My Advanced Lane Lines

October 31, 2018

In [1]:
```
import numpy as np
import glob
import cv2
import matplotlib.pyplot as plt
from moviepy.editor import VideoFileClip
from IPython.display import HTML
from lane_detection_util import *

%matplotlib inline
%load_ext autoreload
```

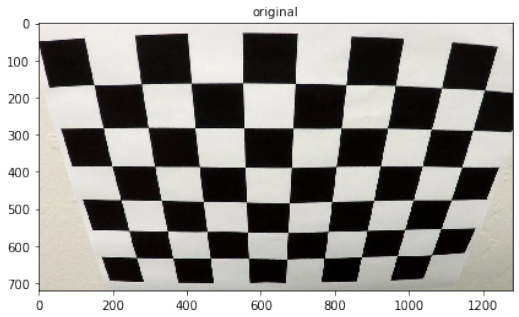
In [2]:
```
images = np.array([plt.imread(i) for i in glob.glob('./test_images/*.jpg')]
                  + [plt.imread(i) for i in glob.glob('./problem_frames/problem_frame*.j
images_cal = np.array([plt.imread(i) for i in glob.glob('./camera_cal/*.jpg')])
image_size = (images[0].shape[1], images[0].shape[0])
```

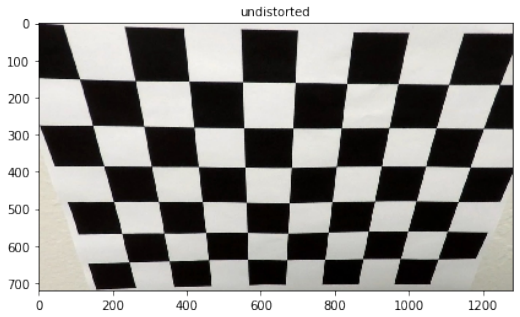
In [3]:
```
# 1. preapre mask
mask_vertices = np.array([[[182, 720], [500, 466], [782, 464], [1234, 720]]])

# 2. setup threshhold in color channel
color_thresh = [90,255]

# 3. setup threshhold in gray channel
gray_thresh = [200,217]

# 4. setup source of perspective transform
src = np.float32([[258, 679], [446, 549], [837, 549], [1045, 679]])

# 5. setup destionation of perspective transform
dst = np.float32([[258, 679], [258, 549], [837, 549], [837, 679]])

# 6. preapre sliding window dimensions
sliding_window = [80,120]
```

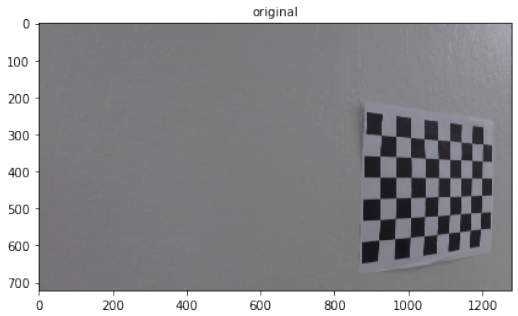
0.1 A. Camera caliberation with parameters

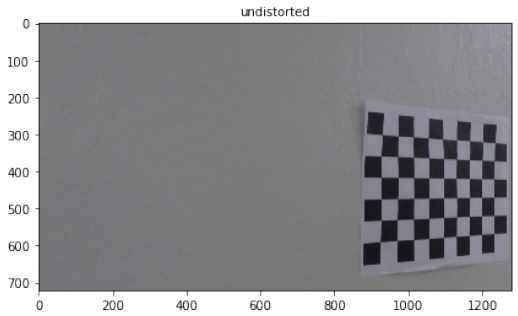
In [4]:
```
dist_matrix, dist_param = camera_cal_parameters(images_cal,image_size)
```

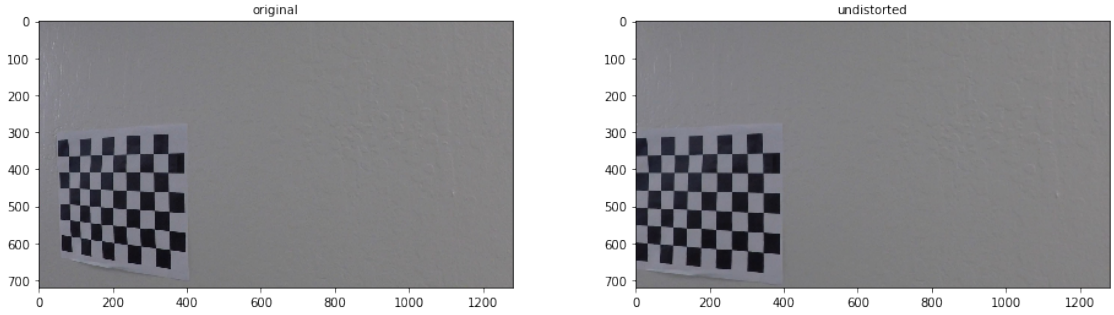
In [5]:
```
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(16,4))
ax1.imshow(images_cal[7])
ax1.set_title('original', fontsize=10)
ax2.imshow(undistort(images_cal[7], dist_matrix, dist_param))
ax2.set_title('undistorted', fontsize=10)

fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(16,4))
ax1.imshow(images_cal[9])
ax1.set_title('original', fontsize=10)
ax2.imshow(undistort(images_cal[9], dist_matrix, dist_param))
ax2.set_title('undistorted', fontsize=10)

fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(16,4))
ax1.imshow(images_cal[2])
ax1.set_title('original', fontsize=10)
ax2.imshow(undistort(images_cal[2], dist_matrix, dist_param))
ax2.set_title('undistorted', fontsize=10)

plt.show()
```



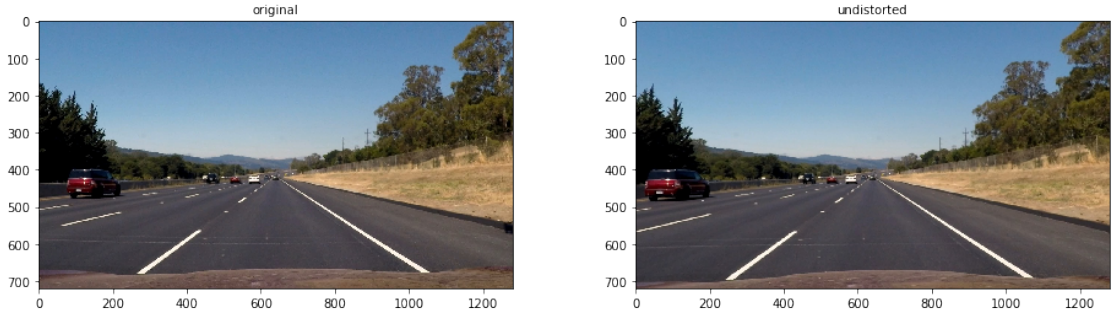






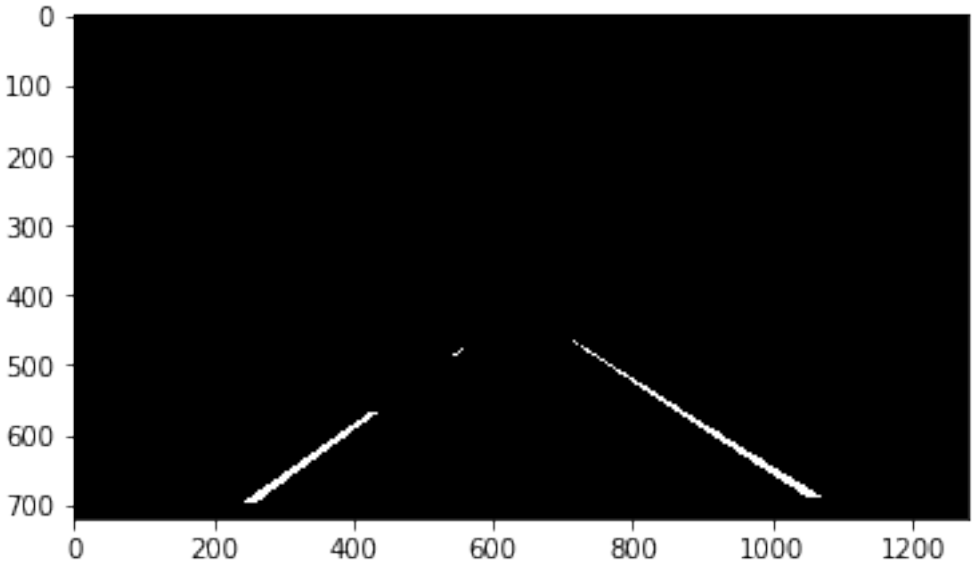



```
In [6]: image = images[4]
        image_undist = undistort(image, dist_matrix, dist_param)
        fig,(ax1,ax2) = plt.subplots(1, 2, figsize=(16,4))
        ax1.imshow(image)
        ax1.set_title('original', fontsize=10)
        ax2.imshow(image_undist)
        ax2.set_title('undistorted', fontsize=10)
        plt.show()
```



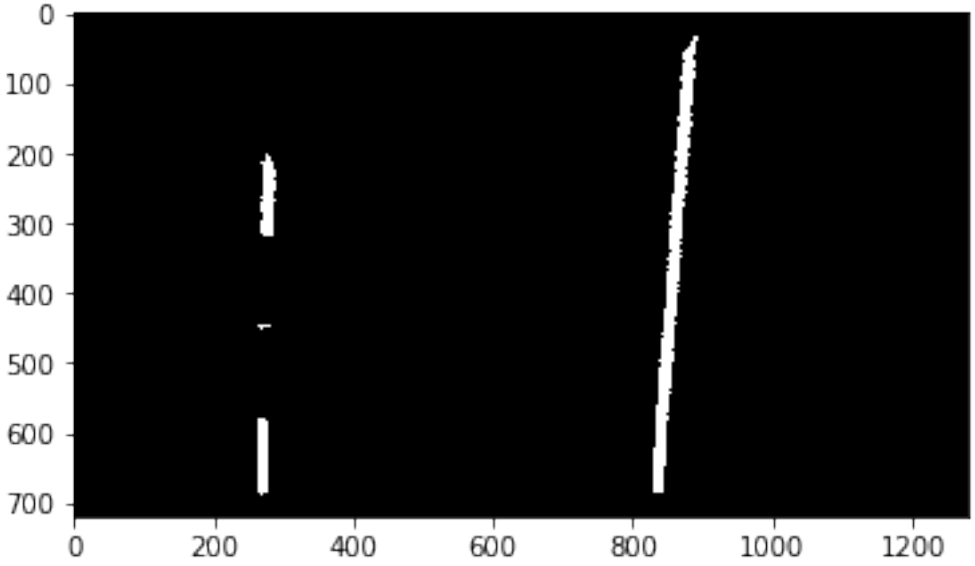
0.2 B. Image thresholding

```
In [7]: image_binary = preprocess(image_undist, mask_vertices=mask_vertices, color_thresh=color_
        plt.imshow(image_binary, cmap='gray')
        plt.show()
```



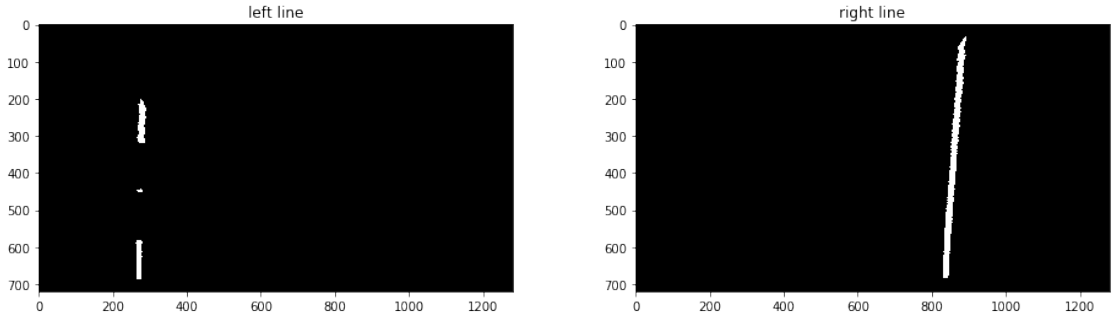
0.3 C. Perspective Transformation

```
In [8]: image_binary_bird = perspective_transform(image_binary, src, dst)
        plt.imshow(image_binary_bird, cmap='gray')
        plt.show()
```



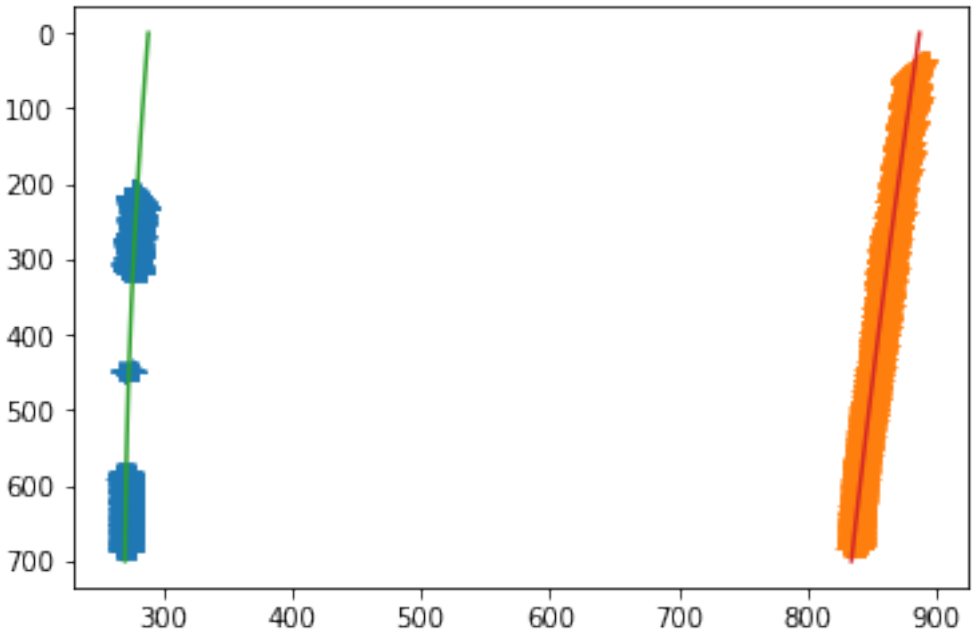
0.4 D. Detect left and right lane lines

```
In [9]: left_lane, right_lane = select_lane_lines(image_binary_bird)
        fig,(ax1,ax2) = plt.subplots(1, 2, figsize=(16,4))
        ax1.imshow(left_lane, cmap='gray')
        ax1.set_title('left line')
        ax2.imshow(right_lane, cmap='gray')
        ax2.set_title('right line')
        plt.show()
```



0.5 E. Fitit positions with a polynomial for lane line

```
In [10]: left_fit, right_fit = fit_lane_line([left_lane, right_lane])

In [11]: yval = np.linspace(0,700)

         left_Y,left_X = np.where(left_lane==1)
         left_fitx = left_fit[0]*yval**2 + left_fit[1]*yval + left_fit[2]

         right_Y,right_X = np.where(right_lane==1)
         right_fitx = right_fit[0]*yval**2 + right_fit[1]*yval + right_fit[2]

         plt.plot(left_X, left_Y, '+')
         plt.plot(right_X, right_Y, '+')
         plt.plot(left_fitx, yval)
         plt.plot(right_fitx, yval)
         plt.gca().invert_yaxis()
```

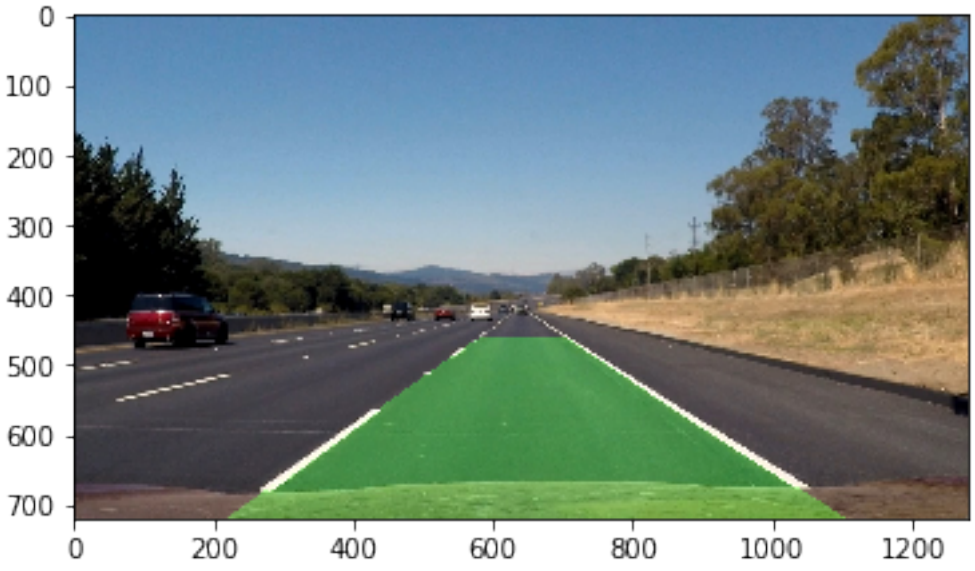


0.6 F. Calculate curvature of the lines

```
In [12]: radius, deviation = cal_curvature([left_lane, right_lane])
```

0.7 G. highlight lane in the original image

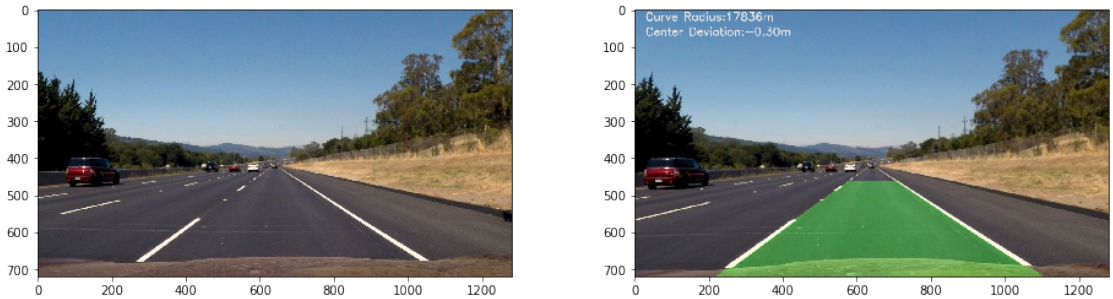
```
In [13]: plt.imshow(draw_lane(image, [left_fit, right_fit], src,dst))
         plt.show()
```



In [14]:
```
i2 = draw_lane(image, [left_fit, right_fit], src, dst)
plt.imshow(print_info(i2, radius, deviation))
plt.show()
```

0.8 H. Combine above steps to do pipline

In [15]:
```
image_highlighted = lane_detection(image, dist_matrix=dist_matrix, dist_param=dist_para
                                   color_thresh=color_thresh, gray_thresh=gray_thresh,
                                   sliding_window=sliding_window)

fig,(ax1,ax2) = plt.subplots(1, 2, figsize=(16,4))
ax1.imshow(image)
ax2.imshow(image_highlighted)
plt.show()
```



0.9 I. Process lane detecting video

```
In [16]: def frame_func(image):
             return lane_detection(image, dist_matrix=dist_matrix, dist_param=dist_param,
                                   mask_vertices=mask_vertices, color_thresh=color_thresh, gray_
                                   src=src, dst=dst, sliding_window=sliding_window)

         project_video_output = 'project_video_output.mp4'
         clip1 = VideoFileClip('project_video.mp4')
         lane_clip = clip1.fl_image(frame_func)
         %time lane_clip.write_videofile(project_video_output, audio=False)
```

```
[MoviePy] >>>> Building video project_video_output.mp4
[MoviePy] Writing video project_video_output.mp4


100%|| 1260/1261 [05:42<00:00,  3.83it/s]


[MoviePy] Done.
[MoviePy] >>>> Video ready: project_video_output.mp4

CPU times: user 3min 25s, sys: 5.59 s, total: 3min 31s
Wall time: 5min 45s
```

```
In [ ]:
```