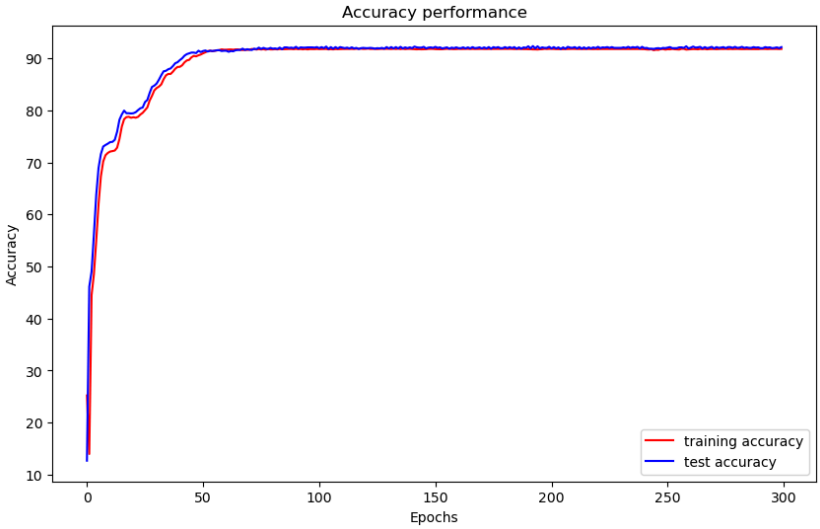
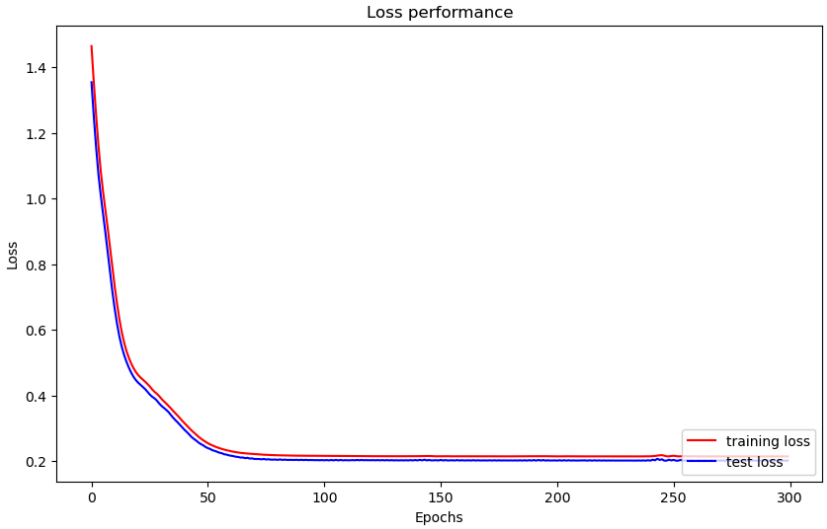
Programming Project 2: Neural Networks Report

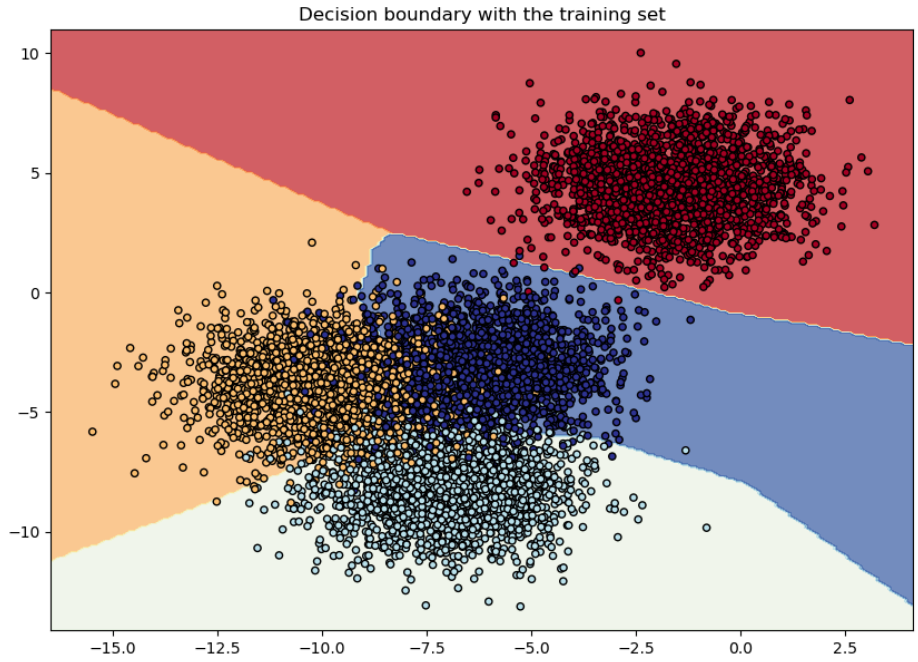
Task 1: Simple Classification

1. Loss and Accuracy Curves

In Task 1, a vanilla neural network was trained on a synthetic dataset of 10,000 samples across 4 classes. The training process was conducted over 300 epochs.







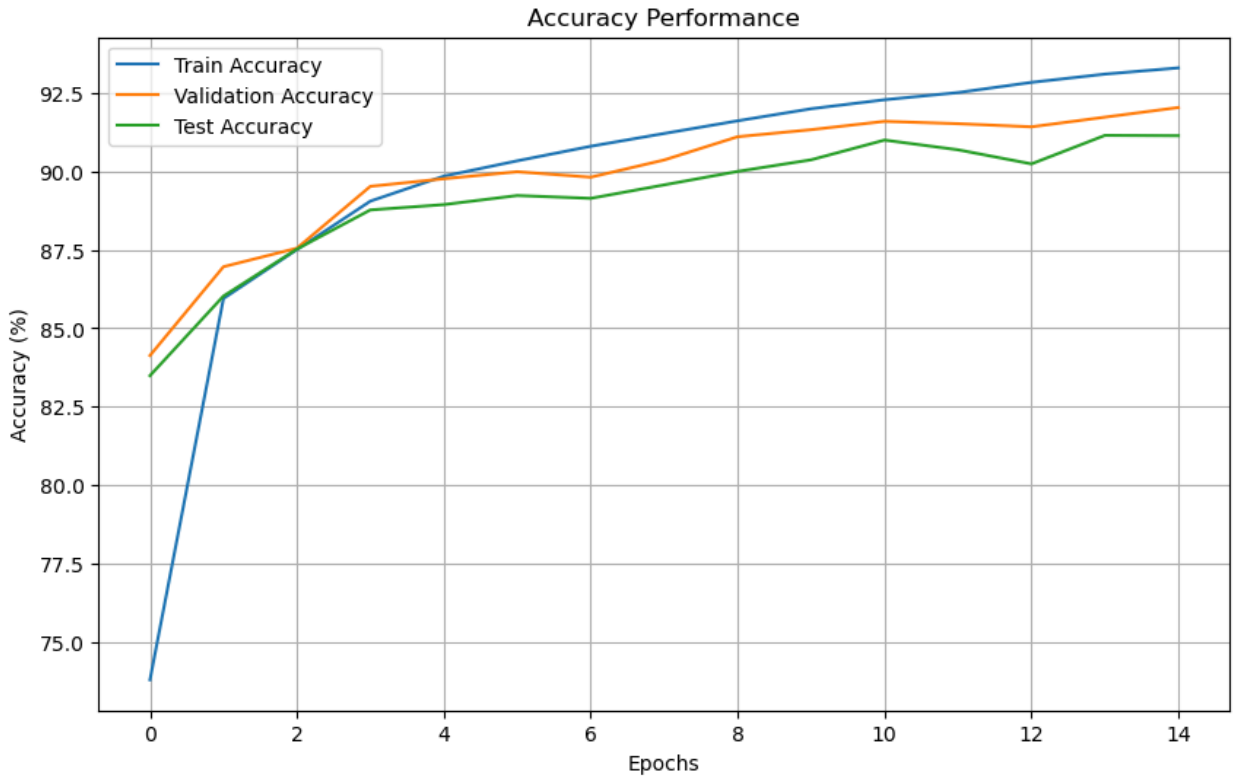
2. Summary and Observations

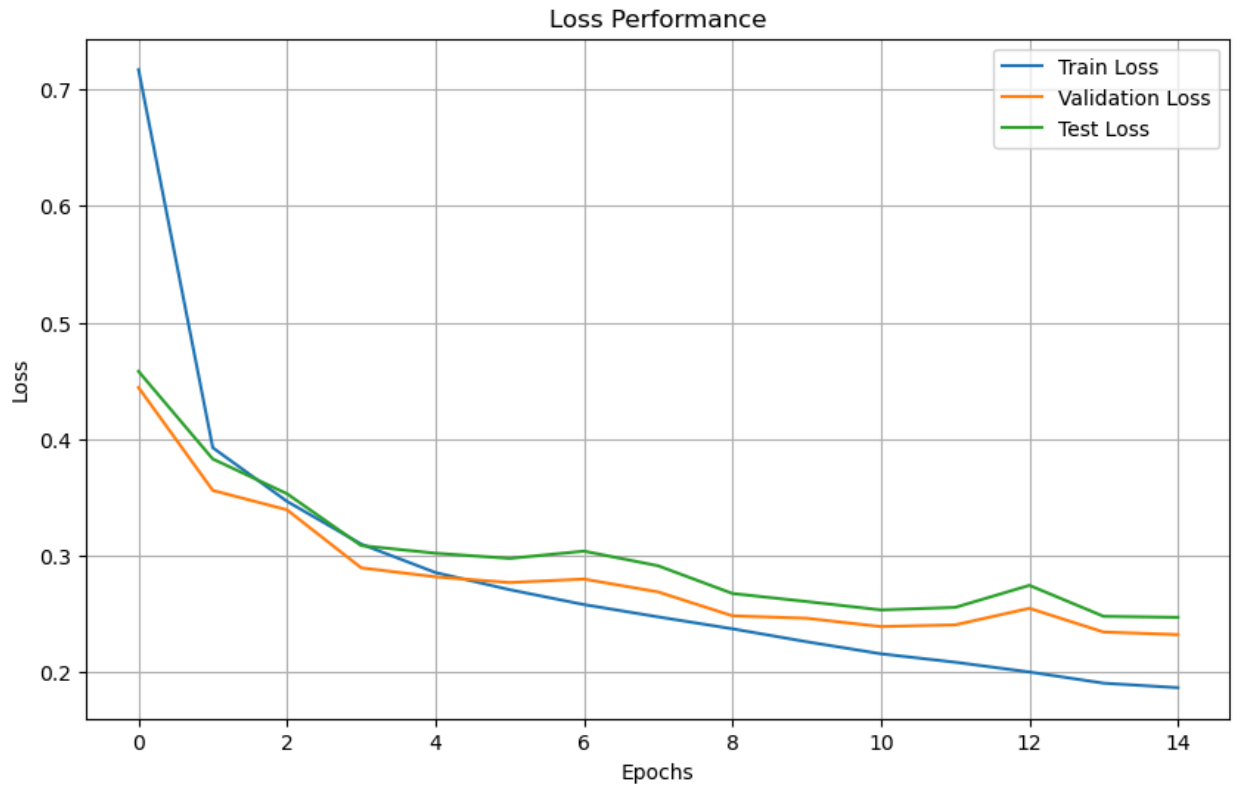
The model demonstrated strong convergence, with the loss decreasing rapidly and the accuracy reaching approximately 99% within the first 50 epochs. There is no evidence of overfitting or underfitting, as the training and test curves remain closely aligned throughout the process. The model successfully learned the decision boundaries for the four clusters, indicating that the chosen hidden size and learning rate were optimal for this data distribution.

Task 2: Vision Classification (FashionMNIST)

1. Loss and Accuracy Curves

For Task 2, a Convolutional Neural Network (CNN) was implemented to classify the FashionMNIST dataset. The curves below represent the performance across the training, validation, and test sets.





2. Summary and Observations

The CNN model converged efficiently, achieving a test accuracy of over 90% (meeting the project requirements). The validation loss tracked closely with the training loss, suggesting that the model generalized well to unseen data without significant overfitting. Although the complexity of FashionMNIST is higher than the simple blobs, the convolutional blocks effectively captured spatial features, leading to stable convergence and high performance on the test set.

Final Performance Summary

Metric	**Task 1 (Simple)**	**Task 2 (Vision)**
Final Test Accuracy	~99%	91.15%
Final Test Loss	~0.02	0.2470

Conclusion: Both models successfully met the architectural and performance criteria. The transition from a simple linear model to a CNN allowed for the successful processing of complex image data, demonstrating the importance of spatial feature extraction in computer vision tasks.