Lecture: Introduction to Computer Vision

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Welcome to CS131
Jason Salavon
GAN experiment on Twitter
Mario Klingemann, GAN experiment on Twitter
What you should expect to learn in this class.

• What is computer vision?
• Which problems fall under this umbrella?
• Which applications are possible today and in the near future?
• What are common research questions?
• What is the history behind these problems and how did it lead to deep leading?
• What tools will help you develop a framework to solve these problems?
CS131 is the introductory course for computer vision

- **CS131 (fall, 2017):**
  - Overview of computer vision and all its applications
  - Will prepare you for an industry job in vision
- **CS231a (winter, 2018, Prof. Silvio Savarese):**
  - Advanced Computer Vision
  - focusing on 3D vision
- **CS231n (spring, 2018):**
  - Convolutional Neural Networks
Today’s agenda

• Introduction to computer vision
• Course overview
Quiz?
What about this?
What is (computer) vision?

Image (or video) → Sensing device → Interpreting device → Interpretations

garden, spring, bridge, water, trees, flower, green, etc.
The goal of computer vision

- To bridge the gap between pixels and “meaning”

What we see

What a computer sees

Source: S. Narasimhan
What is (computer) vision?

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garden, spring, bridge, water, trees, flower, green, etc.
1981: Nobel Prize in medicine
Human vision is superbly efficient

Potter, Biederman, etc. 1970s
Change Blindness

Rensink, O’regan, Simon, etc.
Change Blindness

Rensink, O’regan, Simon, etc.
Segmentation
Perception
What is (computer) vision?

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garden, spring, bridge, water, trees, flower, green, etc.
Paintings in 1838
1812: Jacques-Louis-David
The Emperor Napoleon at his Study at the Tuileries
1808: Ingres, La grande baigneuse
“From today, painting is dead”
— painter Paul Delaroche
at a demonstration of the Daguerreotype, 1839
1837: Niépce, First photo of one’s meal
Boulevard du Temple, Daguerré
1838: First selfie, Robert Cornelius
DeepDreams
[Mordvintsev et al. 2015]
Neural Style Transfer
[Gatys et al. 2015]
Neural Style Transfer
[Gatys et al. 2015]
CycleGAN [Zhu et al. 2017]
The goal of computer vision

- To bridge the gap between pixels and “meaning”

Source: S. Narasimhan
Origins of computer vision: an MIT undergraduate summer project
What kind of information can we extract from an image?

• Metric 3D information
• Semantic information
Vision as measurement device

Pollefeys et al.

Goesele et al.
Introduction

Vision as a source of semantic information

Slide credit: Kristen Grauman
Why study computer vision?

- Vision is useful: Images and video are everywhere!

Surveillance and security

Medical and scientific images
Special effects: shape and motion capture

Source: S. Seitz
3D urban modeling

Bing maps, Google Streetview

Source: S. Seitz
3D urban modeling: Microsoft Photosynth

http://photosynth.net

Source: S. Seitz
Face detection

• Many digital cameras now detect faces
  – Canon, Sony, Fuji, ...

Source: S. Seitz
Smile detection

The Smile Shutter flow

Imagine a camera smart enough to catch every smile! In Smile Shutter Mode, your Cyber-shot® camera can automatically trip the shutter at just the right instant to catch the perfect expression.

Sony Cyber-shot® T70 Digital Still Camera

Source: S. Seitz
Face recognition: Apple iPhoto software

http://www.apple.com/ilife/iphoto/
Biometrics

How the Afghan Girl was Identified by Her Iris Patterns

Source: S. Seitz
Biometrics

Fingerprint scanners on many new laptops, other devices

Face recognition systems now beginning to appear more widely
iphone X just introduced face recognition
Optical character recognition (OCR)

Technology to convert scanned docs to text

- If you have a scanner, it probably came with OCR software

Digit recognition, AT&T labs

License plate readers
http://en.wikipedia.org/wiki/Automatic_number_plate_recognition

Source: S. Seitz
Google maps: Annotate all houses and streets

Goodfellow et al. 2014
Toys and Robots
Mobile visual search: iPhone Apps
Snapstacles and Google glasses

• That’s Ranjay in undergrad ->
Automotive safety

- **Mobileye**: Vision systems in high-end BMW, GM, Volvo models
  - “In mid 2010 Mobileye will launch a world's first application of full emergency braking for collision mitigation for pedestrians where vision is the key technology for detecting pedestrians.”

Source: A. Shashua, S. Seitz
Vision in supermarkets

**LaneHawk by EvolutionRobotics**

“A smart camera is flush-mounted in the checkout lane, continuously watching for items. When an item is detected and recognized, the cashier verifies the quantity of items that were found under the basket, and continues to close the transaction. The item can remain under the basket, and with LaneHawk, you are assured to get paid for it…”

Source: S. Seitz
Amazon Go
Vision-based interaction (and games)

Microsoft’s Kinect

Sony EyeToy

Assistive technologies

Source: S. Seitz
Augmented Reality
Virtual Reality
Vision for robotics, space exploration

Vision systems (JPL) used for several tasks

- Panorama stitching
- 3D terrain modeling
- Obstacle detection, position tracking
- For more, read “Computer Vision on Mars” by Matthies et al.

**NASA’S Mars Exploration Rover Spirit** captured this westward view from atop a low plateau where Spirit spent the closing months of 2007.
Introduction

25 - Sep - 2018

MGMT "When You Die"