

Computational Photography

CS498dh



Derek Hoiem

Today's Class

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

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



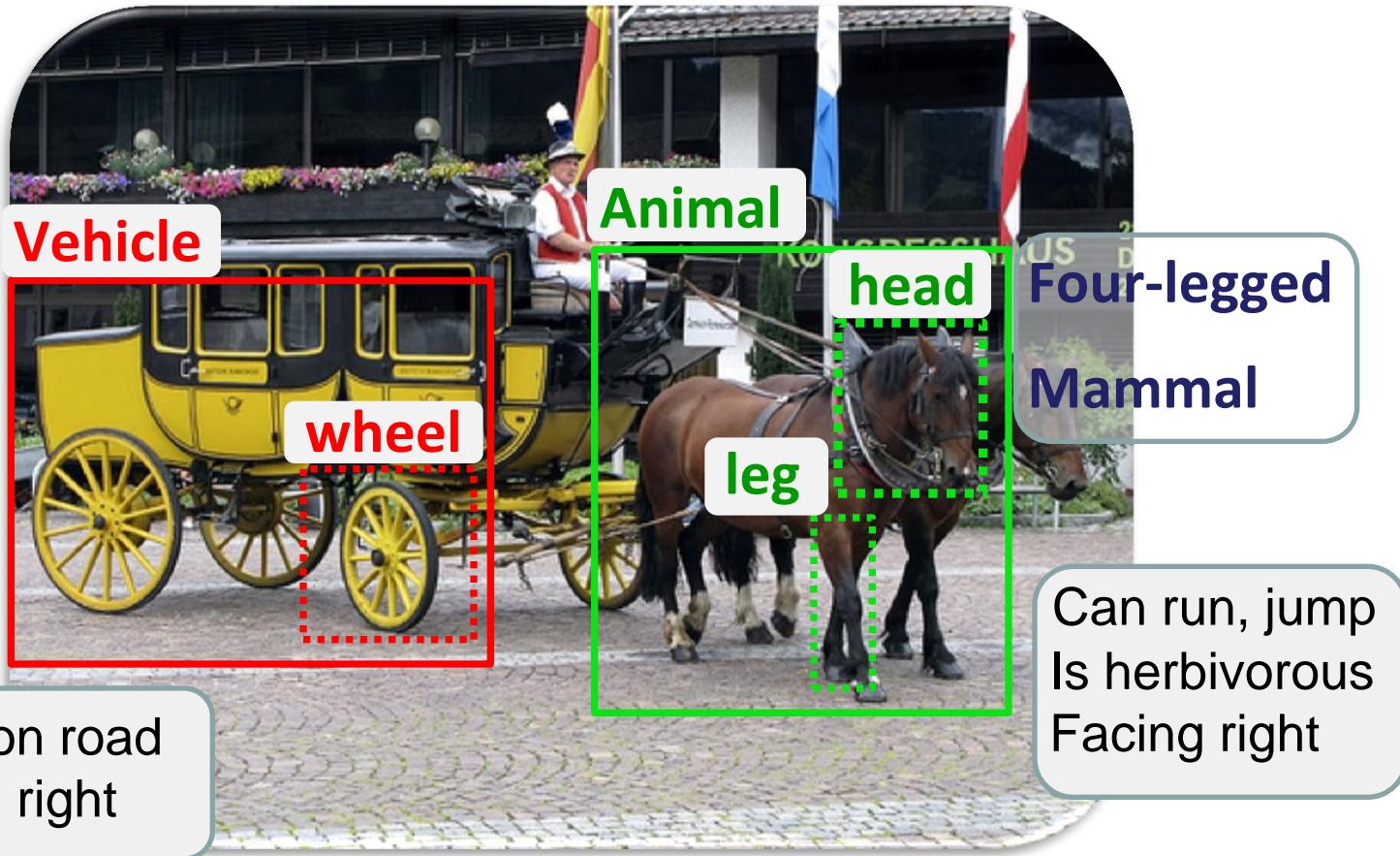
2009-

Assistant Prof in CS at UIUC

My research

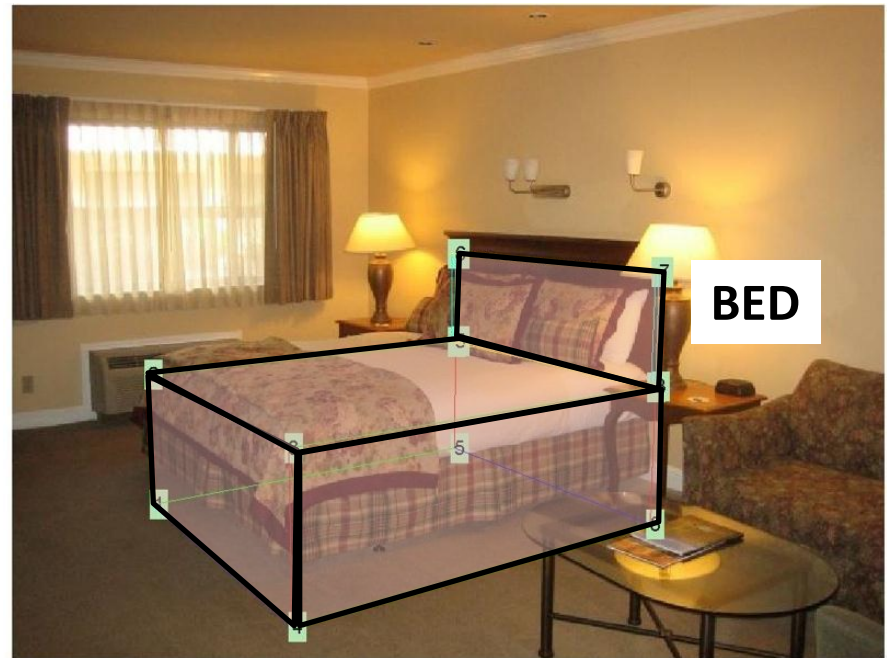
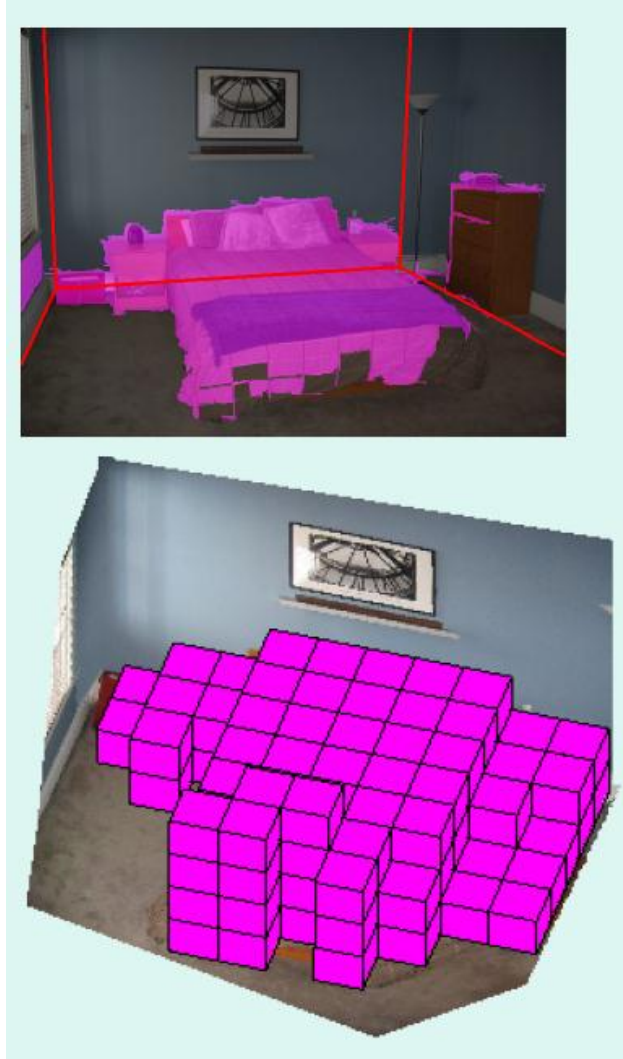


My Research



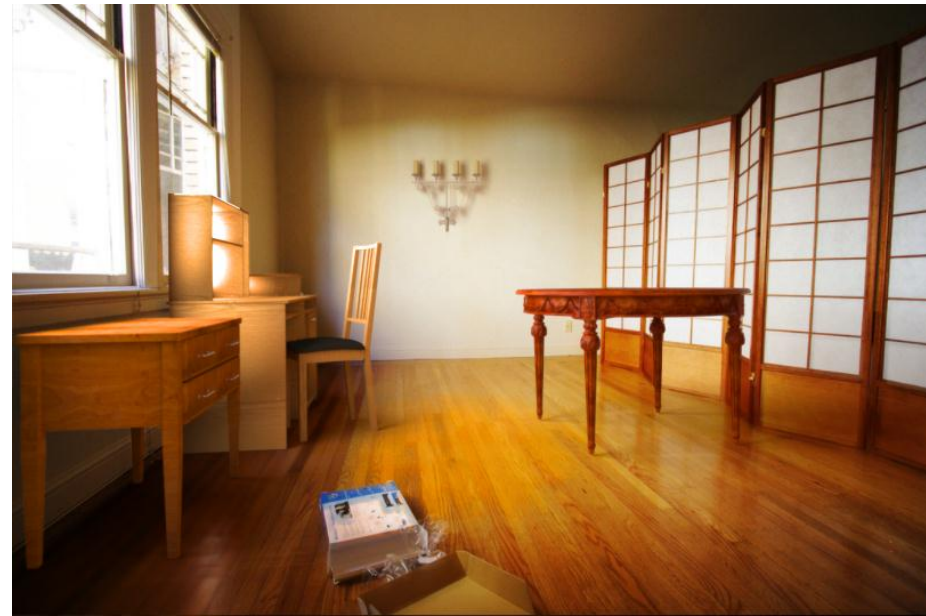
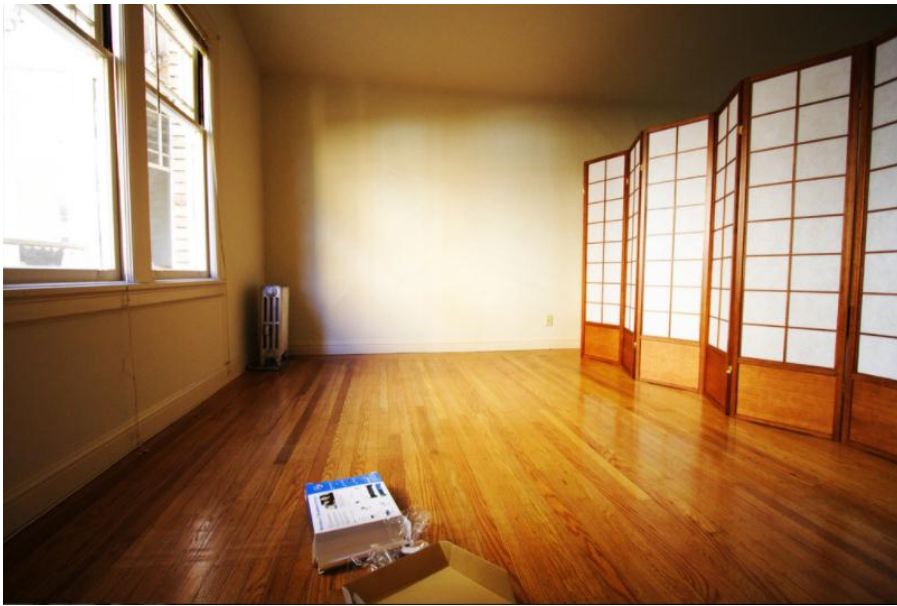
My Research

Recovering 3D layout and context



My Research

Editing images as if they were 3D scenes









Some background to computational
photography and ...

The Pursuit of Realism

Depicting Our World: The Beginning



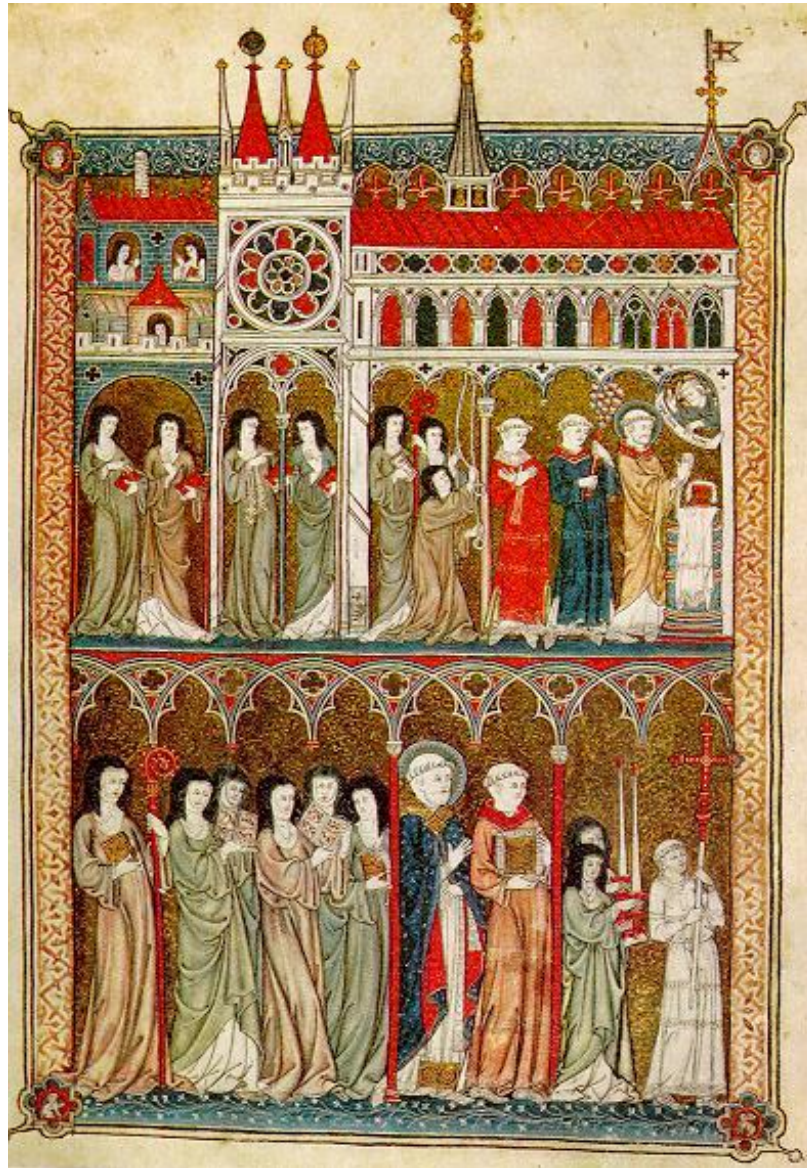
Prehistoric Painting, Lascaux Cave, France
~ 15,000 B.C.

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



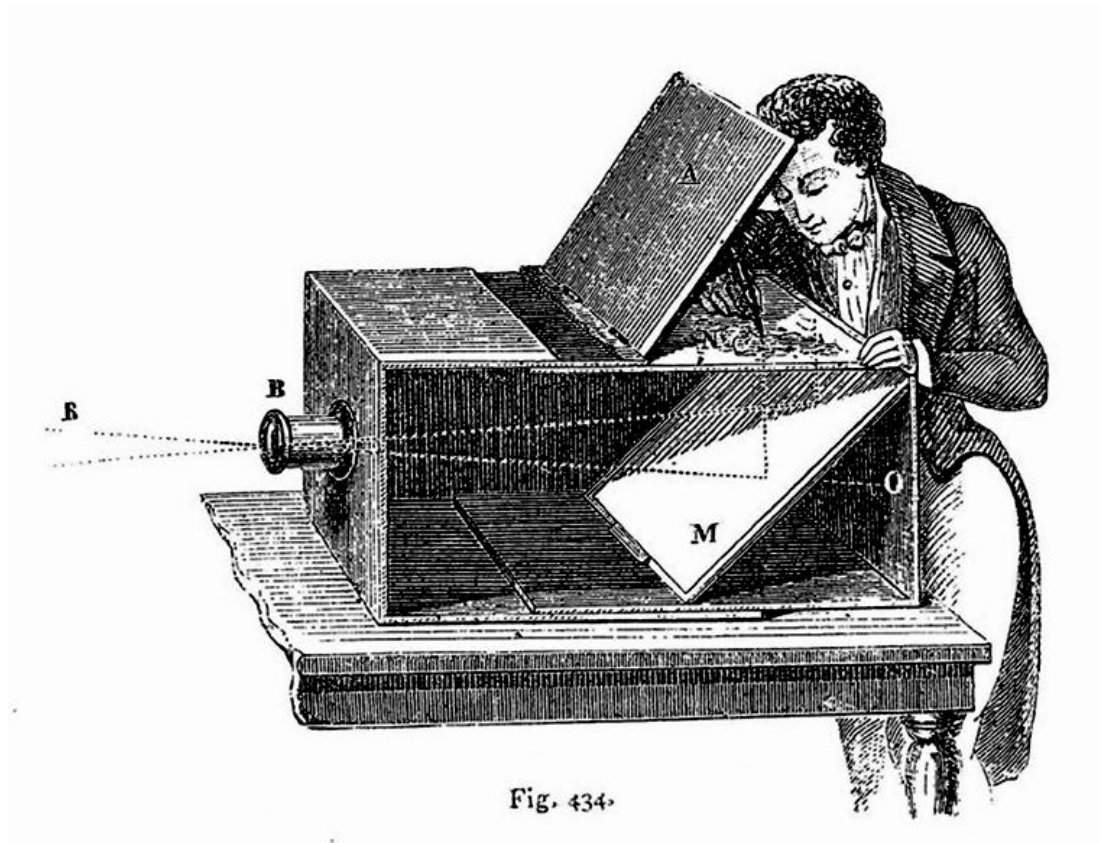
*Paolo Uccello,
Miracle of the Profaned Host (c.1467-9)*

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!

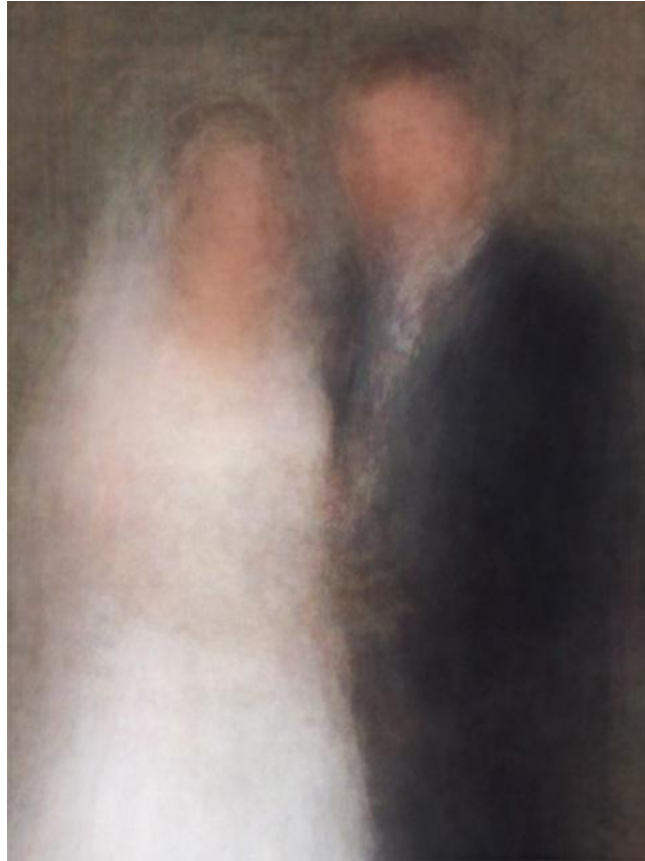


Still Life, Louis Jaques Mande Daguerre, 1837

But is a photo really realistic?



Is reality what we want?



Newlyweds

Better than realism?

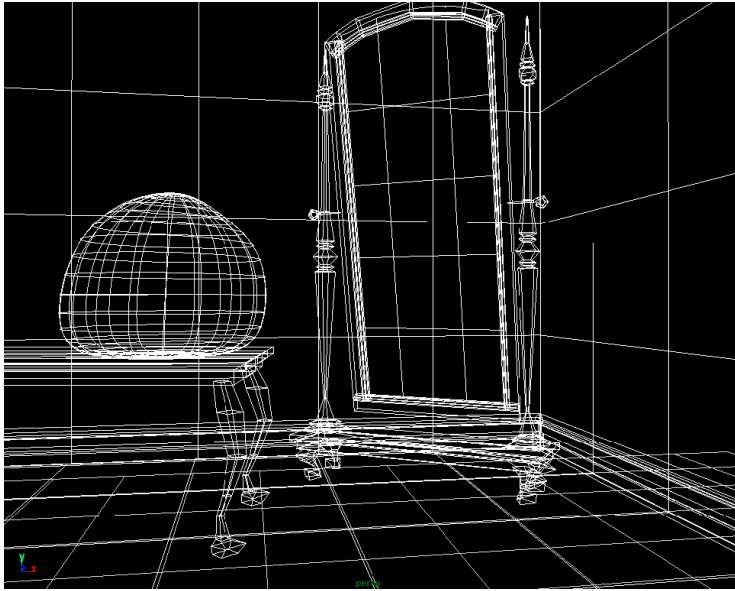


City (westward)

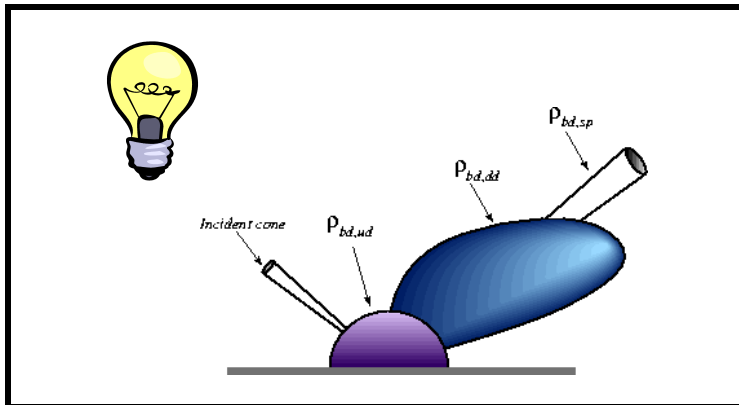


Enter Computer Graphics...

Traditional Computer Graphics



3D geometry



physics



projection

Simulation

GRAPHICS

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 I 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



Photography



- + instantly realistic
- + easy to acquire
- 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@illinois.edu), SC3312

Web page:

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

Course objectives

1. You will have new abilities for visual creation.

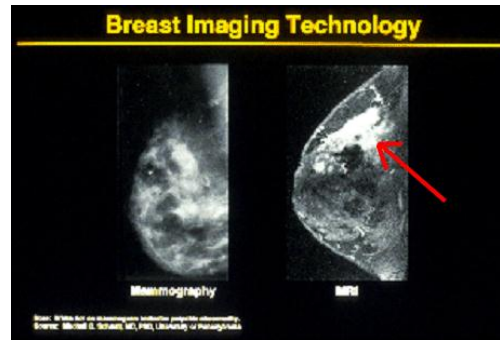


Course objectives

2. You will get a foundation in computer vision.



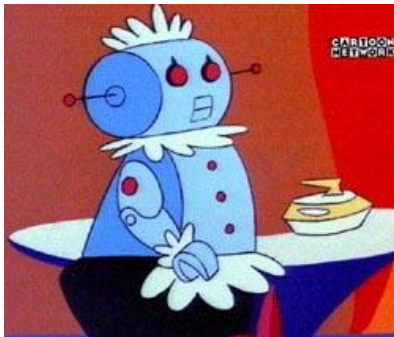
Safety



Health



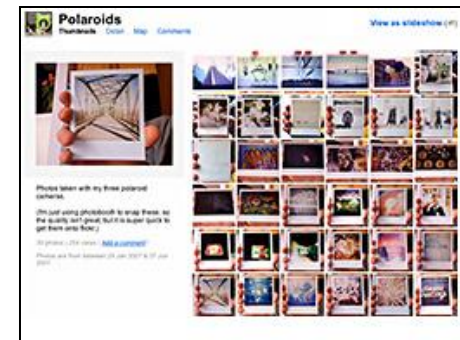
Security



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!

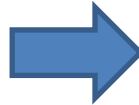
Projects

Project 1: Hybrid Images

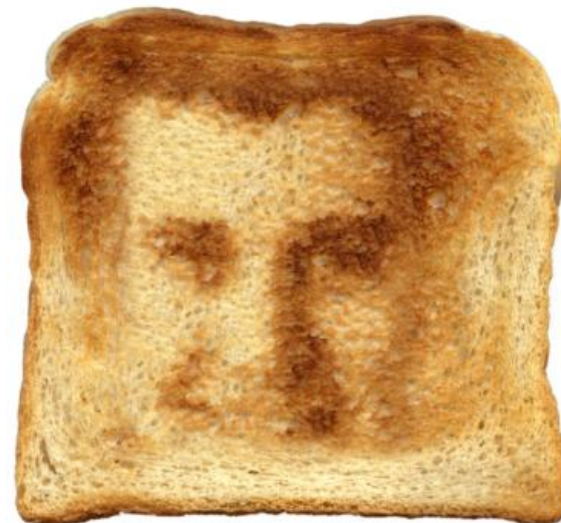
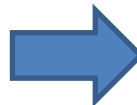
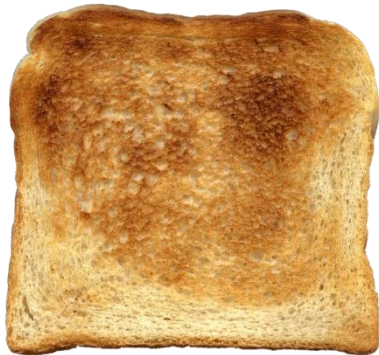


Project 2: Image Quilting for Texture Synthesis and Transfer

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Project 3: Poisson Editing



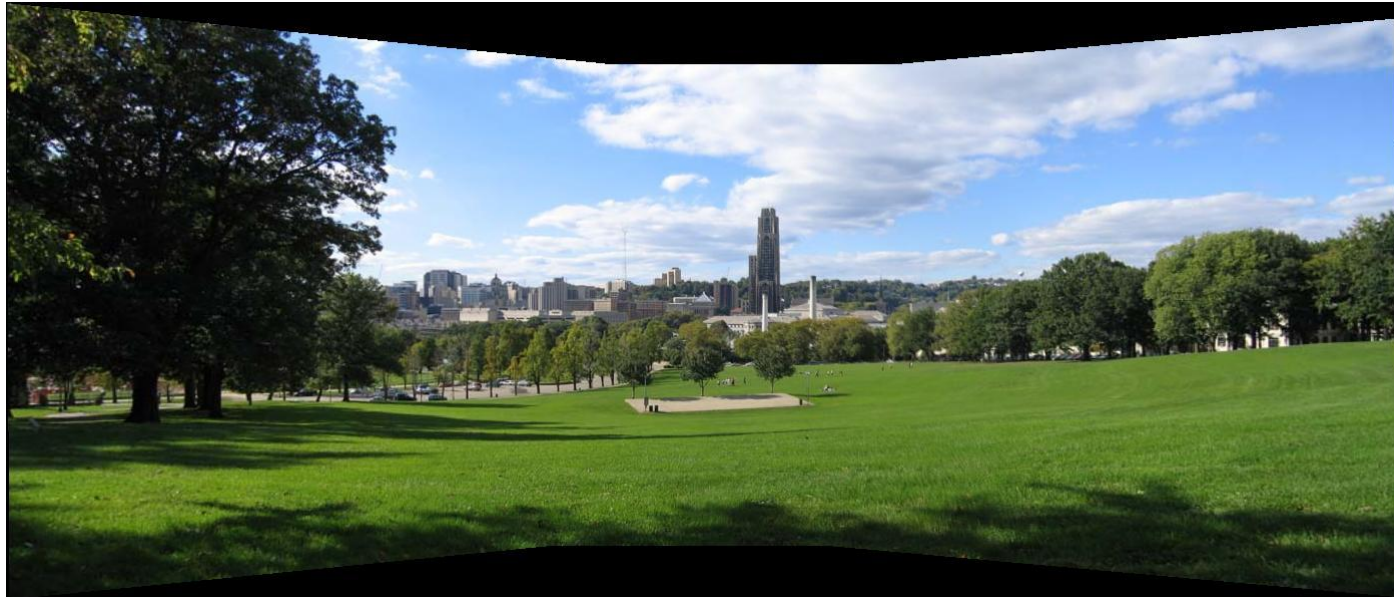
Project 3: Poisson Blending



Project 4: Face morphing



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

- Currently 10-11am Mondays, 3-4pm Thursdays
- Otherwise, just stop by. If I'm not there, send me an e-mail.

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)

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