Computational Photography
CS498dh

Derek Hoiem (instructor)
Amin Sadeghi (TA)
Today’s Class

• A little about me and Amin
• 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

Move on road
Facing right

Vehicle
wheel

Animal
head
leg

Four-legged Mammal
Can run, jump
Is herbivorous
Facing right

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Guo and Hoiem, unpublished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
Class TA

Mohammad Amin Sadeghi
Call me Amin

Email: msadegh2@illinois.edu
Education

Sharif University
BSc Computer Engineering
Iran, 2005 - 2010

University of Illinois
PhD in Computer Science
2010 - present
Awards
Bronze Medal at
IOI’2005

Best Student Paper Award at
CVPR’2011
Image Understanding

Automatic Image description

Visual Phrases

This is a lot of technology. Somebody's screensaver of a pumpkin. Black laptop is connected to black Dell monitor. Old school computer monitor with many stickers on it. A refrigerator full of food.
Fast Object Detection

(a) Input Image
(b) Original HOG
(c) 256 clusters
(d) 16 clusters
Some background to computational photography and ... 

The Pursuit of Realism
Depicting Our World: The Beginning

Prehistoric Painting, Lascaux Cave, France
~ 15,000 B.C.
The Empress Theodora with her court.
Ravenna, St. Vitale 6th c.
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)

http://salavon.com
Enter Computer Graphics...
Traditional Computer Graphics

3D geometry

physics

Simulation

projection

GRAPHICS
Computer graphics

What’s wrong?
The richness of our everyday world

Photo by Svetlana Lazebnik
Which parts are hard to model?
People

From “Final Fantasy”

Alyosha Efros - On the Tube, London
Faces / Hair

From “Final Fantasy”
Urban Scenes

Virtual LA (SGI)

Photo of 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 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), SC 3312
TA: Amin Sadeghi (msadegh2@illinois.edu), SC 3307

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.
Got job?

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

Course objectives

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

Is that a queen or a bishop?
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

(maybe changing for video-based project)
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://doodle.com/49shtvw5haicz498

Matlab + linear algebra tutorial
• TBA: http://doodle.com/f4wzcrshumttkxzt

Discussion board:
• https://piazza.com/class/hyzzw1vjjb83cf

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 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 $$$

• 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 Piazza
  – Doodles for office hours and tutorial

• Next class: pixels and basic filtering