Lab Assignment 3: Date:24/01/25

1- Demonstrate the behavior of **Gradient Descent** and its variants—**Batch Gradient Descent (GD), Stochastic Gradient Descent (SGD), and Mini-batch Stochastic Gradient Descent (Mini-batch SGD) o**n both simple and complex functions, along with plots showing their computational cost and trajectory convergence behavior. Return the optimal final values of the following function f(x) = x^2 and G(x) = x^4+x^3+x^2 for a range of x between -20 to 20, learning rate =.01 and epoch size =50 and plot the trajectory of convergence.

2- Consider this function also cos(pi.x) compute for x -4 to 4,

```
def f(x):
  return np.cos(np.pi * x)
# Derivative of f(x) -> f'(x) = 2x
def df(x):
  return -2 * np.pi * np.sin(np.pi * x)
```

3- Diabetes Prediction with Pima Indians Diabetes Dataset : Develop and train a deep neural network to predict the onset of diabetes using the **Pima Indians Diabetes** dataset. The objective is to perform binary classification to determine whether a patient has diabetes based on diagnostic measurements. This task involves:

1. **Data Exploration and Preprocessing**: Understanding and preparing medical data for modeling.
2. **Model Architecture & Implementation**: Building and training a deep neural network for classification.
3. **Interpretation**: Evaluating model performance and discussing improvements and real-world implications.

Dataset

- **Name**: Pima Indians Diabetes Dataset
- **Description**: Contains diagnostic measurements for female Pima Indians aged ≥21, along with a binary outcome indicating diabetes presence.
- **Link:** https://www.kaggle.com/datasets/uciml/pima-indians-diabetes-database

Task A: Data Exploration and Preprocessing

- Handle Missing Values & Anomalies, class imbalance.
- Apply Feature Engineering

Task B: Model Architecture & Implementation

1) Evaluate the Model:-

- Generate classification metrics:

- Accuracy
- Precision
- Recall
- F1-score
- ROC-AUC

2) **Create a Confusion Matrix and ROC Curve. And Plot Training Curves**

Task C: Interpretation

1. Model Performance Summary

- Analyze whether the model achieves high accuracy (e.g., >75%) and balanced precision and recall.
- Examine F1-scores and ROC-AUC to assess overall performance.

2. Handling Class Imbalance Impact

- Discuss how addressing class imbalance (e.g., using class weights) influenced model performance.
- Compare metrics with and without class imbalance handling if experimented.