YEDITEPE UNIVERSITY- Faculty of Engineering
ES272 (2023-2024 Spring)
HOMEWORK

Due Date: 19 May 2024 23.59 (Please upload well before the deadline. I will not extend the due date even if there is a technical issue! The solution should be uploaded to YULEARN as a single PDF. Email submissions are not accepted!)

The **general least-squares regression** can be stated as

$$y = a_0 z_0 + a_1 z_1 + \ldots + a_m z_m$$

where z0, z1,… are function of x. For n data points, we have the following matrix equation:

$$\{y\} = [Z]\{a\} + \{e\}$$

where

$$[Z] = \begin{bmatrix} z_{10} & z_{11} & \ldots & z_{1m} \\ \ldots & & & \\ \ldots & & & \\ z_{n0} & z_{n1} & & z_{nm} \end{bmatrix} \quad \{a\} = \begin{Bmatrix} a_0 \\ a_1 \\ \ldots \\ a_m \end{Bmatrix} \quad \{y\} = \begin{Bmatrix} y_1 \\ y_2 \\ \ldots \\ y_n \end{Bmatrix}$$

Here n is the number of data points and m is the order of the fit function (In general n>m, so Z is an overdetermined matrix). We minimize the error (e) by minimizing the spread which is equivalent to the following liner equation:

$$[Z]^T [Z]\{a\} = [Z]^T \{y\}$$

Here Z^TZ is symmetric square matrix which can be solved by Gauss elimination, LU decomposition, Cholesky, etc. methods.

Problem: Calibration data for an NTC thermistor is provided at Yulearn (ntccal.dat; Lab 8 part-b). In the dataset, the first column is the resistance (Ohm) and second column is the temperature (in Celcius). Write a MATLAB script that fits data to the following function (known as *Steinhart-Hart equation*):

$$\left[\frac{1}{T}\right] = A + B[\ln(R)] + C[\ln(R)]^3$$

Convert the unit of T into Kelvin and use general linear least-square regression to find the best fitting A, B, C values. Turn in the codes and the graph that shows the data and the best fit curve on the same graph. Also include the values of coefficients (A,B,C) in your figure (you can insert text in MATLAB plot window).