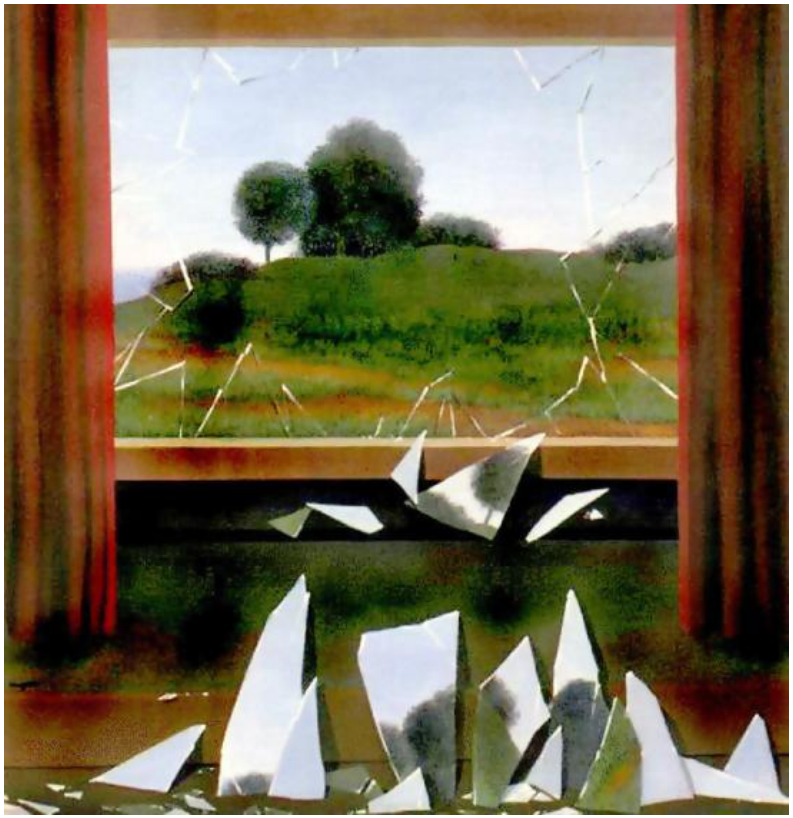
Computational Photography
CS498dh



Derek Hoiem

Kevin Karsch (TA)

Today's Class

- A little about me
- Intro to Computational Photography
- Course outline and logistics
- A little about you

About me

2005-2009
Undergrad at the University of Missouri
B.S., Math and CS

2009-
Grad at UIUC
Ph.D. in computer vision/graphics

Microsoft Research

2010-2012
MSR, Adobe Research
Intern

LEMELSON·MIT

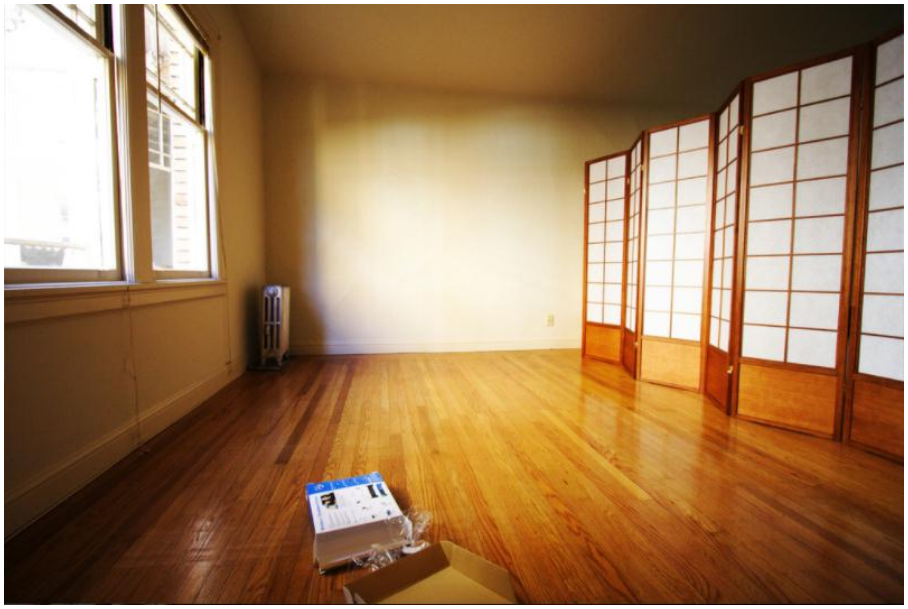
2012 Lemelson-MIT Student Prize Winner

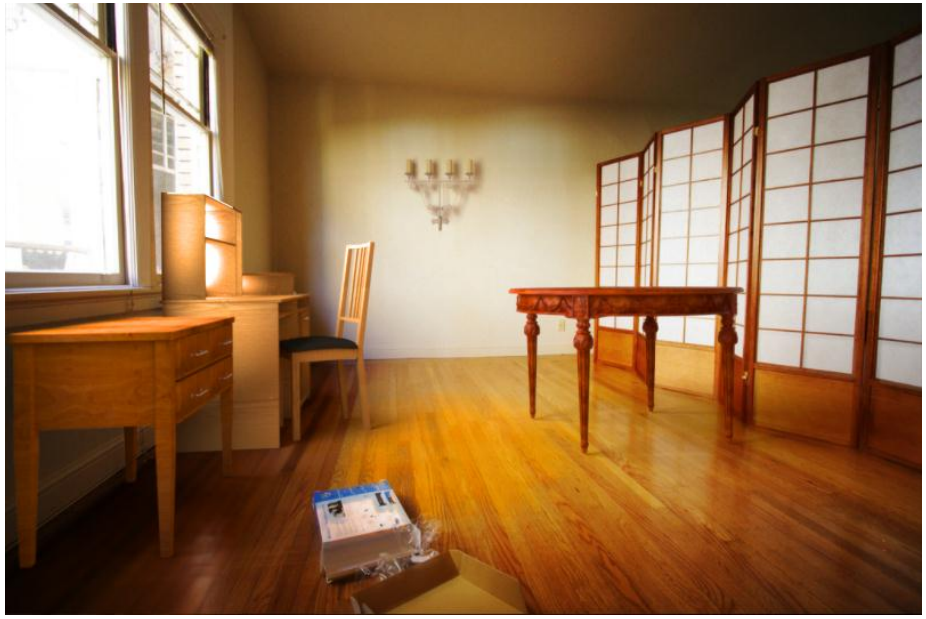
Lemelson-MIT UIUC Student Prize

http://www.tec.illinois.edu/30kprize

My Research

Editing images as if they were 3D scenes



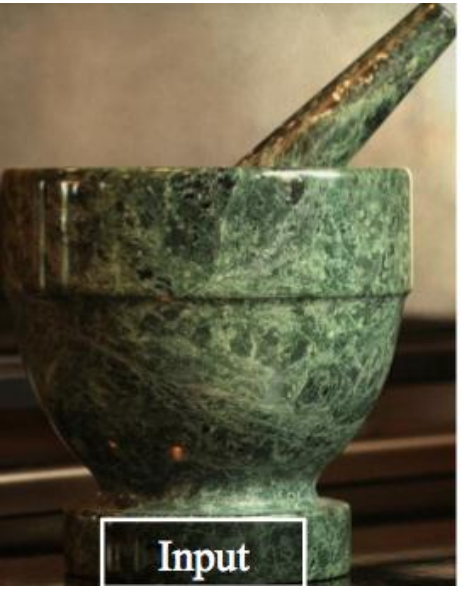


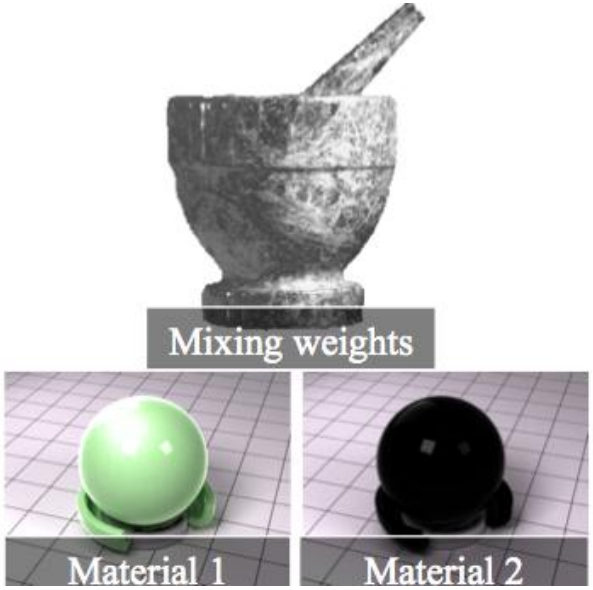

GOLFER

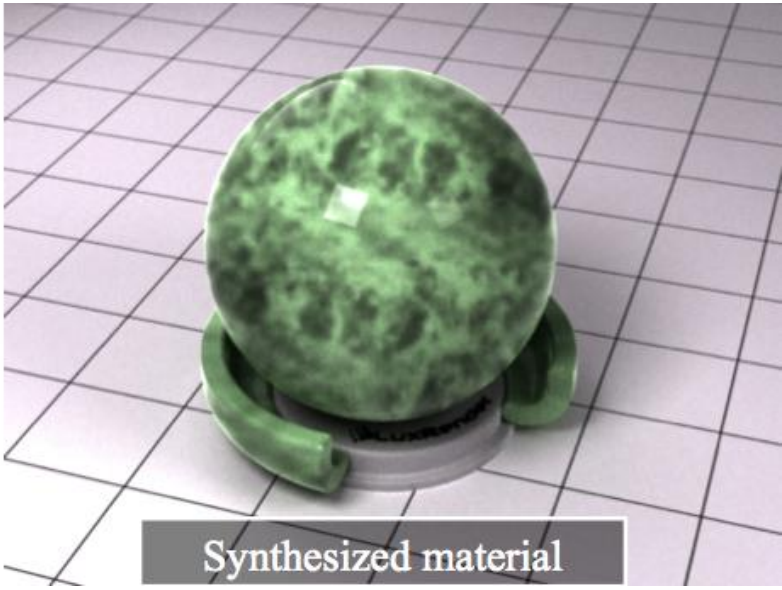

GOLFER

My Research

Material estimation







My Research

Depth / geometry estimation

Some background to computational photography and …

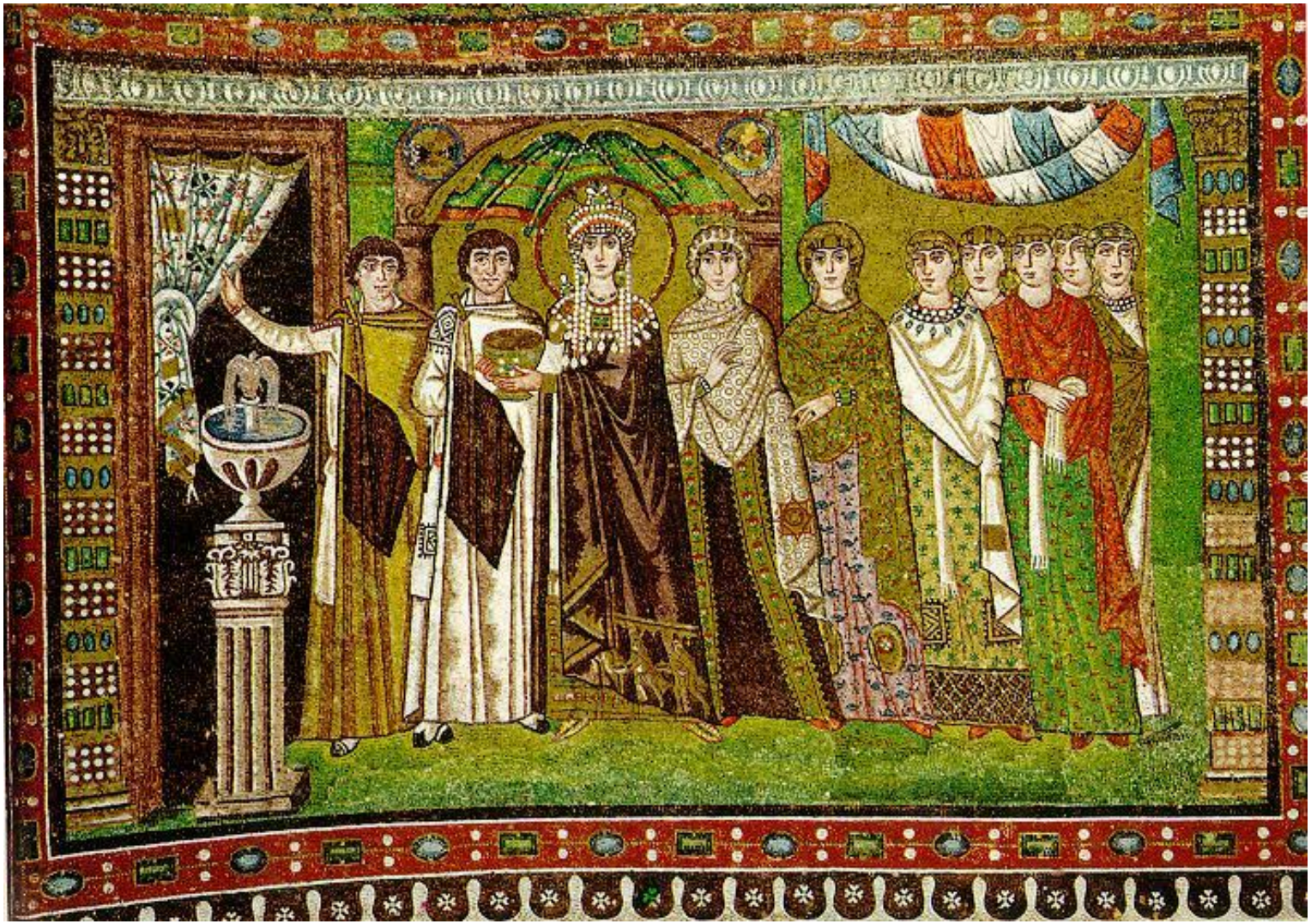
The Pursuit of Realism

Several of following slides from Alyosha Efros

Depicting Our World: The Beginning

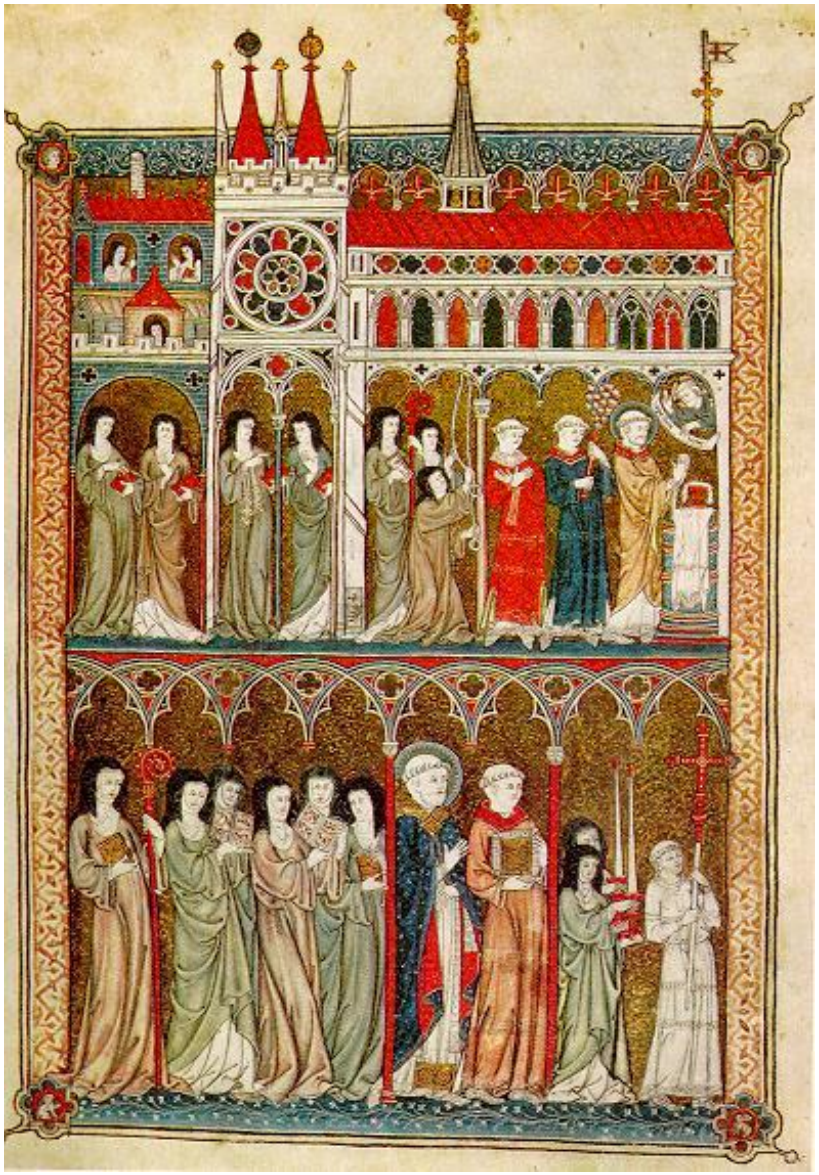
Prehistoric Painting, Lascaux Cave, France
~ 15,000 B.C.

Depicting Our World: Middle Ages



The Empress Theodora with her court.
Ravenna, St. Vitale 6th c.

Depicting Our World: Middle Ages



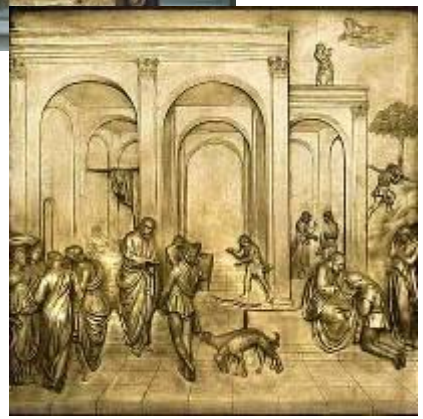
Nuns in Procession. French ms. ca. 1300.

Depicting Our World: Renaissance

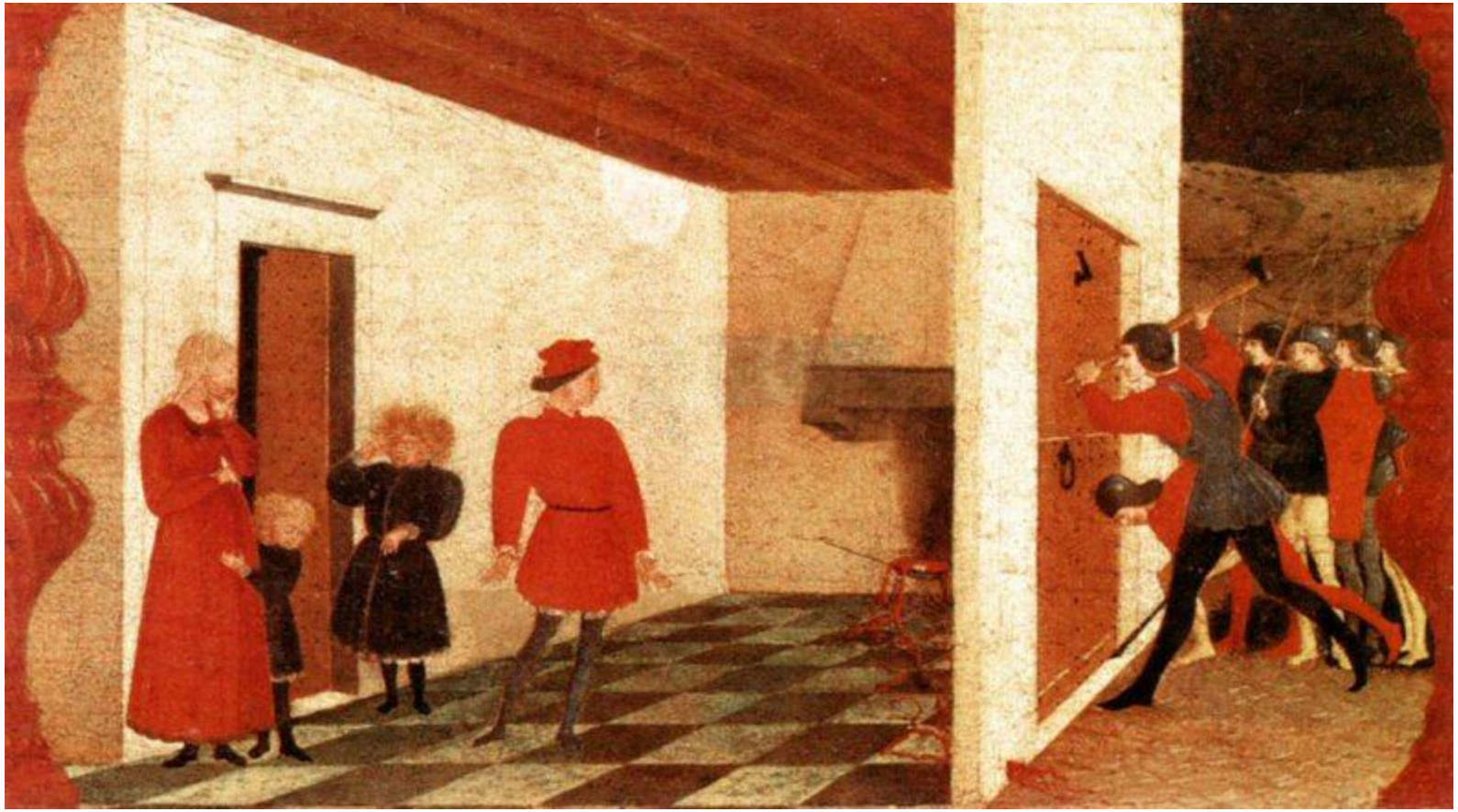
North Doors (1424)

Lorenzo Ghiberti (1378-1455)

East Doors (1452)



Depicting Our World: Renaissance

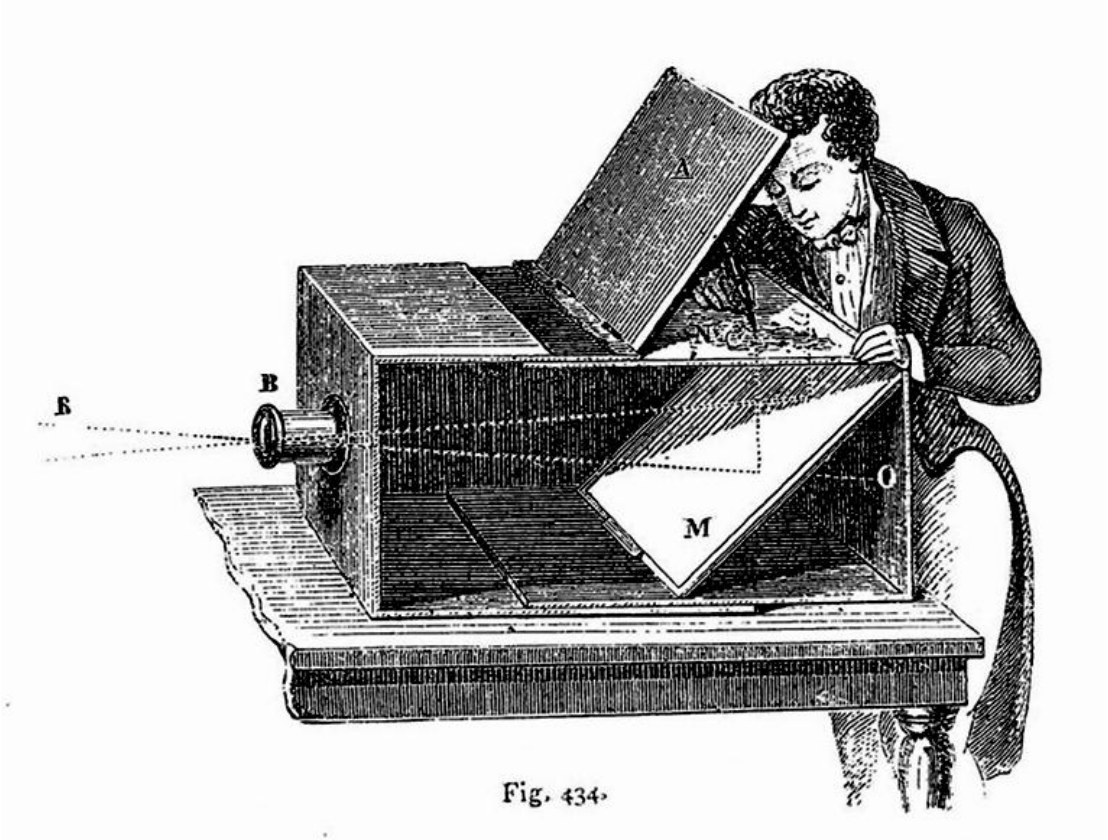


Paolo Uccello,
Miracle of the Profaned Host (c.1467-9)

Depicting Our World: Toward Perfection

Jan van Eyck, *The Arnolfini Portrait (1426-1434)*

Depicting Our World: Toward Perfection



Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

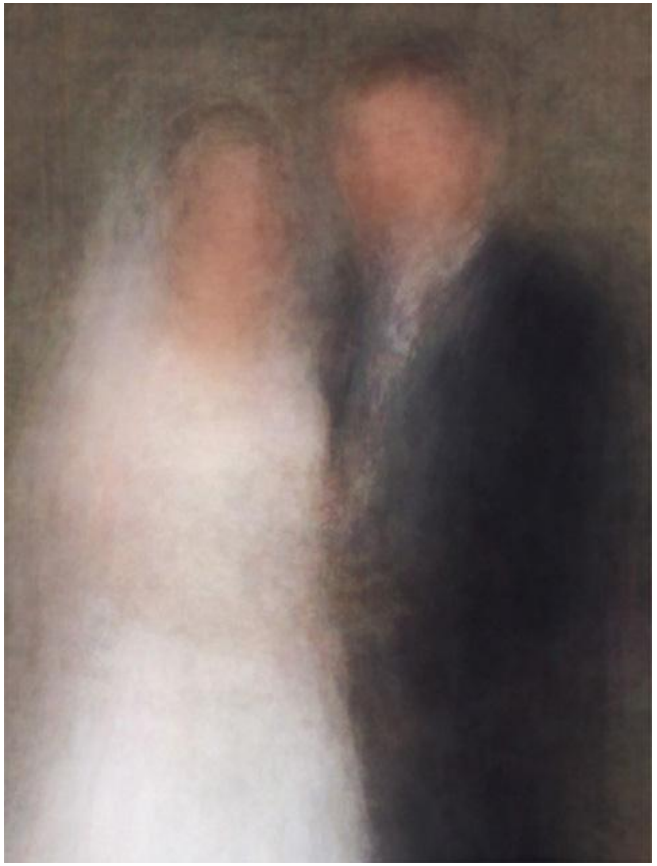
Your own camera obscura?

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

But is a photo really realistic?

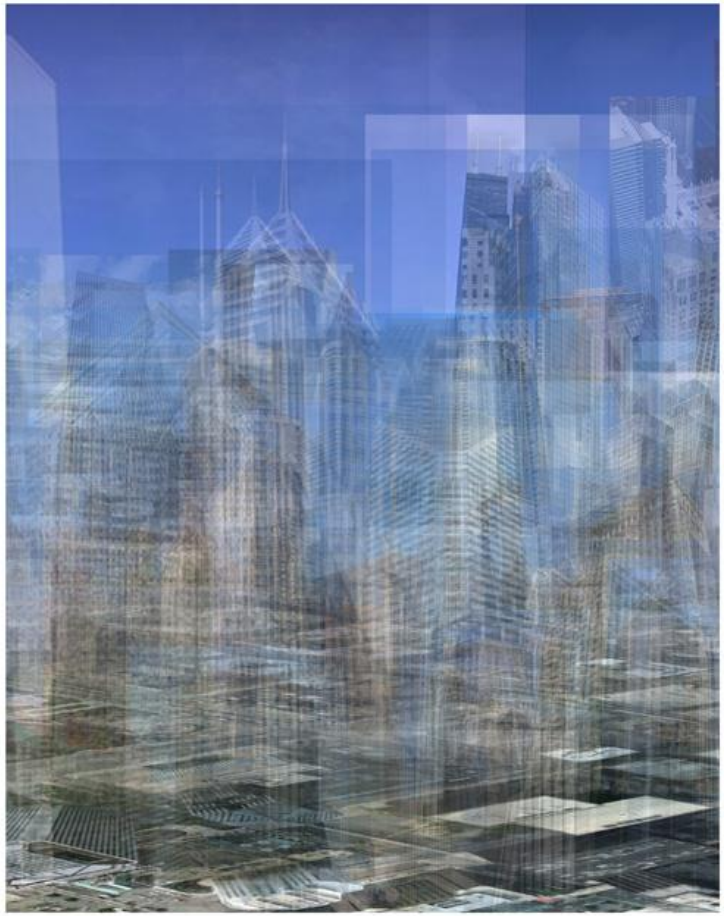
Is reality what we want?



Newlyweds

http://salavon.com

Better than realism?

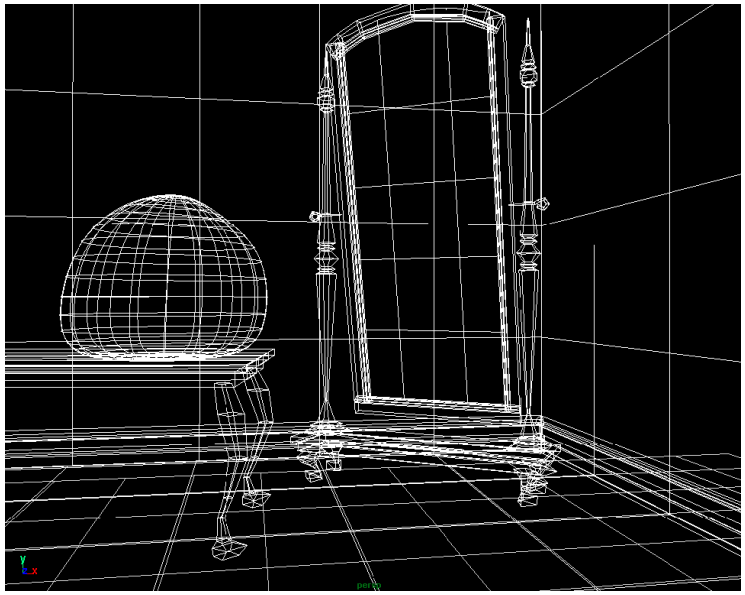


City (westward)

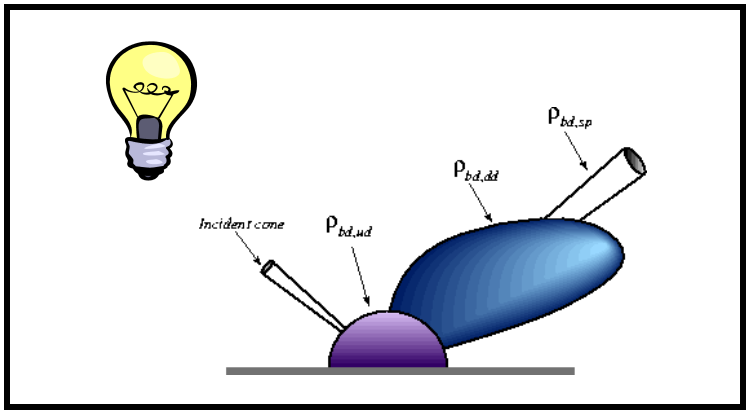
http://salavon.com

Enter Computer Graphics...

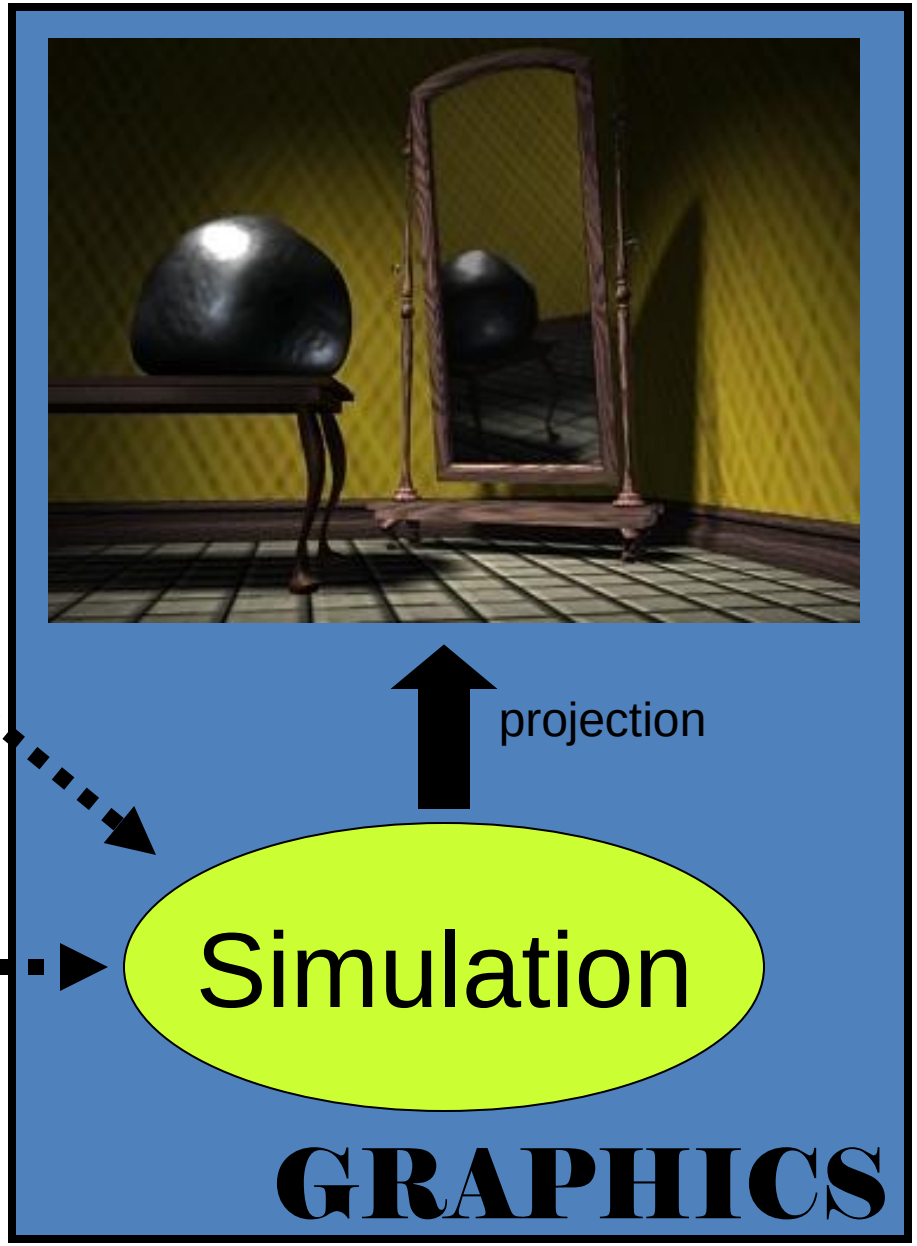
Traditional Computer Graphics



3D geometry



physics



Computer graphics

What's wrong?

The richness of our everyday world

Photo by Svetlana Lazebnik

Which parts are hard to model?

Photo by Svetlana Lazebnik

People

From “Final Fantasy”

Alyosha Efros - On the Tube, London

Faces / Hair

From “Final Fantasy”

Photo by Joaquin Rosales Gomez

Urban Scenes

Virtual LA (SGI)

Photo of l LA

Nature

River Cherwell, Oxford

The Realism Spectrum

Computer Graphics

+ easy to create new worlds

+ easy to manipulate objects/viewpoint

- very hard to look realistic

Computational Photography

Realism
Manipulation
Ease of capture

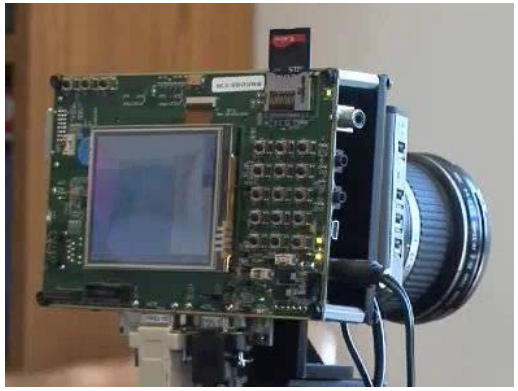
Photography

+ instantly realistic

+ easy to aquire

- very hard to manipulate objects/viewpoint

Computational Photography



How can I use computational techniques to capture light in new ways?

How can I use computational techniques to breathe new life into the photograph?

How can I use computational techniques to synthesize and organize photo collections?

Virtual Real World

Campanile Movie (1997)

http://www.debevec.org/Campanile/

Going beyond reality…

Benjamin Button (2008)

http://digitaldomain.com/projects/8/

Course outline

Prof: Derek Hoiem (dhoiem@illlinois.edu), SC 3312

TA: Kevin Karsch (karsch1@illinois.edu), SC 3238A

Web page:

http://courses.engr.illinois.edu/cs498dh3/

Course objectives

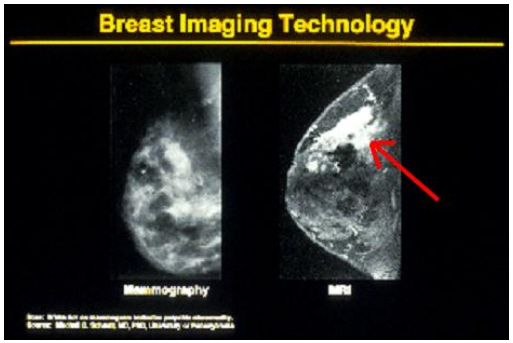
1. You will have new abilities for visual creation.

Graphic by James Hays

Course objectives

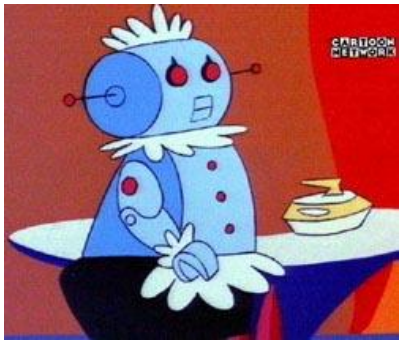
2. You will get a foundation in computer vision.

Safety



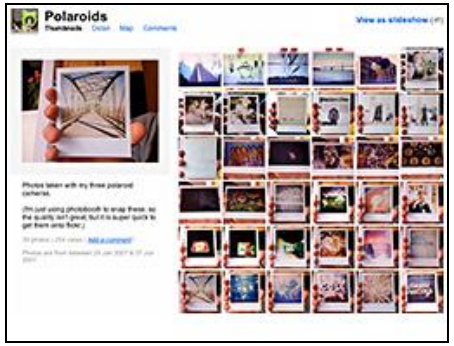
Health

Security



Comfort

Fun



Access

Got job?

- Google, Facebook, Microsoft, Sony, iRobot, Amazon A9, tons of startups, etc.

- http://www.cs.ubc.ca/~lowe/vision.html

Course objectives

3. You'll better appreciate your own visual ability.

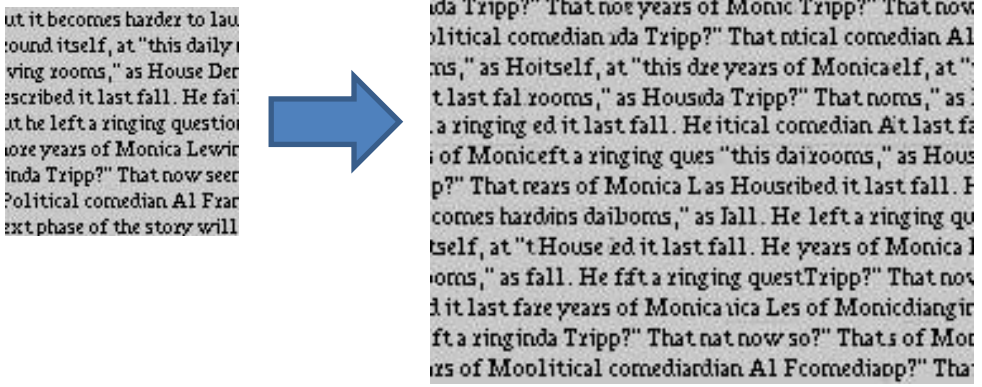
Course objectives

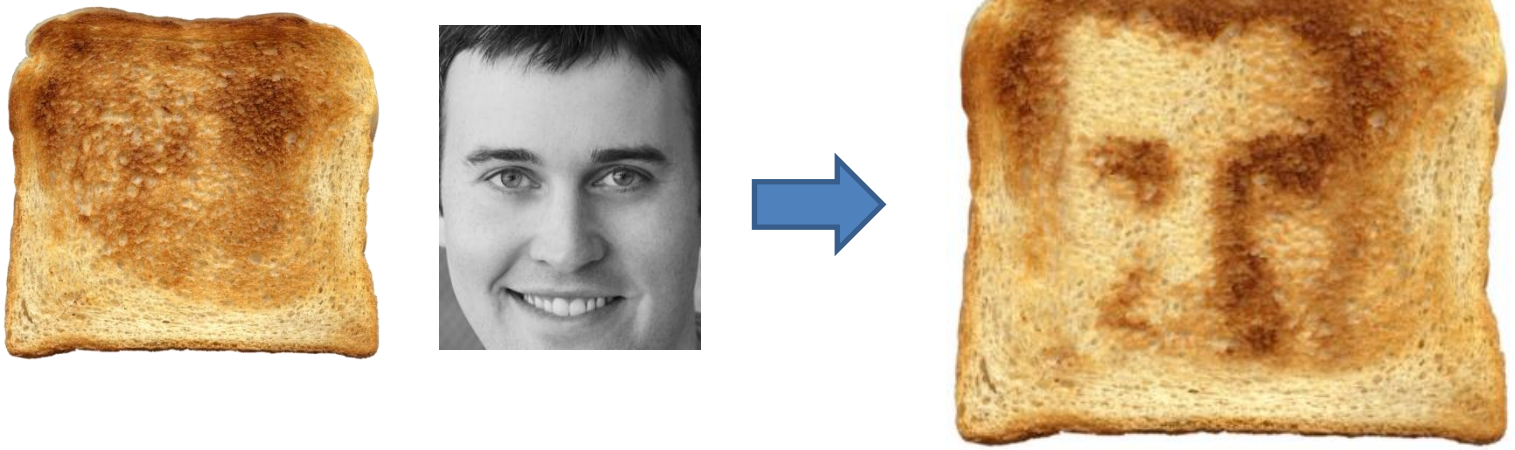
4. You'll have fun doing cool stuff!

Projects

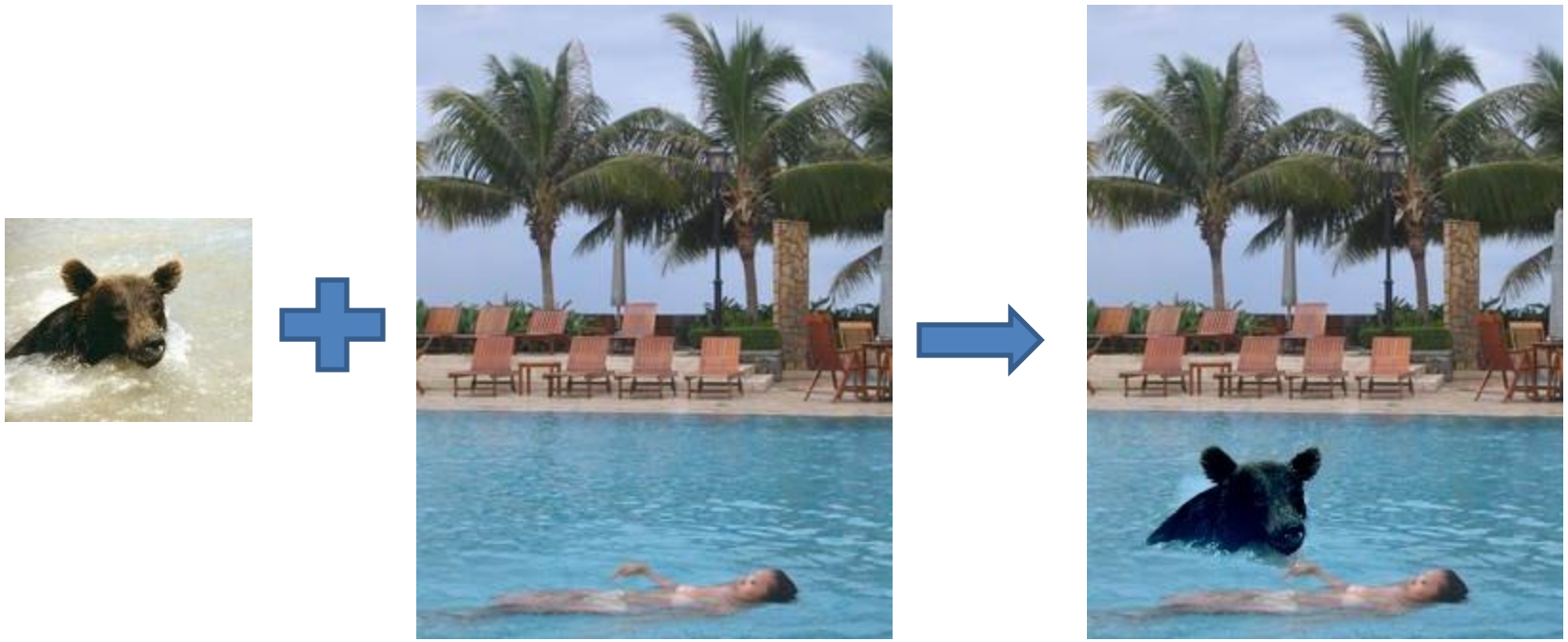
Project 1: Hybrid Images

Project 2: Image Quilting for Texture Synthesis and Transfer



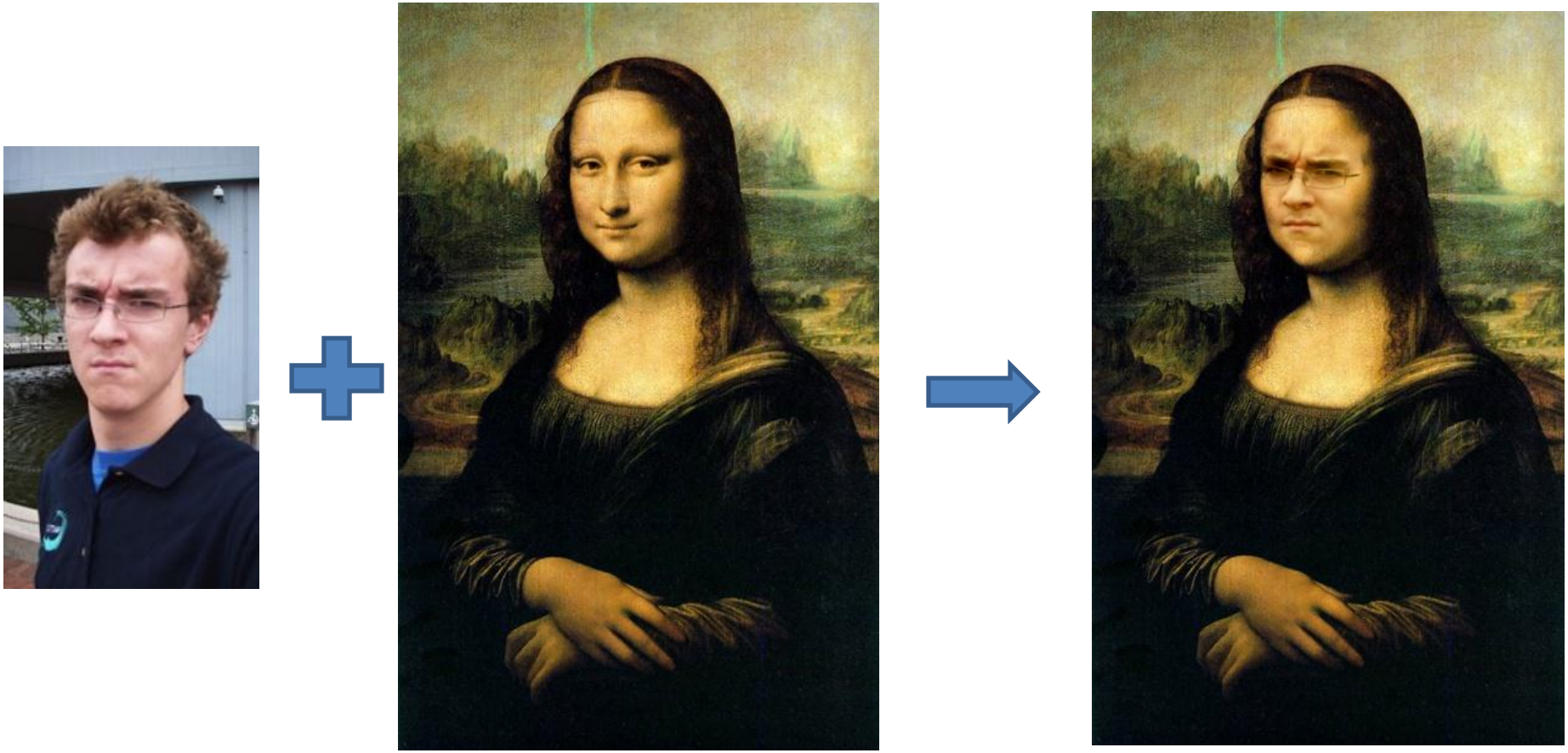


Project 3: Poisson Editing



Photos from James Hays

Project 3: Poisson Editing

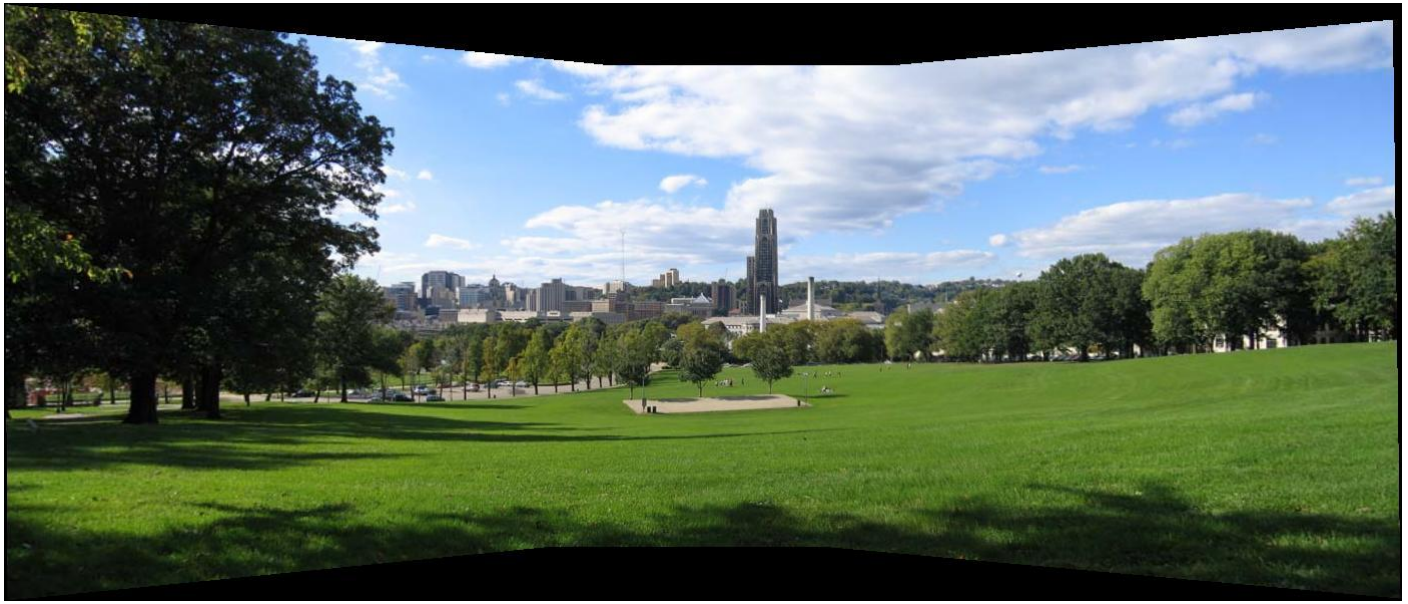


Photos from Evan Wallace

Project 4: Image-Based Lighting

Project 5: Automatic Photo Stitching



Final Project

Something cool!

Project details

- Implement stuff from scratch and apply it to your own photos
- Reporting via web page (plus e-mail code)
- Afterwards, vote for class favorite(s)!
- Software/hardware
  - Matlab!
  - Machines available in EWS labs

Getting help outside of class

Office hours

- TBA: http://www.doodle.com/e9hzmy65k2icdi64

Matlab + linear algebra tutorial

- TBA: http://www.doodle.com/f7bien4sadwfvz64

Discussion board:

- http://groups.google.com/group/cs498-cp-uiuc

Readings/textbook

Grades

- Written and programming assignments (60%)
  - Core projects worth total of 500 points, “bells and whistles” for additional points
  - Undergrads graded out of 525, grads out of 600
- Exam (20%)
- Final Project (20%)
- Participation

Late policy

- Up to five free days total – use them wisely!
- 10 points per day after that

Academic Integrity

- Can discuss projects, but don’t share code
- Don’t look up code (even to get hints) or copy from a friend
- If you’re not sure if it’s allowed, ask
- Acknowledge any inspirations
- If you get stuck, come talk to me

Other comments

Prerequisites

- **Linear algebra**, plus some basic calculus and probability
- Experience with graphics, image processing, or Matlab will help but is not necessary

Your own camera

- Strongly recommended – can get decent cameras for reasonable $$$, e.g., Canon A1300 ($100)
- Pro camera apps for smartphones

Feedback is welcome

Introduce yourselves

Final comments

- Reasons to not take the course…
- To do now
  - Please fill out the feed-forward forms
  - Any Q's or concerns, come talk to me!
- To do later
  - Look over syllabus, etc.
  - Sign up for discussion group
- Next class: pixels and basic filtering