CS550 Assignment 4: Classification using CNNs

Due Date: Oct 16

Dataset: You are provided a medical histopathology dataset with only 2 classes: 0 and 1. The way the dataset is prepared is that for every patient a high-resolution image is taken with a microscope. The image is then divided into many smaller patches which are given to you. 1 represents the +ve class and we would like a high Recall, F1 score and we will also use the AUC for evaluation.

Objectives of the assignment:

a. To provide practice with designing Convolutional Neural networks for classification
b. Understanding the impact of various hyperparameters:
    i. Number of layers, type of layers (convolution, pooling, inception module, skip connections)
    ii. Filter size, stride
    iii. Calculate Accuracy Metrics: Precision, Recall, F1 score, AUC

Note: 25 marks bonus for top 3 solutions (Recall and AUC). You are allowed to create ensembles as well.

References:

Calculation of ROC/AUC for Neural Networks:
https://gist.github.com/rtyasdf/3fe913dae5686ffd66af917c53c468ec

Note (refer book for more details): Please note that adding max pooling layers provides some level of *invariance* to small translations. It also offers a small rotational invariance and a slight scale invariance when it is added every few layers in a CNN.

A. (50 marks) Prepare your dataset, augment the data by using translation, rotation by multiples of 90 degree and implement the following CNN for the task above.

   Architecture: Create the following sequence of Layers. Fill in the answers in place of ?

Layer	Type	Maps	Size	Kernel/Filter Size	Stride	Padding	Activation
Out	Fully Connected	-	?	-	-	-	?
F5	Fully Connected	-	16	-	-	-	ReLU
S4	Max Pool	128	?	3x3	2	“valid”	-
C3	Convolution	128	?	3x3	1	“same”	ReLU
S2	Max Pool	64	?	3x3	2	“valid”	-
C1	Convolution	16	50x50	3x3	1	“same”	ReLU
In	Input	1	50x50	-	-	-	-

B. (25 marks) Evaluate the performance after addition of 2 layers of Inception Modules and a Max Pool to the above neural network after S4.
Hint: Follow GoogLeNet architecture in the book.

C. (25 marks) Create a baseline Neural network using Transfer learning with Resnet-50 (pre-trained model). Compare with the networks A and B above. What do you learn from this?

D. (25 marks) Experiment with number of layers, filter size, stride etc. and neurons per layer to increase the performance metrics. Apply other tweaks and tuning to improve accuracy. You must report the results for at least 2 different designs.

E. (25 marks) Compare the above networks, calculate AUC/ROC, summarize and explain your results.