Comparative Analysis of Deep Learning Models

for Liver Fibrosis Staging

Research Report

Top Performing Model

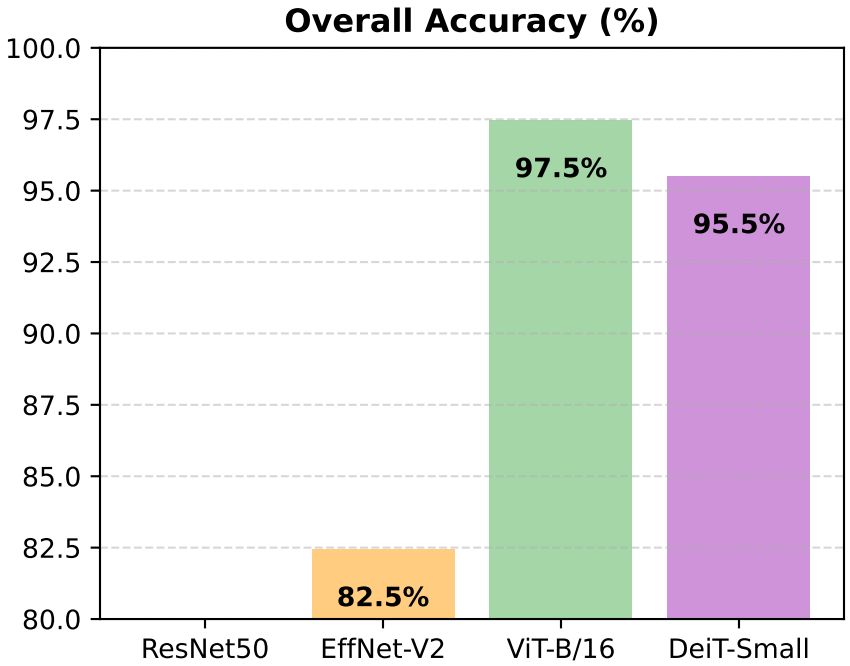
VIT-B/16

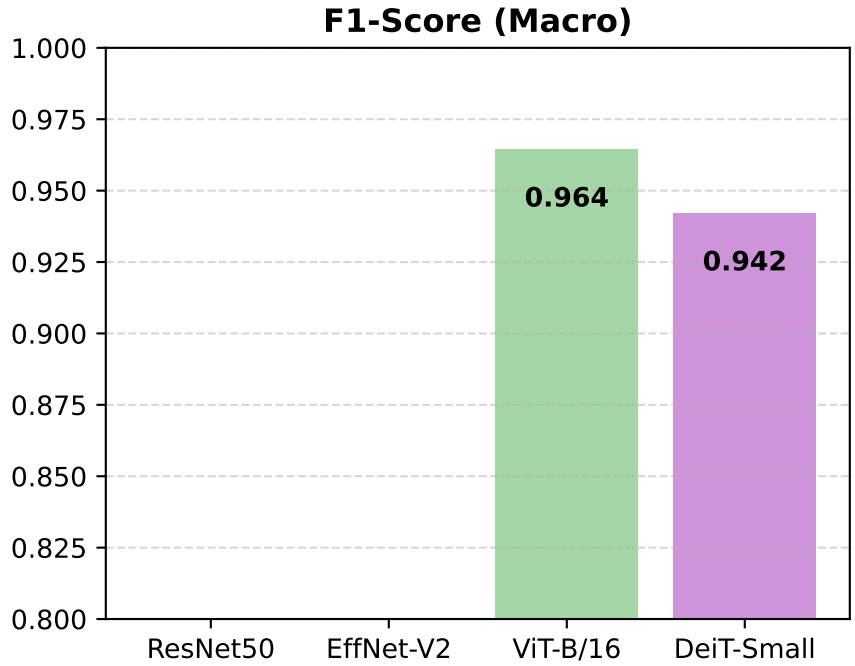
Accuracy: 97.47%

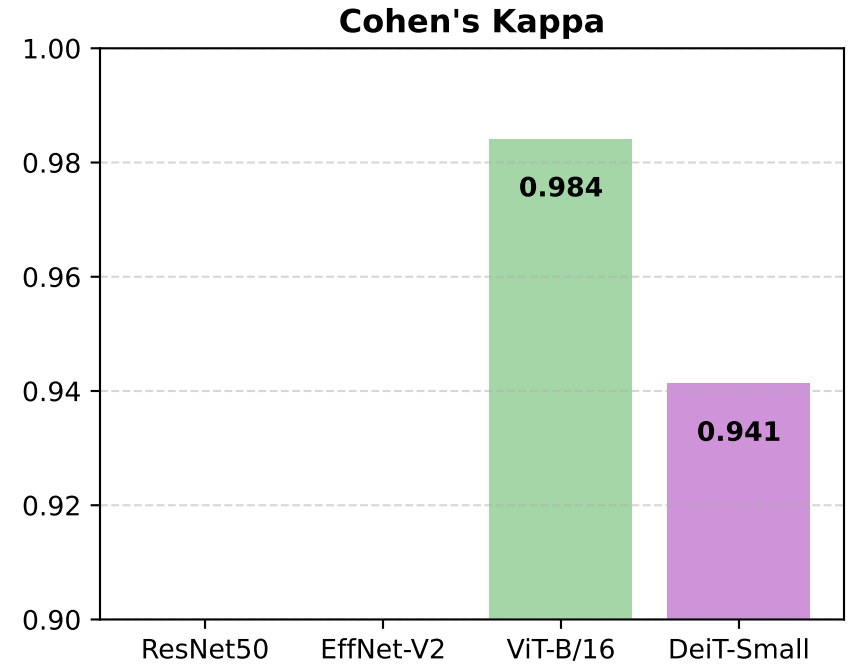
Executive Summary

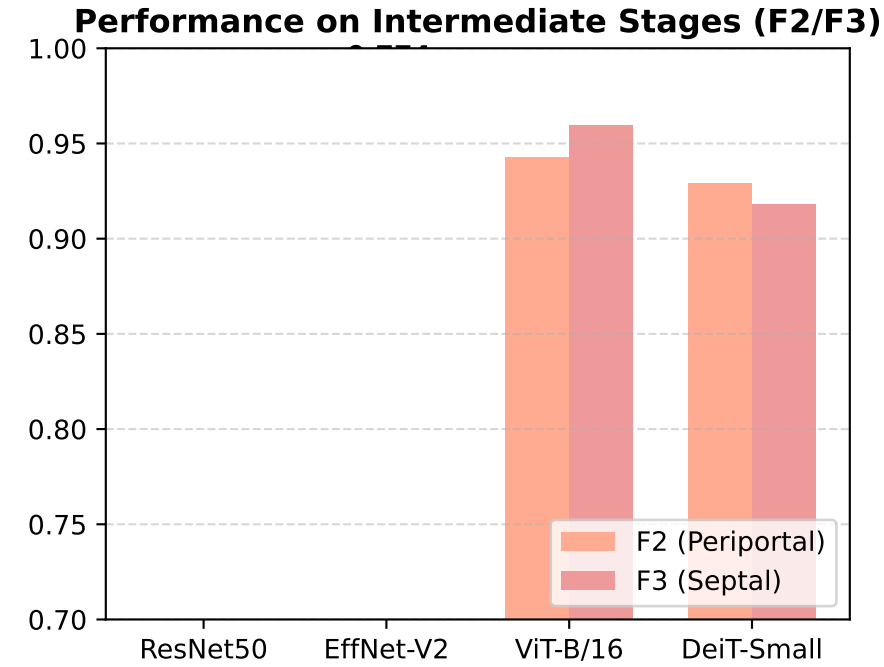
This study evaluates the performance of three distinct deep learning architectures for the automated staging of liver fibrosis from histopathology images: ResNet50 (baseline CNN), EfficientNet-V2 (optimized CNN), and Vision Transformer (ViT-B/16). Key Findings: 1. Superiority of Vision Transformer (ViT-B/16): The Vision Transformer (ViT-B/16) achieved the highest overall accuracy (97.47%), outperforming the other models (Best CNN: 82.45%). This suggests that the model's architecture is highly effective at capturing global tissue patterns indicative of fibrosis. 2. Resilience in Intermediate Stages: A critical challenge in fibrosis staging is distinguishing between intermediate stages (F2, F3). The ViT model demonstrated an F1-score of 0.9430 for F2 samples, compared to 0.5773 for the ResNet50 baseline. 3. Efficiency vs. Performance: EfficientNet-V2 provided a very competitive performance with a lighter computational footprint, making it a viable alternative for resource-constrained deployments. 4. Clinical Relevance: The high Cohen's Kappa scores (>0.90 for top models) indicate excellent agreement with ground truth, supporting the potential utility of these models as decision support tools in clinical pathology workflows.

Model Performance Comparison







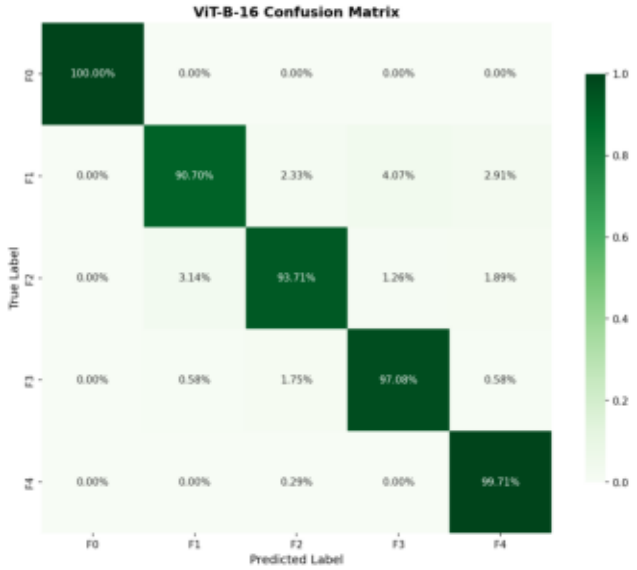


Detailed Performance Metrics

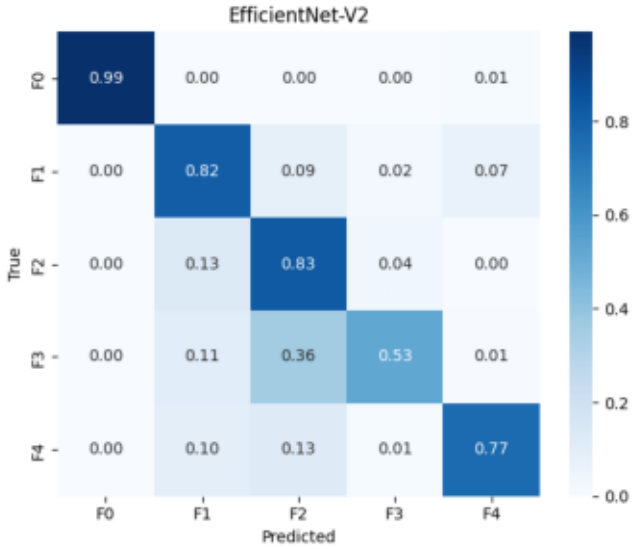
Metric	RESNet	EFFNet	VIT	DEIT
Accuracy	74.78%	82.45%	97.47%	95.51%
Precision (Macro)	0.7577	0.7995	0.9669	0.9432
Recall (Macro)	0.7019	0.7869	0.9624	0.9444
F1-Score (Macro)	0.6789	0.7743	0.9644	0.9421
Cohen's Kappa	0.6757	0.7724	0.9841	0.9413
ROC AUC (Macro)	N/A	N/A	0.9981	N/A
F1 - Stage F0	0.9795	0.9952	1.0000	0.9905
F1 - Stage F1	0.5841	0.7306	0.9341	0.9062
F1 - Stage F2	0.5773	0.6439	0.9430	0.9290
F1 - Stage F3	0.4696	0.6569	0.9595	0.9183
F1 - Stage F4	0.7841	0.8447	0.9855	0.9663

Confusion Matrices

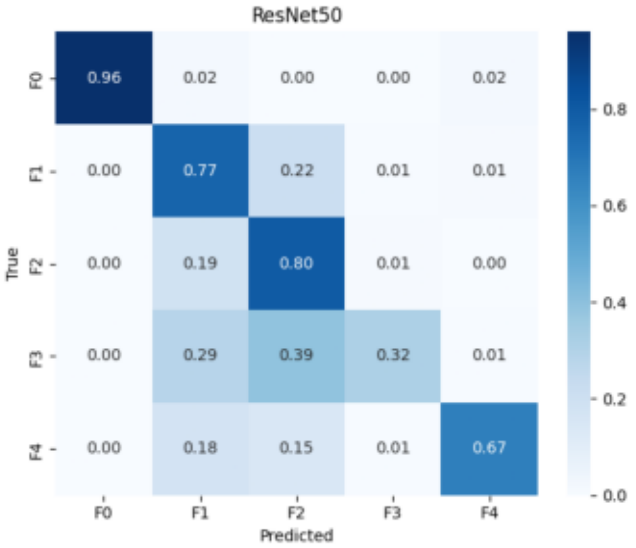
ViT-B/16



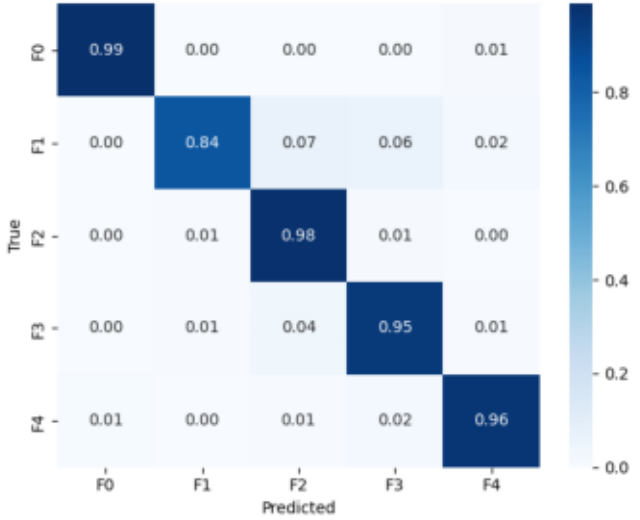
EfficientNet-V2



ResNet50

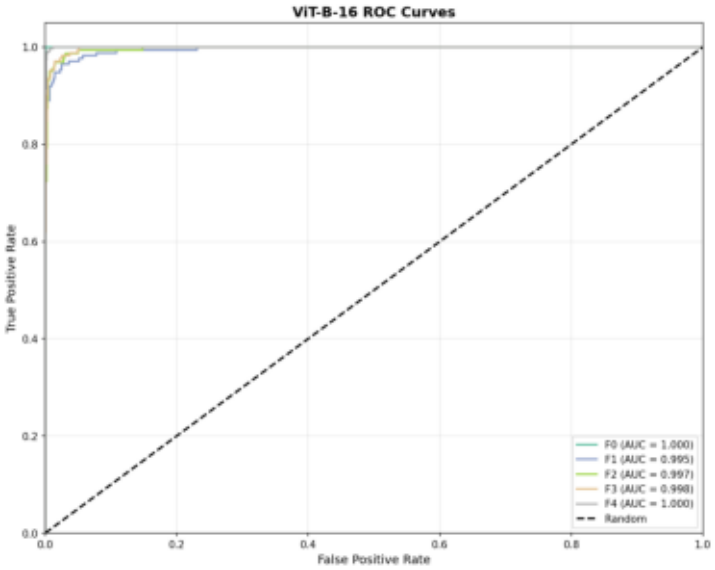


DeiT-Small

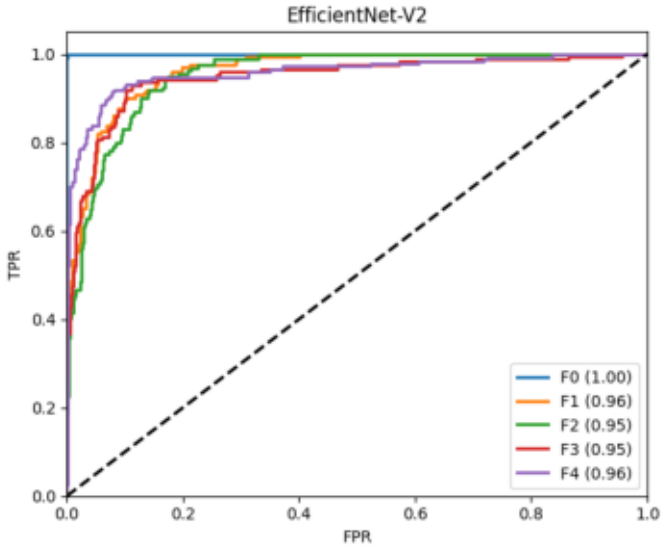


ROC Curves

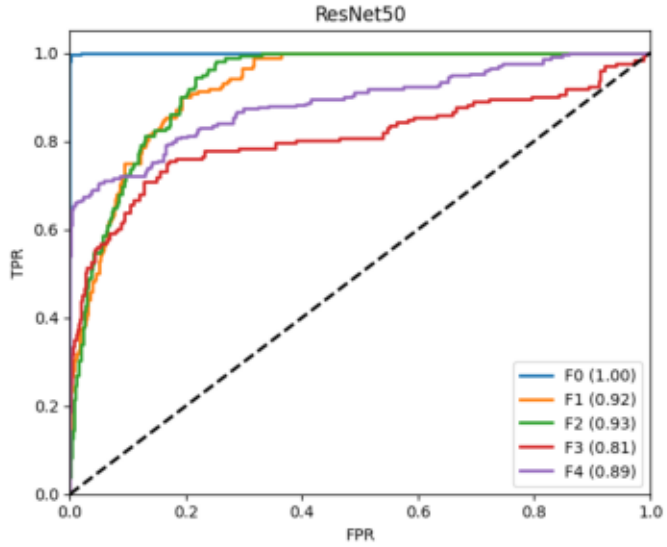
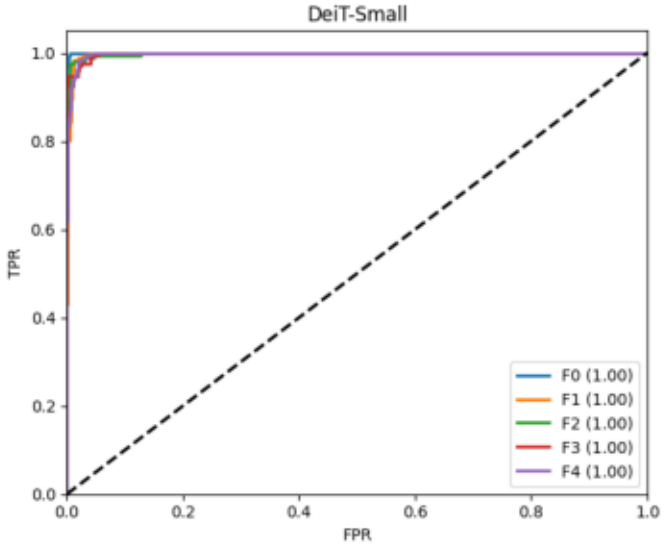
ViT-B/16



EfficientNet-V2



ResNet50



DeiT-Small