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:	9:00 AM – 12:00 PM (M – F)
	Office Hours:	4:00 PM – 5:00 PM (M – Th; by appointment)
Course Homepage:	Google Sites	https://tinyurl.com/harpercv-home
Location:	***Webex***	https://tinyurl.com/harpercv-webex
Repo	GitHub	https://tinyurl.com/harpercv-github
Camp Organizer:	Jeffrey Moy	jmoy@harpercollege.edu
Course Instructor:	***David Hoffman***	hd03994@harpercollege.edu 708-446-0955
Teaching Assistants:	Liam Parker	l_parker16@mail.harpercollege.edu

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. Some 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:

Monday	• Colab and Python
	  ○ Your first Colab Notebook
	  ○ Classes, Functions, Objects, Variables
	  ○ Executing in your Browser
	  ○ Tools: OpenCV, Pillow, Scikit-image, dlib, scikit-learn, Tensorflow, PyTorch
	• Computer Vision Basics
	  ○ Images and Pixels
	  ○ Color Spaces and Color Channels
	  ○ Resizing, Flipping, Rotation
	  ○ Regions of Interest (RoI)
	  ○ Drawing
	  ○ Masking
	  ○ Blurring

Tuesday	• Contours
	  ○ Finding Contours
	  ○ Looping Over Contours
	  ○ Counting
	  ○ Extracting ROIs
	  ○ Filtering Contours (by size, color, aspect ratio)
	  ○ Morphological Operations (erosion & dilation)
	  ○ Moments (Hu, Zernike)
	• Image Descriptors
	  ○ Feature Vectors
	  ○ Keypoint Detectors

Wednesday	• Deep Learning
	  ○ Data
	  ▪ Organizing Data
	  ▪ Tagging and Annotating Data
	  ▪ Data Augmentation
	  ▪ Synthetic Data
	  ○ Convolution & Kernels
	  ○ CNN Building Blocks
	  ○ Common CNN structures
	  ○ Pretrained Models
	  ○ Training your own models
	  ○ Transfer Learning
	• Image Classification
	  ○ KNN
	  ○ Clustering
	  ○ Classifying Images

Thursday	• Object Detection
	  ○ Sliding Windows
	  ○ Image Pyramids
	  ○ Haar Cascades
	  ○ HoG (Histogram of Oriented Gradients) + Linear SVM (Support Vector Machines)
	  ○ Pretrained CNN Object Detectors
	• Video and Streams
	  ○ Accessing Webcams
	  ○ Accessing frames in a Video
	  ○ Forming a Loop over frames in a stream

	○ Classifying individual frames ○ Motion Detection ○ Object Detection ○ Object Tracking • Object Tracking ○ OpenCV's built-in Object trackers (8)
Friday	• Catch up or introduce a new topic

WebEx:

Interactive lectures, interactive labs, and office hours will use the same WebEx link. We may take advantage of the WebEx 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.

Instruction:

Instruction will be delivered over Webex. 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.

TAs:

The TAs will be online to explain assignments and to help you with your code.

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, be prepared to discuss/present your assignment in class.

Office Hours:

Office hours are optional and are hosted by the course instructor. Please email/call the instructor to set up a time. Please join office hours to receive help on your assignments and coding challenges or for general discussions. Office hours will use the exact same Webex 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**
20	Participation
40	Assignments
40	Homework