MLiM 25440 Homework 5 : Programming Assignment

Classifying Normal and Cancerous samples of Breast Tissue

Due Wednesday Nov 13th at Midnight.

Finish the provided python notebook to complete the following experiments and answer the associated questions. Please use the fastai modules and methods indicated. You will submit the requested graphics, results and your final notebook implementation.

All of the necessary modules and their documentation may be found below:

https://docs.fast.ai/vision.data
https://docs.fast.ai/vision.image
https://docs.fast.ai/vision.learner
https://docs.fast.ai/vision.models

a. **[Augmentation]** Implement data augmentation by defining a transform with *fastai*. Apply your transform to a batch of images from the dataset and include the result.

    1. How can data augmentation improve the performance of machine learning models?
    2. Is augmentation only useful for training the model?

b. **[Learning Rate]** Choose a model from the documentation above and use *cnn_learner* to load this model and pass the data function defined in the previous step. Do not pretrain the model. Use *fastai* to find the optimal learning rate to train the model and include the loss plot.

    1. How does the learning rate affect model training?
    2. Why might we consider different rates if we are using a pretrained model?

c. **[Training from Scratch**] Train the model for 1 epoch using the *fit_one_cycle* method and the optimal learning rate found in the previous step.

    1. Report the loss and accuracy of the model.
    2. How do they compare to the baseline accuracy i.e. random chance?

d. **[Pretraining and Fine-tuning]** Now redefine the *cnn_learner* so that it is pretrained. By default, only the last prediction layer will be unfrozen or trainable. Train the model for one epoch as before. Report the accuracy.

    1. How does *fastai* pretrain models?

2. Can a model trained on non-medical data be useful for medical images?
3. Why do we only train the prediction layer?

e. **[Unfreezing]** Using the pretrained model from the previous step, unfreeze all the layers, find the optimal learning rate, and train for at least one epoch.

    1. Report the accuracy.
    2. Why should we consider a different learning rate after unfreezing all the model layers?

f. **[Analysis]** Use *fastai* to plot the confusion matrix and use *sklearn* to plot the ROC curve and report the area under the curve (AUC).

    1. In your opinion, is the accuracy of the model acceptable for potential clinical application?
    2. Besides prediction accuracy, what else may a clinician consider when choosing a model?

g. **[Extra Credit]** Plot a heat-map of where the model focuses when making a prediction for an example image from the dataset.