Term 2 - Project 4: PID controller

1. Describe the effect each of the P, I, D components had in your implementation.
Answer:
The parameter P (“proportional”) plays the most significant impact on the car’s movement. As mentioned in the class, P causes the car to steer proportional either to the center of the lane or away from the center of the lane. It tries to pull the car back to the center of the lane.

However, P causes ringing or oscillations.

The parameter D (“differential”) counteracts the overshooting or ringing caused by P. D helps the car approach the lane smoothly.

However, both P and D can’t compensate the bias caused by the car system (for instance, the tire steering drift). Therefore the parameter I (“integral”) is applied to overcome the bias shift.

In my implementation, I first only assigned P parameter (any arbitrary small value) to investigate its impact on the car behavior. The car drove fine in the straight lane. However, it started to oscillate why driving close to curved lane as expected. The oscillation was so bad that the car was stuck on the curb. Next, I assigned the D parameter (any arbitrary small value). When the car got close to the curved lane again, the oscillation got better and the car drove longer than before. The parameter D tried to compensate the oscillation due to the parameter P. But just a little bit longer. Then the car got stuck again. After adding the last parameter I, the car can drive safely drive a lap around the track.

2. Describe how the final hyper parameters were chosen.
Answer:
PID were manually selected at first. This is due to narrow track which leaves small room for parameter optimization, in the other words, twiddle. I manually tried several groups of parameters P, I, D to help the car drive properly on the track. After 50 steps to converge, the twiddle was implemented to tune the parameters for 600 steps and then waited for 50 converge steps again. The initial chosen parameters for PID are 0.12, 0.0002, 2.