Tracking Steps

1. The first step was to write an Extended Kalman Filter to track a single lidar-detected vehicle. We created a system matrix F and a process noise covariance matrix Q used to predict the next vehicle states by creating and updating the state vector x and an estimation error covariance matrix P.
2. The second step involved initializing the state vector x and matrix P with the sensor to vehicle coordinates and the estimation error covariance of each coordinate, respectively. Then as each track is detected, we would increase the track score for as long as the track remains detected and decrease the score and eventually delete the track if it goes out of view.
3. The third step involved creating an association matrix that contains the Mahalanobis distances between each detected track and each measurement, along with applying Gating to the value by removing any distances that are unlikely to be real. The row and column of smallest entry in this association matrix are taken as the first track and measurement. Then we remove this row and column and exhaustively repeat the search for the smallest entry.
4. The final step involved creating a function that determines if the track is in the field-of-view of either camera/lidar sensor, creating a function that calculates a nonlinear camera measurement function based on the projection from camera to image coordinates, and lastly initializing camera measurement vector and noise covariance matrix.

Conclusion:

All steps produced similar results as shown on the project instructions (exact RMSE somehow!). I would say Step 2 took the most time since implementing tracking score was never explicitly shown as an exercise, and that we had to create our own logic for scoring.

Sensor fusion

1. The camera-lidar fusion confirmed two tracks near the end of the simulation that the lidar only trial failed to track, so there is a clear benefit in using both.

Real-world Challenges

1. A real-world sensor fusion system would need to track pedestrians, traffic lights/signs and the road itself. In this project there were a few pedestrians walking along the sideway, and the road was straight with no traffic lights or signs.

Improvements

1. My tracking score updates were rudimentary (a $\pm$ 1/6 factor every update), but it seemed to work well.