CSCI 5611 Instr.: Guy

HW 3: Numerical Optimization

Homework: Sun., Nov 5

Overview. This assignment is intended to familiarize you with foundational aspects of optimization and data-driven/machine learning including linear algebra, matrix multiplication, numerical optimization, and neural networks.

Unlike HW 2, you may work with a partner this HW – but the partners must be different from the person you worked on Project 2 with, and you cannot work with this person on Project 3. Only one turn-in needed per pair.

For the homework associated with Project 3, you will need to complete two steps. First, write a program that evaluates a neural network. Then, search over the possible input values to find the input that produces an output as close as possible to all zeros.

You may not use any external libraries for part 1. Additionally, you must write your own matrix representation and matrix-multiplication function, even if this functionality is otherwise built-in to the language you are using.

This HW has two turn-in requirements.

A. HW3 Network Execution Online quiz

Use your neural network library to complete the questions posted here: https://canvas.umn.edu/courses/391336/quizzes/816107

This online quiz will show you several neural networks to evaluate with your neural network code.

B. HW3 Integration Code

The file "*networks.txt*" contains 10 neural networks. For each network find the input vector that minimizes the magnitude of the output. If the network output is a single value, find the input which gives the output closest to 0. If the network produces an output with multiple values, find the input for which the *sum of the absolute values* of the outputs is as close to 0 as possible.

For this optimization, feel free to use any technique you like – but you must cite any code or resources you used in your submission readme.txt file.

For part B, submit a zip file containing three files: readme.txt, solutions.txt, code.zip.
1. The file *readme.txt* should have a short description of the approach you took to finding the minimizing inputs.

2. The file, *code.zip,* should have both your code for computing the output of the neural network, and your code for finding the optimal value. [note: you do not need to use processing, but you must write your own matrix multiplication code]

3. The file *solutionts.txt* should contain exactly 10 lines, each with a comma-separated list of values showing the input that minimizes the neural networks. For example, the first three lines might look like:

```
1
-0.8, 10
0.5,-0.93,0.8
…
```