Projects

• Start thinking about project ideas
  – Can be a novel idea
  – Can be a paper we discussed in class
  – Come see me in office hours to discuss

• Project Proposals – March 6
  – 5 minute presentation including:
    • Project goal
    • Some high level details about how you will accomplish your project
    • Timeline
Attribute and Simile Classifiers for Face Verification

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Recognition using visual attributes

4-Legged
Orange
Striped
Furry

White
Symmetric
Ionic columns
Classical

Male
Asian
Beard
Smiling
Attributes can define categories

Female

Eyeglasses

Middle-aged

Dark hair
Attributes can define categories

Caucasian

Teeth showing

Outside

Tilted head
Face Verification Task:

Are these the same person?
Prior approaches

Images $\rightarrow$ Low-level features

- RGB
- HOG
- LBP
- SIFT
- ...

Verification

Different
Our approach: attributes

Images $\rightarrow$ Low-level features $\rightarrow$ Attributes $\rightarrow$ Verification

- RGB
- HOG
- LBP
- SIFT
- ...

+ Male
+ Asian
+ Dark hair
+ Round jaw
- Different
3,000,000 face images

MIT+CMU

Yale A

CMU PIE

MIT+CMU

Yale A

CMU PIE

MIT+CMU

Yale A

CMU PIE

FRGC v2.0
Amazon Mechanical Turk

500,000 Attribute Labels = $5,000 + 1 month

See also [Deng, et al., 2009] [Vijayanarasimhan & Grauman, 2009]
Learning an attribute classifier

Training images → Low-level features → Feature selection → Train classifier

Males
- RGB
- HoG
- HSV
- ... (Edges, Mouth)

Females
- RGB
- HoG
- HSV
- ... (Nose, Eyes, Hair)

RGB, Nose
HoG, Eyes
HSV, Hair

Gender classifier
- Male
  - 0.87
Using attributes to perform verification
Attributes are intuitive

Female
Young
Attractive
White

Black hair
Frontal pose
Mouth closed
Eyes open
Describe faces using similes

Penelope Cruz

Angelina Jolie
Training simile classifiers

Images of Penelope Cruz’s eyes

Images of other people’s eyes
Using simile classifiers for verification
Results
Labeled Faces in the Wild (LFW)

http://vis-www.cs.umass.edu/lfw
Experimental evaluation

LFW Image-Restricted Benchmark:
• 6,000 face pairs (3,000 same, 3,000 different)
• 10-fold cross-validation
Previous state-of-the-art on LFW as of May 2009
Our performance on LFW

85.29% Accuracy
(31.68% Drop in error rates)

as of May 2009
Human face verification performance

- Original: 99.20%
- Cropped: 97.53%
- Inverse Cropped: 94.27%
PubFig dataset & benchmark

Public figures:
- Politicians
- Celebrities

Larger & deeper:
- 60,000 Images
- 200 People
- 300 Images per person

Subsets:
- Pose
- Illumination
- Expression

http://www.cs.columbia.edu/CAVE/databases/pubfig/
Describable visual attributes

- Attributes for recognition
- **State-of-the-art** performance on LFW
- Enormous set of labeled training images
- Automatic training of classifiers
- First human results on LFW
- New large face dataset: PubFig

Questions?

Results on PubFig

![ROC curve for PubFig results](image)

- Full PubFig Benchmark (77.78%)
- "Easy" Pose (80.81%)
- "Difficult" Pose (77.50%)
- "Easy" Lighting (79.54%)
- "Difficult" Lighting (75.32%)
- "Easy" Expression (78.40%)
- "Difficult" Expression (77.66%)

All results computed using our Attribute Classifiers
Attribute Labeling Task

Select all images which match the attribute

"Hair Color is Black"

Please mark ONLY the images which YOU ARE SURE match the above attribute. If we find more than 1 incorrectly marked image, you will NOT receive payment for this HIT. Some guidelines:

- DO NOT mark the image if you don't know what the attribute means
- DO NOT mark the image if you are not 100% sure it matches the attribute
- DO NOT mark the image if it is not a real face - i.e., a cartoon, drawing, etc.
- DO NOT mark the image if it does not load
- DO NOT mark the image if it is of very poor quality
- DO NOT mark the image if it looks like it has been modified (e.g., Photoshopped)

Here are some CORRECT EXAMPLES of the given attribute. You SHOULD mark images like these:

Here are the images to mark. You can click anywhere inside the bordered region to mark the image. This makes it very fast to mark the right images.
Human Face Verification Task

Are the two images of the same person or different?

Please click the button below each pair which best describes your confidence in whether the images are of the same person or not.
(It's fine to mark "maybe same" if you think they're the same person, but are not completely sure (similarly for different). If you cannot tell, please mark the middle "not sure" button.

- Once you make a choice, you can click "next pair" to go to the next pair.
- You can always go back to previous pairs if you want to change your answer.
- Once you finish all 30 pairs, there will be a submit button, which will complete the job.

Pair 1 of 30
FaceTracer: A Face Search Engine

[N. Kumar et al., “FaceTracer: A Search Engine for Large Collections of Images with Faces”, ECCV 2008]
Face Regions

(After Alignment)
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<th>Pixel Value Type</th>
<th>Normalizations</th>
<th>Aggregation</th>
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<tr>
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<td>Mean-Norm</td>
<td>Histogram</td>
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<td>Energy-Norm</td>
<td>Statistics</td>
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<td>Edge Magnitude</td>
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RGB, Mean Normalization, No Aggregation
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Edge Orientations, No Normalization, Histogram
Experimental evaluation

Image-Restricted Benchmark (View 2):
- 6,000 face pairs (3,000 same, 3,000 different)
- 10-fold cross-validation
- Results:
  - ROC curves
  - Average accuracy

Separate Development Set (View 1):
- 3,200 face pairs (2,200 training, 1,000 testing)
Google: “smiling asian men with glasses” 7/08
ECCV 2008, FaceTracer: “smiling asian men with glasses”