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<th>Title</th>
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<td>3. Summary</td>
<td></td>
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<td>4. References</td>
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</tbody>
</table>

### MOTIVATION
Motivation

- Novel technology is often validated in real world case studies.
- Example:
  - Company X wants to improve their knowledge management system by semantic technology.
  - Company Y produces virtual worlds and wants to annotate multimedia elements in these games.
- Common scenarios:
  - Data integration
  - Knowledge management
  - Semantic search

Data integration

- Data integration involves combining data residing in different sources and providing users with a unified view of these data.
- This process becomes significant in a variety of situations both commercial (when two similar companies need to merge their databases) and scientific (combining research results from different bioinformatics repositories, for example).
- Data integration appears with increasing frequency as the volume and the need to share existing data increases.
- In management circles, people frequently refer to data integration as "Enterprise Information Integration" (EII).
- By the use of ontologies, semantic technology can provide a solution to many data integration problems.

Based on http://en.wikipedia.org/wiki/Data_integration
Knowledge management

- Knowledge management comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of insights and experiences.
- Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice.
- Many large companies and non-profit organizations have resources dedicated to internal knowledge management efforts, often as a part of their 'business strategy', 'information technology', or 'human resource management' departments.
- Several consulting companies also exist that provide strategy and advice regarding knowledge management to these organizations.
- The management and preservation of knowledge has become a big topic in our information-based society.
- Semantic technology provides solutions to many knowledge management problems.

Based on http://en.wikipedia.org/wiki/Knowledge_management

Search

- Improved search is the underlying motivation for many semantic technologies.
- Semantic search seeks to improve search accuracy by understanding searcher intent and the contextual meaning of terms.
- Regardless, whether on the Web or within a closed system.
- Rather than using ranking algorithms such as Google's PageRank to predict relevancy, Semantic Search uses semantics to produce highly relevant search results.
- In most cases, the goal is to deliver the information queried by a user rather than have a user sort through a list of loosely related keyword results.

Based on http://en.wikipedia.org/wiki/Semantic_search
TECHNICAL SOLUTION AND ILLUSTRATIONS

Semantics for Search Result Enhancement: Yahoo! SearchMonkey
https://developer.yahoo.com/searchmonkey/siteowner.html
Applications for description, discovery and selection

• This is a category of applications that are closely related to semantic indexing and knowledge management.

• Applications are mainly for helping users to locate a resource, product or service meeting their needs.

• Example application: Yahoo! SearchMonkey

---

SearchMonkey – What is it?

• Search monkey is a framework for adding metadata to Yahoo! Search results.

• Additional data, structure, images and links may be added to search results.

• Yahoo!’s crawler indexes and interprets RDFa, microformats, delicious data, etc.

• It displays the URL as an enhanced result, with standard or custom presentations.

• Yahoo!’s motivation for doing this: “Structured data is the new SEO” (Dries Buytaert, Drupal)

• Creating an ecosystem of publishers, developers and end-users:
  – Motivating and helping publishers to implement semantic annotation.
  – Providing tools for developers to create compelling applications.
  – Focusing on end-user experience.
• Rich abstracts as a first application.
• Standard Semantic Web technology
  – dataRSS = Atom + RDFa (cf. the following slides)
  – Industry standard vocabularies
SearchMonkey search results

an open platform for using structured data to build more useful and relevant search results

Before

<table>
<thead>
<tr>
<th>Topic</th>
<th>SEA: Getting Pregnant, BabyCenter</th>
<th>Find facts about your chances of getting pregnant, what you can do if you're trying to get pregnant.</th>
<th><a href="http://www.babycenter.com/getting-pregnant">www.babycenter.com/getting-pregnant</a></th>
<th>PR - Clicked</th>
</tr>
</thead>
</table>

What is SearchMonkey?

SearchMonkey search results

After

<table>
<thead>
<tr>
<th>Topic</th>
<th>SEA: Allergies, Health Center</th>
<th>Find allergy information and learn about the diagnosis, symptoms, treatment, and prevention of allergies.</th>
<th><a href="http://www.webmd.com/allergies">www.webmd.com/allergies</a></th>
<th>PR - Clicked</th>
</tr>
</thead>
</table>

SearchMonkey – examples

- Deep links
- Image
- Name/value pairs or abstract
SearchMonkey – examples

• SearchMonkey enhances search results related to movies with movie information provided on Netflix (www.netflix.com) (cf. screenshot).

• Netflix is an online service that allows renting movies or TV shows and watching them via the Web.

• The system adds information about the searched movie and links to the search result (cf. screenshot).
SearchMonkey – How does it work?

The user’s applications trigger on URLs in the search result page, transforming the search results.

The inputs of the system are as follows:

- Metadata embedded inside HTML pages (microformats, eRDF, RDFa) and collected by Yahoo Slurp, the Yahoo crawler during the regular crawling process.
- Custom data services extract metadata from HTML pages using XSLT or they wrap APIs implemented as Web Services.
- Metadata can be submitted by publishers. Feeds are polled at regular intervals.
- Developers create custom data services and presentation applications using an online tool.
Defining custom data services

- When defining new custom data services, first some basic information is provided such as name and description of the service and whether it will execute an XSLT or call a Web Service. (cf. screenshots)
- In the next step, the developer defines the trigger pattern and some example URLs to test the service with.
- Next, the developer constructs the stylesheet to extract data or specifies the Web Service endpoint to call.
- Note that custom data services are not required if the application only uses one of the other two data sources (embedded metadata or feeds).
- Creating a presentation application follows a similar wizard-like dialogue (cf. screenshots).
Why semantic technologies for search result enhancement

- Semantic technologies promise a more flexible representation than XML-based technologies.
- Data doesn't need to conform to a tree structure, but can follow an arbitrary graph shape.
- As the unit of information is triple, and not an entire document, applications can safely ignore parts of the data at a very fine-grained, triple by triple level.
- Merging RDF data is equally easy: data is simply merged by taking the union of the set of triples.
- As RDF schemas are described in RDF, this also applies to merging schema information.
- Semantics (vocabularies) are also completely decoupled from syntax.

DataRSS

- For SearchMonkey, the format DataRSS was developed, an extension of Atom for carrying structure data as part of feeds.
- Atom is an XML-based format which can be both input and output of XML transformation.
- The extension provides the data itself as well as metadata such as which application generated the data and when was it last updated.
- The metadata is described using only three elements: item, meta, and type.
- Items represent resources, metas represent literal-valued properties of resources and types provide the type(s) of an item.
- These elements use a subset of the attributes of RDFa that is sufficient to describe arbitrary RDF graphs (resource, rel, property, typeof).
- For querying, SearchMonkey uses an adapted version of SPARQL (cf. lecture 6).
SearchMonkey – Ontologies used

- Common vocabularies used: Friend of a Friend (foaf), Dublin Core (dc), Vcard (vcard), Vcalendar (vcal), etc. (cf. Following slides)
- SearchMonkey specific ontologies provided by Yahoo!:
  - searchmonkey-action.owl: for performing actions as e.g. comparing prices of items
  - searchmonkey-commerce.owl: for displaying various information collected about businesses
  - searchmonkey-feed.owl: for displaying information from a feed
  - searchmonkey-job.owl: for displaying information found in job descriptions or recruitment postings
  - searchmonkey-media.owl: for displaying information about different media types
  - searchmonkey-product.owl: for displaying information about products or manufacturers
  - searchmonkey-resume.owl: for displaying information from a CV
- SearchMonkey supports ontologies in OWL but it does not support reasoning over this OWL data.

SearchMonkey vocabularies

<table>
<thead>
<tr>
<th>Vocabulary prefix</th>
<th>Vocabulary name</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>dc</td>
<td>Dublin Core</td>
<td>Document metadata</td>
</tr>
<tr>
<td>foaf</td>
<td>Friend-Of-A-Friend</td>
<td>Personal profiles and social networks</td>
</tr>
<tr>
<td>vcard</td>
<td>VCard</td>
<td>Personal and business addresses</td>
</tr>
<tr>
<td>vcalendar</td>
<td>VCalendar</td>
<td>Events and other calendar items</td>
</tr>
<tr>
<td>review</td>
<td>hReview</td>
<td>Reviews</td>
</tr>
<tr>
<td>sioc</td>
<td>SIOC</td>
<td>Blogs, discussion forums, Q&amp;A sites</td>
</tr>
<tr>
<td>gr</td>
<td>GoodRelations</td>
<td>Product price specification, delivery and payment etc.</td>
</tr>
<tr>
<td>dbpedia</td>
<td>DBPedia</td>
<td>Generic vocabulary</td>
</tr>
<tr>
<td>fb</td>
<td>Freebase</td>
<td>Generic vocabulary</td>
</tr>
</tbody>
</table>
Example: FOAF

```xml
<item rel="dc:subject">
  <type type="foaf:Person">
    <name>John Doe</name>
  </type>
  <item rel="foaf:homepage" resource="http://www.joeisagaw.com/"></item>
  <item rel="foaf:knows">
    <type type="foaf:Person">
      <name> Jane Doe </name>
    </type>
    <item rel="foaf:gender" resource="http://www.joeisagaw.com/"></item>"
  </item>
</item>
```

Developer tool

Application Dashboard

Presentation Applications
Presentation applications are small PHP apps that display enhanced search results using data services. You can use an existing data service or create a custom service below.

- Create a new application
- Start with a sample application
- Import application

LinkedIn: Presentation Application (SAMPLE)
A sample presentation application for LinkedIn. Displays LinkedIn data directly from profile pages, using a previously created sample LinkedIn custom data service.

Custom Data Services
Custom data services provide structured information to display in Yahoo! Search results. You can create a custom data service by calling an API or by extracting structured data from web pages.

- Create a new data service
- Start with a sample data service
- Import data service
<table>
<thead>
<tr>
<th>Developer tool</th>
<th>Developer tool</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Application Dashboard / LinkedIn: Presentation Application (SAMPLE)</strong></td>
<td><strong>Application Dashboard / LinkedIn: Presentation Application (SAMPLE)</strong></td>
</tr>
<tr>
<td><strong>Basic Info</strong></td>
<td><strong>Basic Info</strong></td>
</tr>
<tr>
<td><strong>URLs</strong></td>
<td><strong>URLs</strong></td>
</tr>
<tr>
<td><strong>Data Services</strong></td>
<td><strong>Data Services</strong></td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
<td><strong>Appearance</strong></td>
</tr>
<tr>
<td><strong>Confirmation</strong></td>
<td><strong>Confirmation</strong></td>
</tr>
</tbody>
</table>
| // Maps | Data inputs, click the link to update the data filter your JMP at the current page description:
| $.html("<div>"); | • #id="identifier"
| $.html(<div class="name">$name</div>); | • #id="name"
| $.html(<div class="value">$value</div>); | • #id="value"
| $.html("<div class="icon"></div>" + $icon); | • #id="icon"
| $.html("<div class="status"></div>" + $status); | • #id="status"
| $.html("<div class="description"></div>" + $description); | • #id="description"
| $.html("<div class="date"></div>" + $date); | • #id="date"
| $.html("<div class="time"></div>" + $time); | • #id="time" |

**Note:** The images contain screenshots of a web page that appears to be part of a guide or tutorial on using a developer tool with Yahoo! Application Platform. The text is a mix of code snippets and instructions, likely for developers to customize and interact with Yahoo! applications.

**Key Points:**
- The code samples are written in JavaScript, indicating interactions with DOM elements.
- The tutorial includes examples of how to manipulate data within a presentation application framework.
- There are sections on mapping data, updating filters, and styling components.

**Conclusion:** The document is a technical guide for developers focusing on integration with Yahoo! Application Platform, emphasizing customization and data management within presentation applications.
Gallery of search enhancements

Online Marketing with Schema.org and Multi-channel Communication

Based on:
Outline

- Introduction
- The Challenge
- The Solution
- Result / Evaluation
- Conclusion and Future Work

Introduction

What travel consumers do online\(^1\):

87% of travelers use the internet for the bulk of travel planning.

Introduction

Online sources of travel inspiration 2:
1. Social networking, video, or photo sites (83 %)
2. Search engines (61 %)
3. Travel review sites/apps (42 %)
4. Destination-specific sites/apps (31 %)
5. Daily Deal sites/apps (27 %)

---

Sources of online visibility:

1. Search Engines

2. Multiple Online Communication Channels
   i. Social Networking
   ii. Video & Photo Sharing
   iii. Travel Reviews
   iv. Booking Sites
   v. ...

---

Introduction

Objective
To help touristic businesses (e.g. hoteliers) to have a strong online presence:
• higher online visibility – positive impact on marketing success – leads to increased sales

Challenges:
1. How to increase online visibility of hotels on search engines?
2. How to increase online visibility of hotels on multiple online communication channels?

Use Case: Kaysers Hotel

A four-star (> > > >) hotel:
• Located in Mieming, province of Tyrol, Austria
• 48 rooms
• Offers: golf, skiing, tennis, hiking, city trips, etc.

Had a limited online presence:
• its own website
• booking platforms
• very limited use of social media, mainly Facebook

http://www.kaysers.at
Use Case: TVB Innsbruck

One of the biggest tourism boards in Austria
- The 2nd biggest TVB in Tyrol
- The 3rd biggest city destination in Austria

Online marketing activities (2014)
- Executed by a team of editors and a blogger network
- 5 websites / mobile apps for iPhone and Android / 6 social media channels / 9 languages

Improve the online visibility – suitable for content sources

Challenges

1. How to increase online visibility of hotels on search engines?

2. How to increase online visibility of hotels on multiple online communication channels?
Semantic Annotations

Semantic annotations:
• the process of marking-up resources with metadata
• computer-understandable descriptions of resources

Schema.org:
• collection of shared vocabularies to mark-up web pages
• can be understood by the major search engines
• index your content better, present it more prominently in search results

Hotel Kaysers – semantic present

– Rich Snippets

Knowledge Graph –
Semantic Annotations

Kayser’s Hotel:
- 268 pages/sub-pages were annotated
- three different languages (German, English, and French)

![Diagram of data model](image_url)
1. How to increase online visibility of hotels on search engines?

2. How to increase online visibility of hotels on multiple online communication channels?

Multi-channel Challenges

- Scalability
  - The overwhelming amount of available communication channels

- Costs
  - Social media experts needed to handle communication channels

- Domain personalization
  - Adaptation, alignment and definition of the content for several channels

- Bilateral communication
  - Feedback and engagement / Reputation management
Multi-channel Online Communication Tool

- A spin-off company of the University of Innsbruck, founded in 2015
- Focus – social media management & marketing
- Innovative technologies – semantic web technology and rule-based systems

4http://onlim.com
Multi-channel Online Communication Tool

Publication Statistics –

Evaluation Setup

• Measurements:
  1. Traffic to website
  2. Traffic to website originated from social media
  3. Work time spent by the hotel on social media management

• Tools:
  1. Google Analytics
  2. Interview
Evaluation (1)

Evaluation period – July - August 2015:

Traffic to website has increased:

![Graph showing increased traffic to the website]

<table>
<thead>
<tr>
<th>Sessions</th>
<th>Users</th>
<th>Pageviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>21%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Evaluation (2)

Traffic to website originated from social media:

<table>
<thead>
<tr>
<th>Social Network</th>
<th>Sessions</th>
<th>% Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 3, 2015 - Jun 30, 2015</td>
<td>70</td>
<td>94.34%</td>
</tr>
<tr>
<td>Jun 30, 2015 - Aug 27, 2015</td>
<td>71</td>
<td>97.26%</td>
</tr>
</tbody>
</table>

- Traffic from Facebook increased by 40%
- 92% of tweets were disseminated through the tool
- Bring more visitors from Twitter (100%)
Evaluation (3)

Work time spent by the hotel on social media management:

- Before deployment ≈ 2.5 hours / day
- After deployment ≈ 1 hour / day

Conclusion

- We utilise semantic web technologies in touristic sector
  - i. to increase the findability of a website through semantic annotation
  - ii. to integrate the distributed and isolated content sources by collecting the annotated content
  - iii. to distribute the collected content to multiple social media channels (semi-automatically)

- Evaluation on the Kaysers Hotel:
  - i. Website traffic has increased by 20%
  - ii. Up to 40% growth of the social media traffic referrals
  - iii. Up to 60% decrease of worktime spent in social media marketing
Touristic Service Packaging

- **Touristic Service Packaging** aims to combine touristic services in a package, for marketing and booking purposes. Currently, this can be supported with semantics and smart data i.e. with:

  - Integrating information from multiple sources and systems employing **linked data as a global information integration platform**, and mining from the depths of the “closed” data, the touristic service package production system would cater to creating the most optimal travel experience for the traveler.

  - Further, the service packages are to be efficiently published and made bookable to the end consumers via intelligently selected most suitable communication and booking channels: especially the ICT channels with rapidly growing user audiences, such as the social media and the mobile apps.
Motivation

In Marketing: The social media revolution has made this job for the organisations -- as well as for their customers when spending time on learning about service offers - much more complicated, because:

- the number of channels has grown exponentially,
- the communication has changed from a mostly unilateral "push" mode (one speaker, many listeners) to an increasingly fully bilateral communication, where individual stakeholders (e.g. customers) expect one-to-one communication with the organization, and the expected speed of reaction is shrunk to almost real-time, and
- the contents of communication is becoming increasingly granular and more dependent upon the identity of the receiver and the context of the communication.

In Sales:

- Currently, there are more than 100 booking and 200 social media platforms available on which the hotelier could be present.
- Utilizing the value of structured, linked, open and closed, big and small data.

Touristic Service Packaging on Social Media: Sample Look

- Generation and publishing of posts suggesting other bookable activities to do while traveling, together with the hotel rooms offer
- Published together with a direct booking link
- Content adaptation for the social media platform and language

Scenario Example: Finding and Consuming the Most Relevant Touristic Services on the Fly

A guest G enters the hotel for the first time. At the check-in desk the receptionist introduces G to the newly launched smartphone app of the hotel. G downloads the app in the free WiFi of the hotel and back in his/her room he/she starts exploring the contents. In the "restaurants"-section of the app she/he finds the menus of the day generated on the fly from linked data of the available restaurants in the nearby, catering to the user's food preferences and dietary restrictions. Since she/he feels quite hungry he/she makes a reservation for a certain preferred type of restaurant in the area directly out of the app.

Goals

**Overall aim:** Being visible, scalable, and “on-demand” (vs. the current manual labor and “one-size-fits-all” types of offers), when it comes to touristic service offers marketing and booking

The major technical objectives are:

- design and implement a scalable online service packaging and provisioning solution based on machine-processable semantics.
- deliver the technology for interacting with this multi-channel solution through various and heterogeneous mobile channels.
- provide support in service packaging, such as accessing, interacting, and value exchange (i.e., booking) of tourism services and their combinations through this infrastructure, using linked data as a global integration platform.
- validate and apply the research and development outcome in pilots focusing on the booking of tourism services.
**Technical Innovation**

Supporting automatic generation, clustering and packaging of semantically annotated touristic service offers from a variety of sources.

Existing information extraction, clustering and publishing is to be adopted and extended in order to:

- obtain the extracted data in a Linked Data format, (semi-)automatically associating metadata;
- generate service representations in Linked Data format according to ontological models;
- interlink, cluster, package and provide services in an automatic way;
- provide a semantic service and an online interface for easy publishing and access to the above mentioned functionalities.

---

**Building Blocks of Service Packaging System**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Outcome</th>
</tr>
</thead>
</table>
| Multi-channel communication        | • Semantic based representation of content (ontology) in intuitive and familiar terminology for tourist service providers.  
• Scalable methods for separating and interweaving content and communication channels, particularly, employing linked data as an integration platform.  
• Online multi-channel communication technical solution. |
| Online interactions                | • Formal communication pattern description mechanism as business processes.  
• Reusable set of communication patterns to structure the online interactions for the tourism domain. |
| Service integration and yield management | • Integration of a booking engine with the necessary infrastructure for tourism services to be directly bookable and configurable for yield management and tailored to the preferences of the end consumers.  
• A technique for enablement touristic service providers to annotate their offers employing linked data for the subsequent multi-platform reuse. |
| Mobile service provisioning         | • Online mobile strategy definition for tourism organizations.  
• Mobile toolbox for the integration of booking services for travel service providers.  
• Mobile framework and components for multi-channel and online interactions management. |
High Level Architecture

Regional Content Use

- Touristic associations and other sources have a lot of regional content helpful for generation of posts for hoteliers e.g. stories, games, etc.

Gewinnspiele (blog.innsbruck.info)
01.03. – 30.09.2014

- That content is used to generate the posts – in TourPack project (http://tourpack.sti2.at) for Innsbruck and Salzburg
We use Schema.org – what is it?

- **Schema.org** provides a collection of shared vocabularies.
- Launched in June 2011 by Bing, Google and Yahoo
- Yandex joins in November
- **Purpose:**

Create a common set of schemas for webmasters to mark-up with structured data their websites.

Web search on Web 1.0

- **Question/Answer**
  - Until now….
Web search on Web 2.0

- Now ... Semantic Search
  - (using the Knowledge graph)

http://moz.com/ugc/i-became-an-entity-how-im-on-the-knowledge-graph

Web search on Web 3.0

- With accounts on Freebase, Wikipedia and social accounts
- And schema.org annotations in your website ...

http://schema.org/Person

http://moz.com/ugc/i-became-an-entity-how-im-on-the-knowledge-graph
Examples of Relevant Web Sites Annotated with Schema.org and/or with Linked Data

- YELP (events, restaurants)

- Food.com (recipes)
  - [http://www.food.com/](http://www.food.com/)

- Linked Open Data Hub for Salzburger Land:
  - [http://data.salzburgerland.com](http://data.salzburgerland.com)

Model of Touristic Service Offer(s) with schema.org

We use schemsa.org for modeling and communication of touristic service packages, including its actionable components for the booking part.
Schema.org for

- Restaurant, Cafes, Bars & Pubs, Sightseeing
  - Name
  - Map
  - PostalAddress
    - streetAddress
    - addressCountry
    - postalCode
    - addressLocality
    - telephone
    - faxNumber

Implementation of semantic annotation with a plugin (Feratel -> Typo3)
TVB Innsbruck: implementation

http://www.innsbruck.info/en

Variety of Touristic Service Providers

<table>
<thead>
<tr>
<th>Type of touristic service provider</th>
<th>Example in Innsbruck</th>
<th>Type of touristic service provider</th>
<th>Example in Innsbruck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartments</td>
<td>Riedz Apartments</td>
<td>Mountain restaurants &amp; Lodges</td>
<td>Höttinger Alm</td>
</tr>
<tr>
<td>Bars &amp; Pubs</td>
<td>Zappa</td>
<td>Payments solutions</td>
<td>Paypal</td>
</tr>
<tr>
<td>Beaches</td>
<td>Baggersee</td>
<td>Rentals</td>
<td>Skirental service</td>
</tr>
<tr>
<td>Cafes</td>
<td>Katzung</td>
<td>Restaurants</td>
<td>Restaurant Burkia</td>
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<td>Galerie Rhomberg, Heaven to Hell</td>
<td>Spas</td>
<td>Aqua Dome Längenfeld</td>
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<td>Stillerhof</td>
<td>Swimmingpools</td>
<td>Höttinger Hallenbad</td>
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<td>Tours</td>
<td>Stadtrundgang Innsbruck</td>
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<td>Insurances</td>
<td>UNIQA</td>
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</tbody>
</table>
Pre-constructed Packages Come in Post
Suggestions ONLIM Dashboard

Post suggestions are spread to multiple channels by the touristic service provider

TourPack iOS client
Projects on Smart Homes:
SESAME, SESAME-S:
http://www.slideshare.net/annafensel/beyond-energy-efficient-smart-buildings,
http://www.slideshare.net/annafensel/ii-was-presentationfinal
OpenFridge: http://www.slideshare.net/annafensel/open-fridge-otm14

For this section of the lecture, follow the external slides on SlideShare.

LARKC case study:

Based on slides by LARKC consortium
LARKC

• LARKC (Large Knowledge Collider) is a European research project that works on large-scale reasoning.

• LARKC has the following core goals:
  – Scaling to infinity by giving up soundness & completeness and by switching between reasoning and search
  – Creating a reasoning pipeline by plugin architecture
  – Building a large computing platform by cluster computing and by wide-area distribution

LARKC technology

• The sketched use cases all involve enormous amounts of data and incomplete information.
• LARKC works on technology that allows massive, distributed, and incomplete reasoning.
• This involves methods for knowledge representations, inference methods, knowledge acquisition tools, for broad domain reasoning.
• The outcome is a platform for infinitely scalable reasoning on the Web.
• The LARKC process is sketched here:
LARKC technology (cont’d)

- For the LARKC basic platform, there are various plug-ins that are used by meta-reasoner and tactical memory.
- Languages that plug-ins use: SPARQL, OWL, CycL, …
- Types of queries plug-in is optimized for: is-a, generalizes, located-in, negated-integer, …
- Types of reasoning: probabilistic, approximate, forward, backward, transformation, removal, …
- Knowledge base: geographical locations, biological taxonomy, history facts, …
- Technical parameters: resource requirements (amount of RAM, disk, processors, time, …), parallelizable (for what queries, how many instances can run in parallel, can they share bindings, …), connection (type, speed, band…)

Today Cities’ Challenges

Our cities face many challenges

- How can we redevelop existing neighbourhoods and business districts to improve the quality of life?
- How can we create more choices in housing, accommodating diverse lifestyles and all income levels?
- How can we reduce traffic congestion yet stay connected?
- How can we include citizens in planning their communities rather than limiting input to only those affected by the next project?
- How can we fund schools, bridges, roads, and clean water while meeting short-term costs of increased security?
Urban Computing as a Way to Address those challenges

Coping with zillions of facts

- Heterogeneous
- Inconsistent
- Unbounded
- Coming in rapid, continuous, time-varying (burst) streams
- Correlated but un-related

Real-time requirements

- All data cannot be taken into consideration at the same time
- Need for abstracting rough data in meaningful facts
- Need for selecting the relevant ones
- Need for parallel inference and query processing
- Graceful approximation of results while applying selection and abstraction techniques

The reasoning challenge
Short Term  
CEFRIEL’s Traffic Predictor

- CEFRIEL together with Milano Municipality has developed a Traffic Predictor (TP) for emergency vehicle routing in the Milano fair area.
- The objective of TP (2 years long for some 60 PM effort) was to simulate real traffic in a metropolitan area in order to achieve:
  - Short-term (i.e.: 10-15 min) traffic conditions on the whole area
  - Emergency Vehicle guidance support system
  - Long-term (i.e.: 6-48 hours) traffic conditions on the whole area

Input data and simulation

- Input data:
  - Static
    - A detailed (1 meter resolution) vectorial map of the 15.3 Km2 of the Milano fair area
    - All vertical and horizontal traffic signs
    - Traffic lights and their daily and weekly timing
    - Parking lots and major destinations
    - Distribution of driving styles among drivers
  - Dynamic
    - 75 traffic detectors in the Milano fair area that generate a stream of data updated every 5 minutes
  - Historical
    - 3 months of data are kept for statistical purposes
Input data and simulation (cont’d)

- Simulation
  - Micro-simulation of position and speed for a maximum of 40,000 "standard" vehicles
  - Macro-simulation of number of vehicles and average speed per segment
- Output data:
  - Number of vehicles and average speed for each segment (junction-to-junction) in the next 10-15 minutes (meaningful up to 48 hours)

Micro-scopic simulation

Simulation from pictures
Short Term
Saltlux’s Ubiquitous City Service

Period
2007. 03 – 2007.06 (4months)

Project
Intelligent Car Navigation Service

Work
- Traffic control application for intelligent car navigation
- Ontology modeling for u-city services
- Development for reasoning technology to cover city-scale
- Development of service scenarios for u-city

Business Modeling
- Scope
- Business process analysis

KB Modeling
- Ontology
- Reasoning Rule

Analysis
- Reasoning Engine
- Architecture
- Related systems

Pilot System
- Infra & reasoning S/W installation
- Applications
- POC verification

Background: U-City Project in Korea

- Korea is a leader in building social spaces online and they connect back to the real world very well
- Ubiquitous technologies will let us strengthen this linkage by:
  - merging online social networks with offline social
  - linking online and offline events and information

Organization: New Songdo City Development LLC(NSC)
Area: Songdo(International Songdo Business Compound) 5,619,834 m²
Period: 2003 – 2014
Cost: 1 billion euro

- Asia Trade Tower(2006 ~ 2010.12)
- Convention Center & Hotel(2006 ~ 2008)
- Apartments & Stores(2006 ~ 2014)
- Central Park (~ 2008.11)
- Ecotarium(2007.2 ~ 2009.12)
- Waterfront Park
- International Hospital
- Golf Course (2007.4 ~ 2009.4)
U-City is an integrated, intelligent and innovative new city-making service that works through **city domain convergence based on ubiquitous computing and information communication technology**. It includes system integration, operation and all services except devices.

### Objective & Scope: Traffic Control System

#### Use case Scenario: Intelligent Navigation

1. Normal Path

2. Detour by Accident at the starting point

3. Detour by Accident on a road
## Use case Scenario: Intelligent Navigation

Identified key concept through domain competency questions and used a traffic agent with U-city ontology and rules.

### Identified Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
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<tr>
<td>Building</td>
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### Diagram 

- **Web application**
- **Agent**
- **Reasoning Core**
- **Knowledge Base**
  - **TrafficAgent**
  - **LDS' Creator**
  - **Resonator**
  - **SOR (with OntoBroker 4.3)**
    - **Ontology**
    - **Rule**

### SUMMARY
Summary

In today’s lecture we looked into example applications of semantic technology.

- Yahoo!’s SearchMonkey for enhancing search results by metadata.
- The multi-channel marketing and dissemination solution based on ONLIM increases the online visibility (of hotels, etc.) using semantic technology.
- The TourPack project’s use cases contains online service packaging, multi-channel marketing and booking.
- Smart Homes application with semantics and rule-based systems are presented with projects SESAME, SESAME-S, OpenFridge.
- The LARKC project’s use cases on urban computing involving large amounts of data and great reasoning challenges.

REFERENCES
References

- Mandatory reading
  - TourPack project website: [http://tourpack.sti2.at](http://tourpack.sti2.at)
  - LarCK project website: [http://www.larkc.org](http://www.larkc.org)

References

• Further reading
  – http://dbpedia.org/About
  – http://semanticweb.org/wiki/Main_Page
  – http://rdfs.org/sioc/spec/

References

• Wikipedia links
Questions?

That's it for the Semantic Web course 2017/18!

Good luck at the exam and further career!!

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