Drivable Area Segmentation

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Abstract

The aim of this project is to train for drivable area detection. The project is motivated from the problem of predicting vehicle trajectory in the absence of lane markings on the streets such as in developing countries.

Data Set Description

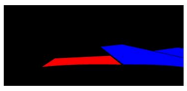
Berkley Driving Dataset[1]

- 70K training images
- 10K validation images
- 20K test images

Covered across various conditions such as different times of the day, weather and scene across different cities

1a) Image during day

2a) Image during night

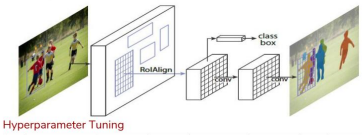


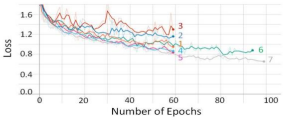
1b)Segmentation mask for 1a

2b) Segmentation mask for 2a

Architecture 1 - Mask RCN

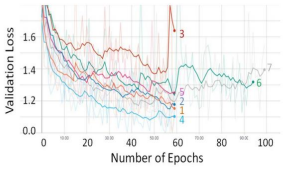
Mask R-CNN Framework[2]





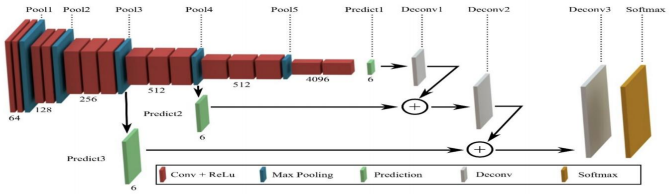
Hyperparameter Tuning

Ex	Training Images	Val Images	Epochs	Image Size	Batch Size	Loss	Val loss
1	1000	20	60	200x256	2	0.94	1.1
2	10000	20	60	200x256	2	1.18	1.15
3	1000	20	60	200x256	1	1.19	1.29
4	1000	20	60	200x256	4	0.84	1.09
5	1000	20	60	100x128	4	0.83	1.24
6	1000	300	90	200x256	2	0.83	1.3
7	1000	300	100	200x256	4	0.65	1.55



Architecture 2 - FCN

FCN based on VGG16[3]

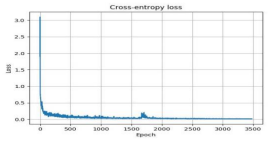


Many iterations were performed to reduce loss and improve accuracy. The following hyper parameters listed were tuned to improve the accuracy.

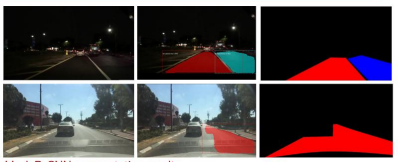
The plotted loss entropy graph has its corresponding hyper parameters shown on to the left.

Hyperparameter tuning

L2_REG = 1e-5
STDEV = 1e-2
KEEP_PROB = 0.8
LEARNING_RATE = 1e-4
EPOCHS = 60
BATCH_SIZE = 8
IMAGE_SHAPE = (160, 576)
NUM_CLASSES = 2



Results and Discussions



Mask R-CNN segmentation results:
Top row-Good segmentation example
Bottom row- Poor segmentation example. Possibly caused by reflection.

FCN segmentation results:
Top row-Good segmentation example
Bottom row- Poor segmentation example.

Future work

- Tune other hyperparameters
- Study possible architectural changes for performance boost.
- Compare the performance of Mask R-CNN and FCN using IoU metric

References

[1] http://bdd-data.berkeley.edu/
[2] He, Kaiming, et al. "Mask r-cnn." Computer Vision (ICCV), 2017 IEEE International Conference on. IEEE, 2017.
[3] Fully Convolutional Networks for Semantic Segmentation, *Jonathan Long, Evan Shelhamer, Trevor Darrell*; The IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015, pp. 3431-3440