Homework #4[1]

Due by 11:59pm 11/28/2018

Overview

The objective of this assignment is to explore the inner workings of a neural network. You don't have to implement your own. Here is a nice neural network simulator that has been implemented with TensorFlow (they also have a link to their GitHub source, so if you do want to get more into the source code, you can). For our assignment, you will be asked to experiment with the data sets, the features, the number of hidden layers, and the number of hidden nodes per layer.

What to do

1. Use the **Gaussian** data (the bottom left data set where the orange and blue blobs are nicely separated), the first two features (i.e., just X_1 and X_2), 1 hidden layer with 1 neuron. Roughly how many epochs does it take to reach a *test loss* of 0?
2. Change to the **exclusive or** data (top right). After 2,000 epochs, what is the *test loss*? Is it correctly classifying most of the data? Does it look like it is getting much better?
3. What is the minimum number of hidden neurons required to quickly (e.g., epochs < 1,000) get nearly all the data right (e.g., *test loss* < 0.04) at least two-thirds of the time?
4. Switch to the **circle data**. Does your current network work well on that data? How many epochs does it take to get a *test loss* that is less than 0.01?
5. Switch to the **spiral data**. Is your network working after 2,000 epochs? Try 8 hidden nodes. What is the *test loss* after 2,000 epochs. How many weights are in this network?
6. Try 2 hidden layers of of 4 nodes each. What is the *test loss* after 3,000 epochs? How many weights are in this network?
7. Try a full network; let both hidden layers have 8 nodes. What is the *test loss* after 2,000 epochs? How many weights are in this network? Try this configuration 3 times and make a screenshot of the best one.
8. Try a deeper network. Make a network with 6 hidden layers, with 3 nodes each. What is the *test loss* after 2,000? How many nodes are in this network?
9. Using the other features, design a network that gets a *test loss* that is less than 0.1 within 2,000 epochs. Take a screenshot. How many weights does this network have?

[1] Shared Google directory (all files are initially committed in github repository)

What to submit

- A *well written, well thought-out* report that answers the above questions. Additional observations or questions of your own are encouraged.

Grading Guideline

Assignments are graded qualitatively on a non-linear five point scale. Below is a rough guideline:

- 5 (100%): Answered all the questions well. Report is well written and informative.
- 4 (93%): Answered all the questions but maybe in a more cursory way. A solid report.
- 3 (80%): A few minor problems with the answers, or a seemingly hastily put together report.
- 2 (60%): The answers reveal significant misunderstanding of the material.
- 1 (40%): An attempt was made, but the report is incomplete.