

# IEOR 160: Nonlinear and Discrete Optimization Course Project

1. Consider the optimization problem

$$\min_{x_1, x_2} e^{x_1 - x_2 - 0.4} + e^{x_1 + x_2 - 0.4} + (x_1 - 1)^2 + (x_2 + 1)^2$$

Write a code to solve this problem using the Gradient method with the backtracking parameters  $\alpha = 1$  and  $\beta = 0.6$ . Draw  $f(x^{(k)})$  versus  $k$  for  $k = 0, 1, 2, \dots, 50$ . Show the trajectory of points  $x^{(0)}, x^{(1)}, \dots, x^{(50)}$  in the 2-dimensional  $(x_1, x_2)$  plane.

2. Redo the previous problem with Newton's method.

3. Consider the optimization problem

$$\min_{x \in \mathbb{R}^n} - \sum_{i=1}^n \log(2 - x_i^2) - \sum_{i=1}^n \log(1 - 2a_i^T x)$$

where  $n = 500$  and  $a_i \in \mathbb{R}^n$  are randomly generated vectors. Solve this problem using Newton's method with the backtracking line search ( $\alpha = 0.4$  and  $\beta = 0.4$ ). Draw  $f(x^{(k)})$  versus  $k$  for  $k = 0, 1, \dots, 300$ .