Today’s Class

• A little about me

• 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-
Prof in CS at UIUC
My research
My research

Recovering 3D layout and context

Hedau et al. 2009, Zou et al. 2021
My Research

3D scene model from RGB+D image

Guo, Zou, Hoiem 2018
My Research

Editing images as if they were 3D scenes

Karsch et al. 2011
My Research

Generating comic videos

Fred wearing a red hat is walking in the living room.

Wilma and Betty are seated at a table in the kitchen.

Gupta et al. 2018
General Purpose Vision

VQA | Captioning | Localization | Classification (cropped) | Classification in Context
---|---|---|---|---
What is this child doing? | Describe the image. | Find the temperature scanner. | What is this? | What is this?
What is he holding? | a close up of a person wearing a kn95 mask | nasal swab | pcr test

Kamath et al. 2022
Reconstruct: vision for construction

Crunchbase top 50 global startups

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.
Depicting Our World: Middle Ages

Nuns in Procession. French ms. ca. 1300.
Depicting Our World: Renaissance

North Doors (1424)

East Doors (1452)

Lorenzo Ghiberti (1378-1455)
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?

Related story: https://www.propublica.org/article/the-toppling-saddam-statue-firdos-square-baghdad
Is reality what we want?

http://www.freephotoediting.com/samples/photo-glamourisation/020_celebrity-skin-retouching.htm
Enter Computer Graphics...
Traditional Computer Graphics

- 3D geometry
- physics

Simulation

projection

GRAPHICS
Computer graphics

What’s wrong?
The richness of our everyday world
Which parts are hard to model?
People

From “Final Fantasy”

Alyosha Efros - On the Tube, London
Faces / Hair

From “Final Fantasy”
Urban Scenes
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

Realism
Manipulation
Ease of capture
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)

https://www.youtube.com/watch?v=TNlj3_SuLt4
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, Adobe, Samsung, Apple, 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: video alignment, stitching, and editing
Final Project

Something cool!
Course outline

Prof: Derek Hoiem dhoiem@illinois.edu

TAs
- Sara Aghajanzadeh, saraa5@illinois.edu
- Yuqun Wu, yuqunwu2@illinois.edu
- Zhen Zhu, zhenzhu4@illinois.edu
Grades

• Projects (55%)
  – 5 projects: each with 100 core points with more optional “bells and whistles”
  – 3 credit (ugrad): graded out of 425 points
  – 4 credit (grad): graded out of 500 points

• Exams (30%)
  • Midterm 15%: covers first half
  • Final 15%: covers entire semester

• Final Project (15%)
  • 1% for proposal, 14% for final submission
  • 2-4 page short report

Late policy
• Up to ten free days total – use them wisely!
• 5 point penalty per day after that
• Project must be submitted within two weeks of due date to receive any points
Covid, masks, sickness

• If you’re well, please come to lectures and office hours. Masks are optional, per university policy. You’re encouraged to follow CDC guidelines for masking.

• If you’re sick, please stay home. No need to show proof of illness or get permission to miss.

• Lectures will be recorded, and exams can be taken from home
Project details

• Implement stuff from scratch and apply it to your own photos

• Submit report PDF, Jupyter notebook, and Python code
Learning resources

Lectures
• In-person, recorded (link will be up once first video is available)
• Older full-length recordings: https://ensemble.illinois.edu/Playlist/CS445_Hoiem_FA19
  • Search by lecture date, e.g. 9.06 for Sept 6, based on schedule here: https://courses.engr.illinois.edu/cs445/fa2019/

Slides, project, schedule
• On website: https://courses.engr.illinois.edu/cs445/fa2022/

Office hours
• Will be updated on pinned CampusWire post

Discussion board: https://campuswire.com/c/G7F6C1BFD  Add code: 9182

Readings/textbook: for depth and details not covered in lecture
Academic Integrity

These are OK
• Discuss projects with classmates (don’t show each other code)
• Use Stack Overflow to learn how to use a Python module
• Get images from online (make sure to attribute the source)

Not OK
• Copying or looking at project-specific code (i.e. so that you claim credit for part of an assignment based on code that you didn’t write)
• Using external resources (code, images) without acknowledging them

Remember
• Ask if you’re not sure if it’s ok
• You are safe as long as you acknowledge all of your sources of inspiration, images, code, etc. in your write-up
Other comments

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

Equipment
• Your own camera, but a smartphone is probably good enough
• A mirrored sphere for project 4 (12 cm or bigger) e.g. [https://www.amazon.com/Stainless-Mirror-Polished-Sphere-Ornament/dp/B01ING7L4U](https://www.amazon.com/Stainless-Mirror-Polished-Sphere-Ornament/dp/B01ING7L4U)
Feedback is welcome