

Computational Vision

CSCI 4270 and 6270

Professor Chuck Stewart

Lecture 01 - Course Mechanics

January 9, 2024

Lecture Overview

- Part 1:
 - About me
 - People and schedules
 - Course mechanics and administrative details
- Part 2:
 - Introduction to computer vision
- Part 3:
 - Introduction to NumPy

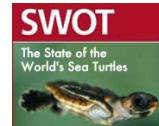
About Me...



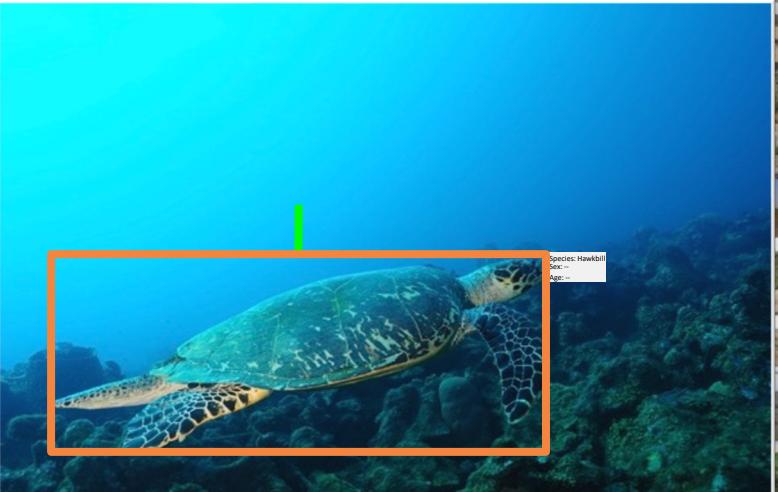
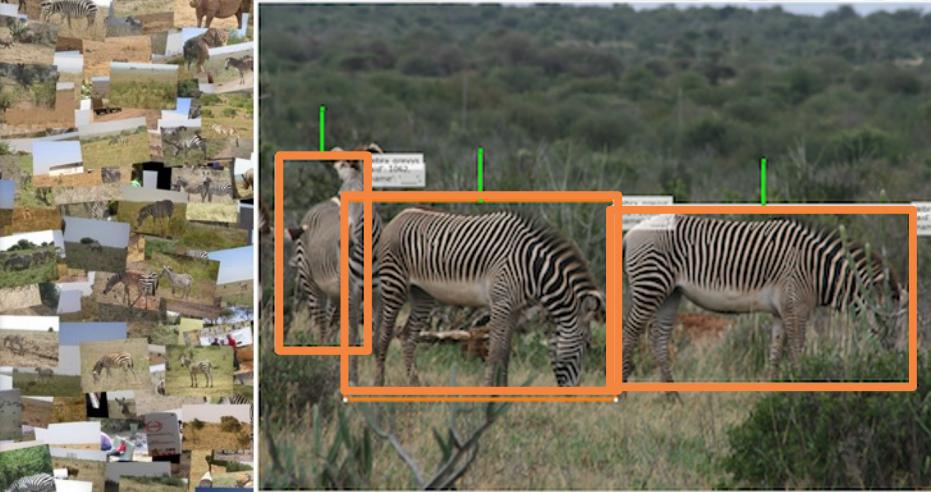
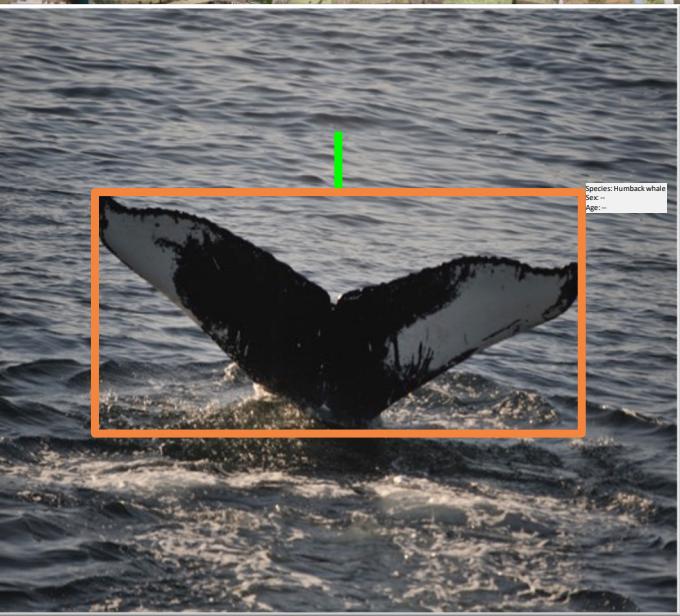
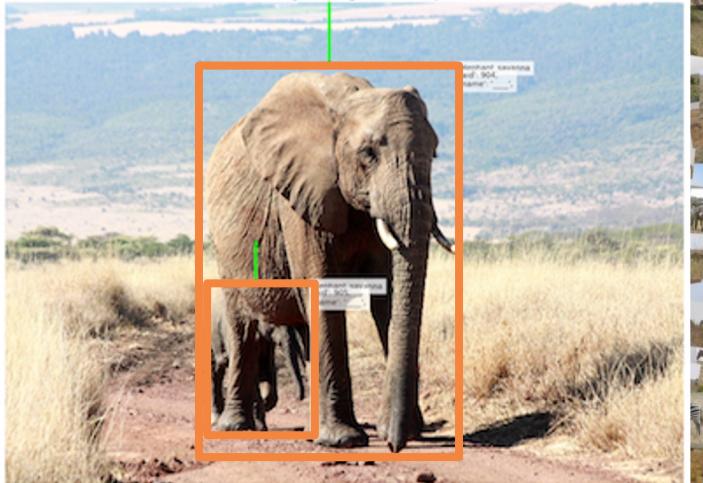
Wildbook Computer Vision Algorithms: From Images to Individual Identities



National Science Foundation
WHERE DISCOVERIES BEGIN









About Me...

The screenshot shows a web browser displaying the homepage of [DualAlign](http://www.dualalign.com/index.php). The page features a dark header with the DualAlign logo and navigation links for HOME, PRODUCTS, TECHNOLOGY, ABOUT US, and CONTACT US. Below the header is a large banner with the text "Better Decisions with i2k Software Products" and an image of the Earth. The main content area includes a "Welcome" section with a sub-section about transforming image registration and recognition technologies, and a "FEATURES" sidebar listing various software capabilities. At the bottom, four software product boxes are displayed: i2kALIGN, i2k"REMOTE" SENSING, i2kPINPOINT, and i2kRETINA.

Advanced Image Registration & ...

http://www.dualalign.com/index.php

Most Visited iGoogle Latest Headlines Gmail - Inbox (1... Gmail - Inbox News Research Data... RPI Weather Outdoors Mark-Recapture VisionWHOI

DualAlign

HOME PRODUCTS TECHNOLOGY ABOUT US CONTACT US

Better Decisions

with **i2k Software Products**

Earth

Welcome

Transforming Image Registration and Recognition Technologies

DualAlign LLC develops advanced multi-image image processing software designed to automatically register and mosaic images over space, sensor/spectrum and time. DualAlign has specialized its' software for the Retinal, Remote Sensing, Machine Vision, and Photographic markets.

DualAlign's software products are based on DualAlign's proprietary image registration and image recognition technologies. DualAlign's worldwide customers are using DualAlign's software to automatically georeference, detect change, get wider fields of view, detect disease, merge sensor data, fuse multiple modalities, and recognize locations better than ever before.

FEATURES

- Automatic Processing
- Generate Control Points
- Process Multiple Bands
- Process Multiple Sensors
- API for Custom Development
- Cross Platform

i2kALIGN
The most advanced

i2k"REMOTE" SENSING
The most advanced

i2kPINPOINT
The most advanced

i2kRETINA
Automatically register and

Dates, Times, URLs

- Class:
 - Tue, Fri 10:00 – 11:50
 - Amos Eaton 214
 - Lecture notes posted on Submitty
- Submitty:
 - *<https://submitty.cs.rpi.edu/courses/s24/csci4270>*
- Email: *stewart@rpi.edu*
- WebEx office:
 - *<https://rensselaer.webex.com/meet/stewart>*
- Campus office: Lally 307
- Office hours:
 - Tue, Wed 1:00 – 2:30
 - Daily checking of Submitty discussion board, weekday late afternoons

TA – Sridhari Sridharan

sridhs3@rpi.edu

OFFICE HOUR LOCATION and TIME are TBD

<https://rensseelaer.webex.com/meet/sridhs3@rpi.edu>

TA – Brendan Cross

crossb@rpi.edu

OFFICE HOUR LOCATION and TIME are TBD

<https://rensseelaer.webex.com/meet/crossb@rpi.edu>

Learning Objectives

At the end of this course, each successful student will be able to

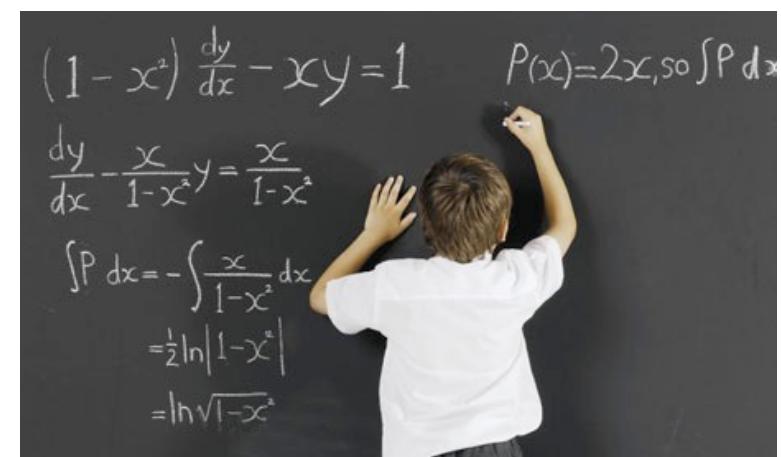
- Apply techniques of calculus and linear algebra to solve problems involved in building the components of a computer vision system.
- Develop efficient algorithms for solving problems in computer vision.
- Write small-sized and intermediate-sized programs for solving problems in computer vision.
- Map potential applications of computer vision into specific technical problems.

Learning Objectives (cont)

- Assess the difficulty of specific technical problems in computer vision and select potential solution techniques.
- Discuss thoughtfully some of the social implications of advanced computer vision technology.
- (6270 only) Evaluate the significance of the ideas and the thoroughness of the experimental analysis of a current research paper in the computer vision field.

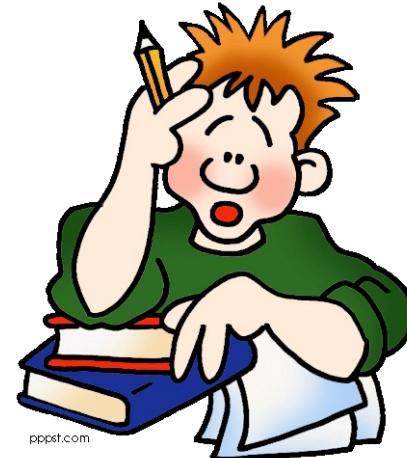
Pre-requisites

- Computer Science
 - Intro programming, esp. Python!
 - Data structures
 - Algorithms
- Mathematics
 - Calculus
 - Multivariable and linear algebra



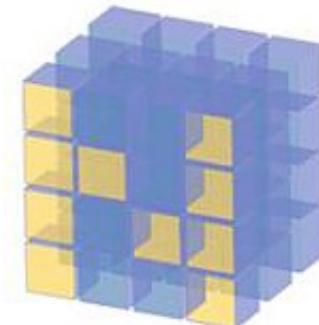
Requirements – 75% Homework and Programming Assignments

- 6 assignments – see syllabus for tentative dates
- Analysis, algorithms, programming and evaluation
 - “Break” your algorithms and code
- Late homework:
 - Five free late days; at most three per assignment
 - After using these 20% per day or part day



Programming

- Python
 - At least 3.9x
- Packages:
 - OpenCV
 - Matplotlib
 - Numpy
 - Scipy
- Recommend Anaconda tools
 - <https://www.anaconda.com/distribution>
 - Install OpenCV
 - Instructions in syllabus
- Also recommend use of virtual environments
- PyTorch midway through the semester



Quizzes – 25%

- Three
 - Worst one is worth 5%
 - Best two are 10% each
- 55 minutes each
- Closed-book and closed-notes
- See syllabus for dates
- Practice problems distributed with lectures



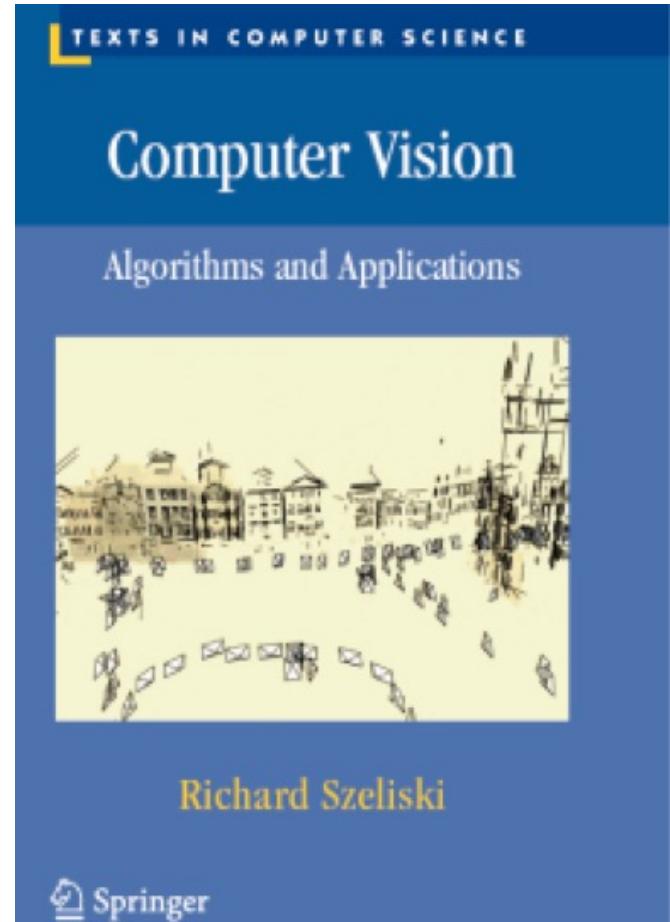
Undergraduate vs. Graduate Level

- Common lectures
- Mostly common homework
- Additional requirements for graduate level in most assignments



No Textbook

- Some background material will reference Rick Szeliski's textbook
 - On-line version at <http://szeliski.org/Book/>
- Other material will be through papers and on-line references
- Students are strongly encouraged to seek and share their own references
 - Post what you find on Submittly!



Academic Integrity - Homework

- See Syllabus for general statement
- Specific guidelines (more detail on HW 1):
 - Discuss problem requirements and techniques presented in class
 - Acknowledge who you worked with
 - Submit own solution; code must be your own.
 - MOSS will be used to compare
- Penalties:
 - First case:
 - 0 on the entire assignment; up to 5% addition
 - Report to the Dean of Students office.
 - Second case: F in the course

AI Tools and LLMs

- Similar to work with other students in the class (and outside):
 - Ask for background
 - Explain concepts
 - Debugging help
 - No writing of solution code
- If you use, please explain in detail how
- Penalties for submitting code you did not write are the same as above: 0 for first infraction, etc.

Academic Integrity - Quizzes

- No copying
- No collaboration
- All your own work
- Penalties:
 - F in the course

Class

- Two more “sub-lectures” of 50 minutes or less, each followed by Q&A
 - Questions welcome in the middle of lecture too!
- Lecture note outlines posted ahead of class
- Most code written in class will be posted afterwards



Use of Submitty

- <https://submitty.cs.rpi.edu/courses/s24/csci4270/>
- All material will be posted here, including
 - Lectures
 - Homeworks
 - Links to data
 - Announcements
- Questions and answers for the discussion area:
 - Clarification on homework questions: Yes
 - Clarification or further explanation of class material: Yes
 - Pointers to good resources: Yes
 - General hints on homework solutions: Yes
 - Questions on OpenCV, Python, NumPy, SciPy, PyTorch: Yes
 - Specifics on solutions to homework: NO!
 - Source code for homework solutions: NO!
- Posting can be anonymous to the rest of the class, but not to me!
- If you have a question on course, on lecture notes, or on homework, do not send email! Instead, post it to Submitty!
 - Other students (or SAlex) may answer long before I do
 - I will answer questions on Submitty (at least once per day), usually late in the afternoon!