ECE 285 - Introduction to Visual Learning

Course Project - Semantic Segmentation for Self-driving Cars

Semantic Segmentation for Self Driving Cars

Aim

- This project aims to explore and compare the performance of three different models, namely U-Net, DeepLab V3, and DeepLab-VIT, for semantic segmentation tasks on a dataset captured from the CARLA self-driving car simulator.

Motivation

- Semantic segmentation plays a crucial role in computer vision applications, particularly in autonomous driving systems. The motivation behind this project lies in the increasing demand for reliable and efficient segmentation algorithms for autonomous vehicles.

Approaches

Models

- UNET
- Deep Lab V3
- Deep Lab VIT

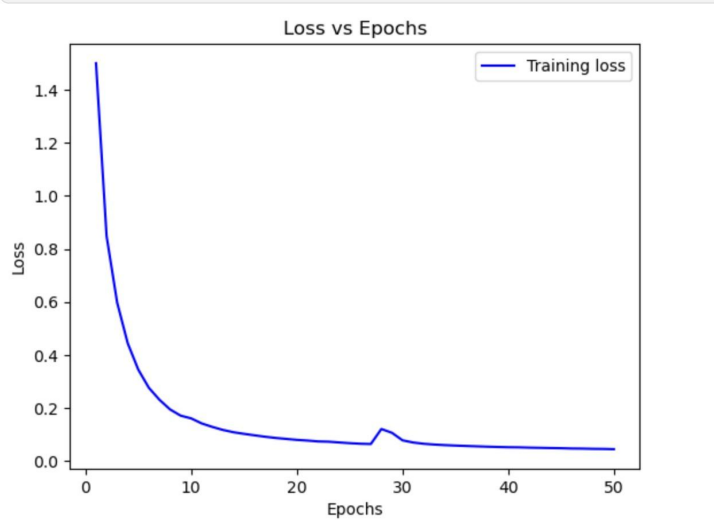
Dataset

- Self Driving Car dataset
- Images Captured from CARLA Simulator
- The data has 5 sets of 1000 images and corresponding labels.

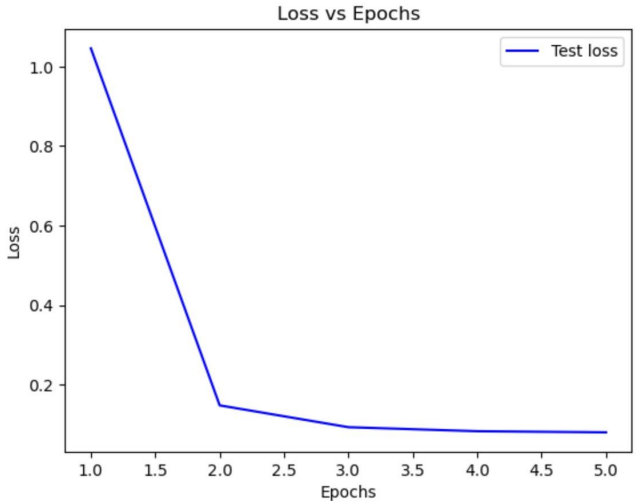
Results

Model	Train Dice Score	Test Dice Score	Train Accuracy	Test Accuracy
Unet	0.83545	0.83259	98.34	97.24
Deep Lab V3	0.79730	0.79736	88.35	88.39
Deep Lab VIT	0.77760	0.77762	83.97	84.07

Results - Unet Losses

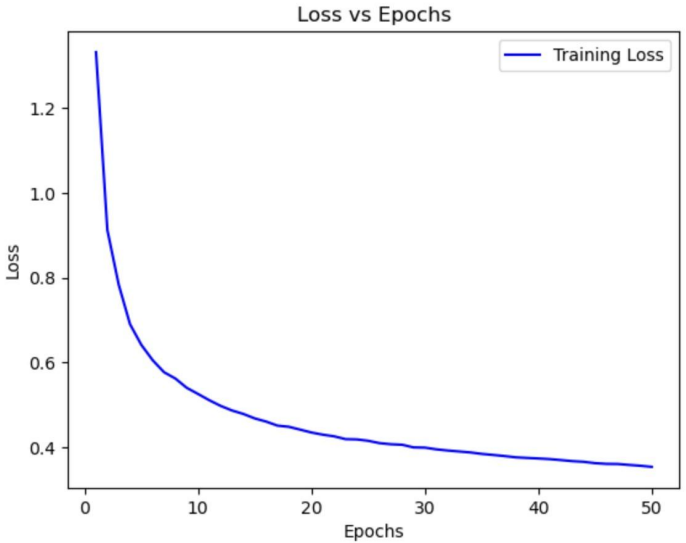


Unet Training Loss

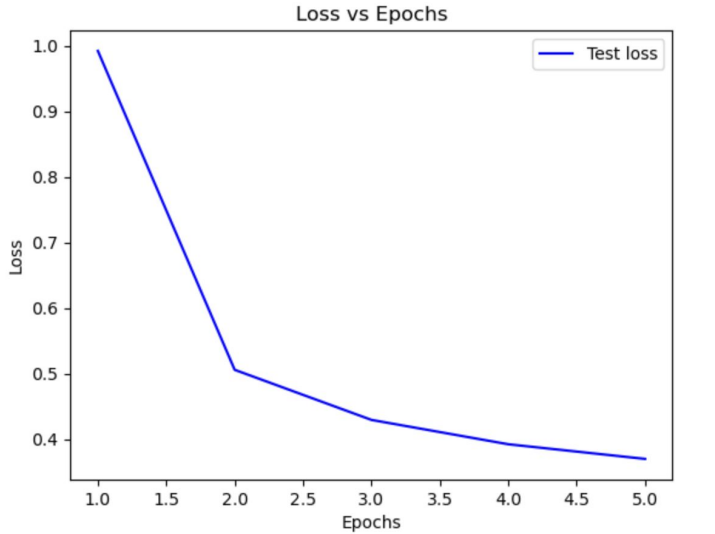


Unet Testing Loss

Results - DeepLab V3 Losses

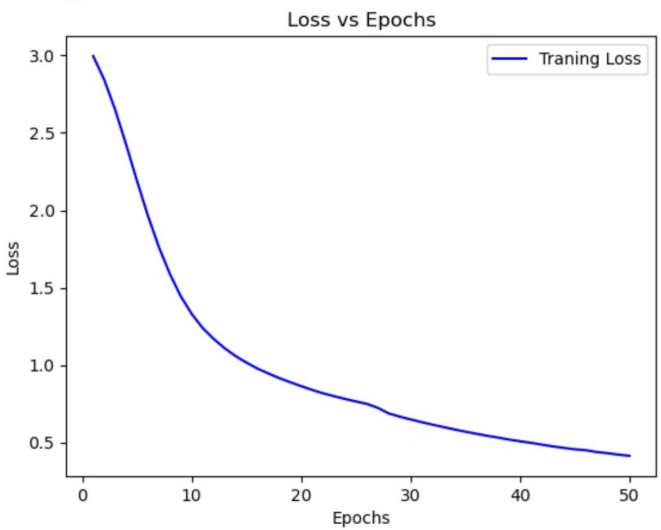


Deep Lab V3 Training Loss

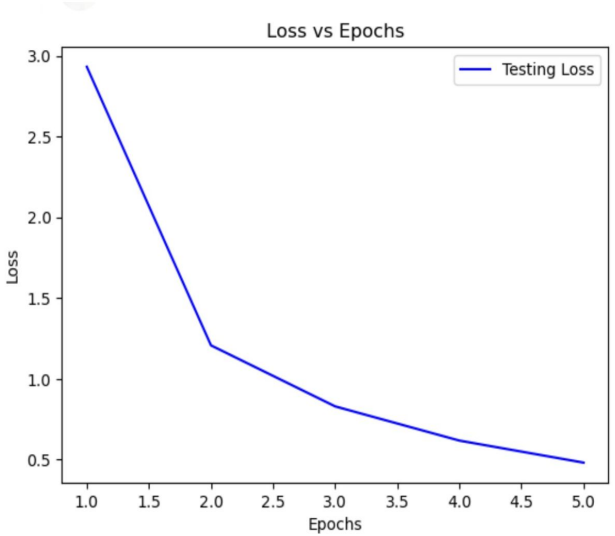


Deep Lab V3 Testing Loss

Results - DeepLab V3 - ViT Losses

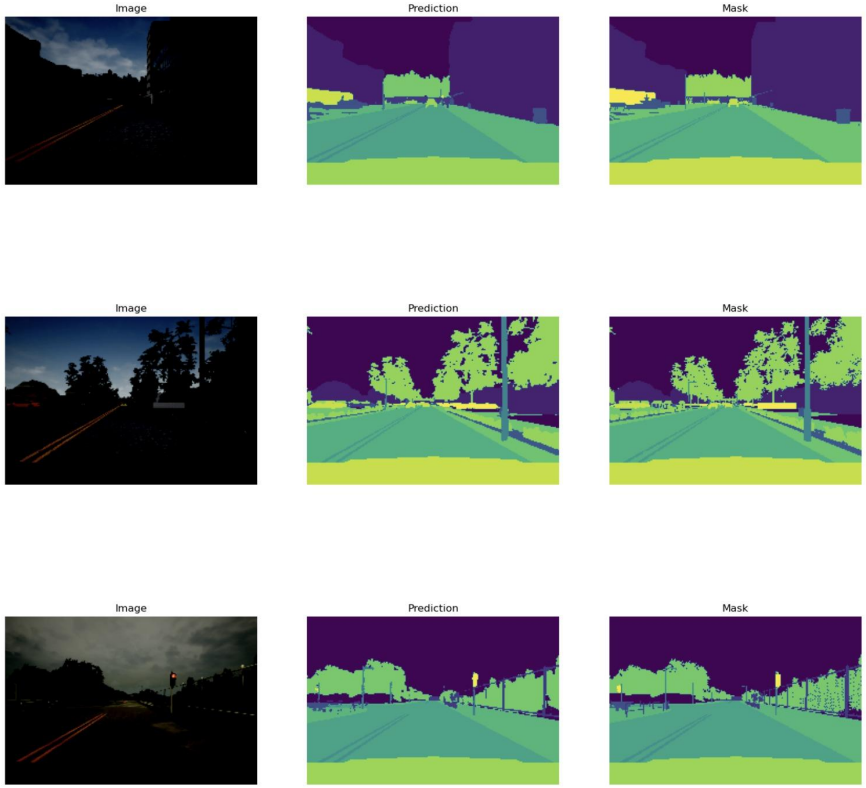


Deep Lab V3 - ViT Training Loss

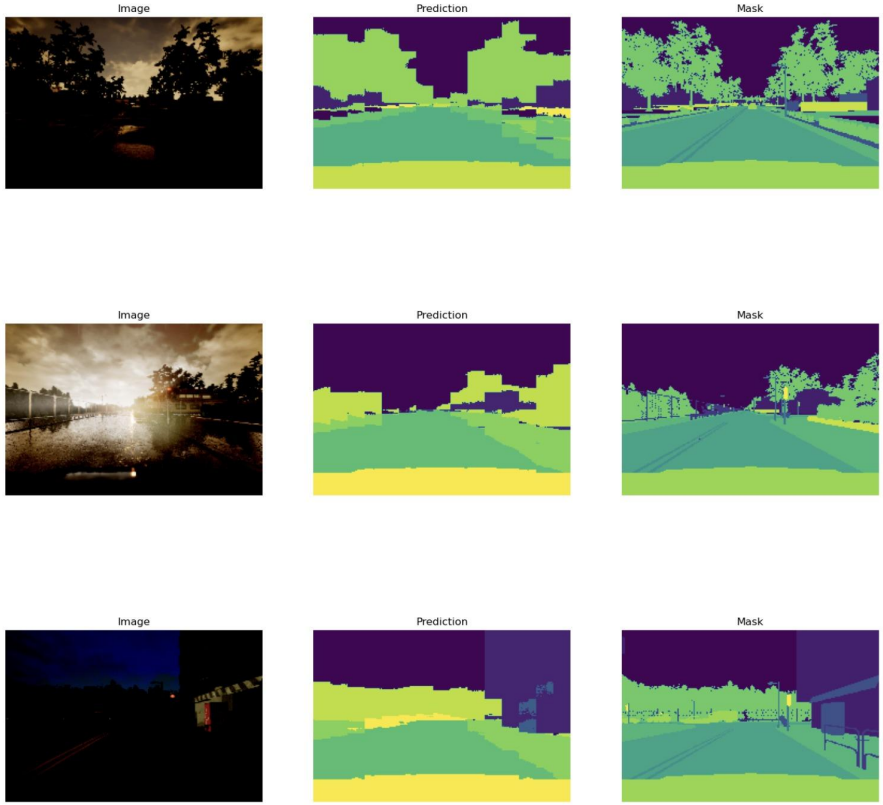


Deep Lab V3- ViT Testing Loss

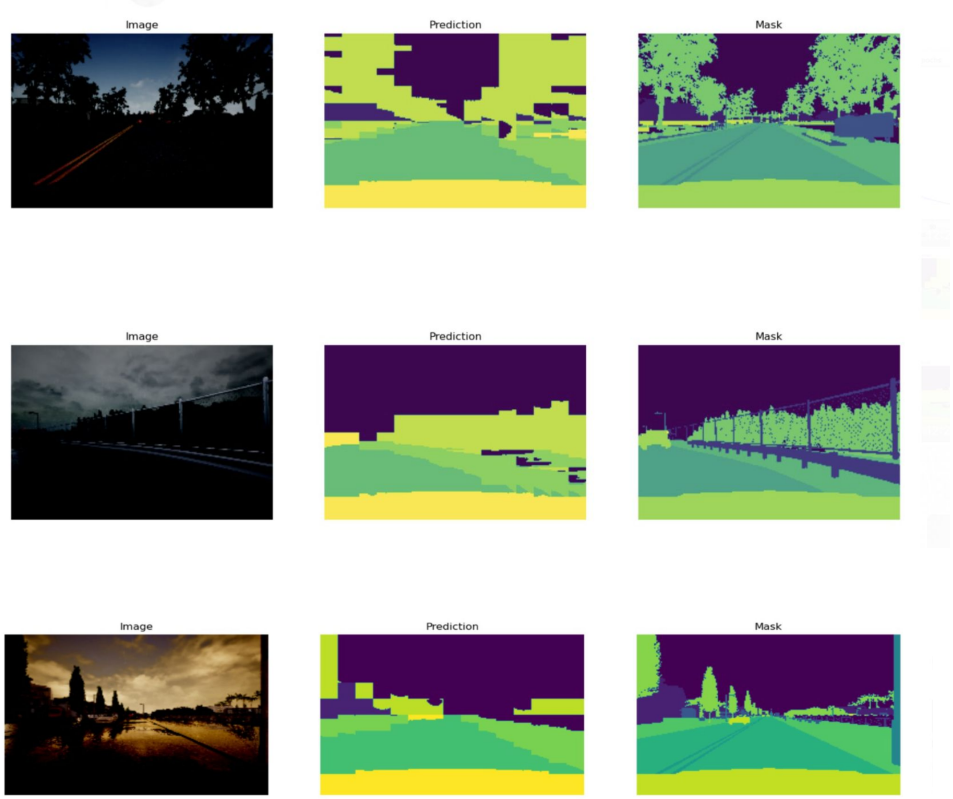
Some Example Predictions for Unet



Some Example Predictions for Deep Lab V3



Some Example Predictions for Deep Lab V3 - ViT



Code Base

Conclusion:

- U-Net performs better than DeepLab and DeepLab-VIT in our case.
- Also U-Net offers better real-time processing capabilities.

- Possible Reasons:
  1. Small Training Data
  2. Dense Feature Extraction
  3. Efficient Handling of Object Boundaries