Deep Learning: Assignment # 1

This assignment consists of the following tasks:

1. You will build a linear regression model as per the following details:

    - The training data consists of 20 pairs of x and y values, representing noisy measurements made on a sine function in the interval of 0-2*P*i. The measurements are made at equally spaced points and are corrupted with noise coming from a normal distribution with zero mean and unit variance. Create a plot of the data.
    - The model equation to be used is $y_i = a_0 + a_1 x_i + a_2 x_i^2 + a_3 x_i^3$
    - The model will be constructed using gradient search along the lines as described under the following link with numpy:
    - PyTorch: Tensors
    - After the model has been trained, you will plot the predicted *y* values against *x* values.
    - Play with the choice of learning rate as well as changing the degree of polynomial in the model equation to 2 and 4. Plot and discuss your results.

2. Build a model to predict corn yield with two independent variables fertilizers and insecticides. The data for this task is as follows. Again, you will build the model using the gradient search and not using the any package.

Corn	Fertilizer	Insecticides
40	6	4
44	10	4
46	12	5
48	14	7
52	16	9
58	18	12
60	22	14
68	24	20
74	26	21
80	32	24

3. Implement in Python the pseudo-inverse approach and determine the prediction model for the data in #2 above. How different are model parameters obtained in exercise #2 with #3?

4. This exercise is to perform digit recognition using logistic regression. You will use sklearn library for this. The link below provides step by step directions for this task.

https://towardsdatascience.com/logistic-regression-using-python-sklearn-numpy-mnist-handwriting-recognition-matplotlib-a6b31e2b166a

5. In this exercise, you will use k-NN classifier to perform recognition. You will use the same training/test set partitioning as done in exercise #4. This will allow for comparison. You will use k=3 in your work. The k-NN will be run in two ways as described below:
    - **a.** In the first experiment, pixel values of the digit images will be used as features.
    - **b.** In the second experiment, you will create features from the input image and these features will be used for recognition. Potential features are: (i) sum of 1s in small windows of suitable choice, (ii)count of 1s along rows and columns, (iii) any other features of your choice.
    - c. Again, analyze your results with plots/tables etc.