IN3060/4060 – Semantic Technologies – Spring 2021

Lecture 1: Introduction

Jieying Chen

15th January 2021

Department of Informatics

University of Oslo

Today's Plan

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

Outline

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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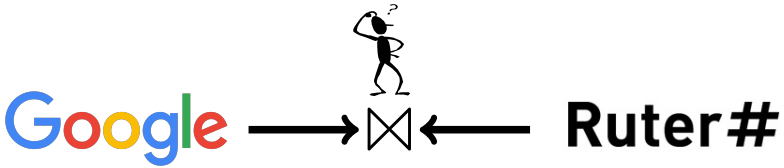
- Essentially a database join!



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

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- The data published by different sources is *linked*.
- Enough domain knowledge is available to machines to make use of the information.
- User-agents can find and combine published information in appropriate ways to answer the user's information needs.

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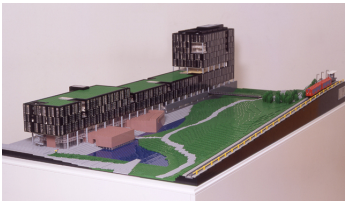

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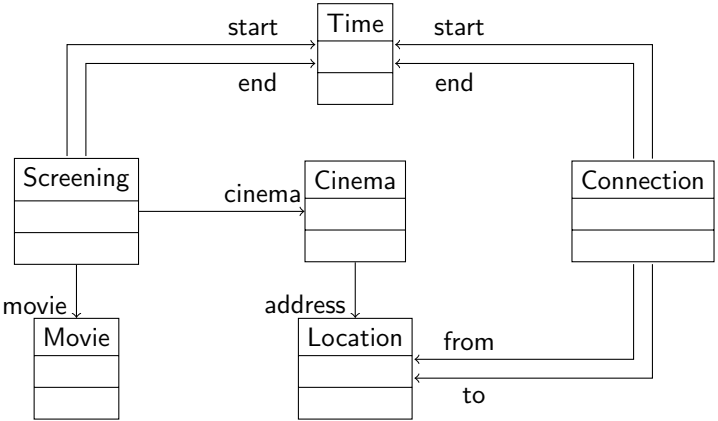
  - Taxonomies (e.g. species, genus, family, etc. in biology)
  - Domain models, e.g. in UML
  - Numerical Models (Newtonian mechanics, Quantum mechanics)

A Cinema Transport Model

An example of a UML domain model:



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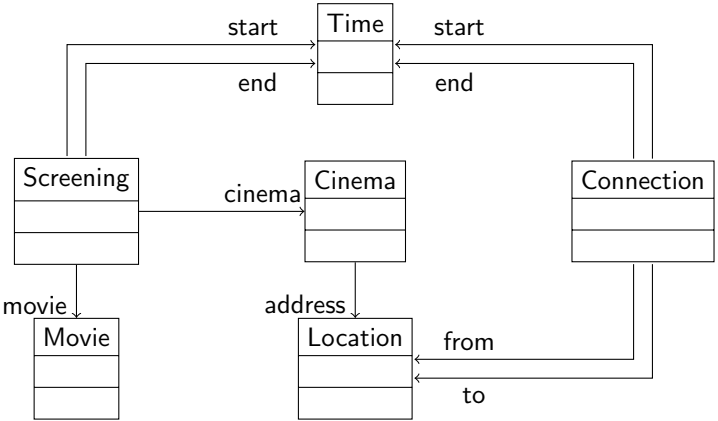

- What is the vocabulary?

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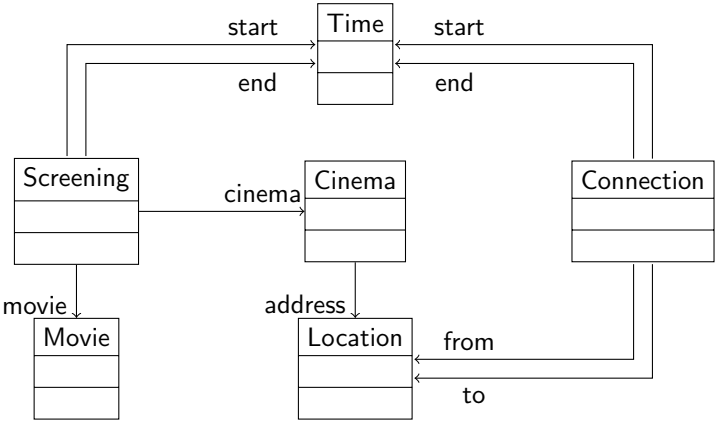

- What is the vocabulary?
- How is it connected?

A Query

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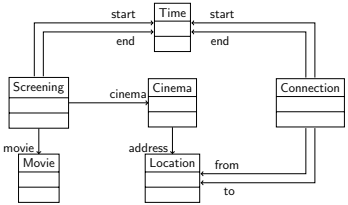
- Screening(s), movie(s, FF9)



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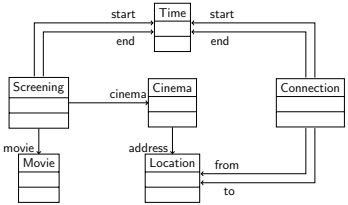

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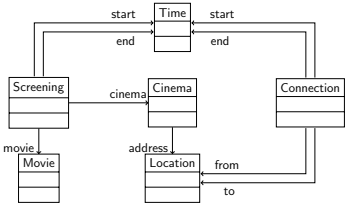

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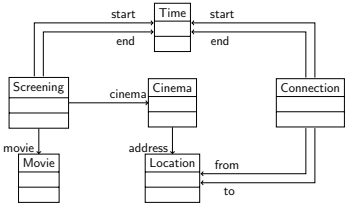

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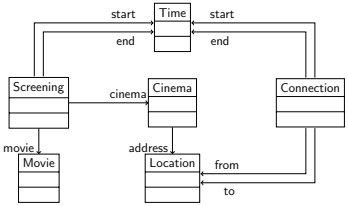

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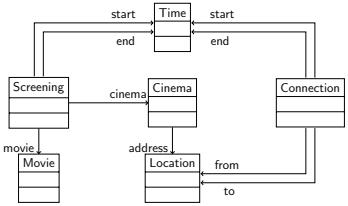

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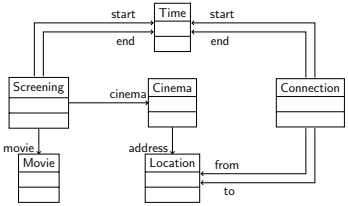

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- Maybe not the easiest way to ask, but it's a start.
- Models are an important part of a Web of Data!
- Need to connect models from different domains.

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

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- Abstraction!

Calculating with Knowledge

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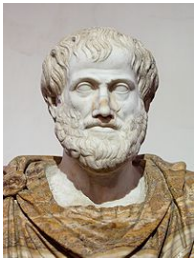

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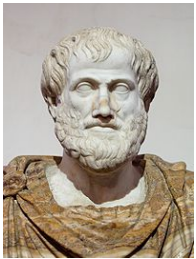

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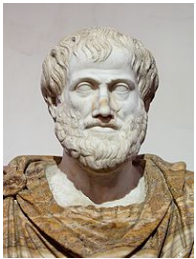

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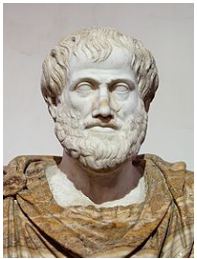

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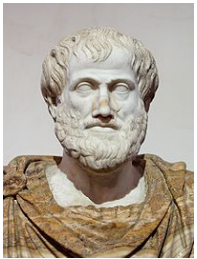

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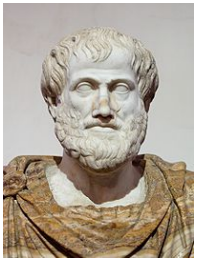

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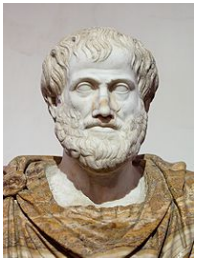

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- Also an abstraction!
- The topic of *formal logic*

Computing with Knowledge About Movies

- Query: find a *fun event* we can reach by public transport

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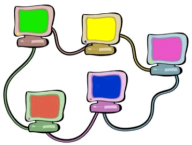
- Computing with Knowledge is an important part of a Web of Data!

Exchanging Information



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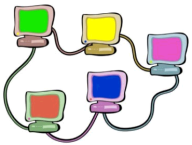

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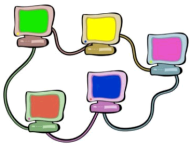

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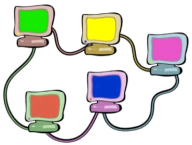

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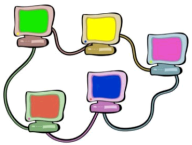

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- Semantic Web standards are being managed by W3C.

The "Home" of the Semantic Web

See the W3C pages for the Semantic Web effort:

`http://www.w3.org/2013/data/`

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

`http://www.w3.org/2001/sw/wiki/Main_Page`

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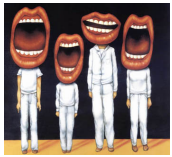
The AAA slogan



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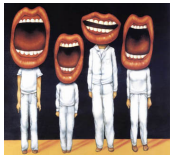

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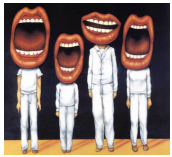

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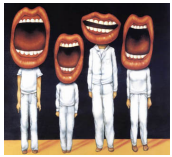

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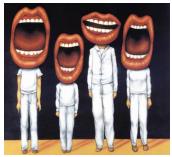

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- We talk about "semantic technologies" since they make sense independent of the Web

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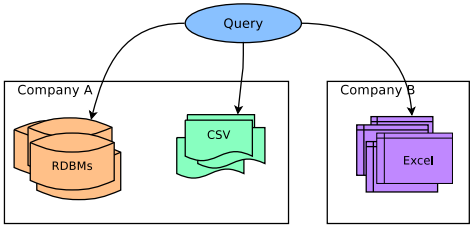

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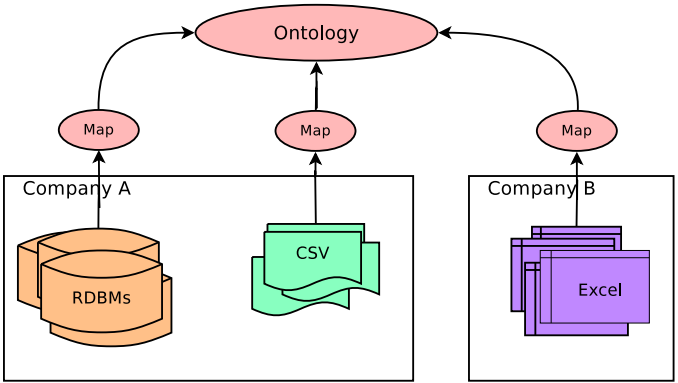

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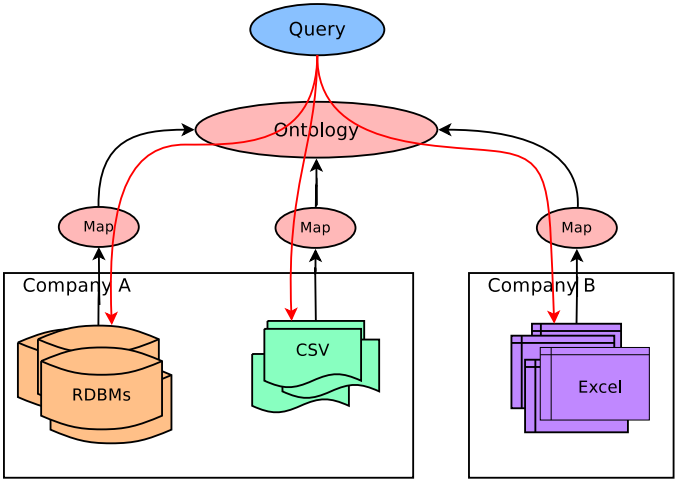
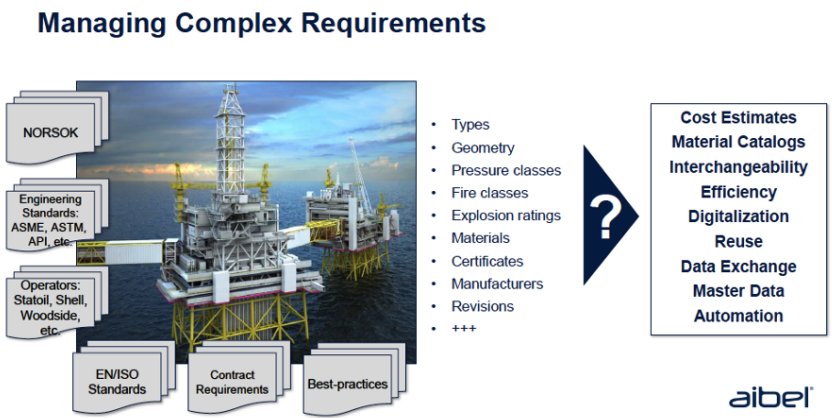


Applications in Norway



Source: Christian M. Hansen (Aibel)

Material Master Data (MMD) for Piping Systems

Axioms	1.840.769
Logical axioms	535.512
Declaration axioms	106.674
Class count	98.133
Object property count	135
Data property count	723
Individual count	20.412
SubClassOf	505.376
EquivalentClasses	745
DisjointClasses	27
AnnotationAssertion	1.198.266

PDF documents:
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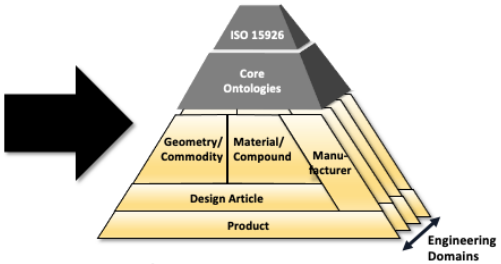

- Represent the contents of documents as an *ontology*
  - PDF documents: Engineering standards, client specifications
- Hierarchy of types and requirements for type membership
- Make explicit the *meaning* of document contents
  - Available to both humans and computers

aibel

Source: Christian M. Hansen (Aibel), David Cameron (SIRIUS)

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If you want to learn more:

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If you want to learn more:

- Contact us for possible MSc degree topics

The ASR group – Analytical Solutions and Reasoning

- Resarch in semantic technologies, mostly around Ontology-based Data Access.
- Optique `http://www.optique-project.eu/`
  - 4 year EU project (2012–2016), led by ASR
  - Ontology Based Data-Access
  - Industry: Siemens, Equinor, 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, 3 left
  - UiO, U Oxford, NTNU, Equinor, IBM, Computas, Numascale ...

SIRIUS Center for Scalable Data Access in the Oil and Gas Domain

sirius-labs.no

PeTWIN: Whole-field digital twins for production optimization and management

Petromaks/FINEP Project: 2020-2023

28M kr project sponsored by Research Council of Norway, FINEP, Equinor, Shell and Petrobras

Source: David Cameron(SIRIUS)

UiO : University of Oslo

UFRGS
UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

With funding from The Research Council of Norway

equinor

BR PETROBRAS

Finep
FINANCIADORA DE INOVAÇÃO E PESQUISA

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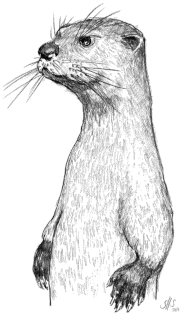
- BigMed: personalised medicine
- Project with NIVA: aquatic life and toxines
- Great opportunities for both practically and theoretically oriented MSc theses, PhD work,... with strong connections to industry and public sector!

MSc project in Brazil?

Open part-time Java programmer position



- On the **OTTR project** (topic of 2 lectures)
- No sem. web tech. experience required, (but beneficial; put your newly acquired knowledge to use)
- Application deadline: January 31 2021
- Full position description:
  `https://www.mn.uio.no/ifi/om/jobb/part-time-programmer-for-the-reasonable-ontology-templates.html`

Outline

When, Where, and Who

When and Where

- Lectures Friday 10:15–12:00 on Zoom: `https://uio.zoom.us/j/64475436633`
- No lecture 2nd of April (Easter break)
- Homepage: `http://www.uio.no/studier/emner/matnat/ifi/IN3060/`

Lecturer

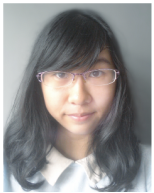
Jieying Chen
(`jieyingc@ifi.uio.no`)

Exercises

Exercises

- Practical exercises every week
- Digital teaching Zoom & Assembler (3417), Monday 14:15–16:00, starting **next** 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



Han Yu (hany@math.uio.no)

Mandatory Assignments

Assignments

- Seven mandatory assignments
- Corrected by teacher. **Tell us if you don't get feedback!**
- Pass/Fail
- Must have passed all assignments in order to attend exam
- First four assignments, and nr 7
  - Small, about one per week (first one published on 22 January)
  - (semi-)automated correction
  - One attempt
- Fifth and Sixth assignment:
  - More substantial, timing will be announced
  - Manual correction
  - Two attempts
- For INF4060:
  - More substantial assignments five and six

Mattermost

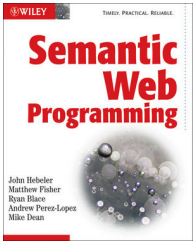
Exam

- Four hours written Exam
- Same exam for INF3060 and INF4060
- Grades A–F
- Probably 11 June – Check semester page!

Reading

- For practical aspects:

  Semantic Web Programming.
  Hebeler, Fisher, Blace, Perez-Lopez.
  Wiley 2009



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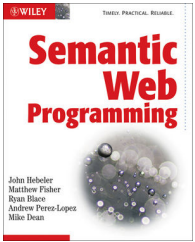

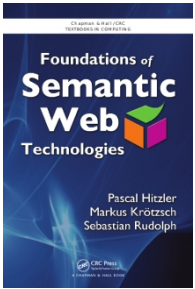

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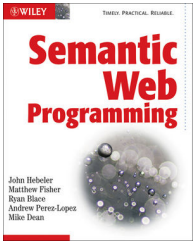

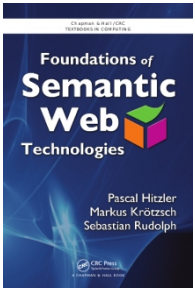

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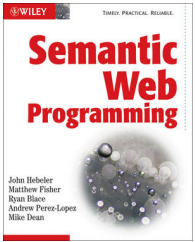
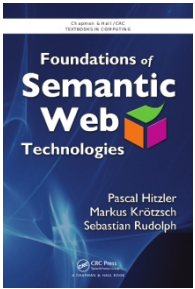
- Slides available on course homepage





Outline

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 latest JDK 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 latest Eclipse 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 3.17.0 from:
`http://jena.apache.org/`

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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
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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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- FaCT++, `http://owl.man.ac.uk/factplusplus/`
- Hermit, `http://hermit-reasoner.com/`
- ELK, `https://www.cs.ox.ac.uk/isg/tools/ELK/`
- etc., `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 5.5 from

`http://protege.stanford.edu/`

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Alternatives:

- see `http://en.wikipedia.org/wiki/Ontology_editor`

Next weeks...

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