VEHICLE -TYPE IDENTIFICATION PROJECT

Group 1: Matthew Caro, Kevin Huang,

Ankith Nagabandi, Yarid Tyran

OUR PROJECT

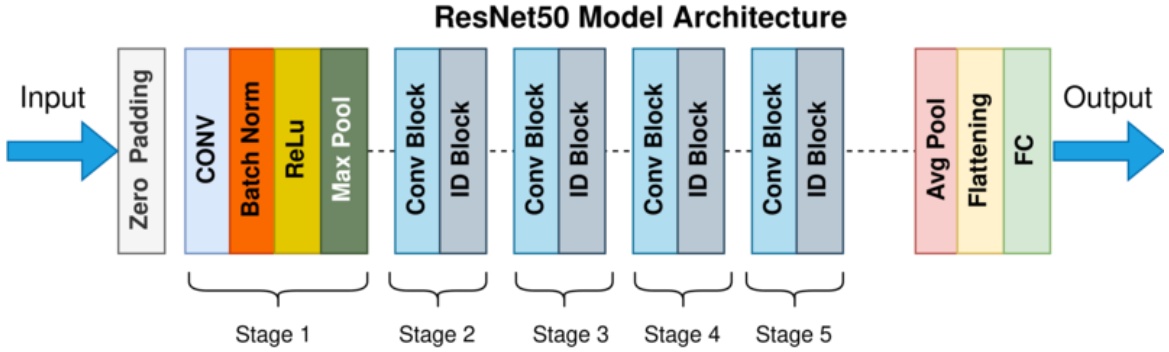
- Compare the performances of different models through training and testing accuracies
- Identify and classify the body type of a car in an image
  - 2-Door
  - 4-Door
  - SUV
  - Convertible
  - Pickup
  - Van

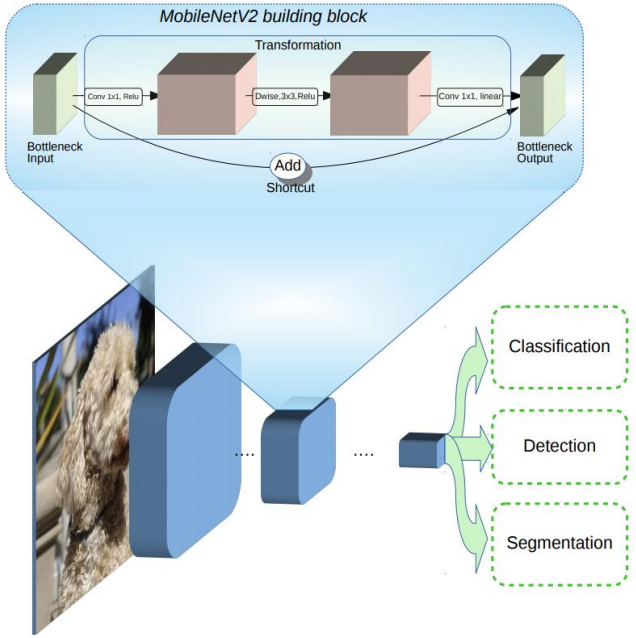
OUR DATASET

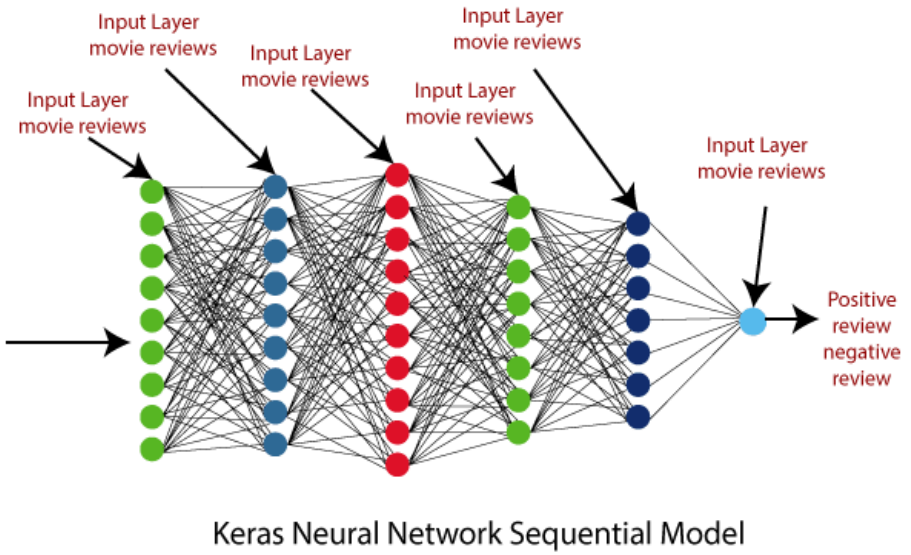
- Preprocessing-
  - 60,000 Images
- Postprocessing-
  - Roughly 45,000 Images
  - ~34,000 Train
  - ~10,000 Test/Evaluation
- Removed some classes such as 3-Door

OUR MODELS

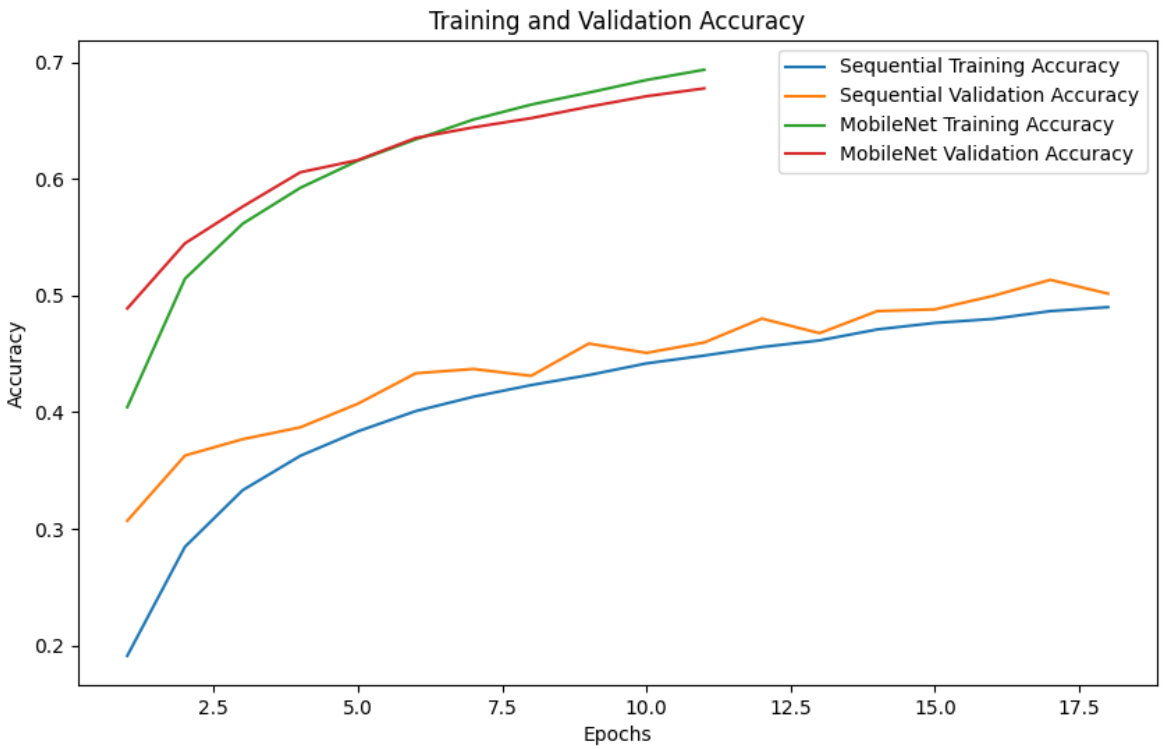
- Used CNNs
  - Sequential
  - MobileNet
  - ResNet50

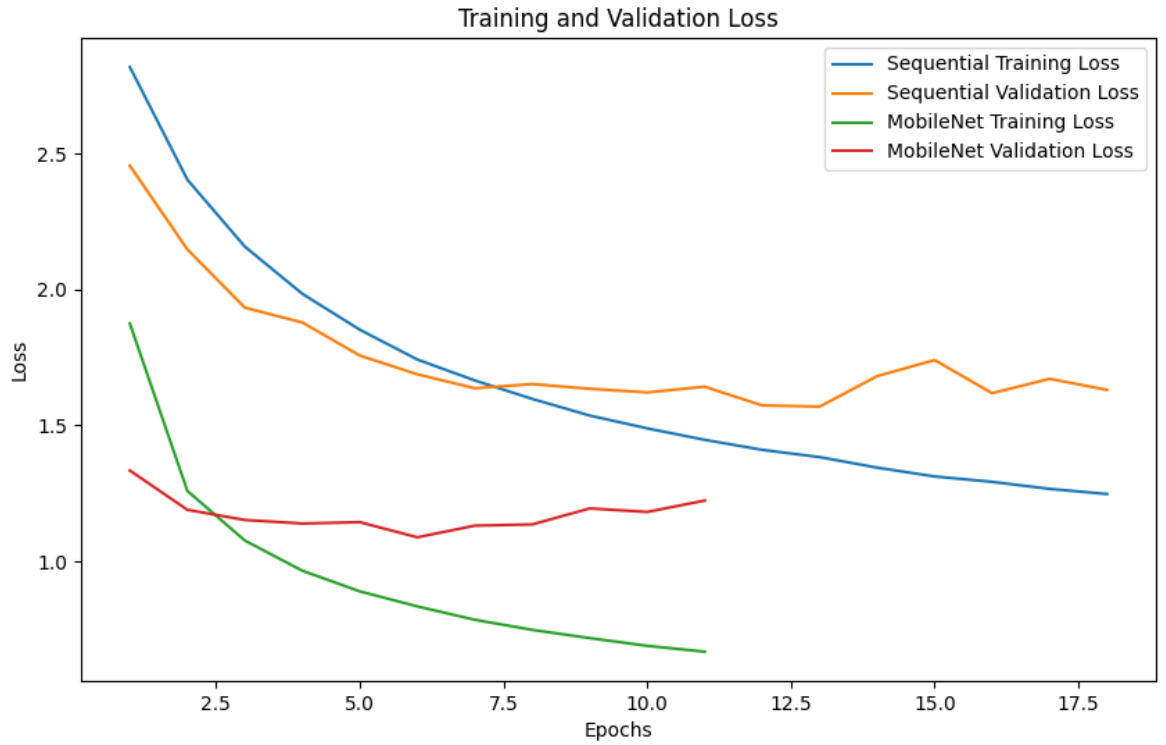




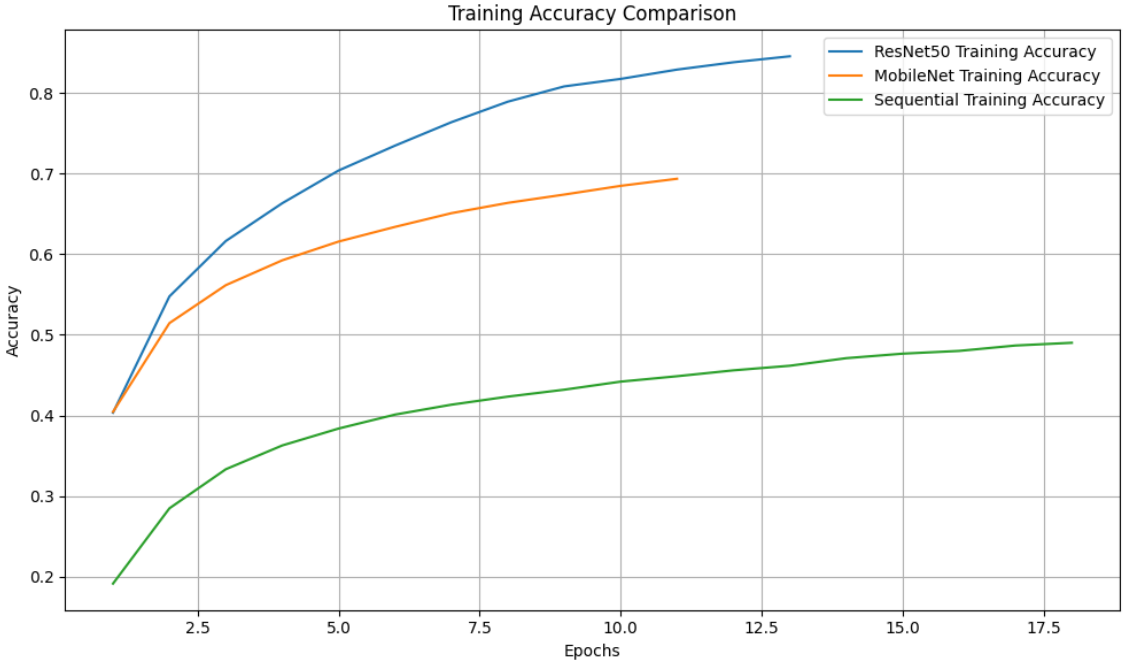


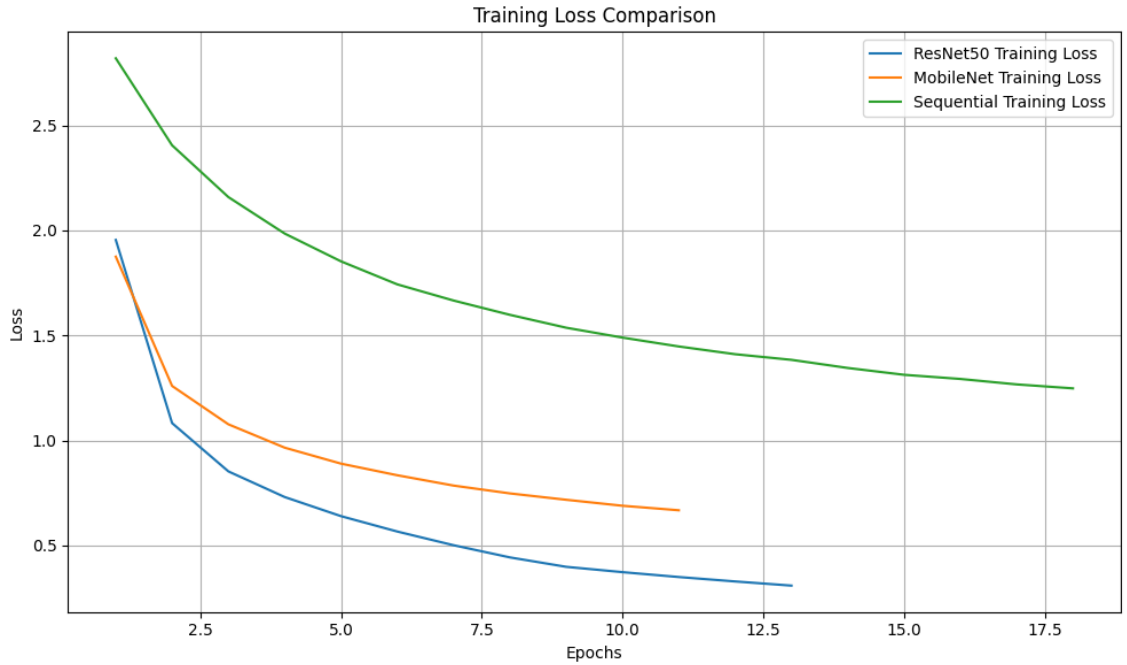
SEQUENTIAL AND MOBILE NET PERFORMANCE





RESNET50 VERSUS OTHER MODELS

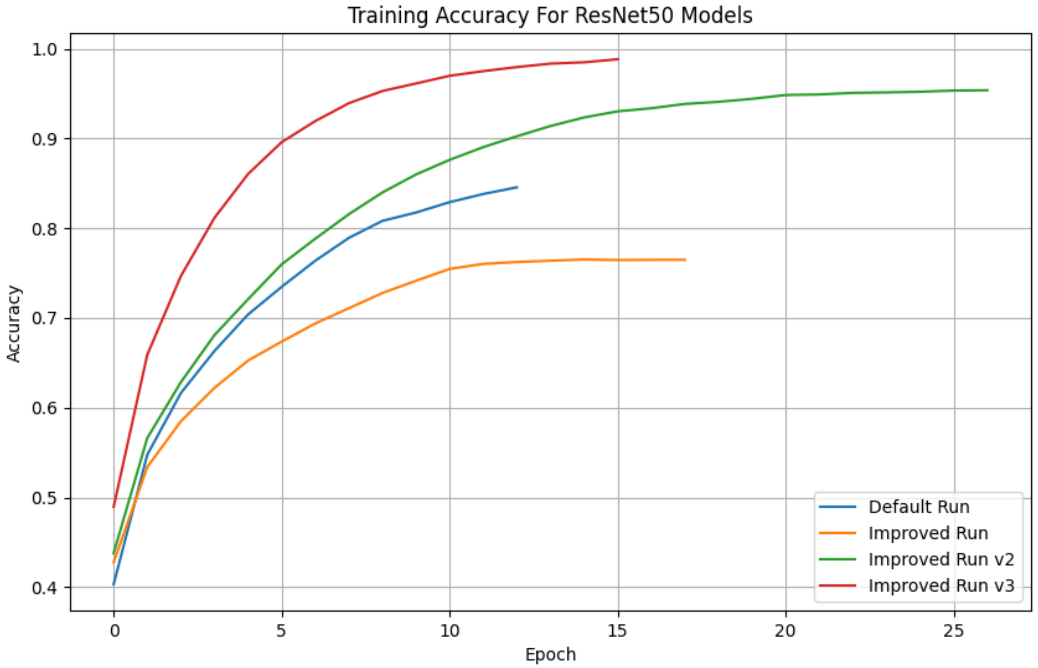


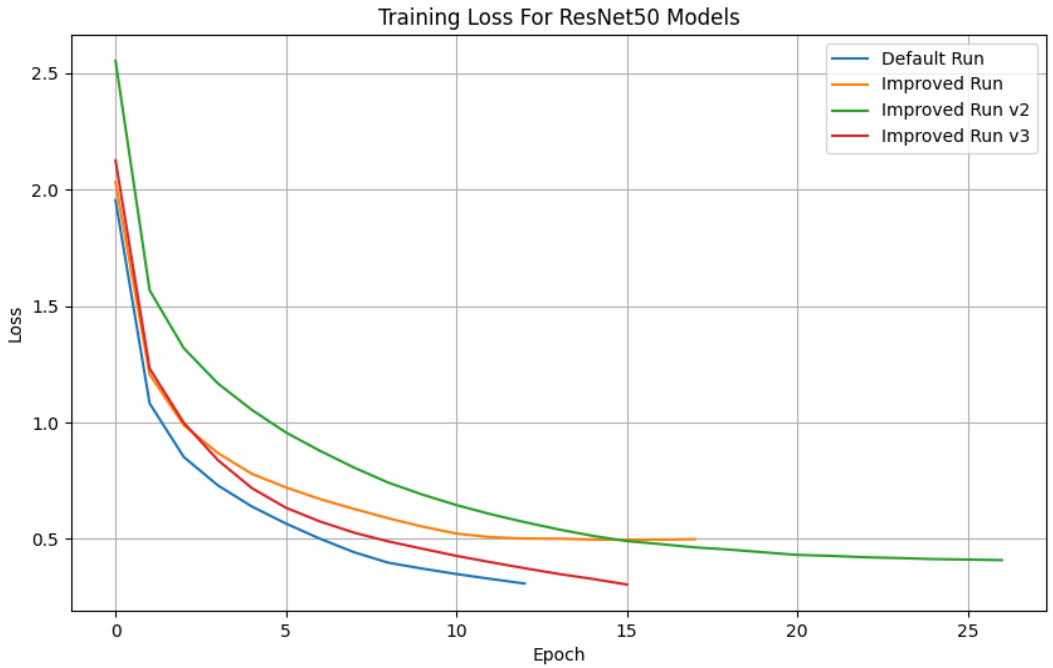


RESNET50 TRAINING TECHNIQUES

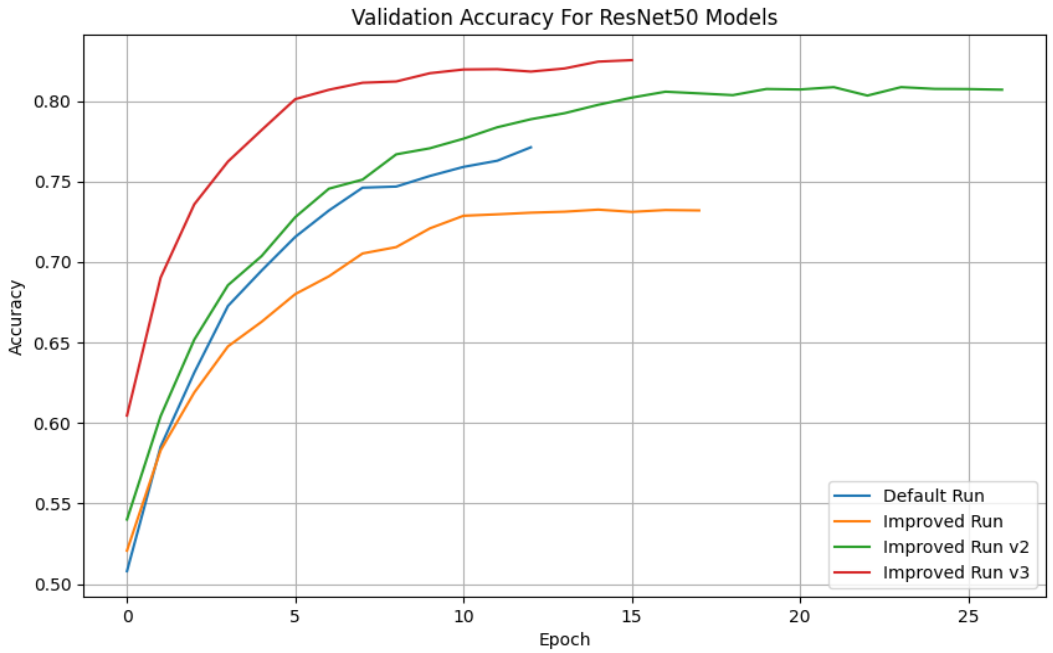
- Fine-Tuning Layers
  - Adjust trainable layers
  - Unfreezing and freezing layers to control deepness of fine-tuning
- Optimizers and Learning Rate Adjustment
  - Adam optimizer
  - Stochastic Gradient Descent
  - Adjust learning rate
  - ReduceLROnPlateau – Dynamically adjust learning rate based on validation loss plateau (Later iterations)
- Regularization
  - Dropout layers set to 50%
  - L2 regularization on dense layers
- Class Imbalance
  - Class weights (scikit-learn compute_class_weight function)
  - Weights higher importance to underrepresented classes in loss function
- Dynamic Training
  - EarlyStopping - Prevent overfitting based on validation loss
  - ModelCheckpointing – Save model at different instances of training

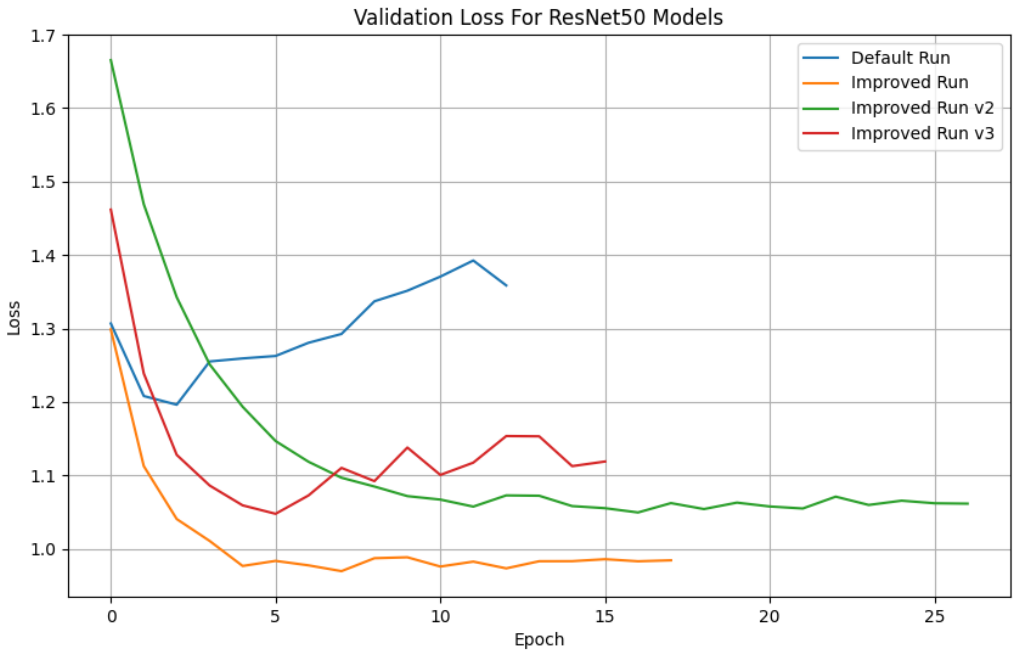
RESNET50 TRAINING PERFORMANCE (TRAINING)





RESNET50 VALIDATION PERFORMANCE (TRAINING)





RESNET50 TRAINED MODELS EVALUATION (TEST SET)

Classification Report:

	precision	recall	f1-score	support
Van	0.18	0.89	0.30	197
SUV	0.85	0.55	0.67	3460
Pickup	0.65	0.97	0.77	971
Convertible	0.40	0.57	0.47	1185
4dr	0.79	0.15	0.25	3367
2dr	0.24	0.70	0.35	1119
accuracy			0.48	10299
macro avg	0.52	0.64	0.47	10299
weighted avg	0.68	0.48	0.48	10299

Default Run

Classification Report:

	precision	recall	f1-score	support
Van	0.42	0.91	0.58	197
SUV	0.86	0.73	0.79	3460
Pickup	0.74	0.98	0.84	971
Convertible	0.48	0.67	0.56	1185
4dr	0.83	0.38	0.52	3367
2dr	0.35	0.74	0.47	1119
accuracy			0.64	10299
macro avg	0.61	0.74	0.63	10299
weighted avg	0.73	0.64	0.64	10299

Improved Run V1

Classification Report:

	precision	recall	f1-score	support
Van	0.73	0.84	0.78	197
SUV	0.86	0.86	0.86	3460
Pickup	0.91	0.96	0.94	971
Convertible	0.68	0.73	0.71	1185
4dr	0.82	0.74	0.77	3367
2dr	0.61	0.70	0.65	1119
accuracy			0.80	10299
macro avg	0.77	0.81	0.79	10299
weighted avg	0.80	0.80	0.80	10299

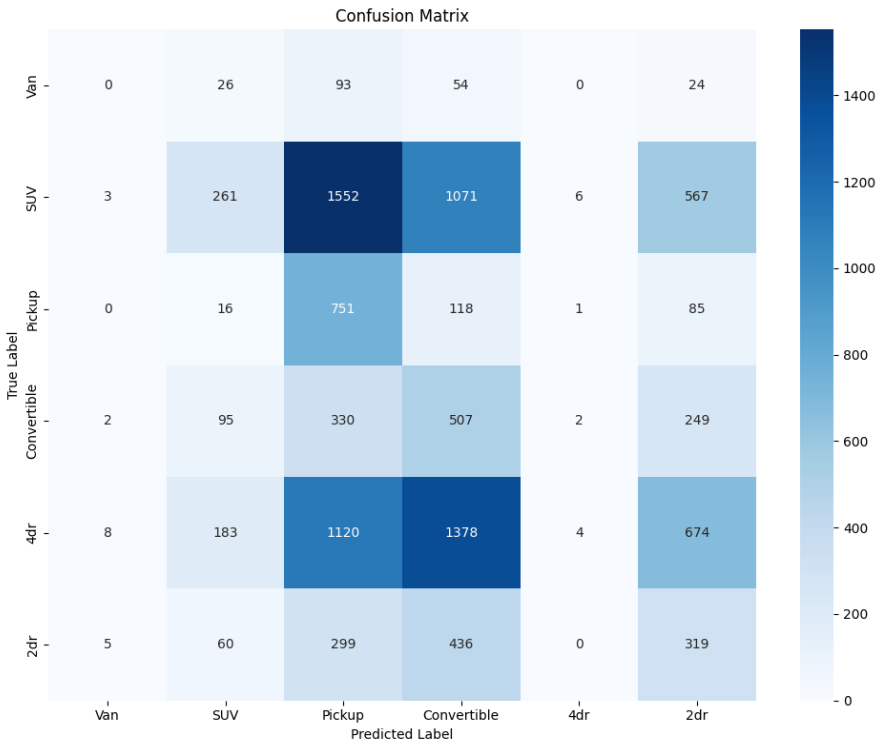
Improved Run V2

Improved Run V3

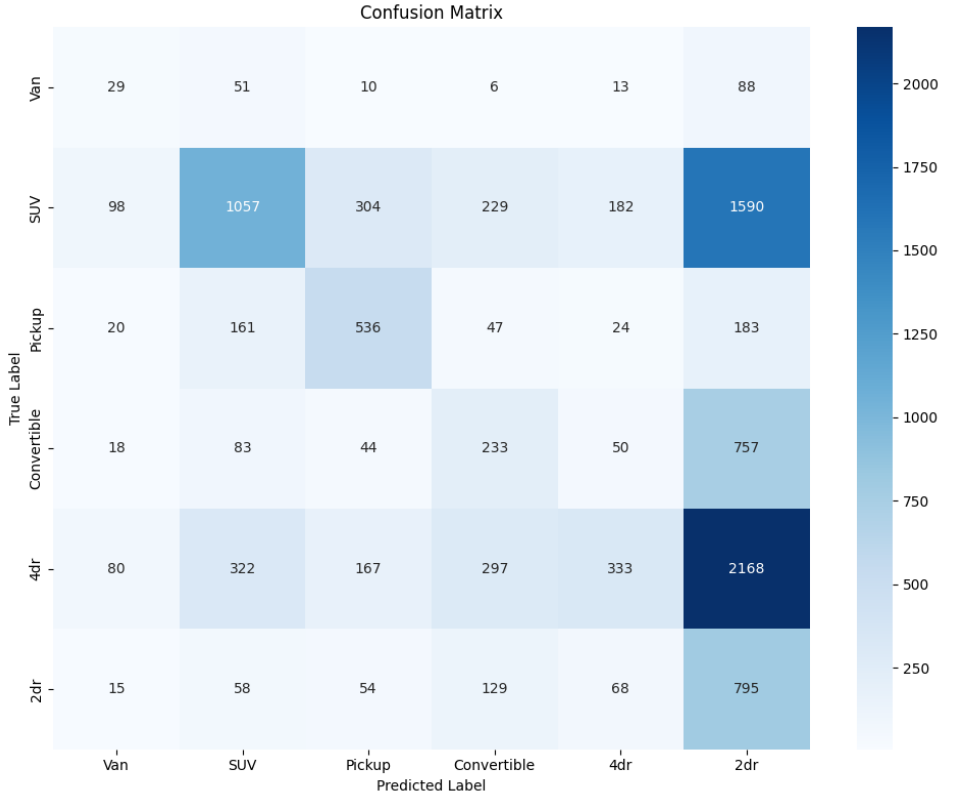
Classification Report:

	precision	recall	f1-score	support
Van	0.69	0.87	0.77	197
SUV	0.88	0.85	0.86	3460
Pickup	0.88	0.97	0.92	971
Convertible	0.66	0.70	0.68	1185
4dr	0.81	0.70	0.75	3367
2dr	0.55	0.72	0.62	1119
accuracy			0.78	10299
macro avg	0.74	0.80	0.77	10299
weighted avg	0.79	0.78	0.78	10299

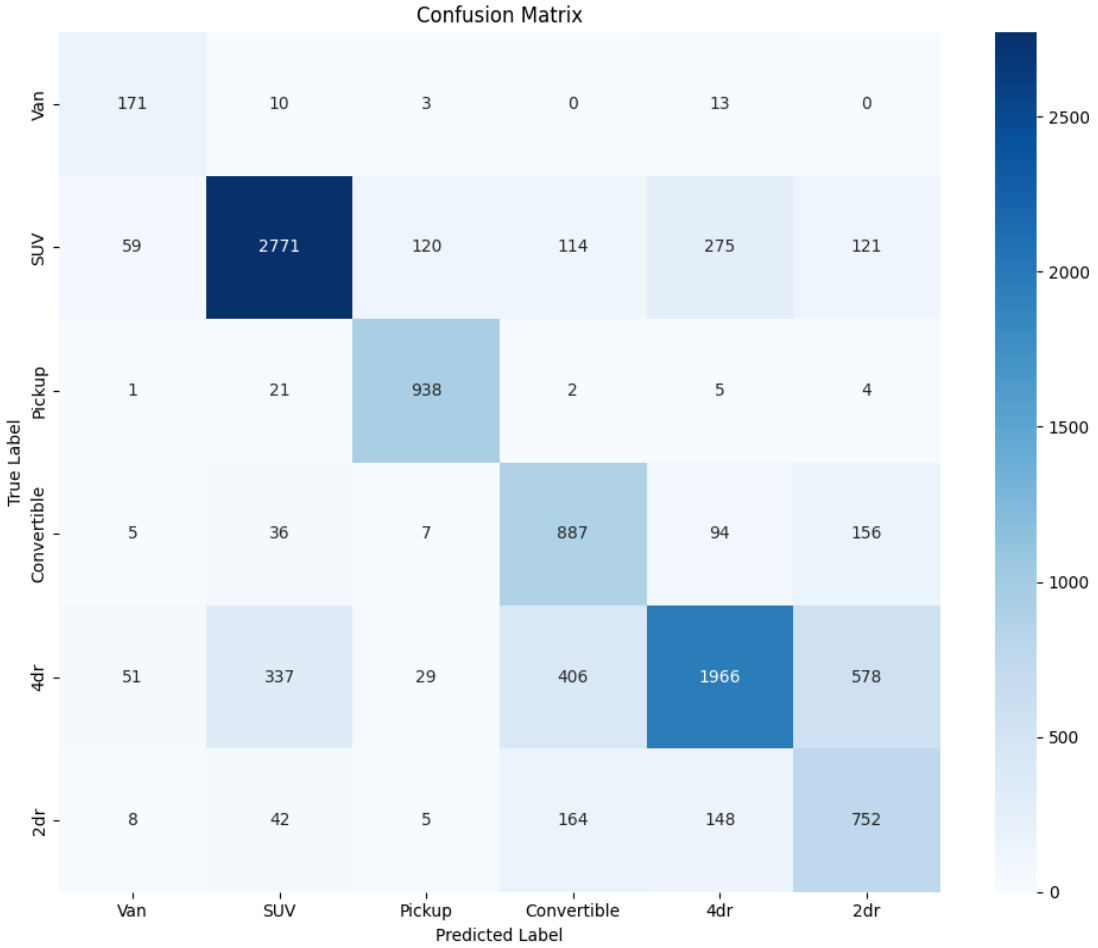
SEQUENTIAL & MOBILENET



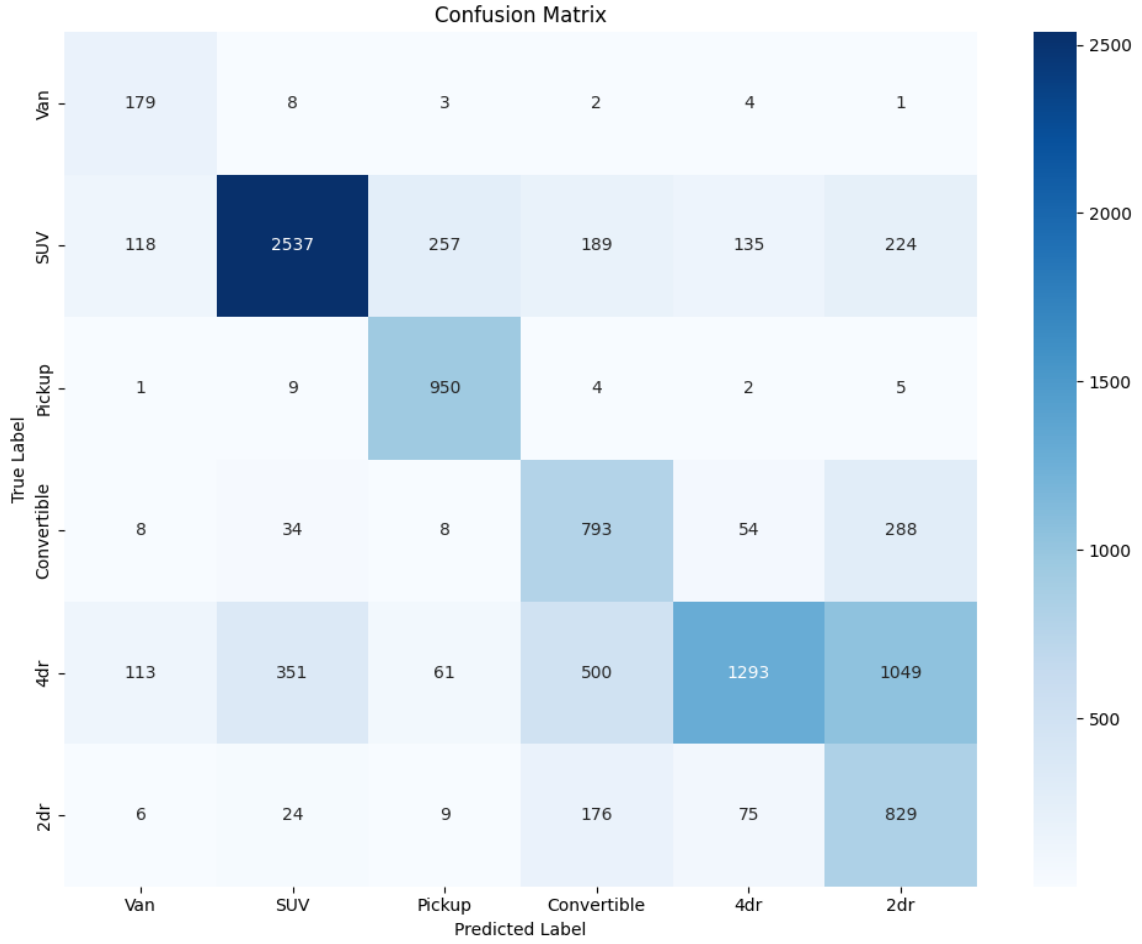
Sequential



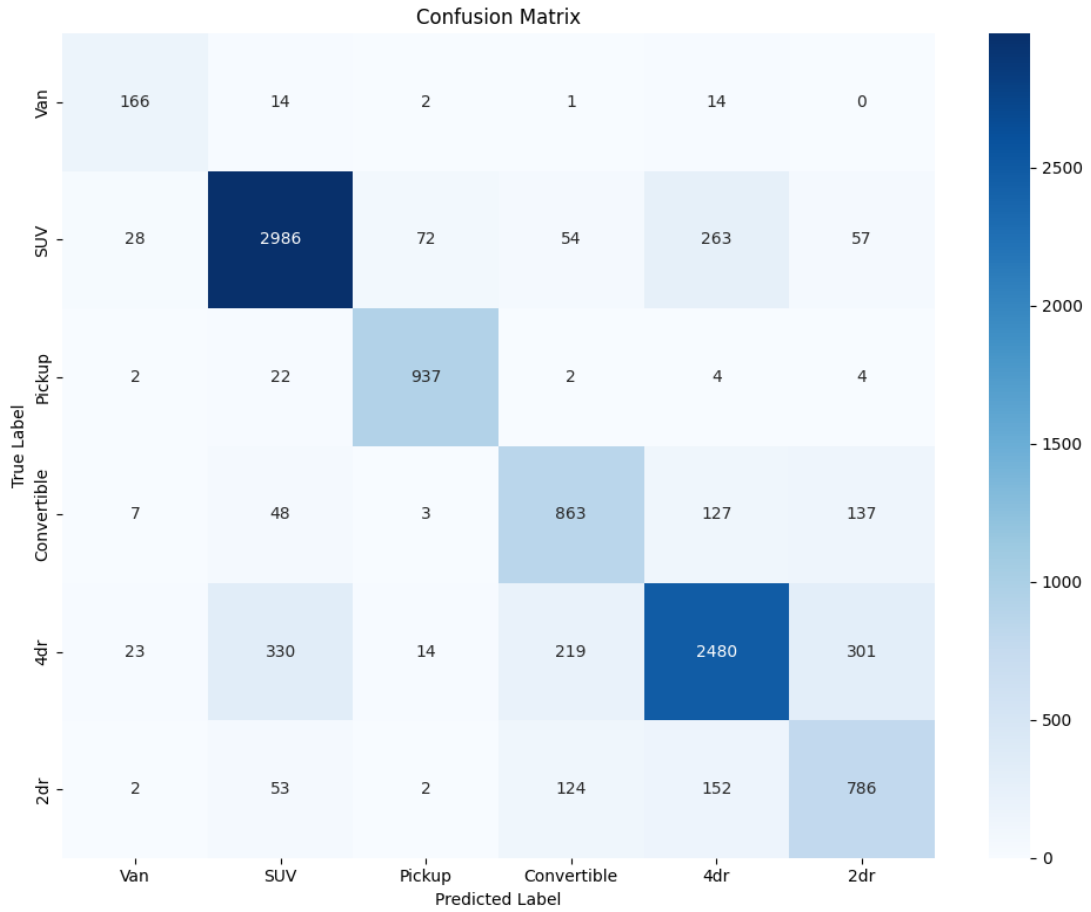
MobileNet



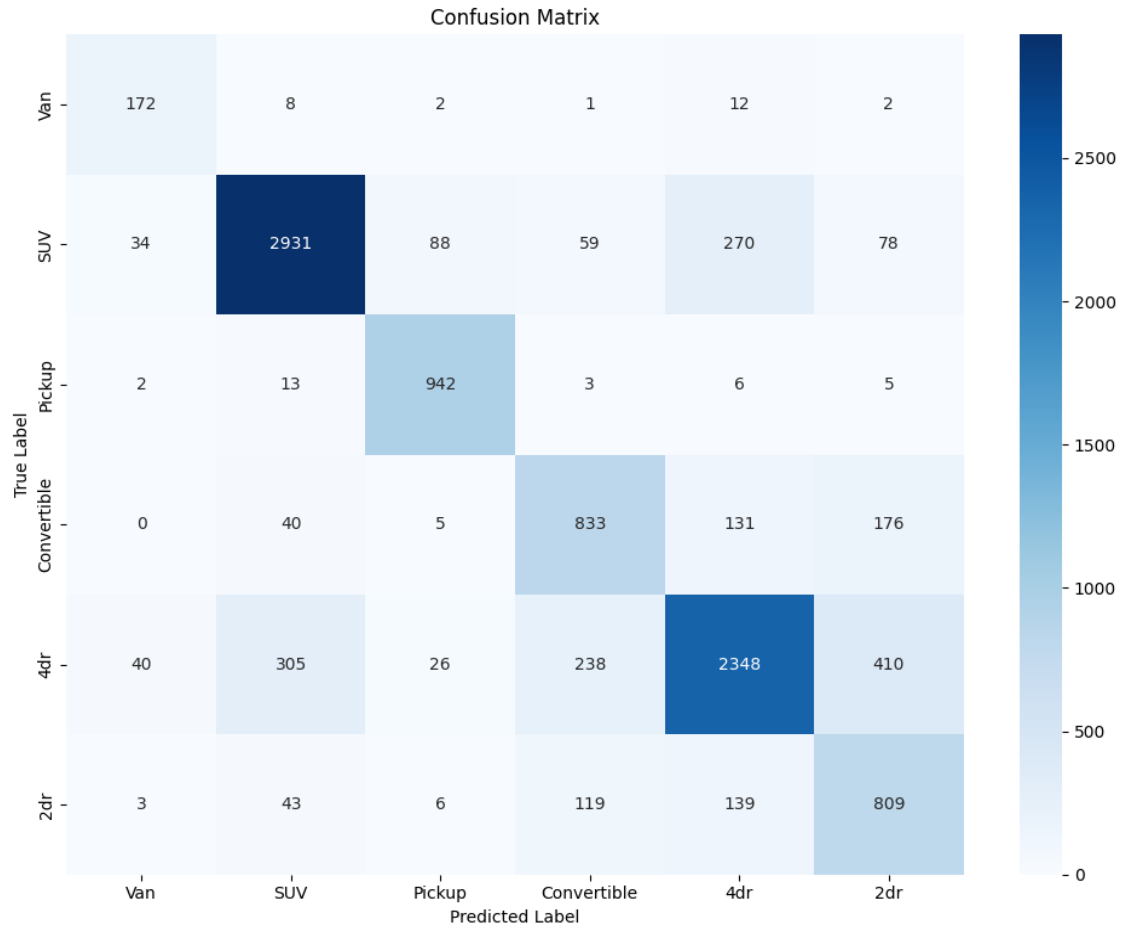
Resnet Default



Resnet V1 Iteration



Resnet V2 Iterations



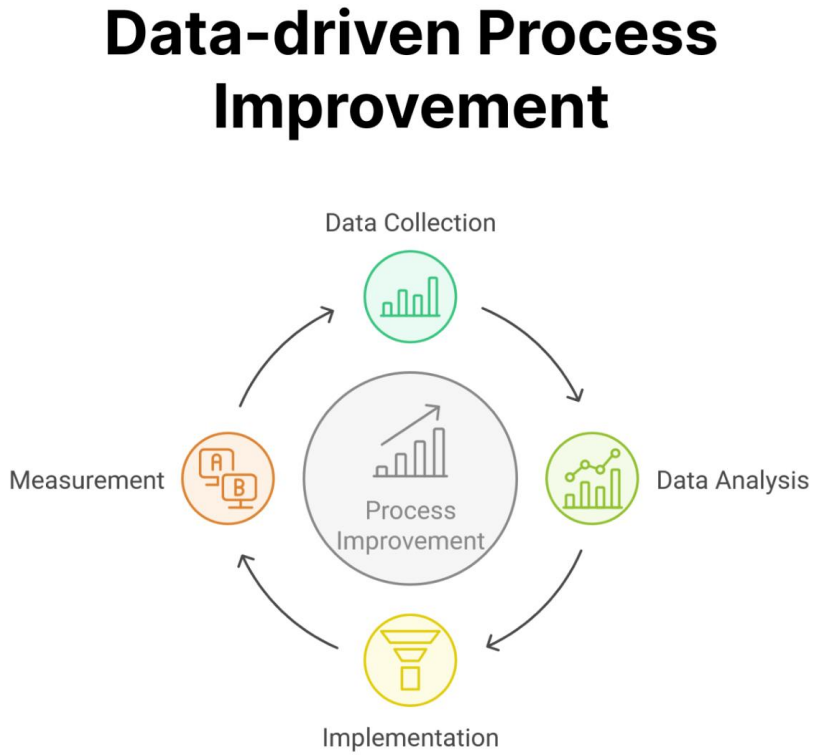
Resnet V3 Iterations

ERROR ANALYSIS

- Accuracy on evaluation set was around 80%
- Post-processed images still included some interior images or part of the vehicle
- Unbalanced data- Different classes were overrepresented and underrepresented
  - Duplicate images
  - Vans had around ~600 images in total vs SUV had over 11,000
- Most of the images were very clean, no clutter
  - Only the car in the center, nothing else
  - For more real-life applications, we should use images with varied clutter
- Low sample size in evaluation set

AREAS OF IMPROVEMENT & FUTURE WORK

- More Data!
  - More even distributing
- Cleaner data
  - Less error images
- More Models
- Expanding past Vehicle Type



USER INTERFACE DEMO

HTTP://10.194.212.45:8501/