

18. Metadata for Multimedia

INFO 202 - 29 October 2008

Bob Glushko

Plan for INFO Lecture #18

Metadata Challenges for Multimedia

"Professional" Metadata

Augmenting Professional Metadata

"Amateur" Metadata

"Contextual" Metadata

What Is Multimedia?

Media:

- Text
- Audio (speech, music, sound)
- Graphics and Images
- Moving Images

Multimedia -- Composed of more than one form of media

Time-based media -- Audio and video

The Metadata Questions - A Reminder

What objects have metadata assigned to them?

What is the granularity of the object?

What metadata is being assigned?

What is the format of the metadata?

What standards for the metamodel or controlled vocabulary are being followed?

Who is assigning the metadata?

What Does it Mean to Describe Something?

Identify / scope the thing to be described

Study it to identify its important properties or features

Compare it with other things like and unlike it

Select or develop a system / vocabulary for description using "good" categories and terms

Create the descriptions, measurements, and other statistics about the object, either "by hand" or by some automated / computational process

Concepts and Relationships for Multimedia "Documents"

playlist, album, queue

composite, collage, mix, remix

clip, sample, bite

remake, cover version

layout, presentation, performance

broad-/narrow-/simul-/tele-/web-/pod- cast

installation, environment

What's Different About Describing Multimedia?

- Sensory Gap
- Semantic Gap
- Proliferation Problem

The Sensory Gap [1]



The Sensory Gap [2]

The gap between an object and a computer's ability to sense and describe the object

An infinite number of different "signals" or representations can be produced by the same object, depending on its distance, orientation, illumination, etc.

Likewise, different objects can produce similar "signals"

Human perception is remarkable in its ability to recognize when different "signal patterns" are the same object or when similar patterns are different ones

But the problem is difficult for computers... "in the case of object classification ... the performance of the best computer models cannot rival the performance of a three year old child"

The Semantic Gap

Instruments, devices, sensors and so on encode data in formats that are optimized for efficient capture, storage, decoding, or other criteria

As a result, the content / representation / encoding / material of the object is semantically opaque, and can't be (easily) processed to understand what the object "means"

So there is a gap between the semantic descriptions that people assign to objects and the descriptions that can be assigned by computers or other automated mechanisms

That's why multimedia needs metadata!

What's this Picture About?

Name That Tune

Text has No "Semantic Gap"

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE slides SYSTEM "slides.dtd">
<slides>
    <title>10. Metadata for Multimedia and Non-text Information
    </title>
    <subtitle>IS 202 - 29 September 2005</subtitle>
    <docinfo>
        <authors>
            <author>
                <firstname>Bob</firstname>
                <surname>Glushko</surname>
            </author>
        </authors>
        <copyright>Copyright © 2005 Robert J. Glushko</copyright>
    </docinfo>
```

The Proliferation Problem [1]

Moore's Law as applied to digital cameras and video recorders has given them vastly higher resolution and greater storage capacity

Non-professional consumers now create very large collections of multimedia objects

With many more objects created by many more people, the average object has less "value" and doesn't justify significant effort to organize and describe it

The Proliferation Problem [2]

Without ways to manage it (metadata creation and use) we lose the advantages of digital media

Many current approaches are insufficient, perhaps misguided, and certainly ignore a lot of what we already know

Great opportunity for innovation and invention, especially interdisciplinary approaches that combine technology and social considerations

Are these "Gaps" Really New Problems?

Museums face some of the same or similar problems in describing art works and artifacts:

- There may be many artifacts that represent the same "work" - this is like the "sensory" gap
- The materials or medium in which the artifact is embodied don't convey semantics "on their surface" - this is the semantic gap
- There may be so many artifacts of a particular type that some get only limited descriptions - this is like the proliferation problem

Museums have been around a LONG time... the [Ashmolean at Oxford](#) was opened in 1683

Just A Matter of Degree?

Horse and Rider



**Unknown
Greek, Boeotia, about 550 B.C.
Terracotta
82.A.D.84**

 [Enlarge](#)

“Black-Throated Wind”

Grateful Dead

1973-02-09

Maples Pavillion, Stanford U.

But Some Problems May Be New

The temporal structure of multimedia, especially video, mandates new descriptive vocabulary

Video and music meet emotional/psychological needs that are more complex than those for "documents" - so the descriptions of the latter have to be able to address these needs

People don't access or retrieve music "to satisfy information requirements"

"Professional" Metadata for Multimedia and Non-textual Works

Museum works and other non-text artifacts have long been described by professionals using structured metadata according to classification rules

The descriptions are often "layered" beginning with accessible properties with more analytic descriptions added for those objects that warrant them

Panofsky's Three Levels of Meaning

Description

Identification

Interpretation

Description

The "primary" or "natural" subject matter of a work

The generic elements or things depicted in, on, or by an object / image / art work

These would be recognizable by anyone, regardless of their expertise or training

Identification

The name of the subject or thing depicted in the work

Can require research or fact assembly from other sources

Interpretation

The meaning or theme represented by the subject matter or iconography of the work

This meaning is often symbolic, and grounded in the culture in which the work was created

Done by domain and methodology experts

EXAMPLE: Mantegna's "Adoration of the Magi"



The Getty Vocabularies

Art and Architecture Thesaurus

- A structured vocabulary of more than 133,000 terms, descriptions, bibliographic citations, and other information relating to fine art, architecture, decorative arts, archival materials, and material culture
- Organized using facets for objects, materials, physical attributes, styles and periods, activities, agents...

Union List of Artist Names

Thesaurus of Geographic Names

Art and Architecture Thesaurus

ID: 300011576

Record Type: concept

 Carrara marble (white marble, <marble by color or pattern>, ... Materials)

Note: Refers to a type of marble quarried in the area around Carrara, in Tuscany, Italy. It is characterized by a fine, compact grain and varies in color from pure white to creamy white, sometimes with a bluish tinge; it is a saccharoidal rock that can appear translucent in the finer grades. It has been a favorite stone of sculptors from antiquity to the present, including Michelangelo Buonarroti. Luna marble was the name used in ancient Rome.

Terms:

[Carrara marble](#) (preferred, C,U,D,American English-P)
[Luna marble](#) (C,U,UF,American English)
[marble, Carrara](#) (C,U,UF,American English)
[marble, Luna](#) (C,U,UF,American English)
[marmor Lunense](#) (C,U,UF,American English)
[marmor Lunense](#) (C,U,UF,American English)

Facet/Hierarchy Code: M.MT

Hierarchical Position:

 Materials Facet
.... Materials
..... materials
..... <materials by composition>
..... inorganic material
..... rock
..... metamorphic rock
..... marble
..... <marble by color or pattern>
..... white marble
..... Carrara marble

Union List of Artist Names

Buonarroti, Michelangelo ([preferred](#), [index](#), [V](#))
Michelangelo Buonarroti ([display](#), [V](#))
Michelangelo Buonarotti ([V](#))
Michelangelo ([V](#))
Michelagnolo di Lodovico Buonarroti Simoni ([V](#))
Michelagniolo di Lodovico de Lionardo di Buonarrot
Simoni ([V](#))
Michelagniolo di Lodovico di Lionardo di Buonarrot
Simoni ([V](#))
Michelangelo di Lodovico di Lionardo di Buonarrot
Simoni ([V](#))
Michelangelo di Ludovico Buonarroti ([V](#))
Buonarroti, Michel Angelo ([V](#))
Buonarroti, Michelagniolo ([V](#))
Bonarroti, Michelangelo ([V](#))
Bonorotti, Michelangelo ([V](#))
Buonarota, Michelangelo ([V](#))
Michael Angelo Buonaroti ([V](#))
Michael Angelo Buonarotti ([V](#))
Michelagniolo Buonarroti ([V](#))
Michelagnolo Buonarroti ([V](#))
Michelagnolo Buonarruoti ([V](#))
Michelange Bonaroti ([V](#))
Michelang.o Bonarota ([V](#))
Michel Angel de Bonarrotta ([V](#))
Michelangelo Bonarota ([V](#))
Michelangelo Bonaroti ([V](#))
Michelangelo Buonarota ([V](#))
Michelangelo Buonaroti ([V](#))
Michelangelo Buonarrotta ([V](#))
Michelangelo Buonarroti ([V](#))
Michelangiolo Buonaroti ([V](#))
Micheleangelo Buonarota ([V](#))
Michel Angelo ([V](#))
Michel'Angelo ([V](#))
Michael Angelo ([V](#))

Thesaurus of Geographic Names

ID: 7006077

Record Type: administrative

 Carrara (inhabited place)

Coordinates:

Lat: 44 05 00 N degrees minutes Lat: 44.0833 decimal degrees
Long: 010 06 00 E degrees minutes Long: 10.1000 decimal degrees

Note: Located on the Carrione river; gained importance as marble-quarrying center, noted for fine white marble suitable for sculpture; was important medieval center; was center of Massa-Carrara principality & duchy (after 1633).

Names:

Carrara ([preferred](#), [C](#), [V](#), [N](#))
Apuania ([H](#), [V](#), [N](#)) ancient name

Hierarchical Position:

-  World (facet)
 - Europe (continent)
 - Italy (nation)
 - Tuscany (region) ([C](#)) part of new kingdom of Italy from 1861
 - Massa-Carrara (province)
 - Carrara (inhabited place)

Place Types:

inhabited place ([preferred](#), [C](#)) was an ancient center
city ([C](#))
quarrying center ([C](#))
episcopal see ([C](#))

"Faceted Metadata for Image Search and Browsing"

Prof. Marti Hearst and graduate students project to complement professional categorization metadata with extracted content metadata

(Semi-)automatically create faceted classification system by aligning descriptions using WordNet ontology

Faceted classification scheme used to generate user interface that encourages browsing along with traditional descriptor search

(The Delphi project goes even further -- we'll talk about it when we get to NLP)

Flamenco Facets

The screenshot shows a web-based application interface titled "Flamenco". At the top, there is a search bar with a "Search" button. Below the search bar, the interface is organized into several colored facets:

- Media** (pink): aquatint (2025), basketry (44), book (666), ceramic (1008), costume (660), decorative box (163), domestic object (176), drawing (2624), drypoint (2143), etching (9507), furnishing (127), glass (651), more...
- Nature** (light blue): animal material (515), birds (1437), bodies of water (3604), creatures (801), fish (219), flowers (1220), geological formations (2122), heavens (2353), hoofed mammals (2480), invertebrates and arthropods (330), mammals (2116), plant material (788), more...
- Location** (yellow): Middle East (78), North America (11111), Oceania (111), Roman Empire (4), South America (453). A tooltip for "Asia" indicates it has 1732 items.
- Places and Spaces** (light blue): bridges (592), building parts (3088), buildings (2393), dwellings (1709), lawn (20), open spaces (1732), roads (1480), workplaces (753).
- Date** (green): 1 - 1000 A.D. (138), 12th century (3), 13th century (1), 14th century (3), 15th century (76), 16th century (1225), 17th century (3058), 18th century (2287), 19th century (7552), 20th - 21th century (18), 20th century (14295), 21st century (12), more...
- People** (purple): aristocrats (974), children (2501), men (7372), occupations (715), women (5906).
- Themes** (light green): military (3237), mortality (591), nautical (1972), religion (5107).
- Shapes, Colors, and Materials** (purple): colors (5861), decorations (1441), fabrics (345), metal (273), paper (457), shapes (2752), visual framing (5911).
- Artists** (pink):

Flamenco Catalog Item

Flamenco

item 1 of 22 (back to results)

next ▶

Bag (ch'uspa)



Current search (start a new search):
Shapes, Colors, and Materials: fabrics > wool X

Select any link to see items in a related category.

more general categories

MEDIA

LOCATION

- South America (453)
 - Bolivia (153)
 - Cochabamba (25)
 - Tapacari (19)

DATE

 - 20th century (14205)

SHAPES, COLORS, AND MATERIALS

 - fabrics (345)

ARTISTS

RECORD NUMBER:

OBJECT TITLE: Bag (ch'uspa)

DESCRIPTION: Small bag, two pieces, patterned double cloth, multicolored, strap, tubular edge binding on sides and top, multicolored wool trim and tassels on bottom.

CULTURE OR PEOPLE: Quecha/Aymara

information about this item

MEDIA costume (660)

LOCATION Challa (10)

DATE 1950 - 1959 (1027)

SHAPES, COLORS, AND MATERIALS wool (22)

ARTISTS unknown (2745)

"Amateur" and "Semi-Professional" Metadata

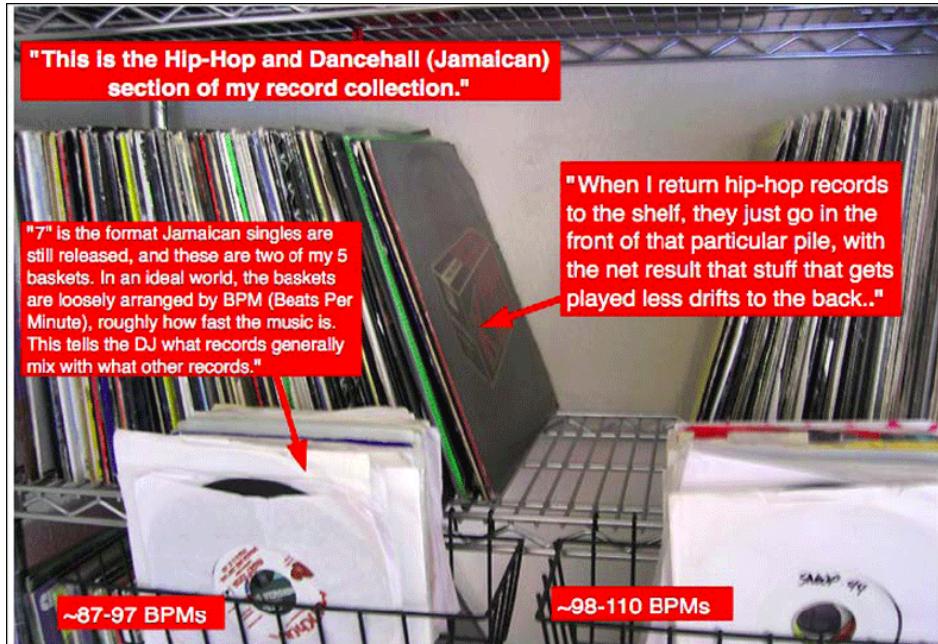
Flickr, YouTube, and other collections of multimedia works are characterized by non-standard classification schemes

There is no "professional" metadata to start with and build upon

Result 1: Unstructured tagging with little use of controlled vocabularies within each collection

Result 2: No standardization or interoperability across collections

PIM in a Music Collection



Movie Categories: Amazon, Blockbuster, Netflix

Action & Adventure
Anime & Manga
Art House & International
Classics
Comedy
Documentary
Drama
Gay & Lesbian
Horror
Kids & Family
Music Video & Concerts
Musicals & Performing Arts
Mystery & Suspense
Science Fiction & Fantasy
Special Interests
Sports
Television
Westerns

Movie Categories
Action & Adventure
African-American
Animation
Classics
Comedy
Documentary
Drama
Family & Kids
Foreign
Gay & Lesbian
Horror
Independent
Music & Performance
Mystery & Suspense
Romance
Sci-Fi & Fantasy
Special Interest
Sports & Fitness
Television
War
Westerns

Action & Adventure
Anime & Animation
Children & Family
Classics
Comedy
Documentary
Drama
Foreign
Gay & Lesbian
Horror
Independent
Music & Musicals
Romance
Sci-Fi & Fantasy
Special Interest
Sports
Television
Thrillers

Podcast Classification - Hierarchical

iTunes Categories for Podcasting

- Arts
 - Design
 - Fashion & Beauty
 - Food
 - Literature
 - Performing Arts
 - Visual Arts
- Business
 - Business News
 - Careers
 - Investing
 - Management & Marketing
 - Shopping
- Comedy
- Education
 - Education Technology
 - Higher Education
 - K-12
 - Language Courses
 - Training
- Games & Hobbies
 - Automotive
 - Aviation
 - Hobbies
 - Other Games
 - Video Games
- Government & Organizations
 - Local
 - National
 - Non-Profit
 - Regional
- Health
 - Alternative Health
 - Fitness & Nutrition
 - Self-Help
 - Sexuality
- Kids & Family
- Music
- News & Politics
- Religion & Spirituality
 - Buddhism
 - Christianity
 - Hinduism
 - Islam
 - Judaism
 - Other
 - Spirituality
- Science & Medicine
 - Medicine
 - Natural Sciences
 - Social Sciences
- Society & Culture
 - History
 - Personal Journals
 - Philosophy
 - Places & Travel
- Sports & Recreation
 - Amateur
 - College & High School
 - Outdoor
 - Professional
- Technology
 - Gadgets
 - Tech News
 - Podcasting
 - Software How-To
- TV & Film

Podcast Classification - Different Hierarchy

Categories of Podcasts

Arts

-- Ambient - Architecture - Arts - Author Interviews - Books - Comedy - Design - Films - Food - Health Food - Literature - Mexican - Movie Reviews - Museums - Other - Performing Arts - Photography - Podcast - Podcasting - Poetry - Public Radio - Reading - science fiction - Spoken word - Stories - Talk - Unknown - Urban Contemporary - Visual Arts - Wine -

Blogs and Commentary

- Art - Arts - College Radio - Educational - Gay - Interviews - Liberal - News - Talk -

Business

-- Agriculture - Arts - Business - Business - Barter - Careers - Environmental Business - Finance - Gambling - Games - Instructional - International - Interviews - Investing - Management - Management and Marketing - Marketing - Non-profit - Personal Finance - Podcasting - Positive Talk - Real Estate - RealEstate - Spoken word - Sports - Talk - Talk Show - Technology - Unknown - Wall Street -

Comedy

-- Absurd - Adult Contemporary - Classic - Comedy - Current Events - Drums and Bass - Education - Entertainment - Films - Judaism - Mexican - Movie Reviews - Music - News - Philosophy - Podcasting - Poetry - Religious - Science Fiction - Talk - Unknown - webcomics -

Culture

- Art - Christian - Current Events - Family - Hard Core - Interviews - Movie Reviews - News - Political Commentary - Rock - Sports - Talk -

Dub

Electronica -

Education

-- Books - Business - Child Development - Christian - Education - Educational - Entertainment - Health - Higher Education - Improvement - Instructional - International - Interviews - K-12 - Language - Language Courses - Language Lessons - Learning - Other - Positive Talk - Religious - Spoken word - Technology - Uni - Unknown - Word of the Day -

Ethnic

- Arts -

Folk

- Family - Instructional - Interviews - Oldies - Positive Talk - Spoken word - Talk -

Food

- Art - Childrens - Spoken word - Talk - Travel -

Games

- PC - Science Fiction - Spoken word - Talk - Video Game - Video Games -

Podcast Classification - Faceted

[PodcastDirectory.com](http://www.podcastdirectory.com)

(<http://www.podcastdirectory.com>) uses facets of Genre, Region, Language, and Popularity

But doesn't control values in all facets!

The Need for Contextual Metadata

"This process of manual metadata tagging, subjective and labor-intensive, may work for Corbis, but it's a lot to ask of the rest of us... The metadata most of us attach to our photos is pretty pathetic. We... end up with a hard disk full of photos with names like DSC00012.jpg and DSC00234.jpg. As the years go on, DSC00234.jpg will become an archaeological artifact that might as well be labeled Don't_Know_Don't_Care.jpg." -- David Weinberger

Contextual Metadata

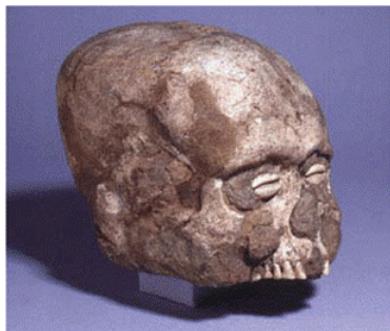
Metadata about the context in which some content was "captured"

Location, time, other people or things present are basic elements, but there are many more

This kind of information has often been collected, but not usually analyzed and applied to description until afterwards

Non-Automated Contextual Metadata in Museum Catalog

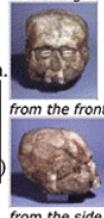
Bone: AN1955.565



- **Object Type:** Plastered human skull
- **Period:** Pre-Pottery Neolithic
- **Material:** Bone
- **Dimensions:** H: 15.2cm. W: 16.7cm. L: 22cm.
- **Region:** Palestine
- **Find's spot:** Jericho: 1953 season of excavation: skull D III (Reg. 534); from square D. I, stage XVI-XVII: phase xlii-xliii)
- **Museum Catalogue No.:** [Moorey \(2004\) 1](#)

Summary page

[More images:](#)



Exchangeable Image File Format (Exif) for Digital Cameras

Manufacturer	CASIO	ComponentsConfiguration	Y Cb Cr -
Model	QV-4000	Compressed Bits per Pixel	4.01
Orientation	top - left	Exposure Bias	0.0
Software	Ver1.01	MaxApertureValue	2.00
Date and Time	2003:08:11 16:45:32	Metering Mode	Pattern
YCbCr Positioning	centered	Flash	Flash did not fire.
Compression	JPEG compression	Focal Length	20.1 mm
x-Resolution	72.00	MakerNote	432 bytes unknown data
y-Resolution	72.00	FlashPixVersion	FlashPix Version 1.0
Resolution Unit	Inch	Color Space	sRGB
Exposure Time	1/659 sec.	PixelXDimension	2240
FNumber	f/4.0	PixelYDimension	1680
ExposureProgram	Normal program	File Source	DSC
Exif Version	Exif Version 2.1	InteroperabilityIndex	R98
Date and Time (original)	2003:08:11 16:45:32	InteroperabilityVersion	(null)
Date and Time (digitized)	2003:08:11 16:45:32		

Extending Exif with Geo-Referencing (Naaman et al)

Time		Time of Day	
2002 (398)	2003 (3306)	Afternoon (12pm-5pm) (1573)	Late night (12am-3am) (28)
Location		Early morning (3am-6am) (22)	Morning (6am-12pm) (923)
Cambodia (151)	Italy (146)	Evening (5pm-8pm) (650)	Night (8pm-12am) (508)
France (167)	Sri Lanka (512)		
Hungary (176)	Thailand (60)		
Israel (670)	United states (1822)		
Elevation		Weather Status	
-2000--1001 (36)	10000-10999 (85)	Clear (944)	Mist (61)
-1000--1 (327)	11000-11999 (59)	Fog (2)	Mostly cloudy (373)
0-999 (2425)	12000-12999 (37)	Haze (135)	Overcast (110)
1000-1999 (151)	13000-13999 (40)	Heavy rain (6)	Partly cloudy (500)
2000-2999 (53)	14000-14999 (33)	Light rain (237)	Patches of fog (1)
3000-3999 (43)	more...	Light rain showers (3)	more...
4000-4999 (57)		Light snow showers (3)	
Season		Temperature	
Autumn/sep 21st-dec 20th (1007)	Summer (june 21st-sep 20th) (1059)	20-40 (87)	80-100 (239)
Spring (march 21st-june 20th) (953)	Winter (dec 21st-march 20th) (685)	40-60 (972)	
		60-80 (760)	
Light Status		Time Zone	
Dawn (47)	Dusk (495)	-5 (8)	-2 (670)
Day (2367)	Night (789)	-7 (180)	-5 (512)
		-8 (1634)	-1 (211)
		-1 (489)	

Integrating Other Resources

ID: 7013386

Record Type: administrative

Berkeley (inhabited place)

Coordinates:

Lat: 37 52 00 N *degrees minutes* Lat: 37.8667 *decimal degrees*
Long: 122 16 00 W *degrees minutes* Long: -122.2667 *decimal degrees*

Note: Located on San Francisco Bay; most of N section of the city was destroyed by fire in 1923, but has since been rebuilt.

Names:

Berkeley (preferred, C,V,N)

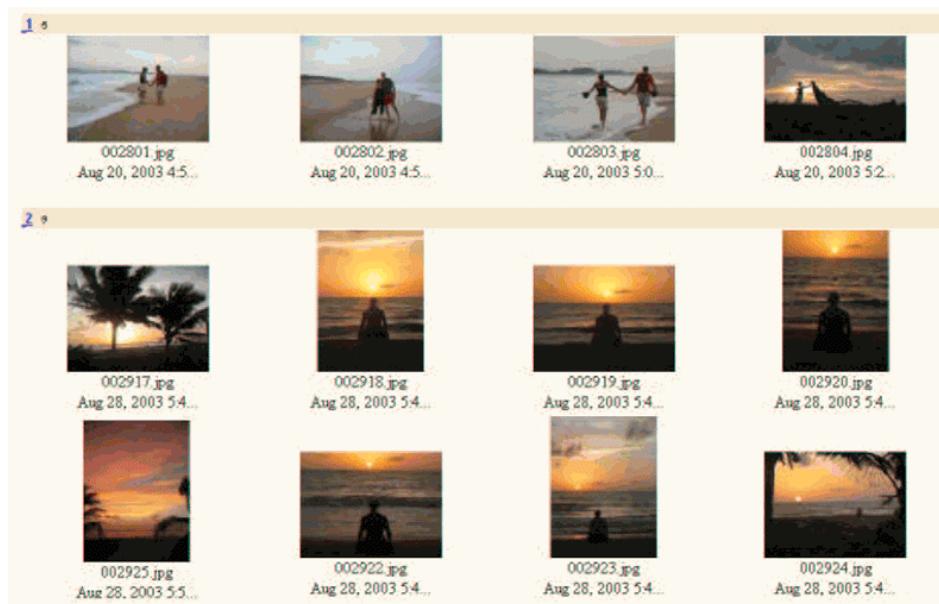
Hierarchical Position:

- World (facet)
 - North and Central America (continent)
 - United States (nation)
 - California (state)
 - Alameda (county)
 - Berkeley (inhabited place)

Place Types:

inhabited place (preferred, C) founded in 1853, incorporated in 1909
city (C)	
industrial center (C) produces engines, serums & vaccines, foundry products & soaps
university center (C) University of California, Berkeley, was founded in 1868

Automatic Metadata Example -- "Sri Lanka at Dusk"



Readings for INFO Lecture #19

Jennifer Tidwell, Designing Interfaces, "Chapter 2, Organizing the Content: Information Architecture and Application Structure."

Jennifer Tidwell, Designing Interfaces, "Chapter 4, Organizing the Page: Layout of Page Elements"

Globalization, Localization, Internationalization and Translation

Mano Marks and Kelly Snow, "User Interface Design Patterns: Strengths, Challenges, and Future Directions"