Logistics Regression (Softmax) Multiclass Classification

📝 **Assignment: Image Classification with Logistic Regression (Binary & Multiclass)**

📘 *Trainee Students — AI/ML/DL*

🎯 **Objective**

Implement **binary** and **multiclass image classification** using **logistic regression**, with and without libraries like scikit-learn.

📚 **Key Topics**

- Logistic Regression
- Sigmoid & Softmax Functions
- Loss Functions
- Evaluation Metrics
- Model Training using Gradient Descent
- scikit-learn vs. manual implementation

🗂️ **Dataset Requirements**

🔶 **Binary Classification Dataset**

Choose **one** from:

- Cats vs Dogs (Kaggle)
- COVID-19 Radiography Dataset (Kaggle)
- Chest X-ray Pneumonia

🔷 **Multiclass Classification Dataset**

Choose **one** from:

- Sign Language MNIST
- Image Segmentation Dataset (UCI)
- Fashion MNIST

⚙️ **Implementation Requirements**

🔶 **Track A: With Scikit-learn**

Use:

- LogisticRegression from sklearn.linear_model
- train_test_split, accuracy_score, classification_report, confusion_matrix

Tasks:

- Preprocess and flatten image data

- Train model
- Evaluate using accuracy, confusion matrix, classification report
- Plot training/test accuracy (optional with cross-validation)

🔷 **Track B: Without Scikit-learn (Manual)**

Implement:

- **Sigmoid (Binary)** or **Softmax (Multiclass)** functions
- **Loss functions:** Binary cross-entropy / Categorical cross-entropy
- **Gradient Descent**
- Model training loop with epochs
- Manual accuracy calculation
- Confusion matrix + precision/recall/F1-score from scratch or with sklearn.metrics

📊 **Expected Plots**

- Training vs Testing Accuracy (line chart)
- Training vs Testing Loss
- Confusion Matrix (heatmap using matplotlib/seaborn)
- Optional: ROC Curve for binary classification

🔍 **Deliverables**

- .ipynb notebook with:
    - ✅ One section for **Scikit-learn implementation**
    - ✅ One section for **Manual NumPy implementation**
- 📄 PDF report:
    - Description of both approaches
    - Performance comparison
    - Screenshots of plots and outputs
    - Final observations and challenges faced

🗓️ **Deadline:** ***25/04/2025***

📨 **Submission:** ***GitHub***