What Makes a Great Picture?

© Robert Doisneau, 1955

With many slides from Yan Ke,
as annotated by Tamara Berg

15-463: Computational Photography
Alexei Efros, CMU, Fall 2008

Photography 101

- Composition
  - Framing
  - Rule of Thirds
  - Leading Lines
  - Textures and Patterns
- Lighting
  - Direction
  - Color coordination / balance
  - “Golden Hour”

Framing

“Photography is all about framing. We see a subject -- and we put a frame around it. Essentially, that is photography when all is said and done.”

-- from photo.blorge.com

Frame serves several purpouses:

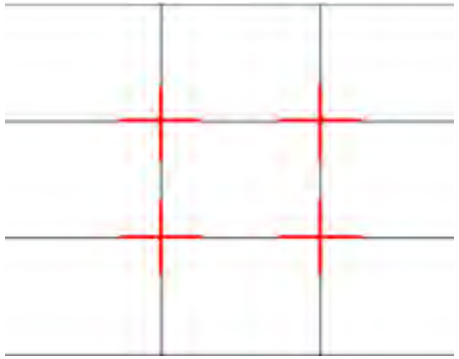
1. It gives the image depth
2. Use correctly, framing can draw the eye of the viewer of an interest to a particular part of the scene.
3. Framing can bring a sense of organization or containment to an image.
4. Framing can add context to a shot.

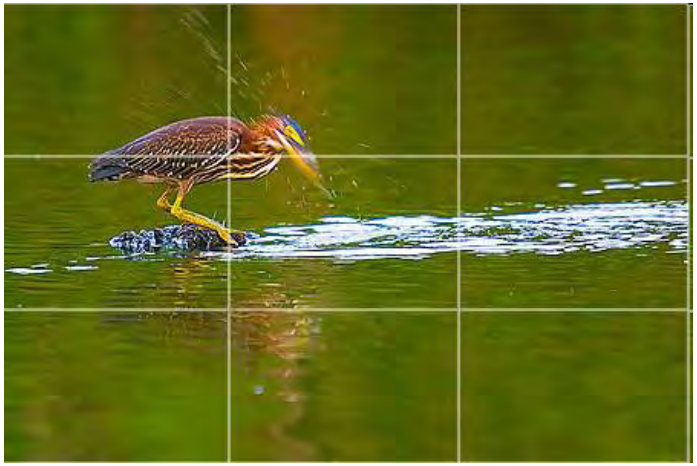
http://digital-photography-school.com/blog/frame-your-images/

Examples of nice framing

http://flickr.com/photos/paulosacramento/226545698/
http://flickr.com/photos/chrisbeach/13868545/
http://flickr.com/photos/74531485@N00/929270814/
http://flickr.com/photos/freakdog/223117229/
http://flickr.com/photos/cdm/253805482/

Rules of Thirds





http://www.photo96.com/blog/?p=371

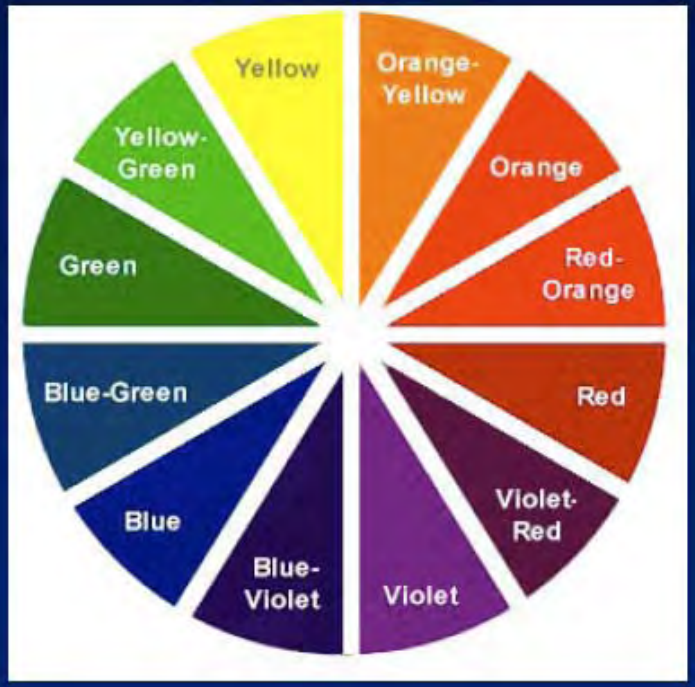
Other examples

Leading Lines

More examples

Textures and Patterns

Color Coordination



Complementary colors (of opposite hue on color wheel)

Front Lighting

Side Lighting

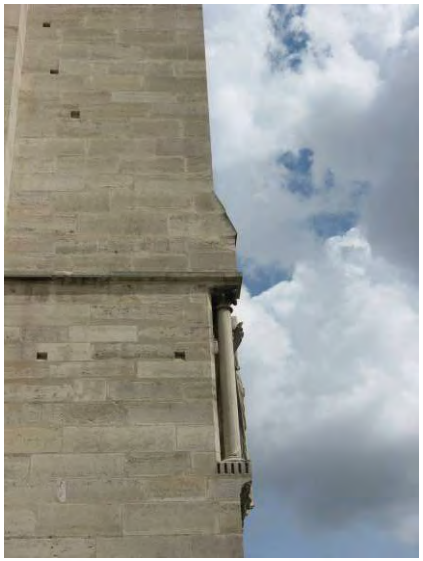
Back Lighting

Photography 101

- Composition
  - Framing
  - Rule of Thirds
  - Leading Lines
  - Textures and Patterns
- Lighting
  - Direction
  - Color coordination / balance

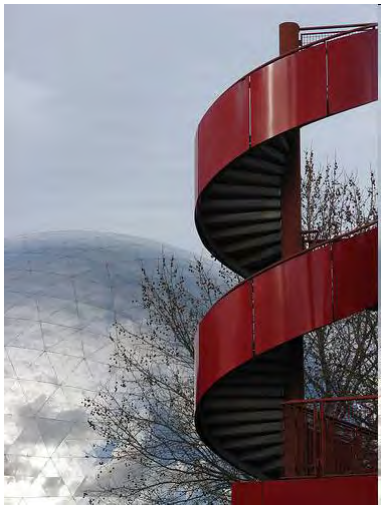
Anyone can take great pictures…

I am a sucky photographer…



…but I am a pretty good photo critic!







http://flickr.com/photos/aaefros/

# of my Paris photos on Flickr: 32

Total # of my Paris photos: ~1250

~2%

The Postmodern Photographer

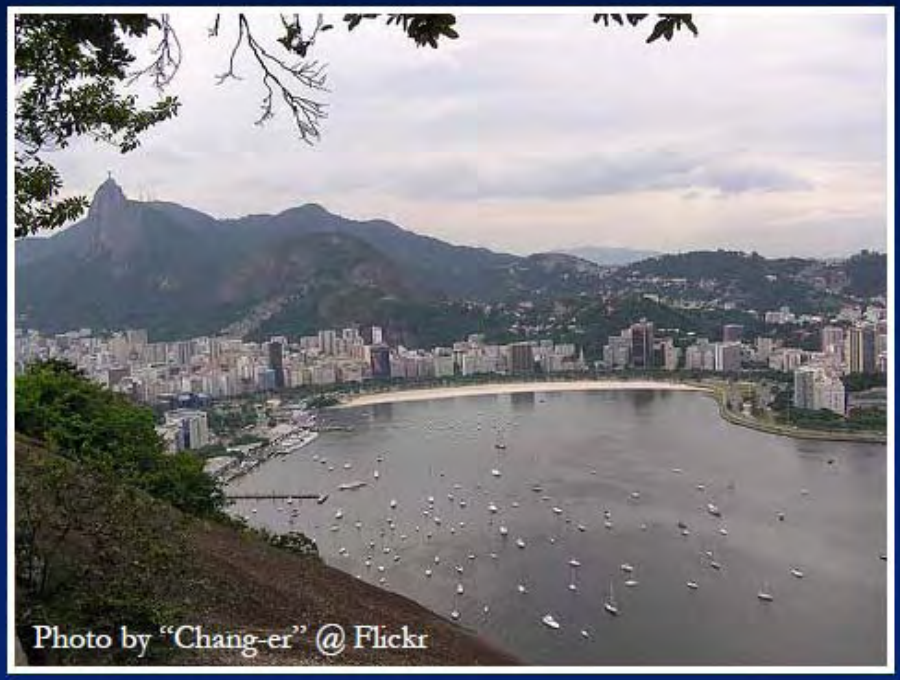
The Old Days: a pre-process

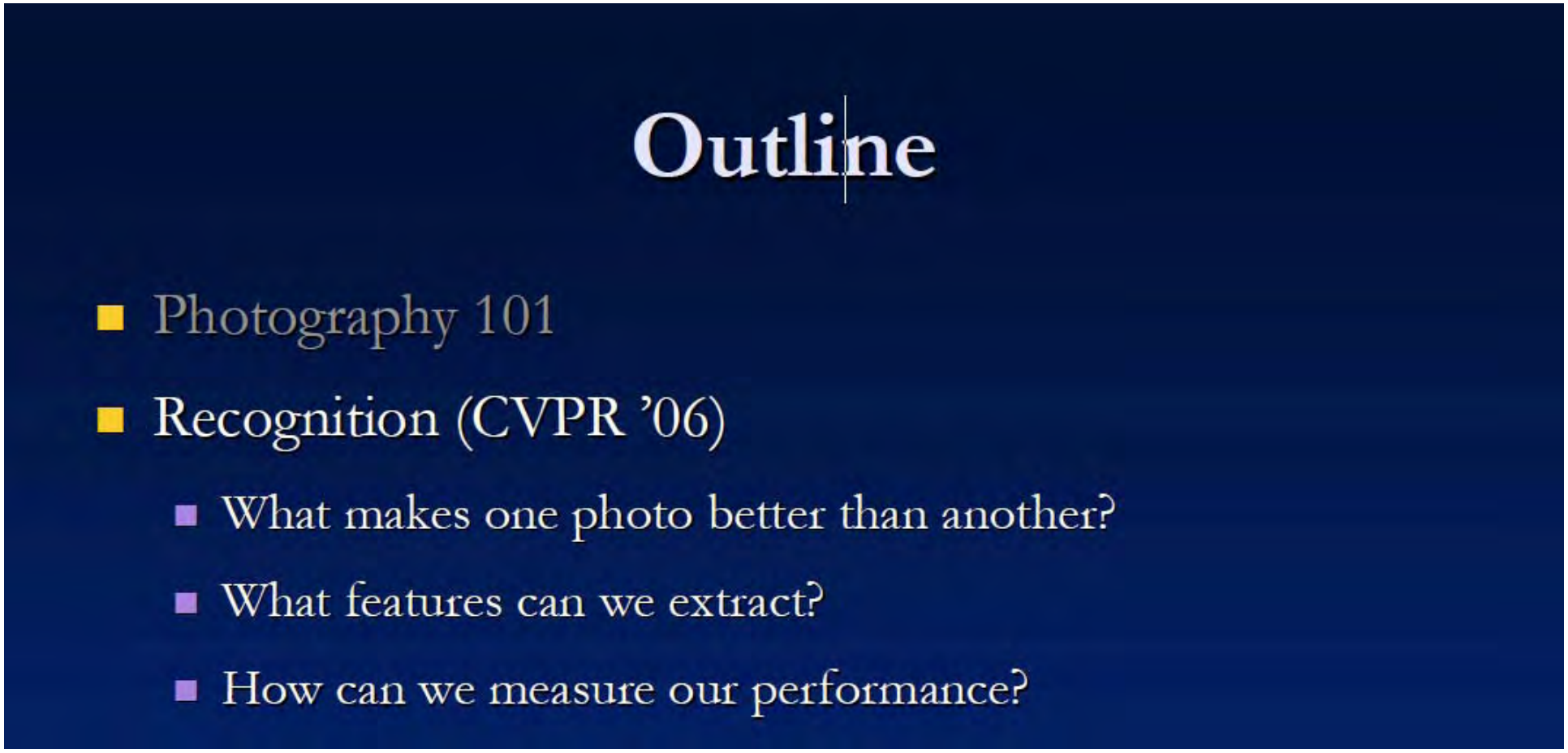
- Load film
- Find subject
- Position camera
- Set all the settings “just right”
- Take a deep breath…
- ...Press buttom!

The New Digital Days: a post-process

- Get a 2 GB memory cartridge
- Take pictures like there is no tomorrow!!!
- …
- Back home, spend hours of agony trying to find 1-2 good ones

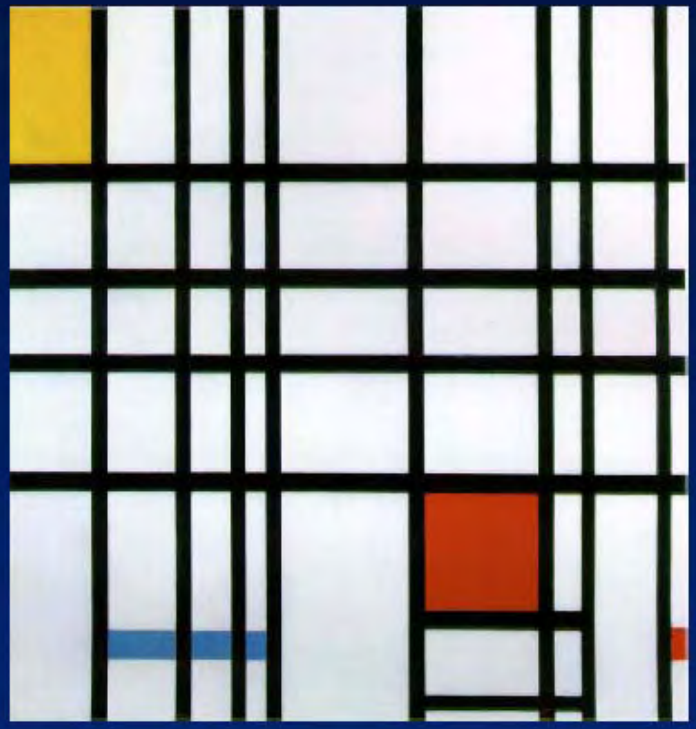
How to recognize the good photos?





Y. Ke, X. Tang, and F. Jing. *The Design of High-Level Features for Photo Quality Assessment*. CVPR 2006.

Not Critiquing Art



Piet Modrian

Lothar Wolleh

Not considering semantic measures of what makes a photo good (subject matter, humor, etc).
Professional = those you would frame, snapshot = those that would stay in photo album.

Applications

Image search for improved quality along with relevance.

Automatically select the best photos from a set of vacation pictures to choose the best ones to show.

See if computer can perform well on a traditionally human task.

What makes one photo better than another?

- Simplicity
- Realism
- Basic photographic techniques

Simplicity

"Look Into" by Josh Brown @ Flickr

Prof - Obvious what one should be looking at ie easy to separate subject from the background. Snap – unstructured, busy, filled with clutter.

Simplicity

"alien flower" by Josef F. Stuefer @ Flickr

Simplicity

"Waiting in line!" by Imapix @ Flickr

Basic techniques

- Blur - Snaps – entire photo blurry indicates poor technique. Prof - background out of focus by widening the lens aperture, but foreground in sharp focus.
- Contrast and brightness

Make the subject pop out by choosing complementary colors for subject & background. Isolate the subject by increasing lighting contrast between subject & background.

Abstract concepts - “Good composition, color & lighting”

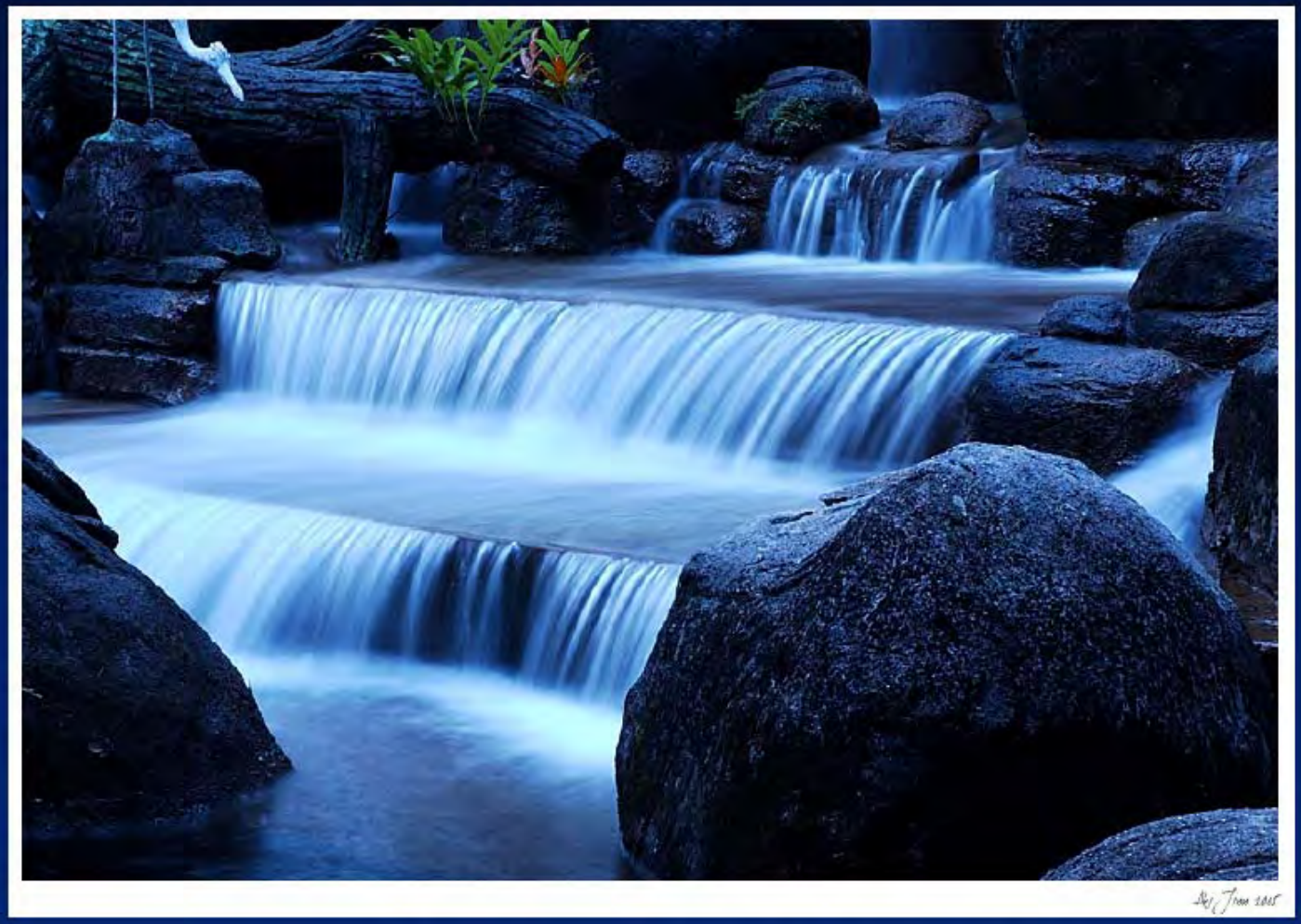
(Sur) Realism

Snaps look real, while prof photos look surreal.

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

"Golden Gate 3" by Justin Burns @ Flickr

(Sur) Realism



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

Techniques

Lighting conditions – time of day (morning, dusk), colored filters to adjust color balance (make sky bluer, sunset more brilliant), careful color selection of scene

Camera settings – adjust settings like focal length, aperture, shutter speeds to modify mood, perspective. Eg might use long shutter speed to capture waterfall and give a misty look

Subject matter – ordinary objects in unusual poses or settings (challenging since would need obj rec first)

Outline

- Photography 101
- Recognition
  - What makes one photo better than another?
  - What features can we extract?
  - How can we measure our performance?

Features – Spatial Distribution of Edges

More edges near border due to background clutter

More edges near center of img

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

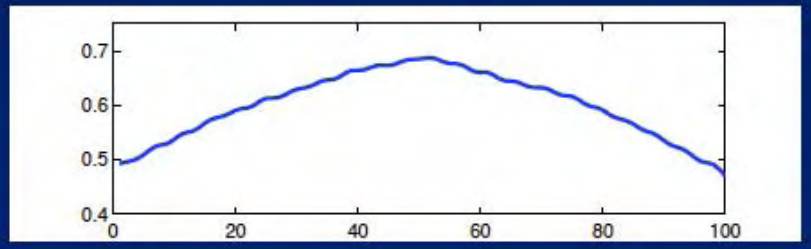
Trying to capture a photo's "simplicity"

Spatial Distribution of Edges

Mean Laplacian of snapshots

M_s

More uniformly distributed

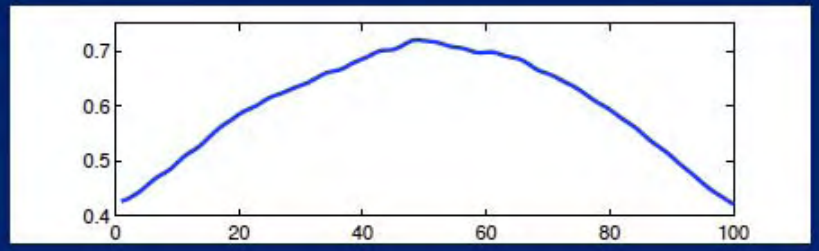


Low quality photos

Mean Laplacian of professional

M_p

More concentrated



High quality photos

Expect high quality photos to have high spatial frequency edges nearer to center than snapshots

Edge width

Calculate area that edges occupy – width of bounding box covering 96% of edge energy

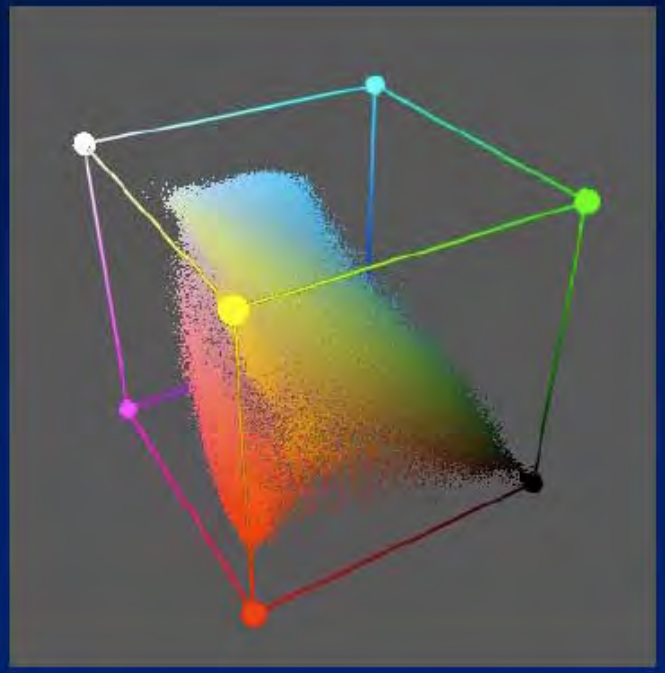
Cluttered regions should tend to produce a larger bounding box, and well defined subjects should produce a smaller one.

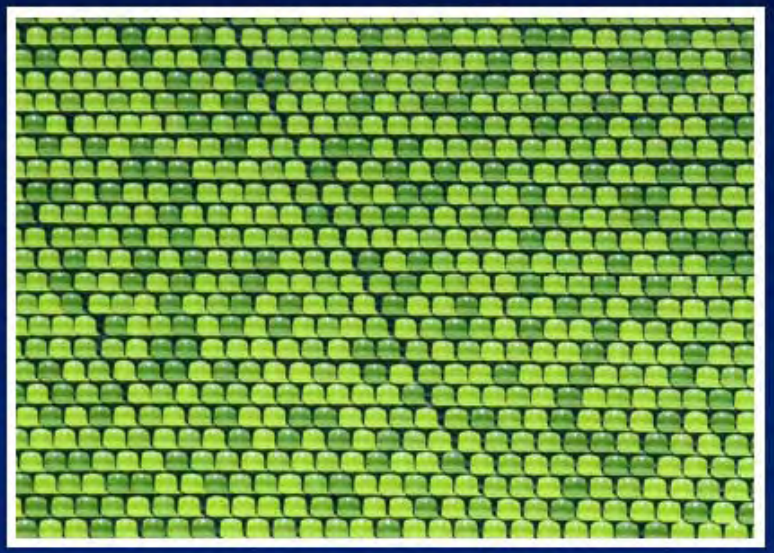
.94

.56

Color Distribution

- K-NN on color histogram



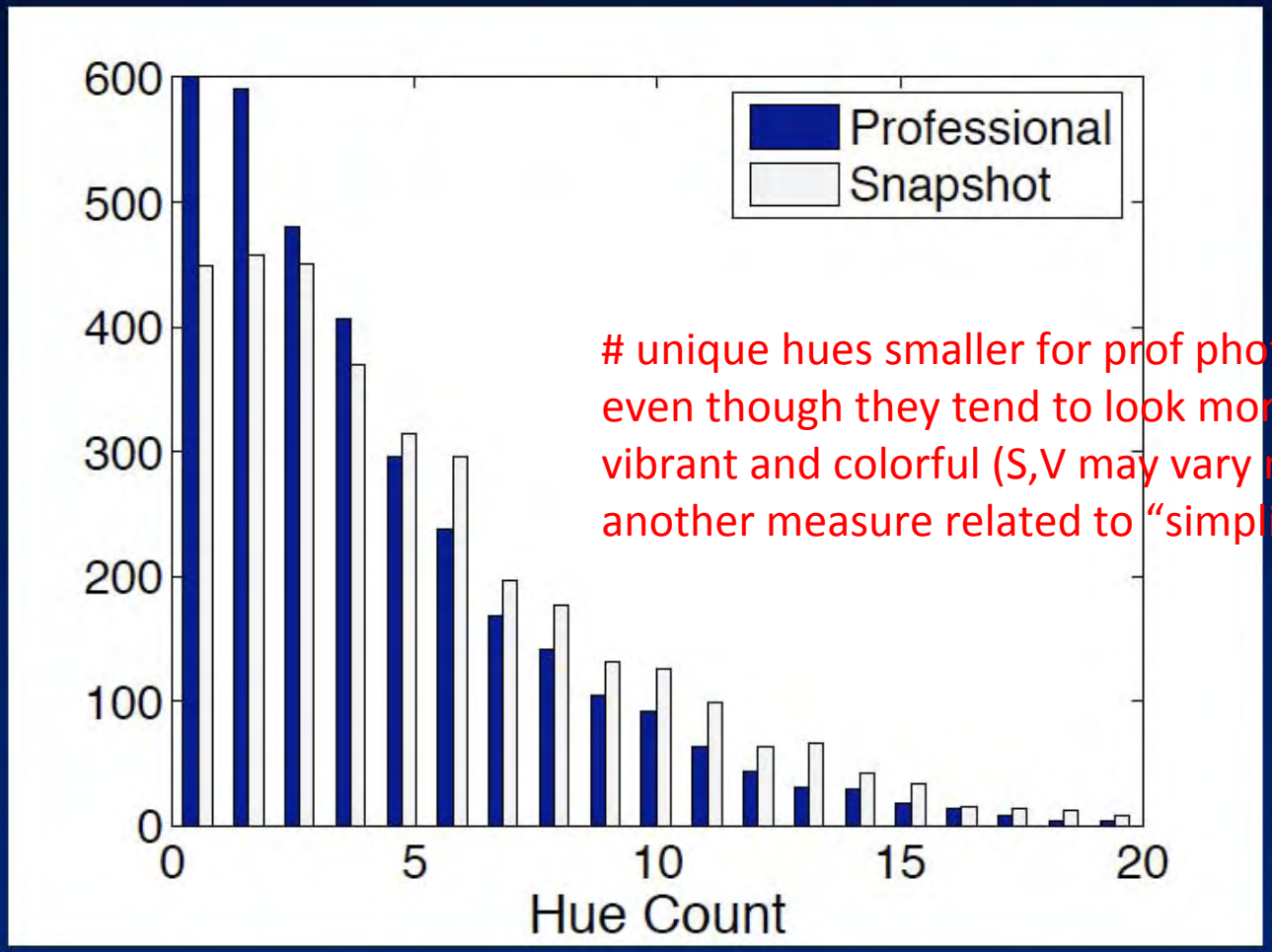


$$q_{cd} = \#professional\_neighbors$$

For query image find k nearest neighbors in training set. Quality = number of prof neighbors in top 5.

20 bin histogram defining possible unique hues

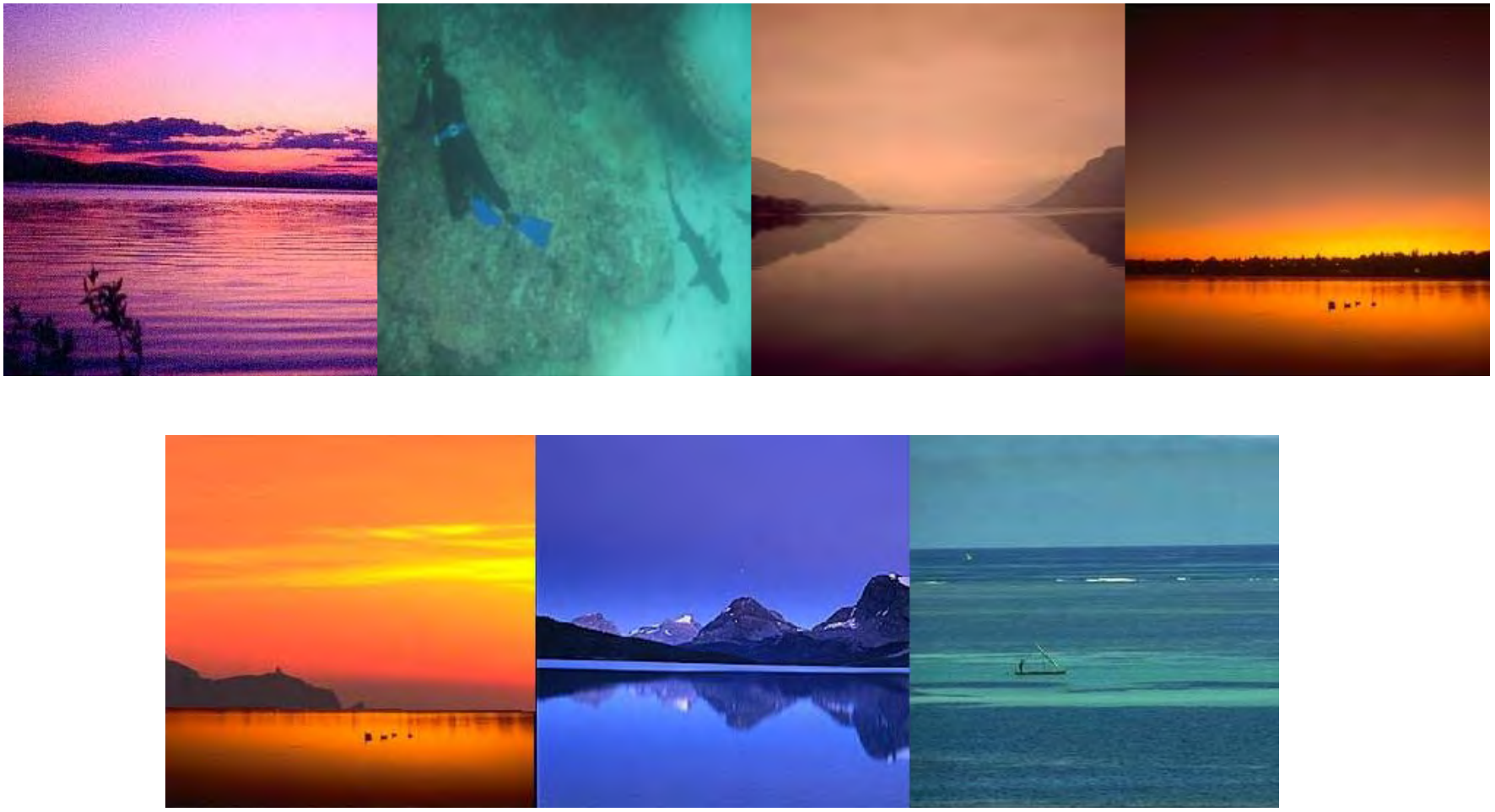
Hue Count



unique hues smaller for prof photos even though they tend to look more vibrant and colorful (S,V may vary more) – another measure related to "simplicity"

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

Most unlikely colors…



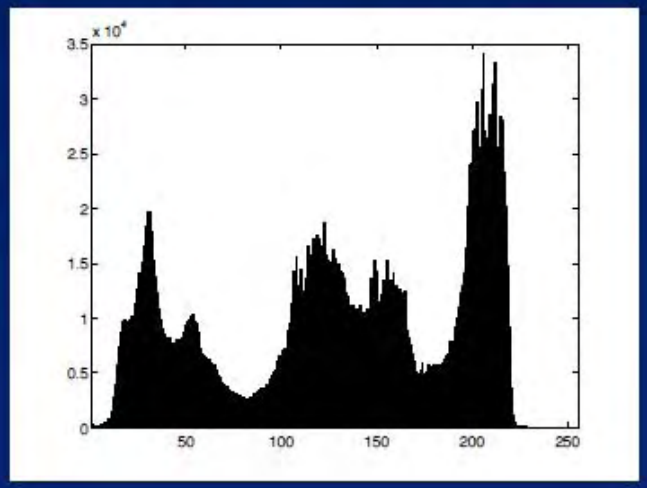
From Lalonde and Efros, ICCV'2007

Blur

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

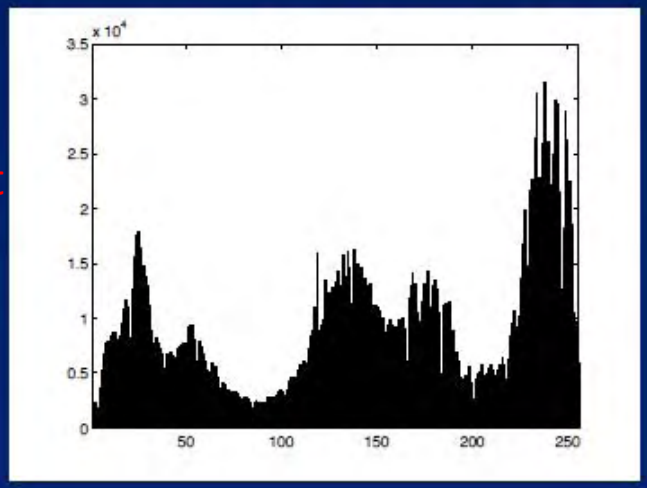
Prof photos should have some part of photo in sharp focus

Low Level Features - Contrast

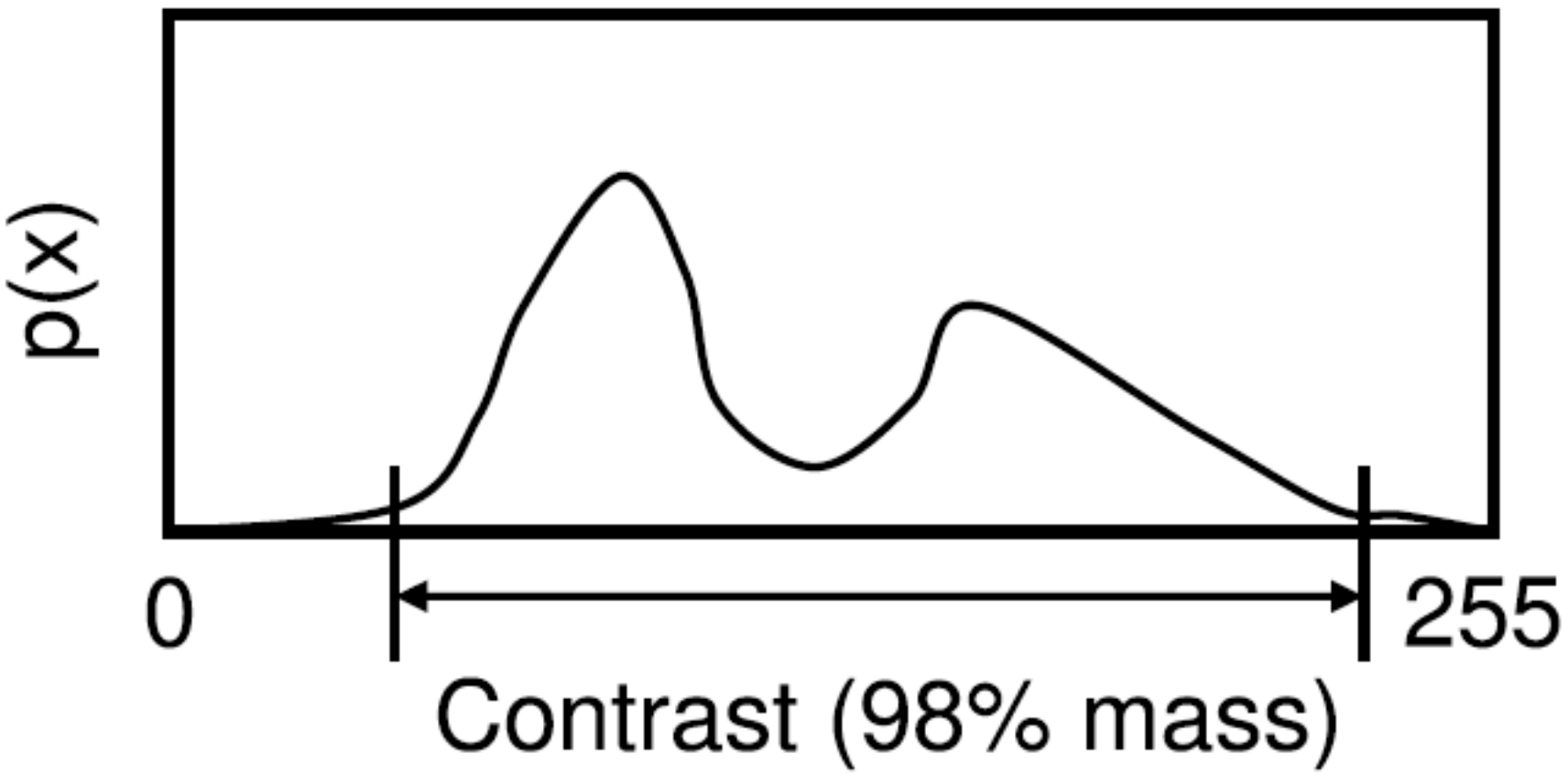


Prof photos usually have higher contrast

Contrast = width of middle 98% mass of hist



Contrast



Low Level Features – Avg. Brightness

Professional photographers may adjust exposure to be correct on subject only so subj pops from bkd. Cameras tend to adjust brightness to average at 50% gray, but prof photos might deviate significantly. Use ave brightness as feature.

Classifier

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

Outline

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Dataset – DPChallenge.com

Use photos average rating as ground truth quality measure

Use only top 10%, bottom 10% as dataset.

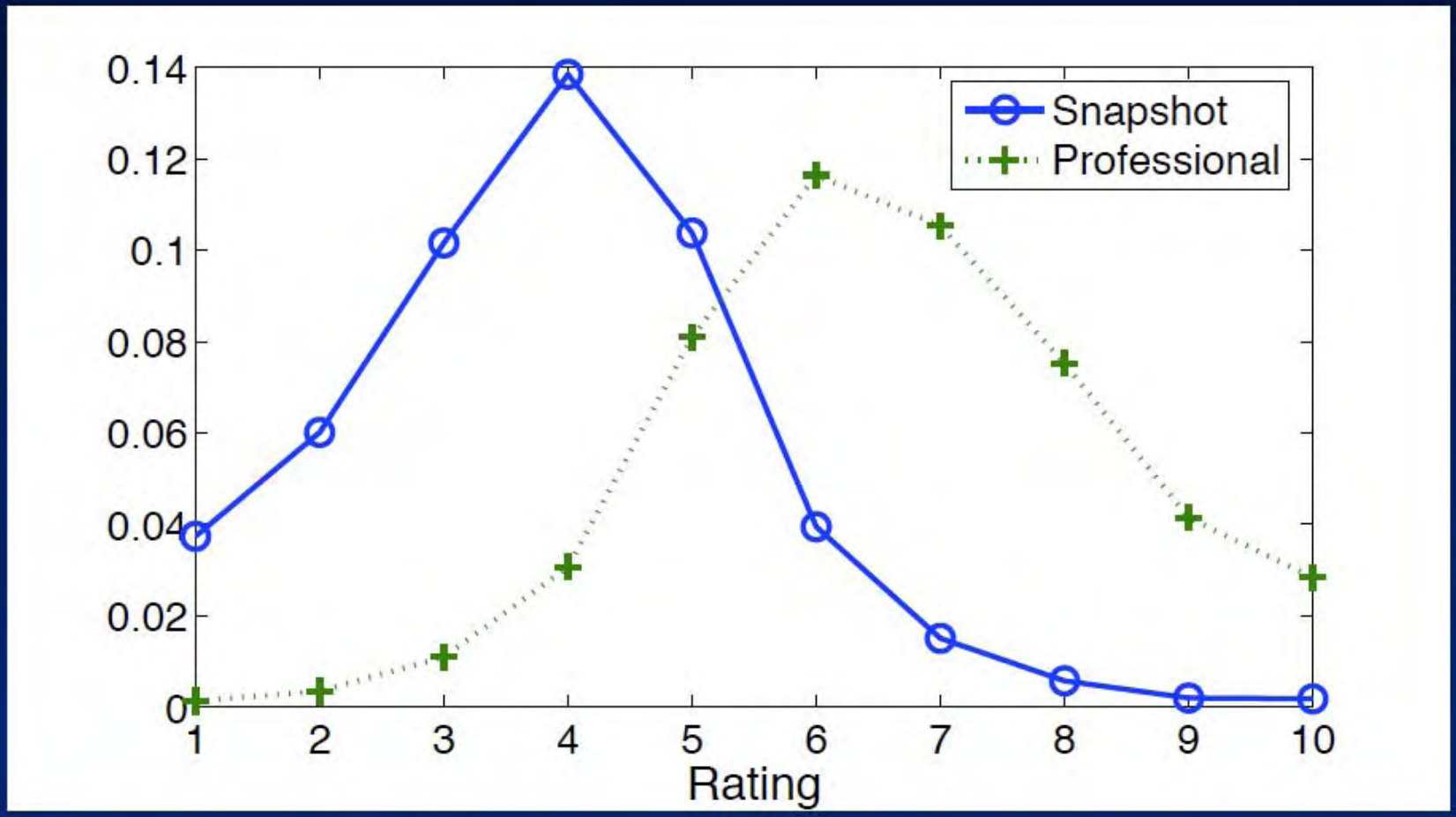
Use half for training/half for testing.

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!	

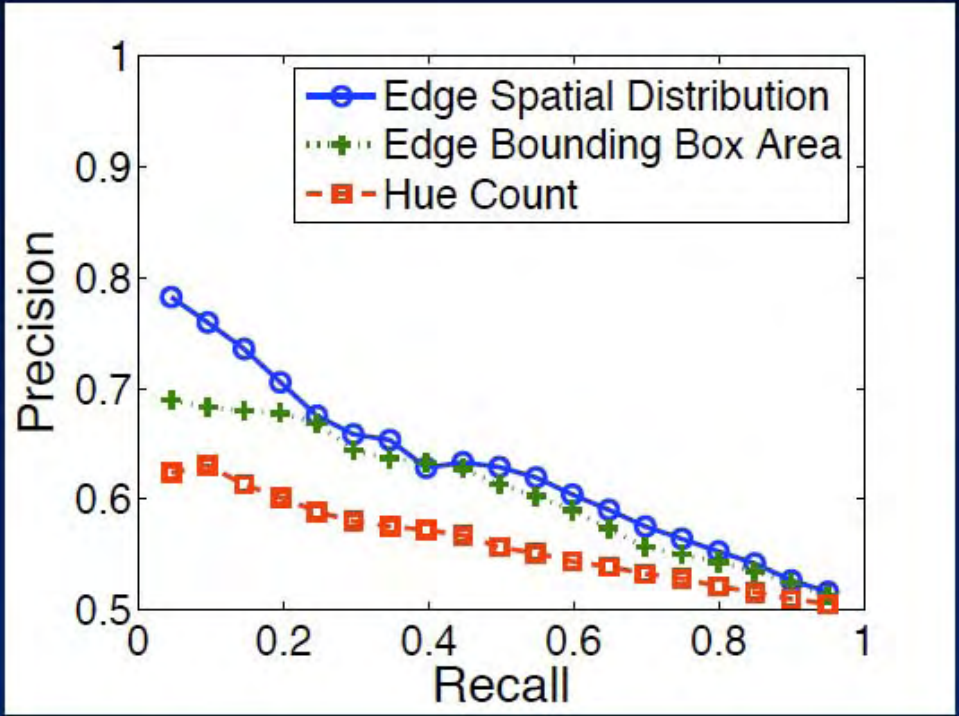
Photo contest website, user rated

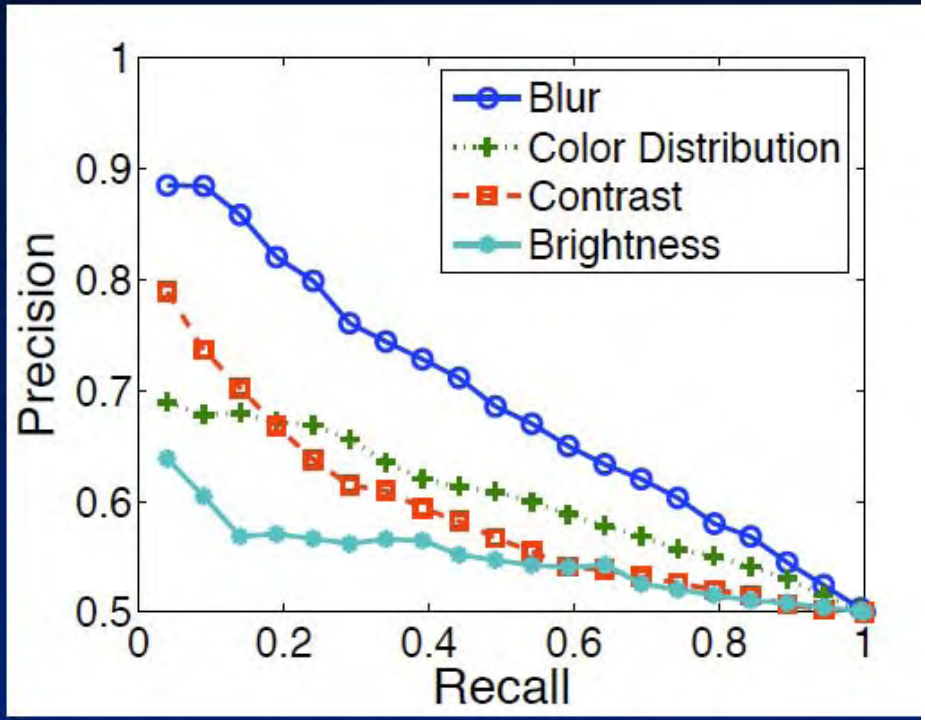
60K photos
40K photographers
10/90 percentile

Difficulty of Dataset



Results





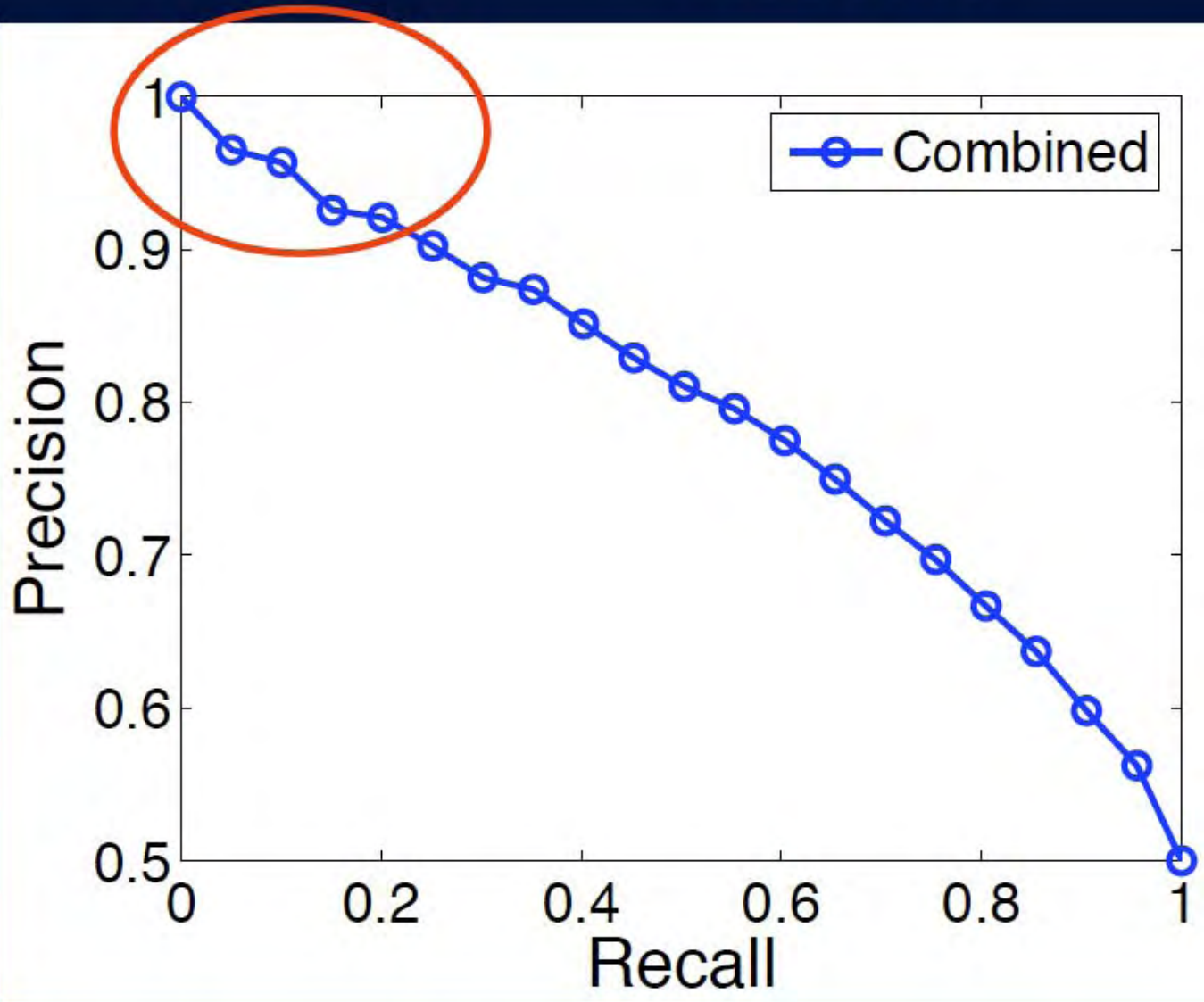
$$recall = \frac{\#\ professional\ photos\ above\ threshold}{total\ \#\ professional\ photos}$$

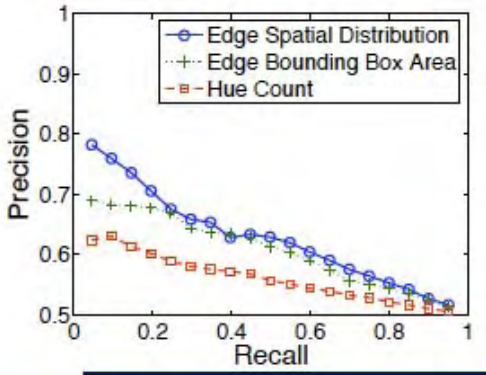
$$precision = \frac{\#\ professional\ photos\ above\ threshold}{\#\ photos\ above\ threshold}.$$

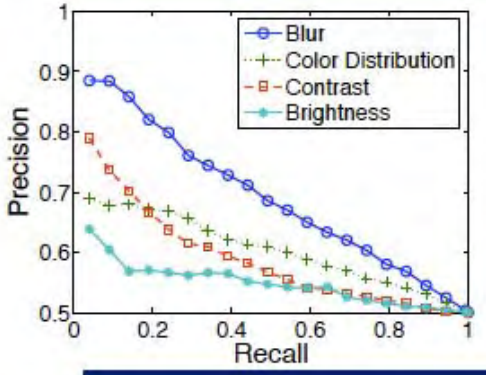
Most Distinctive Feature: Blur

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

Results







72% classification rate

Web Retrieval Results



...



Web Retrieval Results



...



Web Retrieval Results

Wrap Up

© Robert Brown

Looking back…

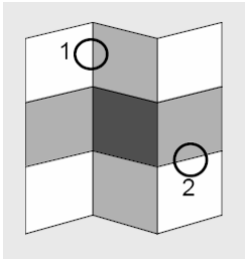
1. Why we were here?
2. What did we learn?
3. How is this useful?

Our Goal: The Plenoptic Function

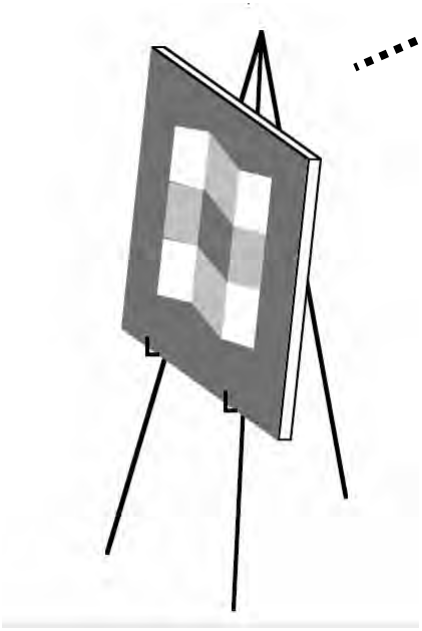
Figure by Leonard McMillan

Our Tools: The “Theatre Workshop” Metaphor

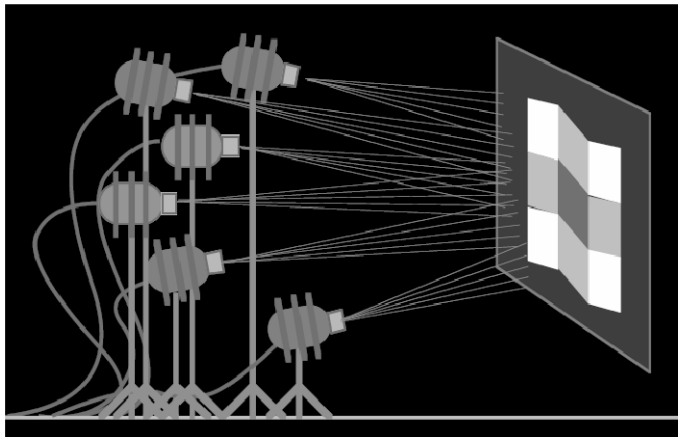
(Adelson & Pentland,1996)



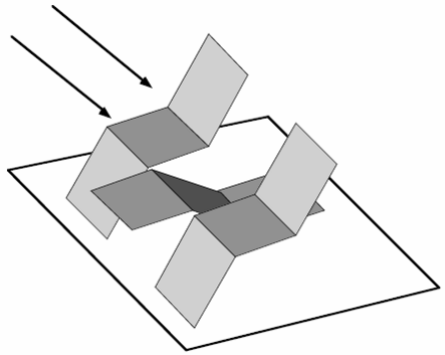
desired image



Painter

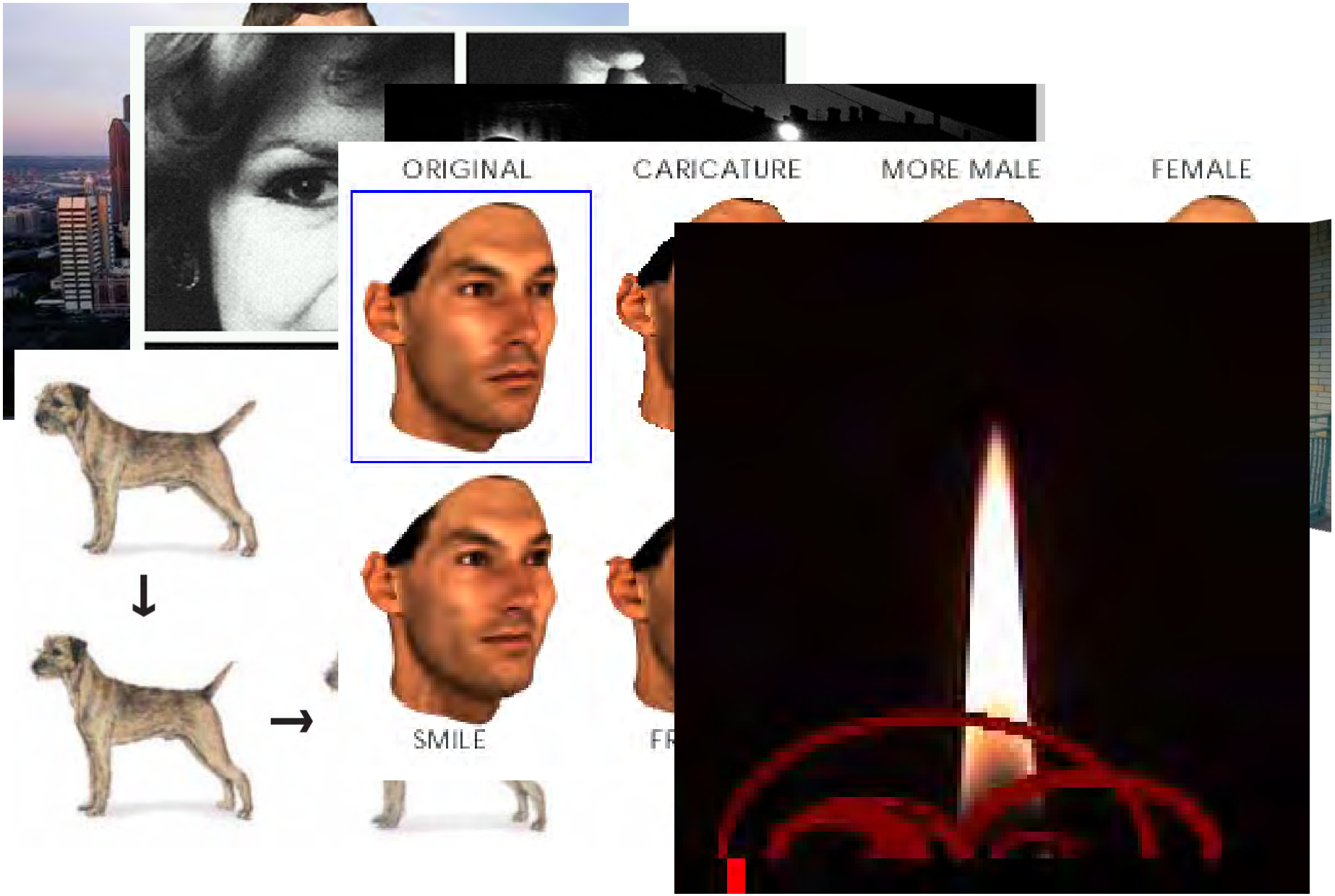


Lighting Designer

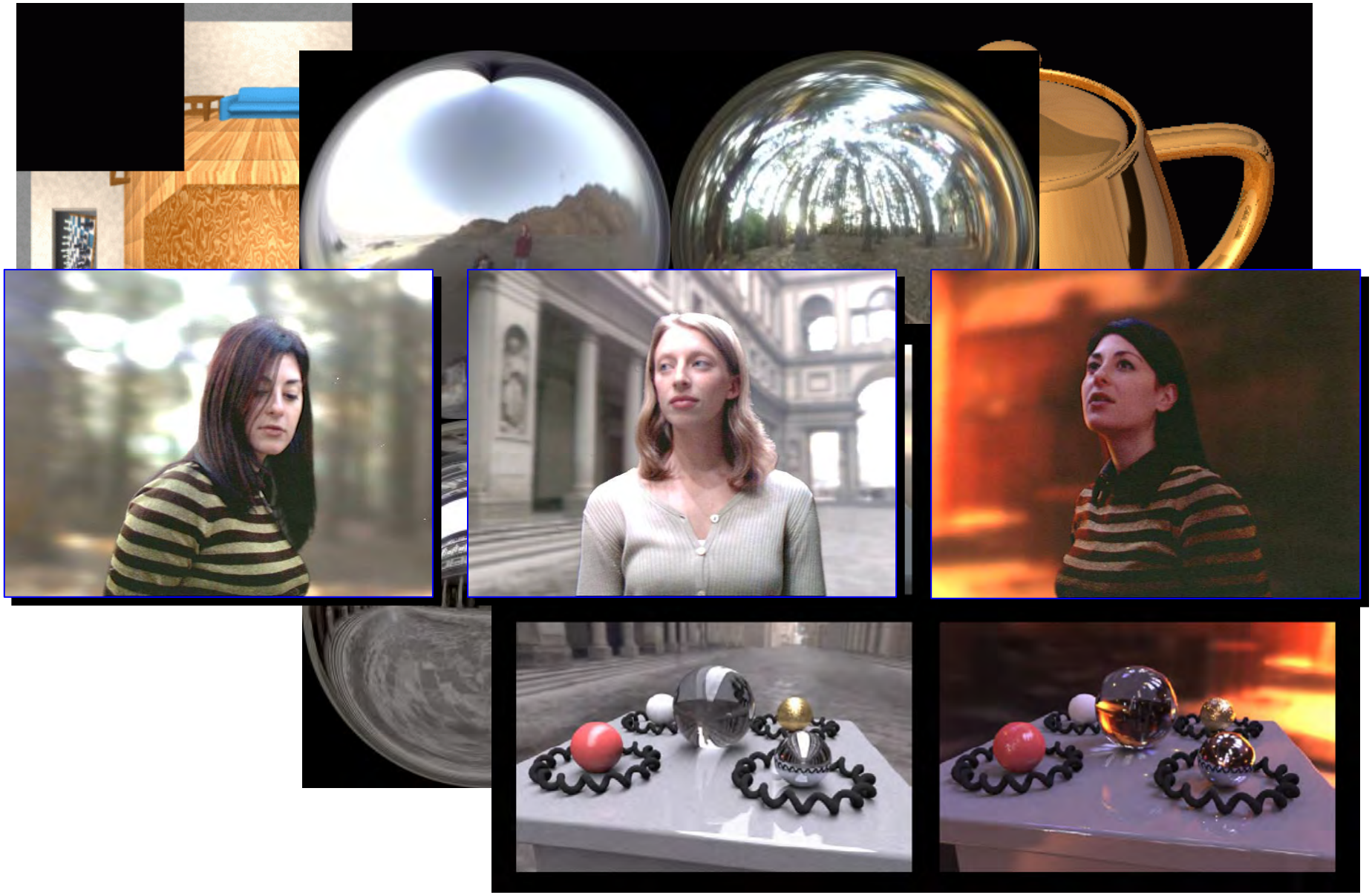


Sheet-metal worker

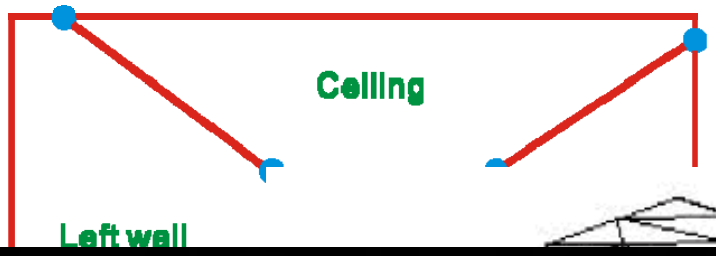
Painter (images)

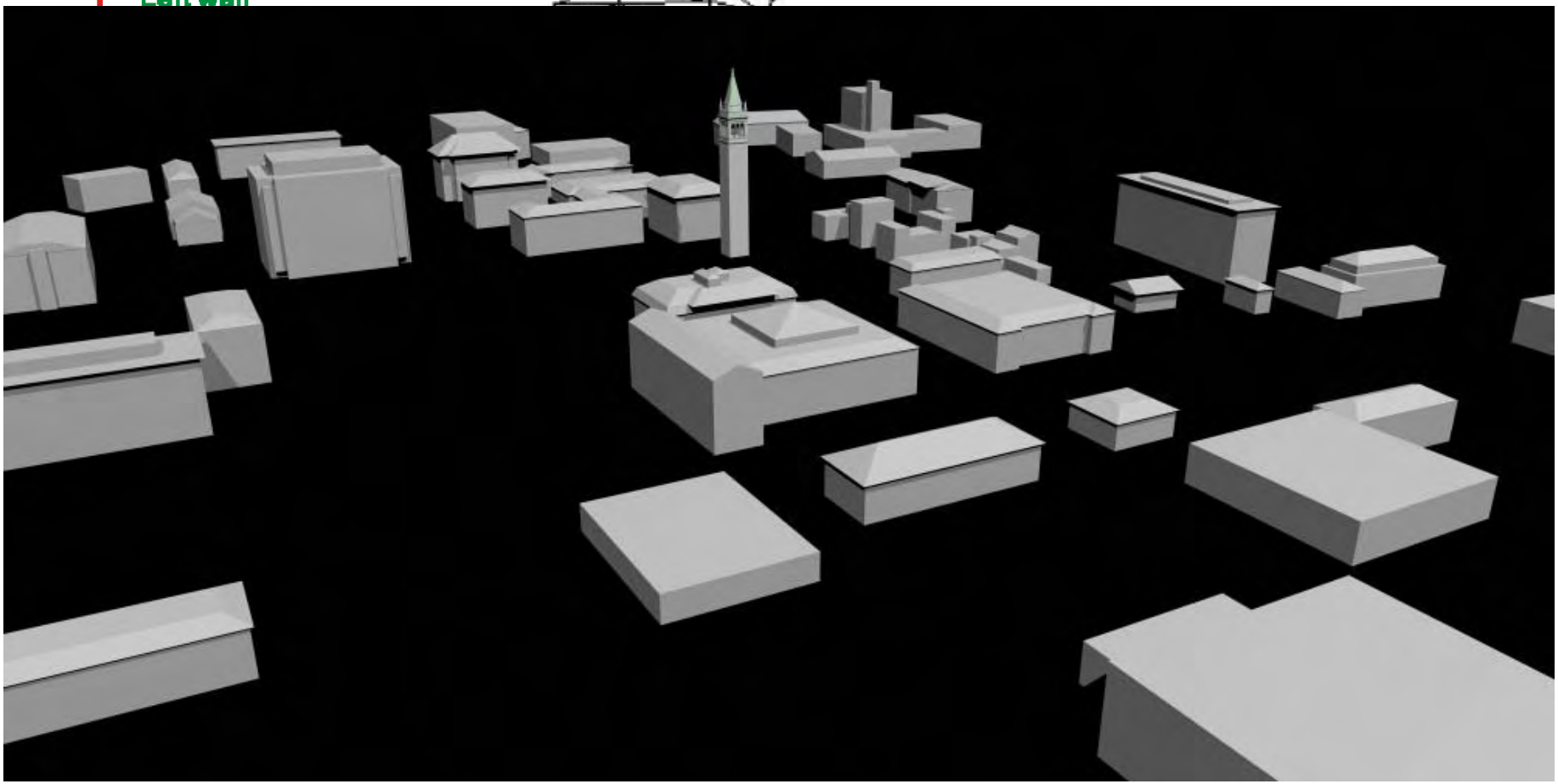


Lighting Designer (environment maps)



Sheet-metal Worker (geometry)





… working together

How is this useful?

1. You learned a basic set of image-based techniques
   - All quite simple
   - Most can be done “at home”
2. You have your digital camera
3. You have your imagination

Go off and explore!

THANK YOU!