Semantic Segmentation

This project labels the pixels of a road in images using a Fully Convolutional Network (FCN) by Long, Shelhamer, and Darrell in https://people.eecs.berkeley.edu/~jonlong/long_shelhamer_fcn.pdf.

Basically, I followed project walkthrough from Aaron Brown and Brok Bucholtz with the VGG 16 pre-trained model and decoded with 1x1 CNN, transpose upsampling, and skipping layers to perform semantic segmentation.

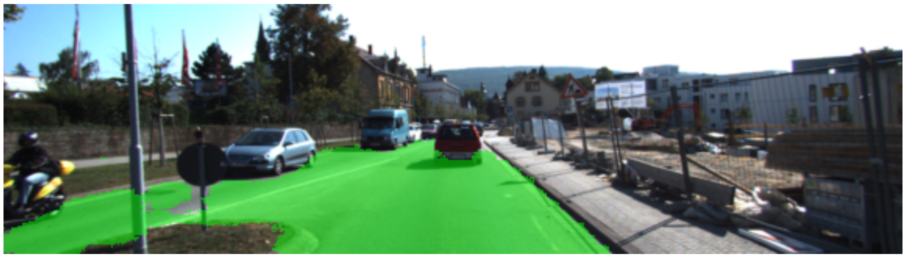
Here are the parameters I used in the training.
epochs = 50
batch_size = 2
drop out = 0.5
l2_regularizer = 0.001
learning rate = 0.001
random_normal standard deviation = 0.01

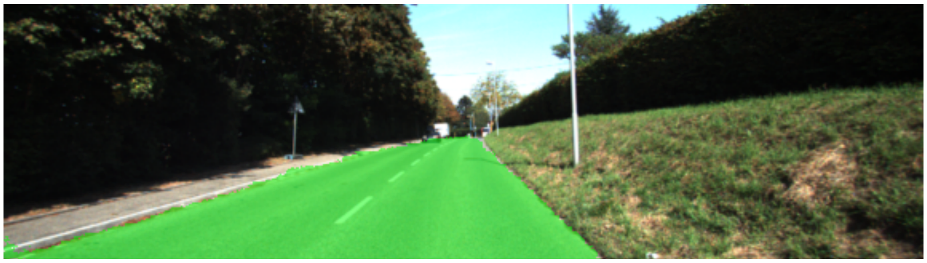
I used an AWS EC2 x2 GPU instance to perform training. Tensorflow ran into out of memory quite often. Finally, I set the batch size to two and GPU memory growth option to true.

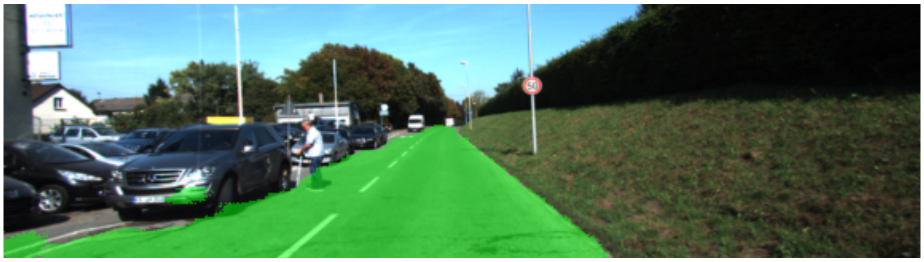
```
config = tf.ConfigProto()
config.gpu_options.allow_growth=True
with tf.Session(config=config) as sess:
```

Following pictures show original images along with results.

Conclusion: The results from this project are satisfactory as model can label most pixels of road correctly. If necessary, we can argument images with brightness to improve results more. We can apply the semantic segmentation technique to other objects besides road.







Original readme:

Semantic Segmentation
Introduction
In this project, you'll label the pixels of a road in images using a Fully Convolutional Network (FCN).

Setup
Frameworks and Packages
Make sure you have the following is installed:
 - [Python 3](https://www.python.org/)
 - [TensorFlow](https://www.tensorflow.org/)
 - [NumPy](http://www.numpy.org/)
 - [SciPy](https://www.scipy.org/)
Dataset
Download the [Kitti Road dataset](http://www.cvlibs.net/datasets/kitti/eval_road.php) from [here](http://www.cvlibs.net/download.php?file=data_road.zip). Extract the dataset in the `data` folder. This will create the folder `data_road` with all the training a test images.

Start
mplement
Implement the code in the `main.py` module indicated by the "TODO" comments.
The comments indicated with "OPTIONAL" tag are not required to complete.

Run

Run the following command to run the project:

```
python main.py
```

Note If running this in Jupyter Notebook system messages, such as those regarding test status, may appear in the terminal rather than the notebook.

Submission

1. Ensure you've passed all the unit tests.
2. Ensure you pass all points on [the rubric](https://review.udacity.com/#!/rubrics/989/view).
3. Submit the following in a zip file.
 - `helper.py`
 - `main.py`
 - `project_tests.py`
 - Newest inference images from `runs` folder (**all images from the most recent run**)