Image Searches, Abstraction, Invariance 36-350: Data Mining 2 September 2009

 Medical: x-rays, brain imaging, histology ("do these look like cancerous cells?")

• Satellite imagery

• Fingerprints

• Finding illustrations for lectures...

Searching for Images by Searching for Text

- Assume there's text accompanying the images ("annotation")
 - tags
- Search those text records with the query phrase
- Take images which appear close to the query phrase on highly-ranked records
- This how Google does it



Pittsburgh's Cathedral of

The Cathedral of Learning

Jen Hartman at Cathedral of

... Cathedral of Learning, U. of Cathedral of Learning.jpg Open "http://images.google.com/imgres?imgurl=http://www.netspace.org...%26safe%3Doff%26client%3Dsafari%26rls%3Den%26sa%3DG" in a new window



4



sometimes it doesn't; depends on the text!



Kitten Anonymous 12th century Álbum ... 440 x 440 pixels - 36k - jpg www.asianart.com



kitten Diler Maaw 450 x 556 pixels - 41k - jpg maaw.net



Wallpaper Musik Atomic-Kitten 1024 x 768 pixels - 99k - jpg www.new-dream.de



kitten information, cat and ... 189 x 226 pixels - 9k - jpg www.kitten-stork.com [More results from www.kitten-



kitten Darwin Maaw 450 x 320 pixels - 31k - jpg maaw.net [More results from maaw.net]

Searching for images by representing images

- For text, we only cared about features, and only worked with feature vectors
- Define numerical features for images and everything carries over
- Abstraction

Abstraction

Remove some of the details but keep others
 Kept details = features

Then act on abstracta

• Hopes:

Simplifies problem

• Lets you treat many problems similarly



- Need to find right (relevant) representation
- Representation = concrete/abstract interface
 - Go read The Sciences of the Artificial!
- Great methods at the abstract level generally fail if the representation is bad
 - missing what's relevant
 - including what's irrelevant
 - comparing apples to kangaroos
 - both multicellular sexually-reproducing carbon-based lifeforms...
- A lot of your work will be designing representations

flowerl

flower2

flower3

tigerl

tiger2

tiger3

Euclidean Distance of Images

- Image is MxN pixels, each with 3 color components, so a 3MN vector
- Euclidean distance possible, and OK for some kinds of noise-removal
- but hopeless even at grouping flower1 with flower2
- or slight changes in perspective, lighting...

Bag of Colors

- "If it works, try it some more"
- For each possible color, count how many pixels there are of that color
- Use Euclidean distance on color-count vectors

 Too many colors, so quantize them down to a manageable number (like stemming, or combining synonyms)

Distances between images

MDS plot of images

Representation and Invariance

- Invariances of a representation = how can we change the underlying object without changing the representation?
- What differences does the representation ignore?

Invariants of bags of words

- Punctuation and word order
- Universal words (exact count of "the", "of", "to", ...), if using inverse document frequency
- Word-endings, if using stemming
- Grammar, context, word proximity ...
 - "Send lawyers, guns and money" vs.
 "Sending the Guns' lawyers for the money"

Invariants of bags of colors

Small changes in orientation, pose, some rotations
Small amounts of color noise or weird colors
Texture

Same color counts, different textures

Non-invariants

- Lighting, shadows
- Occlusion, 3D effects
- Blurring
 - There are good ways to deal with blur (from astronomy)
- but full vision is very, very hard

- Breaking an invariance is easy
 - e.g., add features for textures
 - or sub-divide the image and do colorcounts on each part
- Adding invariances is hard
 - often need to go back to scratch and chose a different representation

Search by: Sketch · Image

Search for similar images by

- · uploading an image file
- or entering the URL of an image.

New! Please help us rate sketches for The Art of retrievr! Only a million to go ...

Still new! You can search by uploading images now as well. Also: Your sketches have URLs! Send 'em around.

This is an experimental service. Please treat it nicely and send copious amounts of feedback! For some background, read here.

retrievr relies on parts of the System One platform.

From capitan-patata

From birdcage

From irishman lost in

From mahtab

Similarity search with real images from the web ("retrievr", see notes)

From sfrances

From blaumond

From mark lennox

Search by: Sketch · Image

From Feuillu

THIS PHOTO IS CURRENTLY UNAVAILABLE.

flickr

From Rebsana

Search for similar images by

- · uploading an image file
- or entering the URL of an image.

New! Please help us rate sketches for The Art of retrievr! Only a million to go ...

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From kelsana

THIS PHOTO IS CURRENTLY UNAVAILABLE. flickr

From Katemina

From mkaggen

From Lydia Pinkham

From Holly Yvonne <><

From alecani

From Mi Xavier

LoveYourDog.com

From heavenuphere

THIS PHOTO IS CURRENTLY UNAVAILABLE.

flickr From pasodoble

 Typically works better with more restricted domains (actually pretty good for medical images)