Assignments due on 10/02/2020

Assignment 1a.

1. Create train dataset with three input [ x1, x2, x3]. Make 1000 data points. Give their class labels for each of them. 0 or 1 for each input data points randomly.
2. Build a two-layer neural network from from scratch where Y\_pred is the output.
   1. Use sigmoid function as activation function in each neuron.
   2. Use sum of square error as your loss function.
   3. Calculate the derivatives for back propagation.
3. Write codes training module for 10 epochs to train the neural network.
4. Then make a test dataset of size 100 data points and give their labels randomly. Test the 100 input data points by classifying them using the trained neural network. Report your accuracy.
5. You cannot use any built-in deep learning functions

Assignment 1b.

1. Modify the above neural network with a softmax layer and cross entropy loss function.
   1. Now there will be two class Y1 and y2. You can use hot encoding for to embed the class labels.
   2. So your output layer will have two neurons. Add a softmax layer after the output layers.
   3. Add cross entropy calculation layer to find the loss L at the end.
   4. Write forward pass module for the modified neural network
2. Derive the derivatives for each of the layer using chain rule. Show your derivations.
   1. Write back propagation code to implement the derivatives.
   2. Train the modified neural network 10 epoch with the training data
3. Classify the test-data (created above) with trained NN and report your accuracy.
4. You cannot use any built-in deep learning functions

Assignment 2. Running mlp from scratch iusing MxNet

* 1. Take the mlp\_scratch notbook (ipnb) from d2l Berkley notebook folder.
  2. Use the install.ipnb from the first chapter.
  3. Run the mlp\_scratch to classify MNIST-Fashion images into 100 classes.
  4. <https://d2l.ai/chapter_multilayer-perceptrons/mlp-scratch.html>

Rules for Submission:

1. **You can copy descriptions, text, code, and figures from the websites below for notebook documentation and codes. A good example of file looks like below when we run it:**

<https://d2l.ai/chapter_multilayer-perceptrons/mlp-scratch.html>

1. For both assignment create two .ipnb (notbook) files.
2. Put the documentation/description/ derivation of each module first. Then put the corresponding code in the note book.

For example:

For Assignment 1a, sequence of the notebook will be:

1. Introductory description of two layer NN and the picture. (Copy the text and figure from the website that I provided in the hw solution folder.)
2. A sample table for your datasets (Show in the website)
3. **Code to create the dataset as instructed above.**
4. Some description about linear layers and sigmoid function. Equations for two linear layers to output.
5. **Code for neural network layers.**
6. **The code for forward pass.**
7. Description for sum of square loss calculation
8. **Code of the loss calculation.**
9. Description and equations how you calculate the derivatives using the chain rule.
10. **Code for back propagation.**
11. Some description about training, epochs…..
12. **Code for training.**
13. Description how you create test data.
14. **Code of the test.**

References:

1. <https://towardsdatascience.com/how-to-build-your-own-neural-network-from-scratch-in-python-68998a08e4f6>
2. <https://deepnotes.io/softmax-crossentropy>