

# INF3580/4580 – Semantic Technologies – Spring 2017

## Lecture 1: Introduction

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16th January 2017



DEPARTMENT OF  
INFORMATICS



UNIVERSITY OF  
OSLO

# Today's Plan

- 1 Introduction to Semantic Technologies
- 2 Practicalities
- 3 Software

# Outline

- 1 Introduction to Semantic Technologies
- 2 Practicalities
- 3 Software

# The Vision of a Semantic Web

## A vision

I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web—the content, links, and transactions between people and computers. A ‘Semantic Web’, which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The ‘intelligent agents’ people have touted for ages will finally materialize.



Tim Berners-Lee

Quoted from: *Weaving the Web: The Original Design and Ultimate Destiny of the World Wide Web*. Tim Berners-Lee with Mark Fischetti. Harper San Francisco, 1999.

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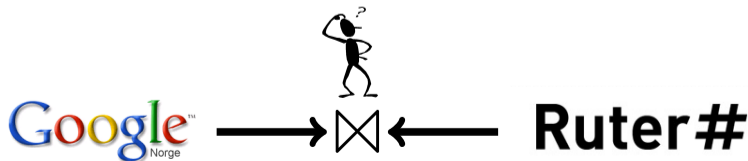
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- Web user needs to combine information from different sites
- Essentially a database join!



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- Can hardly wait for a separate mashup for each useful combination!

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- User-agents can find and combine published information in appropriate ways to answer the user's information needs.

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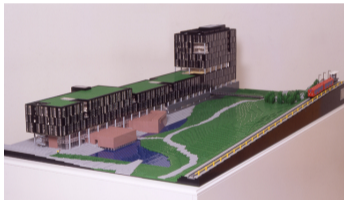
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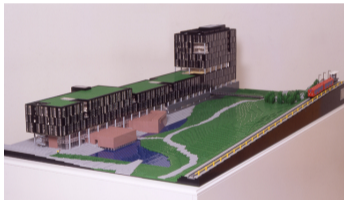
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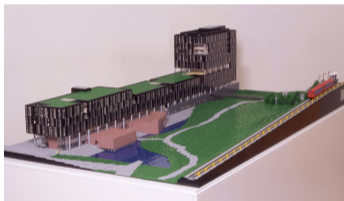
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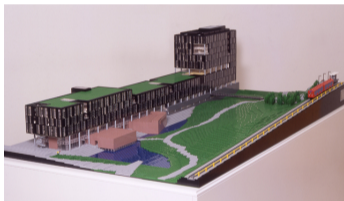
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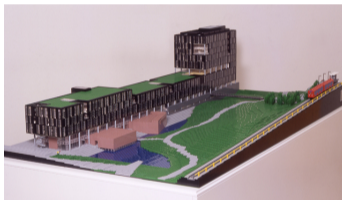
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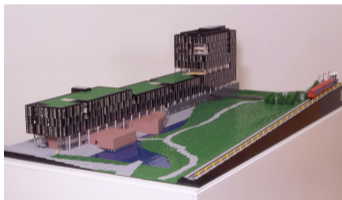
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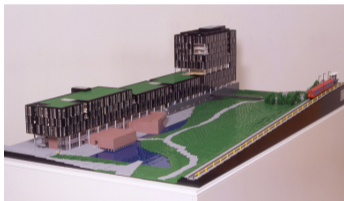
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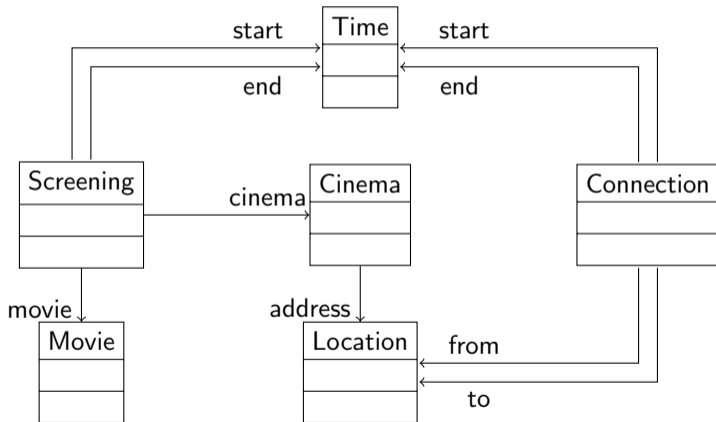
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  - Numerical Models (Newtonian mechanics, Quantum mechanics)



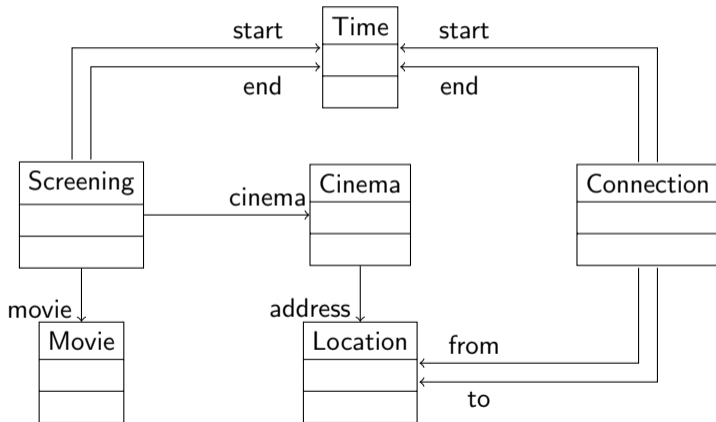
# A Cinema Transport Model

An example of a UML domain model:



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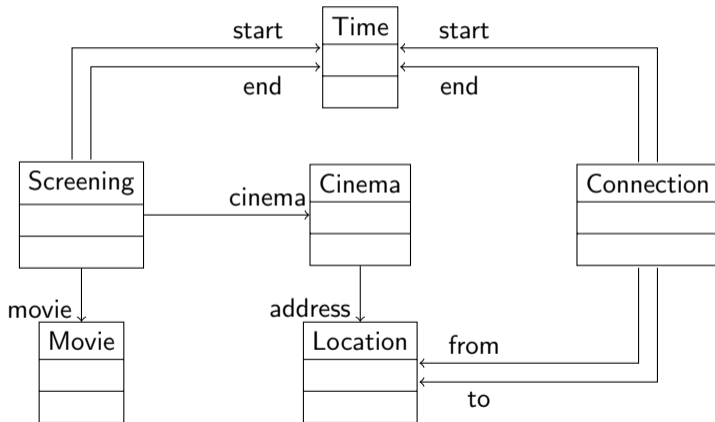
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# A Cinema Transport Model

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- What is the vocabulary?
- How is it connected?

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Find *s*, *k*, *l*, *c*, *cStart*, *cEnd*, *sStart* satisfying this and we have the answer!

- Maybe not the easiest way to ask, but it's a start.
- Models are an important part of a Web of Data!
- Need to connect models from different domains.

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  - ...
- Queries over distributed information are at the centre of all this.



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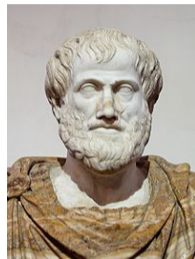
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- Abstraction!

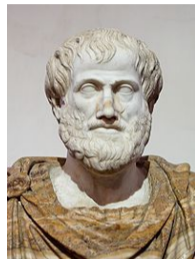
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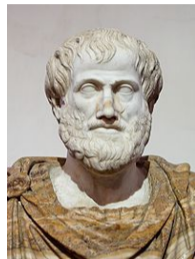
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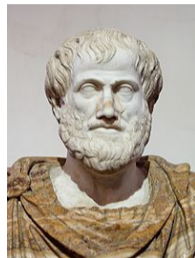
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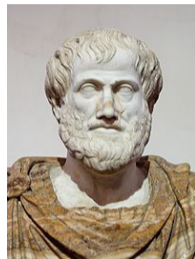
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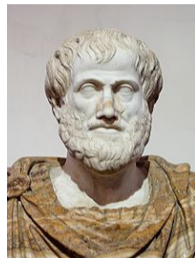
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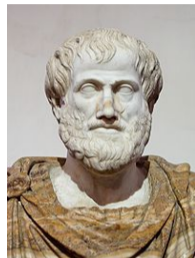
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- Also an abstraction!
- The topic of *formal logic*



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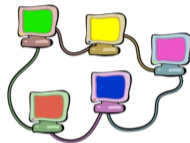
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- Computing with Knowledge is an important part of a Web of Data!

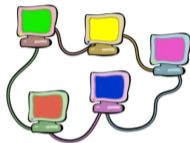


# Exchanging Information



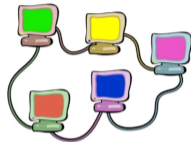
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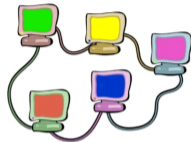
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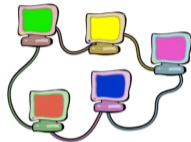
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- All these (and more) are obviously ingredients for a Web of Data!
- Semantic Web standards are being managed by W3C.

# The “Home” of the Semantic Web

See the W3C pages for the Semantic Web effort:

<http://www.w3.org/2001/sw/>

For standards (RDF, OWL, SPARQL, etc.), see:

[http://www.w3.org/2001/sw/wiki/Main\\_Page](http://www.w3.org/2001/sw/wiki/Main_Page)



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- RDF as common knowledge format:



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Anyone can say Anything about Anything.

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- Hype has brought some amount of discredit to the Semantic Web effort.



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- We talk about “semantic technologies” since they make sense independent of the Web

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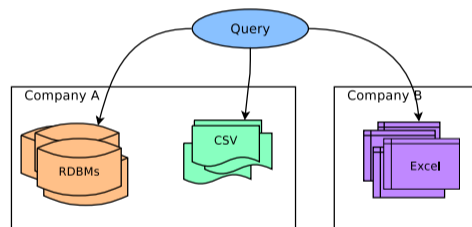
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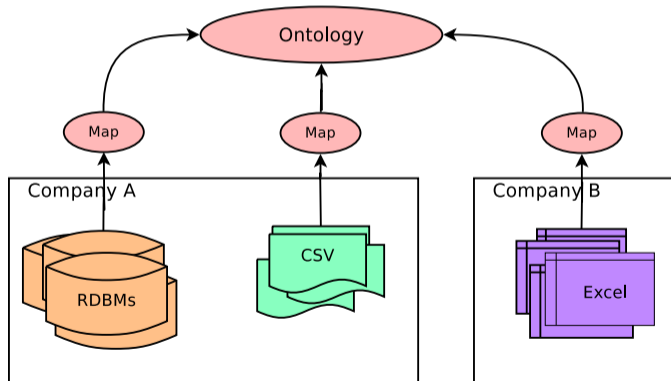
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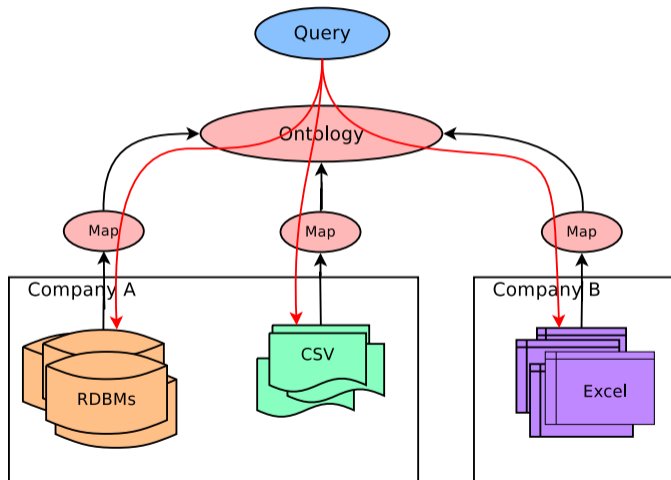
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- Background machinery gives answers as if data had always been stored according to a common data model



## Ontology-based data access (cont.)



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- Contact us for possible MSc degree topics

# The LogID group – Logic and Intelligent Data

- Research in semantic technologies, mostly around Ontology-based Data Access.
- Optique <http://www.optique-project.eu/>
  - 4 year EU project (just finished), led by LogID
  - Ontology Based Data-Access
  - Industry: Siemens, Statoil, DNV, fluid Ops
  - Universities: Oxford, Hamburg, Bolzano, Rome, Athens
- Sirius <http://www.sirius-labs.no/>
  - Center for Scalable Data Access in the Oil&Gas Domain
  - 8 years funding, 7 left
  - UiO, NTNU, Statoil, Oracle, IBM, Computas, Numascale ...
- BigMed: personalised medicine
- Great opportunities for both practically and theoretically oriented MSc theses, PhD work,... with strong connections to industry and public sector!

The logo for the Optique project, featuring the word "Optique" in a stylized orange font with a small blue dot above the letter 'i'.



# Outline

- 1 Introduction to Semantic Technologies
- 2 Practicalities**
- 3 Software

# When, Where, and Who

## When and Where

- Lectures Mondays 14:15–16:00 in OJD 2453, Smalltalk.
- No lecture 10 and 17 April (Easter break), and 1 May
- Guest Lecture: Veronika Heimsbakk, Acando, 24 April

## Lecturers



Martin Giese  
([martingi@ifi.uio.no](mailto:martingi@ifi.uio.no))



Leif Harald Karlsen  
([leifhka@ifi.uio.no](mailto:leifhka@ifi.uio.no))



Ernesto Jiménez-Ruiz  
([ernestoj@ifi.uio.no](mailto:ernestoj@ifi.uio.no))

# Exercises

## Exercises

- Practical exercises every week,
- Limbo (3418), Thursdays 10:15–12:00, starting **this** week
- Exercises available on website well in advance. Come prepared!
- First session: help with setting up software. Bring your laptop!
- In general: part repetition of lectures, part exercises

## Teacher



Ole Jørgen Brønner  
(olebr@student.matnat.uio.no)

# Mandatory Assignments

## Assignments

- Six mandatory assignments
- Corrected by teachers. **Tell us if you don't get feedback!**
- Pass/Fail
- Must have passed all assignments in order to attend exam
- First four assignments:
  - Small, about one per week (first one published on 23.1.)
  - (semi-)automated correction
  - One attempt
- Fifth and Sixth assignment:
  - More substantial, timing will be announced
  - Manual correction
  - Two attempts
- For INF4580:
  - more substantial assignments five and six

# Piazza

# Exam

- Four hours written Exam
- Same exam for INF3580 and INF4580
- Grades A–F
- Probably 15 June – Check semester page!
- Probably 1 May – Check semester page!

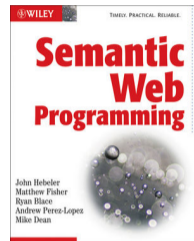
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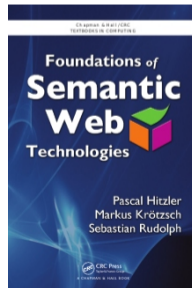
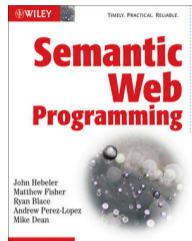
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- For theoretical aspects:

*Foundations of Semantic Web Technologies.*

Hitzler, Krötzsch, Rudolph.

CRC Press 2009





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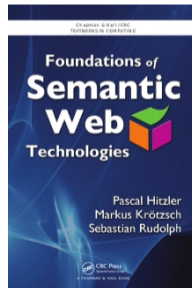
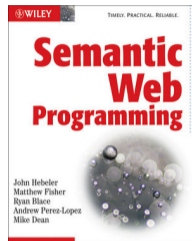
- For theoretical aspects:

*Foundations of Semantic Web Technologies.*

Hitzler, Krötzsch, Rudolph.

CRC Press 2009

- Can buy both in Akademika



# Reading

- For practical aspects:

*Semantic Web Programming.*

Hebeler, Fisher, Blace, Perez-Lopez.

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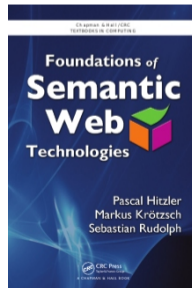
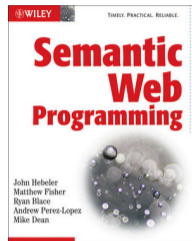
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- Slides available on course homepage



# Outline

- 1 Introduction to Semantic Technologies
- 2 Practicalities
- 3 Software**

# Software

- Programming-oriented course.
- With non-trivial theoretical components.
- Various off-the-shelf software required to work on exercises.
- Installation help in weekly exercises and exercise sessions.
- Most software already installed on ifi machines.

# Software: Java

In principle, any programming language can be used for semantic web programming, but. . .

- Will explain Sem. Web programming using Java libraries
- The textbook concentrates on Java
- Exercises are built around Java

So: get JDK 8 from

<http://www.oracle.com/technetwork/java/javase/downloads/index.html>



# Software: Eclipse

In principle, you can use any environment to develop Java programs, but...

- The Eclipse IDE is free, open source software
- It is particularly suited for Java development
- We will use the Eclipse IDE for demonstrations
- We will be able to help you with Eclipse problems



So: get the Eclipse Neon IDE from

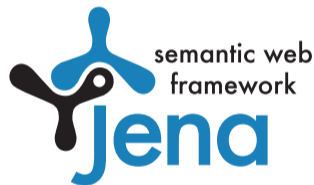
<http://www.eclipse.org/>

## Software: Jena

There are various Java libraries for Sem. Web programming out there, but...

- The textbook uses Jena
- It is one of the most used and mature Java libraries for Sem. Web
- It is powerful enough for our purposes

Download Jena 3.1.1 from:  
<http://jena.apache.org/>



## Software: Jena

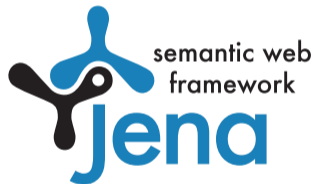
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<http://jena.apache.org/>

Alternatives:

- Sesame, <http://www.openrdf.org/>
- OWL API, <http://owlapi.sourceforge.net/>
- Redland RDF Libraries (C), <http://librdf.org/>
- etc., Google for “RDF library” ...





## Software: Pellet

There are several reasoning systems around, but...

- The textbook uses Pellet
- It is open source software
- It has a direct interface to Jena
- It is one of the more mature and comprehensive reasoners
- It is powerful enough for our purposes

Pellet sources are available from:

`https://github.com/complexible/pellet`

But wait a bit... maybe we can offer a precompiled package.

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Pellet sources are available from:

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But wait a bit... maybe we can offer a precompiled package. Alternatives:

- FaCT++, <http://owl.man.ac.uk/factplusplus/>
- RacerPro, <http://www.racer-systems.com/>
- Hermit, <http://hermit-reasoner.com/>
- etc., [http://en.wikipedia.org/wiki/Semantic\\_reasoner](http://en.wikipedia.org/wiki/Semantic_reasoner)

# Software: Protégé

There are several ontology editors available, but...

- The textbook uses Protégé
- It is open source software
- It is the most widely used ontology editor
- Probably the best non-commercial one



So: get Protégé 5.1 from  
<http://protege.stanford.edu/>

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Alternatives:

- see [http://en.wikipedia.org/wiki/Ontology\\_editor](http://en.wikipedia.org/wiki/Ontology_editor)

## Next weeks. . .

- RDF – knowledge representation – Leif Harald
- Jena – Java API for RDF – Martin
- SPARQL – Query Language – Ernesto
- Maths & Logic – Martin
- . . . reasoning and semantics