CENG216 – Numerical Computation
Homework 3

May 22, 2024

Due Date: June 6 23:59, 2024

Exercise 1. Least Squares and QR Factorization (100 pts)

Bob is a city planner working on building a highway that connects 4 cities. Since there are no empty spaces between buildings in each city, the highway should not go through the cities. Instead, it should pass near the cities as much as possible. The coordinates of the cities are given as follows: (-2,3), (0,1), (3,0), (5,2).

You are expected to implement the codes of the following questions in Python. You should show each question's calculations using the numpy library. The matrices, equation calculations, and all of the important numerical values should be clearly demonstrated in the code and printed. Remember to plot all four roads you have designed separately. Those of you who do not comply with these requirements will not be able to get full points. You should absolutely show each step you have performed in your code.

a. Use the least squares method to find a straight road that can be built according to the requirement given above. (20 pts)

b. Use the least squares method to find a road with a single curve that can be built according to the requirement given above. (25 pts)

c. Calculate the root mean squared error for both roads you have designed in the previous steps. (20 pts)

d. Use the classical Gram-Schmidt method to find the QR factorization so that we can improve the design of these roads in such a way that the roads become even closer to the cities. For the straight road, use reduced QR factorization. For the curved road, use the full QR factorization. (35 pts)

Important Notes

1. You should only submit a single **.py file**. It should be named as StudentID_HW3.py.

2. This is individual homework. Any collaboration between homeworks is not allowed and will be considered as cheating.