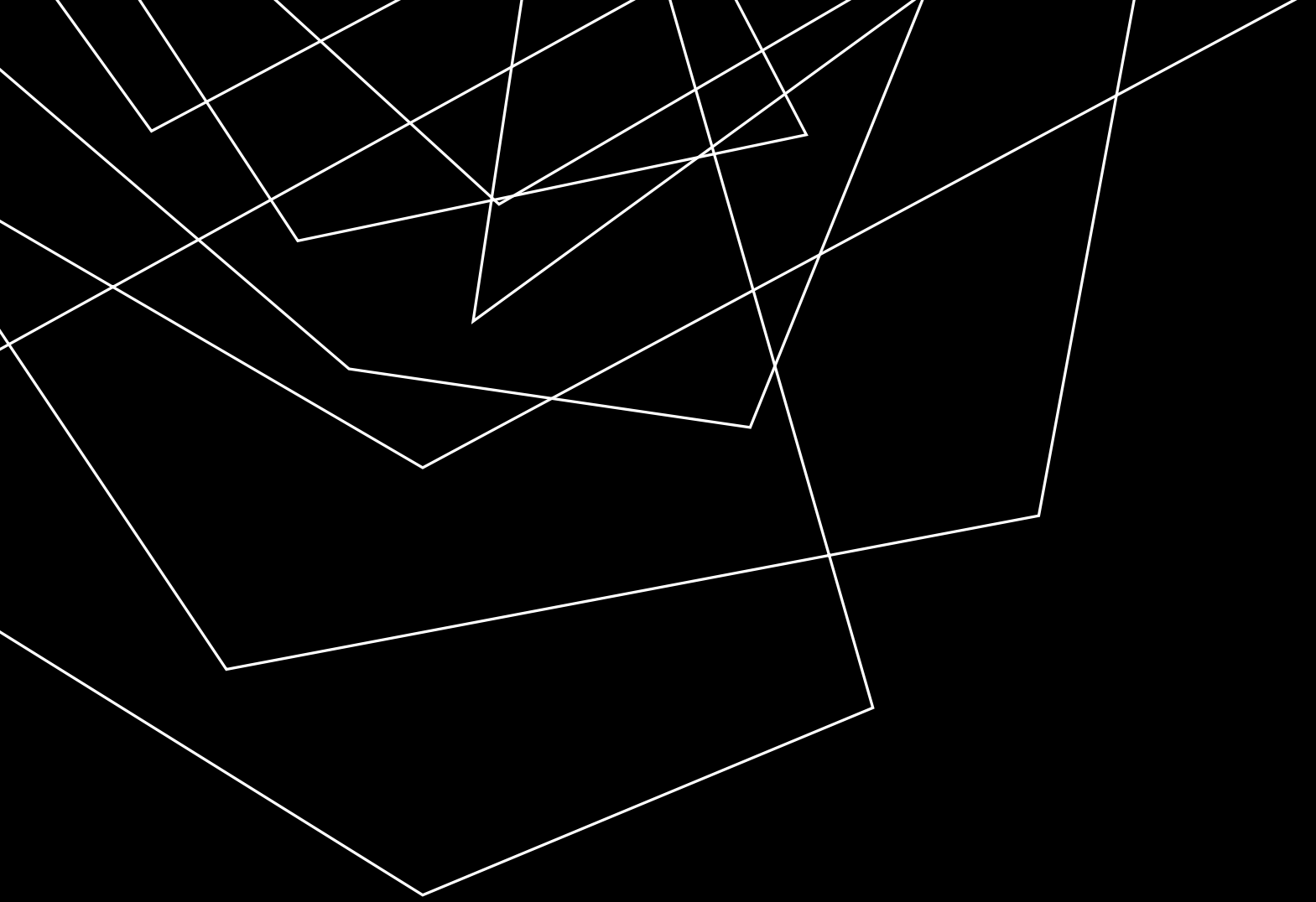

MIDTERM 1378

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INTRODUCTION

Objective:
Build an image classification model for CIFAR-10 and fine-tune it by transfer learning to get better accuracy and better generalization.

Dataset Overview:
CIFAR-10: Has 60,000 32x32color datasets of 10 classes (airplanes, cats etc., trucks).
Balanced dataset: 6,000 images per class.

Why Transfer Learning?
Efficient as it does not learn features from scratch rather it takes them from pre-trained models such as VGG16.
Especially it is good when the amount of parameters is relatively small comparing to, for example, CIFAR-10.

METHODOLOGY

Data Preprocessing:
Image pixel values were brought to range between 0 and 1.
crop and resized images such that they were of VGG16's recommended size of 224 x 224 pixels.
Augmented the data in use through methods such as rotation, horizontal flipping etc.

Model Architecture:
ImageNet pre-trained model VGG16 was used.

Modified final layers:
Flatten layer → Fully connected layers → Output layer → use Softmax For 10 Classes.

Training Strategies:
Some layers were tuned selectively for more efficient feature to be extracted.
This was done in order to prevent overfitting and to reduce its effects; applied dropout layers.
Implemented performance by Validation metrics as well as the use of Early Stopping.

RESULTS

Performance Metrics:
Baseline VGG16 (mostly frozen layers): ~70% validation accuracy.
Fine-tuned VGG16 (data augmentation + unfrozen layers): 85% validation accuracy.

Visuals:
Make use of Training and Validation Accuracy/Loss Curves (will develop these if necessary).

Key Observations:
It was found that data augmentation greatly minimized overfitting.
Convergence was optimized by the best value of learning rate, 0.001 and the best batch size of 32.

CHALLENGES

Overfitting:
First, the model fitted training data and performed worse on validation.
Solution: Optimized using real-time data augmentation and introduced dropout layers.

Computational Constraints:
It took much time and other resources to train with unfreezing many layers of VGG16.
Solution: Reduced depth to encapsulate only the most important layers and made the batch size more optimal.

Image Size:
CIFAR-10 has low resolution at 32×32 which inhibited feature extraction on CIFAR-10 images.
Solution: All images were also rescaled to a size of 224×224 pixels in order to ensure compatibility when having to incorporate the VGG16 model.

INNOVATION

Data Augmentation Strategies:
Random rotations in the vertical plane ±20 degrees.
And so called transversals, which are made in order to create variability of real conditions imitation.
Swapped photos in order to develop positional variety.

Hyperparameter Tuning:
We tried experiment with different learning rates such as 0.01, 0.001 and 0.0001.
Played with the kind of optimizers which are available for deploying such as, Adam, SGD.
Secondly dropout rates were adjusted for increased regularization.

CONCLUSION

Insights:
Some parameter transfer strategies significantly increased accuracy (~150% of them being higher than the baseline).
VGG16 needed to be modified for CIFAR-10, and specific layers were important for modifying.

Future Directions:
Try other pretrained models as like ResNet50 , MobileNetV2 etc.
Use more difficult augmentations that are more complex (e.g., color shift, crop and resize).
Research into the various ensemble techniques and how overall performance of the system could be improved.

REFLECTIONS

Learning Experience: Team Members' Contributions: Some issues could only be solved collectively, for instance, trying out new data augmentations.

Individual Learning: By the end of the report, transfer learning and data preprocessing concepts were mastered. Realized that there should be a system of experiments aimed to achieve better results.

Challenges: It was quite difficult and time-consuming to set up augmentations if proper ones were not implemented and to tune hyperparameters.

Achievements: Implemented and successfully tested a pipeline that uses transfer learning to get good accuracy on Cifar-10.

THANK YOU