DNN-driven autonomous cars which are using sensors like camera and LiDAR can drive without human intervention. However, the existing testing technique for DNN-driven vehicles are heavily dependent on manual efforts which is very expensive to cover corner cases as the number of test conditions increases. The incorrect or unexpected corner-case behaviors could lead to potential fatal accident. In *DeepTest: Automated Testing of Deep-Neural-Network-drive Autonomous Cars*, the author design and implement a systematic testing tool for automatically detecting erroneous behaviors of DNN-driven vehicles – DeepTest. DeepTest leverage the notion of neuron coverage to systematically explore different parts of the DNN logic. DeepTest found thousands of erroneous behaviors which could lead to fatal crashes in the three top performing DNNs in the Udacity self-driving car challenge.

The key contributions of this paper is presenting a systematic technique to automatically synthesize test cases that maximize neuron coverage in DNN. Demontrated the changes in neuron coverage correlate with changes in autonomous car's behavior.
The author defined Neuron Coverages as:

$$Neuron\ Coverage = \frac{abs(Activited\ Neurons)}{abs(Total\ Neurons)}$$

While the activated neuron is an individual neuron's output is larger than DNN-wide threshold (0.2 in this paper). DeepTest generates realistic synthetic images by applying image transformations on seed images and mimic real-world phenomena such as distortions, weather conditions, etc. The author uses a greedy algorithm to search for high neuron coverage: keep track the image transformation that increase neuron coverage and prioritize them while stacking other image transformation. For each images, the author measure the neuron coverage of the underlying models and the corresponding output. The result shows that neuron coverage changes with the changes in output steering angles and steering direction.

There are three limitations of DeepTest:

1) The image transformations such as rain, fog, effects may not be realistic. In real-world, there are several factors might changes as weather changes such as the position of the sun, angle and size of the rain drops, light reflection of surrounding environment. Simply adjusting the brightness or apply certain filters on the base images cannot reflect the real environment.
2) An autonomous vehicle must also handle braking and acceleration besides the steering angle. In reality, the speed of the car will effect the actual steering angle.
3) The three DNNs that DeepTest used are from Udacity self-driving car challenge which are not the DNNs that currently been developed at Tesla, Google. Those model might be flawful due to the limitation of training data.

Some Future work of DeepTest are: 1) including more data from different sensors that cars are commonly used such as radar, accelerometer, panoramic camera, etc. rather than the single image. 2) Use better algorithm to include more factors such as the source/direction of light, size of rain, light reflection, etc. when apply filters on the images to generate more realistic images. 3) Evaluate DeepTest with more realistic DNN model.