CSC320: Introduction to Visual Computing

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• Course Website: http://www.cs.toronto.edu/~csc320h
  • Course information sheet
  • Lecture Slides
• Piazza: http://piazza.com/utoronto.ca/winter2019/csc320
  • Announcements
  • Instructor/TA contact: post private question to “instructors”
  • Course/Assignment Peer Discussion Groups
• MarkUs
  • Assignment upload/grading
What we will cover today

• Course Intro & Admin
  • What is “visual computing” (disciplines, objectives)
  • Is this course for me?
  • Admin stuff

• The Basics of Image Formation
  • Cameras/Optics
  • Photography Basics (focus, DoF, aperture, shutter speed, ISO)
  • Sensor Basics (Mosaicing, Colour, Noise)
What is Visual Computing?

Topic 0: Course Introduction
What is Visual Computing?

• Understand how pixels in digital images and the real world relate

CIFAR10 Training Image

(Single Channel)
Vision is Difficult!

http://www.lyndonhill.com/opinion-cvlegends.html
Visual Computing Disciplines

• Computer vision
• Computer graphics
• Image processing
• Visualization
• Virtual and augmented reality
• Video processing

(also includes aspects of pattern recognition, human computer interaction, machine learning and digital libraries ...)

Visual Computing: Computer Vision

pixels $\rightarrow$ model of real world

Allows us to automate image understanding
Computer Vision: Face Recognition

• Snapchat Lenses:  
  Facial landmark detection
• Apple FaceID:  
  • 3D image
• Some phones:  
  • 2D video
Computer Vision: Object/Scene Recognition

- Automatic image tagging (i.e. with Google Photos)
Visual Computing: Computer Graphics

model of real world $\rightarrow$ pixels

Allows us to experience things we might not in the real world
Realistic Video Games

• Going from a world model to almost photo-realistic real-time graphics
• Real-time raytracing
Virtual Reality

• Occulus Rift, HTC Vive, Playstation VR, ...
• Augmented Reality = computer vision + computer graphics
Objectives of Visual Computing

1. Realistic Image Synthesis
2. Capturing Reality
3. Manipulating Photos & Videos
4. Photo & Video Interpretation
Who are these people?
1. Realistic Image Synthesis: State of the Art

1. Realistic Image Synthesis: State of the Art

• Try it! https://affinelayer.com/pixsrv

2. Capturing Reality: Automatic Panoramas

Automatic Panoramic Image Stitching using Invariant Features, Brown et al., CVPR 2007
3. Manipulating Photos: State of the Art

4. Photo & Video Interpretation: State of the Art

DensePose: Dense Human Pose Estimation In The Wild, Güler et al. arXiv:1802.00434
What do we need to know?

• Be comfortable with
  • Linear algebra
  • Elementary calculus
  • Quite a bit of coding!

• Basic tools for assignments:
  • Python2
  • Numpy
  • OpenCV
  • All are portable and free/open source
Where does this course fit in?

- Computer Graphics (418)
- Intro to Image Understanding (420)
- Foundations of Computer Vision (2503)

• CSC320 is not a prerequisite for these courses
• Math foundations are the same, and will help to understand the foundations of these topics
Course Topics

• Imaging essentials (≈ 3 weeks)
  Understanding cameras, pixel intensity & color

• Image representation & transformation
  Image ↔ 2D array of pixels
  Image ↔ continuous 2D function (≈ 4 weeks)
  Image ↔ n-dimensional vector (≈ 2.5 weeks)
  Hierarchical image representations (≈ 2 weeks)
  Image matching & transformation (≈ 2 weeks)
Reading Research Papers

• Will be assigning research papers as reading
• This is an important skill to learn for both research and industry!
• No one way to do it, everyone has their own style: can only learn by doing it
Grading

• 50%: 4 assignments handed out Monday or Wednesday due at noon on the due date (13.4%, 13.4%, 13.4%, 9.8%)
• 50%: 1 in-class test (20%) + 1 final exam (30%)
• Check website for schedule, dates & more details/policy on late assignments and academic integrity

• First assignment: **out today**, due 3 weeks later
• Start soon! This assignment cannot be done last minute easily.
Tutorials

• Math refreshers, OpenCV & programming tutorials
• Attendance STRONGLY encouraged since lectures/office hours will not be covering basic math, programming or assignment details
• Wednesday 20:00 - 21:00, Friday 14:00-15:00
Next
Topic 1: The Camera