

Very Deep Learning

Assignment 3

November 29, 2018

1 Semantic Segmentation via Fully Convolutional Networks

1.1 Theory Problems

1. How a fully connected layer can be realized as a convolution layer ?
2. What is the importance of skip connections in a CNN for image segmentation and object detection problems?
3. Ground truth labels for image classification problem are class names which are converted to one hot vectors and cross-entropy loss is applied over CNN to train them in supervised manner. What are the ground truth labels in semantic segmentation problem, and by what loss function are they trained over a CNN?
4. How transposed convolution helps in upsampling an image, in case of semantic segmentation ?
5. Why accuracy is not a good measure in case of semantic segmentation ? What measure is used to evaluate results in semantic segmentation ?

Min Submission : Answer all theory questions

1.2 Practical Problems

Download and extract the zip file for assignment 3. Open file `assignment3_1_semantic_segmentation.ipynb`, install the required packages and run the file. Run the file once to get an idea of how to perform semantic segmentation on a custom dataset.

1. Complete the code marked with "###TO DO###"
 - Report the mean iou score on validation dataset after 8000 iterations
 - Submit the prediction on 5 images of validation dataset obtained from the trained model
2. We can improve the results by using FCN8s model instead of FCN32s. Apply following tasks to obtain good results:
 - Use FCN8s model as defined in the paper [1], instead of FCN32s implemented in the jupyter notebook. (Hint: FCN8s implementation can be found at the github repository mentioned in the jupyter notebook)
 - Train the network and report the mean iou score on validation dataset after 8000 iterations

Min Submission : Complete task 1 and 2 and submit results obtained from the validation images

2 Visualizing Convolution Neural Networks

2.1 Theory Problems

1. What is a receptive field of a convolution filter ?
2. How can a receptive field of a filter of a particular layer be obtained in theory ?
3. How can a receptive field of a filter can be obtained in practice ?

2.2 Practical Problems

We use the implementation of this paper [2], to visualize the experimental receptive fields of the convolution filters. Run the jupyter notebook Open file `assignment3_2_visualization.ipynb`, install the required packages and run the file. Complete the following tasks.

1. Send the visualization of 10^{th} unit(filter) of conv layer 4 of Resnet 18
2. Send the visualization of 10^{th} unit(filter) of conv layer 4 of Alexnet

References

- [1] J. Long, E. Shelhamer, and T. Darrell. Fully convolutional networks for semantic segmentation. In *2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 3431–3440, June 2015.
- [2] Bolei Zhou, Aditya Khosla, Àgata Lapedriza, Aude Oliva, and Antonio Torralba. Object detectors emerge in deep scene cnns. *CoRR*, abs/1412.6856, 2014.