ME 8813 ML Fundamental for ME
Homework Assignment 1
(Due 2/8/2024, Thursday, 11:55pm)
(This is an individual assignment)

Electronic Submission Guideline: *your submission to Canvas* should be one (or several) python source file(s), where the main executable file should be named clearly such as **ME8813ML_Homework1_YourLastName_FirstName.py**. You may choose to use Jupyter notebook.

A simple python file regr_data.py is given, where a small dataset $\{x_i, y_i\}$ is generated for regression. Implement the quasi-Newton optimization method, Davidon-Fletcher-Powell Method, to perform the data fitting process. The model to be fitted is:

$$Y = p_0 + p_1 \cos(2\pi x) + p_2 \cos(4\pi x) + p_3 \cos(6\pi x)$$

Your implementation of the optimization method should be included in a function p=DFP_fit(x,y,epsilon) where x and y are the vectors of training data corresponding to the input and output of the model, and epsilon is the error threshold users can specify for the stopping criteria. You can choose to implement any of the stopping criteria discussed in the lecture. The function should return the fitted parameters **p** = [p_0, p_1, p_2, p_3].

Plot the predictions from your fitted model right below the original data as the comparison.

As the hint, the loss function or objective function to be minimized is:

$$L(p_0, p_1, p_2, p_3) = \sum_{i=1}^{data\_size} [p_0 + p_1 \cos(2\pi x_i) + p_2 \cos(4\pi x_i) + p_3 \cos(6\pi x_i) - y_i]^2$$

The search space for the optimization is 4-dimensional as (p_0, p_1, p_2, p_3). The gradient function ∇L as the first derivative respect to p's can be derived analytically and hard coded.