Faceted Metadata in Search Interfaces

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Focus: Search and Navigation of Large Collections

- Image Collections
- E-Government Sites
- Shopping Sites
- Digital Libraries

Example: the University of California Library Catalog
<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Library</td>
<td>ALL Libraries</td>
</tr>
<tr>
<td>Format</td>
<td>ALL Formats</td>
</tr>
<tr>
<td>Language</td>
<td>ALL Languages</td>
</tr>
<tr>
<td>Year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>From (yyyy) To (yyyy)</td>
</tr>
</tbody>
</table>

**Search Examples**

- **Title**: old man sea
- **Title (exact)**: old man and the sea
- **Author (last name first)**: hemingway ernest
- **Words as Phrase**: genetic engineering

**Melvyl Search Tip**: Don't like using your mouse in searching? Try **Command Search**.
Basic Search: **Entire Collection**  

**Search:**  
- Subject  
- Title  
- Title (exact)  
- Journal Title  
- Journal Title (exact)  
- Author (keywords in name)  
- Author (last name first)  
- Author - Organization  
- Author/Title  
- Keywords  
- ISBN (used by UC-eLinks)  
- ISSN (used by UC-eLinks)  
- From (yyyy) to (yyyy)  

**Optional:**  
- Library:  
- Format:  
- Language: Subject  
- Year:  

**Words as Phrase:**  
- art history  
- No  
- Yes  

**Search Examples:**  
- **Title:** old man sea  
- **Title (exact):** old man and the sea  
- **Author (last name first):** hemingway ernest  
- or -  
- hemingway e*  
- **Words as Phrase:** genetic engineering  

**Note:** UC Irvine serials holdings are in the process of being updated. Search the UCI catalog, **ANTPAC**, for the most current information on UCI Libraries holdings.
Search results: 50229 Item(s)

Modify Search

Searched: **Subject= art history**
Collection: Entire Collection

Print / Email  Save  Request

select all  deselect all

1  Full Record

**Author** Peyré, Yves.
**Title** Art deco bookbindings : the work of Pierre Legrain and Rose Adler / Yves Peyré and H. George Fletcher.
**Format** Book
Online
**Library** UCD

2  Full Record

**Author** Darmon, Reed
**Title** Made in China / by Reed Darmon, with assistance from Kalim Winata
**Publisher** San Francisco : Chronicle Books, c2004
**Format** Book
**Library** UCSD

3  Full Record

**Author** Maturo, Carol L. (Carol Linda)
**Title** Malinche and Cortes, 1513-1521 : an iconographic study / Carol L. Maturo
**Publisher** 1994
What do we want done differently?

- Organization of results
- Hints of where to go next
- Flexible ways to move around

... How to structure the information?
The Problem with Hierarchy

Education
College and University, K-12...

Regional
Countries, Regions, US States...

Home > Education

Higher Education

Search

Inside Yahoo!

- Yahooligans! Teacher's Guide - features lesson plans, resources, newsletters, and more.
- Join a Chat
- Live Events
- Headline News

Categories

- Academic Competitions@
- Books@
- College Entrance (444) NEW!
- Colleges and Universities (15780) NEW!
- Distance Learning @
- Graduate Education (74)
- Guidance (66)

- Honors Programs (49)
- News and Media@
- Organizations (104)
- Policy Research Centers@
- Seminaries@
- Student Life (27) NEW!
- Web Directories (16)
The Problem With Hierarchy
The Problem with Hierarchy

U.S. States > California > Education > College and University > Public >
University of California

Inside Yahoo!

- Join a Chat
- Post a Message

Categories

- Campuses (11)
- Institutes (5)
- News and Media (1)

Campuses

Inside Yahoo!

- Join a Chat
- Post a Message

- Berkeley@
- Davis@
- Hastings College of the Law@
The Problem With Hierarchy

- Where is Berkeley?
  - College and University > Colleges and Universities > United States > U > University of California > Campuses > Berkeley
  - U.S. States > California > Cities > Berkeley > Education > College and University > Public > UC Berkeley
Outline

• Motivation: support for browsing big collections
  – Focus on *usability* for a wide range of lay users
• Approach: flexible application of hierarchical faceted metadata
  – Advantages of the approach
  – Results of usability studies
• Opportunities for AI:
  – Creating faceted category hierarchies
  – Assigning items to categories
  – Combine categories to identify tasks
  – A way to focus for personalization research
Why Care? These folks do:

- NYTimes archive
- eBay
- California Digital Library
- US Census
How to Structure Information for Search and Browsing?

- Hierarchy is too rigid
- Hierarchical faceted metadata: A useful middle ground
- KL-One is too complex
What are facets?

- Sets of categories, each of which describe a different aspect of the objects in the collection.
- Each of these can be hierarchical.
- (Not necessarily mutually exclusive nor exhaustive, but often that is a goal.)

GeoRegion + Time/Date + Topic + Role
Facet example: Recipes

- **Cooking Method**: Stir-fry
- **Course**: Main Course
- **Ingredient**: Chicken, Red Bell Pepper, Curry
- **Cuisine**: Thai
Example of Faceted Metadata: Categories for Biomedical Journal Articles

1. Anatomy [A]
2. Organisms [B]
3. Diseases [C]
4. Chemicals and Drugs [D]

1. Lung
2. Mouse
3. Cancer
4. Tamoxifen
Goal: assign labels from facets
Description: 19th c. paint horse; saddle and hackamore; spurs; bandana on rider; old time cowboy hat; underchin thong; flying off.
Motivation

Description: 19th c. paint horse; saddle and hackamore; spurs; bandana on rider; old time cowboy hat; underchin thong; flying off.

By using facets, what we are not capturing?

The hat flew off;
The bandana stayed on.

The thong is part of the hat.

The bandana is on the cowboy (not the horse).
The saddle is on the horse (not the cowboy).
Hierarchical Faceted Metadata

- A simplification of knowledge representation
- Does not represent relationships directly
- BUT can be understood well by many people when browsing rich collections of information.
How to Put In an Interface?
Some Challenges:

- Users don’t like new search interfaces.
- How to show lots of information without overwhelming or confusing?
A Solution  (The Flamenco Project)

• Use proper HCI methods.
• Organize search results according to the faceted metadata so navigation looks similar throughout
  – Easy to see what to go next, were you’ve been
  – Avoids empty result sets
  – Integrates seamlessly with keyword search
The Flamenco Project

- Incorporating Faceted Hierarchical Metadata into Interfaces for Large Collections

Key Goals:
- Support integrated browsing and keyword search
  - Provide an experience of “browsing the shelves”
- Add power and flexibility without introducing confusion or a feeling of “clutter”
- Allow users to take the path most natural to them

Method:
- User-centered design, including needs assessment and many iterations of design and testing
Art History Images Collection
Questions we are trying to answer

- How many facets are allowable?
- Should facets be mixed and matched?
- How much is too much?
- Should hierarchies be progressively revealed, tabbed, some combination?
- How should free-text search be integrated?
<table>
<thead>
<tr>
<th>Media</th>
<th>Built Places</th>
<th>Objects</th>
<th>Themes</th>
<th>Shapes, Colors, and Scenes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Book</strong> (309)</td>
<td><strong>Bridge</strong> (431)</td>
<td><strong>Clothing</strong> (6013)</td>
<td><strong>Military</strong> (2600)</td>
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<td><strong>Built open space</strong> (912)</td>
<td><strong>Food and meals</strong> (3680)</td>
<td><strong>Music, writing, and sport</strong> (5499)</td>
<td><strong>Scene</strong> (6526)</td>
</tr>
<tr>
<td><strong>Glass</strong> (403)</td>
<td><strong>Dwelling</strong> (1528)</td>
<td><strong>Fuel</strong> (453)</td>
<td></td>
<td><strong>Shape</strong> (1566)</td>
</tr>
<tr>
<td><strong>Metalwork</strong> (134)</td>
<td><strong>Part of building</strong> (3159)</td>
<td><strong>Lighting</strong> (386)</td>
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<td></td>
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<tr>
<td><strong>Objects</strong> (1689)</td>
<td><strong>Road</strong> (1204)</td>
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<tr>
<td><strong>Painting</strong> (115)</td>
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<td><strong>Photograph</strong> (333)</td>
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<td>12th century (3)</td>
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<td><strong>Europe</strong> (17758)</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Flamenco Fine Arts Search

Images from the Collections of the Fine Arts Museums of San Francisco; Legion of Honor and de Young Museums, [http://www.thinker.org](http://www.thinker.org)

### Media

- **Book** (309)
- **Ceramic** (896)
- **Drawing** (1547)
- **Glass** (403)
- **Metalwork** (194)
- **Objects** (1689)
- **Painting** (115)
- **Photograph** (333)
- **Print** (18206)
- **Sculpture** (193)

### Built Places

- **Bridge** (431)
- **Building** (2571)
- **Dwelling** (1528)
- **Part of building** (3159)
- **Built open space** (912)
- **Road** (1204)

### Date

- **1 - 1000 a.d.** (136)
- **12th century** (3)
- **13th century** (1)
- **14th century** (3)
- **15th century** (76)
- **16th century** (1226)
- **17th century** (3058)
- **18th century** (2237)
- **19th century** (7651)
- **20th century** (1667)
- **21st century** (14)
- **B.C.** (240)
- **more...**

### Location

- **Africa** (101)
- **Asia** (945)
- **Middle east** (60)
- **North america** (3634)

### Objects

- **Clothing** (6018)
- **Containers** (2632)
- **Food and meals** (3580)
- **Fuel** (453)
- **Lighting** (386)

### Musical instruments** (534)

- **Timepieces** (73)
- **Vehicles** (3457)
- **Weapons** (1)
- **Writing tools**

### Themes

- **Military** (2600)
- **Mortality** (422)
- **Music, writing, and sport** (5499)
- **Nautical** (13)
- **Religion** (4)

### Shapes, Colors, and Scenes

- **Color** (4149)
- **Dessert** (4500)
- **Scene** (6528)
- **Shape** (4583)
### Flamenco Fine Arts Search

Images from the Collections of the Fine Arts Museums of San Francisco; Legion of Honor and de Young Museums, [http://www.thinker.org](http://www.thinker.org)

Questions or Comments? Email Kevin Li (kevlin@sims.berkeley.edu)

#### Media

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<td>B.C.</td>
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#### Built Places

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<tr>
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<td>Lighting</td>
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<td>Timepieces</td>
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#### Themes

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<td>Military</td>
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<tr>
<td>Mortality</td>
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<tr>
<td>Nautical</td>
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<td>Religion</td>
<td>4142</td>
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<tr>
<td>Music, writing, and sport</td>
<td>5499</td>
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</tbody>
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#### Location

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#### Shapes, Colors, and Scenes

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</tr>
<tr>
<td>Scene</td>
<td>6526</td>
</tr>
<tr>
<td>Shape</td>
<td>1566</td>
</tr>
<tr>
<td>Metal</td>
<td>256</td>
</tr>
</tbody>
</table>
These terms define your current search. Click the \( \times \) to remove a term.

**Themes:** military > war

698 items (Ungroup items)

- **Media (group results)**
  - Book (16)
  - Ceramic (3)
  - Drawing (29)
  - Glass (1)
  - Metalwork (6)
  - Objects (6)
  - Painting (2)
  - Photograph (3)
  - Print (634)
  - Sculpture (1)

- **Date (group results)**
  - 1 - 1000 a.d. (1)
  - 15th century (5)
  - 16th century (46)
  - 17th century (131)
  - 18th century (36)
  - 19th century (188)
  - 20th century (49)
  - B.C. (2)
  - Date unknown (5)
  - Multiple centuries (236)

- **Location (group results)**
  - Asia (19)
  - Europe (602)
  - North america (76)

- **Occupations (group results)**
These terms define your current search. Click the X to remove a term.

- keyword "sword"
- Themes: military > war

Items 1 - 40 of 66 results (Group by Themes) sort by: Object Title, Date, Artist

1. [One From] from Callot
   1633

2. 86 engravings from Marlier
   18th - 19th cent...

3. A Game at War
   19th - 20th cent...

4. Aeneas departs f...
   Mitelli
   1663
These terms define your current search. Click the \( \times \) to remove a term.

- **keyword**: "sword" \( \times \)
- **Themes**: military > war \( \times \)

**66 items** (Ungroup items)

**Anonymous**
- Killing the Buff... Anonymous
- 19th century

**Baur, Johann Wilhelm, 1600 - 1640**
- Anonymous
- 19th century

---

**Marti Hearst: UC Berkeley SIMS**

**AAAI'05 Invited talk: Faceted Metadata in Search Interfaces**
**Title:** Image Search

**Current search:**

**Artists:** Goltzius, Hendrik, 1558 - 1617

**Themes:** military > war

**keyword:** sword

**Select any link to see items in a related category.**

**MEDIA**

- print (#62)

**LOCATION**

- Europa (3221)

**DATE**

- 16 - 17th century (983)

**THEMES**

- military (2397)
  - soldier (863)
  - war (620)
- soldiers and fighters (1363)
- weapons (1839)
- castle (266)

**PLACES AND SPACES**

- dwellings (1799)
- castle (266)

**PEOPLE**

- men (1372)
- man (1810)

**SHAPES, COLORS, AND MATERIALS**

- decorations (144)
  - metal (273)
- plume (62)
- metal (183)

**ARTISTS**

- Goltzius, Hendrik, 1558 - 1617 (99)

**RECORD NUMBER:** 8501

**OBJECT TITLE:** Titus Manlius (armed for battle)

**DESCRIPTION:**

An heroic Roman soldier on horseback viewed from behind, bearing shield, sword, metal helmet with plumes, spurs, sandals. Men on horseback battle near castle and military encampment.

**ARTIST NAME:** Hendrik Goltzius, 1558 - 1617
These terms define your current search. Click the \(\times\) to remove a term.

**Built Places:** Dwelling > castle

**Items 1 - 40 of 247 results**  
(sort by: Object Title, Date, Artist)

1. [#17 from] (Set o...  
Meyerinck  
17th - 18th cent...

2. (One from) Lux C...  
Callot  
1623

3. 556. Castle of N...  
Kimbel  
circa 1890

4. 66 engravings fr...  
Marillier  
18th - 19th cent...
# Faceted Metadata in Search Interfaces

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## Date
- **1 - 1000 a.d.** (135)
- **12th century** (3)
- **13th century** (1)
- **14th century** (3)
- **15th century** (76)
- **16th century** (1225)
- **17th century** (3058)
- **18th century** (2287)
- **19th century** (7551)
- **20th century** (1667)
- **21st century** (14)
- **B.c.** (240)
- **more...**

## Location
- **Africa** (107)
- **Asia** (945)
- **Europe**
- **Middle east** (60)
- **North america** (3634)

## Built Places
- **Bridge** (431)
- **Building** (2571)
- **Dwelling** (1528)
- **Part of building** (3159)
- **Built open space** (912)
- **Road** (1204)

## Themes
- **Military** (2600)
- **Mortality** (423)
- **Nautical** (1381)
- **Religion** (4142)

## Objects
- **Clothing** (6018)
- **Containers** (2032)
- **Musical instruments** (634)
- **Food and meals** (3580)
- **Timepieces** (37)
- **Vehicles** (3457)
- **Weapons** (1498)
- **Writing tools** (3636)

## Shapes, Colors, and Scenes
"river" appears in these category names:

- Heaven and Earth > riverbank
- Heaven and Earth > famous rivers
- Heaven and Earth > river
- Heaven and Earth > Rivers, Lakes, Seas
- Artists > Rivera, Diego, 1896 - 1957
- Artists > Rivers, Lany, 1923 -
- Artists > Rivera, Gustavo Ramos, 1940 -
- Location > Congo > Mouth of River Congo
- Location > Gabon > Ngounie River
- Location > Gabon > Ogove River
- Location > Nigeria > Benue River Valley

Location > Nigeria > Ibibio Cross River
Location > Nigeria > Idoma, Cross River
Location > Nigeria > Niger River, prob. Agbarho village
Location > Zaire > Lower Zaire river
Location > Queensland, Diamantina River
Location > Columbia > Middle Cauca River Valley
Location > United States > California > Kern River
Location > Washington > Columbia River
Location > Melanesia > Irian Jaya > Pomatji River
Location > ... > Papua New Guinea > Sepik river
Location > ... > Amazon > Mato Grosso > Juruene River

These terms define your current search. Click the X to remove a term.

keyword "river" X

sort by: Object Title, Date

Items 1 - 40 of 691 results
Marti Hearst: UC Berkeley SIMS

AAAI'05 Invited talk: Faceted Metadata in Search Interfaces

Flamenco Fine Arts Search
Images from the Collections of the Fine Arts Museums of San Francisco, Legion of Honor and de Young Museums, http://www.thinker.org

Current search:
Built Places: Bridge
Date: 20th century
Heaven and Earth: Rivers, Lakes, Seas

Select any link to see items in a related category.

Find Similar Images (48)

7 boats on lake, houses with orange and purple roofs

item 4 of 23 (back to results)

Previous

Next
These terms define your current search. Click the \(oxed{\times}\) to remove a term.

**Media:** Print > woodcut

**Objects:** Vehicles > boats and ships > boat

---

### Items 1 - 40 of 48 results

- **1.** 1 boats on lake, ... Anonymous post World War II
- **2.** 1 boats on lake, ... Anonymous post World War II
- **3.** 3 boats on lake, ... Anonymous post World War II
- **4.** 4 boats on lake, ... Anonymous post World War II
Information previews

- Use the metadata to show where to go next
  - More flexible than canned hyperlinks
  - Less complex than full search
- Help users see and return to previous steps
- Reduces mental work
  - Recognition over recall
  - Suggests alternatives
- More clicks are ok *iff* (J. Spool)
  - The “scent” of the target does not weaken
  - If users feel they are going towards, rather than away, from their target.
What is Tricky About This?

- It is easy to do it poorly
- It is hard to be not overwhelming
  - Most users prefer simplicity unless complexity really makes a difference
  - Small details matter
- It is hard to “make it flow”
eBay Products
4,083 items found in Bedding

- Bed Size
  - Queen (1,123)
  - Twin (1,050)
  - King (1,024)
  - Full (872)
  - Select more/multiple...

- Color
  - Blues (333)
  - Pink (263)
  - Greens (161)
  - Reds (154)
  - Select more/multiple...

- Brand
  - Pottery Barn (550)
  - Pottery Barn Kids (227)
  - IKEA (170)
  - That's Mine (77)
  - Select more/multiple...

- Style or Theme
  - Animals (193)
  - Vintage (99)
  - Rustic Western (83)
  - Country (88)
  - Select more/multiple...

More options to browse:
- Child or Teen
- Fabric
- Quilt Pattern
- Fabric Style
- Additional Keywords
- More item details...

Sort by:
- Time: ending soonest

List View | Picture Gallery

- SHABBY PINK ROSES CHIC FULL QUEEN QUILT RACHEL ASHWELL
  - $94.95
  - End Date: in 2 mins

- OLD GLORY American Quilt, 2 Shams & Bedskirt *QUEEN*
  - $99.99
  - End Date: in 14 mins

- TW0 8x10 VICTORIAN BATH ART
  - Prints TOWELS BATHTUB
  - $1.99
  - End Date: in 6 mins

- NEW IKEA KING DUVET QUILT COMFORTER COVER SET
  - $16.99
  - End Date: in 17 mins
Search Usability Design Goals

1. Strive for Consistency
2. Provide Shortcuts
3. Offer Informative Feedback
4. Design for Closure
5. Provide Simple Error Handling
6. Permit Easy Reversal of Actions
7. Support User Control
8. Reduce Short-term Memory Load

Usability Studies

• Usability studies done on 3 collections:
  – Recipes: 13,000 items
  – Architecture Images: 40,000 items
  – Fine Arts Images: 35,000 items

• Conclusions:
  – Users like and are successful with the dynamic faceted hierarchical metadata, especially for browsing tasks
  – Very positive results, in contrast with studies on earlier iterations.
### Post-Test Comparison

**Which Interface Preferable For:**

- Find images of roses: Baseline 15, Faceted 16
- Find all works from a given period: Baseline 2, Faceted 30
- Find pictures by 2 artists in same media: Baseline 1, Faceted 29

**Overall Assessment**

- More useful for your tasks: Baseline 4, Faceted 28
- Easiest to use: Baseline 8, Faceted 23
- Most flexible: Baseline 6, Faceted 24
- More likely to result in dead ends: Baseline 28, Faceted 3
- Helped you learn more: Baseline 1, Faceted 31
- Overall preference: Baseline 2, Faceted 29
Advantages of the Approach

• Honors many of the most important usability design goals
  – User control
  – Provides context for results
  – Reduces short term memory load
  – Allows easy reversal of actions
  – Provides consistent view
• Allows different people to add content without breaking things
• Can make use of standard technology
Advantages of the Approach

- Systematically integrates search results:
  - reflect the structure of the info architecture
  - retain the context of previous interactions
- Gives users control and flexibility
  - Over order of metadata use
  - Over when to navigate vs. when to search
- Allows integration with advanced methods
  - Collaborative filtering, predicting users’ preferences
Disadvantages

- Does not model relations explicitly
- Does it scale to millions of items?
  - Adaptively determine which facets to show for different combinations of items
- Requires faceted metadata!
Opportunities for AI

• Creating hierarchical faceted categories
  – Assigning items to those categories
  – Adaptively adding new facets as data changes

• A new approach to personalization:
  – User-tailored facet combinations

• Create task-based search interfaces
  – Equate a task with a sequence of facet types
Creating Classifications from Data

- Most approaches are associational
  - AKA clustering, LSA, LDA, etc.
  - This leads to poor results when applied to text

- To derive facets, need a different angle
  - We have a simple approach based on WordNet
Clustering (The Hope)
Clustering (The Hope)
Clustering (The Reality)
Clustering (The Reality)
Example: Recipes (3500 docs)

COOK-3300  ABSTRACT  Molasses Brownies Recipe - Recipe for Molasses Brownies; More Molasses Cookies; Molasses Brownies; 2/3 cup butter; 2/3 cup confectioners' sugar; 2/3 cup Grandma's Molasses; 1 teaspoon vanilla; 2 eggs; 1 3/4 cup sifted all-purpose flour; 1/8 teaspoon baking soda; 1 cup chopped walnuts or pecans; Cream butter and sugar until fluffy. Stir in molasses and vanilla. Beat in eggs. Sift together the flour and baking soda; add to first mixture, blending well. Stir in chopped nuts. Spread batter in two generously greased 9-inch square pans. Bake at 350&deg; for 25 minutes. Makes about 50 molasses brownies.

;

COOK-3301  ABSTRACT  Georgia Mint Julep Recipe - Recipe for Georgia Mint Julep with Peach Brandy; Georgia Mint Julep; Chill silver julep tumblers or mugs. For each tumbler, dissolve 1 teaspoon of sugar in a little water. Reserve. Fill each tumbler with finely crushed ice. Pour in 3/4 ounce brandy and 3/4 ounce peach brandy. Stir in dissolved sugar. Stir until the outside of tumbler is heavily frosted. Garnish with 5 or 6 sprigs of fresh mint, tucked in the ice so they stand out. Serve with a straw, if desired.
black_bean dried_fruit extension macaroni mixture onion ounce pastry thermometer using broiler extension hands lima mixture ounce rolled_oats shortening thermometer using broccoli chapter cinnamon graham graham_cracker mississippi quick_bread using vanilla_extract y candy_thermometer cantaloupe chili_powder cream_sauce cuisine family lemon_peel ounce turning u bread_crumb container drippings filling mixture quick_bread tablespoonful using vanilla_extract cornstarch curry_powder mashed_potato oat ounce pepper_sauce quarters rolled_oats using years brownie custard mixing mixing_bowl nutmeg onion oven pumpkin toothpick using hours jambalaya lima_bean patty pork pork_chop rye salad scraping tabasco gravy lettuce meal onion pastry peppercorn salad_dressing salad_greens sausage zucchini casserole chicken_breast cookbook cookie_sheet ounce peanuts sour_cream spaghetti thermometer u advertisement butter_cookie envelope extension icebox jambalaya logo muscadine ounce week burbage country dried_apricot extension ketchup ounce spareribs tarragon thermometer worcesters basil celery_salt food lemon lemon_juice milk_sugar orange_marmalade shortbread side_dish turke coating cutter hours kernel making rings saucepan storage turning water_chestnut cooking custard grandy lemon lemon_juice louisiana onion pecan thermometer using
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Sanderson & Croft ’99

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Stoica & Hearst '04
WordNet-based
Stoica & Hearst '04
WordNet-based

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- cereal (46)[3]
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- person (371)[16]
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- topping (456)[4]
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- pear (11)[-]
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Stoica & Hearst '04

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- noodle (97)[1]
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- woman (34)[3]
- colleen (8)[1]
- lady (6)[1]
- mrs (19)[1]
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- cook (1018)[1]
- chef (16)[1]
- smith (15)[1]
- temp (12)[1]
P-2 ABSTRACT The Bechtel Group Inc. offered in 1985 to sell oil to Israel at a discount of at least $650 million for 10 years if it promised not to bomb a proposed Iraqi pipeline, a Foreign Ministry official said Wednesday. But then-Prime Minister Shimon Peres said the offer from Bruce Rappaport, a partner in the San Francisco-based construction and engineering company, was "unimportant," the senior official told The Associated Press. Peres, now foreign minister, never discussed the offer with other government ministers, said the official, who spoke on condition of anonymity. The comments marked the first time Israel has acknowledged any offer was made for assurances not to bomb the planned $1 billion pipeline, which was to have run near Israel's border …
company billion inc corp offer group companies million agreement business
trial court prison death convicted judge i murder state attorney
military army president government mrs base two human philippines aquino
party government political opposition elections minister election vote new
southern northern fair inches rain snow temperatures texas high degrees
west dollar german yen east late germany london bid gold
water environmental state new epa years plant year time species
police man two arrested shot found city people car night
mrs family home wife i people years husband life children
panama saudi noriega bush united military troops force drug states
bush dukakis campaign jackson democratic president republican presidential
air plane flight airlines pilots aircraft airline airport eastern planes
church pope mexico people catholic john san quake vatican city
official, functionary (163)
prosecutor, public prosecutor, prosecuting
officer, prosecuting attorney (107)
magistrate (22)
bureaucrat (10)
consul (8)
chief_justice (5)
serviceman, military man, man, military personnel (143)
soldier (137)
trooper (8)
militiaman (7)
johnny (5)
reservist (5)
military officer, officer (96)
commissioned officer (40)
nelson (26)
colonel (10)
colin_powell (5)
executive_officer (34)
military_officer (8)
petty_officer (6)
sergeant (6)
inspector_general (4)
serviceman (17)
military_personnel (12)
gunner (6)
assistant, helper, help, supporter (91)
aide (56)
lieutenant (15)
flight_attendant (11)
paramedic (6)
accomplice (5)
Stoica & Hearst ’04
WordNet-based

institution, establishment (435)
  company (539)
  service (181)
  services (161)
  community_service (12)
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  public_utility (5)

financial institution, financial organization.
financial organisation (135)
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  insurance_company (12)
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  banking concern, banking company (27)
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educational institution (99)
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  tech (15)
  college (12)
  kindergarten (5)
due process, due process of law (339)
  proceeding, legal proceeding, proceedings (238)
  banks (81)
  lawsuit (68)
  intervention (26)
  objection (23)
  litigation (19)
  naturalization (11)
  mistrial (5)
  ordeal (5)
  civil_suit (4)
  judgment, judgement, judicial decision (120)
  conviction (48)
  verdict (28)
  condemnation (9)

  entrapment (5)
vote (216)
  referendum (17)
  general_election (15)
  runoff (14)
conflict, struggle, battle (75)
  rebellion, insurrection, revolt, rising, uprising (49)
    insurgency (11)
  warfare (11)
  strife (10)
  shootout (7)
Associational techniques

• Pros:
  – Sometimes terms grouped to get a general concept
    • Airline, airplane, pilots, flight

• Cons:
  – Highly unpredictable
  – Not comprehensive
    • Dollar and yen but no deutchmarks
    • Eastern but no other directions
  – Not uniform in subject matter
    • Mixing currencies with countries with timing
    • Mixing compass directions with airlines
Lexical Hierarchy-based

**Pros**
- Faceted and hierarchical
- Consistent is-a hierarchies
- Comprehensiveness more likely

**Cons**
- Doesn’t provide overall themes
  - Airlines, pilots, airplanes
- Sometimes uses wrong word sense
- Sometimes the right term/hierarchy is not present
  - Doesn’t have “dish type” nor “cuisine” for recipes
  - Specialized domains won’t work
Our Approach

• Leverage the structure of WordNet

Documents → Select terms → Get hypernym paths → Build tree → Compress tree

WordNet
Our Approach

• Leverage the structure of WordNet
1. Select Terms

- Select well distributed terms from collection
2. Get Hypernym Path

abstraction
  ↓ abstraction
  ↓ property
  ↓ visual property
  ↓ color
  ↓ chromatic color
  ↓ red, redness
  ↓ red

abstraction
  ↓ property
  ↓ visual property
  ↓ color
  ↓ chromatic color
  ↓ blue, blueness
  ↓ blue

Documents → Select terms → Get hypernym paths → Build tree → Comp. tree

WordNet
3. Build Tree

- abstraction
  - property
    - visual property
      - color
        - chromatic color
          - red, redness
            - red
          - blue, blueness
            - blue

- abstraction
  - property
    - visual property
      - color
        - chromatic color
          - red, redness
            - red
          - blue, blueness
            - blue
4. Compress Tree

Documents → Select terms → Get hypernym paths → Build tree → Comp. tree

WordNet

- color
  - chromatic color
    - red, redness
      - red
    - blue, blueness
      - blue
    - green, greenness
      - green

- color
  - chromatic color
    - red
    - blue
    - green
4. Compress Tree (cont.)

Documents

Select terms

Get hypernym paths

Build tree

Comp. tree

WordNet

- color
  - chromatic color
    - red
    - blue
    - green

- color
  - red
  - blue
  - green
Disambiguation

• Ambiguity in:
  – Word senses
  – Paths up the hypernym tree

2 paths for same word

Sense 1 for word “tuna”
organism, being
=> plant, flora
  => vascular plant
  => succulent
  => cactus
  => tuna

Sense 2 for word “tuna”
organism, being
=> fish
  => food fish
  => tuna
  => bony fish
  => spiny-finned fish
  => percoid fish
  => tuna

2 paths for same sense
How to Select the Right Senses and Paths?

- **First: build core tree**
  - (1) Create paths for words with only one sense
  - (2) Use Domains
    - Wordnet has 212 Domains
      - medicine, mathematics, biology, chemistry, linguistics, soccer, etc.
    - Automatically scan the collection to see which domains apply
    - The user selects which of the suggested domains to use or may add own
    - Paths for terms that match the selected domains are added to the core tree

- **Then: add remaining terms to the core tree.**
dip glosses:
Sense 1: A depression in an otherwise level surface
Sense 2: The angle that a magnet needle makes with horizon
Sense 3: Tasty mixture into which bite-size foods are dipped

dip hypernyms
Sense 1
solid
=> concave shape
=> depression

Sense 2
shape, form
=> space
=> angle

Sense 3
food
=> ingredient, fixings
=> flavorer

Given domain “food”, choose sense 3
Opportunities for AI

- New opportunity: Tagging, folksonomies
  - (flickr de.lici.ous)
  - People are created facets in a decentralized manner
  - They are assigning multiple facets to items
  - This is done on a massive scale
  - This leads naturally to meaningful associations
Bobby at the Golden Gate

My little brother visits San Francisco and the Golden Gate Bridge for the first time.

Comments

Emerald2810 says:
Bobby looks brilliant with the golden gate bridge in the background. My Daddy has been to San Francisco and thinks its a fabulous city. I would like to visit one day!

Posted 3 months ago. (Permalink)
http://www.airtightinteractive.com/projects/related_tag_browser/app/
This Doesn’t Solve Everything

- Harder to determine what’s related to more complex terms
- Still not good for finding a recipe using potatoes
Linking Metadata Into Tasks

- Old Yahoo restaurant guide combined:
  - Region
  - Topic (restaurants)
  - Related Information
    - Other attributes (cuisines)
    - Other topics related in place and time (movies)
AAAI'05 Invited talk: Faceted Metadata in Search Interfaces

Marti Hearst: UC Berkeley SIMS

Green: restaurants & attributes

Yellow: geographic region

Red: related in place & time

Yahoo! Restaurants - Biba - Netscape

Top > Massachusetts > Cities > Boston > Eclectic > Biba

Biba

272 Boylston St
Boston, MA 02116
617/426-7878

Map and Directions

Details

Price Range: $31-$50
Credit Cards: AE, V, MC, D, CB
Service:
  brunch: Sun-Sun
  lunch: Mon-Sun
  dinner: Mon-Sun

Find Nearby
  - Movie Theaters
  - Bars, Pubs, and Clubs
  - Cafes
  - More A&E

Features

Descriptions Brought to you by...

CuisineNet
Biba's brash interior includes a bar mural depicting debauchery and an upstairs "food hall" with geometric accents. Chefs Lydia Shire and Susan Regis excite... more

Fodor's
Arguably Boston's best restaurant, and surely one of the most original and high-casual restaurants in America. Biba is a place to see and be seen,... more
Other Possible Combinations

- Region + A&E
- City + Restaurant + Movies
- City + Weather
- City + Education: Schools
- Restaurants + Schools
- …
Creating Tasks from HFM

- Recipes Example:
  - Click Ingredient > Avocado
  - Click Dish > Salad
  - Implies task of “I want to make a Dish type d with an Ingredient i that I have lying around”
  - Maybe users will prefer to select tasks like these over navigating through the metadata.
Summary

- Flexible application of hierarchical faceted metadata is a proven approach for navigating large information collections.
  - Midway in complexity between simple hierarchies and deep knowledge representation.
    - Perhaps HFM is a good stepping stone to deeper semantic relations
  - Currently in use on e-commerce sites; spreading to other domains
AI Opportunities

• Creating hierarchical faceted categories
  – Assigning items to those categories
  – Adaptively adding new facets as data changes

• A new approach to personalization:
  – User-tailored facet combinations

• Create task-based search interfaces
  – Equate a task with a sequence of facet types

• Make use of folksonomies data!
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