Harper College's IDEAShop: Computer Vision, Cameras, & Code

Course Syllabus

Course Title:	IDEAShop: Computer Vision, Cameras, & Code	
Dates:	July 26 – July 30, 2021	
Times:	Interactive Instruction:	8:00 AM – 10:00 AM
	Interactive Lab:	10:15 AM – 12:15 PM
	Office Hours:	7:00 PM – 8:30 PM
Course Homepage:	Google Sites	https://tinyurl.com/harpercv-home or https://sites.google.com/view/harpercv/
Location:	Zoom	https://tinyurl.com/harpercv-zoom
eLearning:	Blackboard	INSERT LINK (Need to create a shell)
Repo	GitHub	https://tinyurl.com/harpercv-github
Camp Organizer:	Jeffrey Moy	jmoy@harpercollege.edu
Course Instructor:	David Hoffman	hd03994@harpercollege.edu
Teaching Assistants:	FName LName	EMAIL → I will reach out to Liam Parker
	FName LName	EMAIL
	FName LName	EMAIL

Course Summary:

This exciting computer vision camp introduces high school students to a visual world behind the lens of a camera. Students will develop working applications using the Python programming language and powerful software including OpenCV, scikit-image, scikit-learn, TensorFlow, and more. Students will build working computer vision pipelines that count objects, classify images, and track motion. Each day, students will learn a new topic, achieve learning milestones, and complete coding challenges. Many challenges will involve a friendly rubber duck from our sister DuckieTown robotics course. Can you make your code play duck, duck, goose? There's no limit to what you can do with creativity, cameras, and keyboards in this 1-week summer camp course!

About the Instructor:

David Hoffman is a computer vision and AI consultant with 10 years of engineering experience. He has a track record of leadership in organizations including robotics, defense, electronics manufacturing, high-tech, and

academia. His expertise is backed by 3 engineering degrees and numerous successful projects. David attend NC State University and earned a B.S. in Computer Engineering and a B.S. in Electrical Engineering. David earned an M.S. in Software Engineering from East Carolina University where he researched image processing on computing clusters and taught undergraduate Discrete Mathematics. David has co-authored a book, *Raspberry Pi for Computer Engineering* and has co-authored over 170 tutorials on computer vision, deep learning, and Python.

Learning Objectives:

I. Colab and Python
   a. Your first Colab Notebook
   b. Classes, Functions, Objects, Variables
   c. Executing in your Browser
   d. Tools: OpenCV, Pillow, Scikit-image, dlib, scikit-learn, Tensorflow, PyTorch

II. Computer Vision Basics
   a. Images and Pixels
   b. Color Spaces and Color Channels
   c. Resizing, Flipping, Rotation
   d. Regions of Interest (RoI)
   e. Drawing
   f. Masking
   g. Blurring

III. Contours
   a. Finding Contours
   b. Looping Over Contours
   c. Filtering Contours
      i. Size
      ii. Color via Masks
      iii. Aspect Ratio
   d. Moments
      i. Hu
      ii. Zernike
   e. Morphological Operations
      i. Why?
      ii. Erosion
      iii. Dilation
   f. Counting ducks
   g. Extracting duck RoIs
   h. Descriptors

IV. Image Descriptors
   a. Feature Vectors
   b. Keypoint Detectors

V. Deep Learning
   a. Data, Data, Data
      i. Organizing Data
      ii. Tagging and Annotating Data
      iii. Data Augmentation

        iv. Synthetic Data
    b. Convolution & Kernels
    c. CNN Building Blocks
    d. Common CNN structures
    e. Pretrained Models
    f. Training your own models
    g. Transfer Learning
VI. Image Classification
    a. KNN
    b. Clustering
    c. Classifying Ducks and Cows
VII. Object Detection
    a. Sliding Windows
    b. Image Pyramids
    c. Haar Cascades
    d. HoG (Histogram of Oriented Gradients) + Linear SVM (Support Vector Machines)
    e. Pretrained CNN Object Detectors
        i. Faster R-CNNs
        ii. Single Shot Detectors
        iii. YOLOv3
    f. Detecting Ducks
    g. Detecting Stop Signs
VIII. Video and Streams
    a. Accessing Webcams
    b. Accessing frames in a Video
    c. Forming a Loop over frames in a stream
    d. Classifying individual frames
    e. Motion Detection
    f. Object Detection
    g. Object Tracking
IX. Robotics
    a. Lighting & Shadows
    b. Stereo & 3D
    c. OpenCV with ROS (Robot Operating System)
    d. Sensor Fusion
    e. Duckie Town

Zoom:

Interactive lectures, interactive labs, and office hours will use the same Zoom link. We may take advantage of the Zoom breakout feature. Use of cameras is always optional however you may be asked to present your screen/application. Please use the reactions feature to raise your hand if you have a question. The instructor and TA hosts reserve the right to mute all microphones.

Blackboard &

The course homepage will have course information and links. Blackboard is an eLearning platform. We will use the following features:

Course Homepage:

- Quizzes – answer multiple choice questions or fill in the answer questions and receive a grade
- Homework (assignments & labs) -- submit the URL to your Colab Notebook
- Roster
- Grades – You'll receive a grade for quizzes, assignments, labs, and participation

Instruction:

Instruction will be delivered over Zoom. Please arrive 5 minutes early prior to the course. If you have a question, please use the reactions feature to raise your hand. During instruction, we'll make use of Google Colab. Instructions will be provided on the first day. You will have the option to make a personal copy of the Colab notebook to use during instruction for notes, questions, examples, and practice. You may be asked to share your screen to present your code after brief polls to the class.

Labs:

Labs are run by the course TAs. The TAs will be online to explain assignments and coding challenges in further detail. Labs will use the exact same Zoom link as the course and one of the TAs will be designated as the host. TAs may initiate the breakout room feature.

Assignments:

Assignments will be provided during labs. It is expected that you work on the assignments during the lab session. If you finish early, that's great and you can begin your coding challenge.

Coding challenges will be provided at the end of each day's lab. The challenges are designed to give you the opportunity to practice what you've learned and be creative. Each day, Tuesday-Friday, please prepare a Colab Notebook and be prepared to present it to the class. One student will be selected at random (we'll use www.random.org) to present. All other students will receive feedback on their assignment before the evening Office Hours session.

Office Hours:

Office hours are optional and are hosted by the course instructor. Please join office hours to receive help on your assignments and coding challenges or for general discussions. Office hours will use the exact same Zoom link as the course.

Grades:

Note: This is not a course for credit. Grades serve as a reference point for students and the instructor to gauge understanding and participating in learning objectives.

Grade weightages are as follows:

%	Task
10	Participation
20	Quizzes
35	Assignments
35	Coding Challenges