# FLOWER CLASSIFICATION

COMP 6721 – APPLIED ARTIFICIAL INTELLIGENCE

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# Project Overview

A significant challenge during development was determining the appropriate hyperparameters for different models, such as batch size, regularization methods, optimizers, and learning rates, while considering various influencing factors. Additionally, training an algorithm on a dataset containing only one flower breed per image often leads to over-specialization, which reduces accuracy when tested on images with multiple flower breeds, causing confusion in predictions. The MobileNetV2 model also demonstrated inferior performance compared to other models. Traditional flower classification methods are time-consuming and inaccurate, and the classification process becomes even more complicated due to large datasets, lighting variations, and visually similar flowers.

# GOALS

The project involves developing nine deep-learning models for flower classification, evaluating their performance using accuracy, precision, recall, and F1 score. CNNs will be used to improve prediction accuracy, with analysis based on hyperparameters like optimizer, loss function, batch size, and learning rate. Data visualization will be performed using t-SNE and graphical methods. Transfer learning will be applied to three models and their performance compared with the others.

# DATASET

Datasets Overview:

- Dataset 1: 5 classes, ~5,000 images
- Dataset 2: 7 classes, ~11,200 images
- Dataset 3: 14 classes, ~13,700 images

Total: 29,000 images (RGB)

Image Sizes:

- D1: 225x225
- D2: 178x256 to 648x500
- D3: 256x256

Re-sized: All images resized to 256x256

Dataset Quality: Well-balanced, no data cleaning needed.

| Name | Total Images | Classes |
|---|---|---|
| Flowers Dataset I | 5k | 5 |
| Flowers Dataset II | 11.2k | 7 |
| Flowers Dataset III | 13.7k | 14 |

# METHODOLOGY

Data Split:

- Data was divided into 80:10:10 for training, validation, and testing across all nine models.

Pre-processing Steps:

- Resize Transformation
- CenterCrop Transformation
- ToTensor
- Normalize Transformation

Hyperparameter Optimization:

- Number of Epochs: 30
- Optimizer: Adam
- Loss Function: Cross-Entropy
- Batch Size: 32

Implemented transfer learning on ResNet18, MobileNetV2, and DenseNet121.

# RESULT ANALYSIS

Model Accuracy:

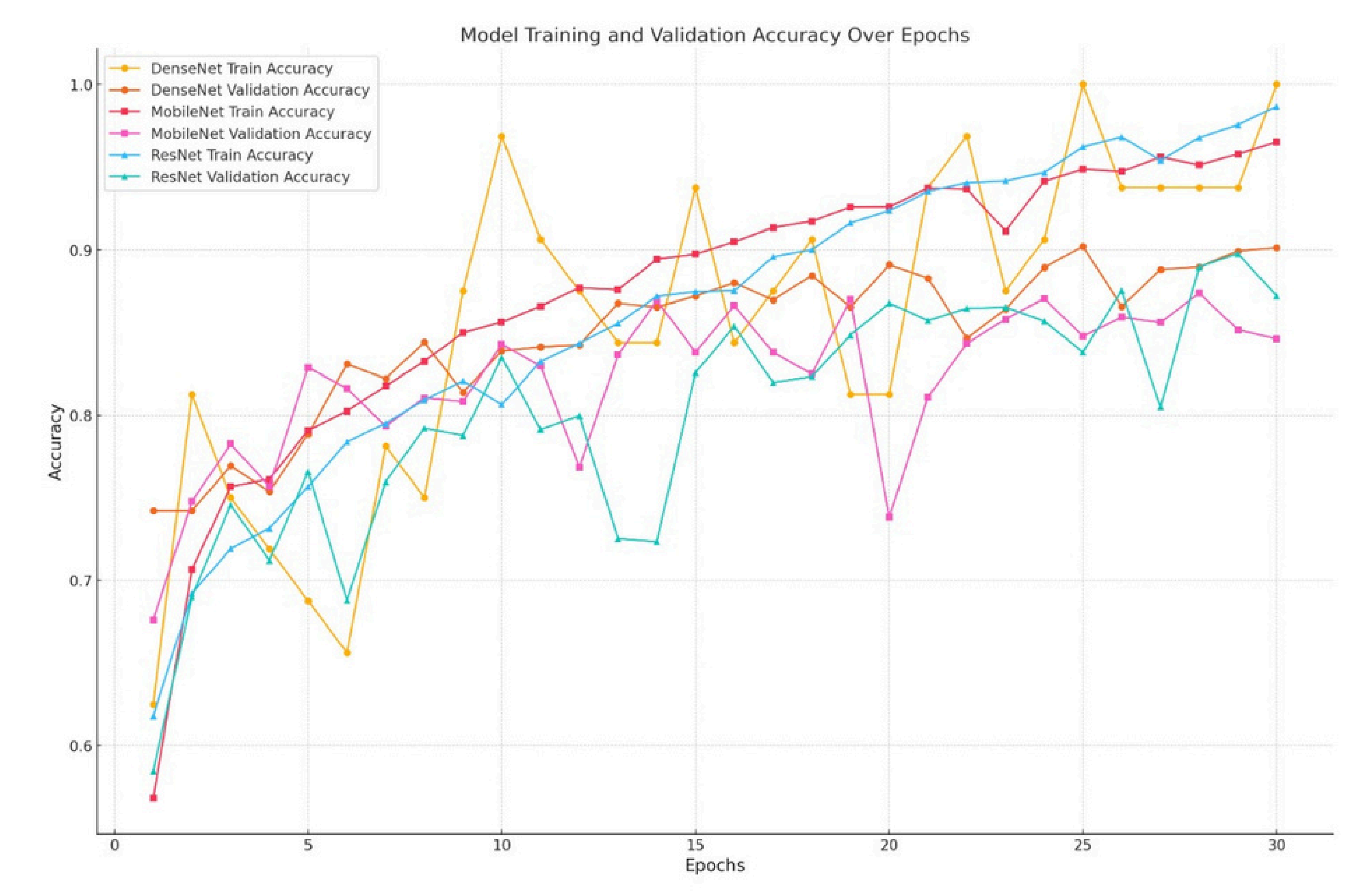
Throughout the nine models, high accuracy was achieved.

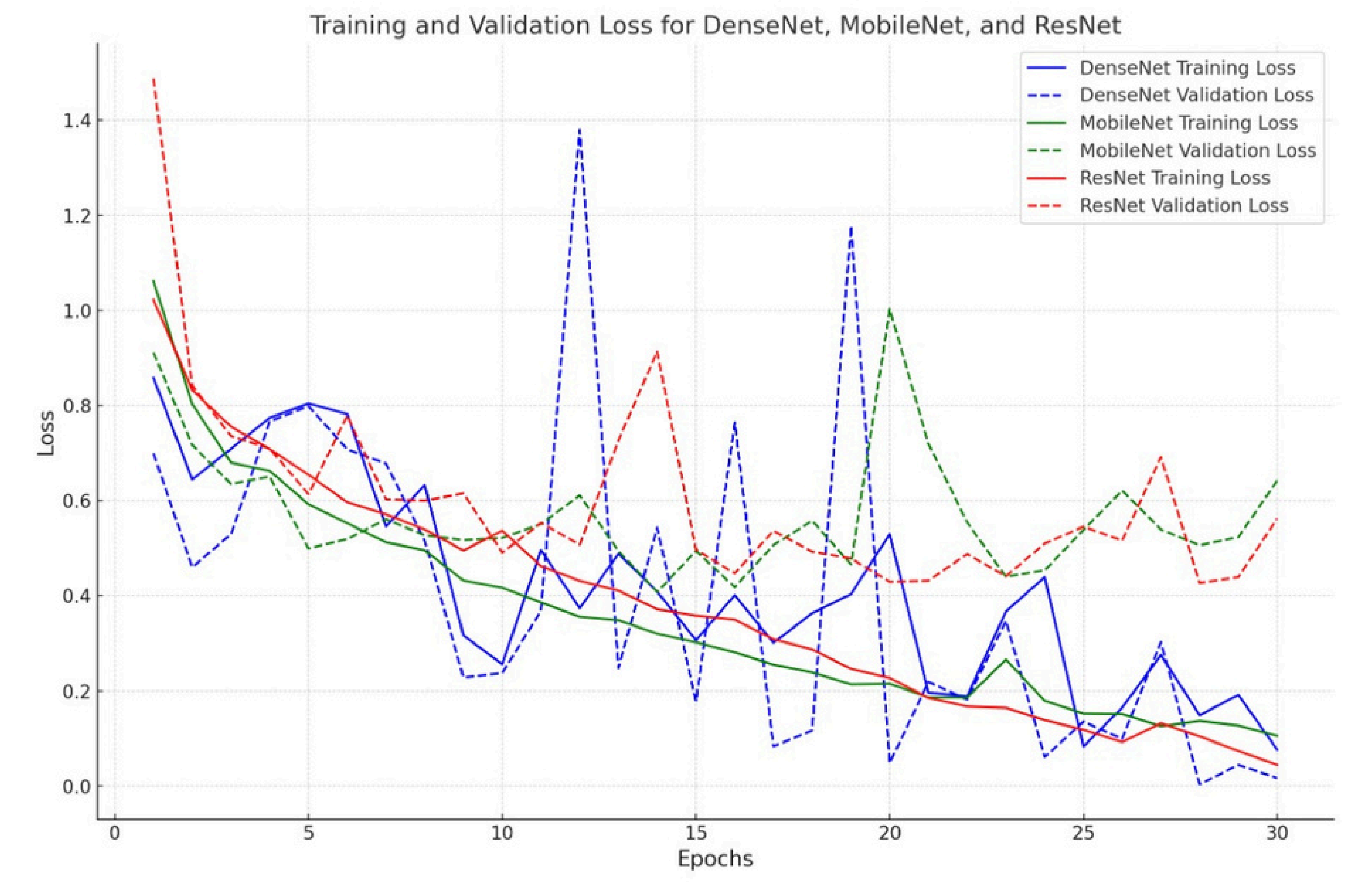
However, in the case of ResNet, hyperparameters were fine-tuned separately to optimize its performance.

| | ResNet-18 | | | MobileNetV2 | | | DenseNet-121 | | |
|---|---|---|---|---|---|---|---|---|---|
| | D1 | D2 | D3 | D1 | D2 | D3 | D1 | D2 | D3 |
| **Accuracy (%)** | 83.40 | 85.36 | 81.63 | 82.57 | 86.52 | 91.84 | 83.29 | 88.57 | 92.86 |
| **Precision (%)** | 82 | 87 | 85 | 83 | 87 | 94 | 82 | 89 | 93 |
| **Recall (%)** | 87 | 85 | 82 | 83 | 87 | 92 | 87 | 89 | 93 |
| **F1 Score** | 83 | 86 | 81 | 83 | 86 | 92 | 84 | 89 | 93 |

# COMPARISON

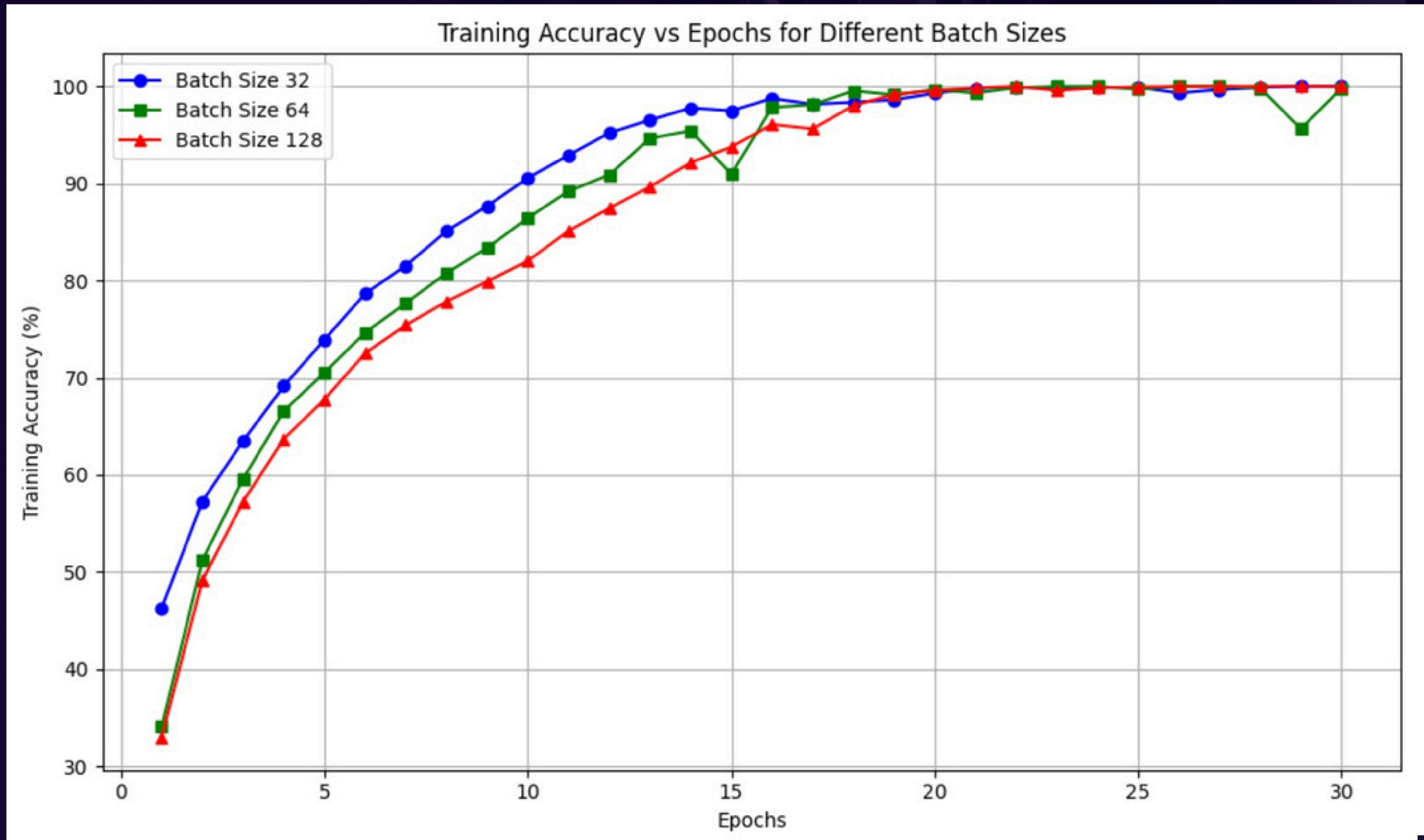
All models on D1 ( 5 classes)

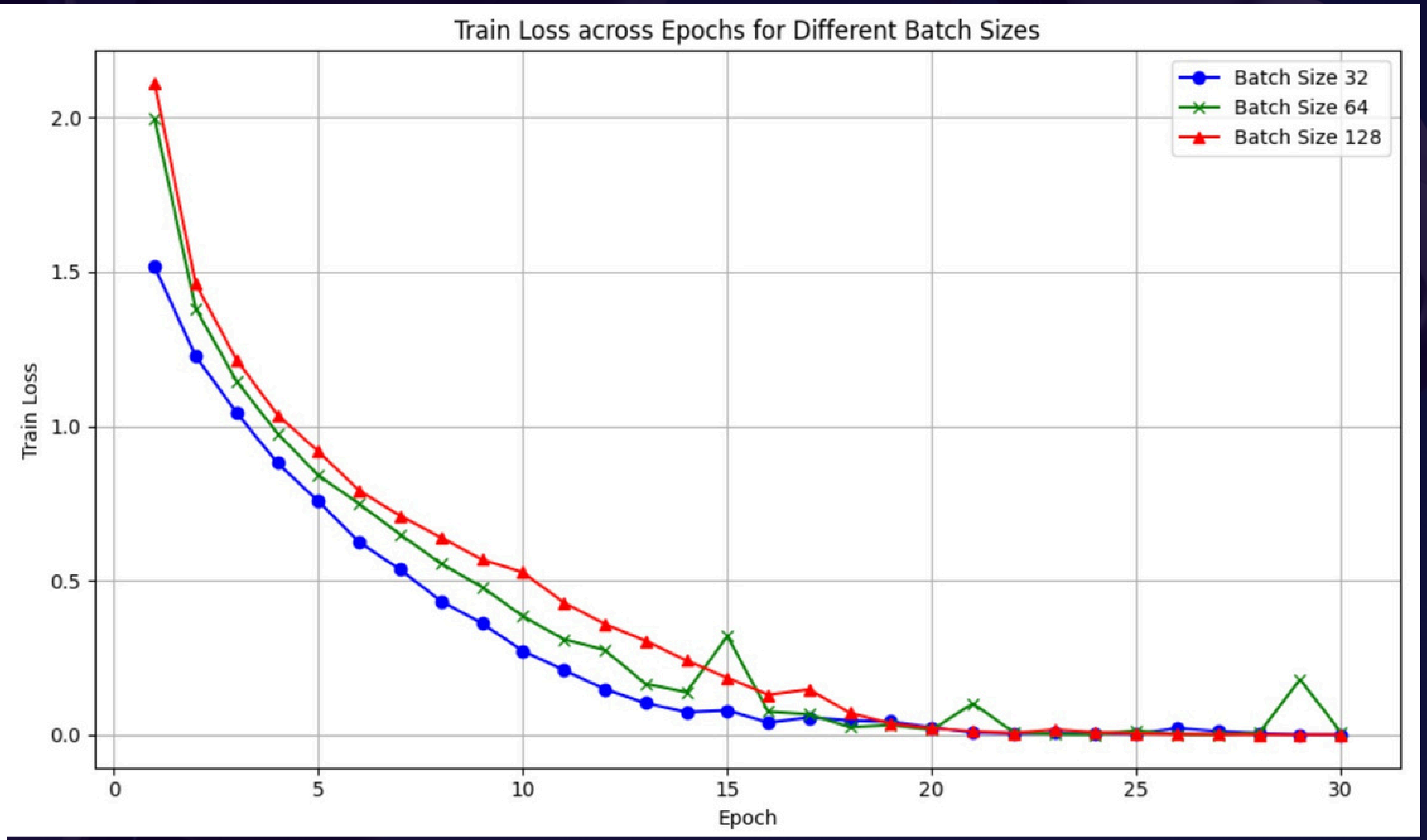


# BATCH SIZE

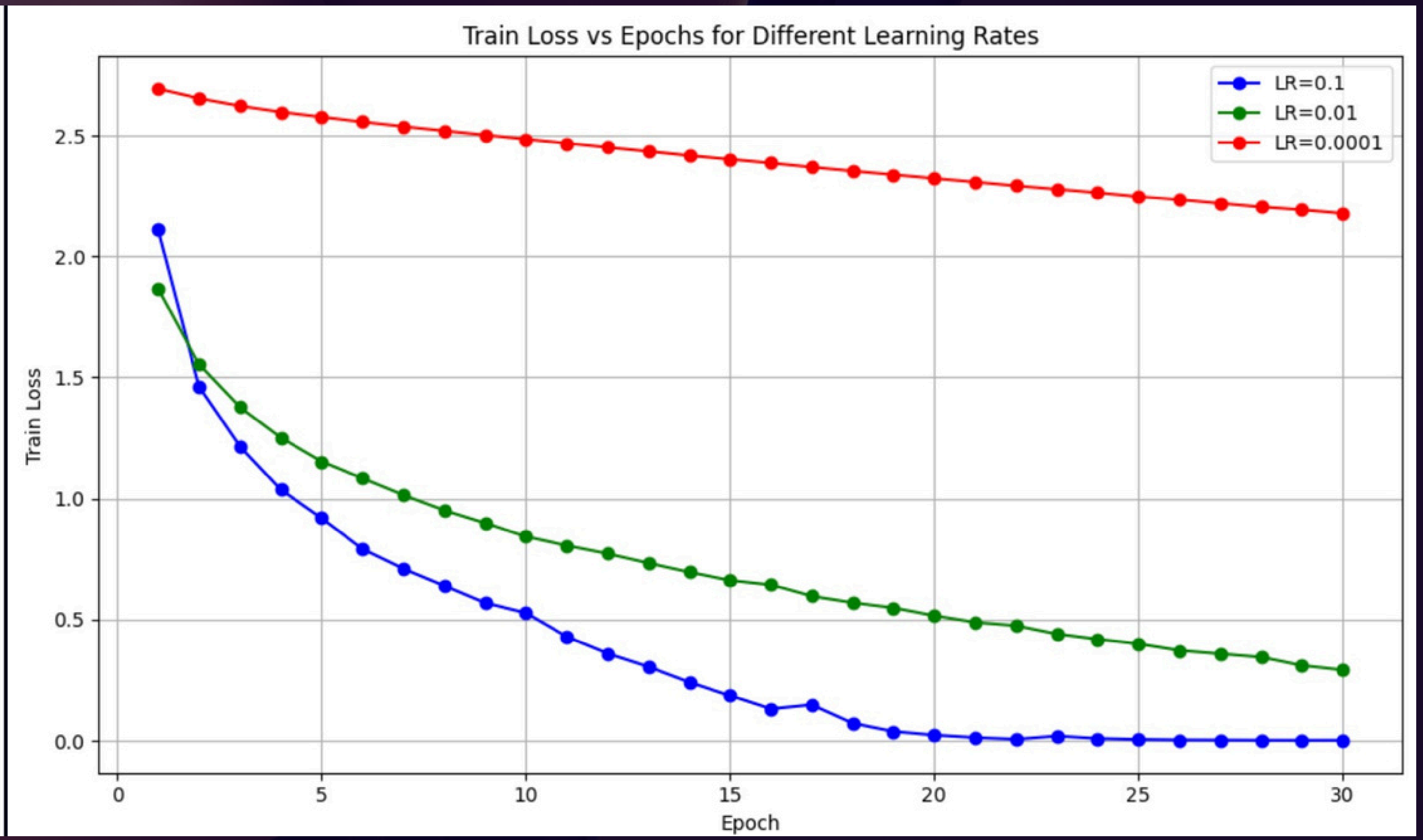
IMPACT OF VARYING BATCH SIZE ON RESNET



# LEARNING RATE

## Comparison of Train Accuracy/Loss Across Different Learning Rates vs. Epochs on Dataset 3 (14 Classes) - ResNet

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# Thank You!