1 Overview of the project

This project basically employ the traditional computer vision methods (such as HOG feature, sliding window techniques and SVM classifier) to find where the car is. More precisely, the following topics will be used in this project:

1. HOG feature
2. Linear SVM
3. Feature normalization
4. Color space and space binning
5. Multi scale sliding windows search

The code for most processing steps are contained in the IPython notebook vehicle_detection.ipynb. Most of the codes are duplicated and rearranged from the lesson codes.

2 Extract Hog Feature.

I started by reading in all the vehicle and non-vehicle images. Here (Fig 1) is an example of vehicle and non-vehicle classes. The HOG feature is calculated directly using the skimage library.

3 Sliding windows search

I recorded the positions of positive detections in each frame of the video. From the positive detections I created a heatmap and then thresholded that map to identify vehicle positions. I then used scipy.ndimage.measurements.label() to identify individual blobs in the heatmap. I then assumed each blob corresponded to a vehicle. I constructed bounding boxes to cover the area of each blob detected. I first tried using single scale sliding windows and without heatmap. Fig 2 is an example result of the detected potential box.

The Fig 3 shows the heatmap detected by multiple scales sliding window method.

4 Briefly discuss any problems / issues you faced in your implementation of this project. Where will your pipeline likely fail? What could you do to make it more robust?.

The most obvious disadvantage of the conventional cv-based method is very time-consuming, we can not detect the object real-time. To improve the recall of detection, we will try larger number of scales, which is more unaffordable. On the other hand, recent researches on convolutional neural network achieved much better performance on object detection, such as YOLO, faster rcnn, SSD and so on. The detection time can be controlled under 30ms, which can be used in real-time application and achieved better precision and recall at the same time.

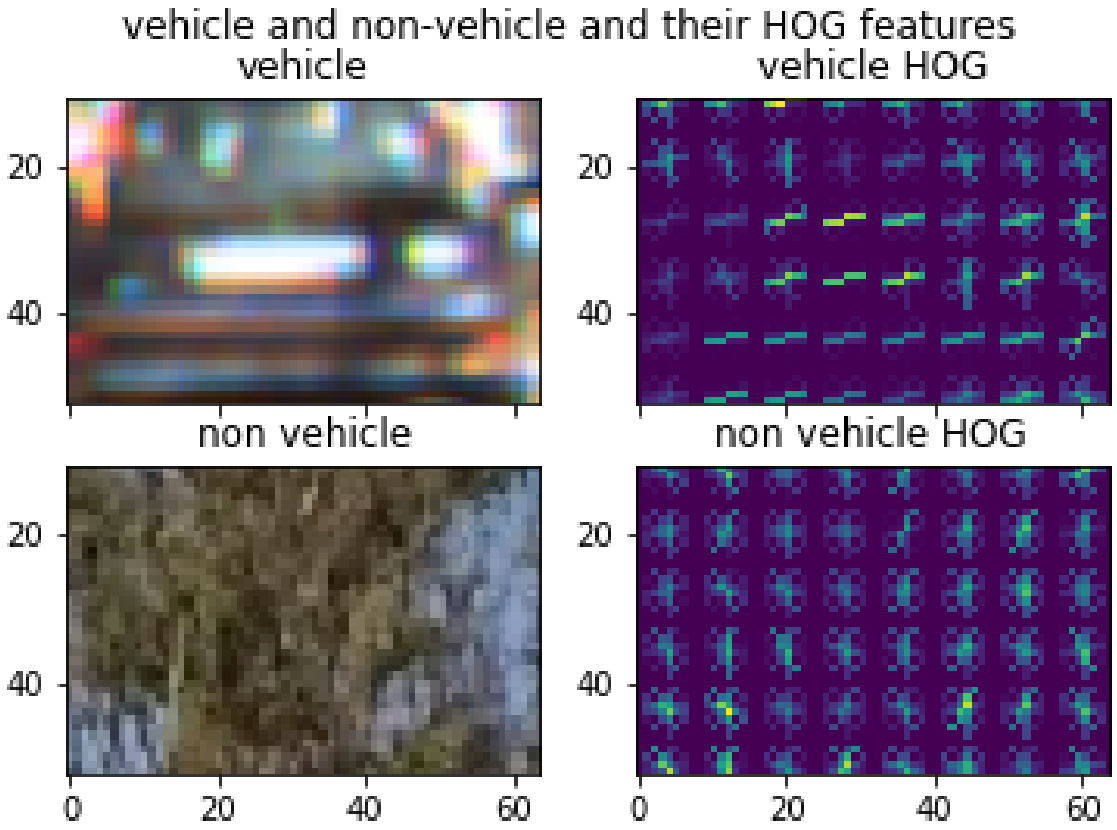

Figure 1: Illustration of vehicle image and it's HOG feature.

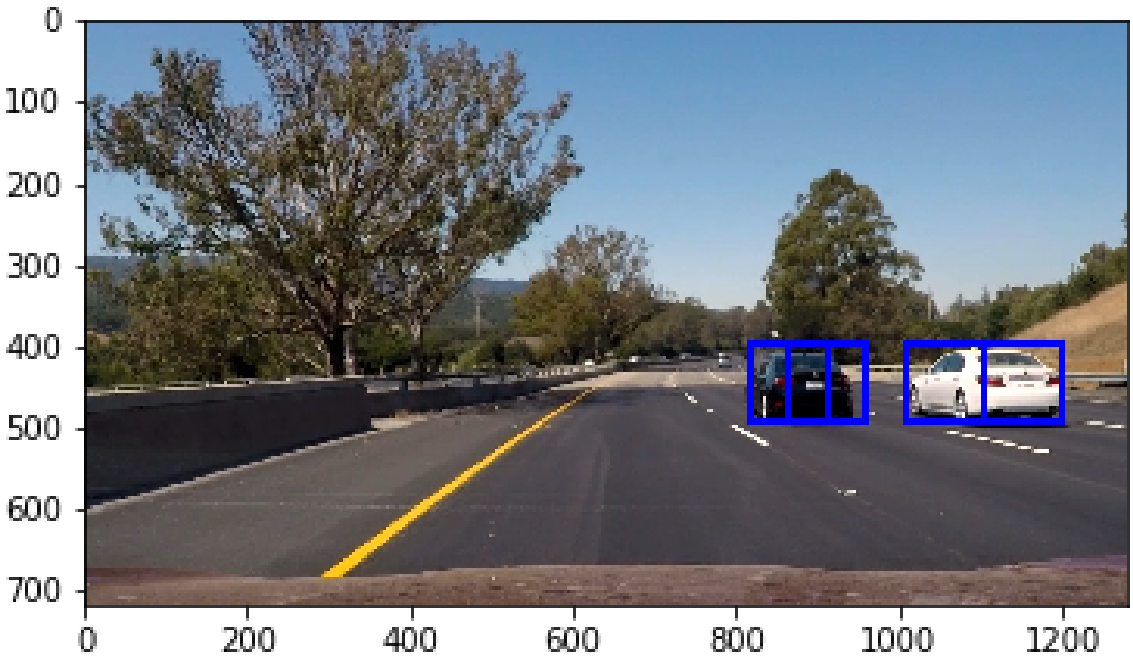

Figure 2: Illustration of scale 1 detected bounding box.

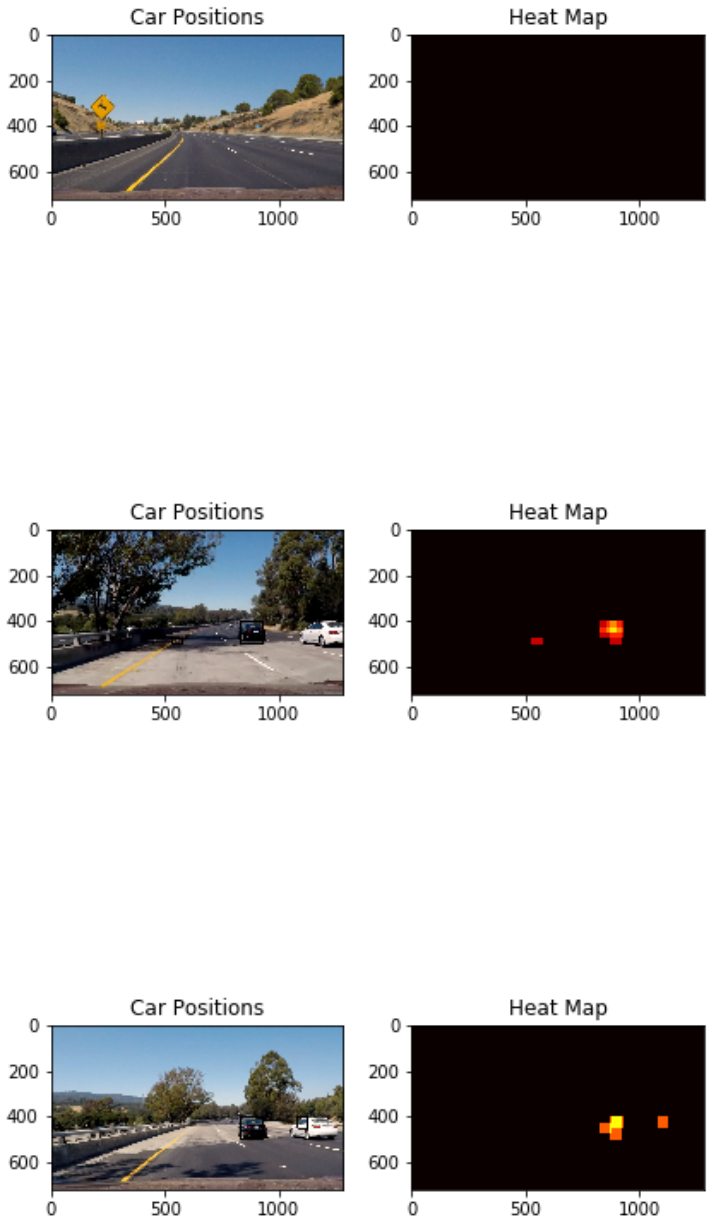

Figure 3: Illustration of detected bounding box and their heatmaps.