COMP318

Ontologies and Semantic Web

Ontology Alignment - Part 1

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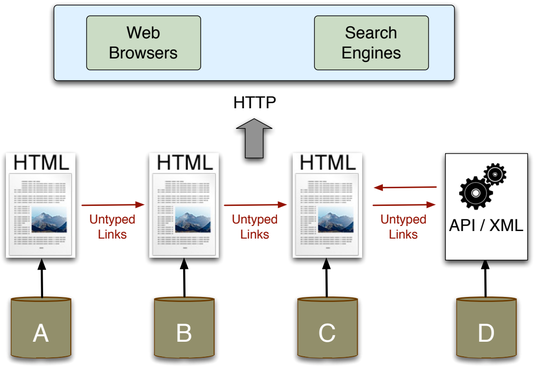
Where were we

- Ontology engineering
  - methodology
  - representation in OWL
  - violations and use of reasoning services

The global dataspace

- The Web allowed the creation of a global information space
  - where structured, semi structured and unstructured information is shared
- By 2012 over 3,000 exabytes of data were be available (IDC and UC Berkeley)
  - Mainly generated through transactions, but later from interactions
- By the end of 2016, global Internet traffic reached 1.1 zettabytes per year, according to Cisco
  - 1 zettabyte = 1 sextillion bytes, or 1,000 exabytes
- Things are now connected online
  - Sensors, devices, appliances… all publishing data
  - “A cross country flight from New York to Los Angeles on a Boeing 737 plane generates a massive 240 terabytes of data”. GigaOmni Media



Diversity in models: friend or foe?

- Different systems (sensors, services, applications, agents...) that generate or use knowledge usually make use of different ontologies
  - Similar or overlapping information is modelled in diverse ways even inside organisations with strong governance and internal communication
- These differences in modelling are an obstacle to systems' interoperability

Interoperability example

- You own a company selling digital cameras
  - You organise your information according to your own schema

- Task: You want your company to sell in a marketplace, e.g.:
  - Ebay:
    - *Home > Buy > Cameras & Photo > Digital Cameras > Digital SLR > Nikon > D34XX*
  - Amazon marketplace:
    - *Home > Department > Electronic & Computers > Camera & Photo > Digital Cameras > Digital SLR > Nikon > D34XX*
- Mappings between:
  - the entries in your schema
  - to the entries of the common catalogues of the marketplaces

The role of ontologies

- Ontologies ***standardise meaning***, define and structure concepts in a domain
  - They are the template for FAIR (**F**indable, **A**ccessible, **I**nteroperable and **R**eusable) data
  - Using standard vocabularies to describe data is key for **Findability**, **Interoperability** and **Reusability**;
  - A hierarchical structure improves **Findability** and facilitates **Interoperability**
  - Having a public knowledge model is key for **Accessibility**

The need for interoperability

- Interoperability measures the extent to which different systems are able to meaningfully exchange information
  - with the aim of reaching some common goal.

- Some (subtle) considerations
  - Data does not interoperate, but is used to support interoperation.
  - (Inter)operability assumes intention and purpose, e.g., a goal.
  - Interoperability is about a degree of meaningful exchange

- Syntactic vs semantic interoperability

The need for interoperability

- **Syntactic interoperability**:
  - If two or more systems are capable of communicating with each other, they exhibit syntactic interoperability when using specified data formats and communication protocols.
    - XML or SQL standards are among the tools of syntactic interoperability

- **Semantic interoperability**:
  - the ability to automatically interpret the information exchanged meaningfully and accurately in order to produce useful results
    - as defined by the end users of both systems.
  - The meaning of the information exchanged is unambiguously defined: what is sent is the same as what is understood.

Standards!

- Standards for representing, publishing, sharing, querying facts, knowledge, data, software and processes

- Provide a scalable approach for the discovery of knowledge that is
  - formulated in different ways, from independent actors
  - distributed physically and logically

No unified vocabulary

- There is never “the” correct ontology:
  - a number of different ontologies can represent the same domain
  - they all capture different contexts, perspectives, requirements
  - and depend on the task that the ontology should support
    - performed by some (autonomous) system — agent / service / API / …
- These differences in modelling become apparent when
  - These systems must be combined (**integration**)
  - Or be made to work together (**interoperation**)

The Architect

When modelling a bridge, important characteristics include:

tensile strength
weight
load
etc

Pat Hayes in conversation with T.R. Payne, 2001

The Military

When modelling a bridge, important characteristics include:

what munitions are required to destroy it!

What are ontologies good for

- They support **independence** of logical/physical schema
  - Formulation of queries closer to domain experts
  - Provide a way to deal with Incomplete and semi-structured data

- Ontology alignment play a key role
  - Help identify and resolve disagreements in the domain
  - Integration of heterogeneous sources

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End Ontology Alignment - Part 1

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