

Homework 5 Writeup

Instructions

- Provide an overview about how your project functions.
- Describe any interesting decisions you made to write your algorithm.
- Show and discuss the results of your algorithm.
- Feel free to include code snippets, images, and equations.
- List any extra credit implementation and result (optional).
- Use as many pages as you need, but err on the short side.
- **Please make this document anonymous.**

Project Overview

- Design a CNN model using several methods of preprocessing.
- Design transfer learning; use VGG model as a feature extractor and train a head.

Implementation Detail

First, implemented basic model with standardization. This type has overfitting issue. Added augmentation method. It ameliorated overfitting issue. So added more parameters to the model. To prevent overfitting, also added dropout layer.

Secondly, designed a head of model using VGG as a feature extractor.

Result

1. Standardization (Figure 2). As expected, this case is overfitting.
2. Standardization + Augmentation (Figure 3). This option is less overfitting than the first one but still has some at the end of training.
3. Standardization + Augmentation + Regularization (Figure 4). This option ameliorates overfitting issue. It has almost the same accuracy on both training and test data.

Dataset mean shape: [224, 224, 3] Dataset mean top left pixel value: [0.5035, 0.5035, 0.5035] Dataset std shape: [224, 224, 3] Dataset std top left pixel value: [0.2653, 0.2653, 0.2653] Found 1500 images belonging to 15 classes. Found 2985 images belonging to 15 classes. Model: "your_model"		
Layer (type)	Output Shape	Param #
conv2d (Conv2D)	multiple	896
conv2d_1 (Conv2D)	multiple	9248
max_pooling2d (MaxPooling2D)	multiple	0
conv2d_2 (Conv2D)	multiple	18496
conv2d_3 (Conv2D)	multiple	36928
max_pooling2d_1 (MaxPooling2D)	multiple	0
conv2d_4 (Conv2D)	multiple	73856
conv2d_5 (Conv2D)	multiple	147584
max_pooling2d_2 (MaxPooling2D)	multiple	0
flatten (Flatten)	multiple	0
dense (Dense)	multiple	3211296
dropout (Dropout)	multiple	0
dense_1 (Dense)	multiple	495
Total params: 3,498,799 Trainable params: 3,498,799 Non-trainable params: 0		

Model: "vgg_base"		
Layer (type)	Output Shape	Param #
block1_conv1 (Conv2D)	(None, 224, 224, 64)	1792
block1_conv2 (Conv2D)	(None, 224, 224, 64)	36928
block1_pool (MaxPooling2D)	(None, 112, 112, 64)	0
block2_conv1 (Conv2D)	(None, 112, 112, 128)	73856
block2_conv2 (Conv2D)	(None, 112, 112, 128)	147584
block2_pool (MaxPooling2D)	(None, 56, 56, 128)	0
block3_conv1 (Conv2D)	(None, 56, 56, 256)	295168
block3_conv2 (Conv2D)	(None, 56, 56, 256)	590880
block3_conv3 (Conv2D)	(None, 56, 56, 256)	590880
block3_pool (MaxPooling2D)	(None, 28, 28, 256)	0
block4_conv1 (Conv2D)	(None, 28, 28, 512)	1180160
block4_conv2 (Conv2D)	(None, 28, 28, 512)	2359808
block4_conv3 (Conv2D)	(None, 28, 28, 512)	2359808
block4_pool (MaxPooling2D)	(None, 14, 14, 512)	0
block5_conv1 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv2 (Conv2D)	(None, 14, 14, 512)	2359808
block5_conv3 (Conv2D)	(None, 14, 14, 512)	2359808
block5_pool (MaxPooling2D)	(None, 7, 7, 512)	0
Total params: 14,714,688 Trainable params: 0 Non-trainable params: 14,714,688		
Model: "vgg_head"		
Layer (type)	Output Shape	Param #
flatten (Flatten)	(None, 25088)	0
dense (Dense)	(None, 100)	2508900
dense_1 (Dense)	(None, 50)	5050
dropout (Dropout)	(None, 50)	0
dense_2 (Dense)	(None, 15)	765
Total params: 2,514,715 Trainable params: 2,514,715 Non-trainable params: 0		

Figure 1: *Left*: My model summary. *Right*: VGG + my head model summary.

- Vgg model + my head(Figure 5)
- Lime(Figure 6). Top 5 superpixels are the ones that contribute the most to classifying the given image as coast. The coast has ocean and sand. Top 5 superpixels resemble ocean and sand, which led to false classification.
- Lime2(Figure 7). This given image is a coast. It's misclassified as a highway. When we drive on highways, we usually see open sky and an edge of a road that separates a road from back scene.

My results are summarized in Table 1.

Preprocessing	Best Accu on val set(%)
Stand	40
Stand & Augment	66.3
Stand & Augment & Reg	66.4
vgg + my head	86

Table 1:

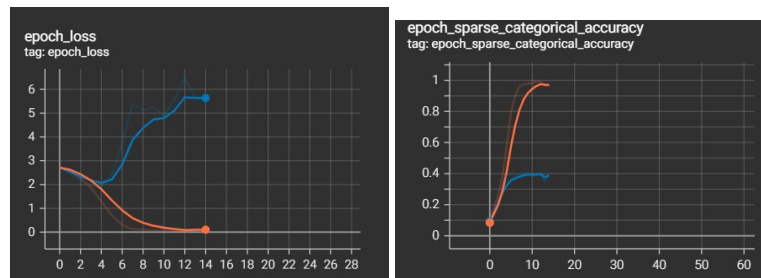


Figure 2: *Left*: Losses on val data set. (Training: orange, Test: blue) *Right*: Accu on val data set.

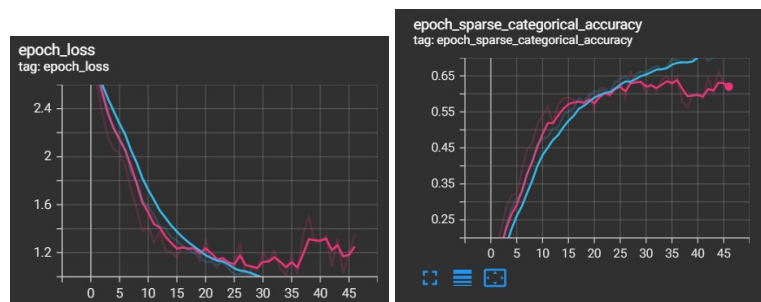


Figure 3: *Left*: Losses on val data set (Training: blue, Test: red). *Right*: Accu on val data set.

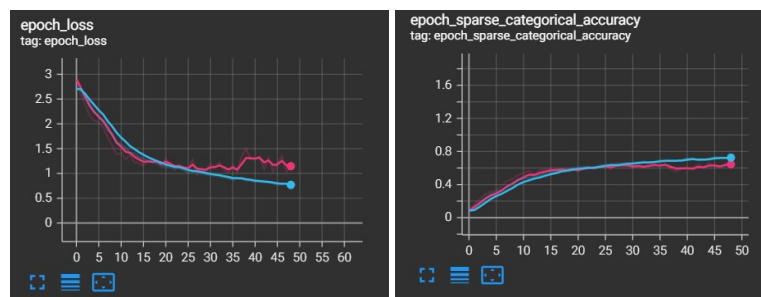


Figure 4: *Left*: Losses on val data set (Training: blue, Test: red). *Right*: Accu on val data set.

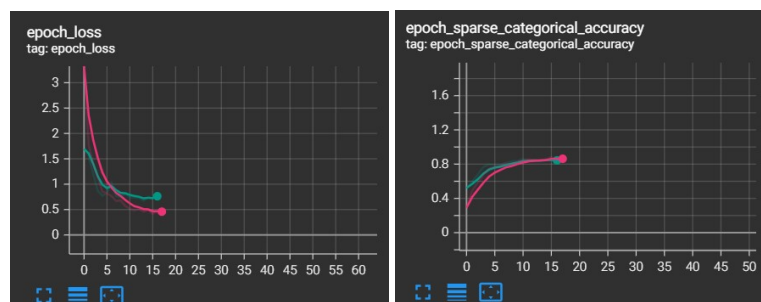


Figure 5: *Left*: Losses on val data set (Training: red, Test: green). *Right*: Accu on val data set.

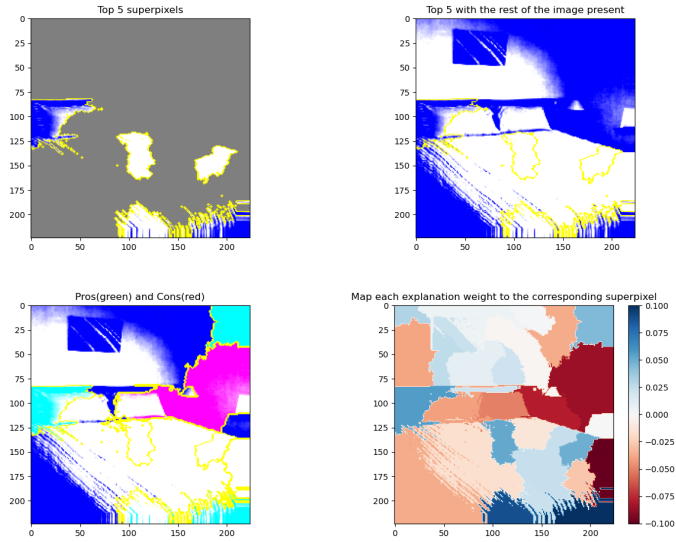


Figure 6:

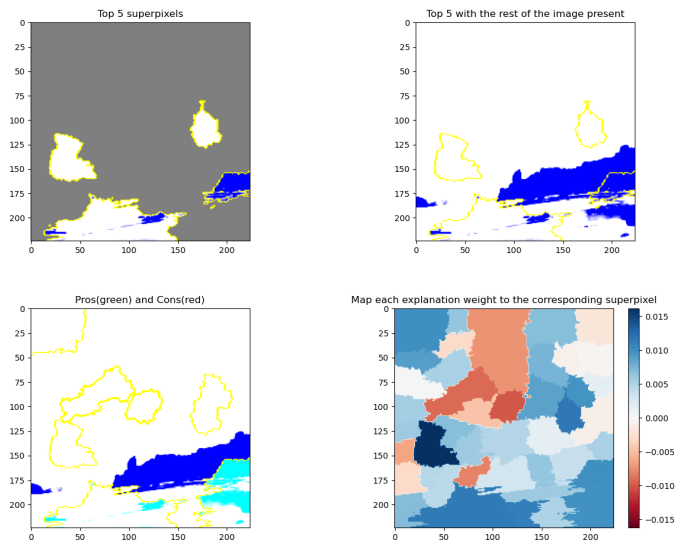


Figure 7: