

CSE330 Section 20, Assignment 4

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1 Instructions

1. The deadline is **7 May 2026, during class**. There will be **no deadline extension**. Hence, don't wait for the last minute to submit.
2. Please start the assignment as soon as possible. If you start it just a day before the deadline, you might not be able to complete it.
3. If you take help from your friend (even if your friend is from a different section), or if you use ChatGPT to help you understand the material, you have to mention it on top of the first page of your assignment. Failing to do so will be considered as plagiarism and will have consequences as per the plagiarism policy.
4. Copying AI-generated answers without understanding or attribution will be treated as academic misconduct.
5. The total mark of this assignment is 15. However, there is 1 bonus question that is worth 2 points. Attempt the bonus questions only after you have solved all the other problems. If you get more than 15, then the extra points will be adjusted with other assignments.
6. Please feel free to reach out to me if you have any questions.

2 Problems

Problem 1 ($1 + 3 + 2 + 2 + 3 = 11$ Points). Consider a set of four data points:

$$f(0) = 0, \quad f(2) = -1, \quad f(-1) = 2, \quad f(1) = 2.$$

We now find the best-fit polynomial of degree two, $p_2(x)$ by the QR-decomposition method using these four data points by answering the following:

- (a) Write down the matrices A and b . Also identify the linearly independent column vectors $\mathbf{u}_1, \mathbf{u}_2, \mathbf{u}_3$ from the matrix A .
- (b) Using the Gram-Schmidt process, construct the orthonormal column vectors $\mathbf{q}_1, \mathbf{q}_2, \mathbf{q}_3$ from the linearly independent column vectors $\mathbf{u}_1, \mathbf{u}_2, \mathbf{u}_3$ obtained in the previous part, and then write down the matrix Q .
- (c) Calculate the matrix elements of R and write down the matrix R .
- (d) Compute Rx and $Q^T b$, where

$$x = \begin{pmatrix} a_0 \\ a_1 \\ a_2 \end{pmatrix}$$

is a column vector and a_0, a_1, a_2 are the coefficients of the polynomial p_2 .

- (e) Using the above result, find the values of a_0, a_1, a_2 and write the expression of the polynomial $p_2(x)$.

Problem 2 (4 Points). Now, with the same data as the previous problem, find the best-fit polynomial of degree three, $p_3(x)$, using the Gaussian elimination method.