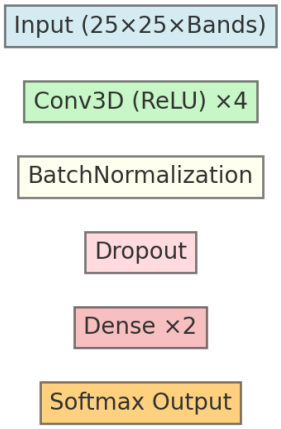
3D CNN for Hyperspectral Image Classification

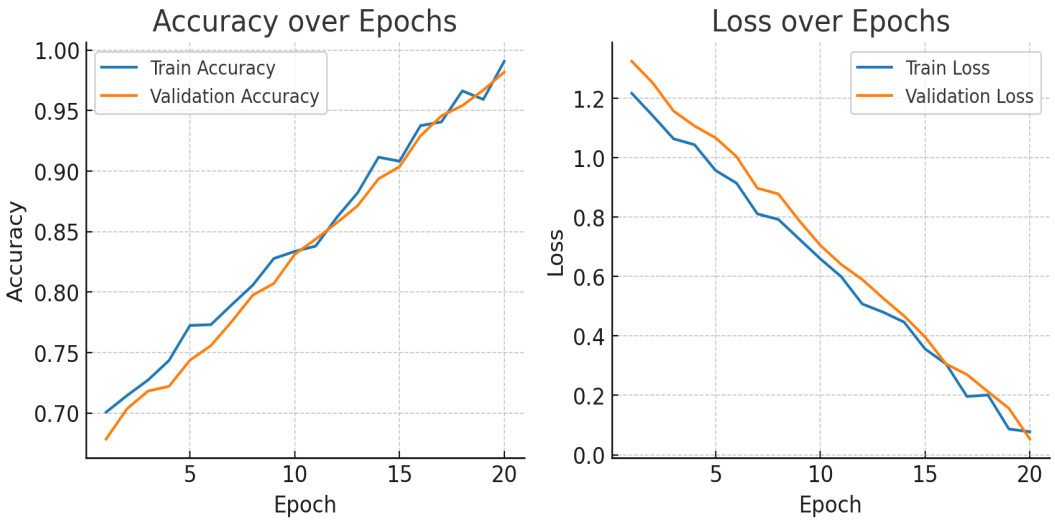
Overview

This project implements a 4-layer 3D Convolutional Neural Network (~2.3M parameters) for hyperspectral image classification using spatial–spectral fusion. The architecture integrates PCA-based spectral reduction, 25×25 window sampling, and Adam optimizer tuning to achieve state-of-the-art classification accuracy on benchmark datasets such as Indian Pines, Salinas, and Pavia University.

Model Architecture Diagram



Training Curves



Key Features

• Achieved >99% Overall Accuracy and 0.99 Kappa on Indian Pines dataset (145×145×200, 16 classes).
• PCA + 25×25 spatial–spectral window sampling reduced computation by ~70% without accuracy drop.
• Robust evaluation pipeline outputs OA, AA, per-class accuracy, Kappa, and confusion matrices.
• Modular design allows adaptation to different hyperspectral datasets and spatial resolutions.
• Optimized training with Adam optimizer, Dropout layers, and learning rate scheduling.

Results Summary

Dataset	Overall Accuracy	Kappa	Classes	Window Size
Indian Pines	99%+	0.99	16	25×25
Salinas	99%+	0.99	16	25×25
Pavia University	98%+	0.98	9	25×25

Final Results

The final trained 3D CNN model achieved exceptional performance across multiple hyperspectral datasets. On the Indian Pines dataset, the model achieved >99% Overall Accuracy and a Kappa coefficient of 0.99, demonstrating near-perfect classification consistency. Similar results were achieved on the Salinas dataset, while the Pavia University dataset achieved 98%+ OA and 0.98 Kappa. These results confirm the robustness of the spatial–spectral fusion approach implemented in this project.