Taking Great Pictures (Automatically)

Computational Photography

(15-463/862)

Yan Ke

11/27/2007

Anyone can take great pictures…

… if you can recognize the good ones.

F8 and Be There

- Anyone can win a Pulitzer…

- In twenty years, many photo journalists will be out of jobs (CNN I-Report, Wikinews....)

Election Campaign, Clinton, Associated Press

Outline

- Photography 101
- Recognition
  - What makes one photo better than another?
  - What features can we extract?
  - How can we measure our performance?
- Enhancement
  - How do we improve photos?
  - How can we do it automatically?

Photography 101

- Composition
  - Rule of thirds
  - Framing
  - Leading lines
  - Textures and patterns
  - Color coordination
- Lighting
  - Direction
  - Color balance

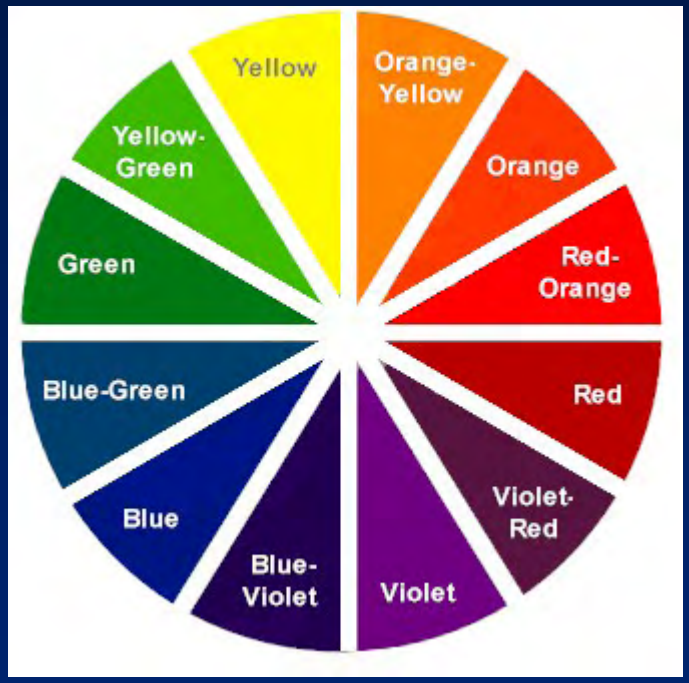
Rule of Thirds

Leading Lines

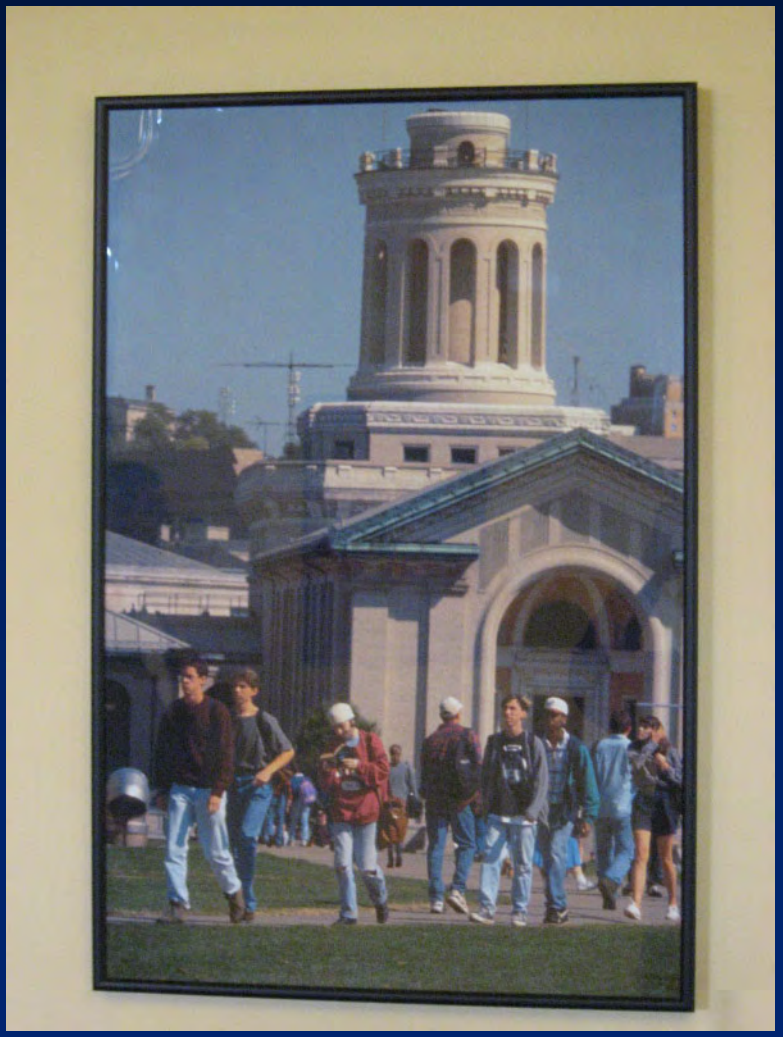
Framing

Textures and Patterns

Color Coordination



Horizons

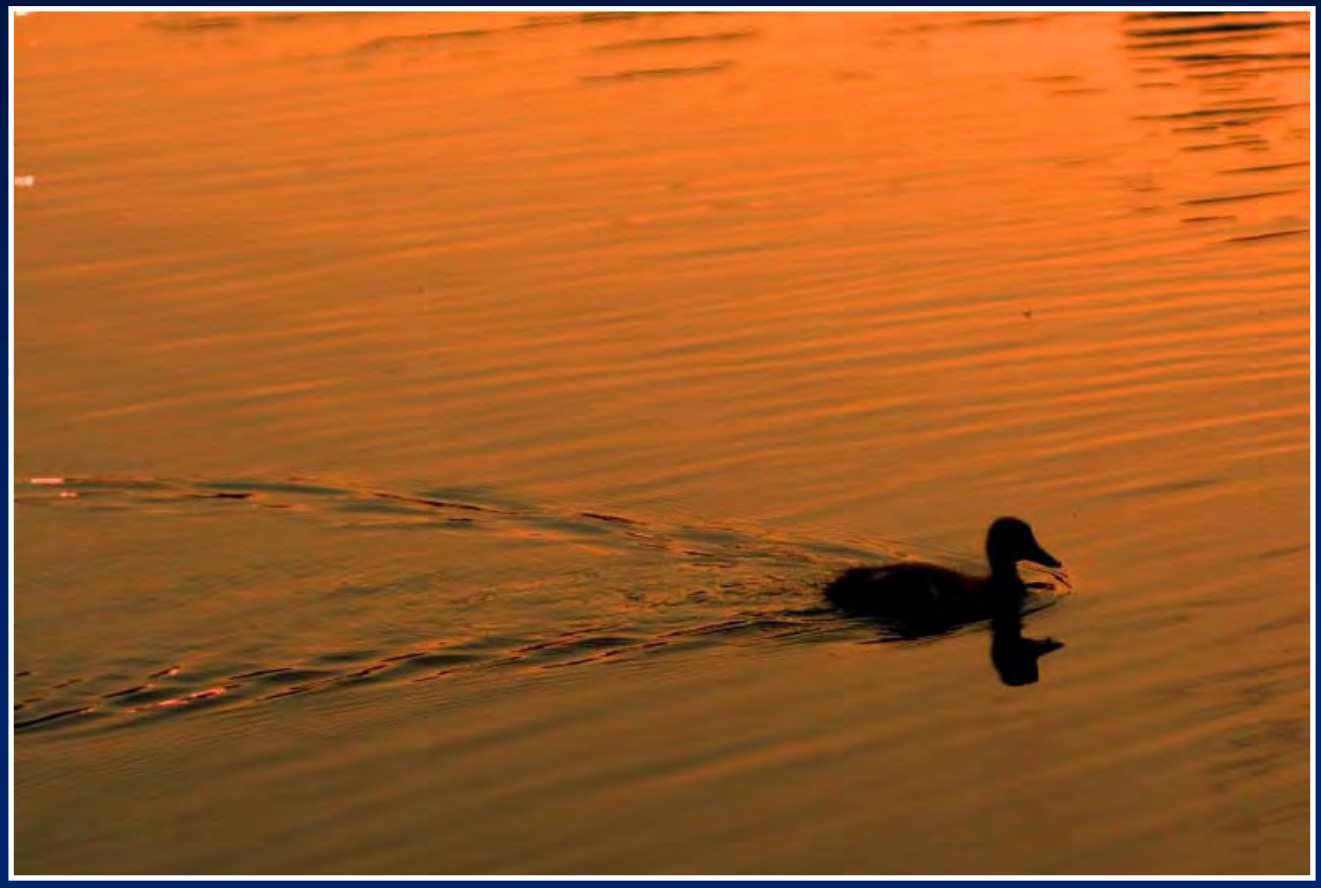


Lighting

Front Lighting

Side Lighting

Back Lighting



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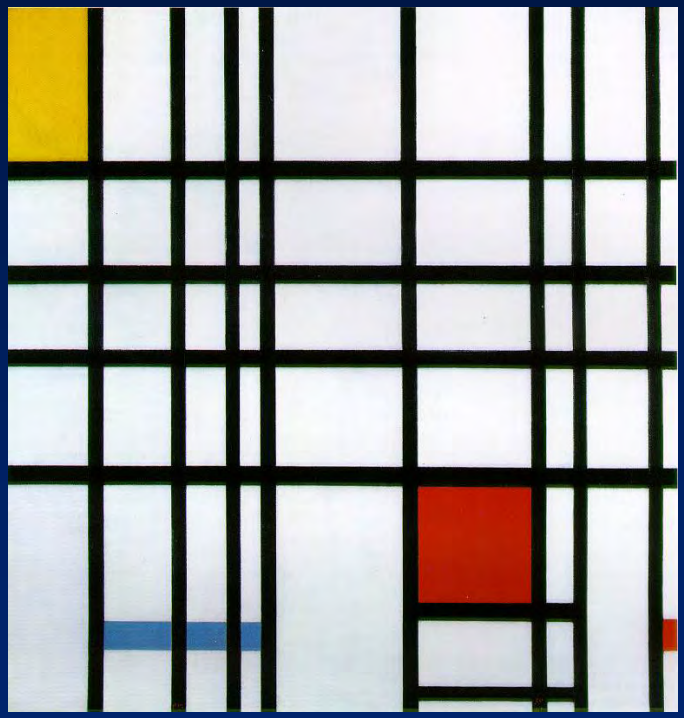
Not Critiquing Art



Piet Modrian

Lothar Wolleh

What makes one photo better than another?

- Simplicity
- Realism
- Basic photographic techniques

Simplicity

"Look Into" by Josh Brown @ Flickr

Simplicity

"alien flower" by Josef F. Stuefer @ Flickr

Simplicity

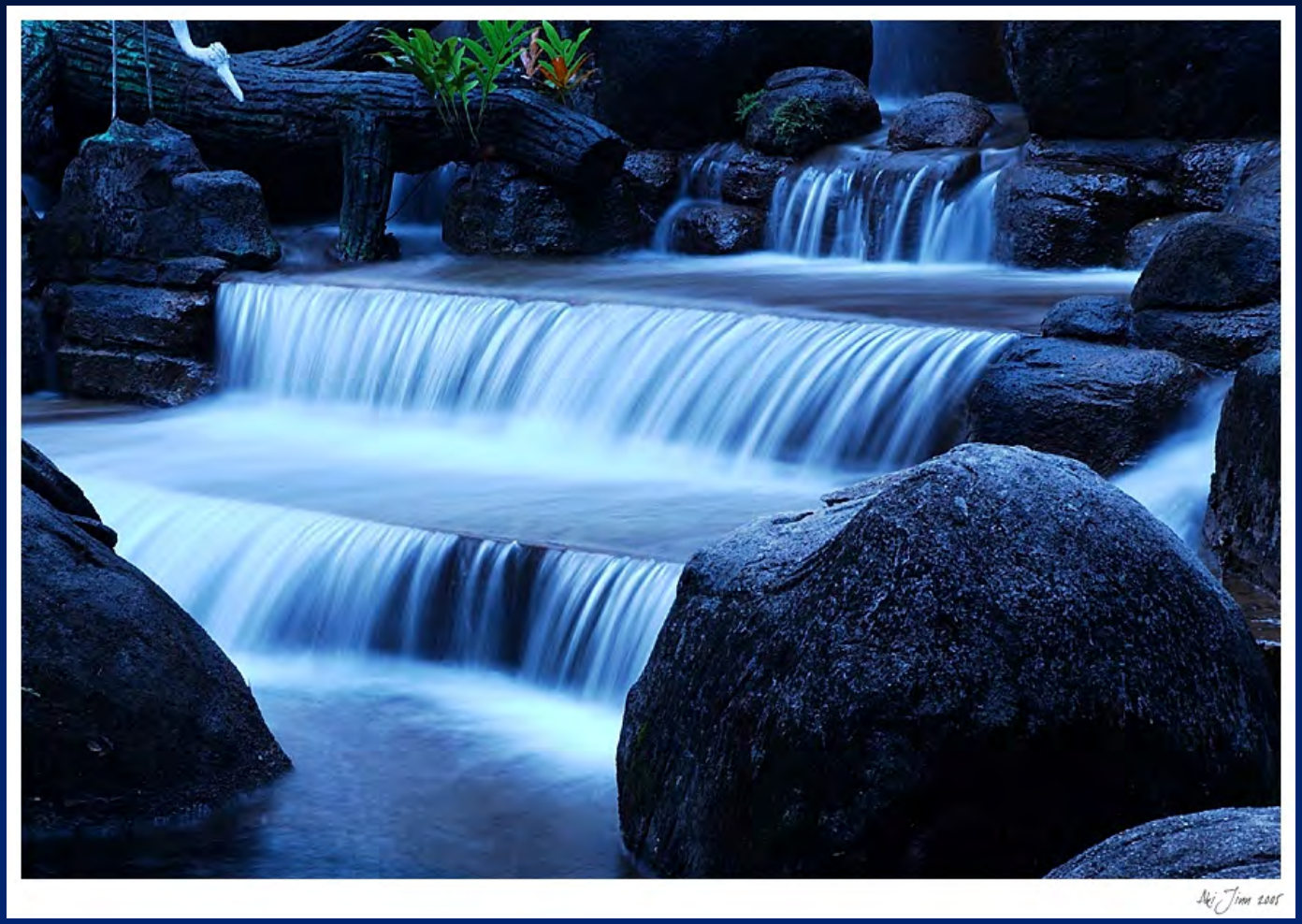
"Waiting in line!" by Imapix @ Flickr

Realism

"Golden Gate Bridge at Sunset" by Buzz Andersen @ Flickr

"Golden Gate 3" by Justin Burns @ Flickr

Realism



"Somewhere Only We Know Prt2 (sic)" by Aki Jinn @ Flickr

Realism

Basic techniques

- Blur
- Contrast and brightness

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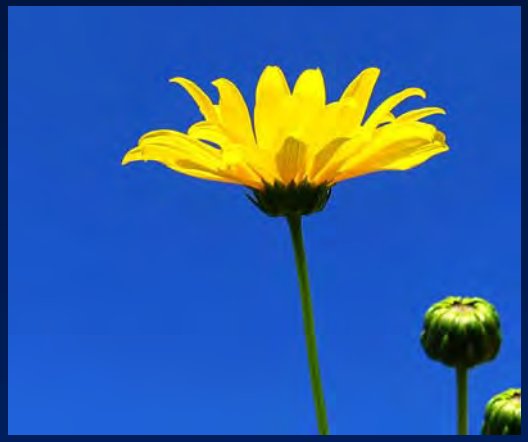
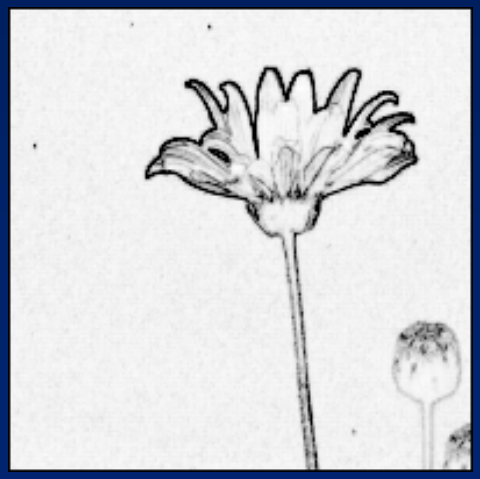
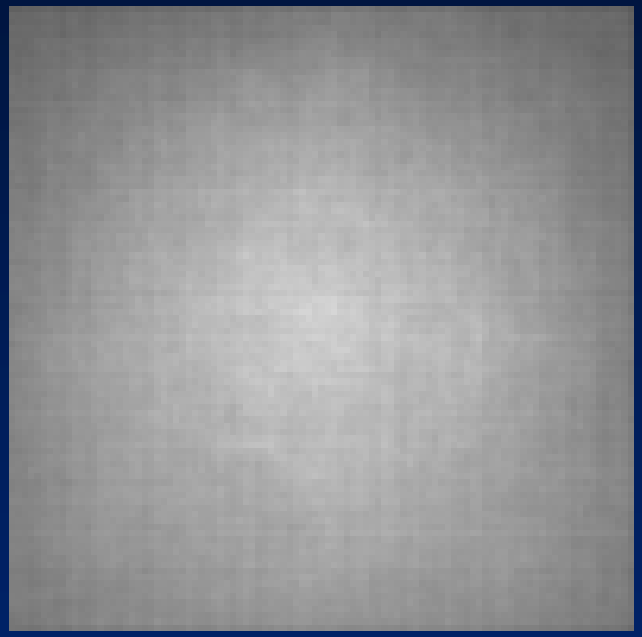
Features – Spatial Distribution of Edges



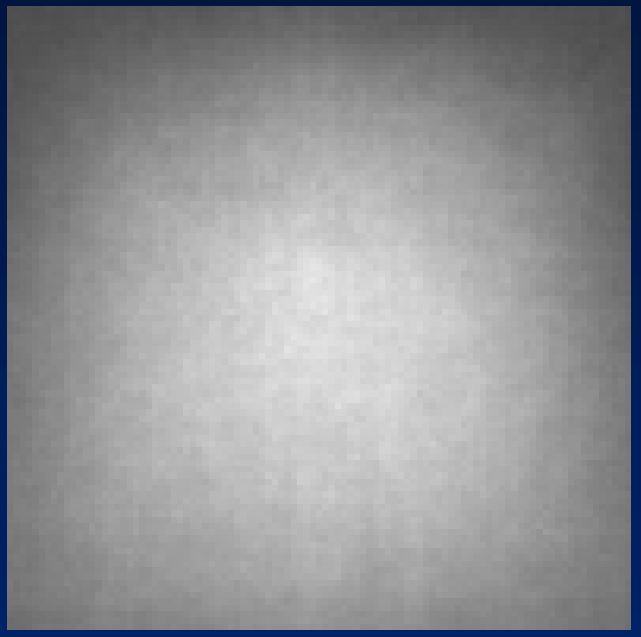


"Picture of a picture…" by Ted Johnson @ Flickr

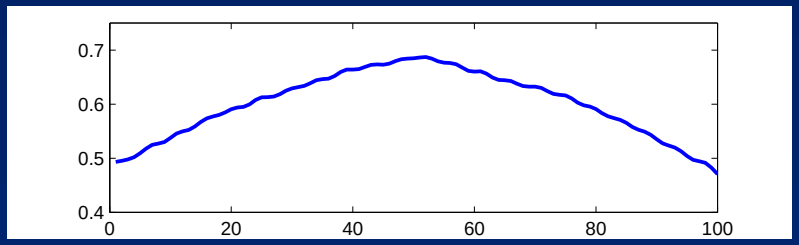
Spatial Distribution of Edges

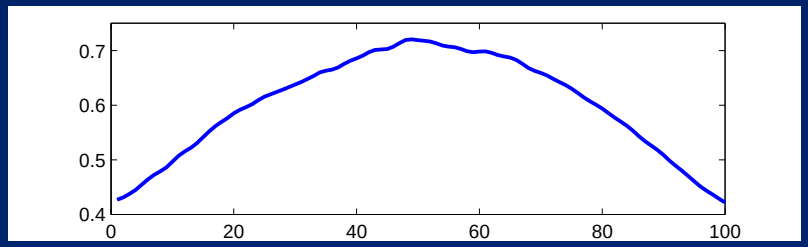


M_s



M_p

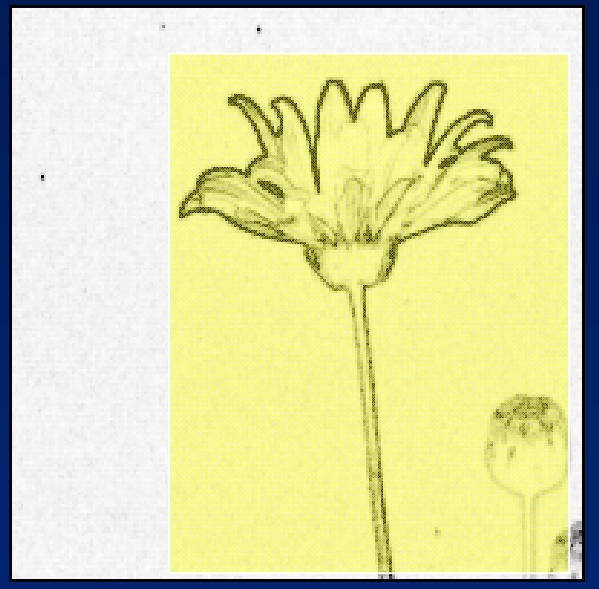




Low quality photos

High quality photos

Spatial Distribution of Edges

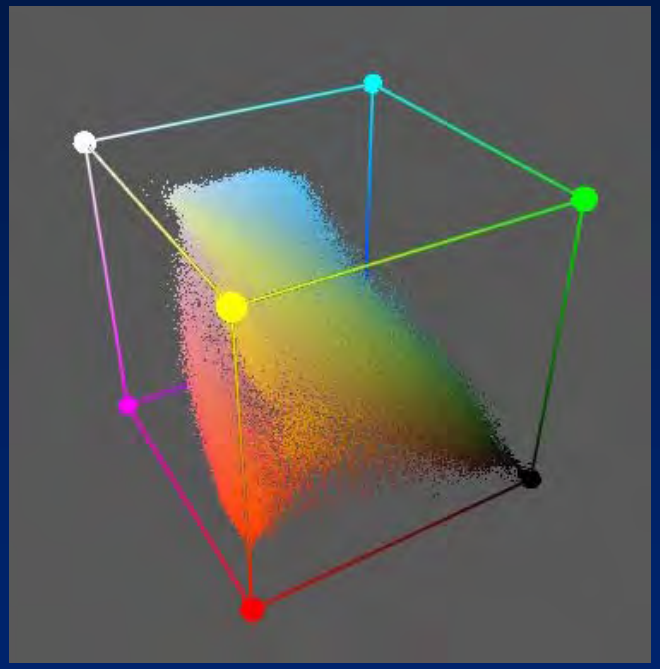


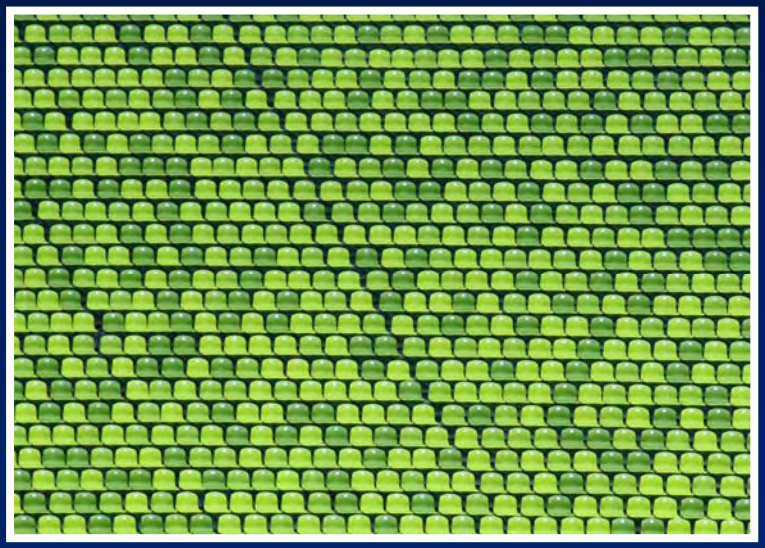
w_y

w_x

Color Distribution

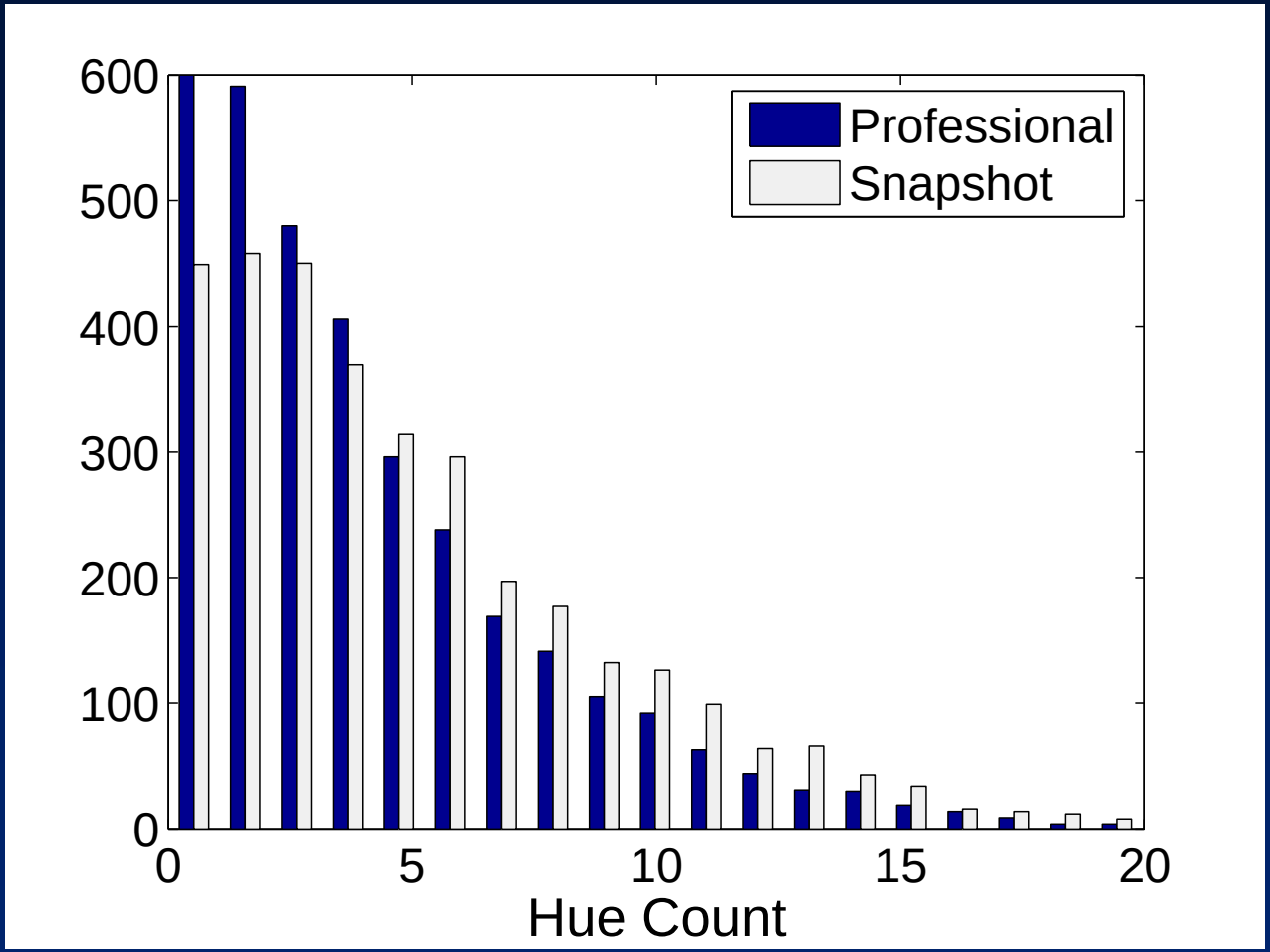
- K-NN on color histogram

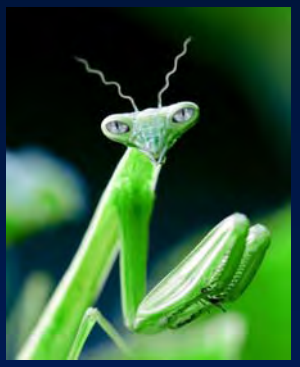




q_{cd} = # *professional_neighbors*

Hue Count

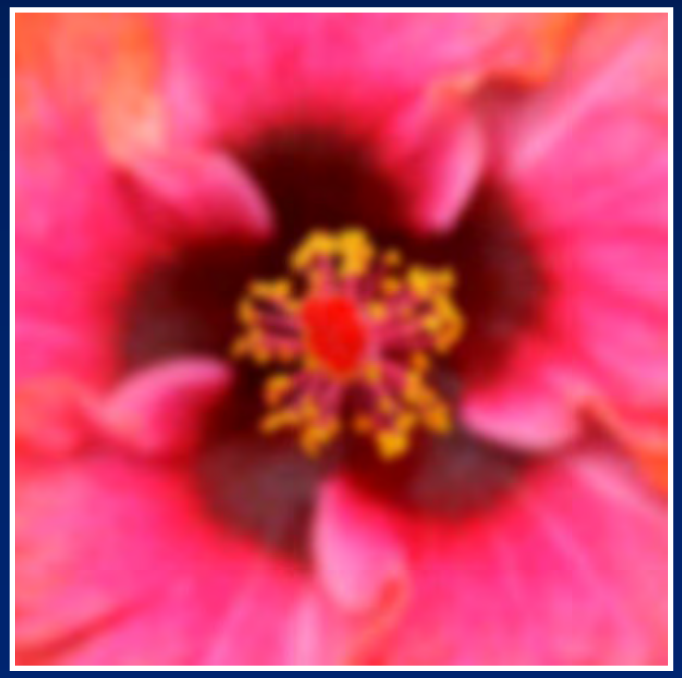




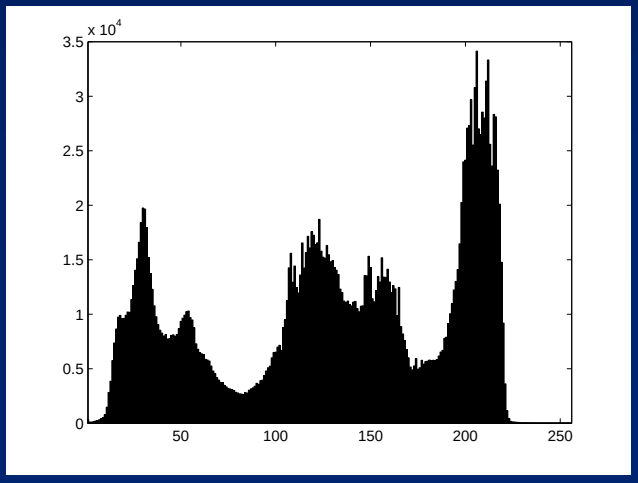
$$q_h = 20 - (\#\ hues > threshold)$$

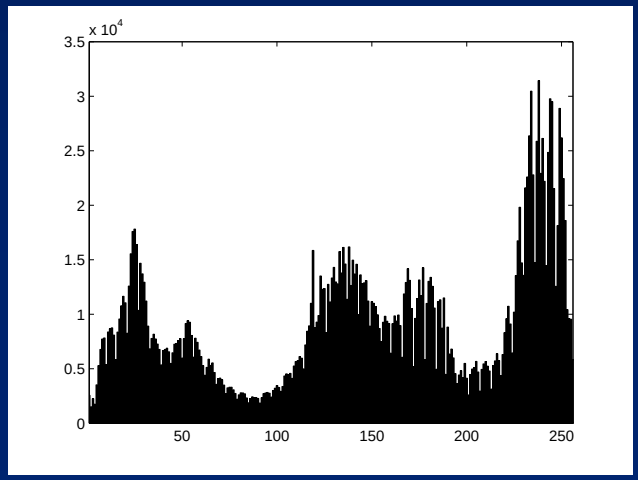
Blur

- Look at frequency distribution.
- Measure the amount of blur in the sharpest object, instead of the *average* blur.



Low Level Features - Contrast





Low Level Features – Avg. Brightness

Classifier

- Naives Bayes
- We assume independence of the features
- We achieve better results with added features even though they are not independent.

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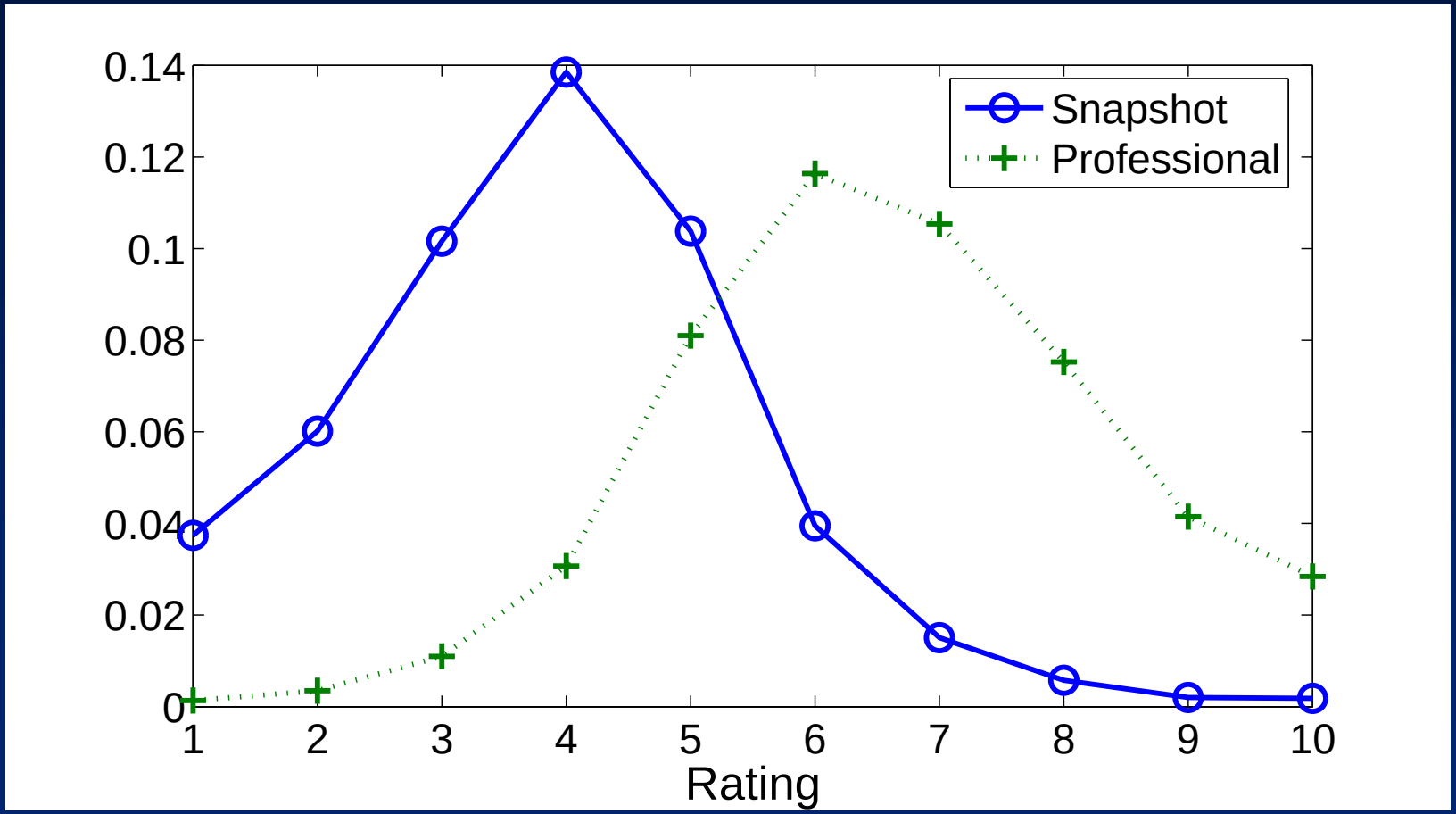
Dataset – DPChallenge.com

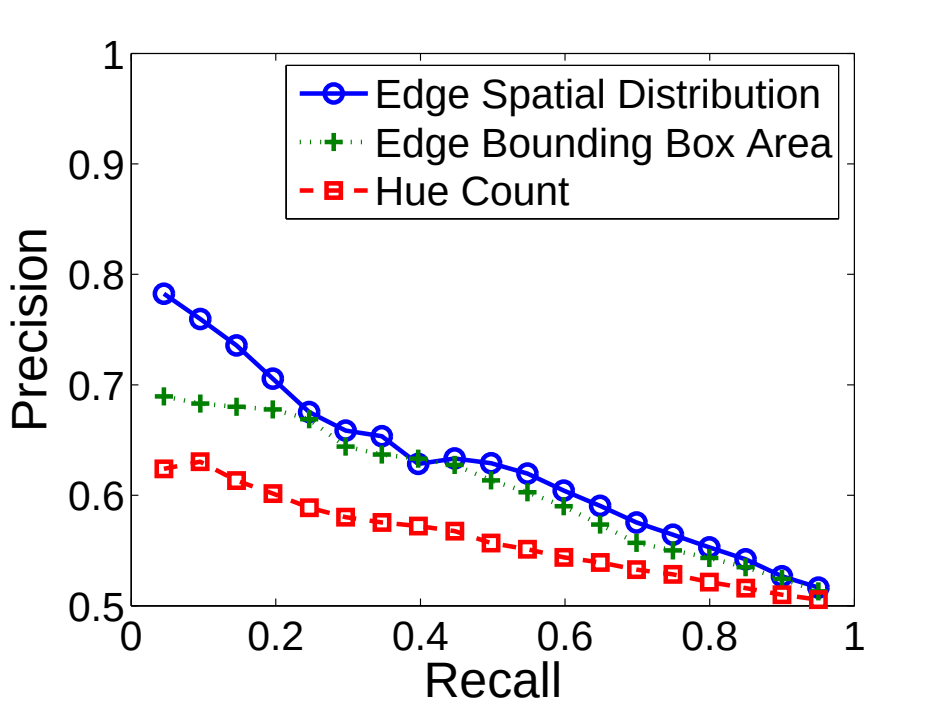
Statistics	Voting Breakdow
Place: 1 out of 829	1 0
Avg (all users): 7.987	2 1
Avg (commenters): 8.805	3 2
Avg (camera): 7.998	4 5
Avg (no camera): 6.333	5 24
Views since voting: 6597	6 54
Views during voting: 1003	7 89
Votes: 478	8 109
Comments: 190	9 89
Favorites: 133 (view)	10 105
Add this photograph to your favorites!	

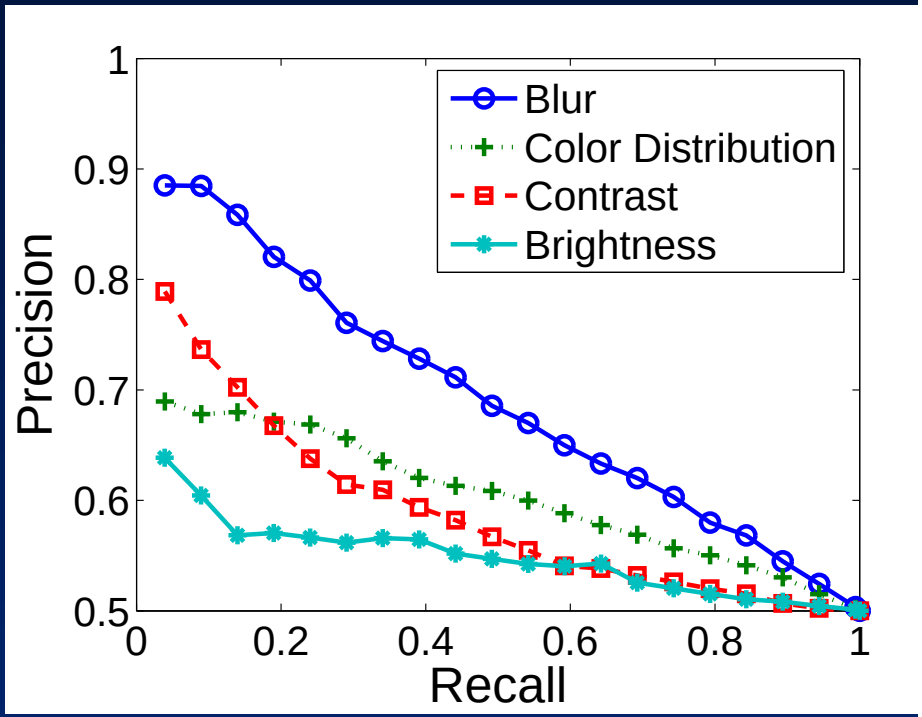
60K photos
40K photographers
10/90 percentile

Difficulty of Dataset



Results





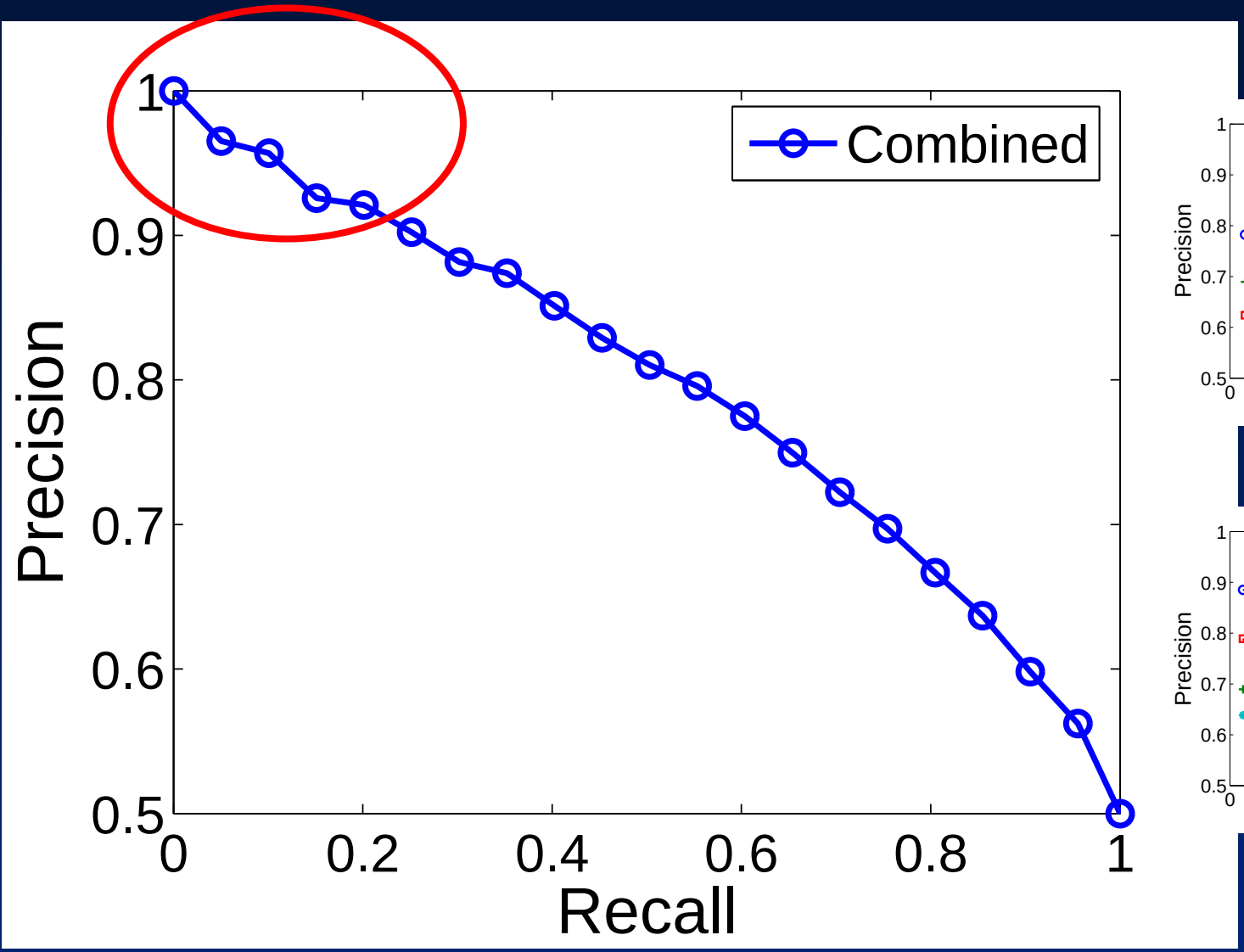
$$recall = \frac{\#\ professional\ photos\ above\ threshold}{total\ \#\ professional\ photos}$$

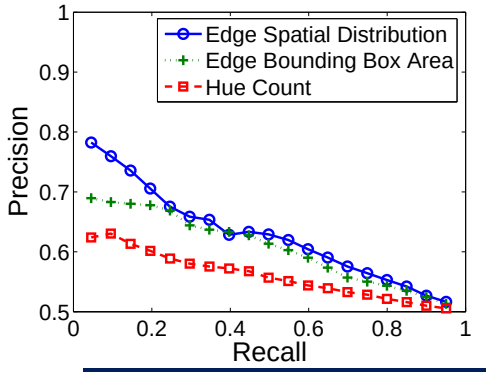
$$precision = \frac{\#\ professional\ photos\ above\ threshold}{\#\ photos\ above\ threshold}.$$

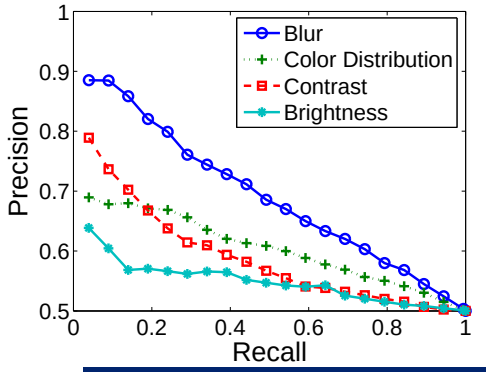
Most Distinctive Feature: Blur

- A *badness* metric, rather than a *goodness* metric.

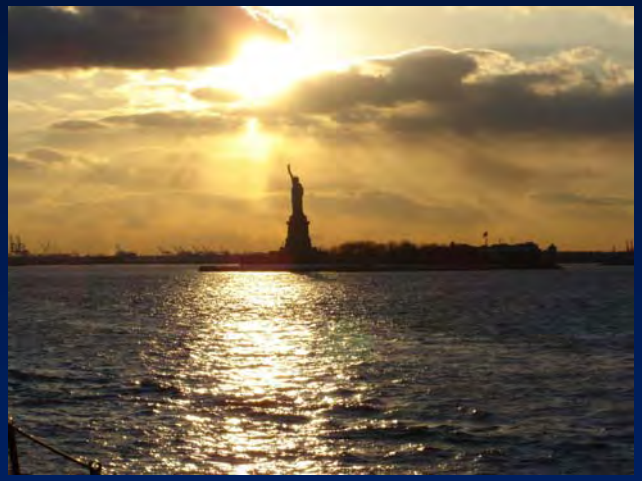
Results


Combined
Precision
Recall
1
0.9
0.8
0.7
0.6
0.5
0
0.2
0.4
0.6
0.8
1


Edge Spatial Distribution
Edge Bounding Box Area
Hue Count
Precision
Recall


Blur
Color Distribution
Contrast
Brightness
Precision
Recall

Web Retrieval Results



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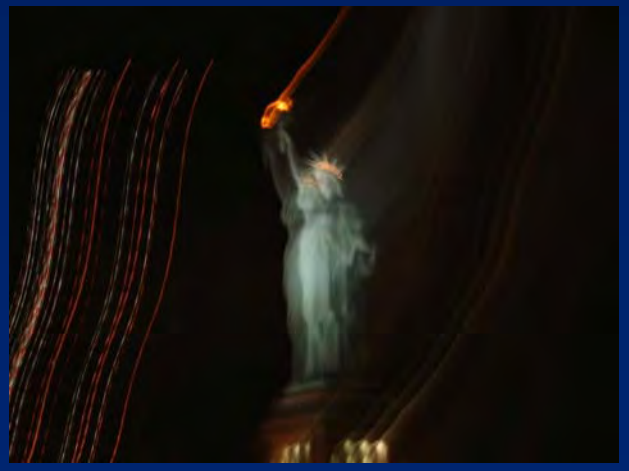



Web Retrieval Results

...

Web Retrieval Results

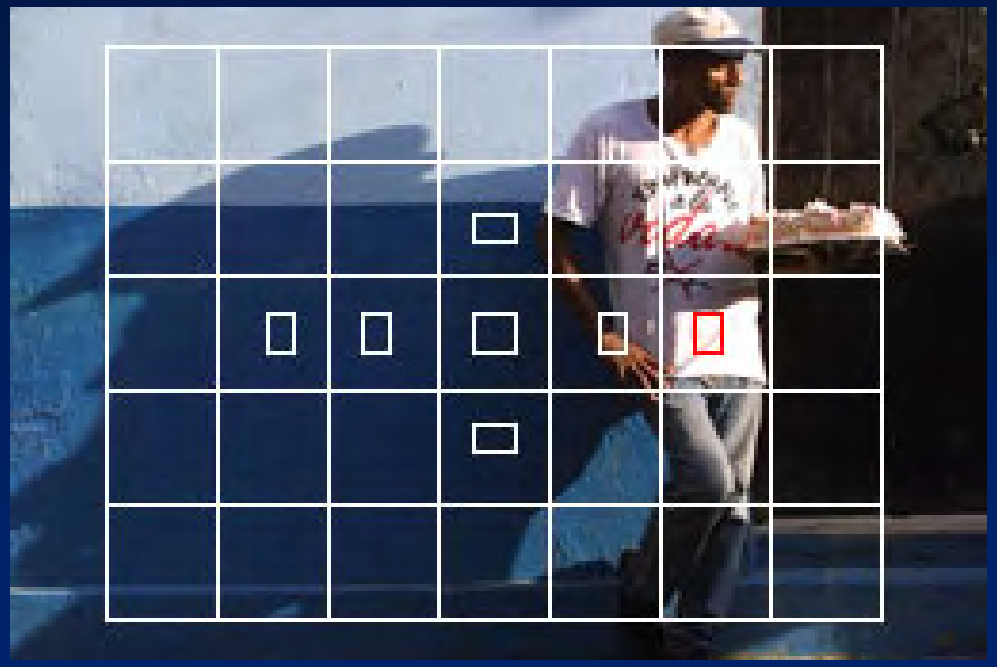
Beyond this paper

- Rule of Thirds
- Patterns and textures

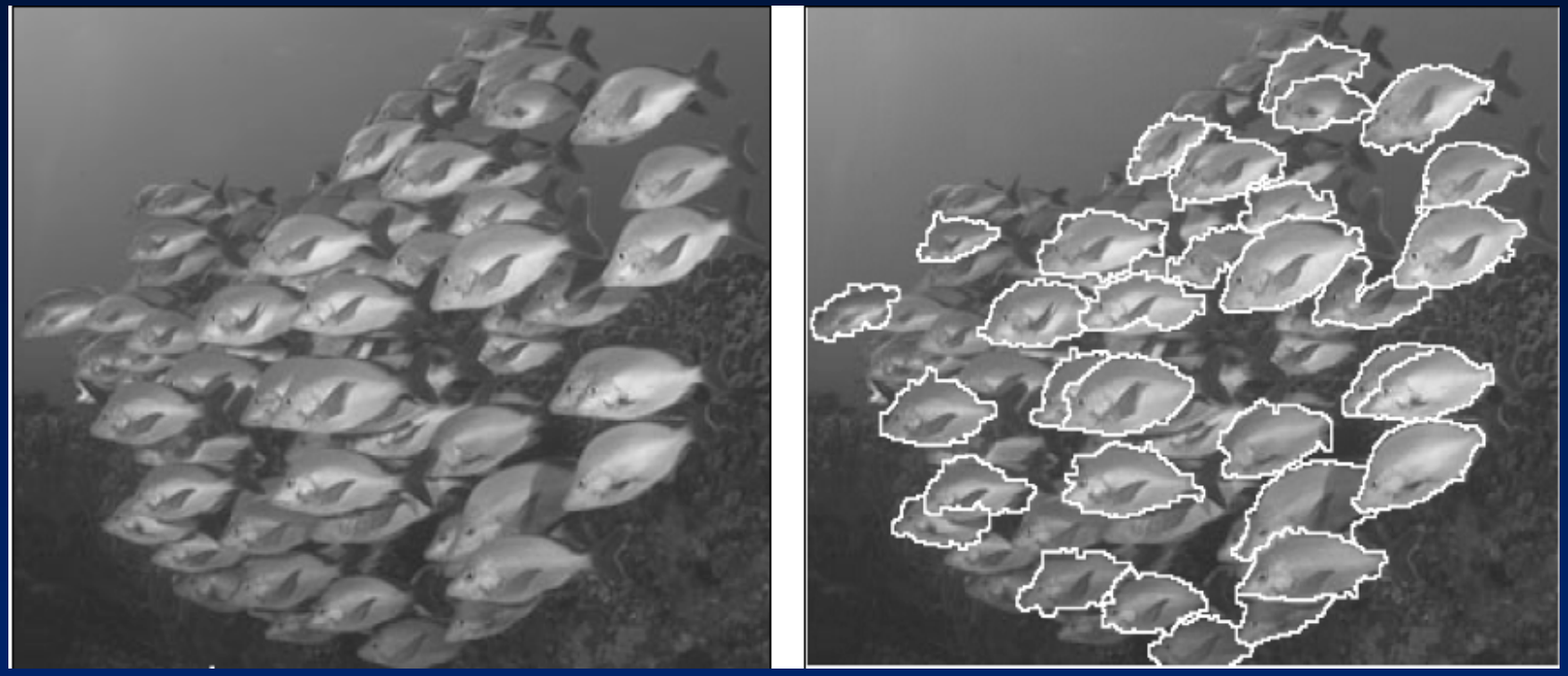
Rule of Thirds

- Object detection
- Saliency
  - "Learning to Detect A Salient Object", Liu, Sun, Zheng, Tang, Shum, CVPR '07.
- Where is the horizon?

Eye Controlled Focus



Textures



- "Extracting Texels in 2.1D Natural Textures", Ahuja, Todorovic, ICCV '07.

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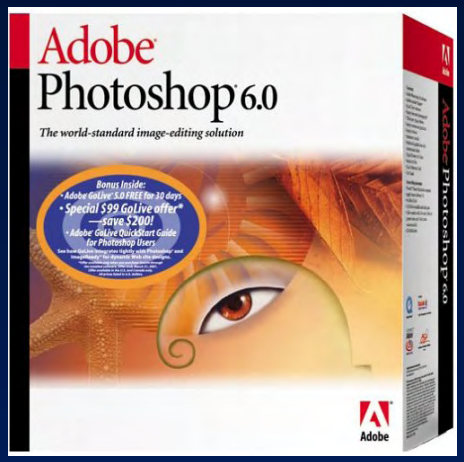
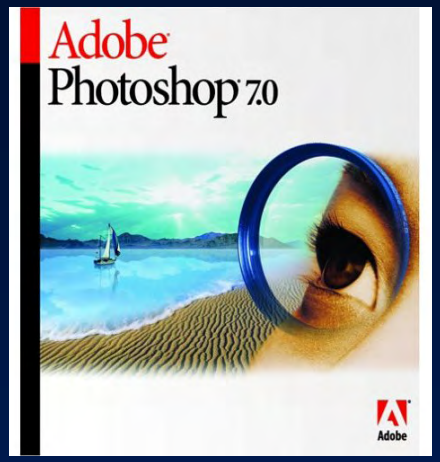

Adobe
Photoshop 6.0
The world-standard image-editing solution
Bonus Inside:
• Adobe GoLive 5.0 FREE for 30 days*
• Special $99 GoLive offer* —save $200!
• Adobe GoLive QuickStart Guide for Photoshop Users
Adobe


Adobe
Photoshop 7.0
Adobe


Adobe Photoshop CS
Adobe Photoshop CS
Adobe

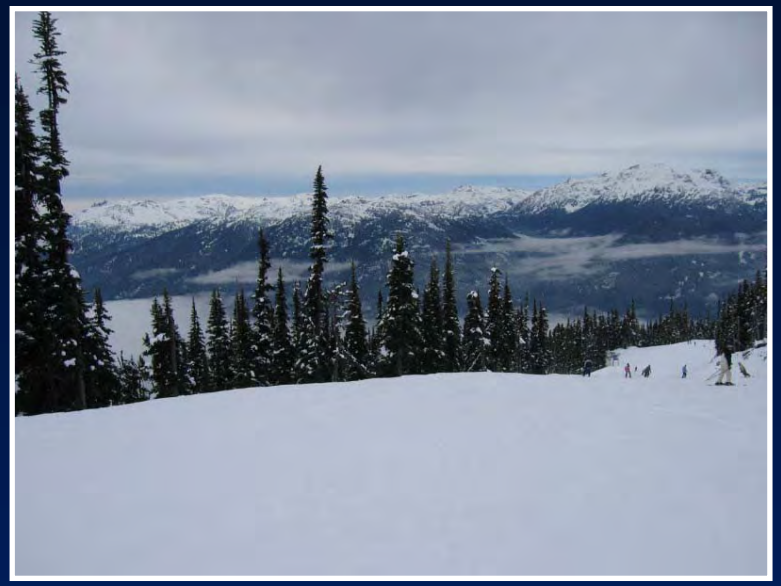

Adobe Photoshop CS2
Adobe Photoshop CS2
Adobe


ADOBE PHOTOSHOP CS3
ADOBE PHOTOSHOP CS3
Adobe

Beyond the (Digital) Dark Room

Low-level Enhancements

"I'm Feeling Lucky"



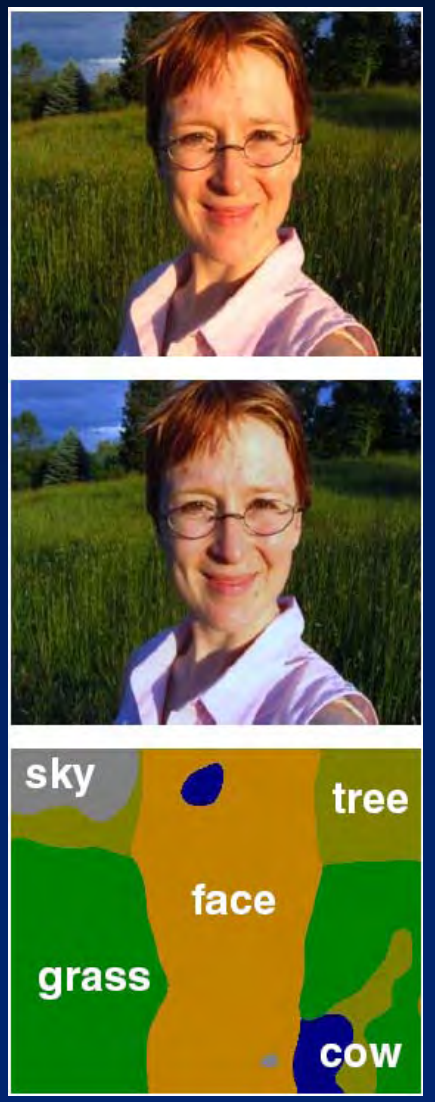
Exposure

- Scene detection
  - Canon's "Evaluative"
  - Nikon's "3D Matrix Metering"
- People/Face/Skin detection
  - Canon's Face Detection

- "Context-based vision system for place and object recognition", Torralba, Murphy, Freeman, Rubin, ICCV '03.
- "Human detection using oriented histograms of flow and appearance", Dalal, Triggs, Schmid, ECCV '06.
- "Robust Real-time Object Detection", Viola, Jones, IJCV '05.

Color balance

- Object recognition
  - Face / Skin
  - Sky
  - Water
  - Trees



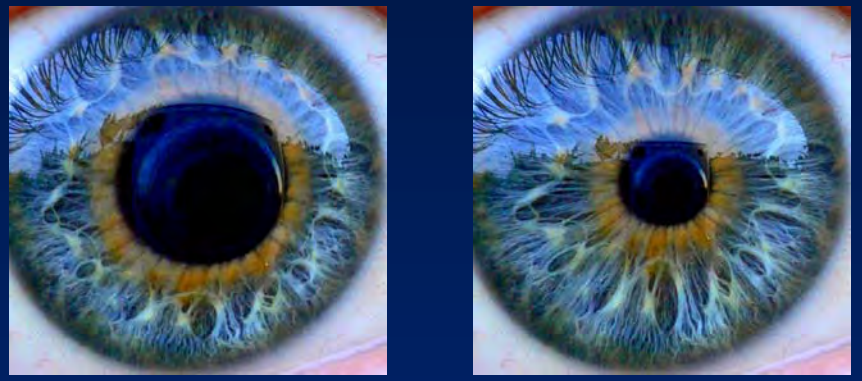
- "Using High-Level Visual Information for Color Constancy", Weijer, Schmid, Verbeek, ICCV '07.
- "The von Kries Hypothesis and a Basis for Color Constancy", Chong, Gortler, Zickler, ICCV '07.

High-level Enhancements

- Case Study – Portraits

Eyes are windows into the soul

- Red eye reduction
- Catch lights
- Eye whites
- Pupil size



"mon oeil" by io2 @ Flickr

- "Corneal Imaging System: Environment from Eyes", Nishino and Nayar, IJCV '06.
- "Red eye detection with machine learning", Ioffe, ICIP '03.

Making People Slimmer (the wrong way)

Mall Studio

Professional Studio

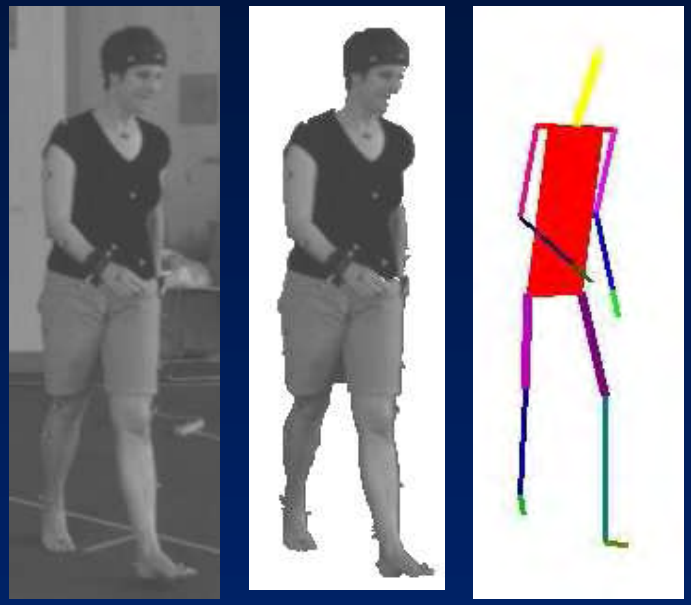
Kids…

Adjust Light Direction

- "From Few to Many: Illumination Cone Models for Face Recognition Under Variable Lighting and Pose", Georghiades, Belhumeur, Kriegman, PAMI '01.
- "Multilinear Subspace Analysis of Image Ensembles", Vasilescu, Terzopoulos, CVPR '03.

Kid Proof

Detect and Adjust Pose



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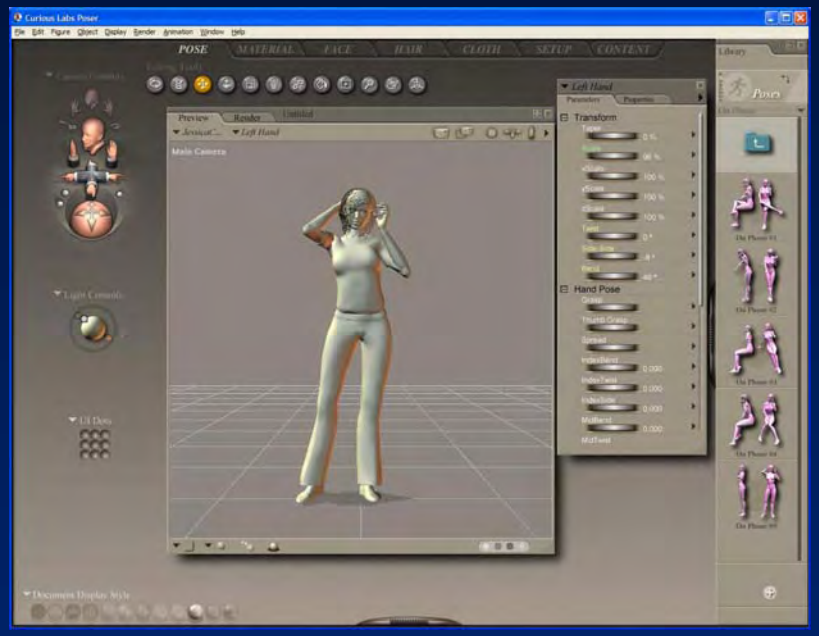
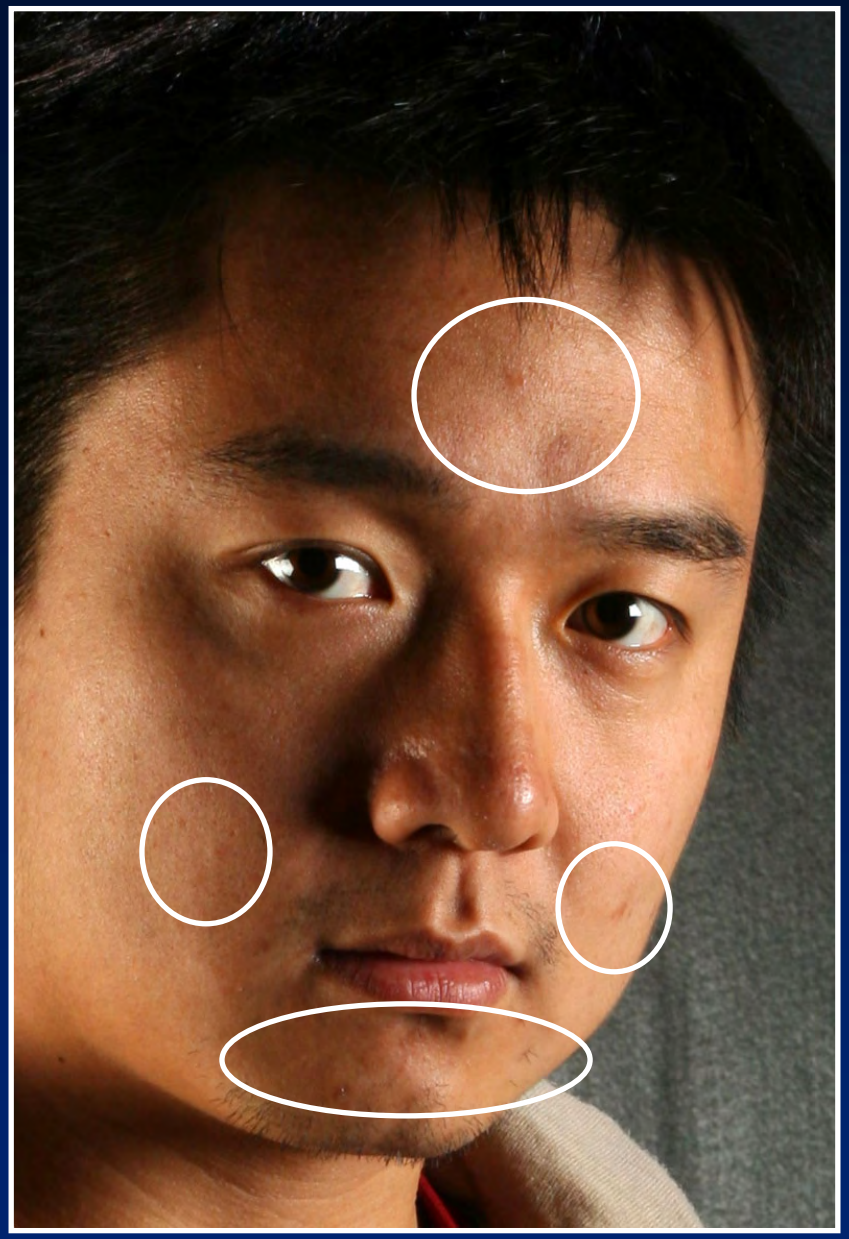


- “PoseCut: Simultaneous Segmentation and 3D Pose Estimation of Humans using Dynamic Graph-Cuts”, Bray, Kohli, Torr, ECCV ’06.
- "Strike a Pose: Tracking People by Finding Stylized Poses”, Ramanan, Forsyth, Zisserman, CVPR ’05.
- Poser by e frontier





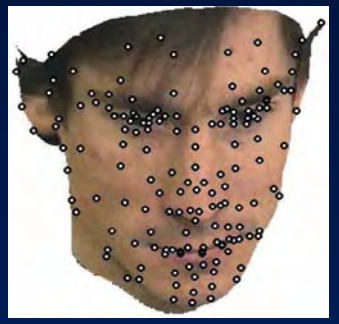


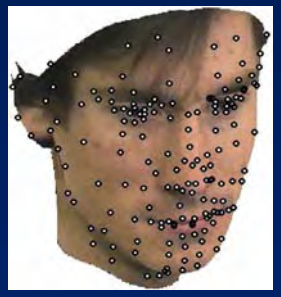




3D Face Alignment – Apply and Transfer

3D Shape





- "3D Alignment of Face in a Single Image", Gu and Kanade, CVPR '06.

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Questions?