UC Berkeley CS 280: Computer Vision

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Time: 10 –11:30am on Wednesdays and Fridays
Location: Soda 306

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1 Introduction

Computer vision seeks to develop algorithms that replicate one of the most amazing capabilities of the human brain inferring properties of the external world purely by means of the light reflected from various objects to the eyes and using this information to control actions in the world.

We can determine how far away objects are, how they are oriented with respect to us, and in relationship to various other objects. We reliably guess their colors and textures, and we can recognize them - this is a chair, this is my dog Fido, this is a picture of me smiling. We can segment out regions of space corresponding to particular objects and track them over time, such as a basketball player weaving through the court. We can use the information we extract from images or video to manipulate objects in the world and navigate in environments while avoiding obstacles.

In this course, we will study the concepts and algorithms behind some of the remarkable successes of computer vision capabilities such as face detection, reconstructing three-dimensional models of cities, automated monitoring of activities, segmenting out organs or tissues in biological images, and sensing for control of robots. We will build this up from fundamentals geometry and radiometry of image formation and statistical machine learning techniques such as neural networks.

A tentative list of topics is:

- Static perspective
- Spatial transformations
- Dynamic perspective
- Radiometry of image formation
- Basic image processing operations
- Biological visual processing
- The feedforward model of visual processing
- Useful patterns for neural networks
- 3D reconstruction from multiple images
- Short-range and long-range correspondence

- Large scale reconstruction
- Applications in augmented and virtual reality
- Perceptual organization
- Contour detection and bottom-up segmentation
- Object detection and segmentation
- Inferring shape and spatial layout
- Image synthesis
- Human pose and activity recognition
- Face recognition
- Visual navigation

2 Administrivia

Textbook. There are no required books. All course materials will be posted on bcourse. Forsyth and Ponces *Computer Vision : A Modern Approach* and Szeliskis *Computer Vision: Algorithms and Applications* books cover much of the same material, and may be useful as a reference for many parts of the course. Szeliskis book is available online for free.

Discussions. Use Piazza for discussions related to the assignments and general announcements. Check Piazza for already posted questions before posting a new one. Unnecessarily clogging up Piazza makes the platform less useable for everybody.

Piazza will be monitored only by teaching assistants (TAs), not by instructors.

Office Hours. You can ask instructors and TAs questions during their office hours. The times and locations will be announced on Piazza. Instructors will only answer conceptual questions during office hours. All the homework questions go to TAs.

Workload. The course will have a midterm examination and a final project. In addition, there will be about four homework assignments, which typically involve Matlab/Python programming; you are free to use alternative packages.

Resources. Matlab runs on all the Instructional Windows and UNIX systems. Instructions and toolkits are described in

http://inst.eecs.berkeley.edu/cgi-bin/pub.cgi?file=matlab.help

CS280 students can use their existing EECS Windows accounts in EECS instructional labs, and they can request new accounts (for non-majors) or additional access to Instructional resources by following the instructions about named accounts in

http://inst.eecs.berkeley.edu/connecting.html#accounts

They can logon remotely and run it on some of our servers:

http://inst.eecs.berkeley.edu/connecting.html#labs

For neural network assignments, we will use pytorch http://pytorch.org/. Knowledge of python will be assumed. We will announce GPU resources and usage instructions.