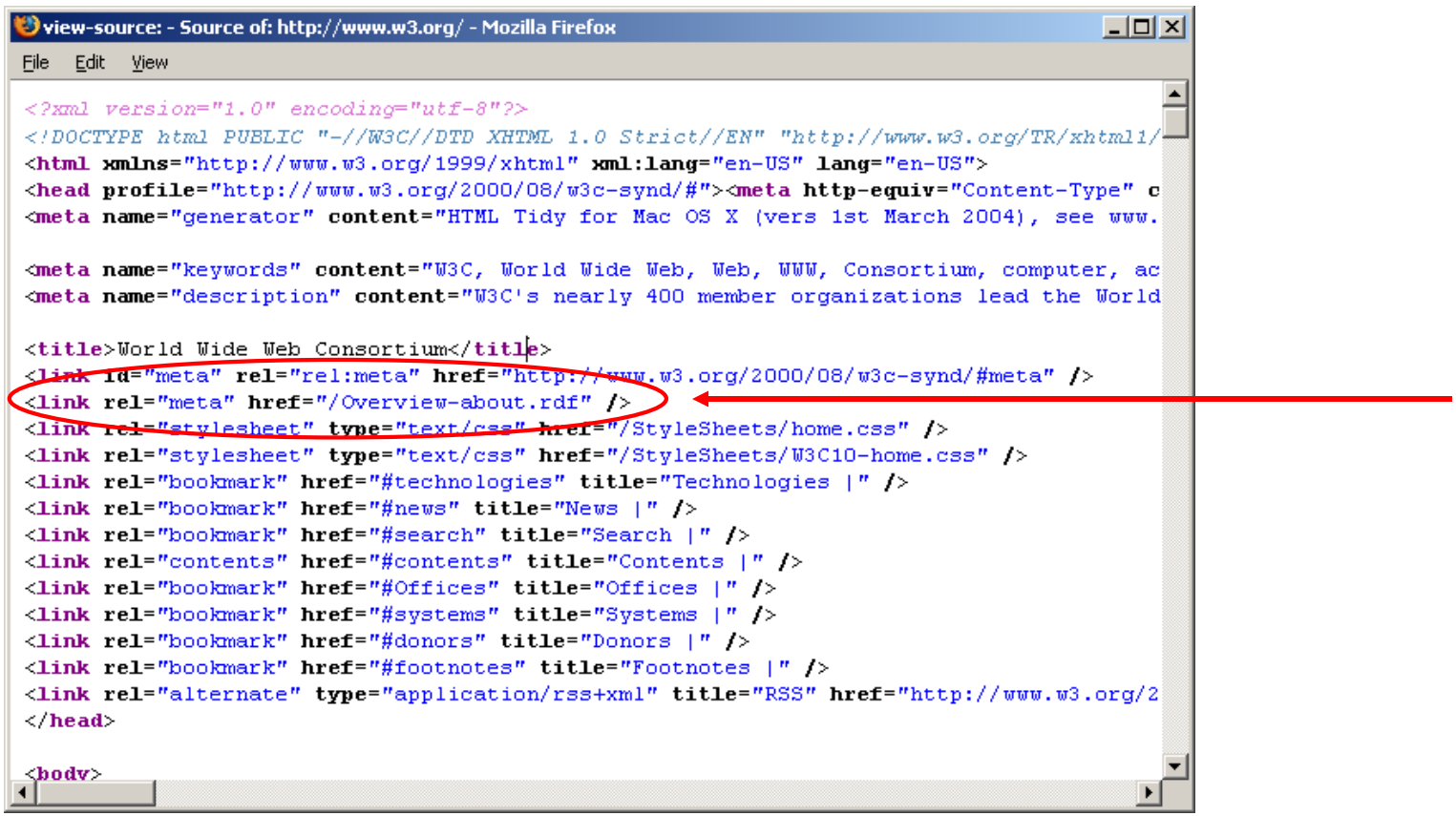
```
<head>
<title>Some Page</title>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:dc="http://purl.org/dc/elements/1.1/">
<rdf:Description rdf:about="http://www.w3.org/"
     dc:title="W3C Homepage"/>
</rdf:RDF>
</head>
```

Extending XHTML to include RDF (II)

```
<!DOCTYPE html SYSTEM "http://infomesh.net/2002/m12n/test/rdf.txt">

<html xmlns="http://www.w3.org/1999/xhtml"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xml:lang="en" >
<head>
<title>Embedded RDF Test</title>
<rdf:RDF>
<rdf:Property rdf:about="http://purl.org/net/swn#homepage">
</rdf:Property>
</rdf:RDF>
</head>
```

Using <link> tag to connect to external RDF file



GRDDL

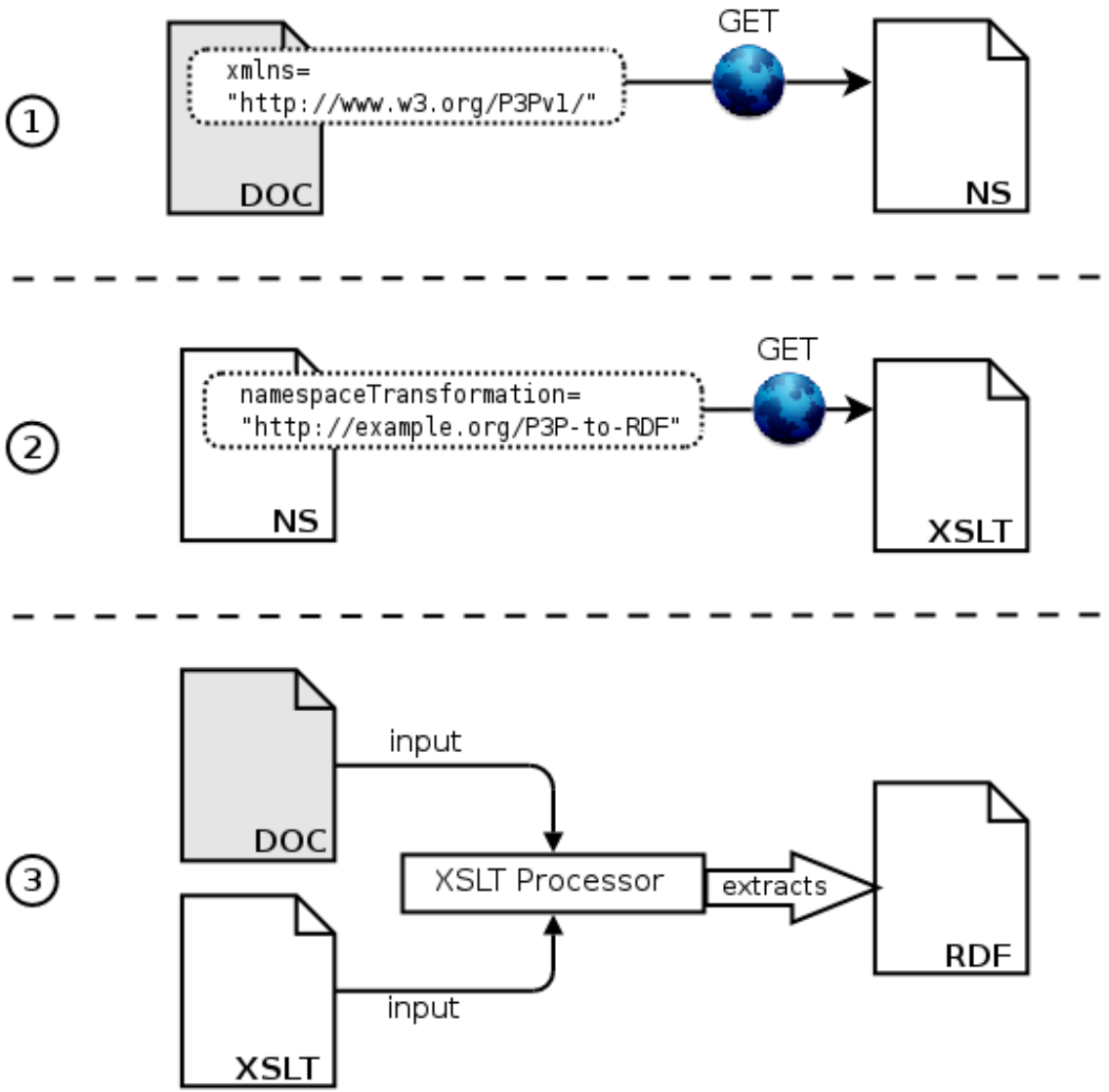
Gleaning Resource Descriptions from Dialects of Languages

- Problem
  - Multitude of data in HTML/XML format
    - e.g. title, metadata in HTML
    - P3P, Atom, etc... in XML
  - Bring this data to "Semantic" world
  - $\Rightarrow$ extract RDF from HTML/XML
    - not natural language extraction
- Solution
  - Use XSLT to transform HTML and XML to RDF/XML
    - XSLT is standard format for translating between XML formats
    - many XSLT processors available
  - Attach XSLT transformation to
    - Types of documents (e.g. HTML, P3P)
    - Individual documents

Transformations for Types and Individual Documents

- Detect type of document
  - Namespace of root element in XML document
    - e.g. `xmlns="http://www.w3.org/P3Pv1/"`
  - Value of `profile` attribute in (X)HTML
    - e.g. `<html profile="http://...">`
  - XSLT associated with type **known** to GRDDL processor
- Specify transformation
  - Attribute of root element of XML document
    - e.g.
      `xmlns:data-view="http://www.w3.org/2003/g/data-view#"`
      `data-view:transformation="http://..."`
  - <link> tag in HTML
    - e.g. `<link rel="transformation" href="http://..."/>`

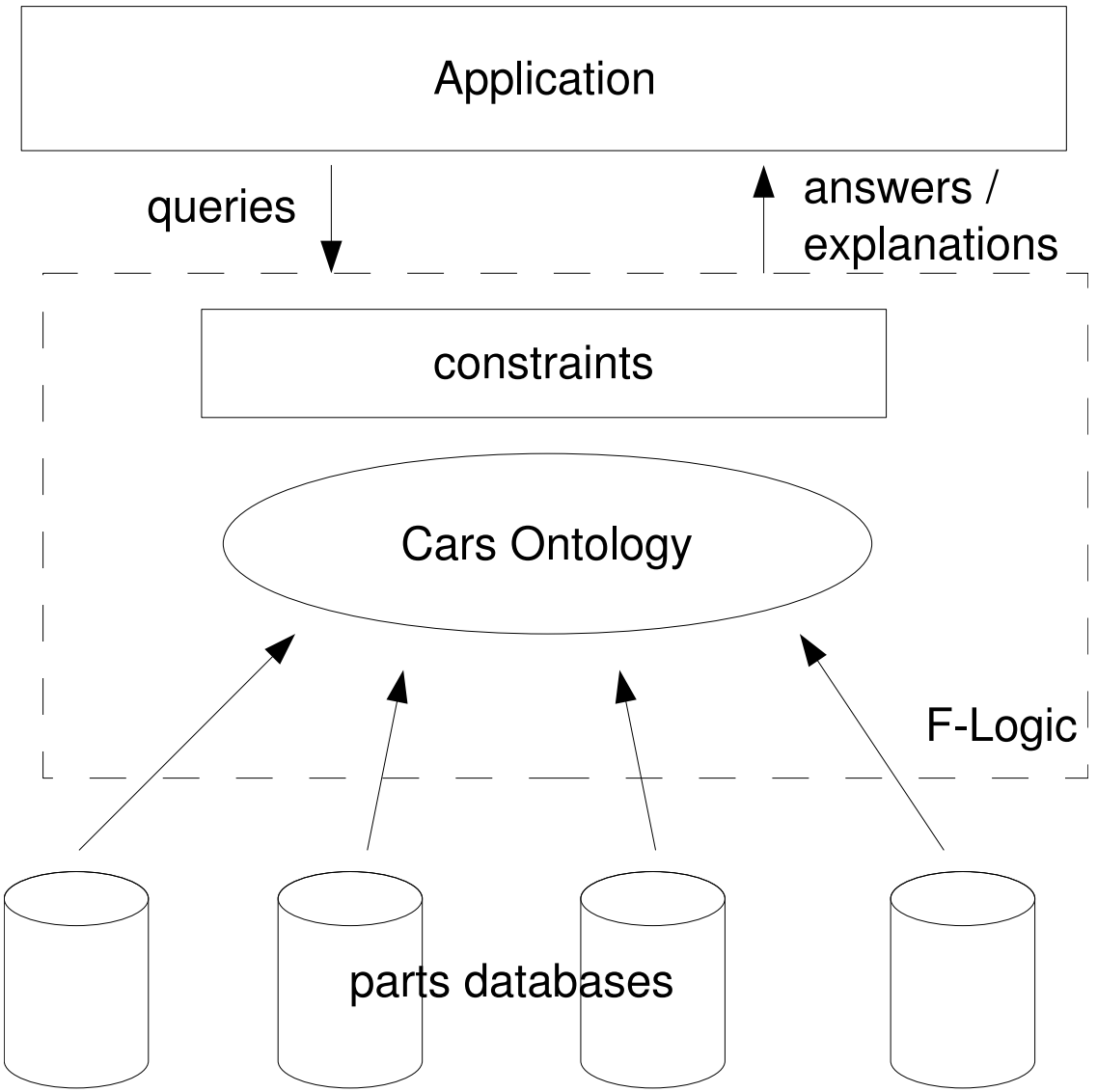
GRDDL Transformation Example



Building Test Cars

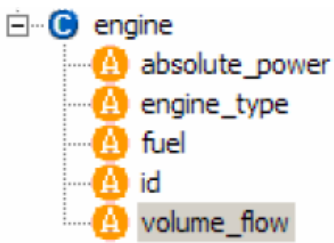
- Test cars test configurations of **parts**
  - e.g. combine gear box of type x with engine of type y and lever of type z
- Often, configurations obviously do not work
  - e.g. lever does not fit in gear box, brakes to weak for engine. etc...
- Misconfiguration very costly
- Solution:
  - Formally model parts
  - Describe dependencies between parts

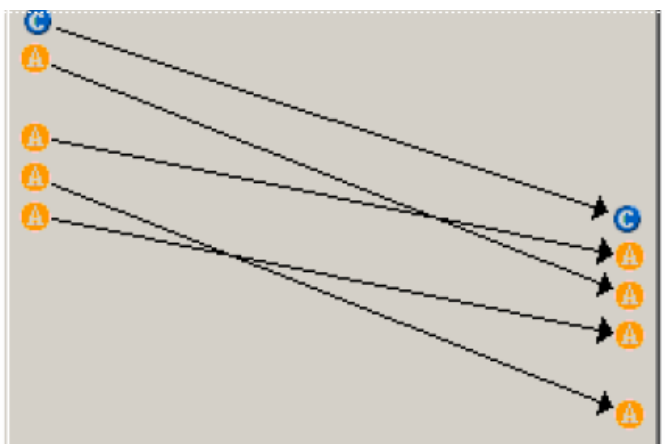
Scenario

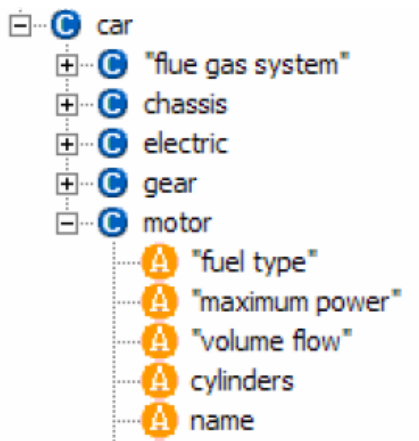

Application
queries
answers /
explanations
constraints
Cars Ontology
F-Logic
parts databases

Database Mapping

- Create "flat" ontology with one-to-one correspondence with DB
  - table↔concept, column↔attribute
- Create mappings between ontologies







Constraints

Rule 1: The maximum power of the motor must not exceed the one of the brakes: Pmotor $<$ |Pbrakes |

```
message("The motor's maximum power exceeds the one of
the brakes.")
!- X:testcar[hasMotor->Y;hasBrake->Z], Y[maximum_power->>Z1],
Z[maximum_power->>Z2], abs(Z1,Z3), lessorequal(Z2,Z3).
```

Rule 2: The filter installed in a catalyst must be able to filter the motor's fuel.

```
message("The installed filter uses another fuel type
than the motor")
!- X:motor[fuel_type->>Z1], Y:filter[fuel_type->>Z2], not equal(Z1,Z2).
```