

TDT 44 – Semantic Web

Starts at 13.15

TDT 44 – Semantic Web

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Let's meet!

Go to [menti.com](https://www.menti.com) and use the code 82 29 19 8

or use this link:

<https://www.menti.com/q64cuijdsf>

About the course

Goal: The students get an orientation of the theoretical, methodological and technological background and of the ongoing standardization work that support semantic Web.

You will gain:

- Background theoretical knowledge
- Insight to relevant problems within Web information resources and services
- Insight to how to use semantic web technology to solve problems in different domains

Mostly self-driven.

Learning Material

BOOKS

ACADEMIC PAPERS

PRESENTATIONS

EXTERNAL LINKS

Follow the course wiki page: <https://www.ntnu.no/wiki/display/idiemner/TDT44+-+Semantic+Web>

Schedule

- 24.09.2020 Introductory meeting
 Presentation of semantic web concepts
- 22.10.2020 Mid-term follow-up meeting - 1 with short presentations from students
- 05.11.2020 Mid-term follow-up meeting - 2 with short presentations from students
- 25.11.2020 Report deadline
- XX.11.2020 (TBA) Oral exam – Presentation of reports

Mandatory activities: Peer review, project report, final presentation.

Final grade: Project report and final presentation.

The details will be available on the wiki page soon.

About the project

First deadline: 9 October 2020

Brief Introduction to Semantic Web

Semantic Web

Machines understanding the meaning
or
Meaning is machine readable.

Why do we need it?

Too much information, too little structure.
Meaning (semantics) of data is only human readable.
Connected data is smarter data.

Semantic Web

Set of standards

W3C - World Wide Web Consortium
<https://www.w3.org/>

Semantic Data

Representation of data

Distributed and connected data

Application areas

- Information retrieval
- Knowledge management
- Natural language processing

“Smart systems of any type”

- Search engines
 - E-learning
 - E-commerce
- Recommender systems

Open World

The world is dynamic.

Information changes all the time.

The Web is an Open World, we treat it using the “Open World Assumption”.

It is very important when we want to draw conclusions based on distributed data.

Semantic Modeling

“to make sense of the world around us”

Models are abstract descriptions that hides certain details while illuminating others.

Models:

Help people communicate

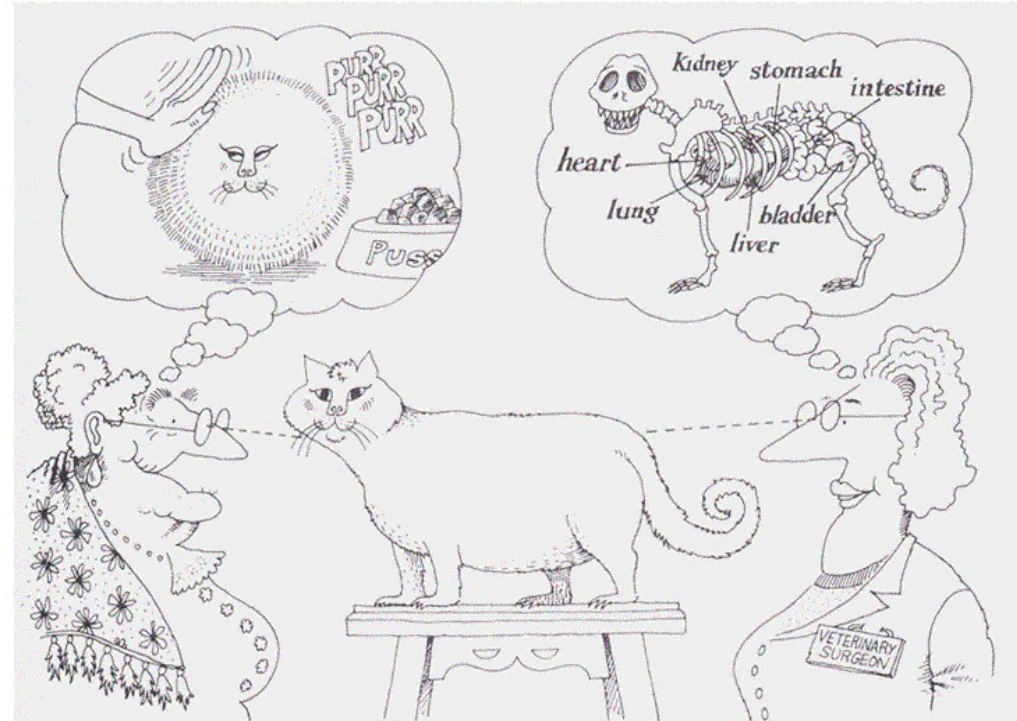
Explain and make predictions

Mediate among multiple viewpoints

The Semantic Web standards enable people to collaborate on models that organizes the information. Common collection of knowledge.

A semantic web model must be able to organize **variations** in a meaningful and manageable way.

In semantic web context, modeling is an ongoing process.



How to do it?

Frameworks, descriptions, structured representation of data, links, inference etc.

Ontology

An ontology describes a formal specification of a certain domain. The types of entities and relationships are defined in ontologies.

There are different ontology/semantic web modeling languages:
XML, RDF, OWL ...

An example:

Class Hierarchy

Hierarchy

- person
 - cat liker
 - dog liker
- driver
 - bus driver
 - haulage truck driver
 - lorry driver
 - van driver
 - white van man
- grownup
 - man
 - white van man
 - old lady
 - woman
 - kid
 - boy
 - girl
- pet owner
 - animal lover
 - cat owner
 - old lady
 - dog owner
- vegetarian
- bone
- brain

Supers

- pet owner

Done

Oiled 3.5.3

File Log Reasoner Help Export

Classes Properties Individuals Axioms Container Namespaces Imports

Classes

- bus company
- bus driver
- car
- cat
- cat liker
- cat owner
- colour
- company
- cow
- dog
- dog liker
- dog owner
- driver
- giraffe
- girl
- grass
- grownup
- haulage company
- haulage truck driver
- haulage worker

Find

Name

dog owner

Properties

SubclassOf
 SameClassAs

Documentation

Classes

person

Restrictions

type	property	filler
has-class	has pet	dog

Inherited Restrictions

type	property	filler
has-class	has pet	animal
has-class	eats	thing

D:\Program Files\Oiled3-5-3\ontologies\mad_cows

What is the usefulness of an ontology?

- To make domain assumptions explicit
 - Ontological analysis
 - clarifies the structure of knowledge
 - allow domain knowledge to be explicitly defined and described
- Enrich software applications with the additional semantics
- To facilitate communications among systems with out semantic ambiguity. i,e to
- achieve inter-operability
- Thus, practically, improving: computer-computer, computer-human, and human-
- human communication
- To provide foundations to build other ontologies (reuse)
- To save time and effort in building similar knowledge systems (sharing)

Challenges

- Scalability
- Logical structure

*“The challenge of the Semantic Web is to find a representation language powerful enough to support automated reasoning but simple enough to be usable”
[AKT 2003]*

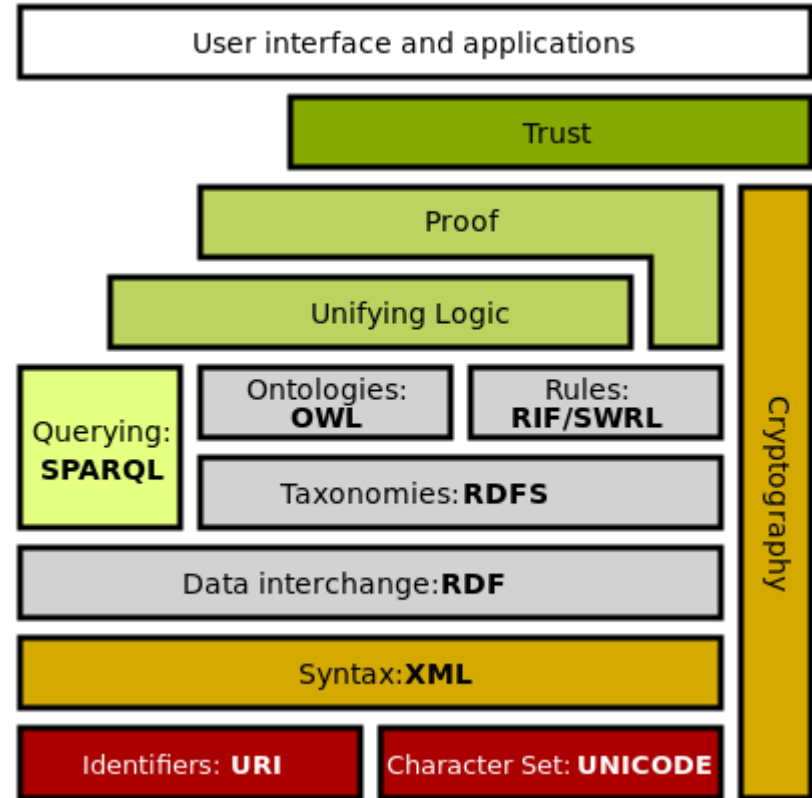
However...

“The Semantic Web is not about getting everyone agree on a single ontology, but rather about coping in a world where not everyone will agree, achieving some degree of interoperability.”

Book: Semantic Web for the Working Ontologist

The Semantic Web Stack

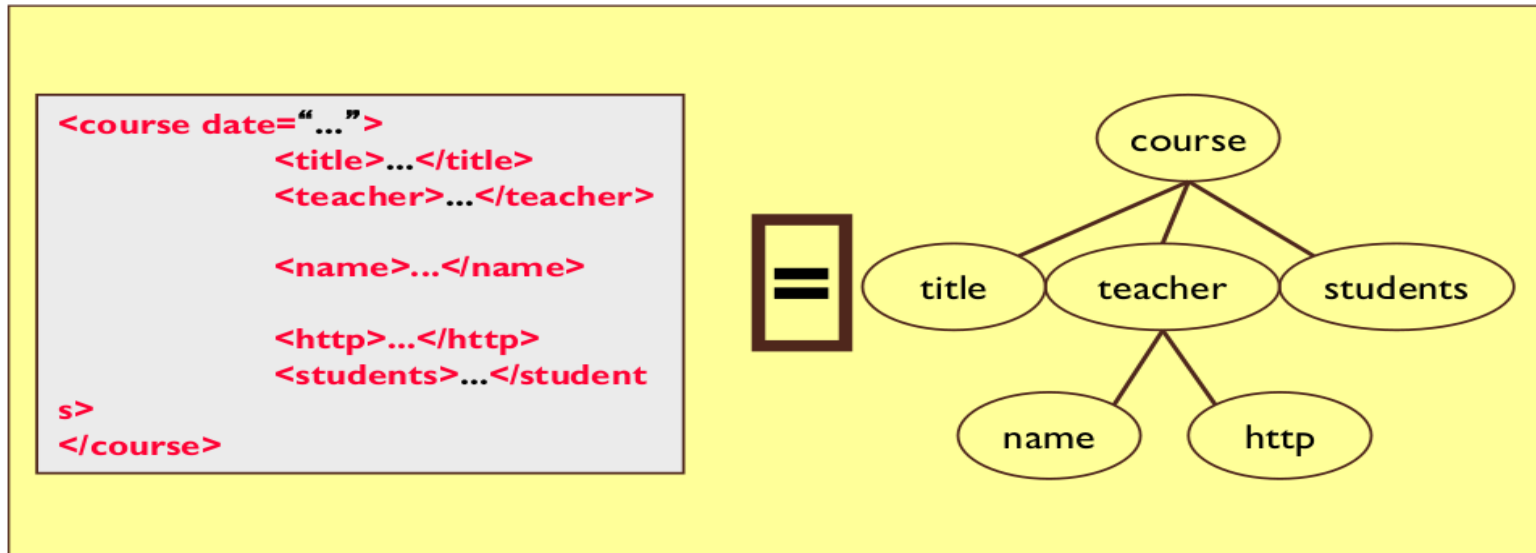
- XML
Surface syntax, no semantics
- XML Schema
Describes structure of XML documents
- RDF
Datamodel for "relations" between "things"
- RDF Schema
RDF Vocabulary Definition Language
- OWL
A more expressive Vocabulary Definition Language



XML

Document is a labeled tree. XML is a markup language that enables creation of documents composed of semi-structured data.

- node = label + attr/values + contents



- **XML Schema**: grammars for describing legal trees and datatypes

RDF → the standard for representing knowledge graphs

RDFS and OWL → two standards for defining ontologies

SPARQL → the standard for querying knowledge graphs

RDF (Resource Description Framework)

RDF is a standard to describe entities/resources. A resource can be anything we can identify, such as a person, a homepage or great dragons in the Game of Thrones.

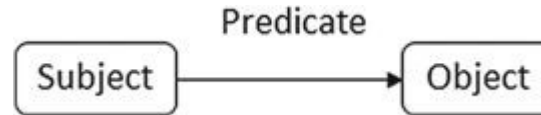
Resources in RDF are described as triplets:

[subject, predicate, object]

[lemon, is, yellow]

[Ann, knows, Barbara]

[Mary, likes, pizza]



RDF

RDF models the relations between things.

- It has more interoperability,
- Provides better understanding of the data.

RDFS

Resource Description Framework Schema

RDF defines the structure of the data
RDFS defines semantic relationships

```
org:Organization rdf:type rdfs:Class .  
org:Start-up a rdfs:Class .  
org:hasHomePage rdf:type rdfs:Property .  
org:Start-up rdfs:subClassOf org:Organization .
```

OWL

Web Ontology Language

<https://www.w3.org/2001/sw/wiki/OWL>

“It is a Semantic Web language designed to represent rich and complex knowledge about things, groups of things, and relations between things.”

SPARQL

Standard query language for RDF and OWL

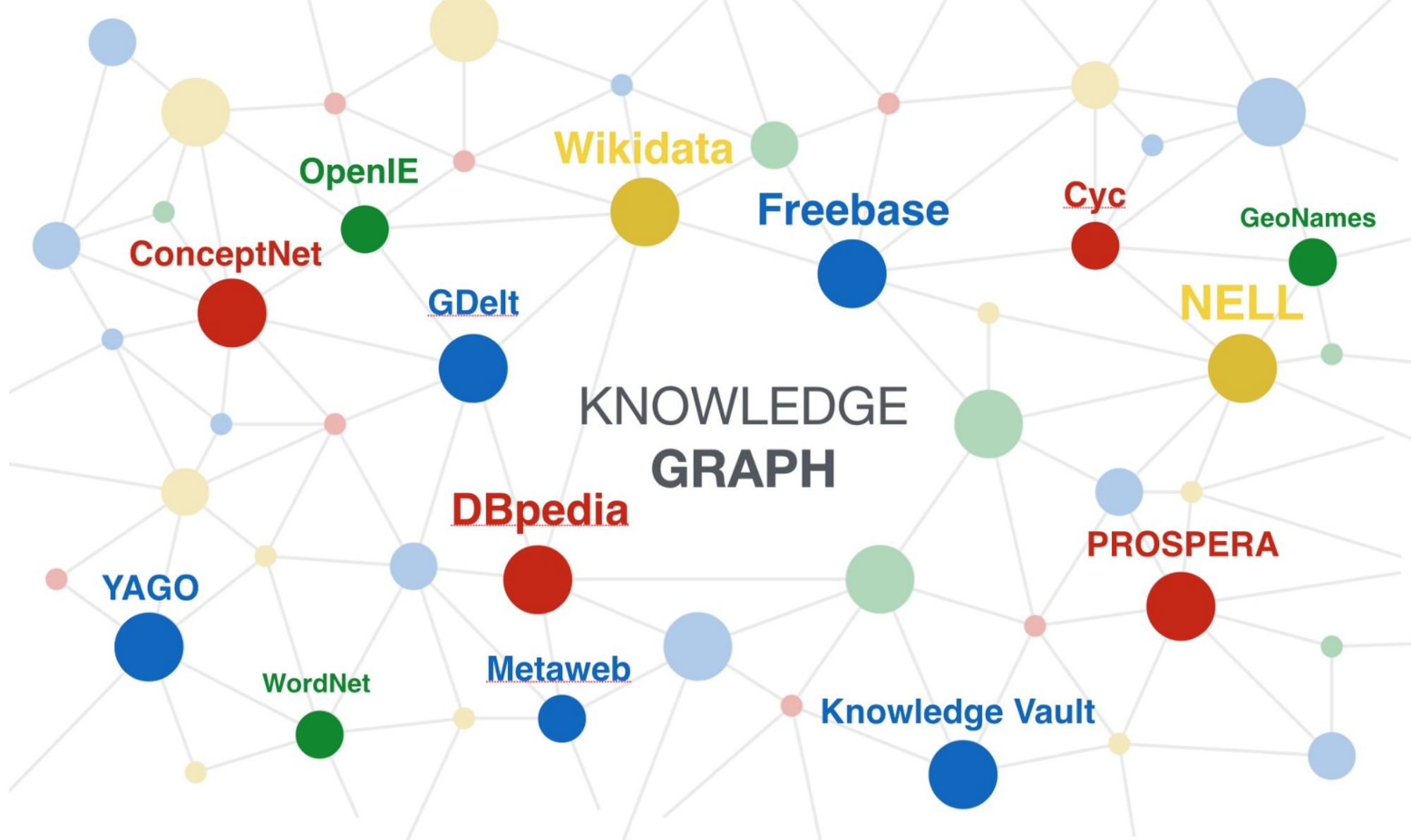
- Turtle syntax
- SQL like
- Based on pattern-matching mechanism

Knowledge Graphs

“A knowledge graph consists of a set of interconnected typed entities and their attributes.”

Popularized by Google in 2012.

Now also used by Facebook,
LinkedIn and Microsoft.

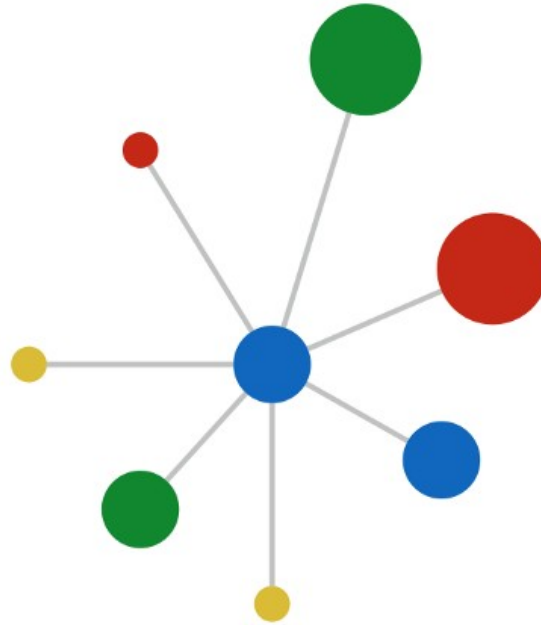




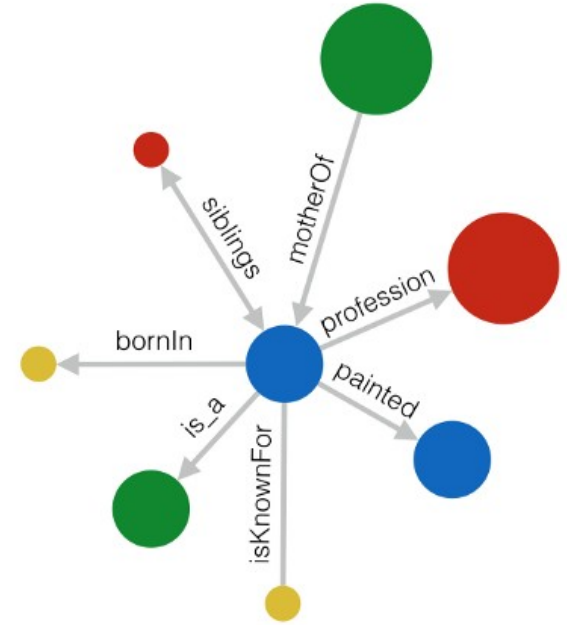
"leonardo da vinci"
String



Leonardo da Vinci
Recognized entity



Leonardo da Vinci
Recognized entity
Related entities



Leonardo da Vinci
Recognized entity
Related entities
Named Relationship

Table 2.3 RDF Datasets versus Linked Data versus Knowledge Graph

Features	Pure RDF datasets	Linked Data	Knowledge Graph
Machine readability	Y	Y	Y
Human readability	NN	NN	Y
Data distribution	N	Y	NN
Inter-dataset linkage	L	Y	Y
Data integration	NN	NN	Y
Data consistency	NN	NN	Y
Reliability	NN	NN	Y
High quality	NN	NN	Y

Y= Yes, NN = Not Necessarily, N = No, L= Limited

Some Standard Ontologies

- Friend-of-a-Friend (FOAF)
[https://en.wikipedia.org/wiki/FOAF_\(ontology\)](https://en.wikipedia.org/wiki/FOAF_(ontology))
- schema.org

