Technologies du Web Sémantique

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Introduction to the Semantic Web

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Semantic Web Technologies

Main ideas (2001)

A web

readable/understandable by software agents

- pages on the web would be meaningful to programs

encompassing not just documents but every kind of data one could imagine

- interconnecting data (stored in different servers)

A use case: organizing Mom's therapy

[...]At the doctor's office, Lucy instructed her Semantic Web agent through her handheld Web browser. The agent promptly retrieved the information about Mom's prescribed treatment within a 20-mile radius of her home and with a rating of excellent or very good on trusted rating services. It then began trying to find a match between available appointment times (supplied by the agents of individual providers through their Web sites) and Pete's and Lucy's busy schedules.

Berners-Lee, Tim, James Hendler, and Ora Lassila. "The Semantic Web." Scientific American, May 2001,

Required technologies

knowledge representation

formally represent the information/knowledge content of a web site

data representation

data representation framework for semi-structured data

interconnection

global/shared object identification technique (for cross-server links)

shared 'vocabularies' and concept description

reasoning/computing services

logical inferences; computation (spatial, temporal, ...); decision making; ...

decentralized web services

Knowledge representation

a typical web page

Human understanding

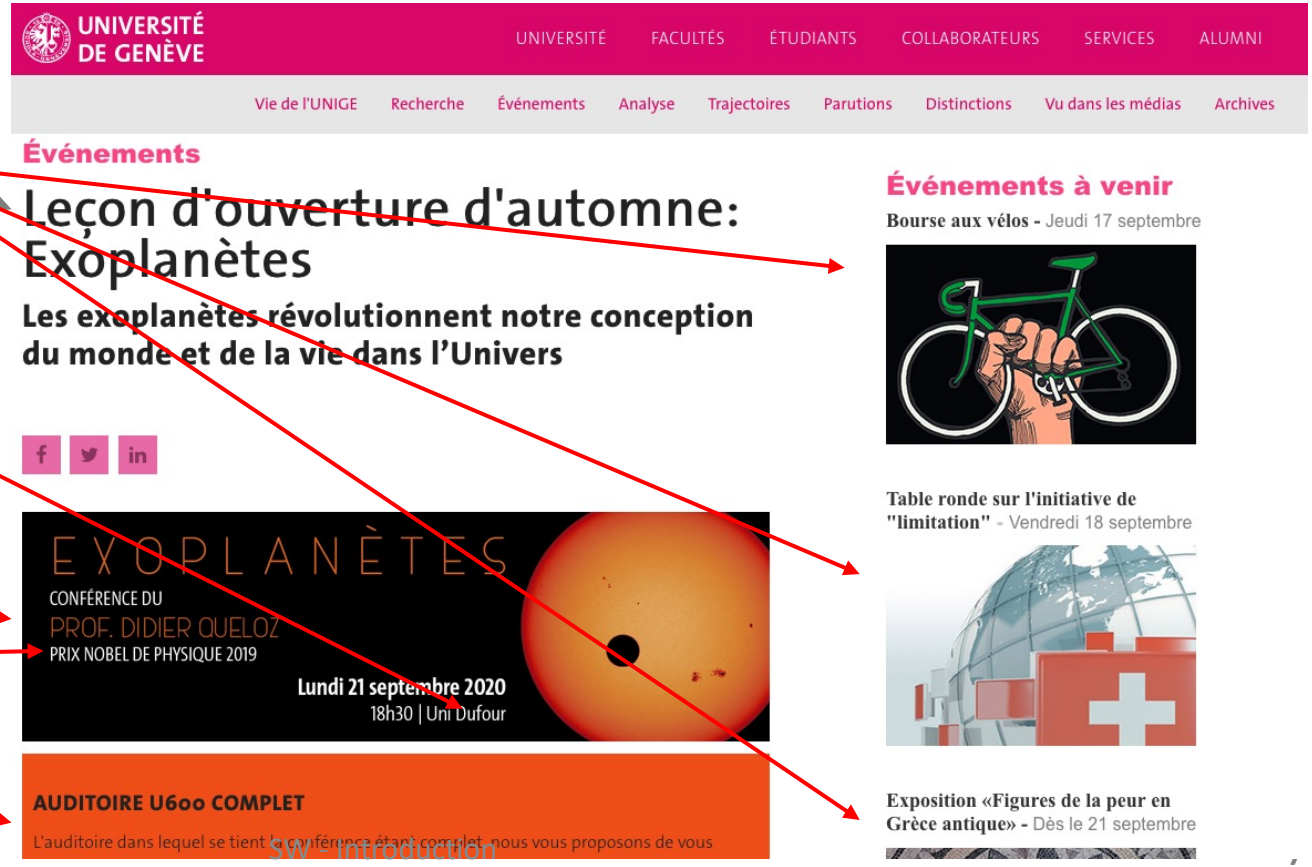
event descriptions

event place

presenter

presenter's attribute

special announcement



Machine understanding

text text text text text text

text text text text

text text text text

text text text

text

text text

a logic-based approach

- define a logical language (vocabulary)
- represent the page content with logical formulae
- represent more general knowledge

the page in Description logic

```
Event(c1)
Conference(c1)
title(c1, "Exoplanètes …'')
speaker(c1, dq)
...
Person(dq)
name(dq, "Didier Queloz")
...
Event(bav)
title(bav, "Bourse aux vélos")
```

Requires some background knowledge. What is a conference?

Not logged in Talk Contributions Creat

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WIKIPEDIA
The Free Encyclopedia

Main page
Contents
Current events
Random article
About Wikipedia
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Special pages
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Academic conference

From Wikipedia, the free encyclopedia

"Symposium (academic)" redirects here. For other uses of symposium, see Symposium (disambiguation).

This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.
Find sources: "Academic conference" – news · newspapers · books · scholar · JSTOR *(May 2009) (Learn how and when to remove this template message)*

An **academic conference** or **scientific conference** (also **symposium**, **workshop**, or **meeting**) is an event for researchers (not necessarily academics) to present and discuss their work. Together with academic or scientific journals and Eprint archives such as arXiv, conferences provide an important channel for exchange of information between researchers.

Conference on medicam
assisted rehabilitation in

Contents [hide]
1 Overview
1.1 Presentations
1.2 Size
1.3 Types
1.4 Infrastructure
2 Organization
3 Fraud
4 See also
5 References
6 External links

Overview [edit]

Conferences usually encompass various presentations. They tend to be short and concise, with a time span of about 10 to 30 minutes; presentations are usually followed by a discussion. The work may be bundled in written form as academic papers and published as the

formalized in description logics

```
Conference
    subclass-of Event
    subclass-of ∃ title . String
    subclass-of ≥1 speaker . Person

Person
    subclass-of HumanBeing
    subclass-of ∃ birthPlace . Place
    subclass-of ∀ employer . (Organization or Person)
```

Data representation

- multiple data models
  - relational databases, spreadsheets, graphs, ...
- different levels of structure
  - text $\rightarrow$ unstructured
  - ...
  - database $\rightarrow$ fully structured

not a new problem

Preview this item

The World Wide Web and databases : International Workshop WebDB'98 : Valencia, Spain, March 27-28, 1998 : selected papers

Author:	Paolo Atzeni; Alberto O Mendelzon; Giansalvatore Mecca
Publisher:	Berlin ; New York : Springer, 1999.
Series:	Lecture notes in computer science, 1590.
Edition/Format:	eBook : Document : Conference publication : English View all editions and formats
Database:	WorldCat
Summary:	This book presents the thoroughly refereed post-workshop proceedings of the International Workshop on the Web and Databases, WebDB'98, held in conjunction with EDBT'98 in Valencia, Spain, in March 1998. The 13 revised full papers presented were selected during two rounds of reviewing from initially 37 submissions. The book is divided into sections on Internet programming: tools and applications, integration and Read more...
Rating:	☆☆☆☆☆ (not yet rated) 0 with reviews - Be the first.
Subjects	Database management -- Congresses. World Wide Web -- Congresses. Database management. View all subjects
More like this	Similar Items

Semi-structured Data

"Roughly speaking, semi-structured data is data that is neither raw data nor very strictly typed as in conventional database systems" (Abiteboul 1997)

Exemples

- Web pages about restaurants
- BibTeX files
- ...

Serge Abiteboul, "Querying Semi-structured data," in *International Conference on Data Base Theory (ICDT)*, pp. 1 – 18, Delphi, Greece, 1997. http://dbpubs.stanford.edu:8090/pub/1996-19.

A BibTeX file

@article{**miller1995wordnet**,
Author = {Miller, George A},
Journal = {Communications of the ACM},
Number = {11},
Pages = {39--41},
Publisher = {ACM},
Title = {WordNet: a lexical database for English},
Volume = {38},
Year = {1995}}

@techreport{**masolo2003wonderweb**,
Author = {Masolo, Claudio and Borgo, Stefano and Gangemi, Aldo and Guarino, Nicola and Oltramari, Alessandro},
Institution = {LOA-ISTC-CNR},
Title = {The WonderWeb library of foundational ontologies and the DOLCE ontology. WonderWeb (EU IST project 2001-33052) deliverable D18},
Year = {2003}}

@inproceedings{**niles2001towards**,
Author = {Niles, Ian and Pease, Adam},
Booktitle = {Proceedings of the international conference on Formal Ontology in Information Systems-Volume 2001},
Organization = {ACM},
Pages = {2--9},
Title = {Towards a standard upper ontology},
Year = {2001}}

Main aspects

Irregular structure

heterogeneous, incomplete elements

Implicit structure

structure in textual parts => parsing

Partial structure

unstructured parts: plain text, images, external data

Indicative structure vs. constraining structure

schema adds information

Main aspects

A-posteriori schema/data guide

created to structure existing data (from the data)

Large schema

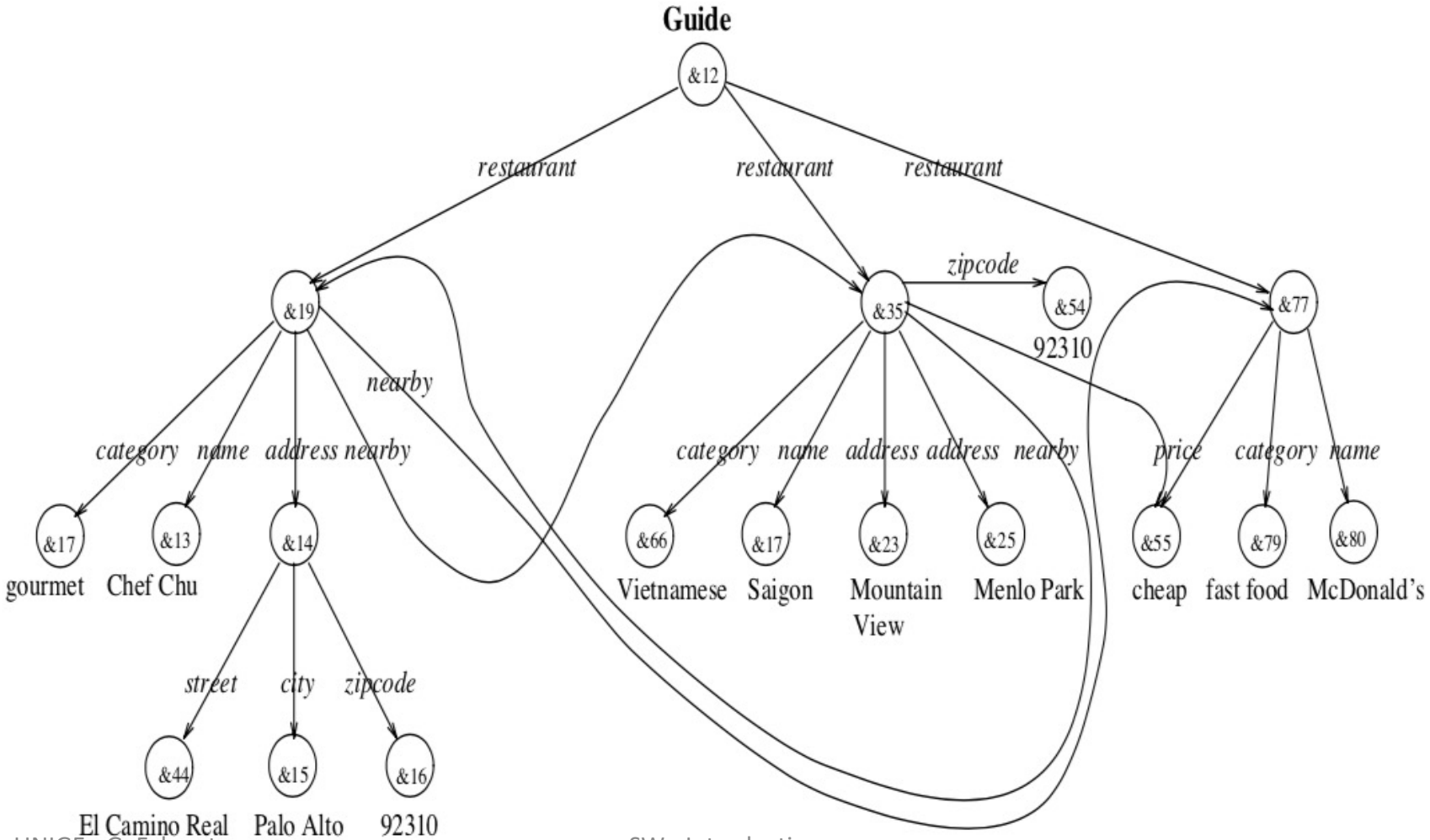
e.g. wikidata

Schema ignored

in discovery/navigation queries the schema must be ignored

Rapidly evolving schema

e.g. in scientific databases (new techniques/knowledge)


Guide
&12
restaurant
restaurant
restaurant
&19
&35
&77
zipcode
&54
92310
nearby
category
name
address
nearby
category
name
address
address
nearby
price
category
name
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&14
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&25
&55
&79
&80
gourmet
Chef Chu
Vietnamese
Saigon
Mountain View
Menlo Park
cheap
fast food
McDonald's
street
city
zipcode
&44
&15
&16
El Camino Real
Palo Alto
92310

in JSON

```
[    {"type": "public-conference", "title": "Exoplanètes ...", ...},
     {"type": "exhibition", "title": " ...", ",
          time-period: {"from": "...", "to": ..."d}, ...
     },
     ...
]
```

“Standard” Solutions

old style: XML

- + XML Schema, XSL transformations, XML APIs

new style: JSON

- + JSON APIs, JSON Schemas

Interconnection

Problem: different databases use different identifiers for the same entity

Part	Origin	...
Motor	DE	
Windows	FR	
Wheels	USA	

Database 1

Company	Headquarters	...
IBM	Unites States	
Telefónica	Spain	
Orange	France	

Database 2

The Semantic Web isn't just about putting data on the Web. It is about **making links**, so that a person or machine can explore the Web of Data.

With Linked Data, when you have some of it, you can find other, related, data.

Tim Berners-Lee

The Linked-data Solution

1. Use URIs as names for things.
2. Use HTTP URIs so people can look up those names.
3. When someone looks up a URI, provide useful information using the standards.
4. Include links to other things, so people can discover more.

A resource is the main information building block

Anything that can be named is a resource.

- **Information resources** entities that convey information and can be completely represented in binary code:
  - documents, images, video, software ...
- **Non-information resources** cannot be represented as bits:
  - people, phenomena, concepts, ideas ...

Web resources are conceptual relations uniquely identified by HTTP URLs

- An HTTP URL points to at most one resource.
- If it is an information resource, HTTP allows clients to retrieve a representation of it.
  - The **concept** pointed to by an URL shouldn't change.
  - The **value** and **representations** retrieved when looking up an URL might change over time.

Using HTTP URIs ensures that anybody can look up the resource

An HTTP URI of a resource can be dereferenced:
use an HTTP client to retrieve a representation.

- Information resources result in a representation.
- Non-information resources result in a 303 redirect.

- Relies on the double role of an HTTP URI as identifier and locator.

- Principle: If you don't know something, look it up. Follow your nose.

Dereferencing a URI should lead to useful information about that resource

"Useful" means the information is available using standard technologies.
(RDF and SPARQL)

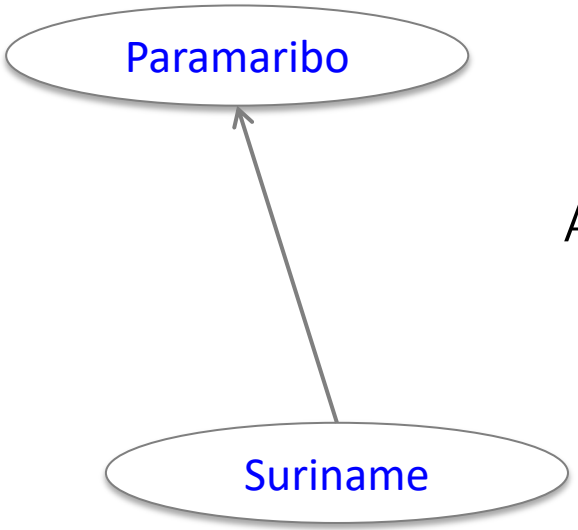
"Useful" also means the information provides explanations and/or context for the resource

Define the resource in terms of concepts the client already knows or can look up.

By including links to other resources, we create a Web of Data

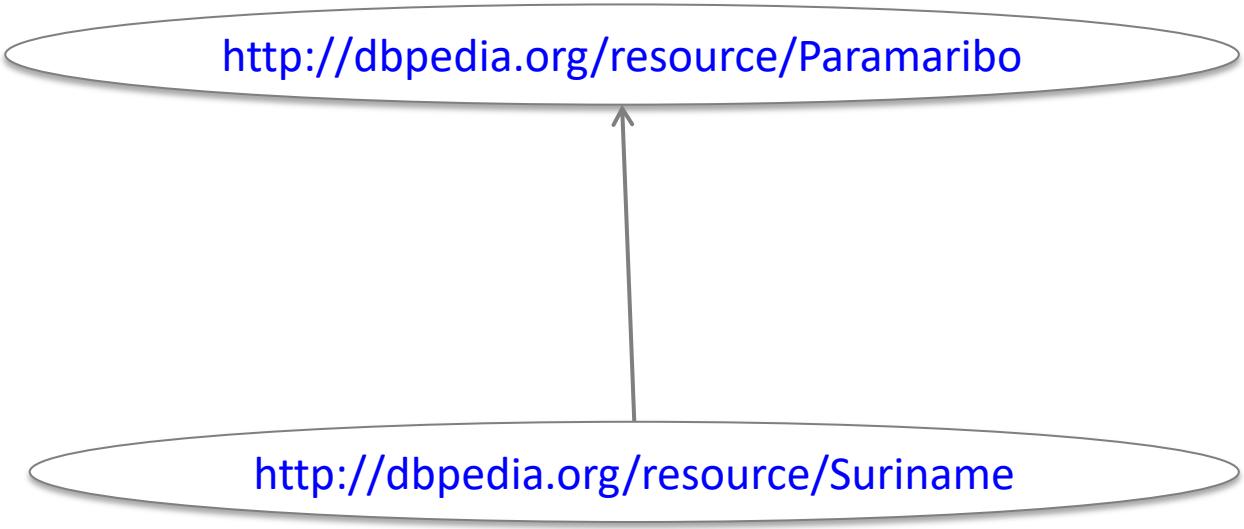
- Links connect a resource to known concepts.
  - Alberto is a researcher at U. of Toronto
- Links give meaning to data.
  - These temperatures are measured in degrees Celsius.
- Links allow exploration of related data.
  - Find more by the same author.

Basic information unit: the link

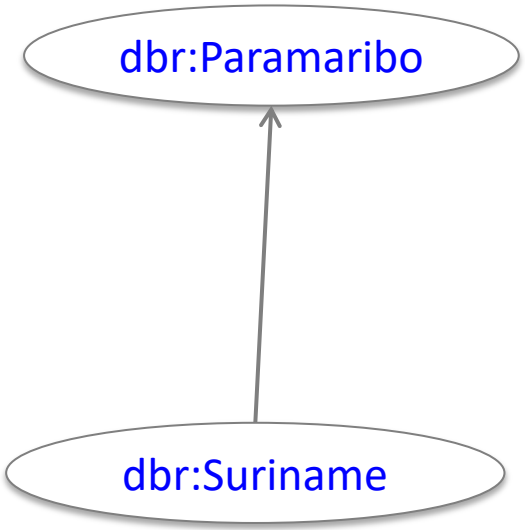


A link connects two resources

The resources are identified by URIs

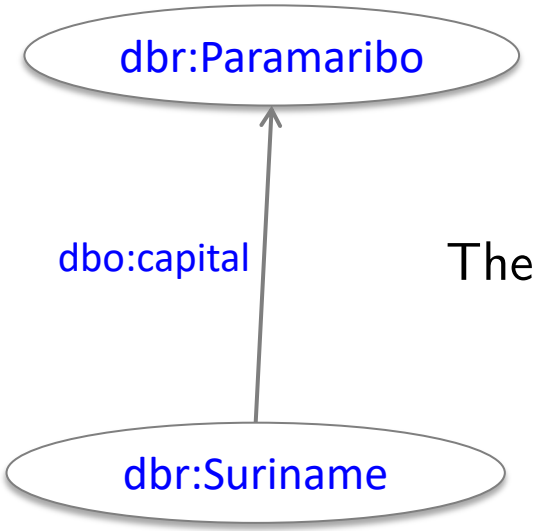


Using prefixes to abbreviate the URIs



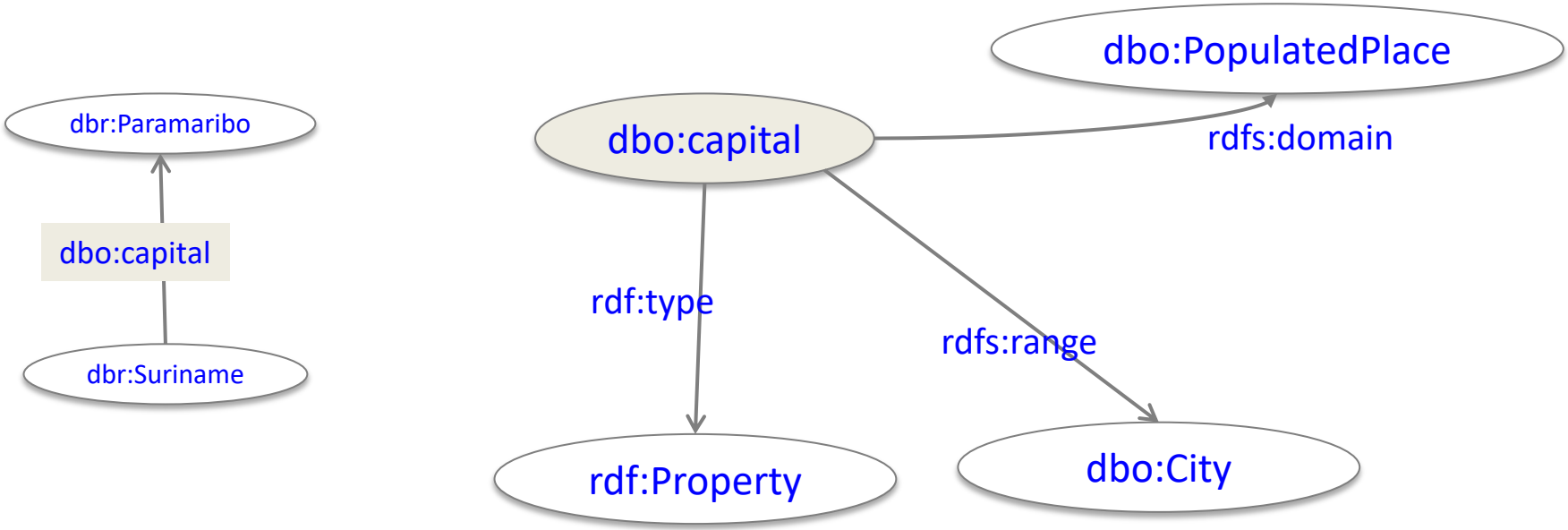
dbr = http://dbpedia.org/resource/

The links are typed (unlike Web links)



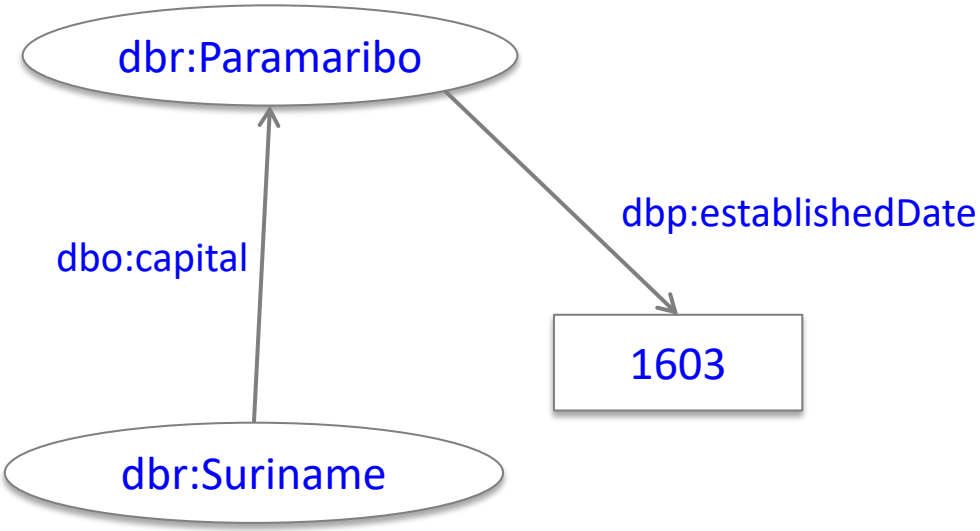
The link type is also identified by a URI

... so the link type can be described

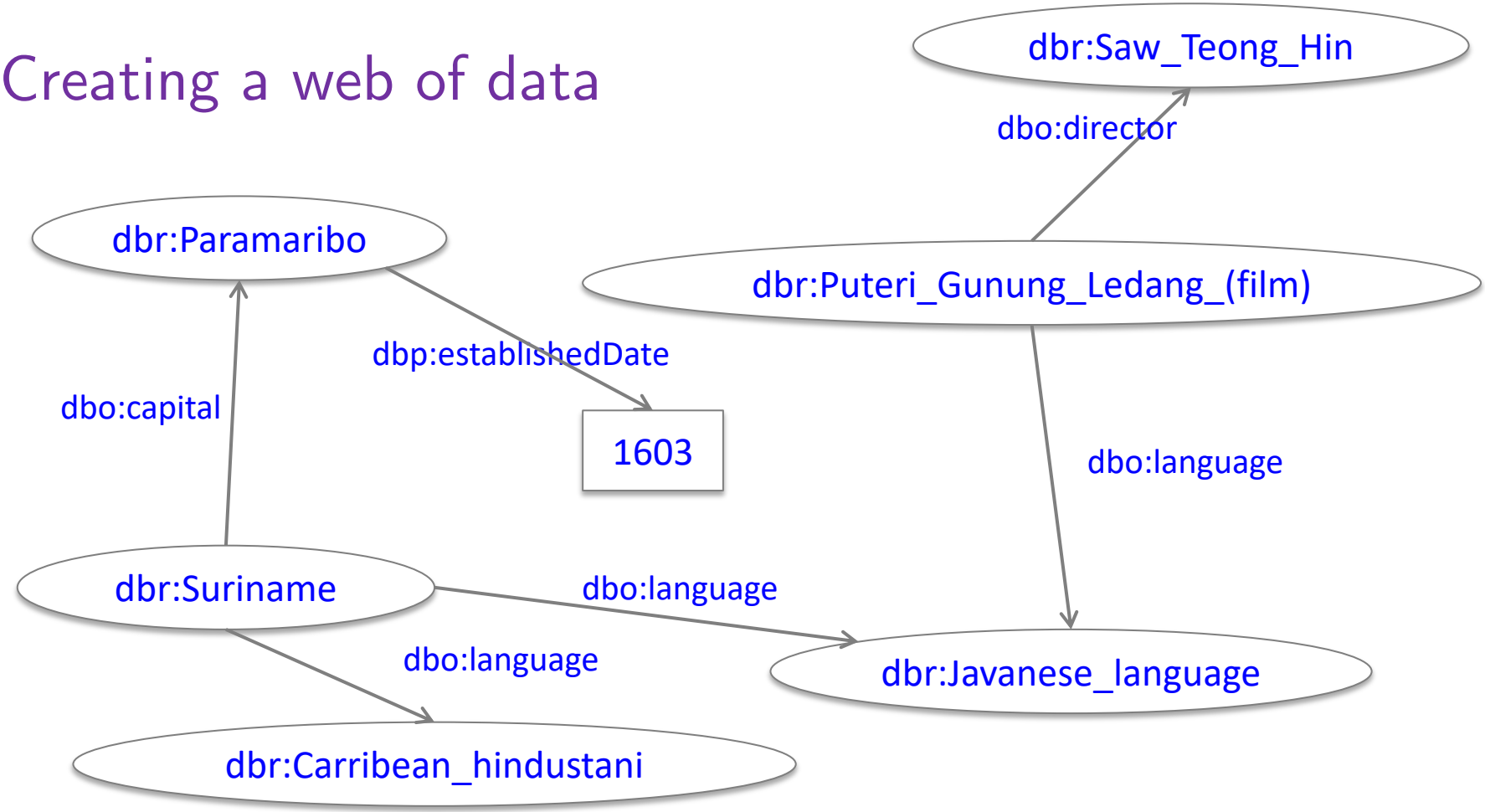


dbr = http://dbpedia.org/resource/
dbo = http://dbpedia.org/ontology/
rdf = http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs = http://www.w3.org/2000/01/rdf-schema#

Links can point to typed literal values



Creating a web of data



In a machine readable form

```
@prefix dbr: <http://dbpedia.org/resource/>
@prefix dbo: <http://dbpedia.org/ontology/>
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>


dbr:Suriname dbo:language dbr:Carribean_hindustani.
dbr:Suriname dbo:language  dbr:Javanese_language.
dbr:Suriname dbo:capital dbr:Parmaribo.

dbr:Parmaribo dbp:establishedDate 1603.

dbr:Puteri_Gunung_Ledang_(film) dbo:dirctor dbr:Saw_Teons_Hin.
dbr:Puteri_Gunung_Ledang_(film) dbo:language  dbr:Javanese_language.
```

Compared to relational databases

No constraining database schema

- DB: putting data in predefined boxes (tables, rows, columns)
- SW: linking data

Open world

- DB: what is not in the database is *true*, what is absent is *false*, (closed world)
- SW: what is described is *true*, what is absent is *unknown*
  - but we may have negative descriptions

Global vocabulary (identifiers)

- the resource and property names (URIs) are globally visible

RDF

- https://rubenverborgh.github.io/WebFundamentals/semantic-web/#rdf-model

Interconnection

Problem: the same term may have different meaning in different databases

Ontology solution: Create shared concept descriptions

- schema.org, Linked open vocabularies, ...
- use common concept description languages (RDFS, OWL, ...)

Reasoning

- Make logical inferences
  - find the logical consequences of facts and rules
  - test the consistency of a set of logical formulae

State of the SW

- the Semantic Web does not exist
  - not as imagined by TBL et al.
  - big companies have created their SW (e.g. Apple Siri, Google services, ...)

- Many SW technologies are operational
  - Resource description framework, Ontology languages
  - Querying and reasoning software
  - Semi-structured databases (RDF triple stores, graph databases, ...)
  - Knowledge graphs

Content of the course

- resource description with RDF graphs
- linked data
- ontologies and logical reasoning for description logic and logic programming
- representing time and space
- interoperability
- knowledge graphs