

# Fall 2018: CSI5139Q

## Assignment 3

Due: Tuesday, November 20th, 2018, 11:00pm in Virtual Campus  
University of Ottawa - Université d'Ottawa

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### 1 Transfer Learning and TensorFlow API

This assignment will give you a chance to familiarize with transfer learning and with the different techniques for monitoring and controlling the training process in tensorflow.

You must use Keras with the tensorflow backend, i.e., the package `tensorflow.keras`. For this assignment, you may use other tensorflow packages and scikit-learn and scikit-image but *not* other deep learning frameworks, e.g., caffe, pytorch, theano etc.

### 2 VGG-16 [3]

This part of the assignment is a continuation from Assignment 2 and as such you will continue to work with the Extended Outex texture dataset from the University of Oulu and LAGIS-FRE CNRS. For download instruction and training/test split, please see Assignment 2 if you have not yet already downloaded and installed the images.

For this part adapt the the VGG-16 network for the task. The pre-trained network is available from `tf.keras.applications.vgg16`. You want to suitably remove some layers (importing with `include_top=False` is a good start but less layers are likely sufficient and will run much faster) and add fully-connected layer(s) and a softmax classifier at the output. You will need to train the new layers with the weights of the existing VGG layers fixed. Once you have a working classifier for the task, try to improve the classification result by training some layers a bit more (typically the higher-level) layers.

### 3 MobileNetV2 [5]

This part of the assignment will use parts of the Caltech-UCSD Birds-200-2011 (CUB-200-2011) dataset. This dataset contains images of 200 different species of birds and different annotations per image. We will use the bird species (categories) and the bounding box annotation. This will give a chance to consider a regression task. As the dataset is of medium size (1.1 GB), we will be working with a subset, in particular, we will only work with the following bird species: cardinal, american goldfinch, evening grosbeak, song sparrow, tree sparrow, house sparrow, fox sparrow, canada warbler, myrtle warbler, house wren, red-winged blackbird, boat tailed grackle.

Similar to Section 2, adapt a pre-trained network for the task. Here, we will use MobileNetV2. You will have to create and compare different versions of the network.

### 3.1 Regularization

Design your model for classification with three different regularizations using dropout, batch normalization and l1-regularization. Briefly compare the obtained models in terms of accuracy. Note that the regularization only applies to layers where weights have not been frozen.

### 3.2 Optimizers

Pick the best performing model from Section 3.1 and evaluate at least three different optimizers. One optimizer must be stochastic gradient descent (SGD). Briefly compare the optimizer performance.

### 3.3 Multi-task Learning

Revise your model from Section 3.2 to add a regression task to the output. You will have to decide on which layers to share between the two tasks. Discuss your observations.

### 3.4 Bonus: Additional Annotations

For bonus extend your model from Section 3.3 to predict further labels: either part labels or attribute labels. Describe your approach and evaluate how successful your attempts were.

## 4 Submission

You will need to submit your solution in a Jupyter file, do *not* submit the data. Make sure you have run all the cells. All text must be embedded in the Jupyter file, I will not look at separately submitted text files. If your Jupyter file needs a local python file to run, please submit it as well. Assignment submission is only through Virtual Campus by the deadline. No late submissions are allowed, you can submit multiple times but only your last submission is kept and marked.