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RDF & SPARQL

The Semantic Web Stack

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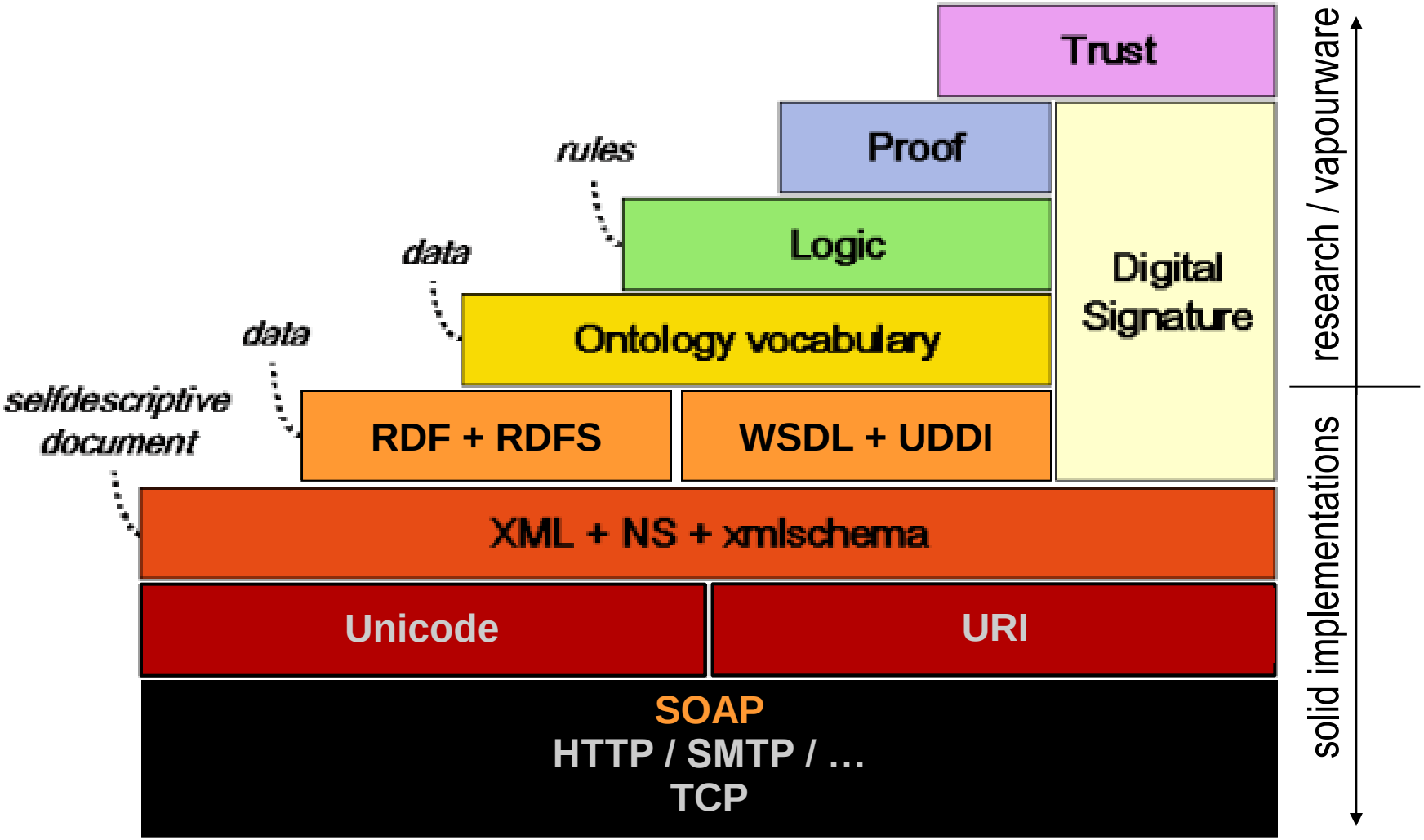

RDF

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- Resource Description Framework (RDF)
  - framework for describing resources on the web, identified by URIs
    = very simple language for making assertions
  - model for data, and a syntax → independent parties can exchange & use it
    - *Query language: SPARQL, see later*
  - designed to be read and understood by computers,
    not designed for being displayed to people
- RDF (conceptual model) is independent from XML (data exchange)
  - XML is a transfer syntax (carrier) for RDF, *not* a component of RDF
  - RDF data might never occur in XML form
- W3C Recommendation, part of W3C's Semantic Web Activity

RDF - Examples of Use

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- Describing properties for shopping items
  - such as price and availability
- Describing time schedules for web events
- Describing information about web pages
  - such as content, author, created and modified date
- Describing content and rating for web pictures
- Describing content for search engines
- Describing electronic libraries

RDF Data Model

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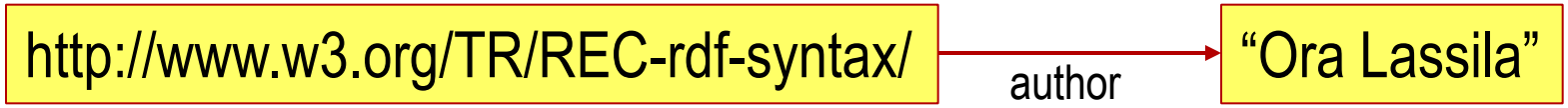
- Conceptual model: directed, labeled graphs
- RDF statements consist of
  - resources (= nodes)
  - which have properties
  - which have values (= nodes, strings)

= subject = object
= predicate = attribute
= object = value

OO Model in Databases?

- Ex: "*http://www.w3.org/TR/REC-rdf-syntax/ has the author Ora Lassila*"



Alternative RDF Representations

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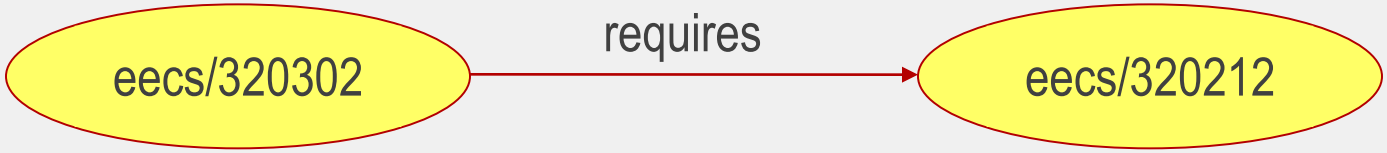
Graphs:



Notation3:

```
@prefix in:http://www.iu-bremen.de/ .
in:eecs/320302 in:requires in:eecs/320212 .
```

compact & readable alternative to RDF's XML syntax

XML:

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:in="http://www.iu-bremen.de/">
    <rdf:description rdf:about="http://www.jacobs-university.de/eecs/320302">
        <in:requires rdf:resource="http://www.jacobs-university.de/eecs/320212"/>
    </rdf:description>
</rdf:RDF>
```

RDF doc root

{ }:

```
{ "http://www. jacobs-university.de/eecs/320302“, requires,
  “http://www. jacobs-university.de/eecs/320212“ }
```

Building Complex Networks

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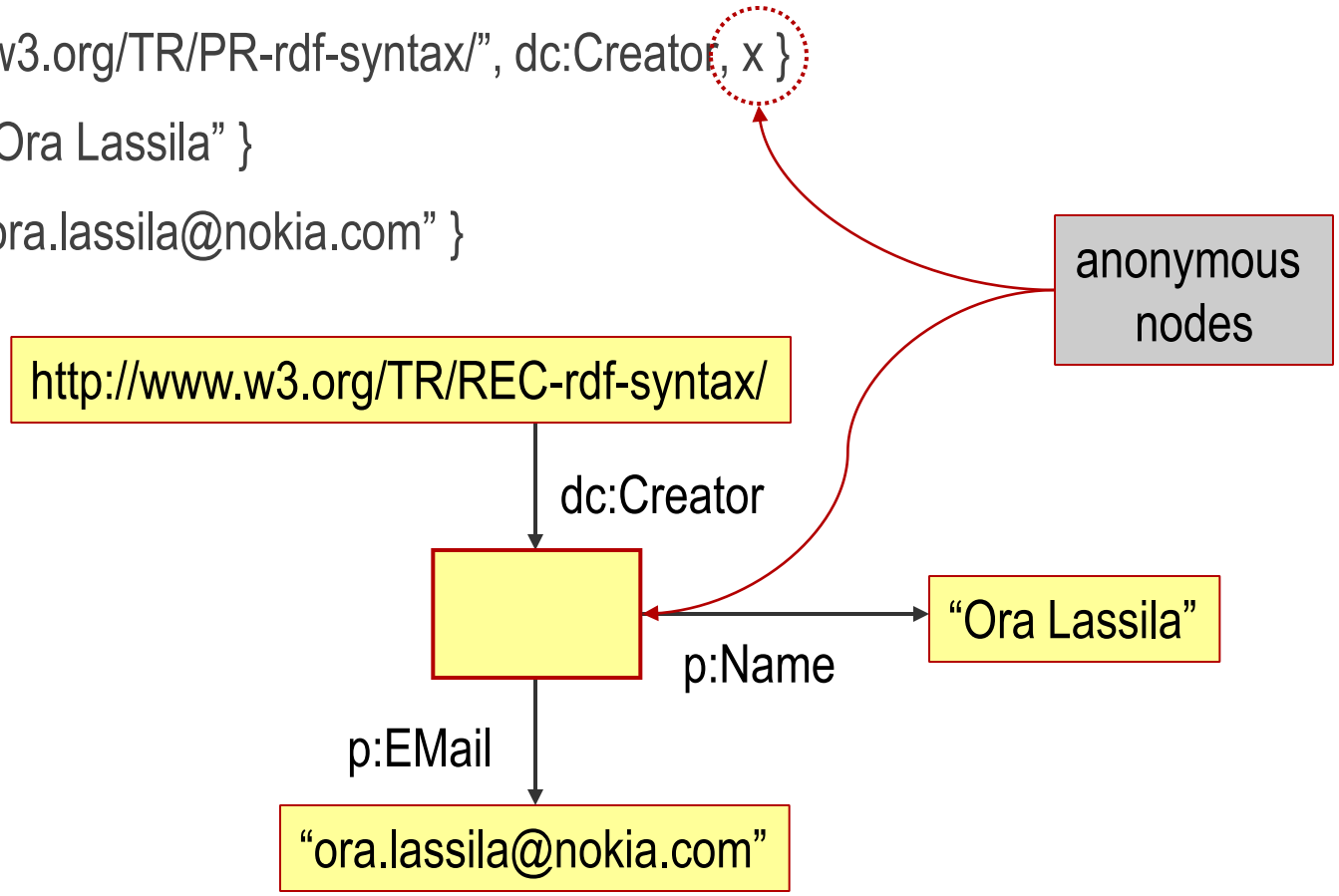
- Corresponding triples:
  - { “http://www.w3.org/TR/PR-rdf-syntax/”, dc:Creator, x }
  - { x, p:Name, “Ora Lassila” }
  - { x, p:EMail, “ora.lassila@nokia.com” }



SPARQL

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- = Simple Protocol and RDF Query Language
  - W3C recommendation
- = QL for RDF
  - extract information in the form of URIs, blank nodes, plain and typed literals
  - extract RDF subgraphs
  - construct new RDF graphs based on information in the queried graphs
- *Let's taste the flavor...*

From SQL To SPARQL

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```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
SELECT ?name ?email
WHERE {
    ?person     rdf:type foaf:Person.
    ?person     foaf:name       ?name.
    ?person     foaf:mbox       ?email.
}
```

FOAF

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- FOAF ("Friend of a friend") = a machine-readable ontology
  - descriptive vocabulary expressed in RDF and OWL
  - Profile = concrete instance of a vocabulary (ie, set of terms)
  - unique identifier (e-mail address, URI, …) for defining relationships → decentralised!
- can describe persons, activities, relations to other people & objects
  - Ex: FOAF profiles to find all people living in Europe,
    list all people both you and a friend of yours know
- FOAF Project defines & extends vocabulary of a FOAF profile
  - started in 2000 by Libby Miller and Dan Brickley
  - first Social Semantic Web application

FOAF: Tech

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- WebID Protocol = decentralized secure authentication protocol utilizing FOAF profile information + SSL
  - usual SSL utilization: require trusted certificate authority
  - Here: does not require dedicated certificate authority to perform user authorization
    → identities can be minted for users easily by authorities
    → FOAF-based web of trust established gradually, without formal key signing parties
  - makes identity more trustworthy + and hard for anyone (even the original issuing authority) to forge
- Related:
  - Description of a Career (DOAC)
  - Description of a Project (DOAP)

RDF Datasets

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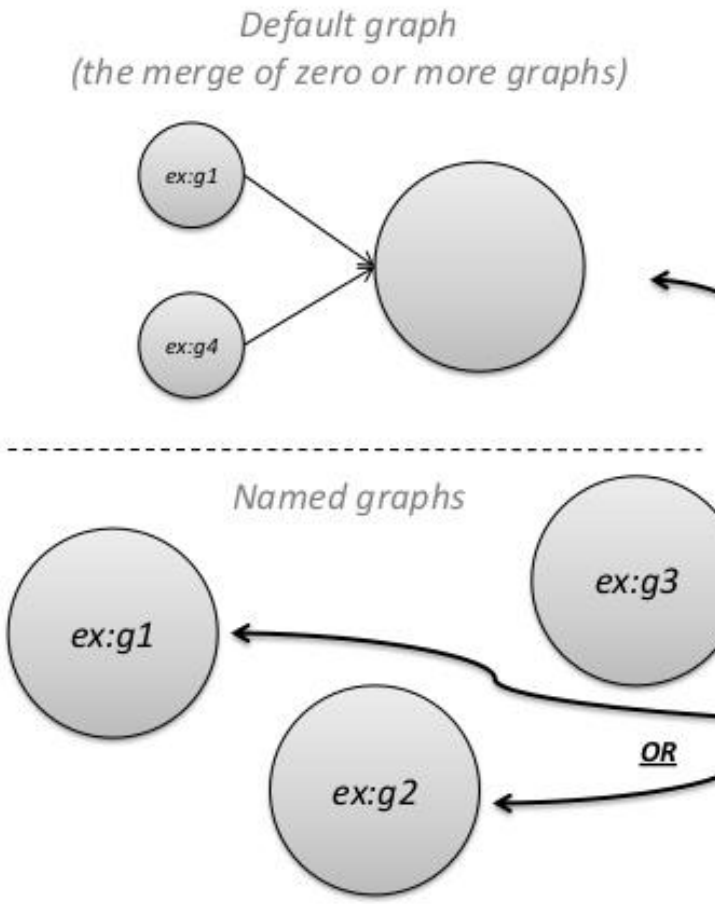
A SPARQL queries a *default graph* (normally) and zero or more *named graphs* (when inside a **GRAPH** clause).




```
PREFIX ex: <…>
SELECT …
FROM ex:g1
FROM ex:g4
FROM NAMED ex:g1
FROM NAMED ex:g2
FROM NAMED ex:g3
WHERE {
   … A …
   GRAPH ex:g3 {
      … B …
   }
   GRAPH ?g {
      … C …
   }
}
```

Summary

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- RDF to model ontologies & graphs
- SPARQL to query RDF
  - Return data items, graphs, Booleans
  - Integrates into SQL
- Implementations:
  - OS: Apache Jena (Java), Sesame (Java), RDF-Query (Perl), Dydra (cloud), ...
  - Commercial: Oracle Semantic Technologies, OpenLink Virtuoso, ...
- See also:
  - Planet RDF, Triplr

Recap:
where do we stand
with Semantic Web Services?

Step 1: What We See

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WWW2002

The eleventh international world wide web conference

Sheraton waikiki hotel, Honolulu, hawaii, USA

7-11 may 2002, 1 location 5 days learn interact

Registered participants coming from

australia, canada, chile denmark, france, germany, ghana, hong kong,, norway, singapore, switzerland, the united kingdom, the united states, vietnam, zaire

Register now

On the 7th May Honolulu will provide the backdrop of the eleventh international world wide web conference. This prestigious event..

Speakers confirmed

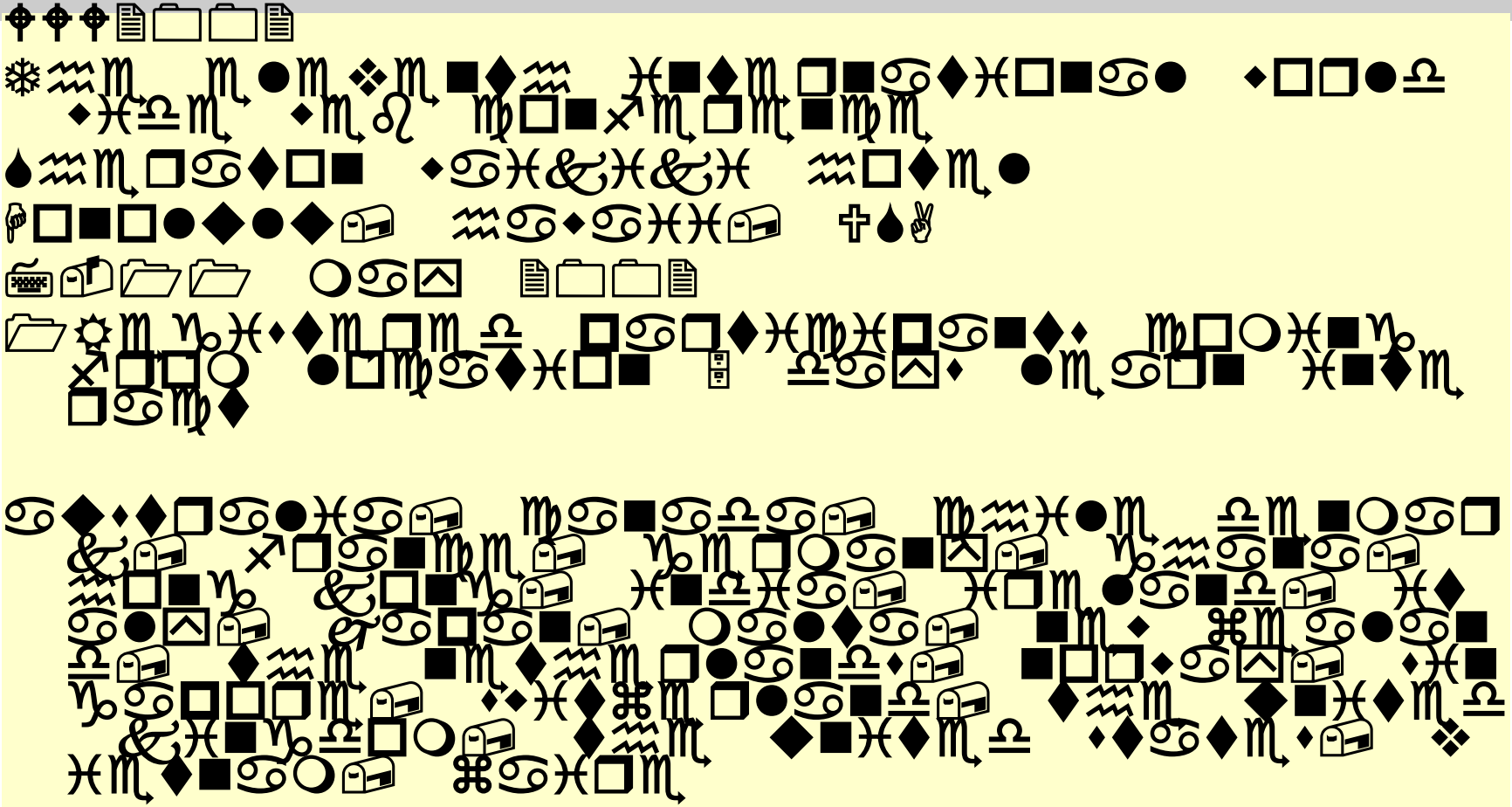
Tim Berners-Lee

Tim is the well known inventor of the Web, …

Ian Foster

Ian is the pioneer of the Grid, the next generation internet …

Step 1: What a Machine Sees



Step 1: What a Machine Sees with XML

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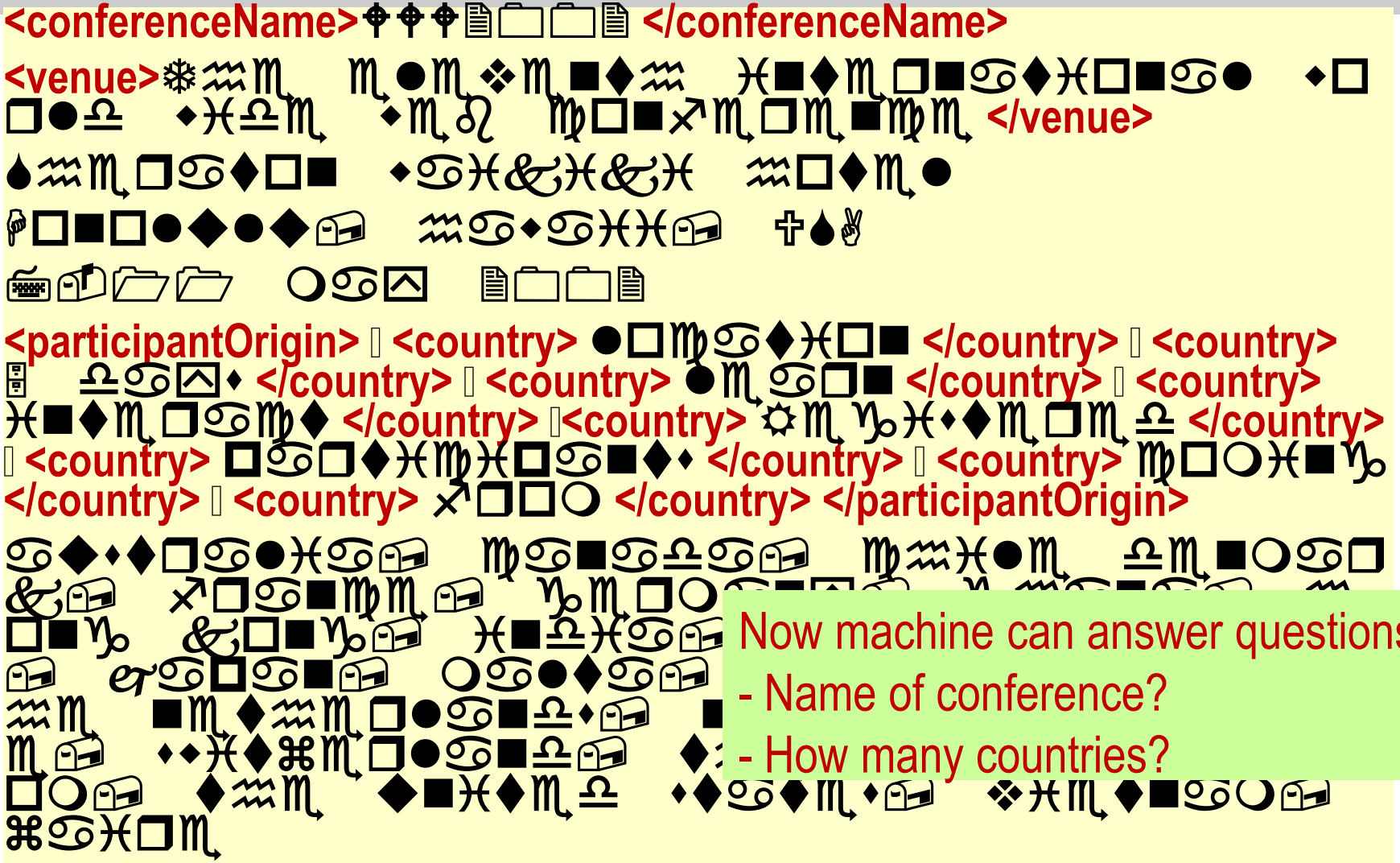

Now machine can answer questions:

- Name of conference?
- How many countries?

Step 2: Understand the Unknown

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"Find Prof. Cook, a professor at U Washington,
earlier a senior lecturer at his alma mater in Australia"

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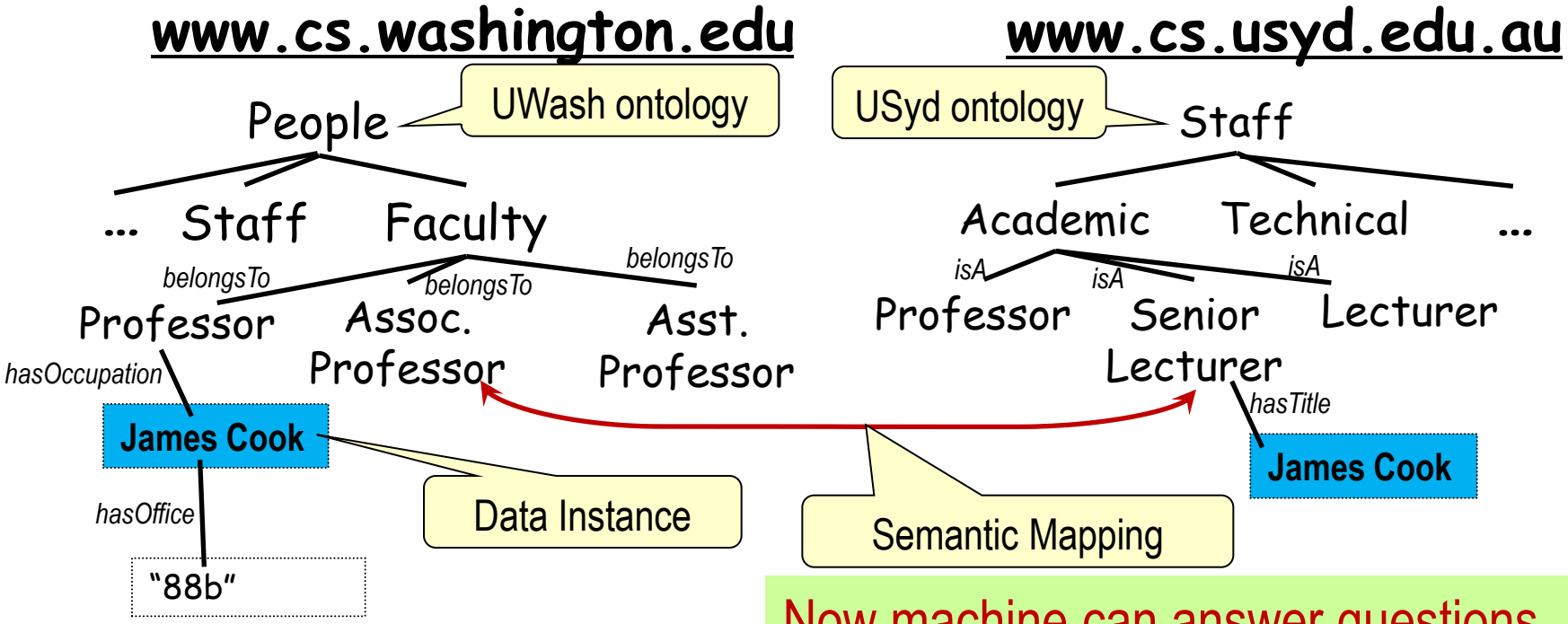

Now machine can answer questions on concept worlds („ontologies")

Resources

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- www.w3.org/RDF/Validator (online RDF validator)
- http://homepages.cwi.nl/~lynda/spool/sw-tue-2003.ppt
- www.ltg.ed.ac.uk/~ht/ora-rdf-dagstuhl.ppt
- www.w3c.org/RDF/Metalog
- Apache Jena™ = Java framework for building Semantic Web applications