ELEC 378 – Spring 2023
Homework 5

Due: Friday February 17, 5PM

1 Playing with Gradient Descent Parameters

a) Using the function $f(x) = x^2$, implement gradient descent to find the minimizer $x = 0$ within 50 iterations, starting with an initial guess of $x = -10$.

b) Using the same function and learning rate from the previous part, what happens to the number of iterations when the initial guess is smaller or larger than $|x| = 10$?

c) Using the same function with initial guess $x = -10$, what is the largest learning rate for which the minimizer can be found? What happens to the gradient descent estimate of the minimizer when the learning rate is too large?

d) Now let $f(x) = x^4 - 5x^2 - 3x$. Find the minimizer by looking at its plot, then try to find the minimizer using gradient descent, again using an initial guess of $x = -10$. How does gradient descent perform on this function compared to the one in (a)? What is the key difference between these two functions with respect to finding their minimizers?

2 Hierarchical Agglomerative Clustering

Use `sklearn.cluster.AgglomerativeClustering` to obtain the hierarchical agglomerative clustering dendogram for the dataset `digits.npy` and write out the merging history in terms of depicted digits.

Submission Instructions

Every student must submit their work in PDF format, providing intermediate and final results as well as any necessary code. Submit your homework on Gradescope.

Collaboration Policy

Collaboration both inside and outside class is encouraged. You may talk to other students for general ideas and concepts, but individual write-ups must be done independently.

Plagiarism

Plagiarism of any form will not be tolerated. You are expected to credit all sources explicitly.