Designing Applications that See
Lecture 1: Course Introduction

Dan Maynes-Aminzade

8 January 2008

Today's Goals

- Overview of CS377S: course structure, schedule, and other administrivia

- Learn about some exciting things we can do with computer vision

- See examples of interesting projects that use computer vision

Basic Course Information

- ## Time and Location
  Tuesday & Thursday 11:00AM-12:30PM in Wallenberg 120

- ## Course Website
  http://cs377s.stanford.edu/
  Check here for syllabus, schedule, assignments, readings, and resources.

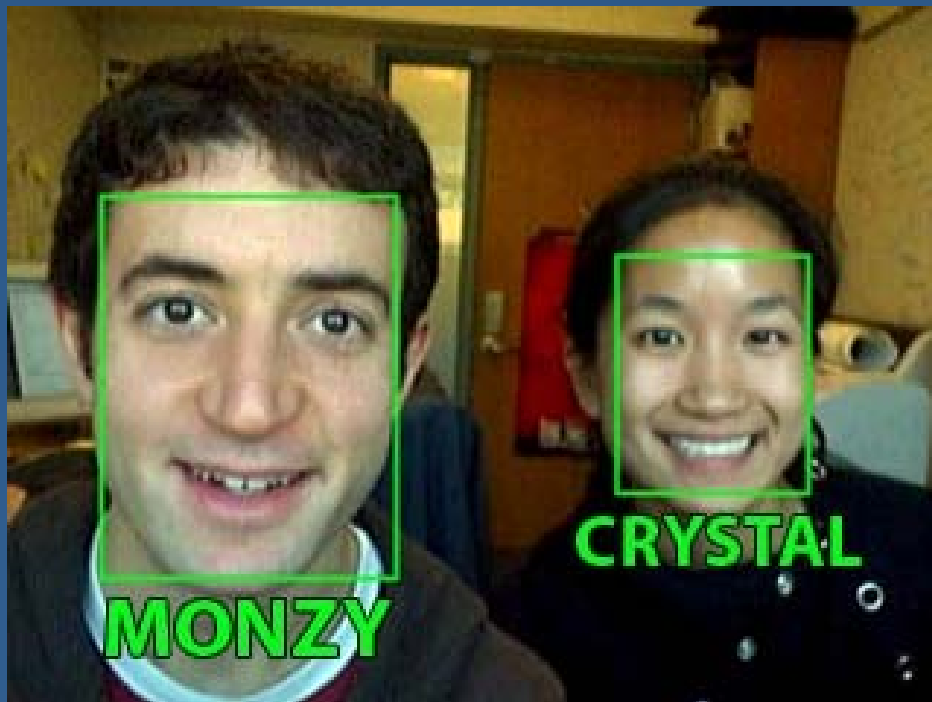- ## Course Newsgroup
  su.class.cs377s
  Use for discussion with other students and general questions about assignments.

Instructor Info

- Dan Maynes-Aminzade (monzy@stanford.edu)
- Office: Gates Bldg. Room 386
- Office Hours: Wednesdays 2:00pm- 4:00pm, or by appointment
- When emailing about the course, please include "CS377S" in the subject.

CA Info

- Crystal Fong (cfongc@stanford.edu)
- Office: Gates Bldg. Room B26A
- Office Hours: Mondays 10:00AM - noon
- When emailing about the course, please include "CS377S" in the subject.

Course Goals

1. Survey the history of computer vision and summarize its main concepts, goals, and techniques.

2. Provide an overview of past HCI research as it relates to computer vision, including the design tools and applications that have been developed.

3. Learn how to apply computer vision techniques to interface design in a real-world context.

Lecture Schedule

Date	Lecture Topic
Jan 8	Course Overview; Introduction to Computer Vision
Jan 10	Human Vision and Perception
Jan 15	Image Processing: Features, Filters, Color, Shape
Jan 17	Nuts & Bolts I: Matlab, Camera Capture
Jan 22	Motion and Tracking: Optical Flow, Temporal Filtering
Jan 24	Nuts & Bolts II: Processing, Processing, JMyron
Jan 29	Machine Learning: Object Detection, Gesture Recognition
Jan 31	Nuts & Bolts III: OpenCV
Feb 5	Computer Vision in HCI: Applications and Examples
Feb 7	Nuts & Bolts IV: Eyepatch
Feb 12	Computer Vision in HCI: Design Tools and Design Challenges
...	Weekly Group Meetings and Advanced Topics (Guest Lectures)

Assignments

- Readings
  - Assigned to correspond to each lecture topic
  - Read before lecture and be prepared for class discussion

- Individual Assignments
  - Hand in at lecture
  - Each assignment has a written portion and an implementation portion
    - Assignment #1: out Jan 15, due Jan 22
    - Assignment #2: out Jan 24, due Jan 31
    - Assignment #3: out Feb 5, due Feb 12

Project

- Five-week team design project during the second half of the quarter

- Build a working prototype of a computer vision-based interactive system.

- Project Milestones
  - Team Registration: due Feb 14
  - Project Proposal: due Feb 19
  - Project Checkpoints: due Feb 26, Mar 4, Mar 11
  - Final Report: due Mar 17

Grading

- Your grade is based on these components:
    - 30% Project Presentation: (team grade)
    - 20% Project Report: (team grade)
    - 30% Individual Assignments
    - 20% Participation
- Attendance at lectures and team feedback sessions is required and will be reflected in your participation grade.

Buy a Webcam, Not a Textbook

Recommended Webcams

- Creative LiveCam Optia AF

- Logitech QuickCamPro 9000

Other Guidelines

- Late Policy: 4 free late days on individual assignments

- Project Team Size: 1, 2, or 3 students

Topics We Will Cover

- Computer Vision Basics
  - Human visual perception
  - Basic image processing: features, filters, color, shape
  - Machine learning: object detection and classification, gesture recognition
  - Motion and Tracking: optical flow, temporal filtering, prediction
- Computer Vision Tools
  - Eyepatch, Matlab, Processing, JMyron, OpenCV, JMF, DirectShow
- Computer Vision in HCI
  - Applications, opportunities, and challenges

Topics We Will NOT Cover

- Basic programming

- Camera models, camera calibration, stereo vision, 3D reconstruction, structure from motion, image mosaics & stitching

- Lots of math

Typical Vision Tasks

- Controlling things (robots, vehicles)

- Detecting events (surveillance, alerts)

- Organizing information (indexing images)

- Modeling objects or environments (inspection, medical image analysis)

- **Interaction** (the focus of this course)

What is Computer Vision?

- Very broadly, computer vision is the science and technology of machines that see.

- This means taking in images or videos and extracting useful information from them.

- Traditionally, computer vision is seen as the inverse of computer graphics.

Computer Graphics

Output

Image

Synthetic
Camera
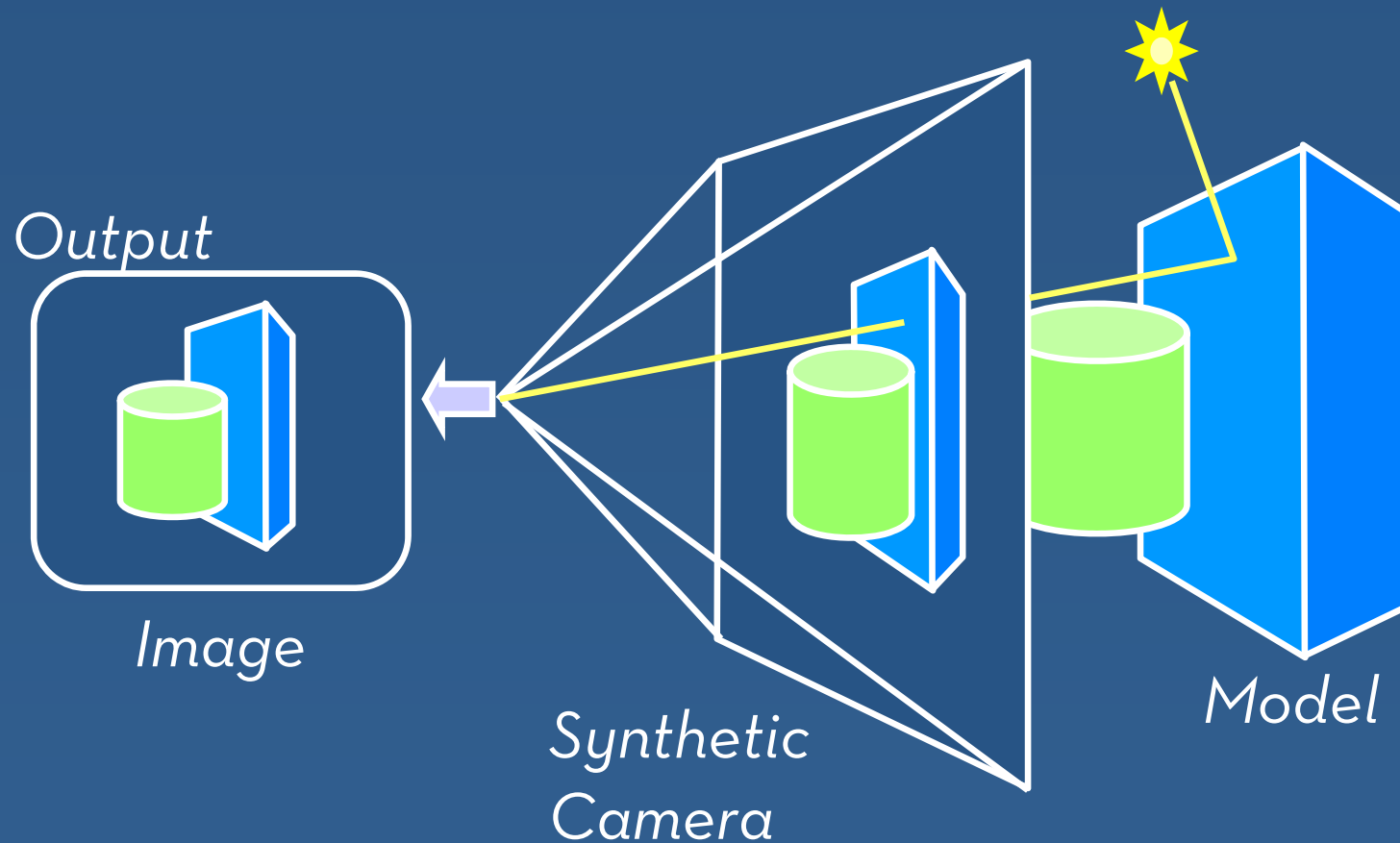
Model

(courtesy of Michael Cohen)
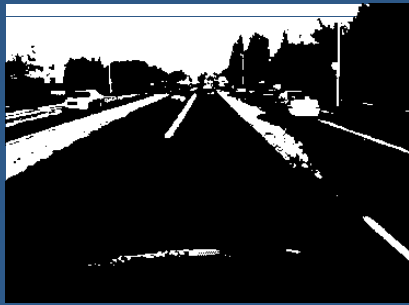
Computer Vision

Output

Model

Real Scene

Real Cameras
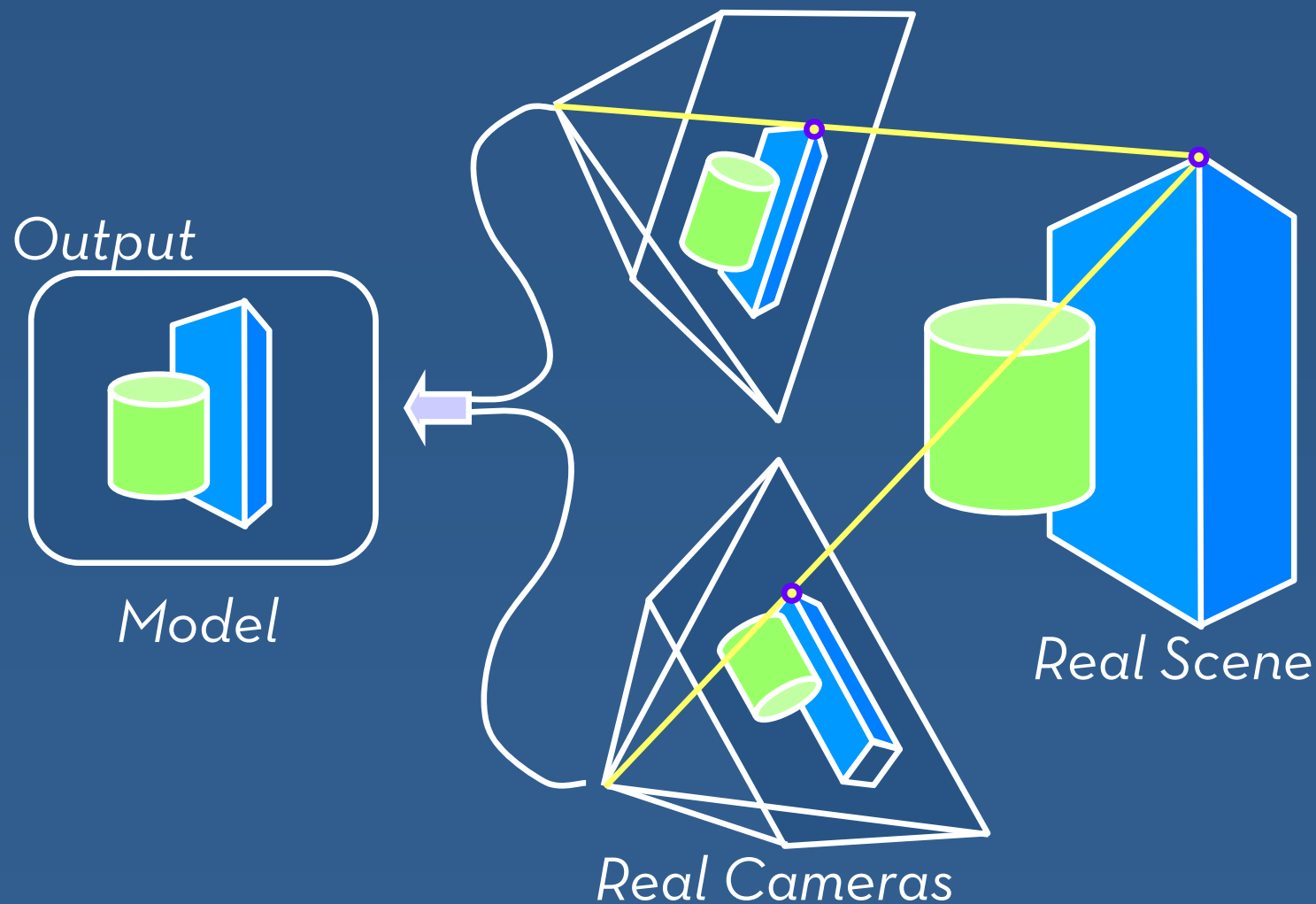
(courtesy of Michael Cohen)

More Realistic Model (for this class)

Extraction of Relevant Basic Features
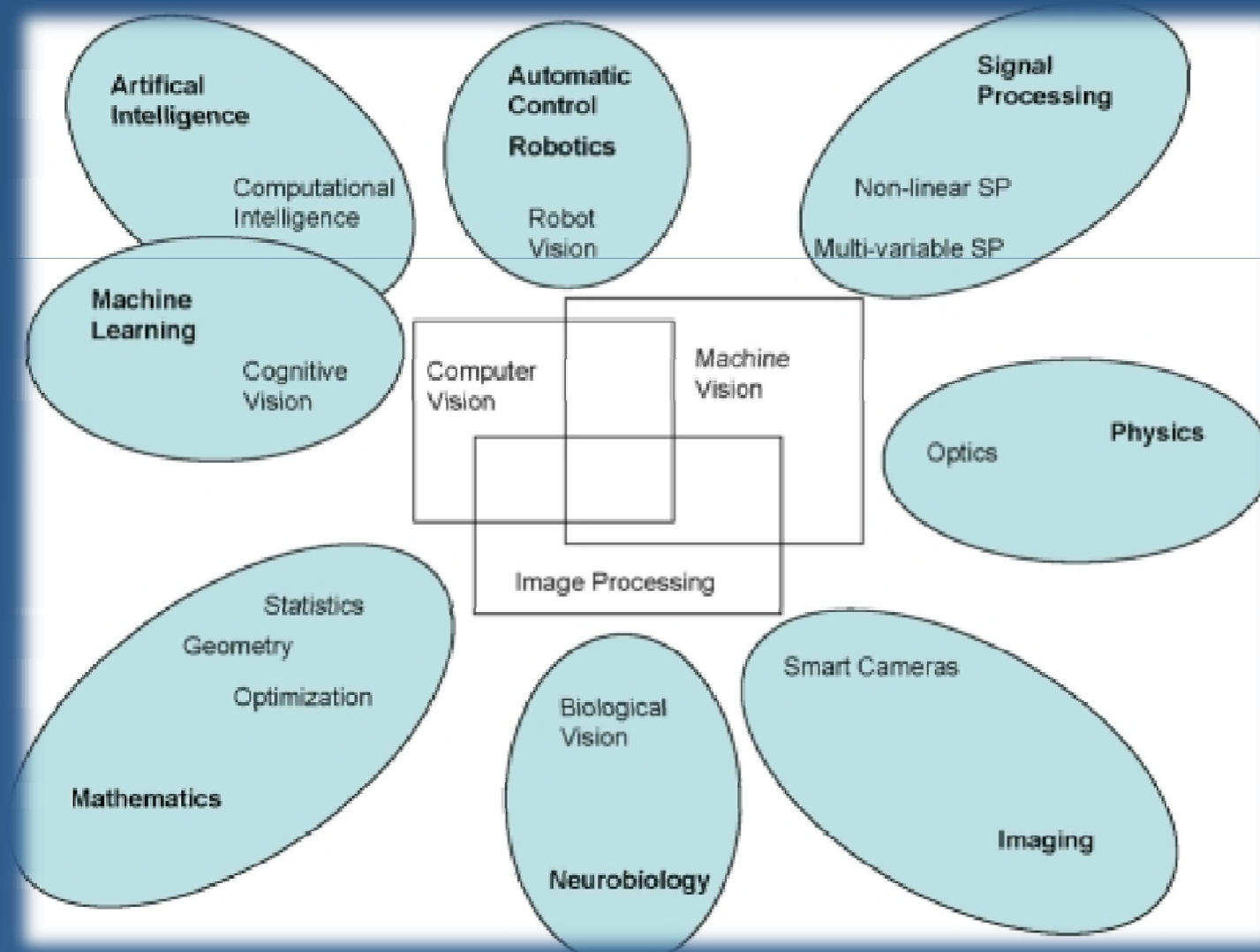
Grainy, Noisy Image

Cheap, Uncalibrated Webcam

Ad hoc estimation of Vague, Approximate Model

Decision Making

Complex Real-World Scene full of Extraneous Information

Computer Vision Disciplines

(courtesy of Wikipedia)

What's the Difference Between...

- Computer Vision

- Image Processing

- Machine Vision

- Imaging

- Pattern Recognition

Some Surprising Facts

1. Computer vision is not actually that hard... the problems are just ill-defined.

Some Surprising Facts

1. Computer vision is not actually that hard... the problems are just ill-defined.

2. Computer vision is basically a collection of hacks... but then, so is human vision.

Some Surprising Facts

1. Computer vision is not actually that hard... the problems are just ill-defined.

2. Computer vision is basically a collection of hacks... but then, so is human vision.

3. Vision systems do not have to be precise or correct all the time in order to do interesting things... provided you pick the right problems and design for uncertainty.
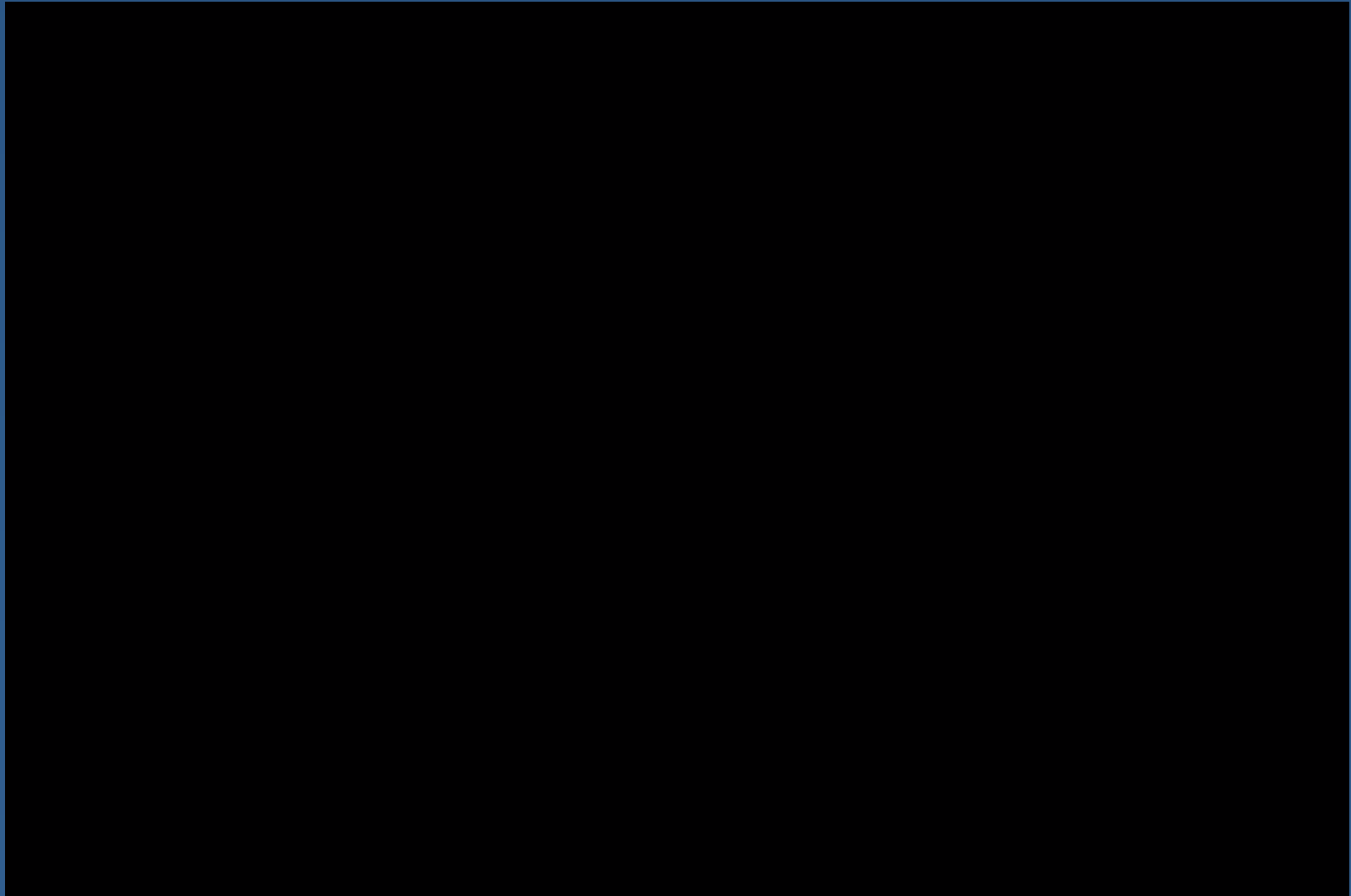
Computer Vision Projects

- Here is a hodgepodge of examples of some of the cool, fun, brilliant, bizarre, and sometimes ridiculous things that people have built using computer vision.

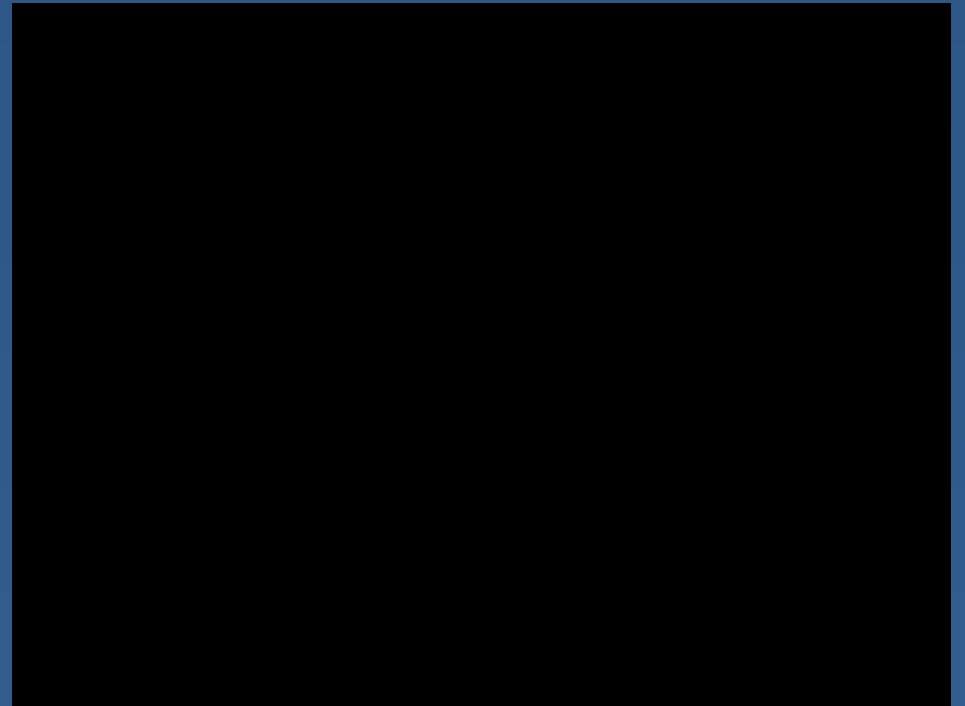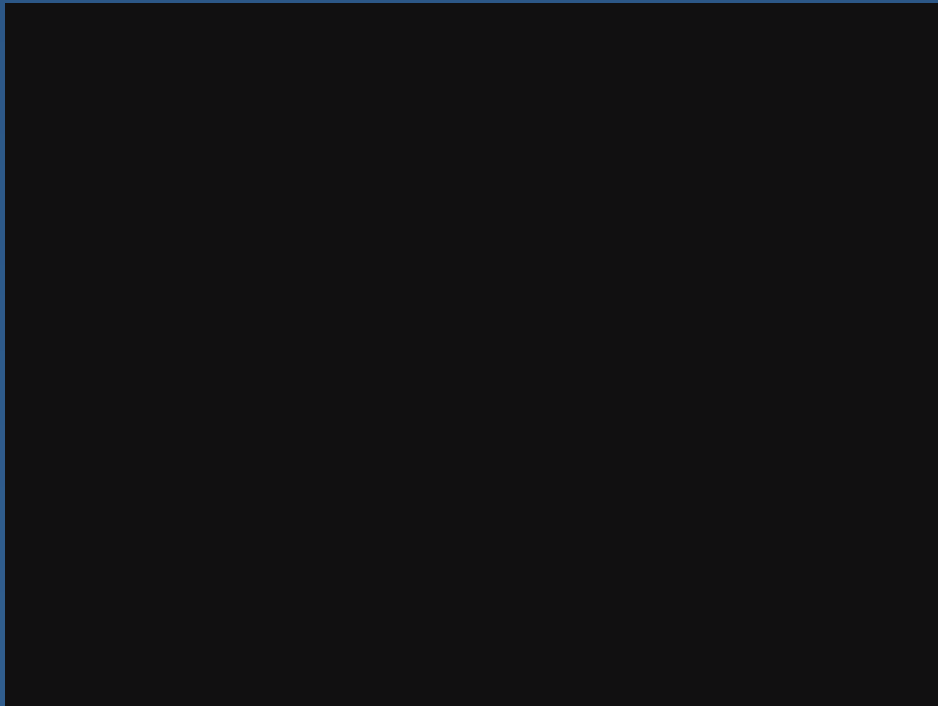- Many more project examples linked from course website.

Last Year's Class Projects

A Few of My Recent Projects

Other Computer Vision Projects

Your Project

- You should have the tools and knowledge necessary to replicate most of these projects by the end of the course.

- Start thinking about what you might do for your group project!

Readings for This Lecture

- **Recent Advances in Computer Vision** Massimo Picardi and Tony Jan, The Industrial Physicist, Volume 9, Issue 1, pages 18-21, 2003.

- **Computer Vision for Artists and Designers: Pedagogic Tools and Techniques for Novice Programmers** Golan Levin, AI & Society, Volume 20, Issue 4, pages 462-482, 2006.

Preview of Next Lecture

- How human vision works (to the best of our current understanding)

- Specialized "subsystems" in human visual processing

- What makes the our visual systems break down