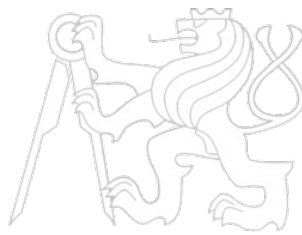# Web 2.0
Lecture 10: Annotations

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Czech Technical University in Prague
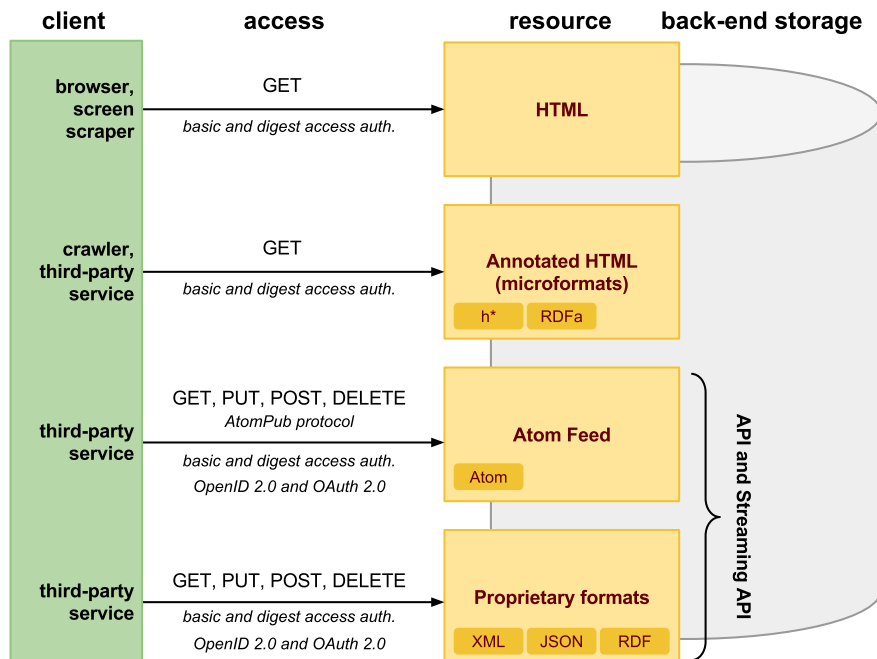
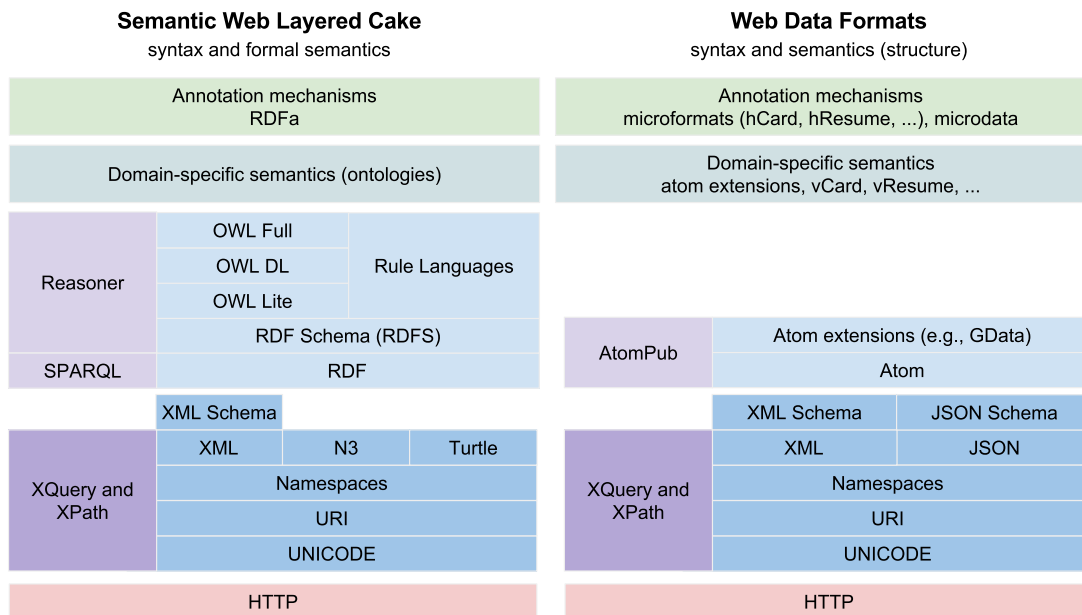Faculty of Information Technologies • Software and Web Engineering • http://vitvar.com/courses/w20

Data on the Web

Data Syntax, Structure and Semantics

Semantic Web Layered Cake					
Semantic Web Layered Cake syntax and formal semantics					

Semantic Web Layered Cake
syntax and formal semantics

Annotation mechanisms RDFa		
Domain-specific semantics (ontologies)		

Reasoner	OWL Full	
	OWL DL	Rule Languages
	OWL Lite	
	RDF Schema (RDFS)	
SPARQL	RDF	

XQuery and XPath	XML Schema		
	XML	N3	Turtle
	Namespaces		
	URI		
	UNICODE		

| HTTP |

Web Data Formats
syntax and semantics (structure)

| Annotation mechanisms microformats (hCard, hResume, ...), microdata |
| Domain-specific semantics atom extensions, vCard, vResume, ... |

| AtomPub | Atom extensions (e.g., GData) |
| | Atom |

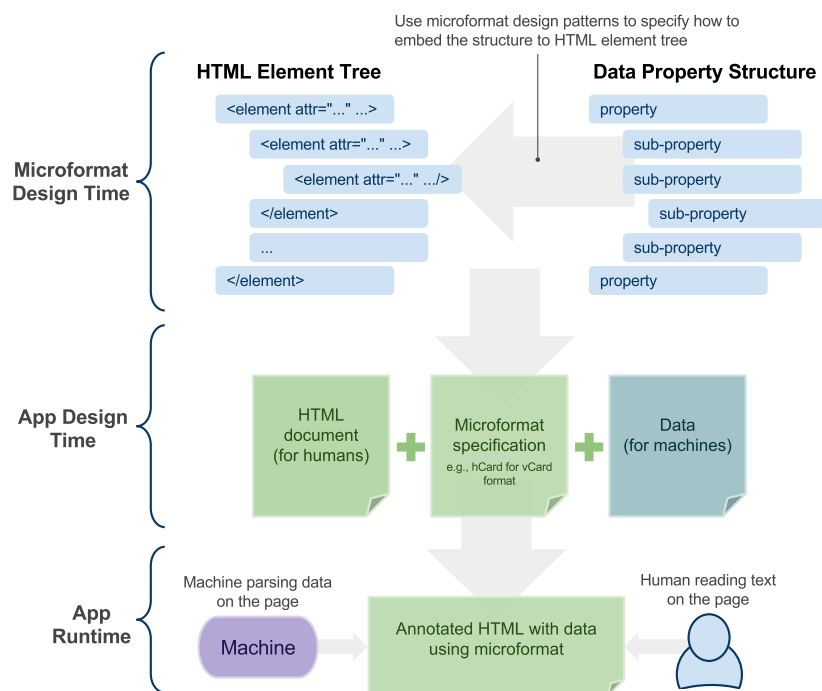| XQuery and XPath | XML Schema | JSON Schema |
	XML	JSON
	Namespaces	
	URI	
	UNICODE	

| HTTP |

Overview

- **Microformats**
- Microdata
- RDF and RDFa
- OpenGraph Protocol

Microformats

- ## What is a microformat
  - *How to embed data in HTML, XHTML, Atom, and XML*
    - → *data: vCard, vResume, vRecipe*
    - → *micorformat: hCard, hResume, hRecipe*
  - *Browsers display HTML, machines process data*
  - *Microformat vs. POSH format*
    - → *POSH is same as microformat but data is not a standard format*

- ## Difference to Atom feeds
  - *Microformats require only a **single HTML document***
    - → *clients run GET to retrieve all data (human readable and machine readable)*
  - ***No significant increase of the size of document***
  - ***No requirements on data representation***
    - → *can be in any representation*

Microformats Usage

Use microformat design patterns to specify how to embed the structure to HTML element tree

HTML Element Tree

`<element attr="..." ...>`	
	`<element attr="..." ...>`
	`<element attr="..." .../>`
`</element>`	
`...`	
`</element>`	

Data Property Structure

property
sub-property
sub-property
sub-property
sub-property
property

Microformat Design Time

App Design Time

HTML document (for humans) **+** Microformat specification e.g., hCard for vCard format **+** Data (for machines)

App Runtime

Machine parsing data on the page

Machine → Annotated HTML with data using microformat ← Human reading text on the page

Principles

- Design Patterns
  - *How to embed data in HTML elements or elements' attributes*
  - *Applied for a particular microformat specification*
- Follow semantics of (X)HTML elements
  - *Use the most appropriate semantic HTML element* ⧉
    → *if not available, use* <span> *or* <div>
- XHTML Metadata Profiles (XMDP)
  - *Definition of metadata of a microformat in (X)HTML page*
  - *Machine and human readable, not a Web standard*
  - *Uses* profile *attribute on* <head> *element*
  - *Is deprecated in HTML5*
  - *Is an analogy to a namespace but not really a*

vCard Example

- Describes contact information

```
1  PROPERTY:value1;value2;...;valueN
2  PROPERTY:SUBPROPERTY1="value";...SUBPROPERTY2="value";...
3
```

```
1   BEGIN:VCARD
2   VERSION:4.0
3   N:Vitvar;Tomas;Ing.;Doc.;PhD
4   FN: Doc. Ing. Tomas Vitvar, Ph.D.
5   ORG:Czech Technical University in Prague
6   TITLE:Associate Professor
7   PHOTO:http://vitvar.com/img/tomvit-portrait.jpg
8   TEL;TYPE="work,voice";VALUE=uri:tel:+420-2-334-334
9   TEL;TYPE="home,voice";VALUE=uri:tel:+420-2-443-554
10  ADR;TYPE=work;LABEL="Thákurova 6, Praha 6, Czech Republic"
11    :;;Thákurova 6;Praha 6;Czech Republic
12  EMAIL:tomas.vitvar@fit.cvut.cz
13  END:VCARD
14
```

  - N – *a structured representation of the name (person/organization)*
  - FN – *formatted name string*
  - ORG – *name of the organization and associated units*
  - TITLE – *job title, functional position*
  - LABEL – *Addressing label*

Design Patterns Rules

- class-design-pattern
  - *semantic meaning indicated on HTML content by* class *attribute*

```
1  <div class="vcard">
2      <a class="url fn" href="http://www.vitvar.com">
3          Tomas Vitvar</a>,
4      <span class="org">UIBK</span>
5  </div>
```

- value-class-pattern
  - *embedding data structure when a property has subproperties*
    (vCard fragment is TEL;TYPE=WORK:+43 554 554 556*)*

```
1  <span class="tel">
2      <span class="type">Work</span>:
3      <span class="value">+43 554 554 556</span>
4  </span>
```

  - *sometimes value needs to be split into multiple pieces as follows*
    (note that dialing +43**0**554554556 *is not valid)*

Design Patterns Rules (cont.)

- include-pattern
  - *to include a subset of data from one area of a page to the other area of the same page (same data to be reused by multiple microformats)*
  - ***cannot be used to include content from other URLs!***
  - *Example, a verbose hCard on a page:*

```
1   <div class="vcard" id="uibk-card">
2       <div class="fn org">University of Innsbruck</div>
3           <div class="adr">
4               <span class="street-address">Technikestrasse 21a</span>,
5               <span class="locality">Tirol</span>
6               <span class="postal-code">6020</span>
7           </div>
8       </div>
9   </div>
10
```

  - *Reviews on the same page:*
    (parser replaces the whole <a> *element including its content)*

```
1   <div class="hreview">
2       <h1 class="summary">A place to study computer science!</h1>
```

hCard Microformat Example

- hCard profile, options:

```
1 | <link rel="profile" href="http://microformats.org/profile/hcard">
2 |
```

```
1 | <...>This content uses <a rel="profile"
2 |    href="http://microformats.org/profile/hcard">hCard.</...>
3 |
```

```
1 | <head profile="http://microformats.org/profile/hcard">..</head>
```

- Example specific rules
  - *vCard properties that do not make sense for hCard*
    - → *e.g., NAME, PROFILE, SOURCE, PRODID, VERSION*
    - → *publishers should not use them, parses should ignore them*
  - *if fn == org (i.e, class="fn org")*
    - → *hCard is a contact for a company, organization or a place*
    - → N *(person's name) property should not be used or be the empty string*
  - *if fn != org AND fn contains two words*
    - → fn *is split into* given-name *and* last-name
    - → *sub-properties of* N *peoperty (by a whitespace or a comma)*
  - *see a complete specification in hCard Microformat Specification* 🔗

Known Issues

- Name conflicts and scalability
  - *More microformats on a page may cause naming conflicts*
    - → *no namespace support,* **microformats do not scale**
    - → *functionality of tools may break when data formats change*

- No formal semantics, no reasoning support
  - *How important is it?*
  - *Semantics defined in XMDP profiles*
    - → *no formal basis though machine processable*

Uptake and some statistics

- Two billion pages annotated with hCard
- Google Rich Snippets
  - *Content indexing with microformats, microdata, RDFa*
    - → *see Google Rich Snippets* ⧉
    - → *94% of the rich snippets data uses microformats*

  Pizza **Pizzas Recipe** : Alton Brown : Food Network
  www.foodnetwork.com › Recipes › Italian
  ★★★★★ 229 reviews - 24 hrs 45 mins
  Food Network invites you to try this Pizza **Pizzas recipe** from Alton Brown.

- Firefox 3
  - *Native API to parse and process microformats in JavaScript*
  - *see Microformats support in Firefox 3* ⧉
- Facebook

Overview

- Microformats
- Microdata
- RDF and RDFa
- OpenGraph Protocol

Microdata

- Part of HTML5 specification
  - *Google is the main driver (rich snippets support)*
  - *spec includes:*
    - → *Microdata vocabularies*
    - → *Microdata Global Attributes*
  - *see W3C working draft*
- Idea similar to microformats, but
  - *items (collection of properties) have ids (URIs)*
  - *Microdata vocabulary, a formal description of terms*
    - → http://schema.org *is becoming a standard*
    - → *e.g., Event, Organization, Person, Product, Review*
    - → *Created and supported by Google, Microsoft, Yahoo!*
    - → *have RDF representation too*
  - *data formats not directly based on formats such as vCard, vCalendar, they define its own "simple" vocabulary*

Global Attributes

- Attributes on any HTML element
- Itemscope
  - *identifies an element which descendants contain some properties*
    ```
    1 | <div itemscope>...<div>
    ```
- Itemtype
  - *pointer to a vocabulary that describes the item and its properties* http://www.data-vocabulary.org/Person/
- Itemid
  - *global identifier of the item (URI)*
  - *such as a book's ISBN in urn schema,* urn:isbn:0-330-34032-8
- Itemprop
  - *a term from the vocabulary which value is in the element's content*
    ```
    1 | <span itemprop="nickname">Johny<span>
    ```
- Itemref
  - *a reference to other item within the same document*
    ```
    1 | <div itemscope itemref="myprofile"/>
    ```

Example

- Non-annotated HTML text

```
1  <section>
2    My name is Peter Brown and I work as a post-doc at the Innsbruck University
3    My friends often call me Pete. My office address is
4    Technikestrasse 21a, 6020, Innbruck, and you can also visit my homepage at
5    <a href="http://peter-brown.org">http://peter-brown.org</a>
6  </section>
```

- Annotated HTML text with microdata

```
1  <section itemscope itemtype="http://schema.org/Person">
2    My name is <span itemprop="name">Peter Brown</span> and I work as a
3    <span itemprop="title">post-doc</span> at the
4    <span itemprop="affiliation">Innsbruck University</span>.
5    My friends often call me <span itemprop="nickname">Pete</span>.
6    <section itemprop="address" itemscope itemtype="http://schema.org/Address">
7      My office address is <span itemprop="street-address">Tchnikestrasse 21a</
8      <span itemprop="postal-code">6020<span>,
9      <span itemprop="locality">Innsbruck</span>
10   <section>
11   and you can also visit my homepage at
12   <a href="http://peter-brown.org" itemprop="url">http://peter-brown.org</a>
13 </section>
14
```

Microformats vs. Microdata

- ## Scalability
  - *Microformats specs are complicated because of specific rules tailored for vCard, vResume, etc.*
  - *Microdata can be easilly extensible, when new property occur they can be added witout breaking conformance of tools*

- ## Standards-based
  - *Microdata is a standard part of HTML5 effort*
  - *Microformats is an "ad-hoc" group of ethusiastic people, though widely supported*
    → *Strength is in underyling well-established formats*

Overview

- Microformats
- Microdata
- **RDF and RDFa**
  - *Structured Property Values*
  - *Encoding RDF in XML (RDF/XML)*
  - *RDF-in attributes (RDFa)*
- OpenGraph Protocol

RDF

- Resource Description Framework (RDF)
  - *Resource – as defined in Web architecture*
    - → *usually anything that can be conveyed electronically*
    - → *plus abstract concepts that have no representation*
  - *RDF is at the bottom of Semantic Web stack of languages*
- References
  - *W3C Recommendations:*
    - → *RDF Suite of W3C Recommendations ⧉,*
    - → *RDF Primer ⧉*

Meaning of Data in XML

- A resource with URI http://www.vitvar.com/data-about-me

```
1   <person xmlns="http://example.org/people">
2       <name>Tomas Vitvar</name>
3       <mailbox>tomas@vitvar.com</mailbox>
4       <city>Innsbruck</city>
5   </person>
```

- No explicit meaning of terms
  - *person, name, mailbox, ... are terms defined in namespace* http://example.org/people *but there is no URI assigned to them this does not work here:* http://example.org/people#name

- No explicit meaning of relationships
  - *a person <u>has</u> name <u>with value</u> Tomas Vitvar (→ Tomas Vitvar <u>is a</u> person), this person <u>has</u> mailbox <u>with value</u> tomas@vitvar.com (→ tomas@vitvar.com <u>is a</u> mailbox), etc. BUT this person lives?, works?, was born?, ... in a city Innsbruck*
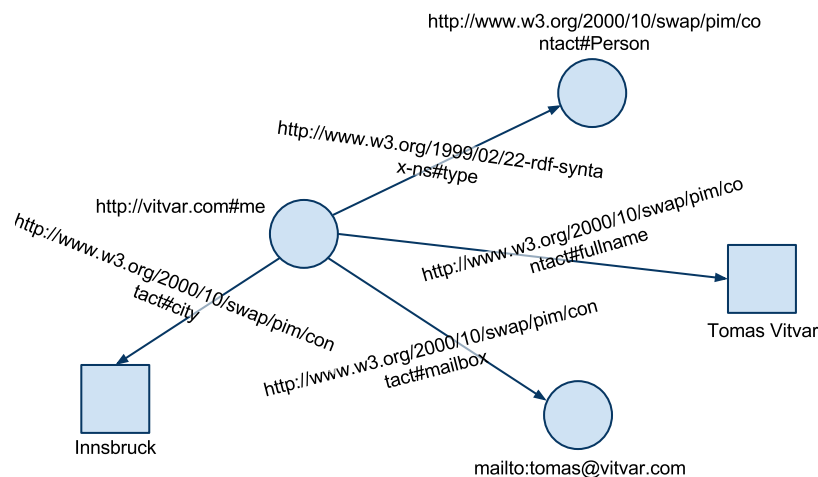
RDF Statement

- RDF Tripple: **subject – predicate – object**
  - *a thing the statement describes (subject)*
  - *a specific property of the object (predicate)*
  - *a value of the property (subject)*
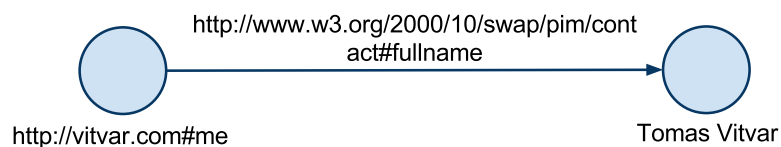
- Representation of statements
  - *using a graph notation*
    - *→ nodes are subject and objects (rectangles are literals)*
    - *→ arcs are predicates*
  - *identifiers to identify subject, predicate, object*
    - *→ URI references (URIrefs)*
  - *machine processable language*
    - *→ RDF serializations in triples, RDF/XML, N3, Turtle*

Meaning of Data in RDF

- **individuals:** Tomas Vitvar identified by
  http://vitvar.com#me

- **kinds of things:** Person identified by #Person
  - *properties* of those things, e.g., mailbox, identified by
    #mailbox

References in statements

- URI identifies
  - *network-accessible things (electronic documents) → URL*
  - *things that are not network-accessible, such as human beings*
  - *abstract concepts that do not physically exist, such as "fullname"*
  - ***RDF uses <u>URI references</u> to identify subjects, predicates, objects***

- URI references (or URIref in short)
  - *URI with an optional fragment identifier*
  - http://www.w3.org/2000/10/swap/pim/contact#fullname
  - ***RDF resource is anything that can be identified with URIref***
  - *a set of URIrefs is called a **RDF vocabulary***

- Literals

RDF Serializations – Triples Notation

- Triples notation
  - *list of all triples from RDF graph*
  - *the full triples notation requires that URI references be written out completely (in angled brackets)*
  - *very long documents, some URIrefs need to be repeated*

```
1 │ <http://www.example.org/index.html> <http://purl.org/dc/elements/1.1/creator>
```

- Simplicity for examples
  - *QNames without angle brackets*
  - *Common prefixes and namespaces:*

```
1 │ rdf:  http://www.w3.org/1999/02/22-rdf-syntax-ns#
2 │ rdfs: http://www.w3.org/2000/01/rdf-schema#
3 │ dc: http://purl.org/dc/elements/1.1/
4 │ ex: http://www.example.org/
5 │ ext: http://www.example.org/terms
6 │ xsd: http://www.w3.org/2001/XMLSchema#
```

  - *example*

```
1 │ ex:index.html dc:creator "Tomas" .
2 │ ex:index.html dc:language "en" .
```

Kinds of Things

- Property rdf:type
  - *defines a type of a resource*
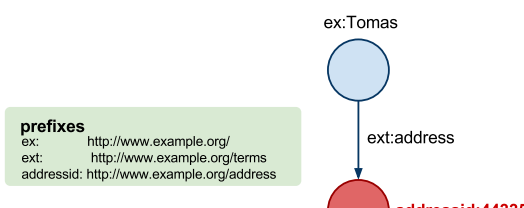
```
1 │ ex:me rdf:type ext:Person .
```

  - *corresponds to "is a member of" relationship*
  - ext:Person *understood as a class*
    - → *however, RDF language does not define its semantics*
    - → *RDF Schema language provides additional vocabulary for class semantics*

Overview

- Microformats
- Microdata
- RDF and RDFa
  - *Structured Property Values*
  - *Encoding RDF in XML (RDF/XML)*
  - *RDF–in attributes (RDFa)*
- OpenGraph Protocol

Structured Property Values

- Consider real-world complex structures
  - *Tomas works at Technikestrasse 21a, 6020 Innsbruck, Austria*
  - *One option to describe this using RDF:*

```
1 | ex:Tomas ext:works "Technikestrasse 21a, 6020 Innsbruck, Aust
```

  - *But this is not often sufficient, such statements usually need to be recored as a structure, i.e. a street, a city, ZIP, ...*
    - → *describe Tomas's **address as a resource** that has a URIref*

ex:Tomas

ext:address

prefixes
ex: http://www.example.org/
ext: http://www.example.org/terms
addressid: http://www.example.org/address

addressid:44335

Blank Nodes

- Does every structure need to have a URIref?
  - *When referenced from outside of the graphs yes, otherwise not*
- Blank nodes
  - *Nodes that do not need to be referenced from outside of the graph*
  - *No need for URIref, they are only used within the graph*
- Blank node identifier
  - *local within a graph: _:localID, must be uniqie within the graph*
  - *two blank nodes in two graphs with the same IDs are not the same!*

ex:Tomas

prefixes
ex: http://www.example.org/

ext:address

Modeling with Blank Nodes

- N-ary relationships
  - *In fact, a blank node is a way to model an n-ary relationships*
  - *A blank node breaks down an n-ary to binary relationships*
  - *3-ary relationship between Tomas and (Technikestr, Innsbruck, 6020)*
    Tomas – Technikestr, Tomas – Innsbruck, Tomas – 6020
- Unidentified things
  - *not always good to use URIs such as e-mails to identify people*
    - → *e-mails may change, disappear, …*
    - → *sometimes no need to assign unique ids to people*
  - *Example*
    - → *the author of the book is* mailto:tomas@vitvar.com*, as oposed to*
      it is a person with e-mail mailto:tomas@vitvar.com

Untyped and Typed Literals

- Untyped Literals
  - *No information about how to interpret a value of the plain literal*
  - *a programme must have a knowledge how to interpret the value*

```
1 | ex:person1 ext:age "24" .
```

- Typed literals
  - *pairing a string with a URIref that identifies a particular datatype*
    (xsd: refers to http://www.w3.org/2001/XMLSchema#)

```
1 | ex:person1 ext:age "24"^^xsd:integer
```

  - *RDF does not define its own data types (except rdf:XMLLiteral)*
    → no need to map external to native ones
  - *RDF uses external data types defined in XML Schema*

Overview

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Basic Rules

- Representation of RDF in XML language
- Example RDF triple
  - *a page* index.html *was created on August 16, 1999*

    ```
    1 | ex:index.html   ext:creation-date   "Aug 16, 1999" .
    ```

- RDF/XML representation
  - *We can interpret a RDF statement as:*
    *a **description** that is **about** a <u>subject</u> of the statement*
  - *XML element (QName) of the description is the **predicate***
  - *a value of the element is the **object***

    ```
    1 | <?xml version="1.0"?>
    2 | <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    3 |     xmlns:ext="http://www.example.org/terms/">
    4 |
    5 |     <rdf:Description rdf:about="http://www.example.org/index.html">
    6 |         <ext:creation-date>August 16, 1999</ext:creation-date>
    7 |     </rdf:Description>
    8 | </rdf:RDF>
    ```

  - ***URIrefs must be written out when in attribute values***

Multiple Statements and Typed Literals

- Example RDF triples

  ```
  1 | ex:index.html   ext:creation-date   "Aug 16, 1999" .
  2 | ex:index.html   dc:language   "en" .
  3 | ex:index.html   ext:rank   "3"^^xsd:decimal .
  4 | ex:index.html   dc:creator   <http://www.vitvar.com#me> .
  ```

- RDF/XML representation

  ```
  1  | <?xml version="1.0"?>
  2  | <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  3  |     xmlns:dc="http://purl.org/dc/elements/1.1/"
  4  |     xmlns:ext="http://www.example.org/terms/">
  5  |
  6  |     <rdf:Description rdf:about="http://www.example.org/index.html">
  7  |         <ext:creation-date>August 16, 1999</ext:creation-date>
  8  |         <dc:language>en</dc:language>
  9  |         <ext:rank
  10 |             rdf:datatype="http://www.w3.org/2001/XMLSchema#decimal">
  11 |             3</ext:rank>
  12 |         <dc:creator rdf:resource="http://www.vitvar.com#me"/>
  13 |     </rdf:Description>
  14 | </rdf:RDF>
  15 |
  ```

  - *a description may combine all properties for a single subject but there also can be a description for every subject (such representations are the same)*

Blank Nodes

- Example RDF triples

```
1   ex:index.html   ext:editor   _:editor332 .
2   _editor332   ext:name   "Tomas Vitvar" .
3   _editor332   ext:homepage   <http://www.vitvar.com> .
```

- RDF/XML representation

```
1   <?xml version="1.0"?>
2   <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
3       xmlns:ext="http://www.example.org/terms/">
4
5       <rdf:Description rdf:about="http://www.example.org/index.html">
6           <ext:editor rdf:nodeId="editor332"/>
7       </rdf:Description>
8
9       <rdf:Description rdf:nodeId="editor332">
10          <ext:name>Tomas Vitvar<ext:name>
11          <ext:homepage rdf:resource="http://www.vitvar.com"/>
12      </rdf:Description>
13
14  </rdf:RDF>
```

  – *A node with id* `editor332` *can be referenced from within the RDF graph,*
  not outside of the RDF graph

Overview

- ## Microformats

- ## Microdata

- ## RDF and RDFa
  - *Structured Property Values*
  - *Encoding RDF in XML (RDF/XML)*
  - *RDF–in attributes (RDFa)*

- ## OpenGraph Protocol

RDFa

- Embedding RDF data in XHTML
  – *XHTML only, is extensible, HTML not*
    → *RDFa defines a number of extension attributes*
  – *Parses may recognize RDFa annotations in HTML too*
  – *RDFa is generic to embed arbitrary RDF data*
    → *however, only standard (commonly agreed) vocabularies make sense*

- W3C Recommendations:
  – *RDFa Specification* ⧉
  – *RDFa Primer* ⧉

Property and Object Values as Resources

- Creating a property using rel attribute
  – *assume, following text is at* http://blog.vitvar.com/?p=107

```
1   Content on this page is licensed under
2   <a xmlns:ext="http://www.example.org/terms"
3      rel="ext:license"
4      href="http://creativecommons.org/license/by/3.0">
5      a Creative Commons License — attribution
6   </a>
```

  – *This corresponds to the RDF triple*

```
1   <http://blog.vitvar.com/?p=107> ext:license
2      <http://creativecommons.org/license/by/3.0> .
```

    → *When the subject is not explicitly stated, then the subject is the URL of the XHTML page being described*

Property and Object Values as Literals

- Creating a property using property attribute
  - *RDFa defines a property extension attribute*
  - *assume, following text is at http://blog.vitvar.com/?p=107*

    ```
    1  <div xmlns:dc="http://purl.org/dc/elements/1.1/">
    2    <h3 property="dc:creator">Tomas<h3>
    3  </div>
    ```

  - *This corresponds to the RDF triple*

    ```
    1  <http://blog.vitvar.com/?p=107> dc:creator "Tomas" .
    ```

- Typed literals
  - *RDFa defines a datatype extension attribute*

    ```
    1  <div xmlns:dc="http://purl.org/dc/elements/1.1/"
    2        xmlns:xsd="http://www.w3.org/2001/XMLSchema#">
    3    <h3 property="dc:creator" datatype="xsd:string">Tomas<h3>
    4  </div>
    ```

- Alternative content
  - *RDFa defines content extension attribute*
    - → *replaces the object value that is in the element's value*

    ```
    1  <div xmlns:dc="http://purl.org/dc/elements/1.1/">
    2    <h3 property="dc:date" content="2011-04-08">8 April<h3>
    3  </div>
    4
    ```

Subject

- Creating a subject using about attribute
  - *RDFa defines about extension attribute*
  - *Let the following text is at http://blog.vitvar.com/?p=107*

    ```
    1  <div xmlns:dc="http://purl.org/dc/elements/1.1/"
    2        about="/p/107" >
    3    <h3 property="dc:creator">Tomas<h3>
    4  </div>
    ```

  - *This corresponds to the RDF triple*

    ```
    1  <http://blog.vitvar.com/p/107> dc:creator "Tomas".
    ```

  - *Also possible to use multiple subjects on a single page*

Types and Blank Nodes

- Types
  - *RDFa defines* typeof *extension attribute*
    → corresponds to rdf:type *property*

- Blank node
  - *When annotation has* typeof *but not* about
    → blank node, that is, a node without a subject

```
1   <div about="#me" rel="foaf:knows"
2     xmlns:foaf="http://xmlns.com/foaf/0.1">
3   <div typeof="foaf:person">
4     <p property="foaf:name">Peter<p>
5     <p>
6       Email: <a rel="foaf:mbox" href="mailto:peter@novak.cz
7         peter@novak.cz</a>
8     <p>
9   </div>
```
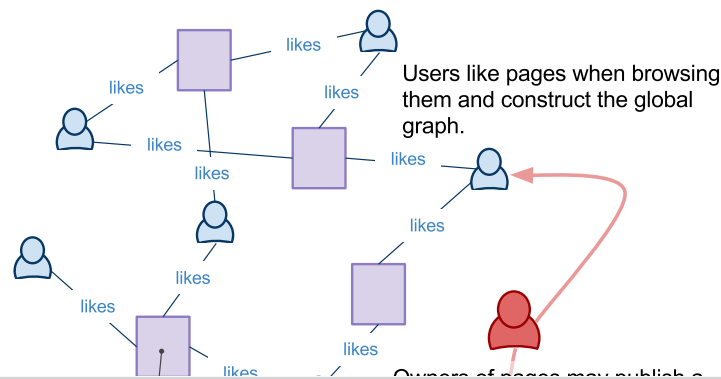
  - *I know Peter who has e-mail petr@novak.cz*

Overview

- Microformats
- Microdata
- RDF and RDFa
- OpenGraph Protocol

OpenGraph Protocol

- Global Social Graph
  - *important adoption of RDFa, see Open Graph Protocol* ⬈
  - *defines meta-data for pages' description so that it can be easily included in a global graph connecting people and pages through "likes" (a person – likes – a page)*

Users like pages when browsing them and construct the global graph.

Owners of pages may publish a

Page Annotations

- Open Graph protocol main properties
  - *a page is the subject in the RDF triple*
  - og:title – *title of the page*
  - og:type – *type of the content (e.g., movie)*
  - og:image – *URL of the image for the page*
  - og:url – *a canonical URL of the page to be used as its permanent ID in the graph*
- HTML page annotation RDFa example

```
1  <html xmlns:og="http://ogp.me/ns#">
2    <head>
3      <title>The Rock (1996)</title>
4      <meta property="og:title" content="The Rock" />
5      <meta property="og:type" content="movie" />
6      <meta property="og:url" content="http://www.imdb.com/title/402/" />
7      <meta property="og:image" content="http://media-imdb.com/rock.jpg" />
8      ...
9    </head>
10   ...
11 </html>
```

Publishing updates

- Ownership
  - *Page must be associated with a Facebook application*
    - → *using* fb:app_id *meta tag*
  - *Owners can publish a stream of updates using the Facebook Graph API* ⧉

- Getting access

```
1   curl -F type=client_cred \
2       -F client_id=app_id \
3       -F client_secret=app_secret \
4       https://graph.facebook.com/oauth/access token
```

- Publishing updates

```
1   curl -F 'access_token=...' \
2       -F 'message=Hello Likers' \
3       -F 'id=http://www.mydomain.com/great_page.html' \
4       https://graph.facebook.com/feed
```