



24-678: Computer Vision for Engineers

Carnegie Mellon University

PS8b

Due: 12/16/2022 (Fri) 5 PM @ Gradescope

Issued: 11/30/2022 (Wed)

Weight: 5% of total grade

Note:

PS8b Human Detection

Human detection is one of the most important computer-vision applications. Figure 1 shows a typical output view in the autonomous vehicle application.

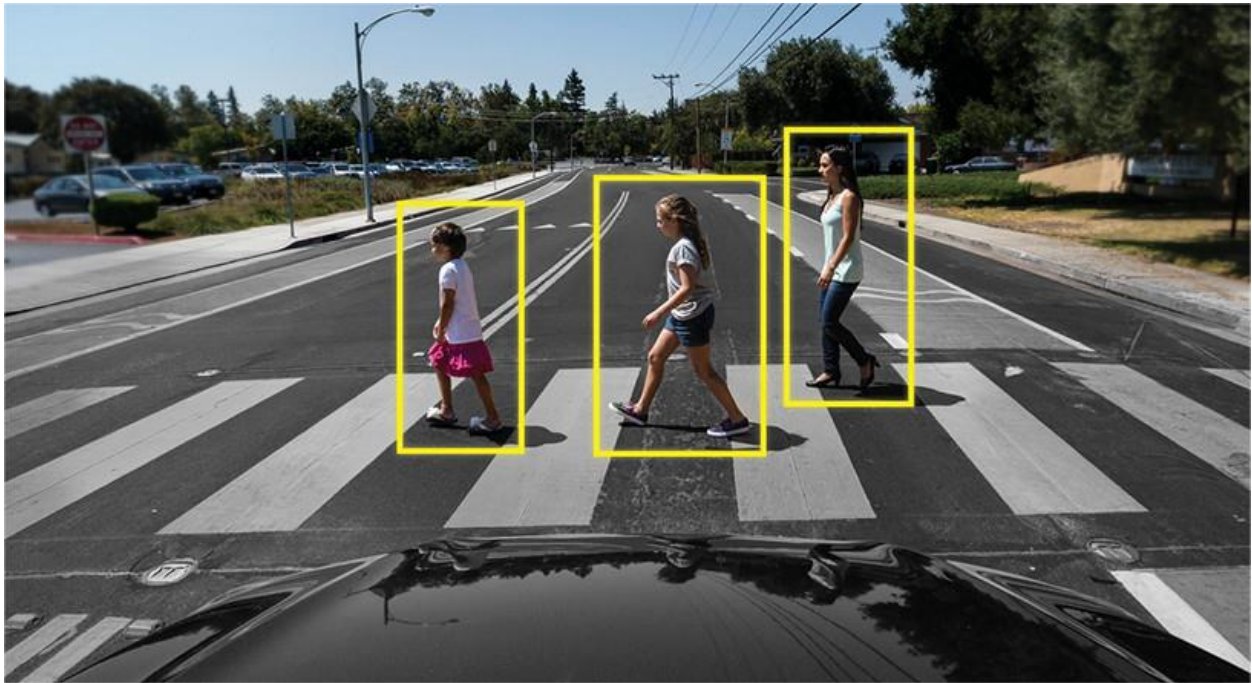


Figure 1: Pedestrian detection on autonomous vehicle

A skeleton OpenCV program is provided for detecting humans in an image. The training.py code trains the model using the images included in the training dataset, ps8b-training-dataset.zip. The testing.py code tests the results with several real-world test images, included in ps8b-test-dataset.zip, by placing a bounding box on each detected person. The test images are:

- Person in the woods
- Football game
- beetles



Figure 2: person in the wood



Figure 3: bounding box result

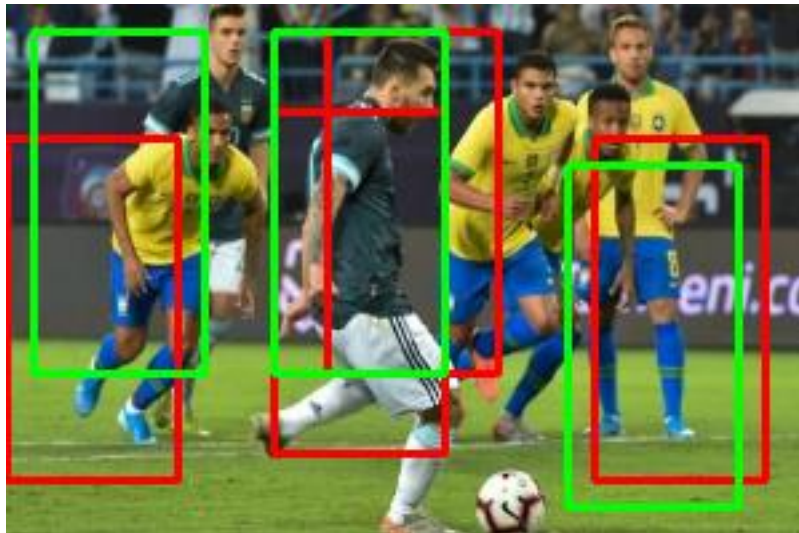
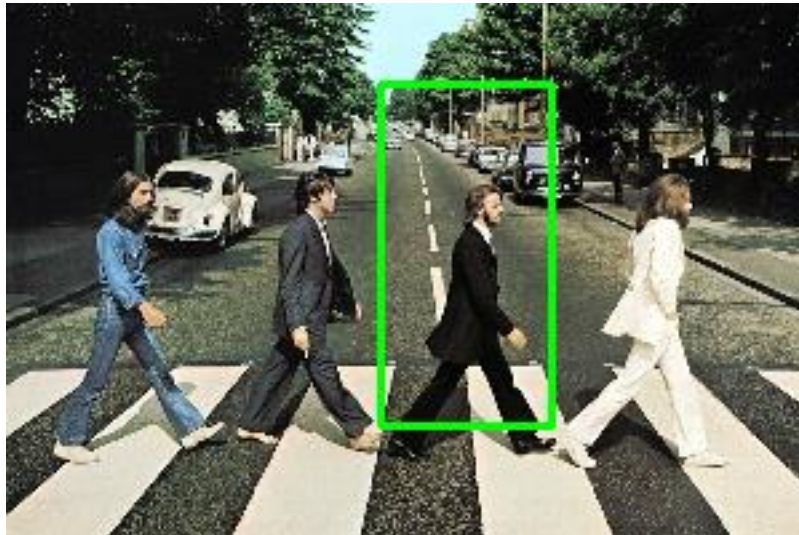
In this problem set, you will study the skeleton code provided, understand how it works, and then modify the program. In class, you have learned KNN, a supervised learning method. In this assignment, you will learn another supervised learning method called SVM. **Test different kernels, linear, svc, poly, and rbf, and discuss your observation when using different kernels.** The detailed parameters are described in this online document:

<https://scikit-learn.org/stable/modules/generated/sklearn.svm.SVC.html>

The skeleton code uses a method called histogram of oriented gradients (HOG) to detect features. The Canny edge detector is one application of this method. You do not need to write your own HOG algorithm, as it is provided in the skeleton code. The following paper discusses HOG for human detection in detail:

<https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1467360>

You are expected to see similar results as the following. This is caused by the limitation of HOG. Write a short paragraph of discussion explaining why this may occur.



Submission

To prepare for the submission of your work on Gradescope, create:

(1) a folder called “ps8a,” that contains the following files:

- source code file(s)
- discussion of your observation
- output image created by your program:
 bounding box on three images
- "readme.txt" file that includes:
 - Operating system

- IDE you used to write and run your code
 - The number of hours you spent to finish this problem
- (2) a PDF file that contains the printouts and screenshots of all the files in the ps8 folder. Include the explanation of what modifications you made to detect all five types of mechanical parts. (Include, if any, the mathematical derivation and/or description of your method in the PDF file. Handwritten notes should be scanned and included in the PDF file.)