Semantic Web Systems

RDF Models

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In the previous lecture

- Metadata: data about data, resource discovery

- Dublin Core: formal metadata scheme

  - Simple DC & Qualified DC

> **Dublin Core**
>
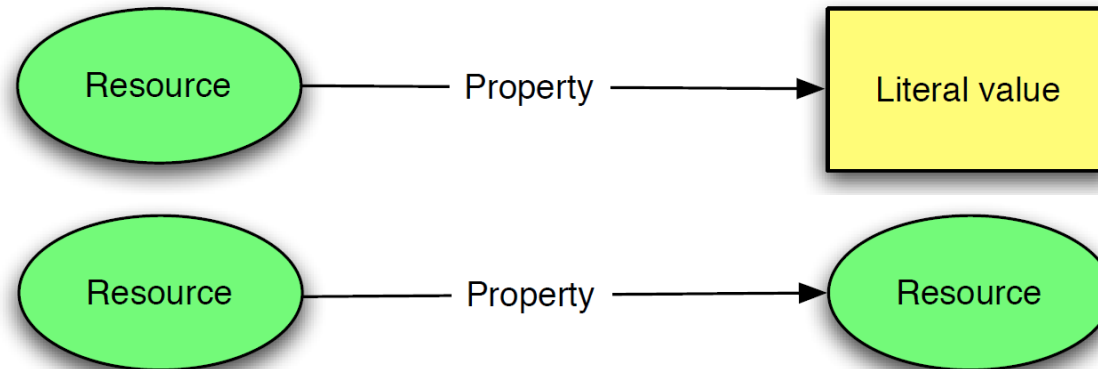> Title = "In the Heart of the Moon"
> Date = "2005"
> Identifier = dbpedia:In_The_Heart_of_the_Moon
> Creator = dbpedia:Ali_Farka_Touré

- Unique Identifiers

  - address ambiguous and synonymous names

  - URIs, e.g. http://dbpedia.org/resource/Johann_Strauss_I

In the previous lecture

- RDF Data Model

Task for today

- Choose 3 things.

- Write down as much metadata about them as you can.

- Consider whether each piece of metadata is functional or not.

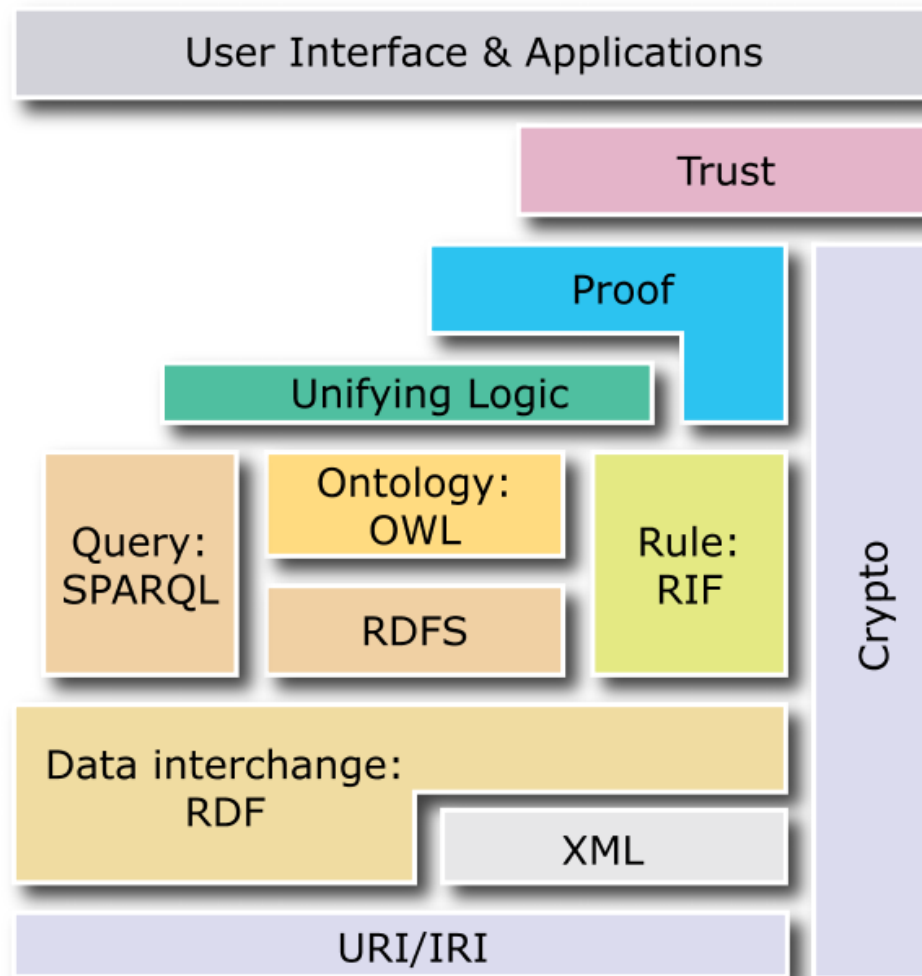- What possible sources of confusion might there be?

In this lecture

- Distributing and merging data on the web

  - Potential approaches

  - AAA: Anyone can say anything about anything

- URIrefs & QNames

- RDF syntax & vocabulary

Semantic Web 'layer cake'

Distributing and merging data on the web

Tabular Data

Name	Location	Stars	LovedBy
Elephant & Bagel	Central	****	Bea, Amy
Artisan Roast	East End	*****	Stuey, Rod
Peter's Yard	Central	****	Amy
Himalaya Art & Craft	Southside	***	Rod
Vittorio	Central	****	Stuey

Relational Data

Cafes

ID	Name	Location	Stars
1	Elephant & Bagel	Central	****
2	Artisan Roast	East End	*****
3	Peter's Yard	Central	****
4	Himalaya Art & Craft	Southside	***
5	Vittoria	Central	****

LovedBy

CafeID	Person
1	Bea
1	Amy
2	Stuey
2	Rod
3	Amy
4	Rod
5	Stuey

Schema Modification

As we add more data, we might want to extend the schema:

Cafes & Restaurants

ID	Name	Cuisine	Location	Stars
1	Elephant & Bagel		Central	****
2	Artisan Roast		East End	*****
3	Peter's Yard		Central	****
4	Himalaya Art & Craft		Southside	***
5	Vittoria	Italian	Central	****
6	Kalpna	Indian	Southside	*****
7	Nile Valley	African	Central	***
8	Olive Branch	Mediterranean	East End	**

Distributed data: simplified relational table

Cafes

ID	Name	Location	Stars
1	Elephant & Bagel	Central	****
2	Artisan Roast	East End	*****
3	Peter's Yard	Central	****
4	Himalaya Art & Craft	Southside	***
5	Vittoria	Central	****

AAA (Tim Berners-Lee)

Anyone can say Anything about Anything

The Web works though anyone being (technically) allowed to say anything about anything.

What the Semantic Web isn't but can represent (1998)

Distributed data: rows

Server1

1	Elephant & Bagel	Central	****
2	Artisan Roast	East End	*****

Server2

3	Peter's Yard	Central	****

Server3

4	Himalaya Art & Craft	Southside	***
5	Vittoria	Central	****

Distributed data: columns

Server1

Name
Elephant & Bagel
Artisan Roast
Peter's Yard
Himalaya Art & Craft
Vittoria

Server2

Location
Central
East End
Central
Southside
Central

Server3

Stars
****
*****
****
***
****

AAA (Tim Berners-Lee)

Anyone can say Anything about Anything

The Web works though anyone being (technically) allowed to say anything about anything.

This means that a relationship between two objects may be stored apart from any other information about the two objects.

What the Semantic Web isn't but can represent (1998)

Distributed data: cells

Server1

	Name
1	Elephant & Bagel

Server2

	Stars
4	***

	Location
3	Central

Server3

	Name
5	Vittoria

Cells as triples
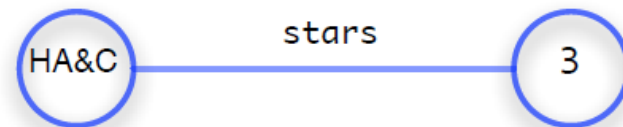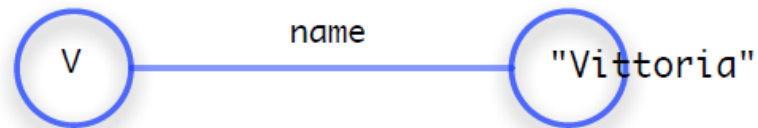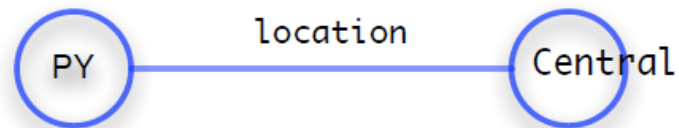
Cafe relation again

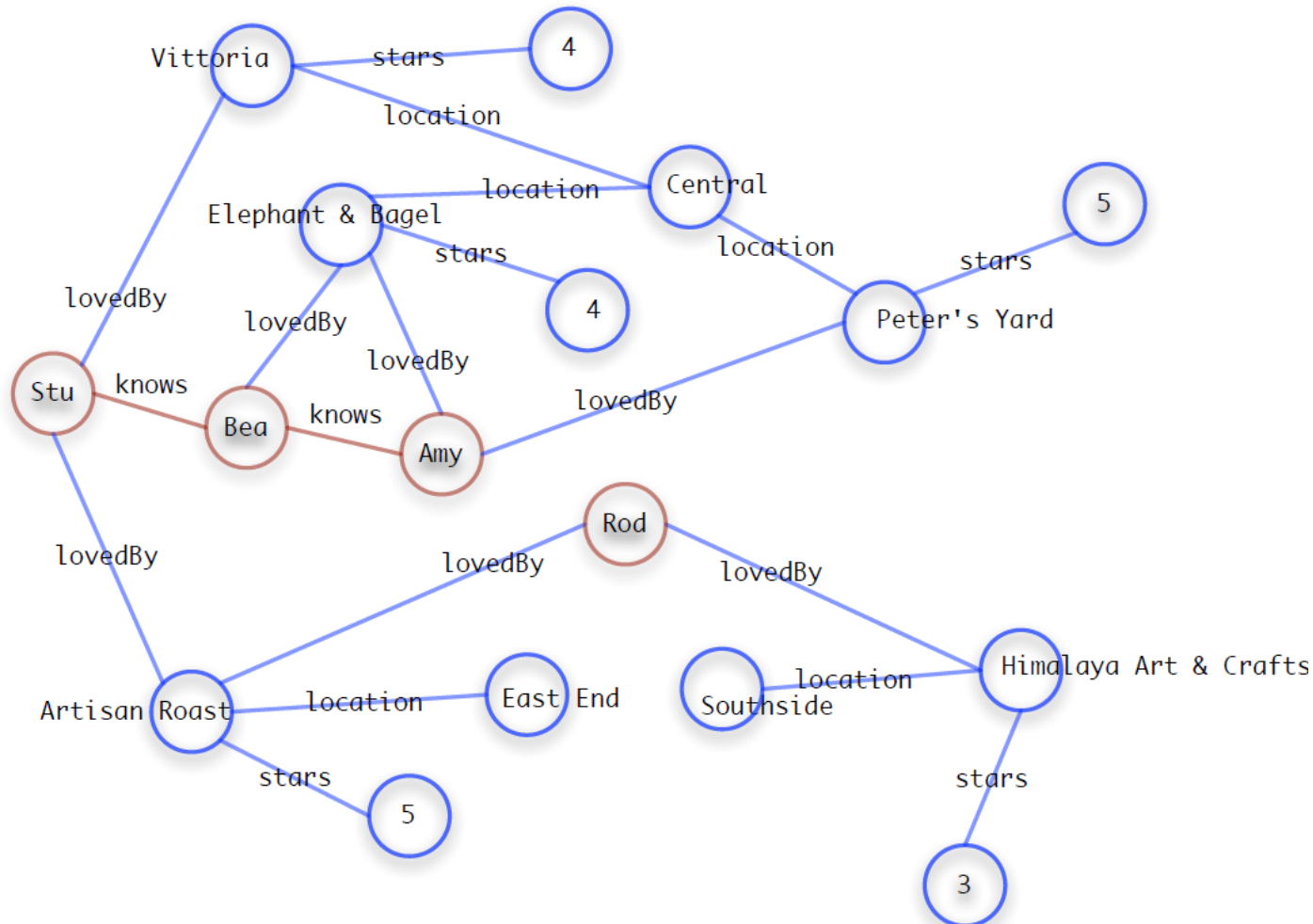| Name	Location	Stars	LovedBy
Elephant & Bagel	Central	****	Bea, Amy
Artisan Roast	East End	*****	Stuey, Rod
Peter's Yard	Central	****	Amy
Himalaya Art & Craft	Southside	***	Rod
Vittorio	Central	****	Stuey

Cafe graph
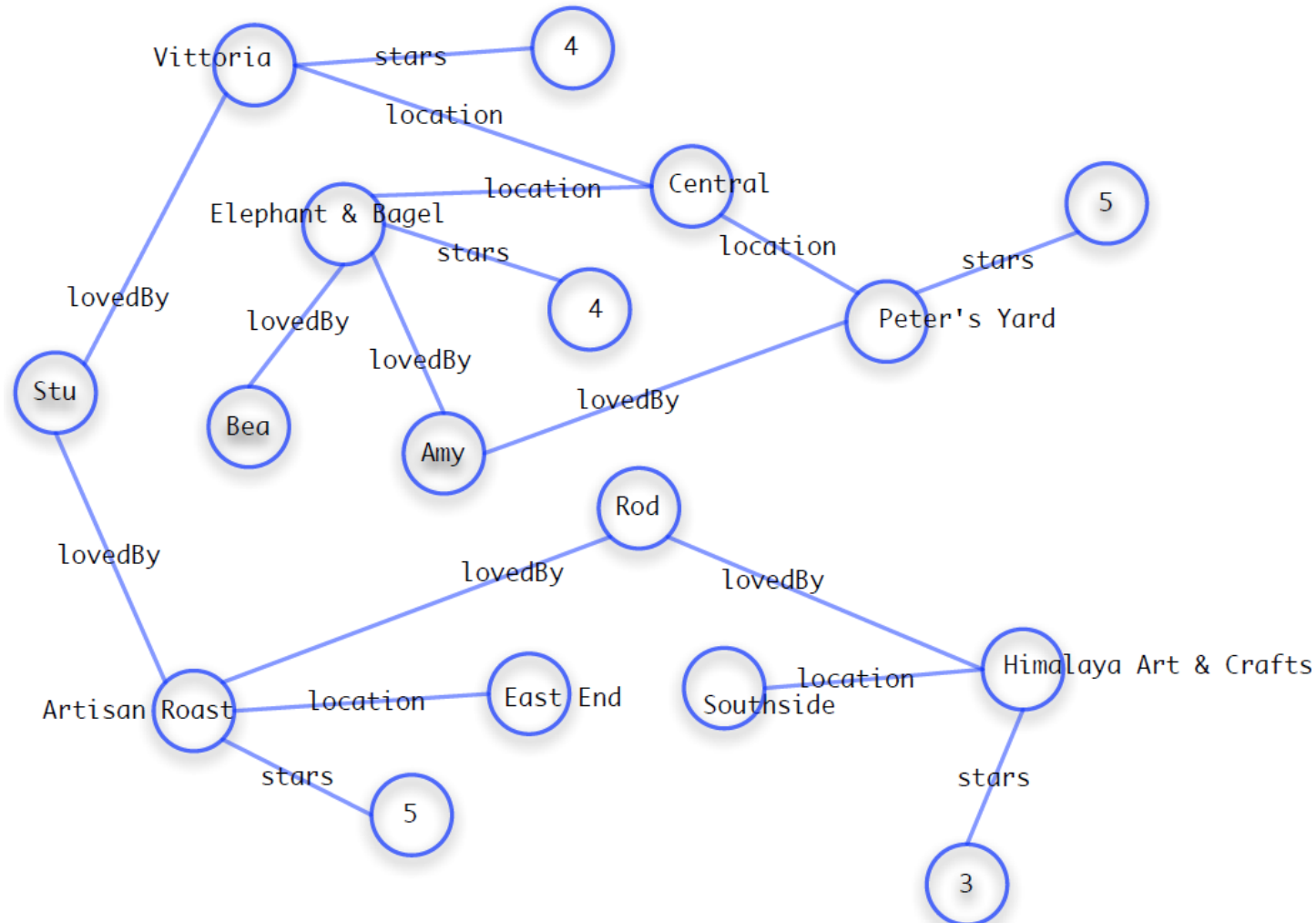
Knows graph

Merging two graphs

URIrefs & QNames

What do HTTP URIs identify?

- In RDF, URIs identify resources, they do **not** retrieve them.

- Not every resource has a digital representation.

- http://homepages.inf.ed.ac.uk/jdf/index.html – does this identify

  - Jacques Fleuriot?

  - a document about Jacques Fleuriot?

- Alternative suggestion:
  http://homepages.inf.ed.ac.uk/jdf/foaf.rdf#jdf

- http://www.inf.ed.ac.uk/ontology#hip-hop will trigger a 404 Not Found response, but it is a valid URI.

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URI references and Fragment Identifiers

A URI Reference (URIref) is a URI with an
optional fragment identifier at the end:

URI with Fragment Identifier
scheme   authority   path   fragment
http ://www.inf.ed.ac.uk /ontology#annotation

URI references and Fragment Identifiers

Fragment identifiers commonly used to identify specific locations in HTML documents:

> **Fragments in HTML pages**
>
> http://www.example.com/index.html
> http://www.example.com/index.html#Section2

In RDF, the two URIs above are independent identifiers.

URIs with fragment identifiers commonly called hash URIs

XML QNames

Tedious to have to write out complete URIs.

Alternative: XML Qualified Names (QNames)

1. Associate a prefix with a URI

2. Follow it with a colon (:) and a local name

Some Prefixes

Prefix	Namespace URI
edstaff	http://www.ed.ac.uk/staffid#
infcourses	http://www.inf.ed.ac.uk/teaching/courses/
dc	http://purl.org/dc/elements/1.1/
dbpedia	http://dbpedia.org/resource/

XML QNames

> **Example of DC statements**
>
> edstaf:9888
>
> infcourses:sws
>
> dc:creator
>
> dbpedia:In_The_Heart_of_the_Moon

- Cf. namespaces in XML

- Qnames are not URIs

- How do we convert QNames back to full URIs?
    - first replace the prefix plus colon by the Namespace URI
    - then append the local name

Using URIs in RDF

- RDF uses URIs for identifying resources.

- Predicate meanings are also resources!

- So URIs also used for identifying the predicates of RDF triples.

- RDF and First Order Logic

  - ex:index.html dc:creator ex:jacques .

  - *triple*(ex:index.html, dc:creator, ex:jacques)

- So subject, predicate and object are all individuals.

- Contrast with frame-based and OO approaches.

RDF syntax & vocabulary

RDF syntax: N3

- Various forms of syntax for expressing RDF

- Although XML is the recommended standard, it is **not** very intuitive.

- N3 (or Notation 3) developed as a simpler human-readable syntax.

  - http://www.w3.org/2000/10/swap/Primer

- I've been implicitly using a N3-style syntax so far.

  - A sequence of three URIs, terminated by a period.
  - Various syntactic abbreviations ...

RDF syntax: Turtle

- N3 has been largely superseded by Turtle (Terse RDF Triple Language), which is a cleaned-up subset of N3:

  - http://www.w3.org/TeamSubmission/turtle

- Originally developed by Dave Beckett, now in the process of becoming a W3C Recommendation.

- Usable within SPARQL RDF queries.

N3/Turtle: RDF Triple with Prefix

```
@prefix  dc:  <http://purl.org/dc/elements/1.1/> .
@prefix  geo:  < http://www.w3.org/2003/01/geo/wgs84_pos#> .
@prefix  :  <http://inf.ed.ac.uk/ont#> .

:E&Bagel   dc:title   "Elephant and Bagel" .
:E&Bagel   geo:location   geo:central .
:E&Bagel   :stars   4 .
```

RDF vocabulary

- An RDF vocabulary is a set of URIs, not words.

- An organization can define its own vocabulary, using its own URI prefix.

- Example: Dublin Core elements (dc:title, dc:creator, dc:date, ...).

- But RDF does **not** analyse URIs and does **not** give special interpretation of common prefix.

- Often a URI will point or redirect to a location where informative content about the resource can be found.

Shared Vocabularies

Using URIs for subjects, predicates and objects in RDF is intended to encourage the development of shared vocabularies on the web.

Example: FOAF vocabulary

- FOAF (Friend of a Friend) Project (http://www.foaf-project.org): defines terms (in RDF) for machine-readable Web homepages for people, groups, companies, etc.

- Initial focus on the description of people, since they link together most other things on the Web:
  - They make documents
  - Attend meetings
  - Are depicted in photos, etc.

- FOAF Vocabulary: http://xmlns.com/foaf/spec

- Early example of linked data

Some FOAF Relations	
foaf:name	foaf:knows
foaf:homepage	foaf:weblog
foaf:mbox	

Summary

- RDF: "Anyone can say Anything about Anything" but only using binary relations.

- RDF only specifies the syntax of subject-predicate-object triples; it doesn't ascribe fixed meaning to any vocabulary (with a small number of exceptions).

- RDF Vocabulary consists of URIs, not ordinary words.

- How do I specify that I'm using 'creator' in the same sense as Dublin Core?

  - I use dc:creator

- How do you know if my myvocab:author is the same as dc:creator?

  - In general, you don't. But there might be a mapping between my vocabulary and Dublin Core.

Review Questions

- Where does RDF allow literal values to occur?

- What is the difference between a URI and a URL?

- What is a fragment identifier?

- What convention is used to abbreviate URIs in informal presentations of RDF?

- What are the main differences between Dublin Core elements and RDF?

- What is an RDF Vocabulary?

- Can a general-purpose RDF processor be expected to know the meaning of dc:creator?

Reading

- SWWO Chapter 3

- Non-compulsory additional reading:
  W3Cs RDF Primer(s)

  - http://www.w3.org/TR/rdf-primer/

  - RDF 1.0 (superseded)

  - RDF 1.1

Practical Task (Optional)

- "Practical" means you can actually create and publish metadata in RDF.

- Task description:

  http://www.inf.ed.ac.uk/teaching/courses/sws/metadata.html

- Why do it?

  - It brings together SWS topics: metadata, URIs, RDF.

  - Practical experience, learning by doing, etc.