Assignment 1 – Practical Deep Learning Workshop (submit by Apr 13th EOD)

1) Present an exploratory data analysis of the dataset that you selected.

5 pts

   a. What is the dimensionality of the data?
   b. What data does each sample contain? (size, channels, how many classes? Should we preprocess the data? Or is it ready for use? Can we use augmentation? If so what kind of augmentation would be valid?)
   c. Is the data balanced? (How many examples there are per class?)
   d. Are there any benchmark results for different methods used on this data?
   e. Show some samples from each label (if there are many categories try and present examples of easily separable ones vs. harder more similar categories)

2) Form a neural network graph based on the components we used in the walkthroughs in class.
   Use KFold cross validation (K>=5) to measure model performance and comparisons of different settings as described below

10 pts

   a. Fit your model to the data and analyze the results (Use visualizations to present your loss and other metrics you find relevant, show examples for good and bad classification with high probability, and refer to the uncertain predictions.
   Compare the results you got on the training data vs. your results for the validation/test data)
   Present the validation and test metrics for each fold and compare them to the test result achieved from mean of all folds prediction

5 pts

   b. Try to figure out where & why is the model misclassifying and suggest at least 3 ways to improve the results
   c. Prioritize the list of suggestions for improvements and implement the first 2 suggestions and repeat section b.

15 pts

   d. In addition to the two suggestions you applied, implement inference-time-augmentation (aggregation of multiple predictions on augmented test examples) and report the improvement in metrics you received.

10 pts

   e. Add few images of a **new category** of the same domain, then retrain your models to include the new category you added

3) **Select 4 or more** trained model architectures (you can use the ones available in the torchvision.models sub-library, or any other model with pretrained weights you find relevant) **for each of them**:

5 pts

   a. Change the last layer to correspond to the task at hand.

20 pts

   b. Perform the relevant preprocessing steps and fine-tune the model to your new task.

5 pts

   c. Fill the table below:

Model Name	# parameters	Validation Loss	Validation Accuracy	Test Loss	Test Accuracy	# unique correct samples	# unique errors
1.							
2.							
3.							
4.							

15 pts

   d. Use one of the trained models you got in 3c as a "feature extractor" (remove the last layer, and then use predicted values as features for a classical ML algorithm of your choice. How does your results for this combination compare to your previous results?

5 pts

   e. Present a table that summarizes your experiments. For each include runtime, loss, additional metrics, parameter settings, main processing changes, and any other significant changes you performed

5 pts

4) Write a report that summarizes your research. Think what you would like to emphasize and what is of lesser importance. * Ideally you would publish your report as a blogpost or social media article

Optional Datasets: (if you would like to use another please confirm with me first)

- https://www.kaggle.com/crowww/a-large-scale-fish-dataset
- https://www.kaggle.com/gpiosenka/100-bird-species
- https://www.kaggle.com/jessicali9530/stanford-cars-dataset