

# Web 2.0

## Lecture 10: Annotations

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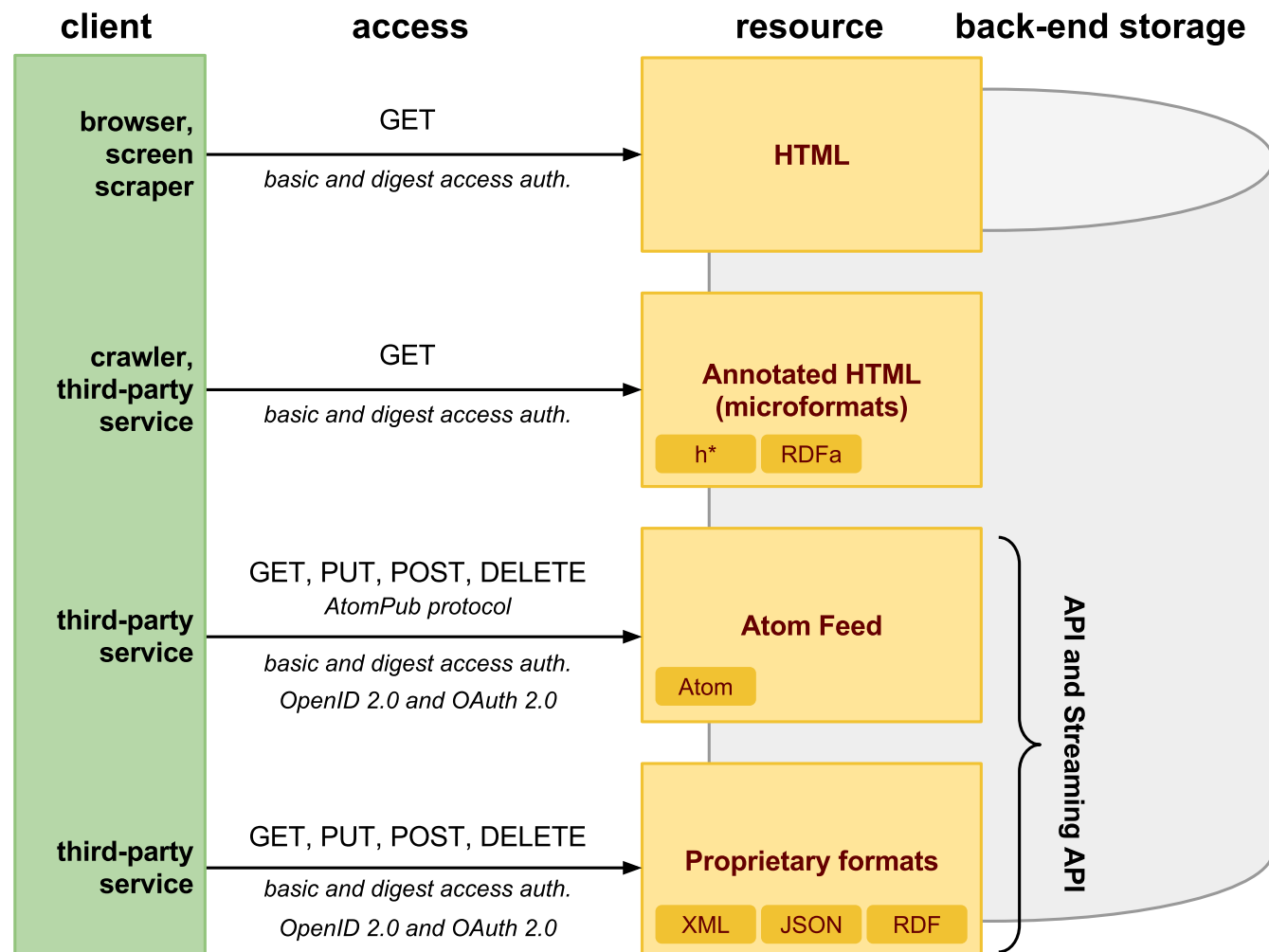
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Evropský sociální fond  
Praha & EU: Investujeme do vaší budoucnosti

Modified: Thu May 01 2014, 09:51:25  
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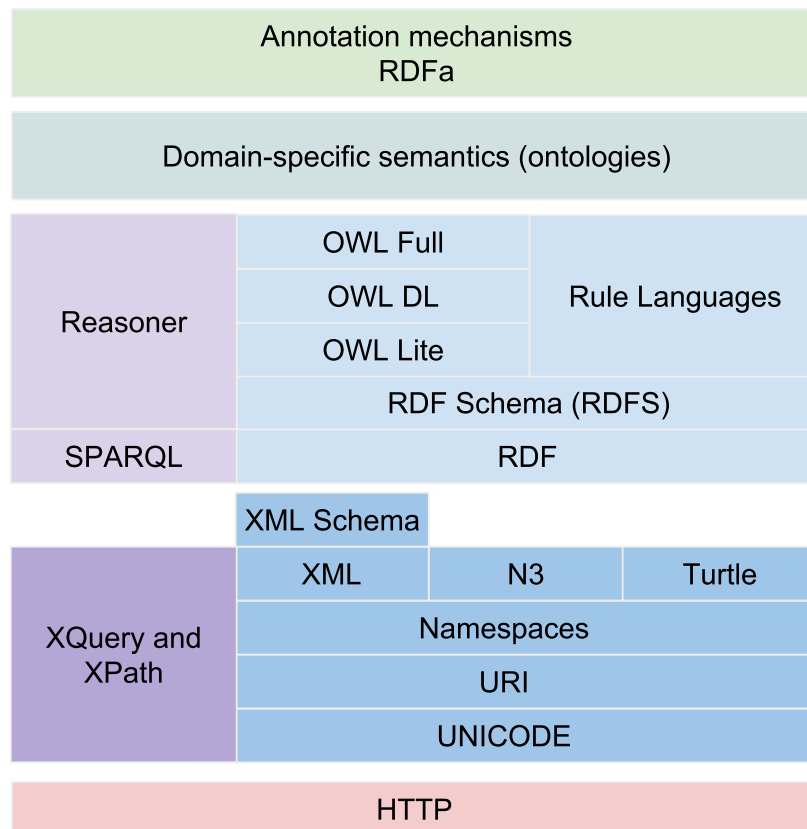
# Data on the Web



# Data Syntax, Structure and Semantics

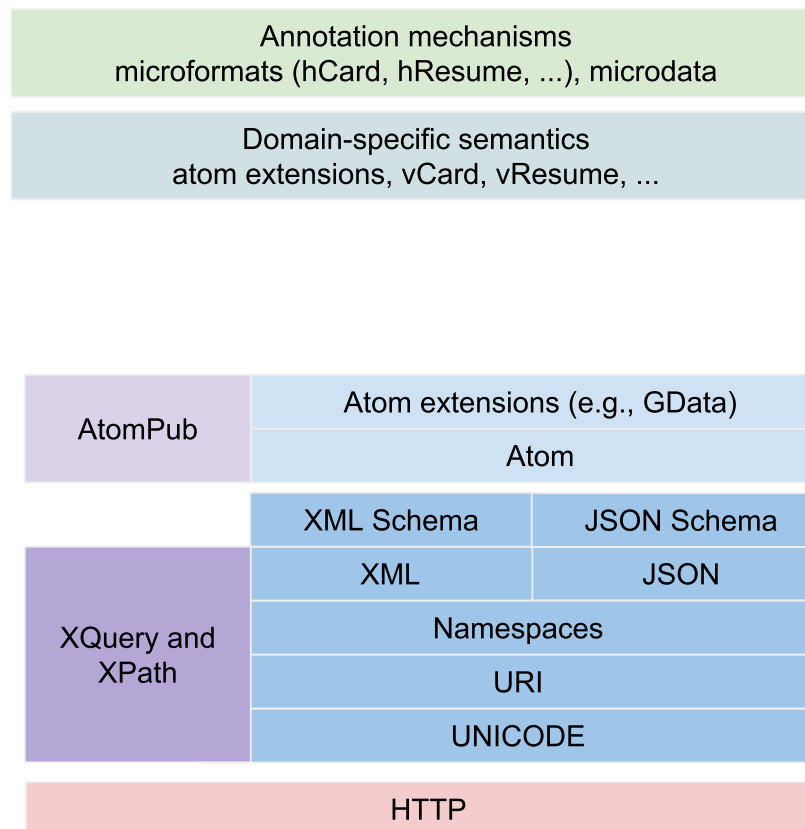
## Semantic Web Layered Cake

syntax and formal semantics



## Web Data Formats

syntax and semantics (structure)



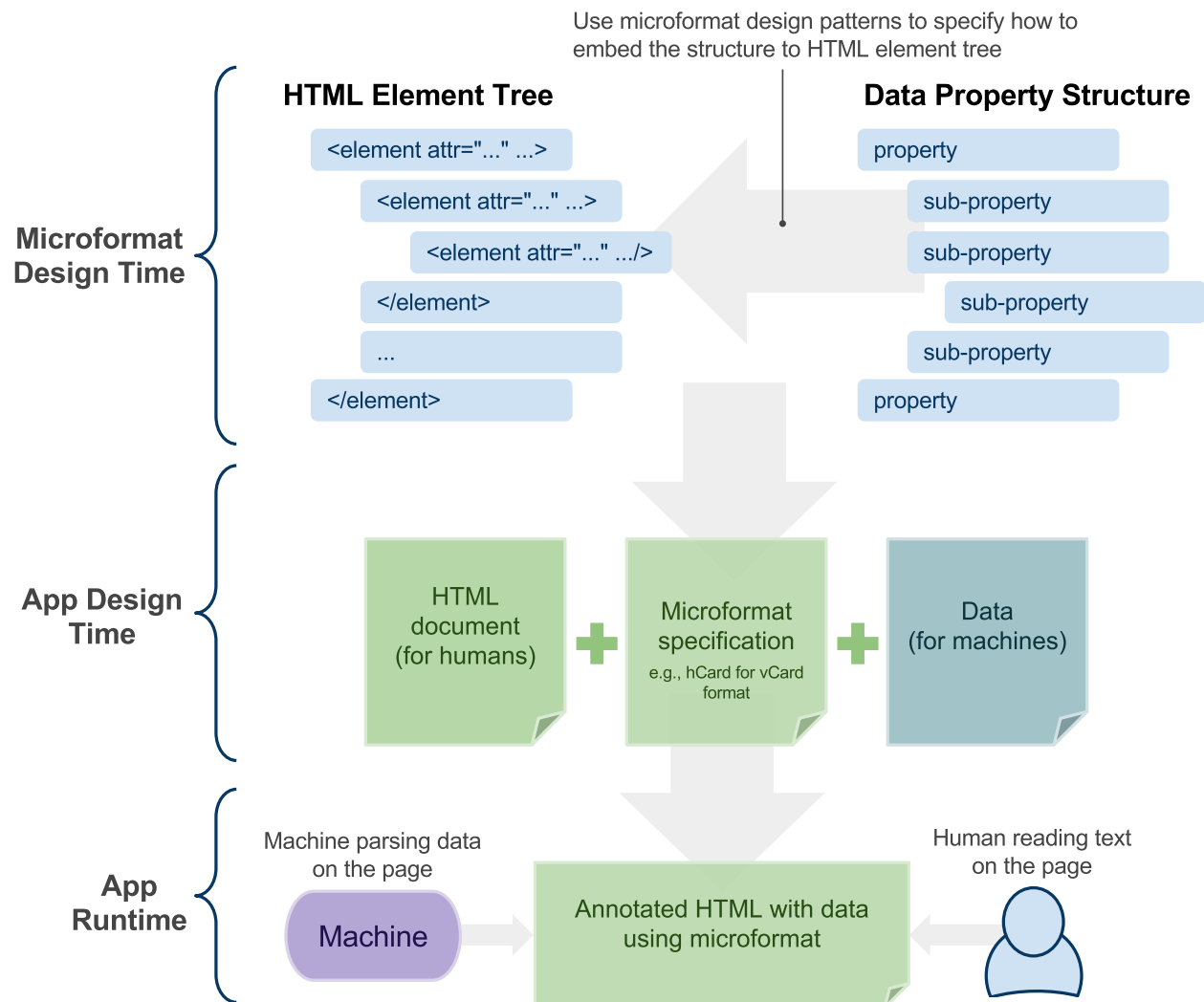
# Overview

- 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*
    - *should be defined in a well-established format spec*
    - *a microformat spec needs to be defined for every data*

# Microformats Usage



# 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 namespace!*
  - *See XHTML Metadata Profiles [↗](#) specification*

# 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 **+430554554556** is not valid)*

```
1 <span class="tel">
2   <span class="type">Work</span>:
3   <span class="value">+43</span>(0)
4   <span class="value">554 554 556</span>
5 </span>
```

# 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>
3    <div class="item"><a class="include" href="#uibk-card">Innsbruck Uni</a></div>
4    <p class="description">Courses in English, fields of computer science.</p>
5  </div>
```

# 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** property (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*
    - *lack of compatibility with RDF/RDFa*
    - *See [Microformats and RDF/RDFa compatibility](#) for details.*

# 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
  - *hCalendar and hCard for events*
  - *see Microformats in 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">Johnny<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</span>
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 easily extensible, when new property occur they can be added without breaking conformance of tools*
- Standards-based
  - *Microdata is a standard part of HTML5 effort*
  - *Microformats is an "ad-hoc" group of enthusiastic people, though widely supported*
    - *Strength is in underlying well-established formats*
  - *Microdata have links to Semantic Web efforts and Linked Data (via RDF), microformats not*

# 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

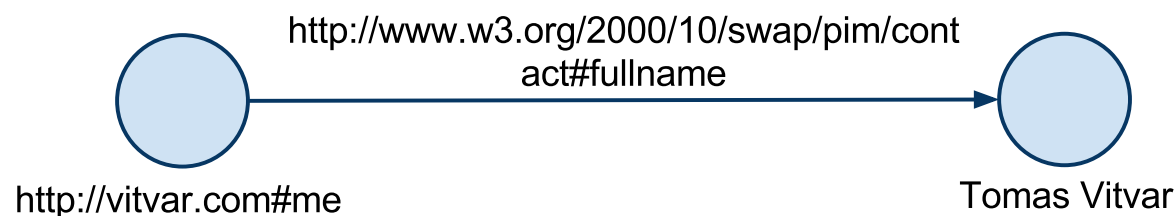
- A resource with URI <http://www.vitvar.com/data-about-me>

```
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 has name with value Tomas Vitvar (→ Tomas Vitvar is a person), this person has mailbox with value tomas@vitvar.com (→ tomas@vitvar.com is a mailbox), etc.  
BUT this person lives?, works?, was born?, ... in a city Innsbruck
- Need for a language to describe statements  
→ Resource Description Framework

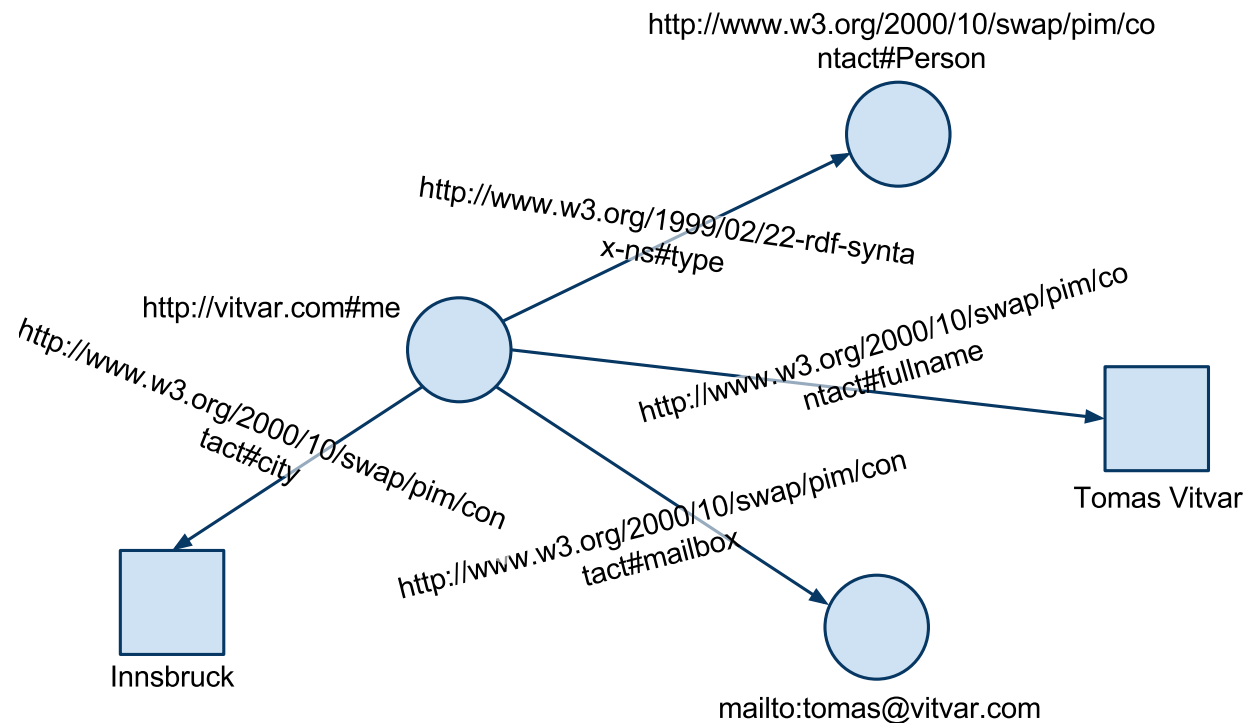
# RDF Statement

- 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 notations*

# 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`
  - *values* of those properties, e.g. `mailto:tomas@vitvar.com`
  - + values of other data types such as strings, integers, dates, etc.

# 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 URI references to identify subjects, predicates, objects***
- URI references (or URIs 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 URIs***
  - *a set of URIs is called a **RDF vocabulary***
- Literals
  - *character strings to represent property values*
  - *can only be assigned to objects in RDF*  
*(in other words, objects can be either URIs or literals)*
    - *they cannot be assigned to subjects or properties*
  - *two kinds: **plain literals** and **typed 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 URIs need to be repeated*

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

- 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*

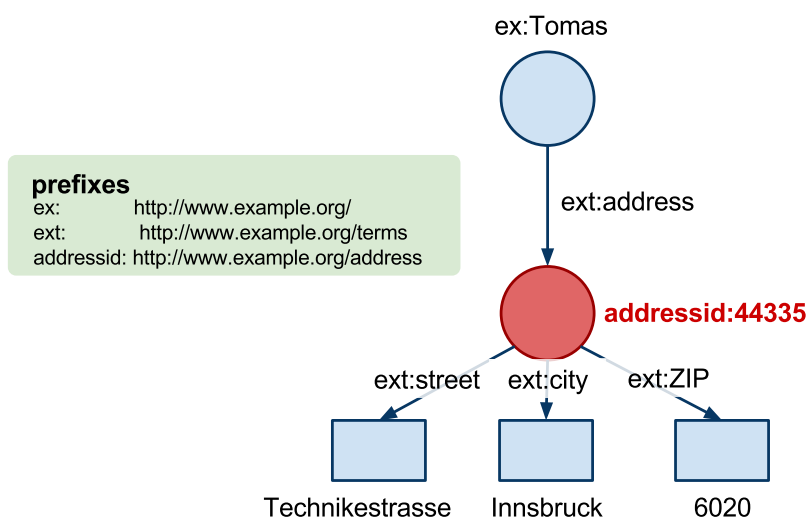
- *RDF Schema language provides additional vocabulary for class semantics*

# Overview

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

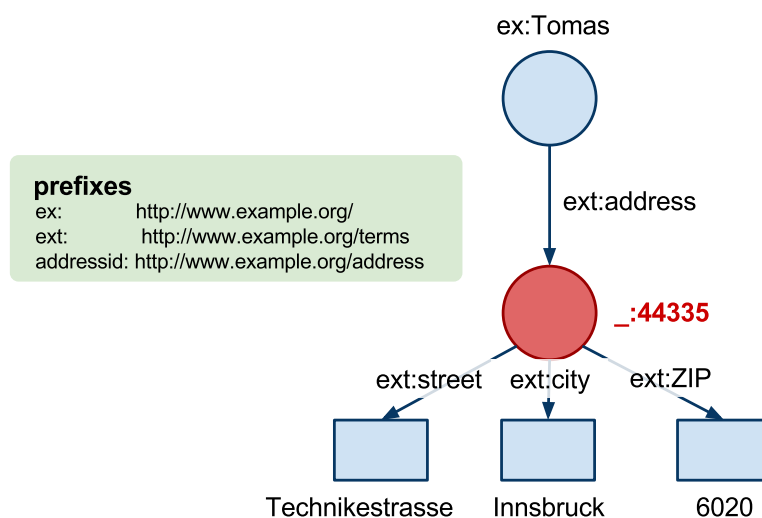
# Structured Property Values

- 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, Austria" .`
  - *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*



# 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 unique within the graph*
  - *two blank nodes in two graphs with the same IDs are not the same!*



# 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`*
  - *A person is an **abstract concept** that can be modeled using a blank node*

```
1 | ex:book23 ext:author _:author1 .
2 | _:author1 ext:email <mailto:tomas@vitvar.com .
3 | _:author1 ext:name "Tomas Vitvar" .
4 | _:author1 rdf:type ex:person .
```

# 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*  
→ *not all are suitable, only basic ones such as **string, integer, date***

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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 subject 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

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# RDFa

- Embedding RDF data in XHTML
  - *XHTML only, is extensible, HTML not*
    - *RDFa defines a number of extension attributes*
  - *Parsers 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/licenses/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/licenses/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>
```

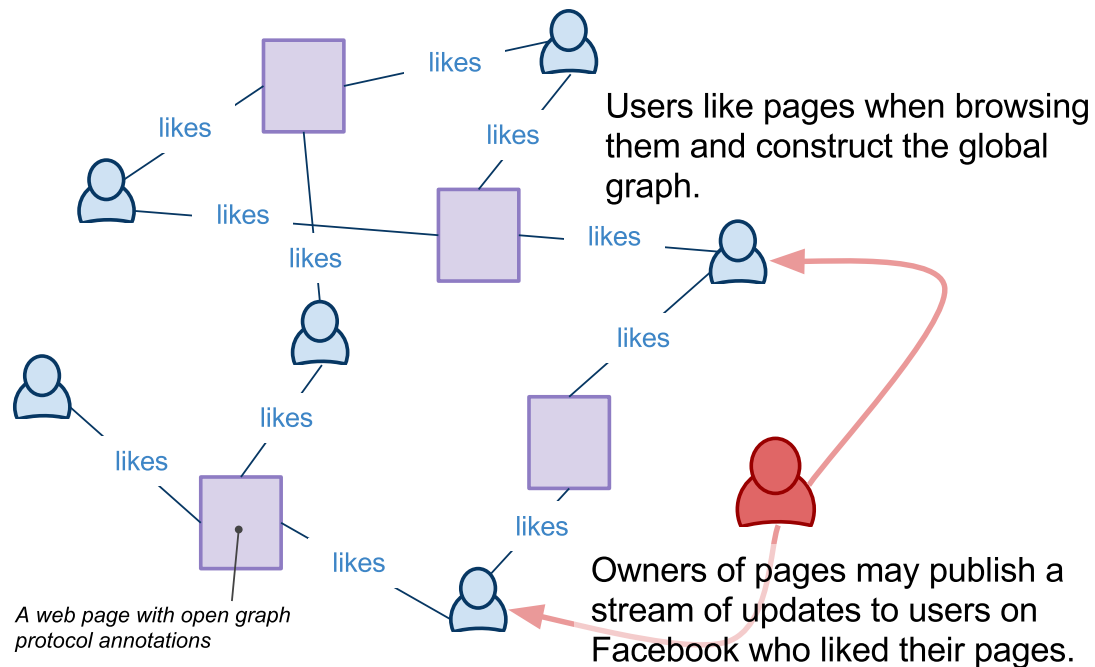
- *I know Peter who has e-mail petr@novak.cz*

# 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)*



# 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
```