CS257 Linear and Convex Optimization

Homework 8

Due: November 16, 2020

November 9, 2020

For this assignment, you should submit a report in pdf format as well as your source code (.py files). The report should include all necessary figures, the outputs of your Python code, and your answers to the questions. Do NOT write your answers in any of the .py files.

1. Consider the optimization problem in (9.20) of Boyd and Vandenberghe,

$$\min_{x_1,x_2} \; f(x_1,x_2) = e^{x_1+3x_2-0.1} + e^{x_1-3x_2-0.1} + e^{-x_1-0.1} \tag{1}$$

First implement the function `gd_armijo` and `newton` in `algo.py`, then complete the code in `hw8.py`.

(a). What's the optimal solution $\boldsymbol{x}^*$ and the optimal value $f(\boldsymbol{x}^*)$?

(b). Solve (1) numerically using your implementation of gradient descent with backtracking line search. Use $\alpha = 0.1$ and $\beta = 0.7$ as in Boyd and Vandenberghe. Use the initial points $\boldsymbol{x}_0 = (-2, 1)^T$. Report the solution, the number of iterations in the outer loop and the total number of iterations in the inner loop. Plot the trajectory of $\boldsymbol{x}_k$, the error $f(\boldsymbol{x}_k) - f(\boldsymbol{x}^*)$ and the step sizes t_k.

(c). Redo part (b) using the initial point $\boldsymbol{x}_0 = (2, 1)^T$.

(d). Solve (1) numerically using your implementation of Newton's method. Use the initial point $\boldsymbol{x}_0 = (-2, 1)^T$. Report the solution and the number of iterations. Plot the trajectory of $\boldsymbol{x}_k$ and the error $f(\boldsymbol{x}_k) - f(\boldsymbol{x}^*)$.

(e). Repeat (d) for the initial point $\boldsymbol{x}_0 = (2, 1)^T$.