

## **Project Title**

Clothing Item Classification Using Deep Learning on Fashion MNIST

## **Project Overview**

This project aims to develop a deep learning model using Fashion MNIST to classify clothing items into 10 categories (T-shirt, Trouser, Pullover, Dress, Coat, Sandal, Shirt, Sneaker, Bag, Ankle Boot). The model will be trained using a Convolutional Neural Network (CNN) implemented in Python and PyTorch.

## **Why is this project good?**

- Fashion item classification is a fundamental problem in computer vision, applicable in e-commerce, retail, and automated inventory systems.
- Deep learning, especially CNNs, has been highly effective for image classification tasks.
- This project will enhance understanding of CNNs, feature extraction, and optimization techniques.
- The Fashion MNIST dataset is well-suited for testing and benchmarking classification models.

## **Key Objectives:**

- Understand and preprocess the Fashion MNIST dataset (grayscale 28x28 pixel images).
- Build and train a CNN model to classify clothing items.
- Optimize model performance using hyperparameter tuning, dropout, and batch normalization.
- Compare CNN performance with fully connected neural networks (MLP).
- Visualize model performance using accuracy curves and a confusion matrix.

## **Project Methodology:**

### **1. Data Preprocessing:**

- Load the Fashion MNIST dataset.
- Normalize pixel values and reshape images.
- Perform data augmentation (rotation, zoom, shift) to improve generalization.

### **2. Model Implementation:**

- Implement a CNN with multiple convolutional layers using PyTorch.
- Compare it with a \*basic fully connected network (MLP).
- Train both models and evaluate their accuracy.

### **3. Performance Evaluation:**

- Use accuracy, precision, recall, F1-score as evaluation metrics.
- Visualize training/validation loss and accuracy curves.
- Plot a confusion matrix to analyze misclassified images.

#### 4. Optimization Techniques:

- Apply Dropout and Batch Normalization to improve generalization.
- Tune hyperparameters (learning rate, batch size, optimizer).
- Use data augmentation to enhance model performance.

#### 5. Results & Interpretation:

- Compare CNN with MLP and discuss why CNN performs better.
- Highlight challenges in fashion item classification.

#### **What data will be used?**

The Fashion MNIST dataset will be used, which consists of 70,000 images (60,000 for training and 10,000 for testing). Each image is a 28x28 grayscale image belonging to one of 10 clothing categories.

#### **How will the system's performance be evaluated?**

- The system's performance will be measured using accuracy, precision, recall, and F1-score.
- A confusion matrix will be generated to analyze misclassifications.
- Training and validation loss and accuracy curves will be plotted to visualize the learning process.
- The performance of the CNN model will be compared to an MLP model to demonstrate the advantages of deep feature extraction.

#### **Expected Outcome:**

- A trained deep learning model achieving high classification accuracy on Fashion MNIST.
- Performance comparison between CNN and MLP architectures.
- Insights into model optimization and real-world applications (e.g., fashion retail automation).