CS212 Topics in Computing 2
2018, Term 2 Second Half: Lab 3, Part 14
Optimization, Gradients, Theano

This part of Lab 3 has been posted separately due to the snow cancellations delays.

Assessment & Submission
The report for this assignment, including your screenshots and answers as instructed below, needs to be uploaded to myPlace before our lab next (11am on March 28st) and shown to the demonstrators no later than by the end of the lab 1pm. Note that we will also have a test on that day so it is advised to have your lab marked during any of the announced additional lab sessions. The submissions uploaded before the due time, but not marked by demonstrators on Marc 28th, will be marked by the lecturer based on your uploaded reports.

You can work on this part in the groups of your choice no larger than 3 students. But make sure everyone retains the copy of the code and the screenshots and reports the accomplished lab individually.

Aims
Practice using Python and Theano
See how this can work in a real life application: MNIST handwritten digits recognition

Instructions

Task 14. (40% of Lab 3 marks)

(a) (10%) Using the lecture slides as guidance, verify by searching for 3 arbitrary non trivial (not all 0s) sequences of pixels from the testing file, that the same sequences do not exist in the training file.
(b) (20%) Using Theano library, write a Python program that implements a neural network with no hidden layers **or** with a single hidden layer to recognize handwritten digits. Use the lecture slides and the posted template as guidance ("L3 template-MNIST.py").
Hint: you can accomplish this by copying your Theano model from Task 12, and making necessary changes to the sizes of your Theano variables. Make sure your inputs and outputs for the Theano functions match those in the template.
Use the file *train.txt* (inside a zip file posted) to train your program. Use the file *test.txt* to evaluate its accuracy. The format is self-explanatory: the files can be viewed in any text editor. The label for the image is the very first number on each line. The images are 28 by 28. The pixel brightness values can vary between 0 and 255. Each image takes 28 lines in the file. The template already includes all the necessary code to read the images and convert to vectors. You only need to define the model in Theano. There are some comments in the template that are worth reading, but you are not going to be tested on remembering/understanding them. We will discuss some parts of the template during lectures. When finished, take the screenshot of your code and your output.

(c) Using the lecture slides as guidance, test your program on the posted file "test-anonymous.txt" that does not have the correct image labels. Modify your code so it will print the output label when testing. Check the first 10 outputs. How many of them are correct? Add the screenshot of the output and your answer to the report.

Optional Prize Competition: The top 5 best performing results will earn you a test score of 100% without sitting it. To improve the score you can use any configuration of a network and experiment with parameters including learning rate, initial weight values, number of training cycles, and anything else in the template you may be brave to change! You can not use other additional machine learning libraries such as TensorFlow, Keras, etc. In order to enter the competition, you need to upload your report no later than Sunday March 25th 23:59pm, with your usual screenshots of your code and outputs. I will let the winners know by the end of working day on Monday.