Today

- Quick course overview
- What is computer vision?
- Relationships to other fields.
- Goals of computer vision.
- Assignment 1: 
  *The Prokudin-Gorsky photos.*
- MATLAB.
Course Overview

• Computer vision as a decision making process under uncertainty.
  – Emphasis on decision making using probability and statistics.
  – General strategies apply to any area of artificial intelligence.

• 7 problem sets – 1 every two weeks
  – Some programming
  – Some math

• tests: 1 midterm, 1 final.

• Final grade: 60% assignments, 20% midterm, 20% final.
  – Possible quizzes or “fudge factor” for participation.

• Not everything will be available on line.
  – You need to come to class!
Web Page

- Google me "Learned-Miller"
- Go to Teaching Link
- Top link is CS370.
CS370: Introduction to Computer Vision

• Spring 2011; Monday and Wednesday, 10:35-11:20 • LGRC 310A (See map)

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Prerequisites

Reading Materials
I do NOT recommend buying the textbook unless you want it for your own purposes. We will use it some in this course, but not a lot. You should be able to get by the on-line version.

Resources
MATLAB Tutorial
Interesting Links
Movie shown in class on optical illusions
Checker shadow illusion
Early color photographs by S. M. Prokudin-Gorsk
Flower Garden movie
Non-Lambertian reflectance functions
Explanation of hexagonal sampling efficiency
Homework 3 Sample Solution

Problem Sets
Description
Schedule

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<tr>
<th>Date</th>
<th>Lecture topic</th>
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<tr>
<td>Jan. 19</td>
<td>Introduction. What is Computer Vision?</td>
<td>Assignment 1: Read Lightness Perception and Lightness Illusions</td>
<td>Ax. 1 due Jan. 26</td>
<td>Handout: Introduction to Computer Vision</td>
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<td>Jan. 24</td>
<td>Introduction to using MATLAB for Computer Vision. Matlab Session Transcript from Lecture</td>
<td>Assignment 2: Colorizing the Prokudin-Gorskoy photo collection</td>
<td>Ax. 2 due Feb. 2</td>
<td>Probability handout (see lecture description)</td>
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<td>Jan. 26</td>
<td>Formalizing the decision making process. Minimizing error. Maximizing utility. Review of basic probability theory. You will be responsible for all of the basic probability theory in this handout.</td>
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Other stuff

• Textbook
  – free, on-line. see web page
• Programming Language: Matlab
  – Very good for images.
  – Will cover in class.
  – Not too difficult to learn if you know Java or C++. 
Options for Matlab (or Octave)

1. **Recommended:**
   - Buy student version of Matlab: $99.00.
     - Highest convenience factor.
     - Use on your own machine (laptop, desktop).

2. **Use open source package Octave**
   - Almost identical to Matlab
   - Can be tricky to install
   - No fancy user interface

3. **Use Departments EdLab Computers**
   - Must be used remotely (with remote login), which can be slow.
   - If too many people use this, it will be slow (only 5 different computers).
First assignments

• Prokudin-Gorsky photos (will discuss at end of class).
  – Follow instructions on web page to do write up.
  – Due on Wednesday, Jan. 29\textsuperscript{th} at 11:59 pm.
    • 10\% deduction for every day late (12:01 am counts as 1 day late).
  – Email Cheni your assignment (usually includes some code and some results and discussion).
    • .pdf is preferred for write-up part.

• Also read: Intro to Comp. Vision, available on web page. Look in right column under first lecture. (please send me emails if there are errors)
  – Due in next class. Possible quiz.
Here we go...
The Checker Shadow Illusion
The "Proof"
Takeaways

• The human vision system is not designed to measure absolute values of light.
• It is designed to try to understand "what's there" in the world.
Ambiguity: The Necker Cube
Ambiguity: The Necker Cube
Ambiguity: The Necker Cube
Ambiguity: The Necker Cube
The Bas-Relief Ambiguity

Sculpture by Amy Kahn
Takeaway

- Images are fundamentally ambiguous:
  - Computer vision is *ill-posed*.
- We cannot be sure about what is there
- We use as many cues as we can to make our best guess as to what is there.
- Amazingly, *the human visual system usually guesses correctly*.
  - Or does it?
  - When do we make a guess?
Related Fields

• Optics, Photography, Photogrammetry
  – Optics: study of light
  – Photogrammetry: practice of determining geometry from images

• Computer Graphics and Art
  – Computer graphics: forward
  – Computer vision: backwards
More Related Fields

- Neuroscience and Physiology
- Psychology and Psychophysics
- Probability, Statistics, and Machine Learning
Goals

- Engineering
- Basic Science
Reminder

• Check web page for current reading assignment and homework assignment.
  – Get started now!

• Make sure you get a copy of matlab running as soon as possible. Don’t wait until day before assignment is due to figure out how to get matlab. It could take a couple of days.
Matlab demo

• By the way, there is a link to a matlab tutorial on the course web page under “Resources”.
  – highly recommended.
Assignment 1
The Time Traveler’s Camera
The Time Traveler’s Camera
The Time Traveler’s Camera
The Time Traveler’s Camera

• As it turns out...
  – *Displaying* holograms is very difficult, BUT...
  – *Recording them* is EASY
The Time Traveler’s Camera

• As it turns out...
  – *Displaying* holograms is very difficult, BUT...
  – *Recording* the...
Sergey Prokudin-Gorsky

- Russian chemist and photographer
- 1909-1915: toured Russia for the czar to record pictures of Russia
- Took color “negatives” even though there were only extremely crude ways to reproduce them!
Some dude with a big sword
actually the Emir of Bukhara
Some dude with a big sword
Some dude with a big sword
Assignment

• You will be given images like this:
Next:

• Chop them up into thirds of the same size:
then...

- Pick one as the “base image”, and shift the other two relative to that image, using the MATLAB command circshift.
finally...

• Assemble them into an 3-channel (RGB) image and display.
• You will need to experiment with:
  – The amount of shift for the second and third images to best align them with the first component, and
  – The order of the images in the final RGB image (which image is “R”, which is “G”, and which is “B”) to get the most realistic looking image.
“The sad irony of the technique of the Three-Color Photography was that Prokudin-Gorsky himself never saw the entire collection of his images in color. Most of the surviving images are preserved in the form of triple black and white negatives and only rarely as historic color prints or slides which in any case are no match to present day color photographs.”
End