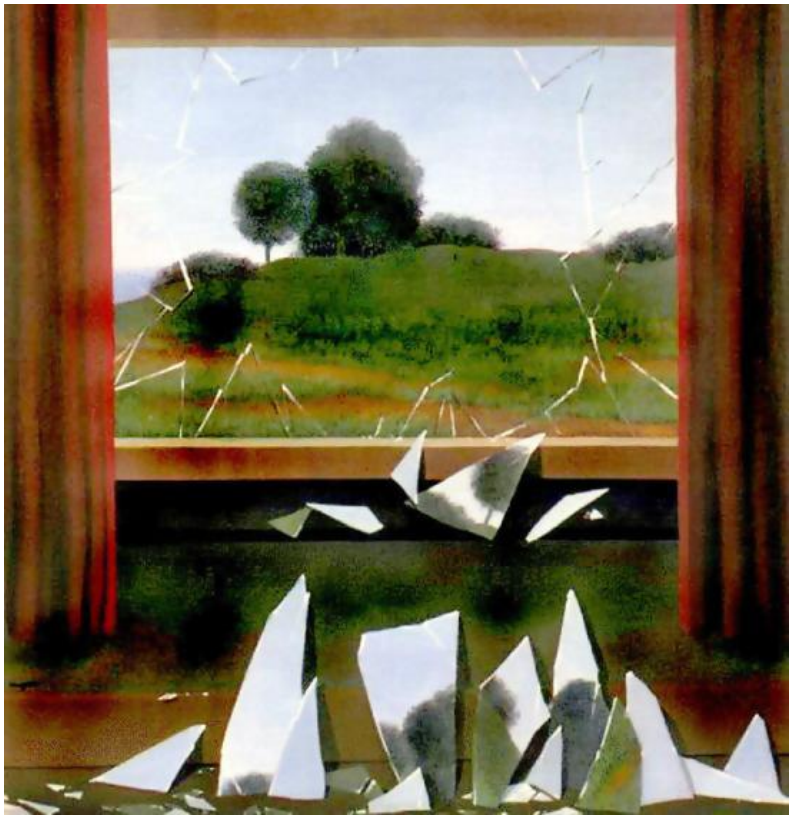
Computational Photography
CS445



Derek Hoiem (instructor)

Daeyun Shin, Mariya Vasileva (TAs)

Today's Class

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

About me

Raised in “upstate” NY

About me

1998-2002
Undergrad at SUNY Buffalo
B.S., EE and CSE

2002-2007
Grad at Carnegie Mellon
Ph.D. in Robotics

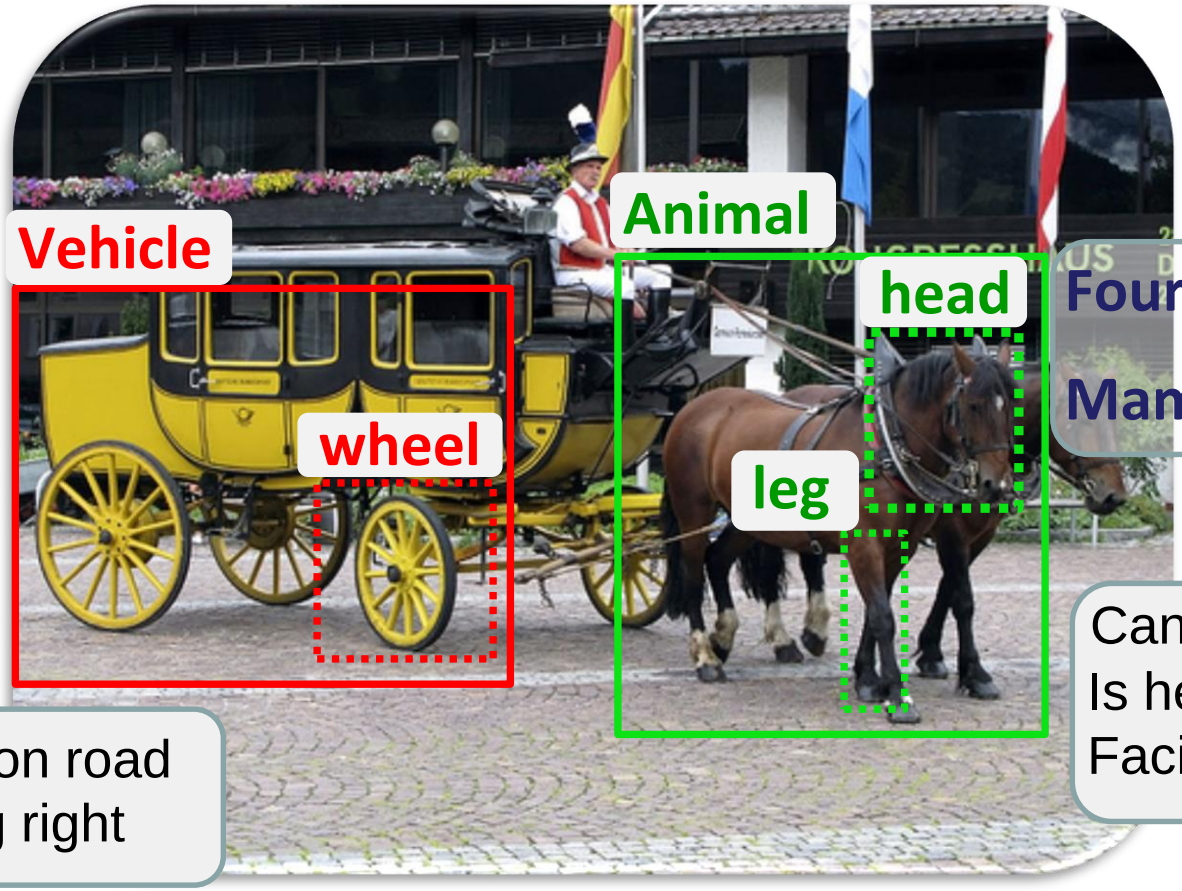
2007-2008
Postdoc at Beckman Institute

2009-
Asst/Assoc Prof in CS at UIUC

My new baby Isla (born last Monday)

My research

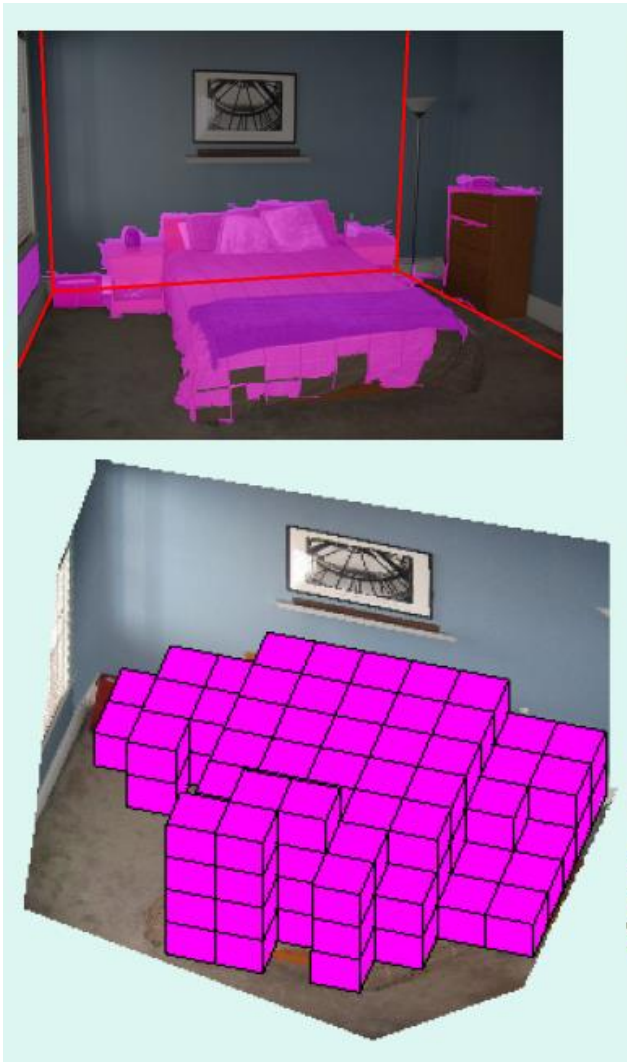
My Research

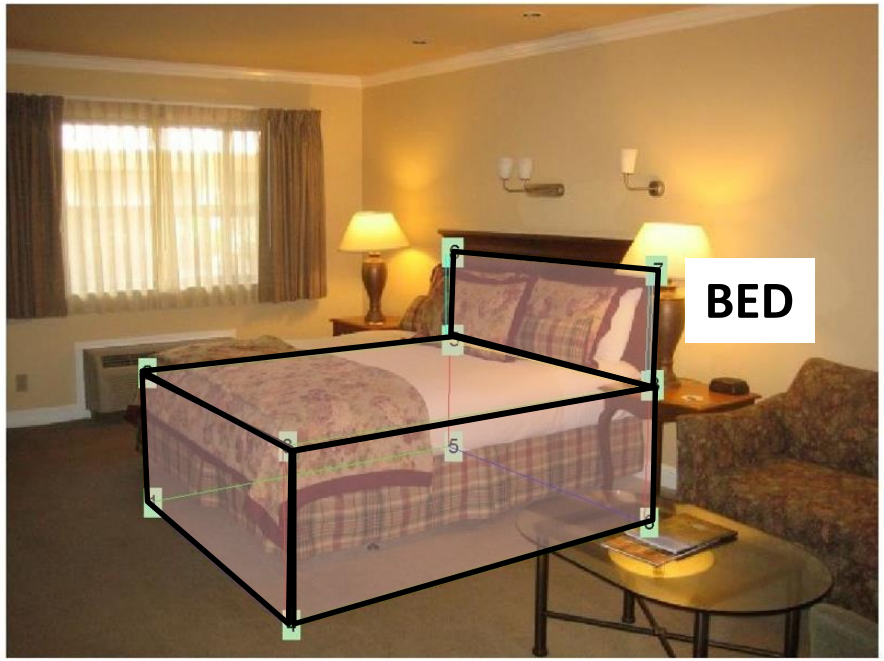


Farhadi et al. 2010

My Research

Recovering 3D layout and context



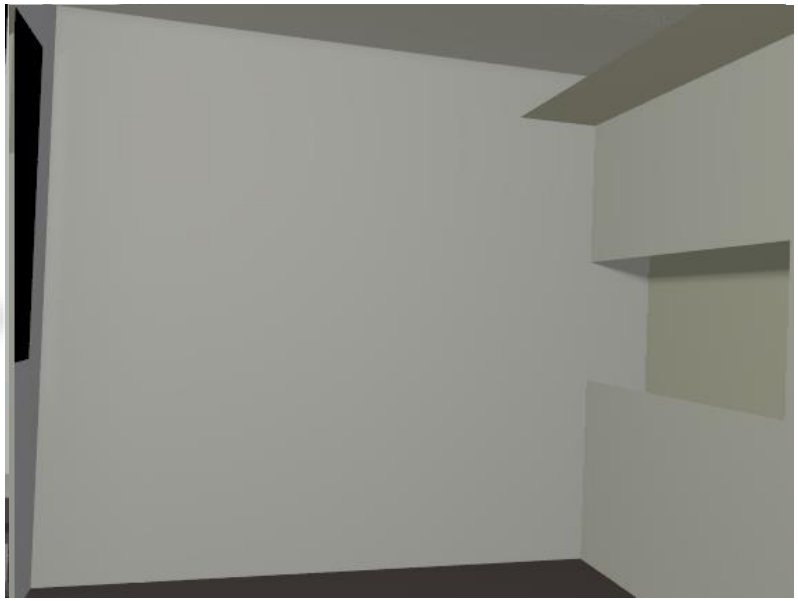


Hedau et al. 2009, 2010

My Research

3D scene model from RGB+D image

RGBD Image

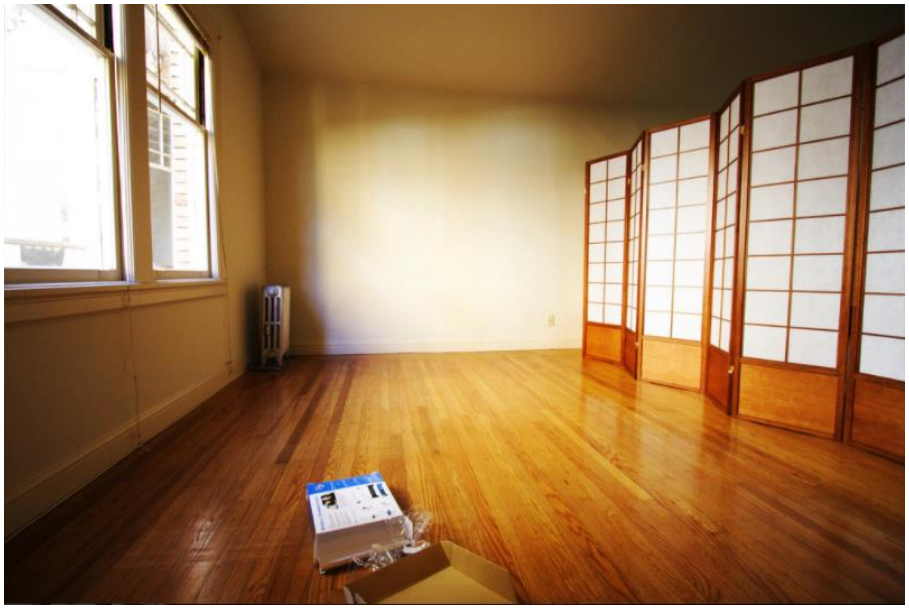


3D Model

Guo and Hoiem, unpublished

My Research

Editing images as if they were 3D scenes



Karsch et al. 2011


GOLFER


GOLFER

Name: Daeyun Shin *(pronounced day-yoon)*
Email: dshin11@illinois.edu

Education

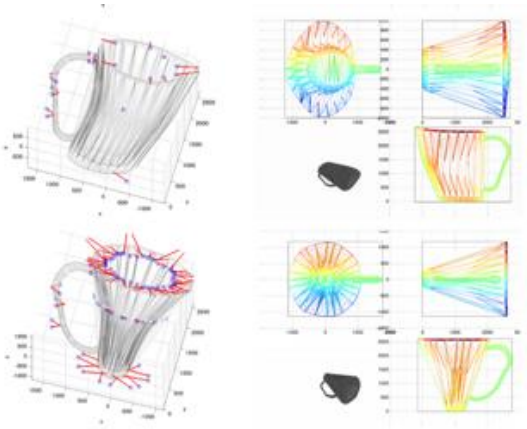
University of Illinois at Urbana-Champaign
B.S. in Computer Science 2011-2015
M.S. in Computer Science 2015-present

Industry Work

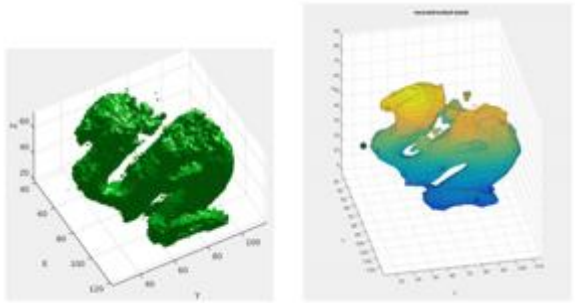
I worked with the Computer Vision team in Amazon.com's Fulfillment Technologies division (Seattle, Summer 2013), Amazon Web Services in Palo Alto, CA (Summer 2014). I was at Google's Pittsburgh office (Display/Video Ads team) this summer.

Research Interests

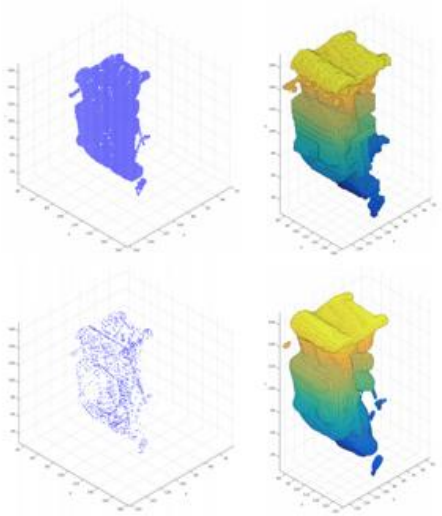
Vision, graphics, machine learning. 3D reconstruction, recognition, retrieval, and narrowing the gap between vision and graphics.



3D deformation



3D shape from images



Mesh from voxels

Name: Mariya Vasileva
Email: mvasile2@illinois.edu

Education

California Institute of Technology
B.S. in Mechanical Engineering 2009-2013

University of Illinois at Urbana-Champaign
M.S. in Applied Mathematics 2014-present
Ph.D. in Computer Science 2014-present

Work Experience

Schlumberger

NASA Jet Propulsion Laboratory
California Institute of Technology

Research Interests

Vision, machine learning, natural language processing.

Object detection and recognition

View interpolation from multiple images

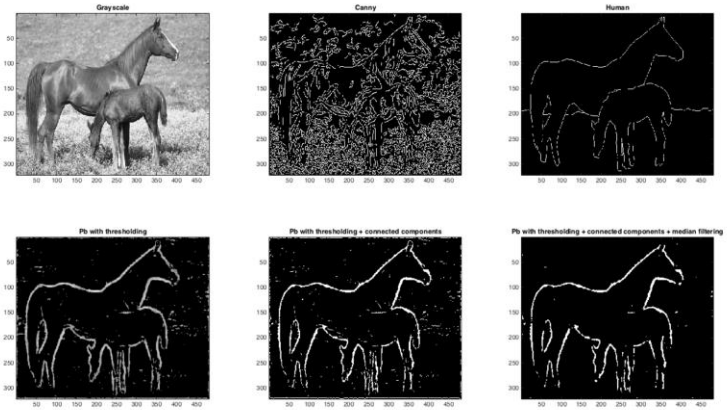


Image segmentation and spatial understanding

Some background to computational photography and …

The Pursuit of Realism

Several of following slides from Alyosha Efros

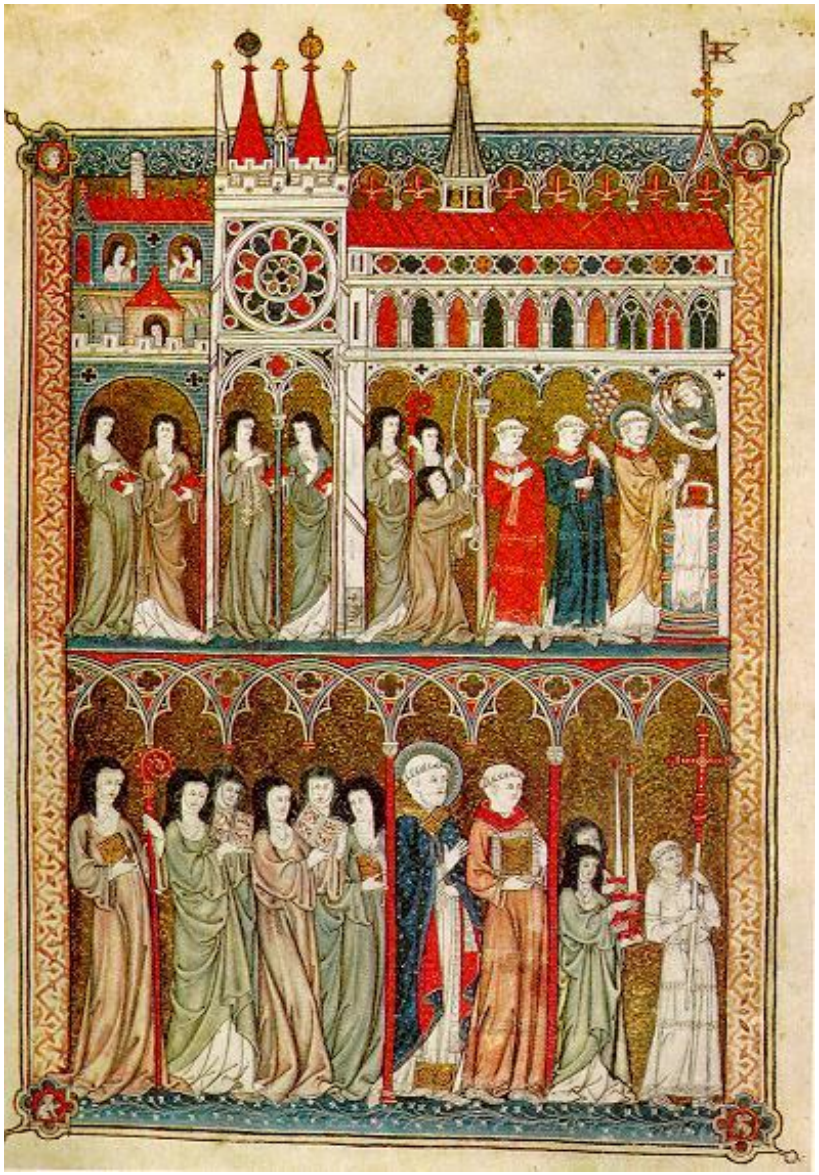
Depicting Our World: The Beginning

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



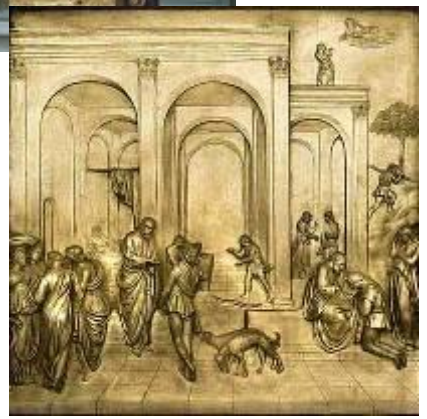
Nuns in Procession. French ms. ca. 1300.

Depicting Our World: Renaissance

North Doors (1424)

Lorenzo Ghiberti (1378-1455)

East Doors (1452)



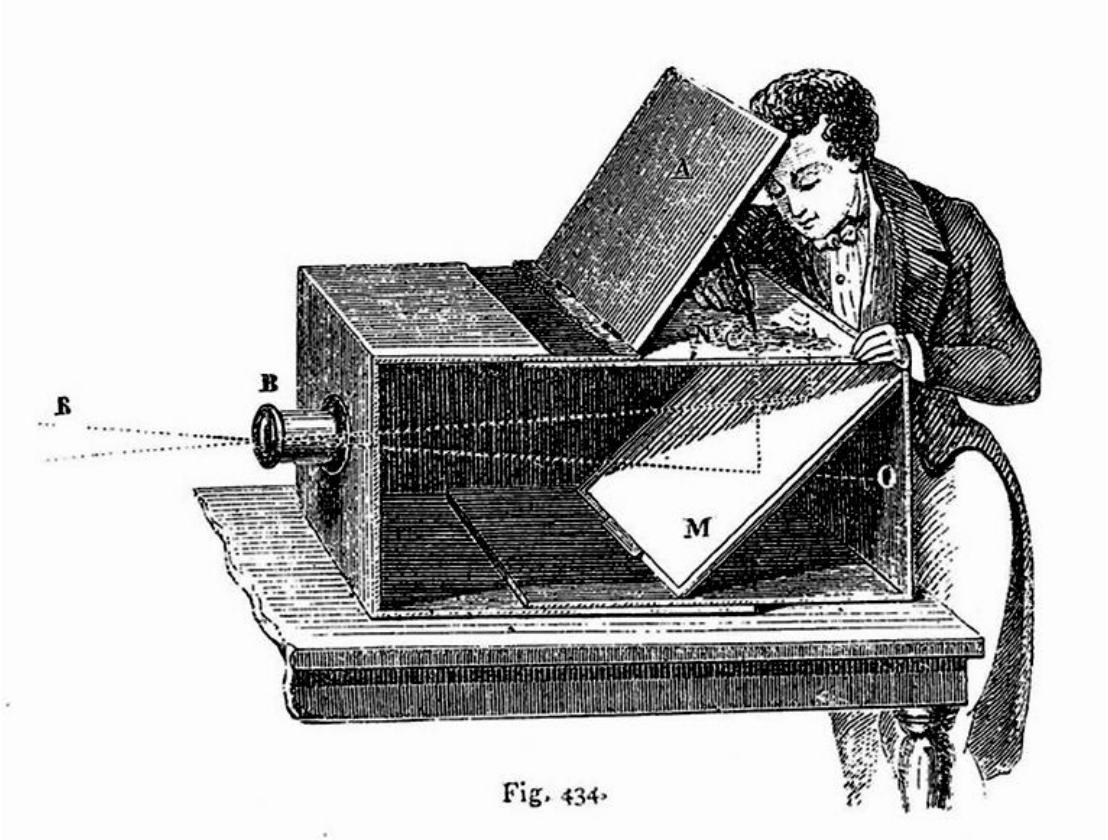
Depicting Our World: Renaissance

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



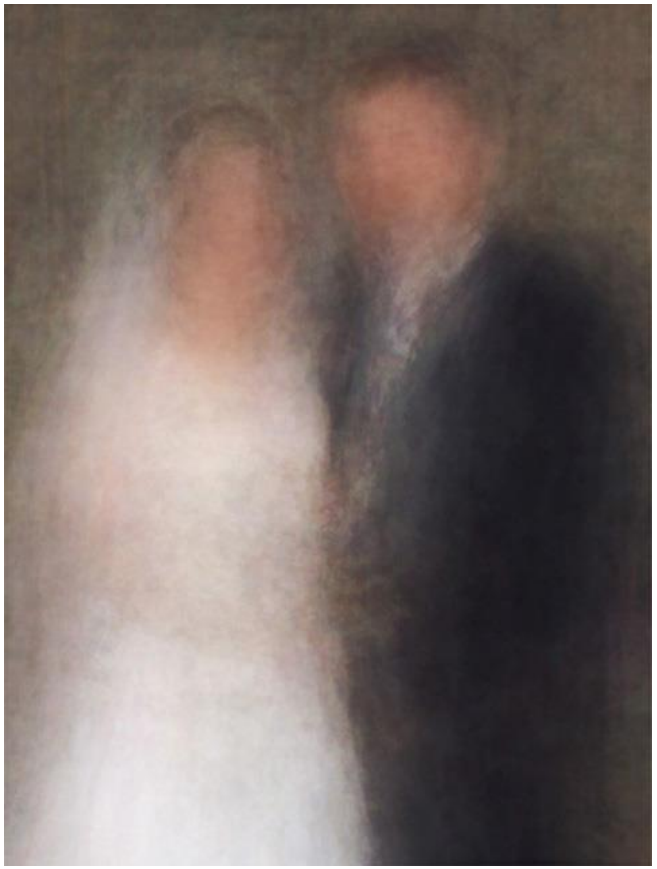
Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837

But is a photo really realistic?

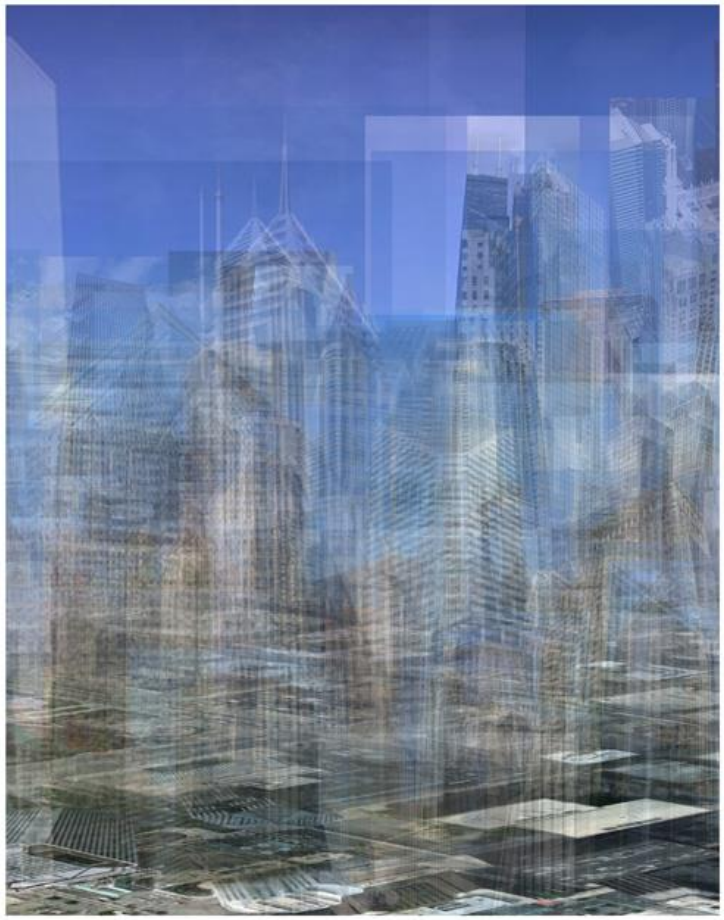
Is reality what we want?



Newlyweds

http://salavon.com

Better than realism?

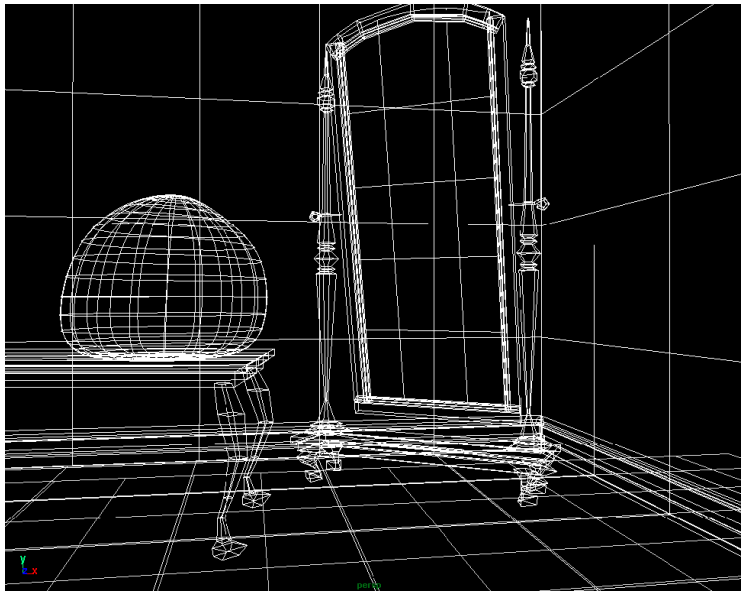


City (westward)

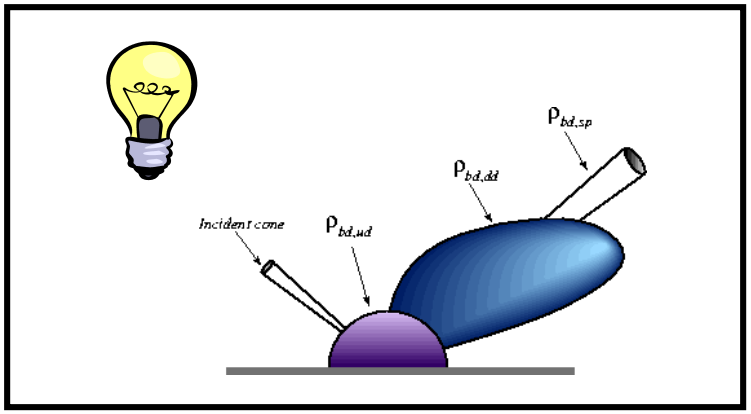
http://salavon.com

Enter Computer Graphics...

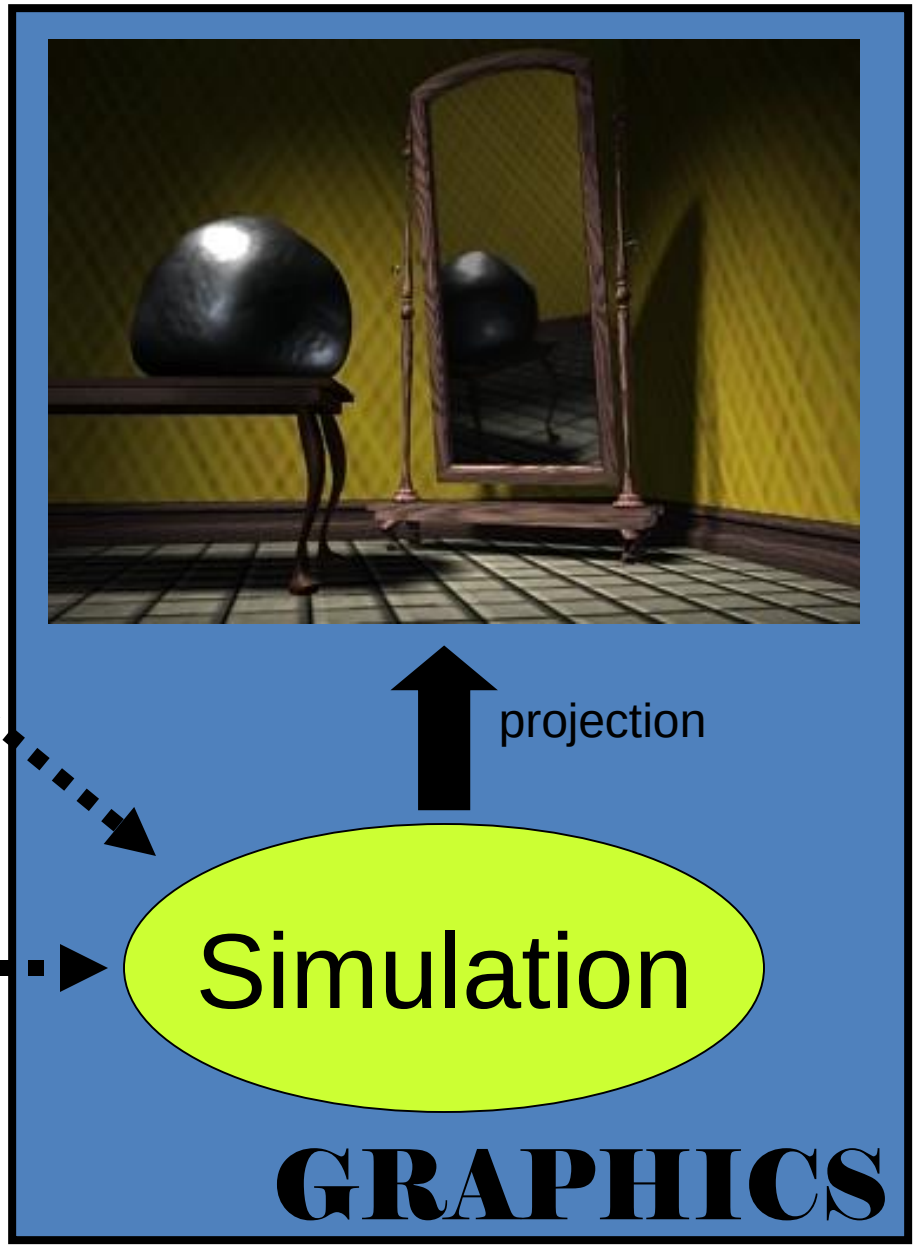
Traditional Computer Graphics



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/

Another example of blending reality with fantasy

Samsung Galaxy S6 regular and “beauty” selfie

Galaxy S6 beauty selfie

Reality

Reality++ (?)

http://www.greenbot.com/article/2940375/smartphones/the-great-android-phone-selfie-shootout.html

Course outline

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

TAs: Mariya Vasileva (mvasile2@illinois.edu)

Daeyun Shin (dshin11@illinois.edu)

Web page:

http://courses.engr.illinois.edu/cs445/

Course objectives

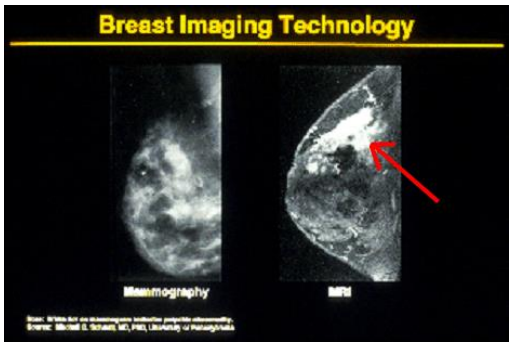
1. You will have new abilities for visual creation.

Graphic by James Hays

Course objectives

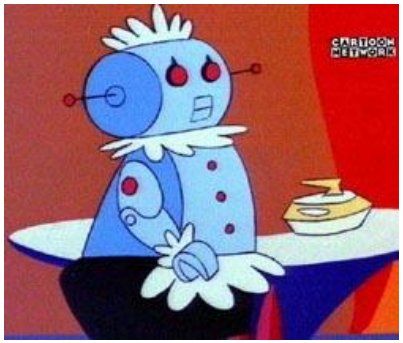
2. You will get a foundation in computer vision.

Safety



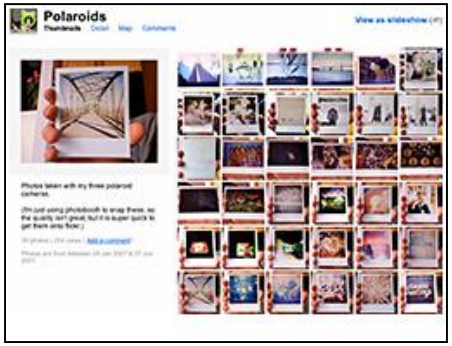
Health

Security



Comfort

Fun



Access

Got job?

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

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

Course objectives

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

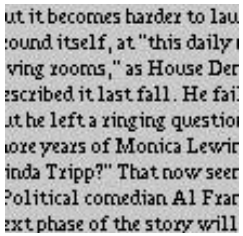
Course objectives

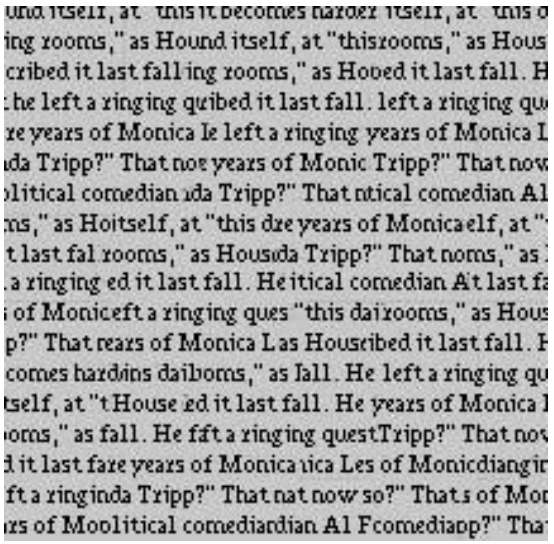
4. You'll have fun doing cool stuff!

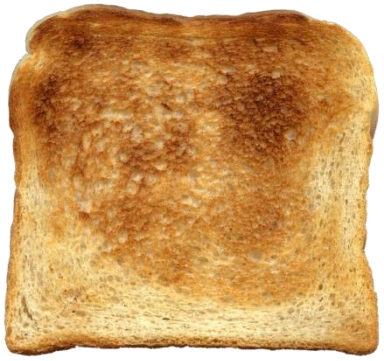
Projects

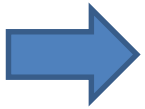
Project 1: Hybrid Images

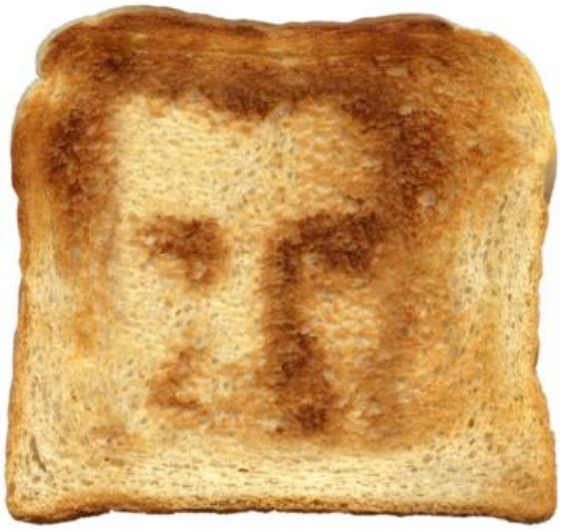
Project 2: Image Quilting for Texture Synthesis and Transfer



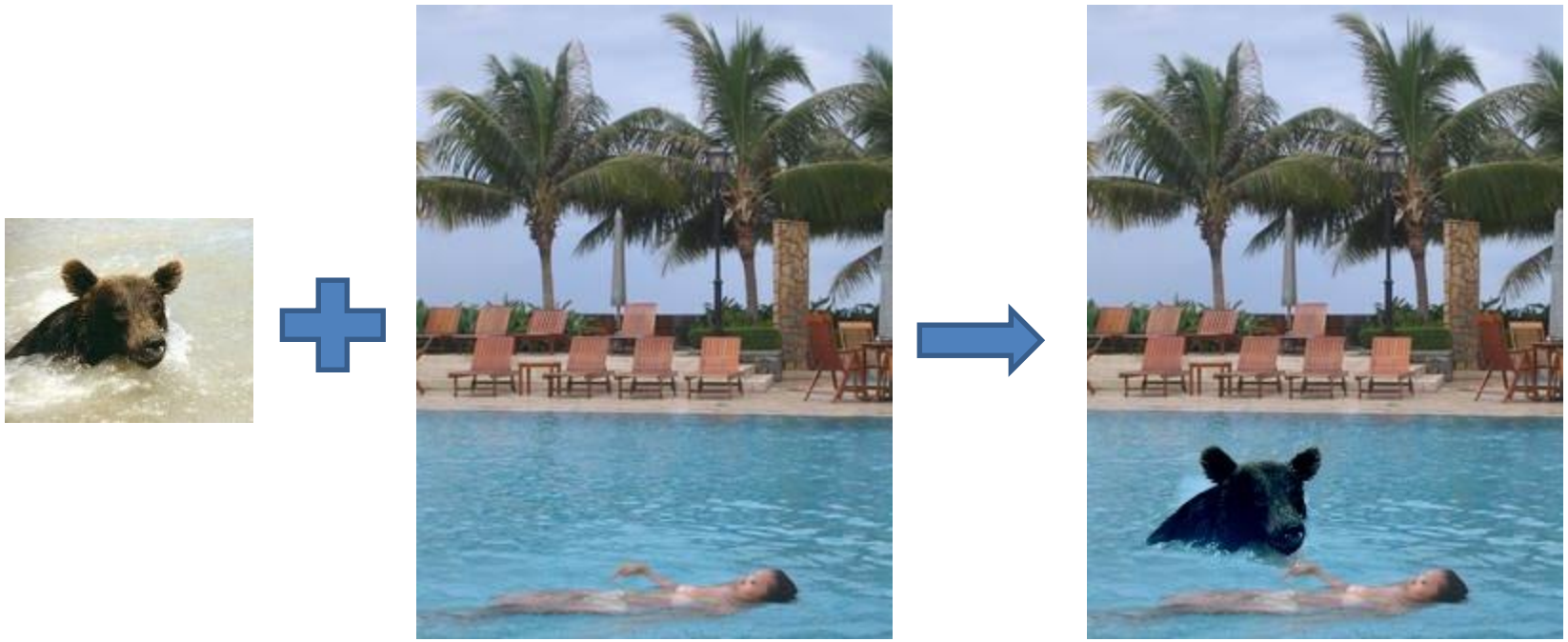






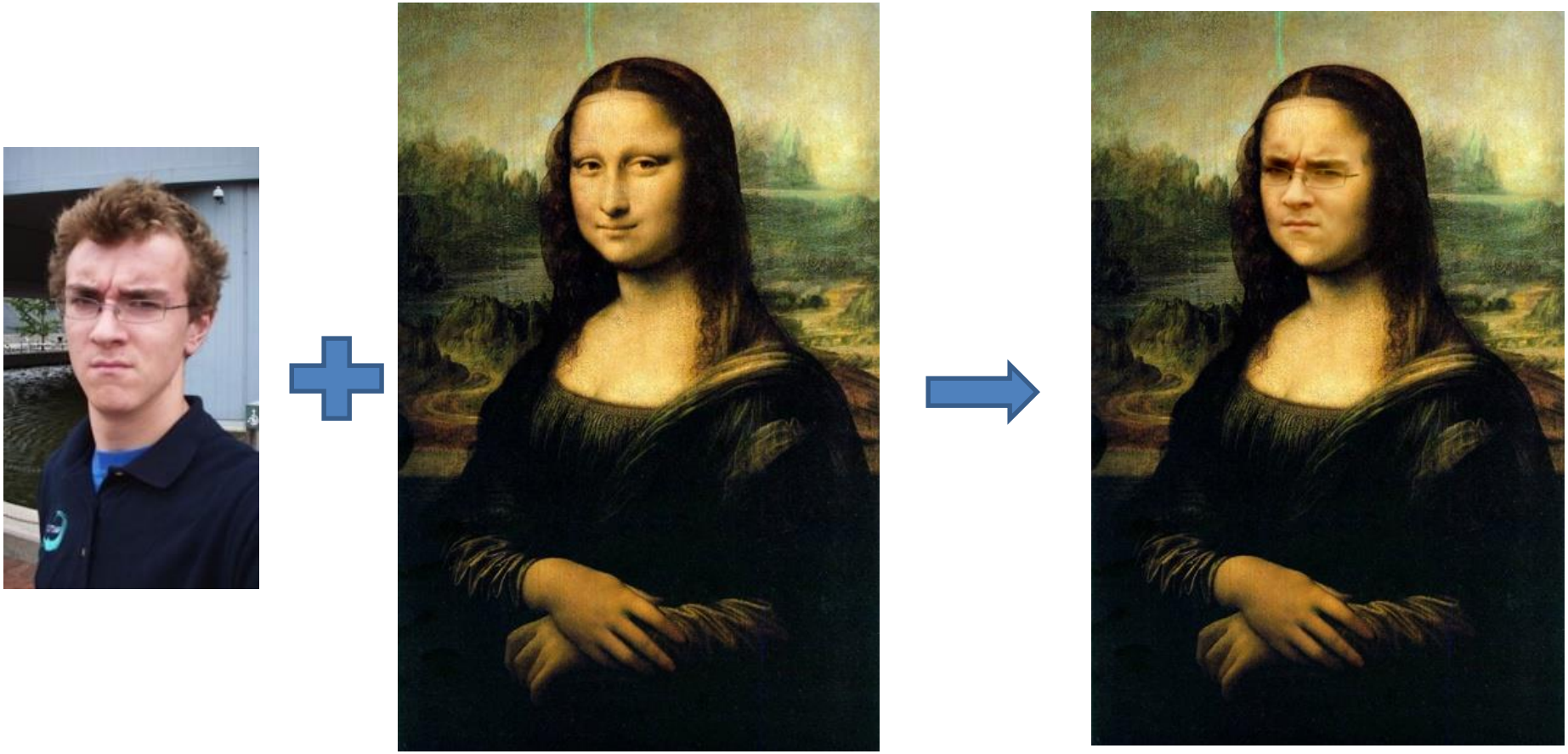


Project 3: Poisson Editing



Photos from James Hays

Project 3: Poisson Editing



Photos from Evan Wallace

Project 4: Image-Based Lighting

Project 5: video alignment, stitching, and editing

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)
- Software/hardware
  - Matlab!
  - Machines available in EWS labs

Getting help outside of class

Office hours

- TBA: http://doodle.com/8cqbis4qx52wm5fs

Matlab + linear algebra tutorial

- Wed 9/2, pick time: http://doodle.com/6drhrg3kdedu892x
- **Discussion board**: https://piazza.com/class/idbqt0ejczu4su

Readings/textbook

Grades

- Written and programming assignments (55%)
  - Core projects worth total of 500 points, “bells and whistles” for additional points
  - Undergrads graded out of 525, grads out of 600
- Exam (25%)
- Final Project (20%)
- Participation

Late policy

- Up to five free days total – use them wisely!
- 10 point penalty 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 $$$
- Pro camera apps for smartphones

Feedback is welcome

Final comments

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