Semantics in User Interfaces

Steffen Staab
Maciej Janik

Semantic Web
2009-07-07
Motivation

- Why do we need semantics in user interfaces?
  - Browsing large knowledge bases
    - Use schema metadata, classes, relationships
  - Easy and understandable search capabilities
    - Navigation across different interesting aspects of data
  - Provide meaningful presentation of underlying data
    - Show additional metadata
  - Customize presentation layer
    - Based on underlying knowledge
    - Based on user preferences
Knowledge base browsing / querying

Problem:
- Data is in the knowledge base, but we need an easy way to access it
- Querying with SPARQL gives correct results, but is not for everybody
  - Query writing is error prone
  - No information what elements include in the query

Solution
- User interface that hides this complexity
- Easy and intuitive to use by anybody
- Providing navigational suggestions for better explore data
  - Suggest how knowledge can be browsed to discover what is there
Examples of semantic user interfaces

- Freebase Parallax
  - Semantic browser
  - http://mqlx.com/~david/parallax/

- /facet
  - E-Culture MultimediaN - cultural heritage search

- Fresnel lenses
  - Lena project

- Semantic Desktops
  - Haystack http://groups.csail.mit.edu/haystack/
  - X-Cosim http://isweb.uni-koblenz.de/Research/ontologies/x-cosim
  - Nepomuk KDE http://nepomuk.kde.org/

- Semaplorer
  - http://btc.isweb.uni-koblenz.de/

- Checkout the Semantic Web Challenges of the Int. Semantic Web Conference
Freebase Parallax

- Originally designed and built by **David Huynh**

- Open, shared database that collects data from the Web to build a massive, collaboratively-edited database of cross-linked data.

- Built and edited by the community, for the community.

- Free for anyone to query, contribute to, build applications on top of, or integrate into their Web sites.

- Focus is on organizing and managing complex data structures by use of Semantic Web technologies.

- Enables extraction of ordered knowledge from the current Web.
Freebase repository

- Covers millions of topics in hundreds of categories.
- Draws from large open repositories like Wikipedia, MusicBrainz, and the SEC archives.
- Contains structured information on many popular topics (movies, music, people, locations, etc.)
- Information is reconciled.
  - Single person/object in real world is reconciled into one entity, despite that information comes from multiple sources.
- Freely available via an open API.
- User community contributes to Freebase information by adding and editing information
Freebase semantics

- Freebase spans multiple domains and knowledge bases, but requires that a particular entity exists only once, even if it might normally be found in multiple databases.

- Example: Arnold Schwarzenegger
  - Actor → movie database
  - Governor → political database
  - Mr. Universe → bodybuilder database

- Freebase:
  - Only one entity for Arnold Schwarzenegger
  - View includes all three facets

- The unified entity acts as an information hub, making it easy to find and contribute information about him.
Freebase example

How Arnold Schwarzenegger is related to John F. Kennedy?

- On exercises:
  - dbpedia.org + SPARQL query
  - Finding intermediate resources and relationships
  - Composing complex query

```prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix dbpedia: <http://dbpedia.org/resource/>
prefix foaf: <http://xmlns.com/foaf/0.1/>
where { dbpedia:Arnold_Schwarzenegger ?a ?b .
  ?b ?c ?d .
  ?b rdf:type foaf:Person .
  filter (?b != dbpedia:Arnold_Schwarzenegger ) .
  filter (?d != dbpedia:Arnold_Schwarzenegger ) }
```

We can do better!
Arnold Schwarzenegger

Also known as: Arnold Alois Schwarzenegger, The Governor

Vanessa Williams
http://www.whoisintwmo.com/celebrities/people/dating-Williams.html

Maria Shriver
http://www.pacificrice.org/events.html

Garneres ANSI
http://www.sunglassasid.com/index.php?g=Arnold-Schwarzenegger

Schatzi

Cafe Roma
http://www.iceteo.com

David Orgell
http://www.merodia.com/entry/arnold-schwarzenegger-shops-at-david-orgell-on-saturday/18603599

Hermès
### Arnold Schwarzenegger

**Also known as:** Arnold Alois Schwarzenegger, The Governor

<table>
<thead>
<tr>
<th>As Celebrity</th>
<th>Religion</th>
<th>Roman Catholicism</th>
</tr>
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<tbody>
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<td></td>
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<tr>
<td>As Topic</td>
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</tr>
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<td>Children</td>
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<td>Quotations</td>
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<td><strong>As Topic</strong></td>
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<td><strong>Siblings</strong></td>
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<tr>
<td>Sibling</td>
<td>Meinhard Schwarzenegger</td>
<td></td>
</tr>
<tr>
<td><strong>Spouse (or domestic partner)</strong></td>
<td>Spouse</td>
<td>Maria Shriver</td>
</tr>
<tr>
<td>From</td>
<td>1986-04-26</td>
<td></td>
</tr>
<tr>
<td><strong>Employment History</strong></td>
<td>Employer</td>
<td>Flex Magazine</td>
</tr>
<tr>
<td>Title</td>
<td>Executive Editor</td>
<td></td>
</tr>
<tr>
<td><strong>Data of birth</strong></td>
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<td>Tulln</td>
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<td><strong>Weight</strong></td>
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<td></td>
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<td><strong>Career End</strong></td>
<td>1990</td>
<td></td>
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<td><strong>Country of nationality</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Profession</strong></td>
<td>Bodybuilder</td>
<td></td>
</tr>
<tr>
<td>Businessperson</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entrepreneur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Politician</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Film director</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Film producer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Arnold Alois Schwarzenegger (English pronunciation: /ˈʃvɑːrtʃenəɡər/, German [ˈʃvaʁtsənaˌɡɐ], born July 30, 1947) is an Austrian American bodybuilder, actor, businessman, and...
Maria Shriver

Also known as: Maria Owings Shriver

Religion: Roman Catholicism
Ethnicity: Irish American
Parents: Eunice Kennedy Shriver, Sargent Shriver
Siblings: Robert Sargent Shriver II
Spouse: Arnold Schwarzenegger

Data of birth: 1956
Place of birth: Chicago
Gender: Female
Country of nationality: United States
Profession: Writer, Journalist, TV/Actor, Person, Author

Maria Owings Shriver (pronounced "Shruhver"); born November 6, 1956) is an award-winning American journalist, author and First Lady of California. She is married to Governor of California Arnold...
Eunice Kennedy Shriver

Religion: Roman Catholicism

Parents:
- Joseph P. Kennedy, Sr.
- Rose Fitzgerald Kennedy

Children:
- Maria Shriver
- Timothy P. Shriver
- Robert Sargent Shriver III

Siblings:
- John F. Kennedy

Spouse (or domestic partner):
- Sargent Shriver

Date of birth: 1921-07-10
Place of birth: Brookline
Gender: Female
Country of nationality: United States

Eunice Mary Kennedy Shriver (born July 10, 1921) is a member of the Kennedy family and helped to found the Special Olympics in the 1960s as a national event. Born in Brookline, Massachusetts,...
John F. Kennedy

Also known as: John Kennedy, Jack Kennedy, JFK, President John F. Kennedy, John Fitzgerald Kennedy

Religion: Roman Catholicism
Ethnicity: White
Parents: Joseph P. Kennedy, Sr. - Rose Fitzgerald Kennedy
Children: Carole Kennedy - John F. Kennedy, Jr. - Patrick Bouvier Kennedy
Spouse (or domestic partner): Jacqueline Kennedy - Kennedy/Casis

Date of birth: 1917-05-29
Place of birth: Brookline
Gender: Male
Date of death: 1963-11-22T12:30
Place of death: Dallas
Date murdered: 1963-11-22T12:30
Place murdered: Dallas
Place of death: Dallas
THOMAS ID: K000107
Country of nationality: United States

Profession: Politician
Murdered by: Lee Harvey Oswald
Facet ...

- **Facets** are flat faces on geometric shapes. [Wikipedia]

- **Facet** [Webster dictionary]
  - a small plane surface (as on a cut gem)
  - any of the definable aspects that make up a subject (as of contemplation) or an object (as of consideration)
  - the external corneal surface of an ommatidium
  - a smooth flat circumscribed anatomical surface (as of a bone)

A Ruby with visible facets
What is a facet?

- **Facet** (can be viewed as)
  - Aspect, phase, restriction, filter …

- A faceted classification system allows the assignment of **multiple classifications** to an object, enabling the classifications to be **ordered in multiple ways**, rather than in a single, pre-determined, taxonomic order.

- **Faceted browsing**
  - Enable a user to navigate information along multiple paths corresponding to different orderings of the facets
  - Facets are applied at search time
  - Active interface creating dynamic combination of search and browse features
Faceted navigation

- Facets are **not categories**
  - Entities or concepts belong to a category
  - Entities have facets

- Facets are **metadata**
  - Are based on properties or attributes
  - Entities or concepts fit into one category
  - All entities have all facets – defined by set of values

- Facets are **orthogonal**
  - Describe mutually exclusive dimensions
  - An event is not a person is not a document is not a place.
  - A winery is not a region is not a price is not a color.
Faceted navigation

- Example of faceted search and navigation
  - E-Culture MultimediaN
- Sample dimensions of facets

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Semantic Web
ISWeb - Information Systems & Semantic Web
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Semantic Web
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ISWeb - Information Systems & Semantic Web
### E-Culture MultimediaN

**Cultural heritage search**

#### Search Options
- **search**
- **browse**
- **annotate**
- **thesaurus**

#### Login and Help Options
- **login**
- **help**

#### Language Selection
- **English**

---

#### Table of Artworks

<table>
<thead>
<tr>
<th>Work</th>
<th>Creator</th>
<th>Style/Period</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Steps</td>
<td>Vincent van Gogh</td>
<td>Post-Impressionist</td>
<td>1887-1888</td>
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<tr>
<td>Branches with Almond Trees</td>
<td>Vincent van Gogh</td>
<td>Post-Impressionist</td>
<td>1889</td>
</tr>
<tr>
<td>Wheat Field Under Thatched Cottages</td>
<td>Vincent van Gogh</td>
<td>Post-Impressionist</td>
<td>1887</td>
</tr>
<tr>
<td>Road with Cypress Trees</td>
<td>Vincent van Gogh</td>
<td>Post-Impressionist</td>
<td>1887</td>
</tr>
<tr>
<td>Portrait of Dr. Gachet</td>
<td>Vincent van Gogh</td>
<td>Post-Impressionist</td>
<td>1890</td>
</tr>
</tbody>
</table>

---

powered by CliPatria 1.0 beta 2.5 (28/03/2009)

SWI Prolog 6.7.10 28-gsf37c11

cst.ino.cwi.nl
Road with Cypress and Star

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creator</td>
<td>Gogh, Vincent van</td>
</tr>
<tr>
<td>Date</td>
<td>1889</td>
</tr>
<tr>
<td>Location</td>
<td>Saint-Remy, de Provence; Rijksmuseum Kröller-Müller, Otterlo, The Netherlands</td>
</tr>
<tr>
<td>Material</td>
<td>canvas; oil paint</td>
</tr>
<tr>
<td>Style/Period</td>
<td>Post-Impressionist</td>
</tr>
<tr>
<td>Title</td>
<td>Road with Cypress and Star</td>
</tr>
</tbody>
</table>

links
- full view
- annotate
Fresnel lenses for RDF

- Fresnel lenses
  - Presentation layer for underneath knowledge
    - Same knowledge structures can have multiple views
  - Customized view of specific knowledge structure
    - Selection and arrangement of data
    - Styles (CSS)
  - Lenses can include sub-lenses
    - Nesting of lenses – hierarchical definitions
    - Reuse of existing lenses for smaller parts of knowledge

- Application of lenses
  - Specific classes / resources of specified type
  - Displayed resource match given SPARQL query
  - Additional constraints

Available classes
- channel has 6 items
- LearningResourceType has 23 items
- Person has 41 items

Select a different lens for visualizing this instance:

Lenses used for visualizing current instance:
1. http://example.org/fos:foafPerson
2. http://example.org/fos:foafKnowsSublens

Name of the Person: IVAN HERMAN

depiction: http://www.ivan-herman.net/me2013-small.png

This person knows this people:

<table>
<thead>
<tr>
<th>Name of known Person</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIM HENDER</td>
<td></td>
</tr>
</tbody>
</table>

homepage: http://www.cs.umd.edu/~handler/
mbox_sha1sum: 8de0565c0f1b32148bd71121a55edfa91cfd51cfa
click here for more: details
<table>
<thead>
<tr>
<th>Name of the Person:</th>
<th>IVAN HERMAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>surname</td>
<td>Herman</td>
</tr>
<tr>
<td>nick</td>
<td>Ivan</td>
</tr>
<tr>
<td>birthday</td>
<td>02-24</td>
</tr>
<tr>
<td>depiction</td>
<td><img src="image" alt="IVAN HERMAN" /></td>
</tr>
</tbody>
</table>

---

**This person knows this people:**

Jim Hender

That a person knows somebody does mean that the other person also knows her.

**interest**

- http://www.w3.org/2001/sw (external link)
- http://www.w3.org/International (external link)
- http://www.w3.org/SWC (external link)

**worksWith**

- bNode

**publications**

Fresnel lenses

- Specific properties and structure for defining lenses
  - Use on N3 notation
  - Defined vocabulary
    - http://www.w3.org/2004/09/fresnel#
  - Selector for applicable classes
    - Specifying domain (as URI of class or instance)
    - Internal selector language (adding constraints)
    - Using SPARQL query to match elements
  - Methods for grouping attributes
  - Sublenses

- Support for CSS
Lena project ➔ Fresnel lenses

- Lena project
  - **LEns based NAvigator**
    - Fresnel LEns based RDF/Linked Data NAvigator with SPARQL selector support
  - Use of Fresnel Display Vocabulary
  - View RDF data in browser
  - Rendering specific RDF view according to given selector
  - Allows multiple views (lenses) for the same type of resource

- Developed at ISWeb Uni-Koblenz 😊
- Now available via google code
Fresnel lens: the code

(300) :PersonLens a fresnel:Lens ;
(301) fresnel:classLensDomain foaf:Person ;
(302) fresnel:showProperties ( 
(303)   foaf:name
(304)   foaf:mbox
(305)   [rdf:type fresnel:PropertyDescription ;
(306)   fresnel:alternateProperties ( 
(307)     foaf:depiction foaf:img p3p:image )
(308)   ) ) .

(309) :nameFormat a fresnel:Format ;
(310)   fresnel:propertyFormatDomain foaf:name ;
(311)   fresnel:label "Name" .

(312) :mboxFormat a fresnel:Format ;
(313)   fresnel:propertyFormatDomain foaf:mbox ;
(314)   fresnel:label "Mailbox" ;
(315)   fresnel:value fresnel:externalLink ;
(316)   fresnel:valueFormat [ fresnel:contentAfter ",," ] .

(317) :depictFormat a fresnel:Format ;
(318)   fresnel:propertyFormatDomain foaf:depiction ;
(319)   fresnel:label fresnel:none ;
(320)   fresnel:value fresnel:image .
Multimedia Interfaces
The Challenge: Many Shades of Multimedia Meaning

Links

Location

Persons

low- to midlevel features

Knowledge

Tags

Maciej Janik
janik@uni-koblenz.de
Many sources – little context

Links Location

Person Knowlsedge Tags

low-to midlevel features

The Romantic Rhine. Koblenz

Koblenz Castle in Germany

Von Marcel & Victoria

Koblenz Castle

Von mbell1975

The Romantic Rhine. Koblenz
Agenda

- Semaplorer: Faceted Browsing of Semantic Multimedia Data
- Linked Open Data by Collective Intelligence
- Semaplorer Architecture
- Linking High-Level and Low-Level Data
  - Representational Paradigm
    - COMM – Core Ontology for MultiMedia
  - Computational Paradigm
Choosing between Koblenz – and Koblenz
Contextual Information

Map of Koblenz with various locations and tags.

Locations:
- Koblenz
  - Koblenz, Switzerland
  - Koblenz Hauptbahnhof

Tags:
- koblenz
- castle

Search:
- koblenz castle

Wikipedia:
Koblenz
Koblenz (also Coblenz in pro-L...
Tag-based refinement
A tag view of „Koblenz“ & „Castle“
Persons – Celebrities, FOAFers & Flickr Users
Some Shades of Multimedia Meaning
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Collective Intelligence

Different Flavors

- Collective datasets
  - Hosted public datasets
  - Gated datasets
    - Social networks,…

- Wikipedia style
  - Actually includes
    - Discussions
    - Editor hierarchies
    - Policies

- Pagerank style
  - highly effective
  - no coordination
  - no control (modulo spamming)

Linked Open Data

- Gene ontology
- DBPedia, Public census data
- Facebook, LinkedIn

- Wikiversity
- FAQs
  - Yahoo Answers, Lycos IQ

- Tagging
  - Flickr, Delicious, …
  - geotagging

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  - Yahoo Answers, Lycos IQ

- Tagging
  - Flickr, Delicious, …
  - geotagging
Linked Open Data: Example Instances
Linked Open Data: Instance Containers
LinkedIn Open Data: Classes

As of October 2008
Agenda

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Billion triples challenge: Use Linked Open Data

Common approach:
Import dump to new data silo

RDFS rules geo ...

birthplace

PlaceOfBirth birthplace

WordNet + Swoogle

fulltext

Since Dec, Amazon part shut down

Since mid Nov: Flickr API

flexible

extensible

scaleable

webby

Inflexible

Monolithic

Not scaleable

Semantic Web?
A federated RDF repository

WordNet
Rules
RDFS
fulltext

GeoNames
Swoogle
Amazon Web Services

Since mid Nov:
Flickr API

Maciej Janik
janik@uni-koblenz.de
Architecture of Federated Infrastructure

- Semantic Annotation Tool KAT
  - Extended by generic and application-specific plugins
  - Providing SemaPlorer’s UI
  - Plugin: Download image content from flickr
  - Plugin: Map component using OpenStreetMap
Architecture of Federated Infrastructure

Views:

?person birthplace ?city
=>
?person birthplace ?city
UNION
?person placeOfBirth ?city

Locating endpoints:

graphname endpoint

Query Splitting:

?geoSight owl:sameAs ?dbpSight.
=>
   ?geoSight owl:sameAs ?dbpSight.
   DISTRIBUTED JOIN
**Architecture of Federated Infrastructure**

**Endpoints:**
- Autonomous RDF repositories
- Connected via SPARQL
- Dynamic (added by reconfiguring SourceFinder)
- 25 repositories, > 400GB including fulltext indices

**Inferencing and Querying:**
Can vary from repository to repository

Here:
- SPARQL based Views
- RDFS
- transitivity rules for SKOS
- Geo range queries in SPARQL
- fulltext search in SPARQL via Lucene
Control EC2 Instances:

Administration Component updates Source Finder Configuration, no need for the application to know.

Repositories:

10 running at Koblenz University, Germany
15 running at Amazon EC2, USA
Semaplorer

- Semaplorer
  - Scaleable
  - Flexible
  - Federated

- Semantic Web infrastructure using
  - RDFS
  - Rules
  - Views
  - Geoqueries
  - Fulltext Search
  - Based on
  - Cloud Computing and
  - NetworkedGraphs

http://btc.isweb.uni-koblenz.de
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Linking Low-Level Data, Too: Multiple Tools

Yalta Conference

Winston Churchill Recognizer

Franklin D. Roosevelt Recognizer

Josef Stalin Recognizer
Creating a Multimedia Presentation

- Winston Churchill Recognizer
- Franklin D. Roosevelt Recognizer
- Josef Stalin Recognizer

- History Ontology
  - World War II
  - Yalta

- MPEG-7

http://en.wikipedia.org/wiki/Yalta_Conference
How do you formulate a query to get images showing Churchill et al.?

First Shot (XPath):
//StillRegion[./Keyword="Churchill" or ./Keyword="Roosevelt" or ./Keyword="Stalin"]
What is the Problem with MPEG-7?

- Annotations are not interoperable!
  - Ambiguities due to complementary description tools
  - *Multiple ways to model semantically identical descriptions*
  - Several alternatives for placing description tools inside an annotation

- Complex queries needed to cover all alternatives!

- *Incompatible with (semantic) web technologies!*
  - You cannot link to the outside world!
Capabilities and Maturity Levels

- no standard, no vocabulary
- manual 1:1 agreement on format and semantics
- tight coupling of data and applications

- standard vocabulary
- manual 1:1 agreement on mpeg-7 vocabulary
- tight coupling of data and applications

- standard vocabulary
- pre-defined meaning
- ad-hoc coupling of data and applications

Integration
Automation

Former Situation
Current Situation
Future / Desired Situation

COMM
MPEG-7
Formerly
Requirements for COMM

- **Reusability**
  Design a core ontology for any multimedia related application

- **MPEG-7-Compliance**
  Support most important description tools

- **Extensibility**
  Enable inclusion of further
  - *description tools* (even those that are not part of MPEG-7!)
  - *media types*

- **Separation of Concerns**
  Clear separation of domain knowledge and knowledge about structure

- **Modularity**
  Enable customization of multimedia ontology

- **High degree of axiomatization**
  Ensure interoperability through machine accessible semantics
Requirements on a high quality MM Ontology
How to Design a High Quality Multimedia Ontology?

- Approach from [Oberle, 2005], [Oberle et al., 2006]: Use a well designed foundational ontology as a modelling basis to avoid shortcomings

- Foundational ontologies provide
  - Formal precision
  - Domain independence
  - Broad scope

- Building upon foundational ontologies
  - prevents easy inclusion of modeling artefacts
  - reduces conceptual ambiguity
  - inherit rich axiomatization
Methodology for Design Pattern Definition

• Identification of most important MPEG-7 functionalities [Arndt et al., 2007]:
  - **Decomposition** of multimedia content into segments
  - **Annotation** of segments with meta data (e.g. visual descriptor, media information, creation & production, …)
  - General:
    - Identify repetitive structures and describe them at an abstract level
    - **Describe digital data by digital data at an arbitrary level of granularity**

• Additional patterns are needed for:
  - **Complex data types** of MPEG-7
  - **Semantic annotation** by using domain ontologies
    - *Interface between reusable multimedia core and domain specific knowledge*
DOLCE Design Patterns: OIO and D&S

- DOLCE is a library of foundational ontologies that provides 2 design patterns (extensions) that are especially important for MPEG-7:

- **Ontology of Information objects (OIO):** Formalization of information exchange
  - Relevance for multimedia ontology:
    - MPEG-7 describes digital data (multimedia information objects) with digital data (annotation)
    - Digital data entities are information object

- **Descriptions & Situations (D&S):** Formalization of Context
  - Relevance for multimedia ontology:
    - Meaning of digital data depends on context
    - Digital data entities are connected through computational situations (e.g. input and output data of an algorithm)
    - Algorithms are descriptions
    - Annotations and decompositions are situations that satisfy the rules of an algorithm / method
Distinction between:
- DOLCE ground entities (regions, endurants, perdurants)
- Descriptive entities (parameters, roles, courses)

Descriptions
- Formalize context
- Define descriptive concepts

Situations
- Are explained by descriptions
- Are settings for ground entities
Putting it Together: Decomposition Pattern

Simply see the example on the next slide....
Decomposition by Example

Image1 playsRole SegmInput
Segment1 playsRole SegmOutp
Segment1 playsRole SegmInput
Segment3 playsRole SegmOutp
Segment4 playsRole SegmOutp
Segment2 playsRole SegmOutp

Via its role in a computational task the different parts may be arbitrarily nested and related to different computing algorithms.

Querying for all subparts takes place along a well-defined pattern.
Methodology

Requirements: High Quality MM Ontology

Identification of repetitive structures

Quality Measures for Ontologies

MPEG-7 Compliance

Quality of Ontologies

Attention Focus

Repr. of Context

Repr. of Information

Pattern definition through Specialization

Reference Ontologie

Legend

Building Block

COMM
Multimedia ontology consists of
- **Core module** that contains the design patterns
- Modules that specialize the core module for **different media types**
- Modules that contain **media independent MPEG-7 description tools** such as media information or creation & production
- **Data type module** that formalizes MPEG-7 data types e.g. matrices, vectors, unsigned-int-5, float-vector, probability-vector, …
Does the Multimedia Ontology fulfil the Requirements?

- **Reusability**
  - Easy to query

- **MPEG-7-Compliance**
  - Design patterns enable the representation of description tools

- **Extensibility**
  - Design patterns are media independent → possibility to include
    - further media types
    - arbitrary descriptors
  - Extensions of multimedia ontology will not affect legacy annotations due to DOLCE+D&S+OIO

- **Separation of Concerns**
  - Clear separation between domain specific and multimedia related knowledge
  - Link to Linked Open Data possible!

- **Modularity**
  - Modular architecture allows customization

- **High degree of axiomatization**
  - Design patterns come with generic axiomatization that is refined in derived ontology modules

One such extension has already been done for Text Annotation. Another one for compound document annotation is currently developed!

Content & Media Annotation Pattern
Semantic Annotation Pattern

See slide before this slide!

OWL-DL version available for download.
“Creating a Multimedia Presentation” Revisited

Sparql: select ?image where {
?image plays AnnotatedDataRole.
?x plays SemanticLabelRole.
?x rdf:type pol:President }

http://en.wikipedia.org/wiki/Yalta_Conference
Agenda

- Semaplorer: Faceted Browsing of Semantic Multimedia Data
- Linked Open Data by Collective Intelligence
- Semaplorer Architecture
- Linking High-Level and Low-Level Data
  - Representational Paradigm
    - COMM – Core Ontology for MultiMedia
    - F – Event Ontology
  - Computational Paradigm
Computational Paradigm for Understanding High-level Semantics

- Good to have: inside/outside, water,…
- EXIF!
- No „one approach fits all“
- Interesting directions:
  - Joining logical and probabilistic/fuzzy reasoning, e.g.
    - S. Dasiopoulou et al., SAMT 2008; Ralf Möller et al.
  - Joining collective intelligence and implicit high level semantics
    - Flickr, YouTube, etc.: An unprecedented set of training data!
      - Several approaches for joining query log analysis / tags with low-level analysis
    - Use semantic data that was not built for your task!

Active research area!
Conclusion: Recipe

- Link existing data sources
- Join existing computational resources
- Take Semantic Web as common denominator
- Invest a couple of person months
- There you are!

- Canonical representation
  - COMM – Multimedia
    http://comm.semanticweb.org
  - F – Events
  - X-COSIMO – Communication
  - COS – Software
Conclusion: Open Issues

- The Semantic Web challenges the way that user interfaces work

- We need
  - Living user interfaces
    - End-user adaptation
    - Data-adapated user interfaces
  - Complex Event-based user interfaces