Integrating Multiple Computational Techniques for Improving Image Access: Applications to Digital Collections

Twitter hashtag: #hci
Presenters

- Judith L. Klavans, University of Maryland
- Jennifer Golbeck, University of Maryland
Interdisciplinary Project

• Computer Science
  – Computational Linguistics
  – Social Network Analysis
  – Trust systems (recommendation, personalization)
  – User-driven system evaluation

• Information Science
  – Metadata and Knowledge structure

• Museums and Libraries
Computer Science Meets Museums and Libraries

• Fundamental Problem of Museums: how to help people find images?

• Three approaches:
  – Vision research – engineering and CS
  – Natural Language Processing –
    • Text
    • Tags
  – Hybrid
1. Catalog Entry

Limited Subject Description

<table>
<thead>
<tr>
<th>Main Entry: Category or Artist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt (New Kingdom)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title or Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queen Nefertiti: (front view), ca. 1350 B.C. [Dynasty XVIII]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location • AICT Photo ID #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aegiptisches Museum, Berlin #EN010</td>
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</tbody>
</table>

Text References

Adams 3: pl. 5.22 [alt.]
2. Art Historians

Nefertiti Gardner (v. 11, pl. 3-33)

The famous painted limestone bust of Akhenaton’s queen, Nefertiti (fig. 3-33), exhibits a similar expression of entranced musing and an almost mannered sensitivity and delicacy of curving contour. The piece was found in the workshop of the queen’s official sculptor, Thutmose, and is a deliberately unfinished model very likely by the master’s own hand. The left eye socket still lacks the inlaid eyeball, making the portrait a kind of before-and-after demonstration piece. With this elegant bust, Thutmose may have been alluding to a heavy flower on its slender stalk by exaggerating the weight of the crowned head and the length of the almost serpentine neck…
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3. Viewers

Bust of a woman
One eye
Big hat
Smooth skin
Ancient Egypt
Fantastic necklace
Funny looking ears
Rust-colored ribbon on headdress
Snakes on head piece
Elegant
Incroyable jeunesse
Delicat
Images and Words

An image can never be captured in words

BUT

Words are what we use to describe, catalog, and search.
The subjects, eight-year-old Jenny and twelve-year-old Berthe, were daughters of a family friend. Their penetrating gazes, typical of Lemmen’s detailed, austere approach to portraiture, recall the precise likenesses of the northern Renaissance tradition. Nothing could be further from a conventionally sentimental image of childhood.

(Excerpt from IMA handbook description, 2005)
## Multi-Word Tags: Part of Speech

<table>
<thead>
<tr>
<th>Part of Speech</th>
<th>n</th>
<th>Percentage</th>
<th>Example</th>
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<tr>
<td>NOUN-NOUN</td>
<td>5826</td>
<td>58%</td>
<td>sibling rivalry</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>money plant</td>
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<tr>
<td>ADJ-NOUN</td>
<td>500</td>
<td>36%</td>
<td>double portrait</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>red dress</td>
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<tr>
<td>ADV-ADJ</td>
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<td>1%</td>
<td>very perplexing</td>
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<tr>
<td>VERB-X</td>
<td>500</td>
<td>1%</td>
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<tr>
<td>OTHER</td>
<td>500</td>
<td>3%</td>
<td>jewel-like eyes</td>
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</table>

Compared multi-word tags to Wikipedia article titles to identify

• Lexicalized phrases or idioms
  – “sibling rivalry”, “money plant”

• Proper Nouns
  – “Ancient Egypt”

• Results
  – 45.8% of tokens matched
  – 29.9% of types matched
Goal – Help Users Find Images

Tags – Informal
Text – Formal

• How much overlap? What kinds of phrases?
• Outcome – to identify which tags or terms might be useful to characterize the individual distinguishing features of images
• Thus be helpful to users in differentiating and/or searching images.
Novel Algorithm – Weighting TT

• Algorithm combines weights over both tags and terms
• Frequency as an inverse of document frequency
  – where “document” in this case refers to either the tag or term dataset.
• The normalized tag/term frequency by tag/term denominator
# Overlap of Tags and Terms

<table>
<thead>
<tr>
<th></th>
<th>(O): Overlap between Tag and Term Sets</th>
<th>(T+T): Unique Tags + Unique Terms</th>
<th>(Tag): Total Tags</th>
<th>(Term): Total Terms</th>
<th>O/T+T</th>
<th>O/Tag</th>
<th>O/Term</th>
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<tr>
<td>Image 4</td>
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<tr>
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<tr>
<td>Average</td>
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<td></td>
<td></td>
<td>9.4%</td>
<td>20.2%</td>
<td>15.2%</td>
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</tbody>
</table>
Using Tags for Image Retrieval and Personalization

• People use tags differently based on the image type
  – E.g. Abstract images get more color/shape tags

• If tags are used to search for images, this creates bias
  – Abstract images more likely to appear on searches for a color
Improving Image Search

• Our research shows no correlation between how often a tag is applied to an image and where the image should rank in search results

• Implication: other factors must be considered when ranking image search results
Possible Factors

• Frequency of the tag or term in the language
• Type of image being tagged
• Personalization Results:
  – User’s preferred types of image
  – User’s social connections
Technology Impacts Art

• Opportunities in the Arts
  – Music
  – Visual Arts

• Impact in many areas of Humanities

• ....and you never know where this will lead
Participants

Judith L. Klavans [1], Jennifer Golbeck [1], Dagobert Soergel [2], Susan Chun [3], Robert Stein [4], Ed Bachta [4], Irene Eleta [1], Beth Emmerling [1], Raul David Guerra [1], Jessica A. Koepfler [1], Rebecca LaPlante [1]

[1] University of Maryland, College Park;
[2] University at Buffalo, SUNY;
[3] Independent Museum Consultant, NY;
[4] Indianapolis Museum of Art
Thanks to the following sponsors and partners

Steve.museum.org
Questions?

t3-info@umiacs.umd.edu

Or

http://www.umiacs.umd.edu/research/t3/