HU Extension   Assignment 04   E89 Deep Learning

Handed out: 09/26/2025   Due by 1 PM EST on Saturday, 10/04/2025

Problem 1. Please implement an edge detector using the discrete Laplacian operator as presented in Lecture 04. From the Internet, download an image of a cat and produce an image of edges. Create a Laplacian matrix, format your image as one matrix (for simplicity, use one channel, not three) and literally scan the image matrix with the Laplacian. At every stop calculate element wise product of the Laplacian and the area of the image below it. Present the resulting matrix as an image.
(25%)

Problem 2. Modify kernel size in the second convolutional layer in the CNN for Classification of MNIST Images as defined on slide 55 of the lecture notes. Let the second and the third Convolution layers use kernel size of (4,4). For the first layer keep kernel size of (3,3). Print the summary of your model. Please provide detailed explanation (calculation) for all numbers of trainable parameters.
(25%)

Problem 3. For the model presented in the notebook `5.1-introduction-to-convnets.ipynb`, change the size of the kernel on the first convolutional layer from 3x3 to 4x4, then to 5x5 and finally 6x6. Run the training each time. Record and report the accuracy for different filter sizes. Plot the evolution of accuracy with epoch for every change. Select the best model. Next change the batch size to 32, then 128 and see the impact on the number of batches per epoch. What impact does this have on accuracy ? We learnt about callbacks , implement callback function for CSVlogger where all information from Epochs will be logged in to a CSV.
(30%)

Problem 4. Use your own handwriting to create 2 images each of numbers 0,1,2,3, 4. Test the ability of the best model selected in problem 3 to recognize those numbers. Assess the accuracy of the model using just those 18 digits as the test set. Compare with the result of problem 3.
(20%)

Please, place your full name in the form "Last name, first name" on all submitted artifacts. CSCIE89_YourLastName_FirstName_solution< >.html , CSCIE89_YourLastName_FirstName_solution< >.ipynb

When submitting Jupyter ipynb files, please submit an HTML image of that file as well. Your main submission should be made of one or several Jupyter notebook(s) and (its) HTML image(s). Your notebook(s) should include all results, images and comments. Please include full statement of every problem in a markdown field before you start implementing that problem. If your notebook(s) contain(s) excessively long outputs,

please copy a meaningful and illustrative number of initial and/or final lines and paste those in a markdown (comment) cell. Then, delete the long output(s).
Please do not describe your solution of any of these problems on Ed.