

Fashion Item Classification Using a Convolutional Neural Network (CNN)

1. Title Page

- Project Name: Fashion Item Classification Using CNN
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- Submission Date: 14/12/2025
- Course Name: Neural Networks – CS 417
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2. Introduction

- What is the Problem?

Fashion item classification aims to identify the category of a clothing item from grayscale low-resolution images.

This is a single-label, multiclass classification problem.

- Why is it Important?

Demonstrates how CNNs learn hierarchical features such as edges, textures, and shapes.

Serves as a foundation for more complex image-processing tasks.

Has real-world applications in e-commerce recommendations, automated tagging, and inventory management.

3. Dataset

- Source of Dataset

Dataset: Fashion MNIST

Source: TensorFlow/Keras datasets, Zalando Research

- Number of Classes

10 clothing categories:

1. T-shirt/top

- 2. Trouser
- 3. Pullover
- 4. Dress
- 5. Coat
- 6. Sandal
- 7. Shirt
- 8. Sneaker
- 9. Bag
- 10. Ankle boot

- Number of Images per Class

Training Set: 60,000 images

Test Set: 10,000 images

Balanced across all classes

- Preprocessing Steps

Reshaped images to (28, 28, 1)

Normalized pixel values to [0, 1]

4. Methodology

- Model Architecture

Baseline CNN with layers:

Conv → ReLU → MaxPool

Conv → ReLU → MaxPool

Flatten → Dense → Softmax output

- Data Augmentation

Applied to training set (rotation, zoom, horizontal flip, width/height shift) Normalized pixel values for all sets

- Training Procedure

Used Adam optimizer with categorical cross-entropy loss

Monitored accuracy and loss on training and validation sets

EarlyStopping, ReduceLROnPlateau, and ModelCheckpoint callbacks

- Hyperparameters Used

Batch size: 32

Epochs: 30

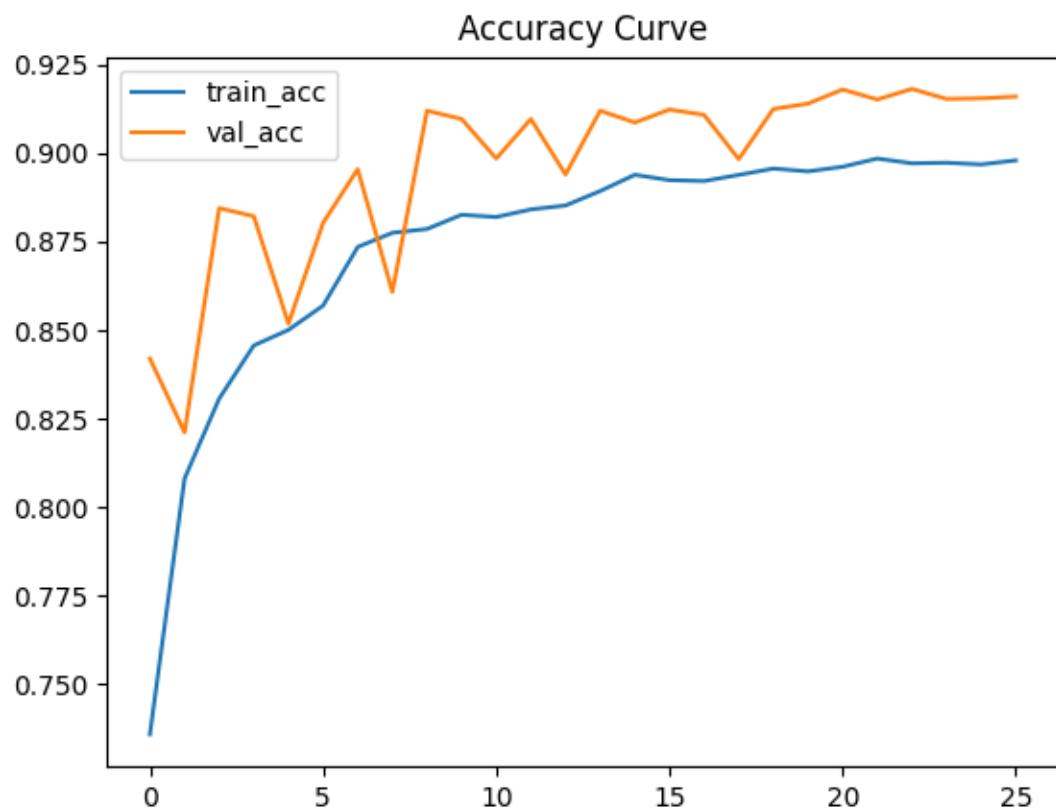
Input image size: 28×28×1 (grayscale)

Number of classes: 10

5. Results

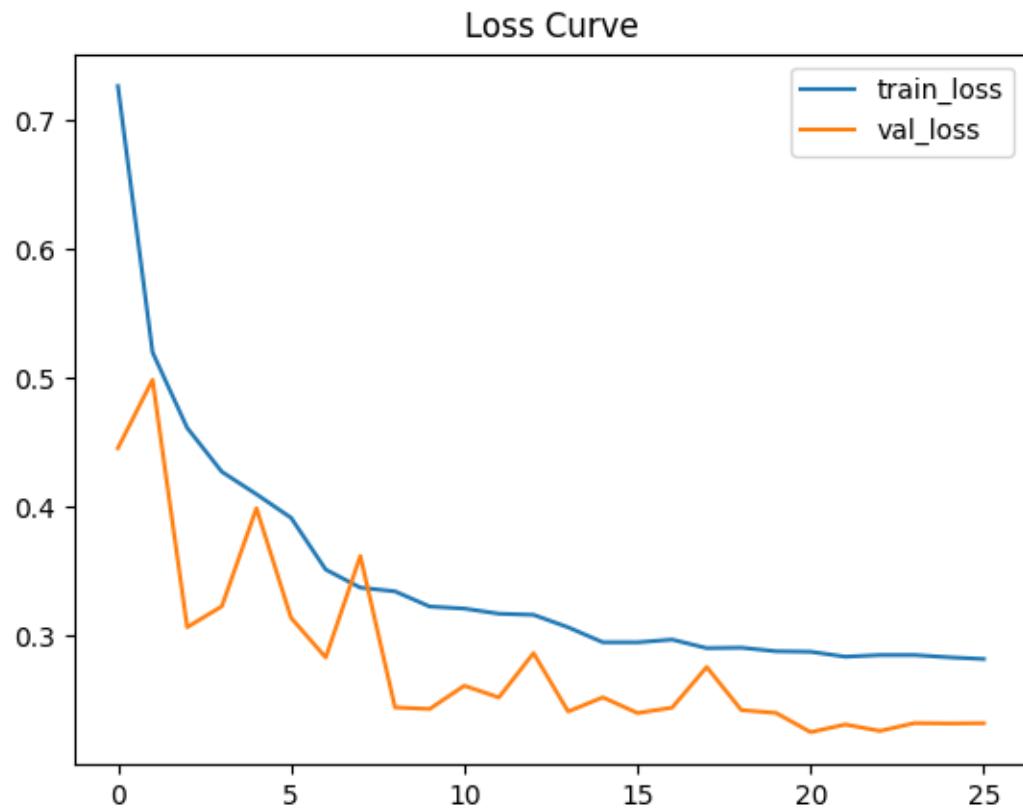
- Accuracy
 - The curves show that the model gradually stabilized during training without significant overfitting.

Figure:



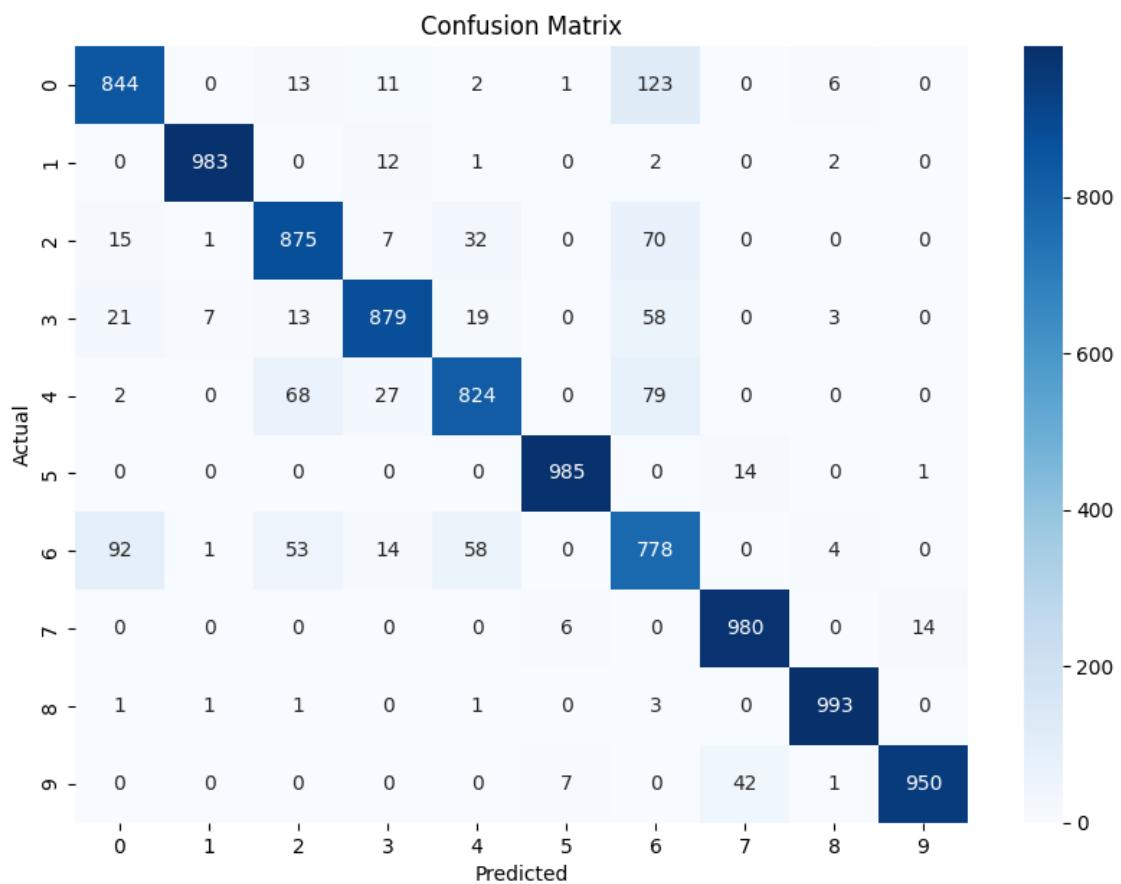
- Loss Curves

Figure:

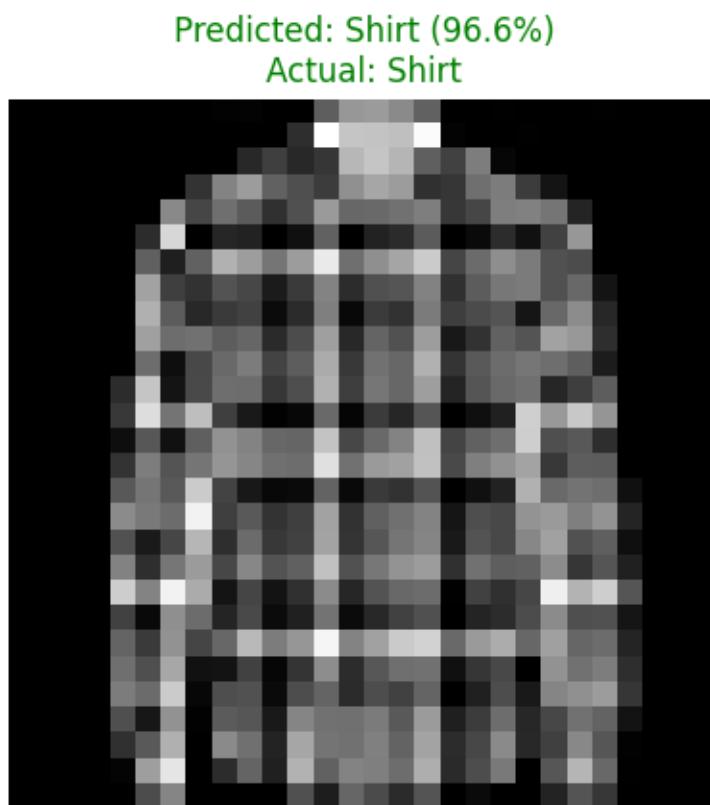


- Confusion Matrix
- A confusion matrix was generated to visualize misclassifications between visually similar classes such as Shirt vs T-shirt and Coat vs Pullover.
- The matrix shows that most classes were classified correctly, with minor confusion between similar categories.

- **Figure:**



- Sample Prediction



- F1-Scores
 - F1-scores for each class were computed using `classification_report` from scikit-learn.
 - The results indicate balanced performance across most classes.
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6. Discussion

- What Worked Well

Baseline CNN architecture achieved strong performance

Proper preprocessing and normalization improved model stability

- What Failed and Why?

Misclassifications occurred between visually similar categories due to low resolution and grayscale images

- Limitations

Model trained only on grayscale 28×28 images

Limited ability to distinguish fine-grained visual details

7. Conclusion & Future Work

- Conclusion

CNN can effectively classify Fashion MNIST images

Demonstrates practical understanding of image classification pipelines

- Future Work

Use deeper CNN architectures (VGG, ResNet)

Apply transfer learning

Train on RGB or higher-resolution images

Fine-tune hyperparameters and augment data further

8. References

Fashion MNIST Dataset (TensorFlow/Keras)

Zalando Research Documentation

Deep learning literature on image classification