

Graduate Computer Vision

CS670

Unit 1: Introduction

Erik Learned-Miller

Today

- Quick course overview
- What is computer vision?
- Relationships to other fields.
- Goals of computer vision.
- Intro to Matlab

Course Overview

- Computer vision as a decision making process under uncertainty.
 - Heavy emphasis on decision making using probability and statistics.
 - General strategies apply to any area of artificial intelligence.
 - This is a CORE AI class now.
- problem sets 6-8, varying difficulties
 - Some reading and prose
 - Some programming
 - Some math
- 1 test. Focus on basic principles and math. Near end of semester.
- Final project.
- 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 CS670.

CS370: Introduction to Computer Vision

• Spring 2011; Monday and Wednesday, 10:35-11:50 • LGRC 310A ([See map](#))

Instructor

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Prerequisites

Reading Materials

Textbook: Algorithms and Applications, by Richard Szeliski: [On-line copy available here](#)

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-Gorsky](#)

[Flower Garden movie.](#)

[Non-lambertian reflectance functions](#)

[Explanation of hexagonal sampling efficiency](#)

[Homework 3 Sample Solution](#)

Problem Sets

Description

Schedule

| Date | Lecture topic | New assignments | Assignments due | Reading |
|---------|--|--|-------------------|--|
| Jan. 19 | Introduction. What is Computer Vision? | Assignment 1: Read Lightness Perception and Lightness Illusions Come up with five questions relevant to the paper. These can be things you didn't understand after a careful reading of the paper, or questions which the paper raises. Turn in the answer written up as a .pdf file. You will be graded on the depth of your questions and how much thought you were judged to have put into them. | As. 1 due Jan. 26 | Handout: Introduction to Computer Vision |
| Jan. 24 | Introduction to using MATLAB for Computer Vision. Matlab Session Transcript from Lecture | Assignment 2 : Colorizing the Prokudin-Gorsky photo collection | As. 2 due Feb. 2 | |
| Jan. 26 | 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 . | | | Probability handout (see lecture description). |

Other stuff

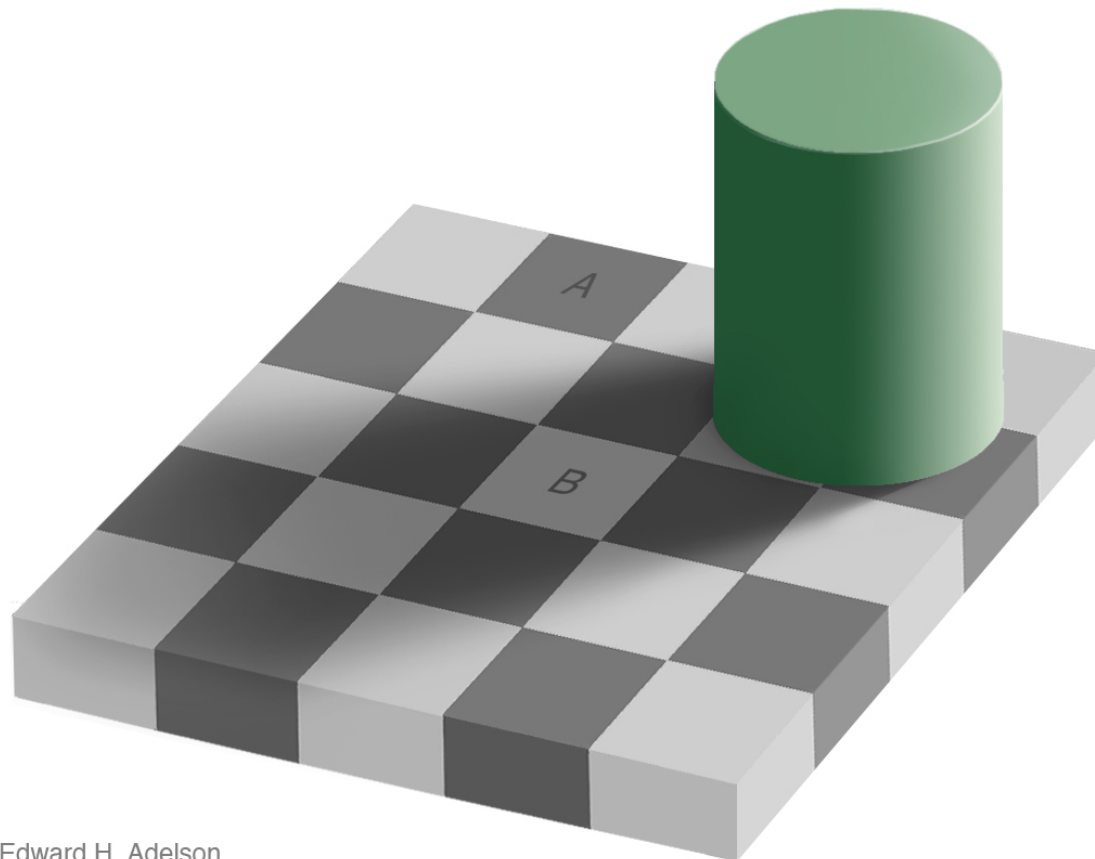
- Textbook
 - free, on-line. see web page
 - Haven't used it much in the past
- Programming Language: Matlab
 - Very good for images.
 - Will cover in class.
 - Not too difficult to learn if you know Java or C++.
 - Options:
 - Find through your lab.
 - Use edlab version
 - Buy student version.
 - Use Octave, an open source, Matlab-like language.

First assignments

- Readings (numbered at top of course web page):
 - Reading #1. Introduction to Computer Vision.
 - Reading #2. A review of basic probability.
 - Reading #3. Supervised learning and Bayesian classification.
- Programming assignment 1.
 - Handwritten digit classification.
 - Due in 1 week.
 - See web page.

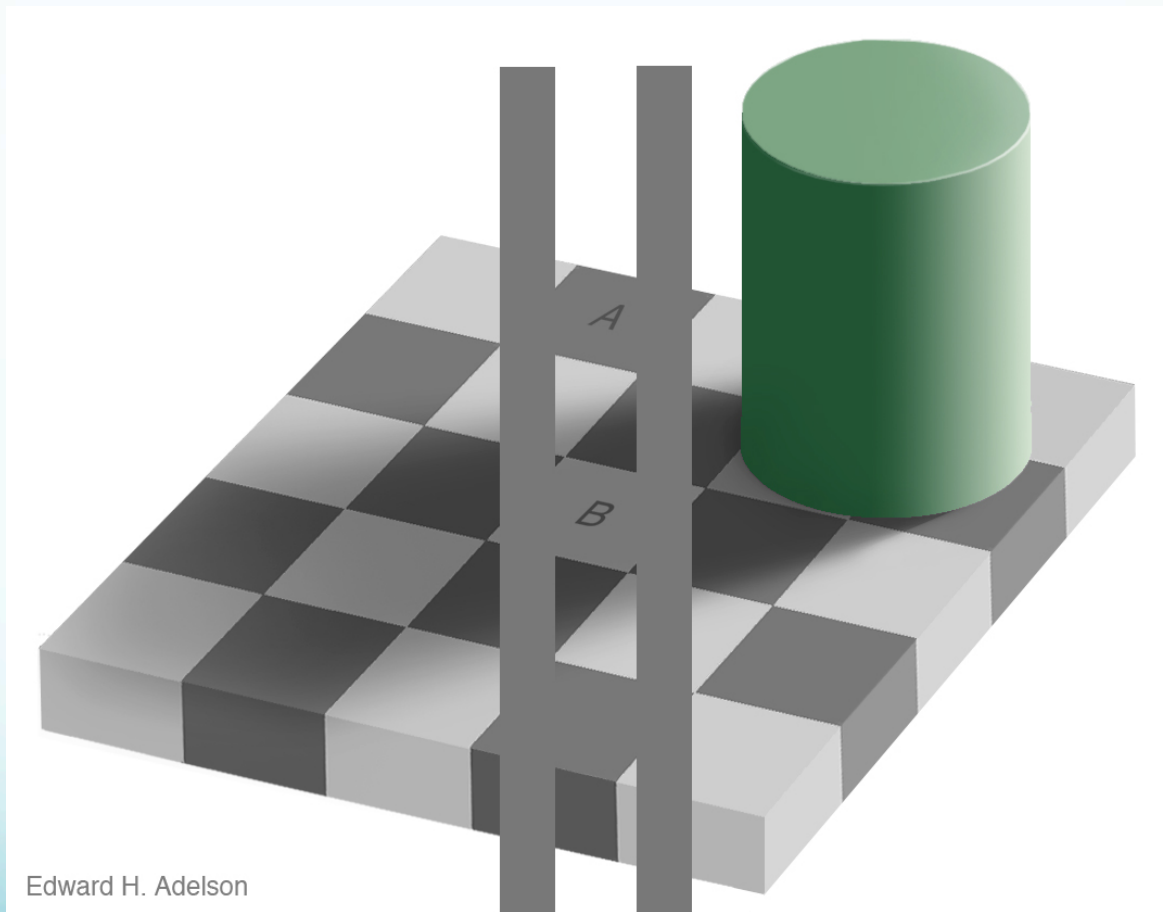
Dramatic Pause...

The Checker Shadow Illusion



Edward H. Adelson

The "Proof"



Edward H. Adelson

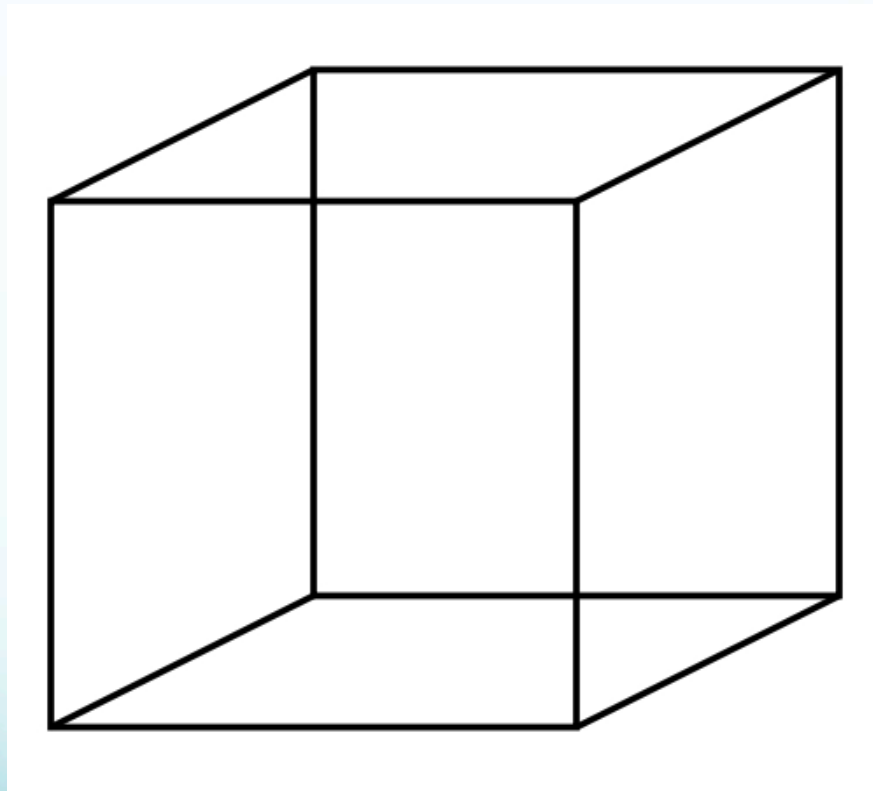
Takeaways

- 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.

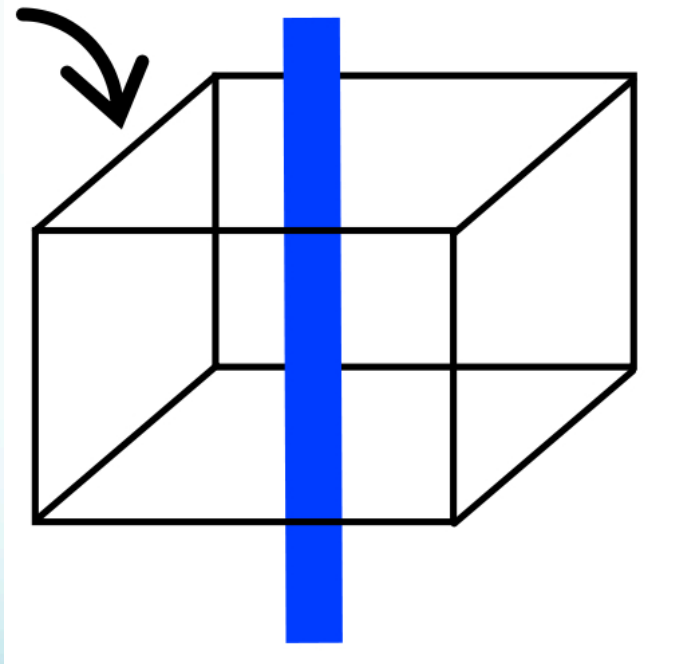
Terminology Interlude

- *Reflectance*
 - percentage of light reflected by a surface
 - also called *albedo*
- *Radiance*
 - how much total light is coming off of a surface
 - What are the factors affecting radiance?
- *Illuminance (irradiance)*
 - how much light is shining on a surface

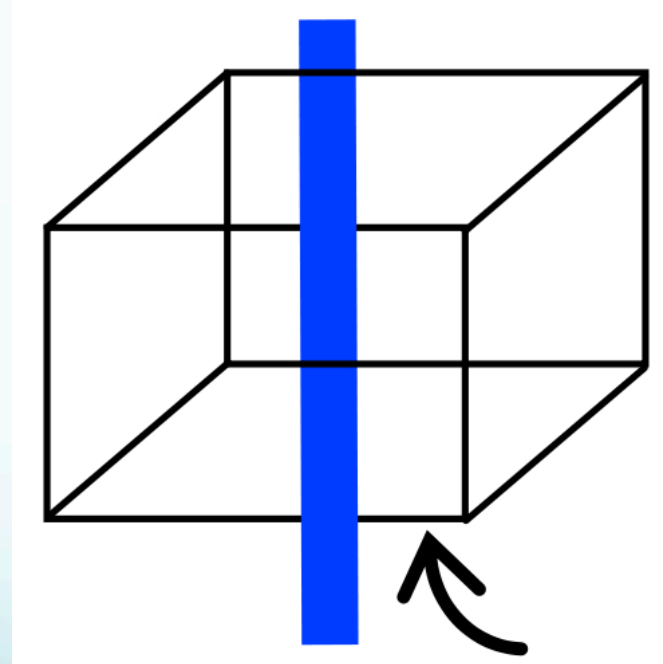
Ambiguity: The Necker Cube



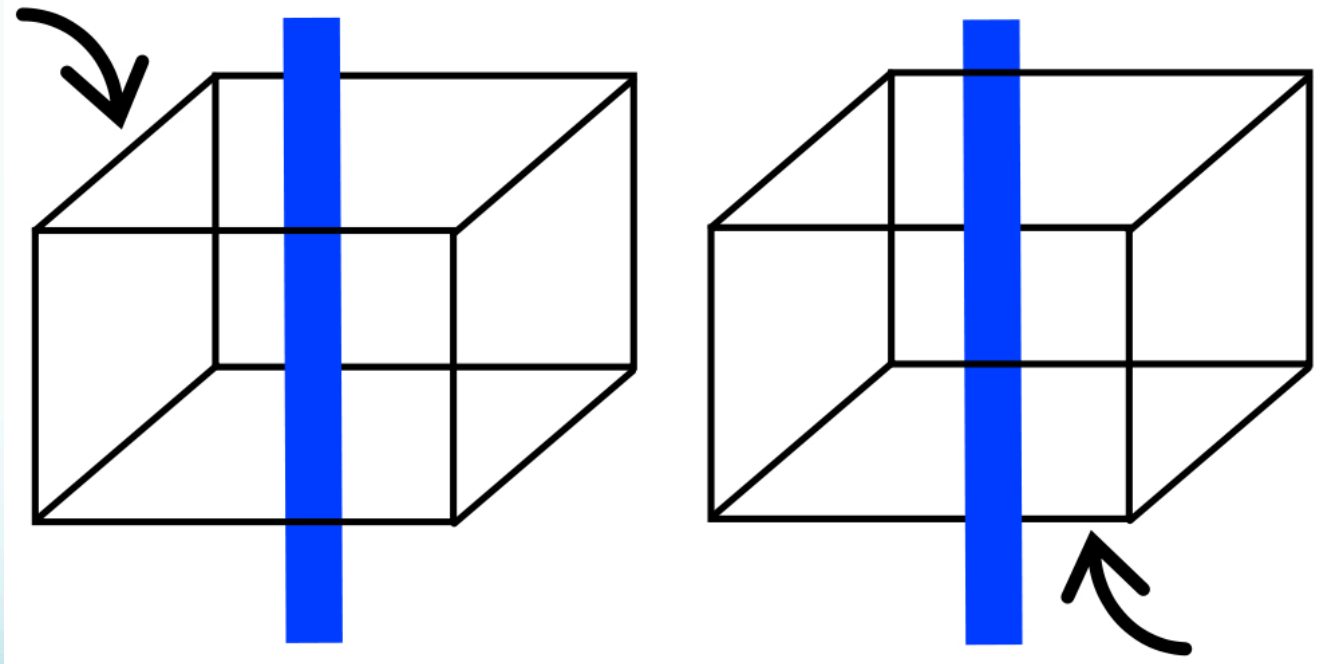
Ambiguity: The Necker Cube



Ambiguity: The Necker Cube



Ambiguity: The Necker Cube



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!

Matlab