Use Case: Buying a book at amazon.com

- Do you read the book before buying?
- Do you search in books contents?
  - aliens AND space ships AND war
Use Case: Buying a book at amazon.com
Though a lot of SF writers are more or less efficiently continuing the tradition of Robert A. Heinlein, Scalzi's astonishingly proficient first novel reads like an original work by the late grand master. [...]
Bestsellers in Space Opera

21. *The Restaurant at the End of the Universe* by Douglas Adams
   - Rating: 4.5 stars (124 customer reviews) | 1 customer discussion
   - Auto-delivered wirelessly
   - Kindle Price: $6.39

22. *Star Wars: Fate of the Jedi: Allies* by Christie Golden
   - Release Date: May 25, 2010
   - Available for Pre-order
   - List Price: $27.99
   - Price: $17.82
   - You Save: $10.17 (36%)

23. *The Last Colony* by John Scalzi
   - Rating: 4.5 stars (94 customer reviews) | 1 customer discussion
   - Auto-delivered wirelessly
   - Kindle Price: $6.39

   - Rating: 4 stars (38 customer reviews) | 1 customer discussion
Metadata for books

- Genre & classification
- Topseller ranks
- Comments & reviews
- Awards & prizes
- Recommendations
- Links to other books — sequels, referrals, etc.
- Authors
What is Metadata?

*Metadata is Data about Data*

*Meta^2 data is data about metadata*
Agenda

• Motivation & Introduction
• Metadata Standards
• Multimedia Metadata
Libraries are perfect examples for document collections.

- Wall paintings in caves
  - e.g. Altamira, ~ 18,500 years old

- Writing in clay, stone, bones
  - e.g. Mesopotamian cuneiforms, ~ 4,000 BC
  - e.g. Chinese tortoise-shell carvings, ~ 6,000 BC
  - e.g. Hieroglyphic inscriptions, Narmer Palette ~ 3,200 BC
History …

- **Papyrus**
  - Specific plant (subtropical)
  - Organized in rolls, e.g. in Alexandria

- **Parchment**
  - Independence from papyrus
  - Sewed together in books

- **Paper**
  - Invented in China (bones and bamboo too heavy, silk too expensive)
  - Invention spread -> in 1120 first paper mill in Europe
History ...

- **Gutenberg’s printing press (1454)**
  - Inexpensive reproduction
  - e.g. “Gutenberg Bible”

- **Organization & Storage**
  - Dewey Decimal System (DDC, 1872)
  - Card Catalog (early 1900s)
  - Microfilm (1930s)
  - MARC (Machine Readable Cataloging, 1960s)
  - Digital computers (1940s+)
Library & Archives today

- Partially converted to electronic catalogues
  - From a certain time point on (1992 - ...)
  - Often based on proprietary systems
  - Digitization happens slow
  - No full text search available
  - Problems with preservation
    - Storage devices & formats
History of Searching

- **Browsing**
  - Like “Finding information yourself”
- **Catalogs**
  - Organized in taxonomies, keywords, etc.
- **Content Based Searching**
  - `SELECT * FROM books WHERE title='%Search%'`
- **Information Retrieval**
  - Ranking, models, weighting
  - Link analysis, LSA, ...
Metadata: What for?

- Consumer needs help in
  - Finding & Filtering: *Indexing & Classification*

- Consumption constraints
  - Device capabilities: *Interoperable Descriptions*
  - Rights & billing: *Interoperable Processes & Formats*

- Processing online or in real time
  - Search & Filtering: *Based on Metadata & Text*
  - Adaptation: *Distributed, Based on Metadata*
Metadata Problems

• Interoperability
  – Complexity of Metadata vs. Integration in (different) applications

• Preservation
  – Readability in 100, 1000 years
  – Description how to decode ...

• Transmission
  – Synchronized, partially, etc.

• Timeliness
  – Changing with audiovisual content while editing?
Aspects of Metadata

- Content Description
- Administrative Aspects
- Quality Metadata
- Legal Metadata
- Technical Metadata
Aspects of Metadata: Content Description

• Agenda
  – Overview about a presentation or a sequence of information to a particular topic

• Table of Contents
  – A list of all segments and their position

• Abstract
  – Describes the topic of a content within a few sentences.

• Preface
  – Some words of the author

• Structure
  – For consumption & navigation
Aspects of Metadata: Content Description

- Keywords & index
  - Content description and lookup of concepts
- Summary
  - Overview of the most important aspects of an content or its deductions, e.g. video summary
- References & footnotes
  - Additional material, sequels, ...
- Comments
  - For interactive environments
- Categories
  - Conceptual classification in taxonomies (genre, audience etc.)
- Languages
  - Which languages are used / available
Aspects of Metadata: Administrative Metadata

• Associated persons
  – Authors: Content creators
  – Contributors: People who contributed to the content

• History of Changes
  – Changes in content and metadata with author, date, position in the content and sort of action
  – Especially in production

• Unique identifier
  – e.g. URI or database id

• Versions
  – Versioning information related to the history
Aspects of Metadata: Quality Aspects

- **Weight**
  - Prioritization of segments, e.g. scenes

- **Expiration Date**
  - Time period of validity of the content

- **Recessions**
  - Opinions, arguments from others

- **Process description & history**
  - Who corrected, translated and approved the content e.g. within an workflow

- **Quality Assessment**
  - Rating of the (e.g. visual) quality of the content
Aspects of Metadata: Legal Metadata

• Copyright
  – Person or company legally permitted to sell or trade with the content.

• Publishing Date
  – Date when the content has been released to public.

• License Model
  – This is the mode how consumers are allowed to reuse the content
Aspects of Metadata: Technical Metadata

- **Standards**
  - Description of the standard for storage / transmission
- **Application/System**
  - Tools for content and metadata processing
- **Resolution & compression**
  - Note: Compression & container are different aspects
- **Encryption Method**
  - In case of encrypted content / DRM
- **Storage Media**
  - CDs, tapes, MO, paper, HDD, etc.
- **Logs**
  - Technical history
Satisfied with results?
Satisfied with results?
Question: What is so special ‘bout Mona Lisa’s smile?
Semantic Gap

- Defined as
  - Inability of automatic understanding
  - Gap between high- and low-level features / metadata

- Actually hard task for humans also
Semantic Gap (1)

- General Definition: Santini & Jain (1998)
Semantic Gap (2)

Where actually is the Semantic Gap?

- Classification based on Concepts
- Segmentation & Object Recognition
- ...

Daten | Information | Wissen | Weisheit

Bitströme und Rohdaten | Terme und Features | Konzeptuelle Modelle und Strukturen | Semantik und Verständnis
Demo ...

- TagRecommend & windows example images
Metadata Standards

• Languages & Models
  – XML, RDF, OWL
  – Dublin Core

• Standards
  – EBU pmeta, ...
  – MPEG-7
Ontologies: RDF

- Metadata Model published by the W3C
  - Reaction on the insufficiency of HTML metadata for search & inference
  - Based on “Subject – Predicate – Object” triples
  - Uses URIs for identifying concepts
  - Spans a directed graph
  - Is used in conjunction with vocabularies (e.g. DC, FOAF)
Ontologies: SKOS

• Simple Knowledge Organization System
  – RDF Vocabulary for KOS

• Knowledge Organization Systems are
  – Taxonomies, Thesaurii, Classification Schemes, etc.

• Can be used to organize multimedia data
XML & RDF

XML
- Hierarchie
- Tree structure
- Schema
- DOM/SAX Parser

RDF
- Set of statements
- Graph structure
- Vocabulary
- Reasoner (~)
Media Production: Dublin Core

• Aims to provide
  – Common denominator for metadata
  – Simple yet powerful schema

• Dublin Core Metadata Initiative defined
  – 15 elements (author, date, title, type, ...)
  – Further refinements (creation date, extent, ...)

• Dublin Core does not provide
  – A schema for storage
  – A schema for data types (e.g. dates)
EBU P/Meta

• Aims to provide …
  – a universal standard for metadata exchanges between professional media organizations
  – a definition of common meaning to the data fields and values that most broadcasters use in order to enable exchanges
  – designed for use in a wide range of broadcasting activities
  – both language and system independent
  – a joint development by EBU (European Broadcasting Union) members on a not-for-profit basis
  – a scheme that makes use of other standards where possible, e.g. ISO country codes.
Others …

- **eXtensible Metadata Platform (XMP)**
  - Initiative from Adobe
  - Based on RDF, embedded in document
  - Also used in PDF, AI, PSD, etc.

- **ID3**
  - Metadata for MP3, spread by popular players
  - Two versions ...
    - v1: 128 Byte block coding some fields at end of file
    - v2: Several optional tags inside stream
Others ...

- **Electronic Program Guide (EPG)**
  - In use in conjunction with DVB
  - Simple format in additional stream

- **Multimedia Home Platform (MHP)**
  - In use in Austrian DVB-T
  - Proprietary format for data + function
  - Based on Java
Model vs. Standard

- **Metadata model** defines
  - Structure and goals
  - Semantics
  - Logical & semantic links to content

- **Metadata standard**
  - De facto vs. de jure
  - Typically has model
  - Typically „ready to implement“
MPEG-7

• Make searching for multimedia content as easy as searching for text is today
• Interoperable management of A/V data, such as
  – Searching
  – Filtering
  – Indexing
  – Accessing

• Associates descriptions (meta data) with content
  – Format of the descriptions must be standardized
  – Generation and consumption of those generally not
Kinds of descriptions

- Information about the content
  - Title, author, recording date, copyright, coding format ...

- Information extracted from the content
  - Combination of low and high level descriptors

- Forms of descriptions
  - Textual (XML document)
  - Binary Format for MPEG-7 (BiM)
Elements of the MPEG-7 standard

- **Descriptors**
  - Syntax and semantics of exactly one (low or high level) elementary feature

- **Description Schemes**
  - Defines structures within a framework

- **Description Definition Language (DDL)**
  - Extension of XML Schemes

- **Coding Schemes**
  - Create and interpret descriptions in BiM
Structural vs. conceptual aspects

- Program DS (in sense of TV program)
- Analogy to
  - Table of content – Region tree (linear partitioning)
  - Index – Object tree (non-linear structure)
Region and object trees
Scope of MPEG-7

from: http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm
MPEG-7 High Level Descriptors

- Textual Descriptions
  - text to describe temporal / spatial regions
- The W’s
- Instead of Textual descriptions
  - Controlled Terms (Dictionaries, Taxonomies, Classifications Schemes)
  - Semantic Description Scheme
MPEG-7 Semantic Description Scheme
Actual Description in MPEG-7
Metadata Generation & Annotation

• Process of creating data about data
• Content has to be known
  – Watch & understand video / image collection
  – Listen and assess audio
• Metadata standard has to be known
  – What are the possible fields?
  – What are the used classification systems?
Evaluation (1/2)

- **Goal:** Identify user opinions on manual semantic annotation

- **5 users’ (median) background:**
  - 17 years of computer experience
  - Using a computer 50 h / week
  - 2 years experience with digital photo cameras
  - 4 years experience with imaging software
Evaluation (2/2)

• 2 tasks:
  – Annotate a photo with a given description and an extensive prior introduction to semantic photo annotation with Caliph
    • video was shown,
    • concept was explained and
    • questions were answered
  – Annotate a photo fully on your own
  – After Tasks:
    • Questionnaire with several subjective questions
    • Evaluation Scale from: -3 (strongly disagree) to 3 (strongly agree)
Evaluation Results: General Questions

– The concept of meta data is very new to me: -2.6
– It was easy to understand the concept of semantic meta data while using Caliph: 1.8
– The visualization of the semantic meta data within Caliph is easy to understand and interpret: 2.2
– The annotation of images with textual descriptions can be done fast and easily: 1.4
– The annotation of images with semantic meta data can be done fast and easily: 1.2
– I can see an obvious benefit by using semantic meta data for image (multimedia) annotation: 1.4

Scale: (disagree) -3 to 3 (agree)
Evaluation Results: Scenario based questions

1. The complexity of semantic annotation is too high to be useful for organizing photos.
2. I would find it easy to annotate a large set digital photos (e.g. 100+).
3. I would recommend Caliph or a similar tool to annotate digital photos.
4. I can see an obvious benefit by using semantic meta data for the organization of photos.

<table>
<thead>
<tr>
<th>Personal</th>
<th>Newspaper</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.6</td>
<td>-1.8</td>
</tr>
<tr>
<td>-0.6</td>
<td>-0.2</td>
</tr>
<tr>
<td>0.8</td>
<td>1.4</td>
</tr>
<tr>
<td>1.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Scale: (disagree) -3 to 3 (agree)
Evaluation Results: Annotation performance

![Bar chart showing annotation performance for User 1 to User 5 across Test 1 and Test 2.](chart.png)
Evaluation Results: Annotation performance

– Median times for annotation:
  • 15.4 minutes for the 1st test and
  • 6 minutes for the 2nd test

– Median time in a self test with 17 photos:
  • 1 minute and 53 seconds per photo

– That results in an approximate time of 10 h 27 min. for annotation of a set of 333 photos
Evaluation Results: Diversity of Annotations (2\textsuperscript{nd} test)

- Structured text annotation field “Who”:
  1. Vedran, Wolfgang, Armin
  2. Wolf, Armin, Vedran
  3. Wolfgang Kienreich, Vedran Sabol, Armin Ulbrich
  4. wolfgang, armin, vedran
  5. W.Kienreich,A.Ulbrich,V.Sabol
Evaluation Results: Diversity of Annotations (2\textsuperscript{nd} test)

- **Free text annotation:**
  1. Stadthalle, Graz, Austria I-Know '04 Knowledge Management Conference
  2. The three are sitting ...
  3. Wolfgang Kienreich, Armin Ulbrich und Vedran Sabol (v.l.n.r.) sprechen miteinander auf der I-Know. Wolfgang Kienreich, Vedran Sabol, Armin Ulbrich are at I-Know, Graz for Talking
  4. Stadthalle, Graz, Austria I-Know '04 Knowledge Management Conference
  5. Wolfgang, Armin and Vedran talking to each other on I-Know 04 at Stadthalle Graz.
Evaluation Results: Diversity of Annotations (2nd test)

User 1: Wolfgang Kienreich → I-Know'04 → Talking → Vedran Sabol

User 2: Armin Ulbrich → Summer 2004 → I-Know → Talking → James Bend

patientOf

locationOf

timeOf
User 3:

Graz

I-Know

Armin Ulbrich

Vedran Sabol

Wolfgang Kienreich

User 4:

stachus graz

Summer 2004

time

patientOf

patientOf

patientOf

patientOf

Wolfgang Kien

Armin Ulbrich
Evaluation Results: Diversity of Annotations (2\textsuperscript{nd} test)

User 5:
Lessons Learned

- Users like the graphical annotations editor
- Users can see value in semantic annotation in a professional (business) environment
- Semantic annotation is very time consuming
- The MPEG-7 nomenclature is not intuitive
  - Semantic agent / place / object & relations
  - Creator of image / description / quality rating
- Tagging with central tag repository ...
Conclusions ...

• Metadata for metadata‘s sake?
  – model only if needed
  – extendability fine, but not the key

• Technology driven thinking ...
  – leads to complexity
  – and lots of „integration work“

• Keep it small and simple!
  – ... do what is needed.
  – metadata should add value, not work
Thanks

... for your time

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