

Recovery



What happens if you don't train for recovery!

If you drive and record normal laps around the track, even if you record a lot of them, it might not be enough to train your model to drive properly.

Here's the problem: if your training data is all focused on driving down the middle of the road, your model won't ever learn what to do if it gets off to the side of the road. And probably when you run your model to predict steering angles, things won't go perfectly and the car will wander off to the side of the road at some point.

So you need to teach the car what to do when it's off on the side of the road.

One approach might be to constantly wander off to the side of the road and then steer back to the middle.

That's not great, though, because now your model is just learning to wander all over the road.

Training Recovery



Training the car to recover back onto the center of the road.

A better approach is to only record data when the car is driving from the side of the road back toward the center line.

So as the human driver, you're still weaving back and forth between the middle of the road and the shoulder, but you need to turn off data recording when you weave out to the side, and turn it back on when you steer back to the middle.

It's probably enough to drive a couple of laps of nice, centerline driving, and then add one lap weaving out to the right and recovering, and another lap weaving out to the left and recovering.

Multiple Camera Angles



A camera mounted on the Udacity self-driving car.

You also might wonder why there are three cameras on the car: center, left, and right.

That's because of the issue of recovering from being off-center.

In the simulator, you can weave all over the road and turn recording on and off. In a real car, however, that's not really possible. At least not legally.

So in a real car, we'll have multiple cameras on the vehicle, and we'll map recovery paths from each camera. For example, if you train the model to associate a given image from the center camera with a left turn, then you could also train the model to associate the corresponding image from the left camera with a somewhat softer left turn. And you could train the model to associate the corresponding image from the right camera with an even harder left turn.

In that way, you can simulate your vehicle being in different positions, somewhat further off the center line. To read more about this approach, see [this paper](http://images.nvidia.com/content/tegra/automotive/images/2016/solutions/pdf/end-to-end-dl-using-px.pdf) (<http://images.nvidia.com/content/tegra/automotive/images/2016/solutions/pdf/end-to-end-dl-using-px.pdf>) by our friends at NVIDIA that makes use of this technique.

While this is a necessary approach in real life, in the simulator, the weave and recover option is more effective.

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