Summary

• We looked at:
  – Traps and pitfalls
  – Part whole relations

• To come:
  – Ontology applications
Injuries, Faults, Diseases, Etc.

• A hand is not a kind of a body
  – ... but an injury to a hand is a kind of injury to a body

• A motor is not a kind of automobile
  – ... but a fault in the motor is a kind of fault in the automobile

• And people often expect to see partonomy hierarchies
Using part-whole relations: Defining injuries or faults

- **Injury_to_Hand** = Injury has locus some Hand_or_part_of_hand
- **Injury_to_Arm** = Injury has locus some Arm_or_part_of_Arm
- **Injury_to_Body** = Injury has locus some Body_or_part_of_Body

- The expected hierarchy from point of view of anatomy
Parts & wholes: Some examples

• The leg is part of the chair
• The left side of the body is part of the body
• The liver cells are part of the liver
• The ignition of part of the electrical system of the car
• The goose is part of the flock
• Liverpool is part of England
• Computer science is part of the University
Five families of relations

• **Partonomic**
  – Parts and wholes
    • The lid is part of the box
  – Constitution
    • The box is made of cardboard
  – Membership?
    • The box is part of the shipment

• **Nonpartonomic**
  – Containment
    • The gift is contained in the box
  – Connection/branching/Adjacency
    • The box is connected to the container by a strap
Ontology
Applications
RDF Stores

• Jena (jena.semanticweb.org)
  – Popular RDF store
  – RDF (SparQL) and RDFS (RQL) querying
  – Limited OWL reasoning
  – Forward chaining and backward chaining rule engines
  – Open source implementation in Java
  – Command-line and Java API access

• Sesame (sesame.semanticweb.org)
  – Scalable RDF store
  – Open source implementation in Java
  – RDF and RDFS querying
  – Limited OWL reasoning
  – Forward chaining rules engine
  – Java API and HTTP access

• RDFStore
  – C-based RDF store
  – RDQL support
RDF Vocabulary

• Use existing vocabularies whenever possible!

• Dublin Core: document metadata
• vCard: business cards
• RSS: news feeds
• FOAF: social links between people
Dublin Core

- The Dublin Core Metadata Set
  - standard vocabulary for describing resources
  - originates from library domain
  - RDF syntax
  - keywords
    - title
    - description
    - author
    - creator
    - format
    - date
    - type
    - relation
    - ...
Dublin Core Example

```xml
<?xml version="1.0"?>
<rdf:RDF xmlns:dc="http://purl.org/dc/elements/1.1/"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
  <rdf:Description rdf:about="http://www.w3.org/">
    WWW, Consortium, computer, access, accessibility, semantic,
    worldwide, W3, HTML, XML, standard, language, technology, link,
    CSS, RDF, XSL, Berners-Lee, Berners, Lee, style sheet, cascading,
    schema, XHTML, mobile, SVG, PNG, PICS, DOM, SMIL, MathML, markup,
    Amaya, Jigsaw, free, open source, software</dc:subject>
    <dc:description>The World Wide Web Consortium (W3C) is about 400
    organizations leading the World Wide Web to its full potential.
    Founded by Tim Berners-Lee, the Web's inventor. The W3C Web site
    hosts specifications, guidelines, software and tools. Public
    participation is welcome. W3C supports universal access, the
    Semantic Web, trust, interoperability, evolvability,
    decentralization, and cooler multimedia.</dc:description>
    <dc:date>2003-03-13</dc:date>
    <dc:format>text/html</dc:format>
    <dc:language>en-US</dc:language>
    <dc:creator>W3C Communications Team</dc:creator>
    <dc:publisher>W3C - World Wide Web Consortium -
    http://www.w3.org/</dc:publisher>
    <dc:rights rdf:resource="http://www.w3.org/Consortium/Legal/copyright-documents/>
    <rdfs:seeAlso rdf:resource="http://www.w3.org/2000/08/w3c-synd/home.rss"/>
  </rdf:Description>
</rdf:RDF>
```
RSS

• RDF Site Summary
• Basic RSS:
  – channel
  – title
  – link
  – description
  – items
    • title
    • link
    • description
    • ...

RSS (2/3)

- RSS 1.0 is RDF-based
  - Module mechanism for extension; a number of modules is standardized (e.g. Dublin Core)
  - Allows integration with other RDF-based vocabularies
  - Allows structured content
  - Allows reuse of RDF vocabulary

- RSS 2.0 is XML-based
  - Extension via namespaces
  - Limited reuse of vocabulary
  - More convenient to write
Foaf

- Foaf: Friend of a Friend
- Establishing social links between people using RDF
  - Person
  - name
  - surname
  - firstName
  - homepage
  - depiction
  - knows
  - ...

Foaf

```xml
<rdf:RDF
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
   xmlns:foaf="http://xmlns.com/foaf/0.1/"
   xmlns:base="http://www.debruijn.net/foaf.rdf">
  <foaf:Person rdf:about="#me">
    <foaf:name>Jos de Bruijn</foaf:name>
    <foaf:title>Mr</foaf:title>
    <foaf:firstName>Jos</foaf:firstName>
    <foaf:surname>de Bruijn</foaf:surname>
    <foaf:mbox_sha1sum>b944d8e09ad2da21aa2126ee900bcd930eacd2f</foaf:mbox_sha1sum>
    <foaf:homepage rdf:resource="http://www.debruijn.net/">
      <foaf:depiction rdf:resource="http://www.debruijn.net/images/jos.jpg"/>
      <foaf:workplaceHomepage rdf:resource="http://www.deri.org/"/>
    </foaf:homepage>
    <foaf:knows>
      <foaf:Person>
        <foaf:name>Holger Lausen</foaf:name>
        <foaf:mbox_sha1sum>32d5b1dc86b5134914d9a57e4732f054ac670781</foaf:mbox_sha1sum>
        <rdfs:seeAlso rdf:resource="http://members.deri.at/~holgerl/foaf"
          rdf:resource="http://www.deri.at/holgerl/foaf"
        ></foaf:Person>
      </foaf:knows>
    </foaf:knows>
  </foaf:Person>
</rdf:RDF>
```
Ways of annotating web pages

• Including RDF as Comments
  – Hard to do using existing XML tools
  – Easy for user (in case of small annotations)
  – A comment is a comment

• Extending XHTML to include RDF
  – Simply embed RDF in XHTML
  – Two approaches:
    1. Invalidate XHTML
    2. Use extended DTD
  – Embedding is non-standard

• Using <link> tag to connect to external RDF file
  – Need to maintain additional file
Including RDF as a Comments

• Extending XHTML to include RDF
  – Simply embed RDF in XHTML
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    1. Invalidate XHTML
    2. Use extended DTD
  – Embedding is non-standard
• Using <link> tag to connect to external RDF file
  – Need to maintain additional file

```html
<div id="cc-footer">
  <p><a rel="license" href="http://creativecommons.org/licenses/by/2.5/">Except where otherwise noted</a> licensed under a <a rel="license" href="http://creativecommons.org/licenses/by/2.5/">Creative Commons License</a></p>
  <rdf:RDF xmlns="http://web.resource.org/cc/">
    <Work rdf:about="">
      <license rdf:resource="http://creativecommons.org/licenses/by/2.5/" />
    </Work>
    <License rdf:about="http://creativecommons.org/licenses/by/2.5/">
      <requires rdf:resource="http://web.resource.org/cc/Attribution" />
      <permits rdf:resource="http://web.resource.org/cc/Reproduction" />
      <permits rdf:resource="http://web.resource.org/cc/Distribution" />
      <permits rdf:resource="http://web.resource.org/cc/DerivativeWorks" />
      <requires rdf:resource="http://web.resource.org/cc/Notice" />
    </License>
  </rdf:RDF>
</div>
```
Extending XHTML to include RDF

<head>
<title>Some Page</title>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:dc="http://purl.org/dc/elements/1.1/">
    <rdf:Description rdf:about="http://www.w3.org/">
        dc:title="W3C Homepage"/>
</rdf:RDF>
</head>
Extending XHTML to include RDF (2/2)

<!DOCTYPE html SYSTEM "http://infomesh.net/2002/m12n/test/rdf.txt">
<html xmlns="http://www.w3.org/1999/xhtml"
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xml:lang="en" >
<head>
<title>Embedded RDF Test</title>
</head>
<rdf:RDF>
<rdf:Property rdf:about="http://purl.org/net/swn#homepage">
</rdf:Property>
</rdf:RDF>
</head>
Using <link> tag to connect to external RDF
The Semantic Web

World Wide Web
- URI
- HTTP
- HTML

Semantic Web
- RDF
- OWL
- Rules

RDF store
SparQL

Tableaux reasoner

Rules engine

Semantic Web Application
Knowledge Management

- Organize, structure information
- Search according to concepts in ontology
- Ontology makes hidden relationships visible
- Web = Knowledge Management on a global scale
- Knowledge Management inside enterprise
KM scenario

RDF store

SparQL

Knowledge Management Application
SW technologies and KM

• RDF
  – Heavily used for annotating documents
• SparQL
  – Heavily used for searching
• RDF Schema
  – Used for simple relationships (mainly taxonomies)
• OWL
  – Use minimal
  – Mainly Transitive, inverse properties
• Rules
  – Reasoning with RDFS, OWL subset
  – Use limited
Enterprise Information Integration

- Traditional integration requires $n^2$ mappings, where $n$ is the number of data sources
- Using Semantic Web technology to integrate applications in an enterprise
- Ontologies make semantics of information explicit
- Explicit semantics enables detecting correspondences between data sources
Information Integration Scenario

• Traditional integration requires $n^2$ mappings, where $n$ is the number of data sources
• Using Semantic Web technology to integrate applications in an enterprise
• Ontologies make semantics of information explicit
• Explicit semantics enables detecting correspondences between data sources
Information Integration Scenario

RDF

OWL

Rules

RDF
Global Information Integration

- Integrating applications of business partners
- Finding new business partners on the fly, based on semantic descriptions
- Automatically converting data between formats (rules)
- Testing whether a service fulfills the requirements (subsumption reasoning)
E-Commerce Scenario
SW technologies and E-commerce

• RDF
  – Data exchange between organizations
  – Organizations publish RDF on the Web
• SparQL
  – Retrieving RDF
• RDF Schema
  – Used for less demanding applications
• OWL
  – Heavy usage to make semantics explicit
• Rules
  – Heavy usage to relate ontologies/data sources
  – Transforming data between formats