

ECE/CS 559 - Fall 2023 - HW #5

Due: 10/26/2023, 11:00pm Chicago time.

The purpose of this assignment is to practice with the standard Pytorch blocks to train and test neural networks.

Q1. (100 pts) Download `geometry_dataset.zip` from Box “lecture videos” folder (I did not want to upload to Piazza due to file size). The dataset contains 90,000 images, where each image has size 200x200 and belongs to one of the 9 classes: Circle, Square, Octagon, Heptagon, Nonagon, Star, Hexagon, Pentagon, Triangle. There are 10,000 images per class.

- (a) Write a program that reads the files and creates one variable for training and another for testing. The training set should contain 8,000 images per class, and the test set should contain the remaining 2,000 images per class, with the corresponding labels as indicated by the file names. You can split the training and test sets alphabetically according to file names. This process will take some time, and is to be done only once, so it will be a good idea to save these variables to new files, like `training.file` and `testing.file`.
- (b) Design and implement a neural network that will take a 200x200 image and decide which one of the 9 classes the input corresponds to. Hints: A standard convolutional neural network will be useful for this purpose (e.g. to classify a CIFAR image). Since the images are large, you may want to downsample them in a first layer for faster processing.
- (c) What are you going to submit:
 - Report on Gradescope:
 - The details of your neural network design process, what did you try, what worked, what did not... The optimizer, the loss function, and other hyperparameters that you utilized.
 - A graph that shows epochs vs loss on training set, and on the same graph epoch vs loss on the set set.
 - A graph that shows epochs vs accuracy on training set, and on the same graph epoch vs accuracy on the set set.
 - All your codes.
 - You also need to update the following files to Box:
 - `0601-IDNumber-LastName.py`: The code that reads the files, generates training and test files, and trains the model, and saves the model to `0602-IDNumber-LastName.ZZZ`.
 - `0602-IDNumber-LastName.ZZZ`: The trained neural network model. Your model size should not exceed 50MB.

- 0603-IDNumber-LastName.py: Inference module. This code should use the model 0602-IDNumber-LastName.ZZZ to provide the inference results for all images in the current directory. The output should be like: image1.png: Star, image2.png: Hexagon, etc. We will use this to evaluate your model on a separate validation set.