Case

A Semantic Web based service of Church Art and Architecture

Reflections on Action Oriented Modelling of Domains
Initial partners

- Institute for Church Art and Architecture, University of Jyväskylä
  - Research databases
  - Inventories from about 600 Lutheran churches
  - Image archives (partly digital)

- Department of Practical Theology, University of Helsinki
  - Digital image archive mainly of contemporary church architecture

- KuvaKotimaa
  - Commercial image bank
Goals of project

- Build an **infrastructure** for **integration** of distributed data stored in heterogeneous formats (image files, text files, databases)
- Enable **knowledge creation** using semantic web methods and tools
- Enable **knowledge** sharing and **collaboration** among researchers
- Create a **public service**
Project status

- **First phase:** Proprietary application to maintain contents of research databases and image archive. Export capabilities to RDF-format. Commercial database and application server.

- **Second phase:** Complete turn-around to Open Source technologies. Development of semantic web enabled Open Source framework.

- **Current phase:** Ontology development with Protege-OWL

- **Next phase:** Use in research. Dissemination.
Open Source tools

- Linux (Debian) environment
- Protégé-OWL for RDF/OWL modelling
- Sesame RDF/OWL-repository
- PostgreSQL database backend
- Python application development environment
- Wiki-farm for documentation and collaboration
- Tools for semantic annotation of text and images

Reasons for Python preference:

- More functionality with less lines of code
- More maintainable code
- Failover option: Java
Qualitative goals

Something like the Paris Metro:

- Complex
- Yet efficient, cheap and easy to use
- Scaled for the masses
- Produces a predictable outcome
Different application strategies

- **Semantic Google**
  = semantically enhanced search engine

- **Semantic Encyclopaedia**
  = illustrated RDF/OWL-repository

- **Embedded Semantics**
  = ontology based data integration, knowledge creation and information sharing with high variety of application formats. Avoiding gridlocked projects.
Trust based (paranoid) development

- Customers have to trust in the solutions they invest in. There have to be objective reasons for that trust. Our task is to find or create those reasons.
The practice of paranoia

- Models and data are stored in XML as well as in backend databases. Data from backend databases are stored in normalized databases.

- Ideally automated synchronization with easy downgrade e.g. from OWL-DL to Owlim compatible code.

- From Well Formed to Very Well Formed models and storage
Well vs. Very Well Formedness

Well Formed (WF)
- Machine readable

Very Well Formed (VWF)
- Machine readable
- Human readable
- Modular
- Separation of schema and data
- Semiautomatically and manually maintainable: sort, insert, update, delete
Pluggable ontologies

High Level Ontology (CIDOC-CRM like)

Plug

OWL Schema

Merge

Data Module (list)

Imported Ontologies

Thesauri

RDBMS
First observations about ontologies

Seemed to reflect Aristotelian metaphysics

- Substance oriented
- About what is permanent in existence
- Operate with properties and classes
- Can be manipulated with logic
- Root class of OWL: **owl:Thing**

Heidegger's re-evaluation of Aristoteles

- Existence is about being that is in a permanent state of becoming
- Heideggerian root class: **owl:Beeing-Becoming**
How permanent are concepts?

Is stroke a disease?
N=30

YES 16
NO 14
+1 month 11 changed their minds

Is pumkin a fruit?

YES 16
NO 14
+1 month 8 changed their minds
How concepts actually are formed

- Construction or automatic generation with the help of **distinguishing attributes**
- Creation from **thesauri**
- Based on **expert knowledge**
- Based on **prototypes**
- Generated from **exemplars** (based on frequency of configurations of attributes)
- Based on **behaviour** (evolutionary view)
- Encoded in the **neural architecture**
Natural sources of ontologies

Knowledge about **living things** and **tools** are processed differently and in different places of the brain

- Living things are processed visually
- Knowledge about tools are processed functionally (based on what they are used for)

### Processing of information about persons

- WRUs = word recognition units
- FRUs = face recognition units
- NRUs = name recognition units
- PINs = person identity nodes
- SIUs = semantic information units
Flashbulb memories

An exceptional event activates a special neural mechanism that renders exceptionally long lasting, accurate and vivid memories.

- Informant (source)
- Place where the news was heard
- The event itself
- Own emotional state
- Emotional state of others
- Consequence of the event

Constituents in describing an episode
Types of long term memory

- **Semantic** memory (knowledge about the world)
- **Episodic** memory (memories about ourselves)
- **Perceptual** representation system (sensory input)
- **Procedural** memory (how to do things)
Episode as a frame in action oriented modeling

- An episode is not an event
- Events are parts of episodes
- Episodes contain a setting, events, actors, actions including speech, emotions, intentions, causes and consequences
- Gossip depicts episodes
- Episodes are the building blocks of our autobiographic memory and narratives
Action oriented modeling

Ontologies should be about defining domains

- Domains are about dynamic processes occurring in specific settings and can be only partially modelled with *substance-oriented* concepts and categories (substantives & adjectives)

- These have to be complemented with *action-oriented* concepts and categories (verbs & adverbs)
High level view of man

Environment

Information

Store

Goal

Control

Action

Energy

Store

Forms of Action

Non Verbal Behaviour

Speech

Artefacts

Forms of Communication

SYNAPSE COMPUTING
RDF/ OWL in modeling action

- With OWL it seems to be possible to model **transitive causal** as well as **intentional** chains
  \[ A \rightarrow B \rightarrow C \]

- OWL is oriented towards **definitions** and **reasoning**. Natural language is **declarative** and **descriptive**.

- Verbs can form ”kind-of” relations to form **action oriented class hierarchies** in ontologies, e.g. painting and sculpting are ”kinds-of” creating.

- Inverse functional properties works with verbs ”A knows B” – ”B is knownBy A”
Human information processing is **highly specialized**, but mind experiences things as a **whole**.

- **Integrative functions of mind**
  - Consciousness
    - Global workspace
  - Working memory
    - Visuo-spatial sketchpad (inner eye)
    - Central executive
    - Episodic buffer
    - LTM
  - Specialized storage
    - Acoustic loop (inner ear)
    - Specialized storage
Analogy to mind in MVC-architecture