MACHINE LEARNING
Final Project

Using the SVM (Support Vector Machine), Random Forest, and CNN models the fashion images are classified. And an ensemble model is created by averaging the predictions of SVM, Random Forest and CNN models for the test set. By using these models, we also calculate the accuracy, precision, recall and F1 score.

Preprocessing –

The Fashion MNIST dataset is loaded as it contains a collection of images. They are scaled to values between 0 to 1 for better model performance. For SVM and Random Forest, the images were flattened into 784-dimensional vectors and for CNN, the images are reshaped into 28x28x1 format to keep the original shape. The data is split into 70:30 ratio i.e., 70 for training and 30 for testing. To improve the generalization of CNN model, data augmentation is done like rotating, zooming and shifting the images to the training set.

Models –

SVM – A model that can help in finding the best way to separate different classes. It is trained using the flat image data. It is implemented with an “rbf” kernel and probability (for soft predictions)

Random Forest – A model is made up of 100 decision trees and it is also trained with flat image data.

CNN – A deep learning model that can help in processing the original shape of the image. This process in done by using layers for detecting the features, pooling and classification. The model was trained for 10 rounds. The model is compiled using “adam” optimizer and sparse categorical cross entropy loss.

ENSEMBLE MODEL – it is combination of the models i.e., all the three models are combined to take the average for all the three model’s predictions.

The final class predictions are obtained by taking the highest class with high average probability.

Evaluation –

The SVM, Random Forest, CNN and Ensemble are checked how well the models have performed using

Accuracy means Overall Correctness,

Precision means how many predictions were made correctly,

Recall means how many actual items were found correctly,

F1 Score means the balance between the precision and recall.

The results for each model:

Model	Accuracy	Precision	Recall	F1 Score
SVM	0.8907	0.8902	0.8907	0.8902
Random forest	0.8829	0.8823	0.8829	0.8816
CNN	0.9109	0.9113	0.9109	0.9107
Ensemble	0.9112	0.9107	0.9112	0.9107

Comparative Analysis of each model with the Ensemble –

SVM vs. Ensemble – The ensemble model performed very well compared to SVM in all evaluation metrics. The accuracy of SVM is of 0.8907 and F1 Score is 0.8902 whereas ensemble's accuracy and F1 Score both are improved to 0.9112 and 0.9107. This shows that the combination of three models can predict even over stronger than the individual performance of the SVM.

Random Forest vs. Ensemble – Its performance is lower than all the models even among the three individual model and the combining model with accuracy of 0.8829 anf F1 Score of 0.8816. So, the ensemble learning helps the models like random forest by mixing its results with stronger ones.

CNN vs. Ensemble – CNN has very strong individual performance compared to SVM and random forest with accuracy of 0.9109 and F1 Score of 0.9107 as same of ensemble model but the accuracy, precision and recall has improved slightly. This indicates that the ensemble matches the CNN's Strength but adds some benefits of stability by averaging across the models.

To conclude, by using SVM, Random Forest, and CNN models together an ensemble model is created. The Ensemble model gives better results than SVM and Random Forest and equally with the CNN model and sometimes slightly better. This shows that combining models can help in improving the overall accuracy and makes predictions more reliable. So, it is a good way to get strong performances using combining models especially when the models are not good enough to perform on their own.