

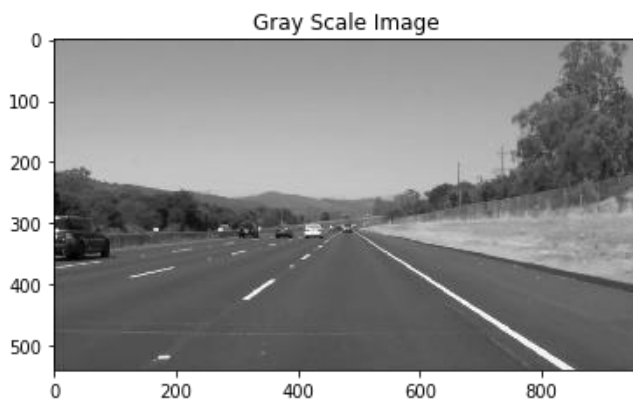
# Finding Lane Lines on the Road

The goal of this project is to create a simple pipeline to detect lane lines in a series of individual images of road lanes or video streams.

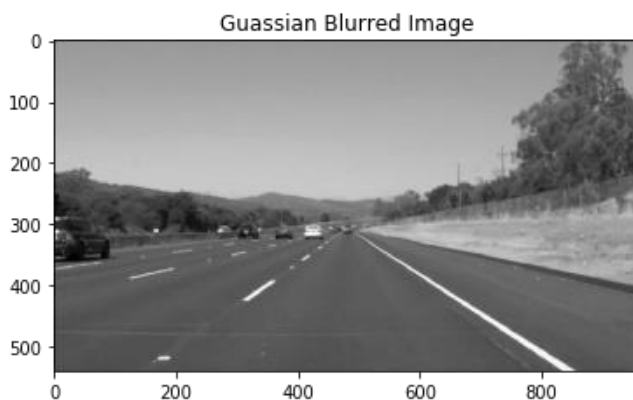
## 1. Pipeline

The pipeline consists of 5 steps.

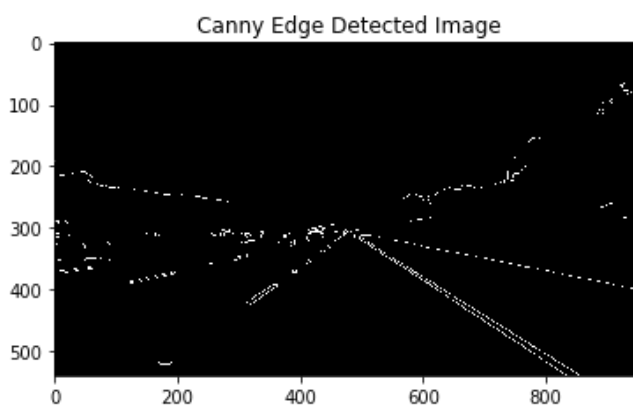
Step 1: Convert the image into grayscale.



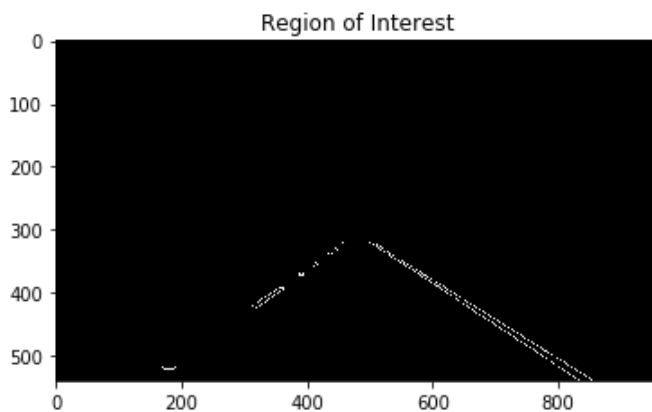
Step 2: Apply Gaussian filter on the image with kernel size = (5, 5)



Step 3: Apply Canny Edge Detection Technique on the image to get the image only with the edges and other regions blacked out. Threshold values are chosen in between 100 and 200 (with the ratio 1:2).



Step 4: Find the region of interest. Since the camera is mounted on a fixed position on the top of the car, lane lines are expected to be captured with the polygon defined by vertices (100,540), (445,320), (520, 320), (960,540).

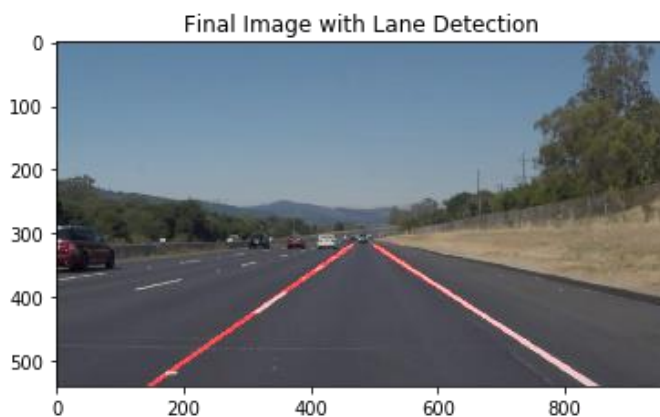


Step 5: Apply Hough Transform on the obtained image from previous step to detect the lines. Following parameters were selected:  $\rho=1$ ,  $\theta=\pi/180$ , threshold=40, min\_line\_len=100, max\_line\_gap=200.

In the next step, the lines obtained from Hough Transform are extrapolated to identify the full extent of the lane and to mark it clearly.

Slope of each line is calculated, and these lines are separated based on positive (left lane) and negative (right lane) slopes. Average slope of left lane and right lane are calculated. In the next step, average value of x and y co-ordinates (intercepts) for both left and right lane are calculated. With the known value of bottom left, top left, bottom right and top right co-ordinates of y-axis (considering image shape), the bottom left, top left, bottom right and top right co-ordinates of x-axis are calculated. These co-ordinate values are then used to draw the lane lines.

Finally, these lines are added to original image by taking weighted sum.



As video is a series of images, the above pipeline is repeated for each individual image frame of a video to draw the lane lines.

## **2. Potential shortcomings with current pipeline**

The potential shortcomings with this current pipeline are:

1. Current pipeline is only limited to the lane lines which are straight. In practical scenarios, lane lines need not always be straight. It may have curvature. This pipeline cannot detect the lane lines properly if it has curvature.
2. Region of interest is assumed based on the position of the camera on the top of the vehicle/car. If the position of the camera is changed, the pipeline cannot detect the lane lines properly.

## **3. Possible improvements to pipeline**

The possible improvement in the pipeline could be as follows,

1. The pipeline could be improved to detect the lane lines even if it has curvatures.
2. If the pipeline can automatically detect the region of interest, even if the camera position is changed, it can still properly detect the lane lines.