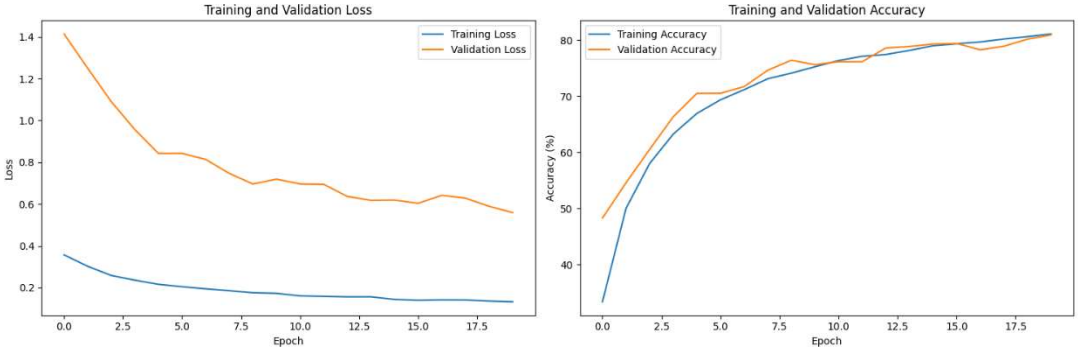
Problem 1 (30 pts)

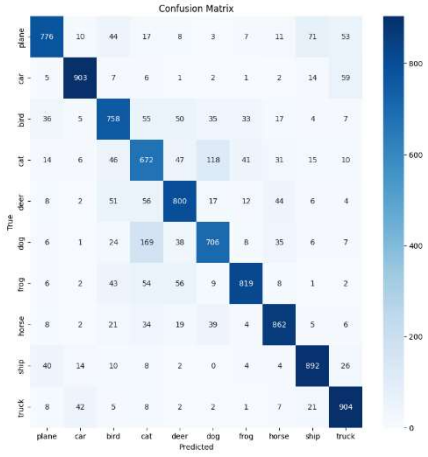
Question:
AlexNet is originally proposed for 227×227 image sizes. It may be too complex for the CIFAR-10 and CIFAR-100 datasets, in particular, due to the low resolution of the initial images; try simplifying the model to make the training faster while ensuring that the accuracy stays relatively high. Report the training loss, validation loss, and validation accuracy. Also, report the number of parameters in your modified version of AlexNet and compare it against the number of parameters in the original AlexNet architectures.

- Explore the option of applying Dropout techniques for training your customized AlexNet.
- Compare the training and validation results against the baseline model without any dropout.
- Compare the results between CIFAR-10 and CIFAR-100.

Result:

- The simplified AlexNet architecture was implemented and trained on both CIFAR-10 and CIFAR-100 datasets.
- The number of parameters in the modified AlexNet is significantly reduced compared to the original AlexNet.
- **CIFAR-10 Results**





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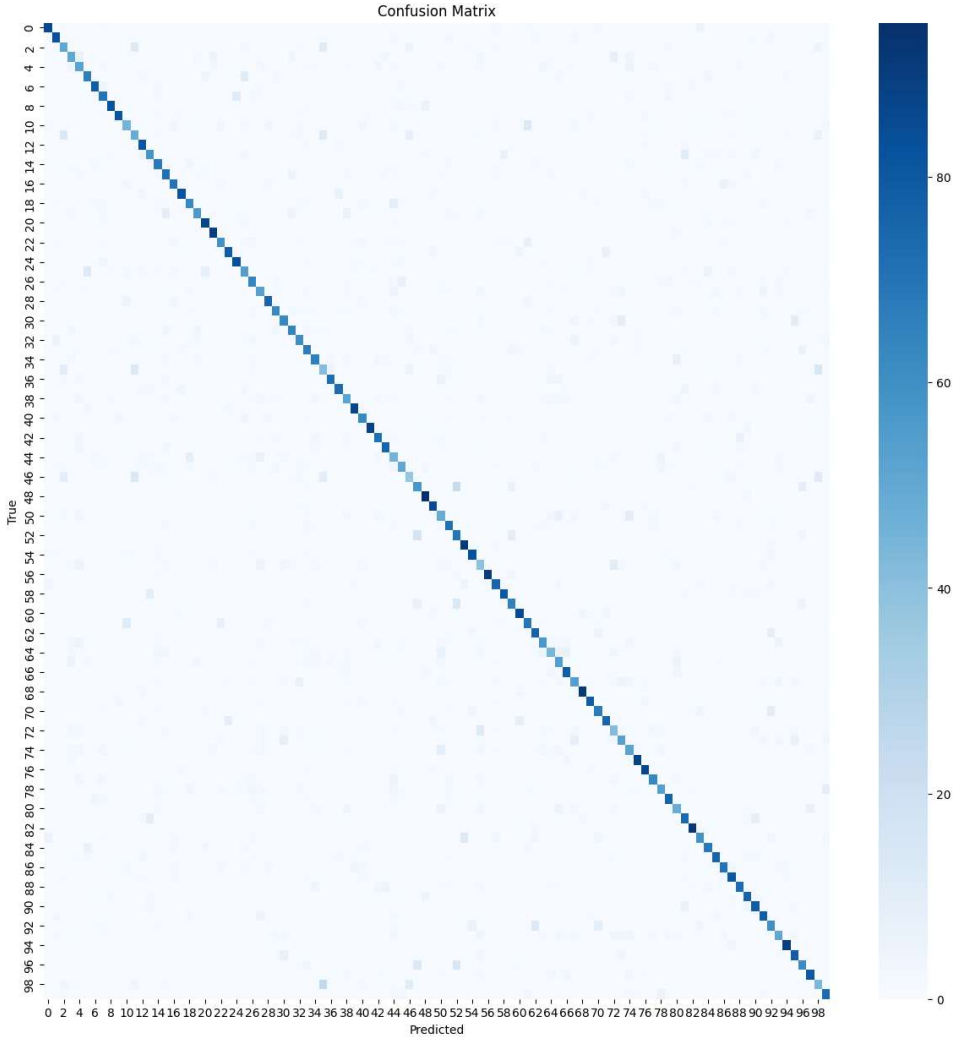
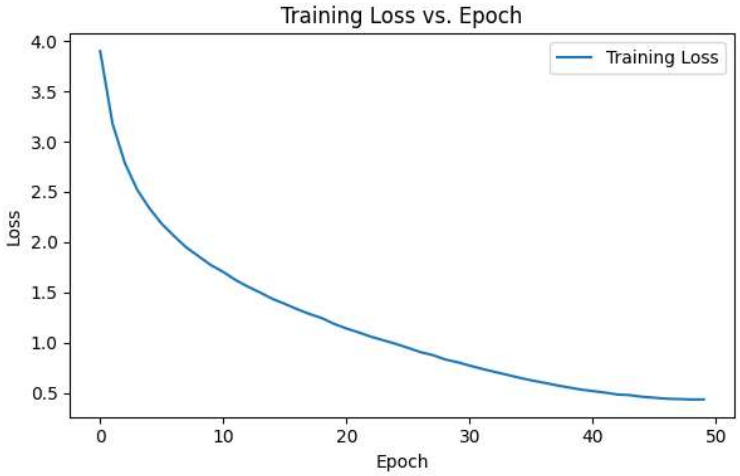
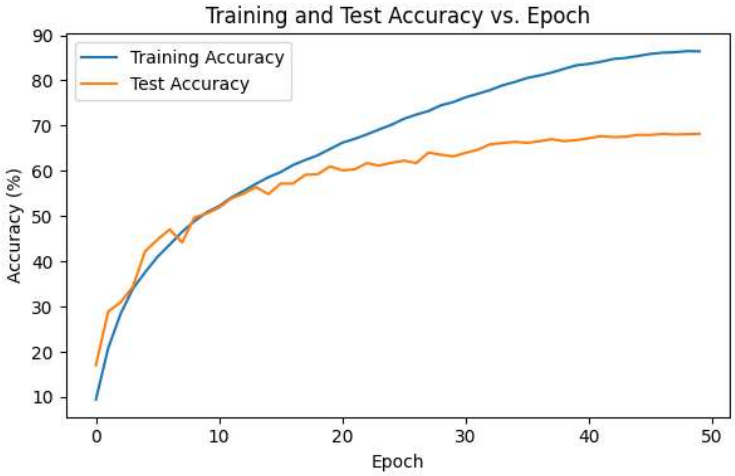
- **CIFAR-100 Results:**







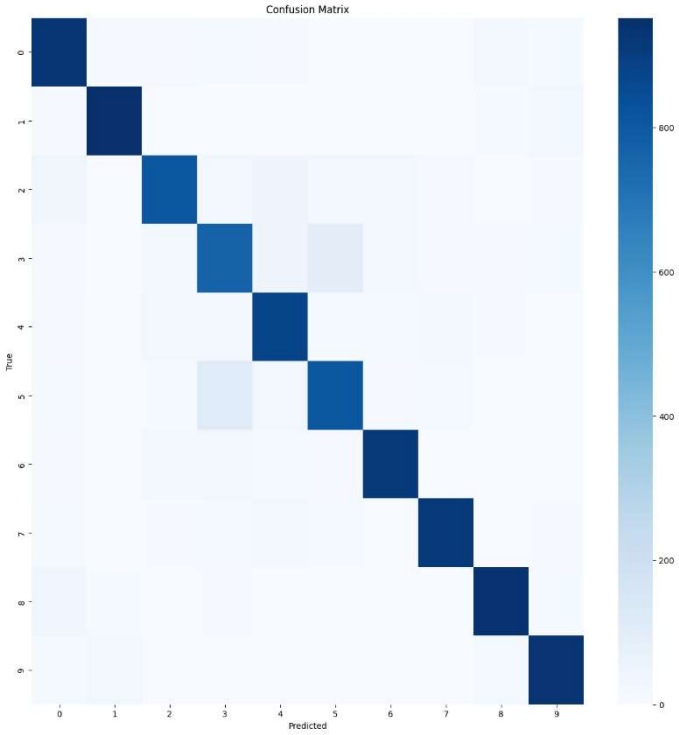
Problem 2 (30 pts)

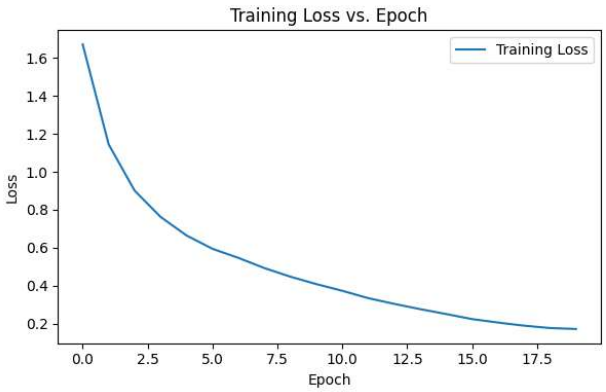
Question:
Repeat Problem 1, but this time for VGGNet. Identify the VGG configuration that matches the nearest number of parameters to the AlexNet architecture you used in Problem 1 for CIFAR-10 and CIFAR-100 datasets. Compare your training and evaluation results against AlexNet from Problem 1.

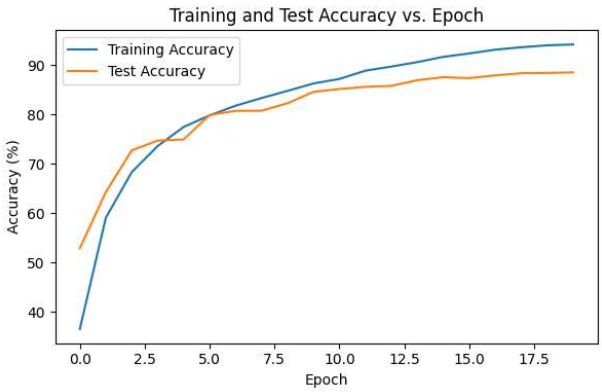
Here is a good reference guide to VGGNet:
https://www.kaggle.com/code/blurredmachine/vggnet-16-architecture-a-complete-guide

Result:

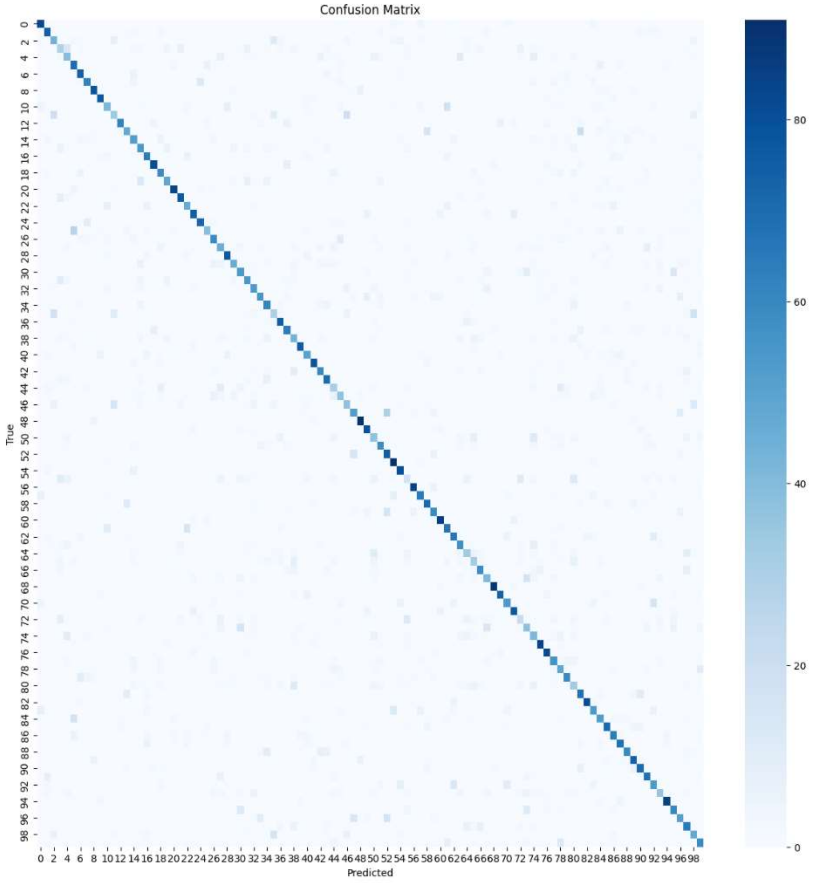
- **VGGNet Model Selection:** A VGG configuration was selected that closely matches the number of parameters in the modified AlexNet.
- **CIFAR-10 Results:**

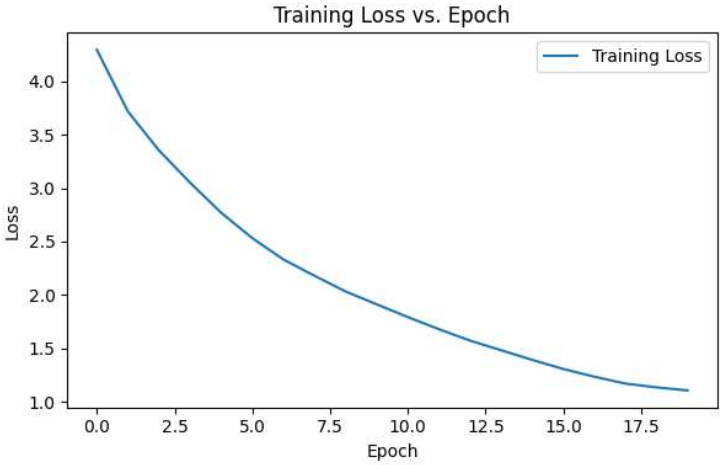


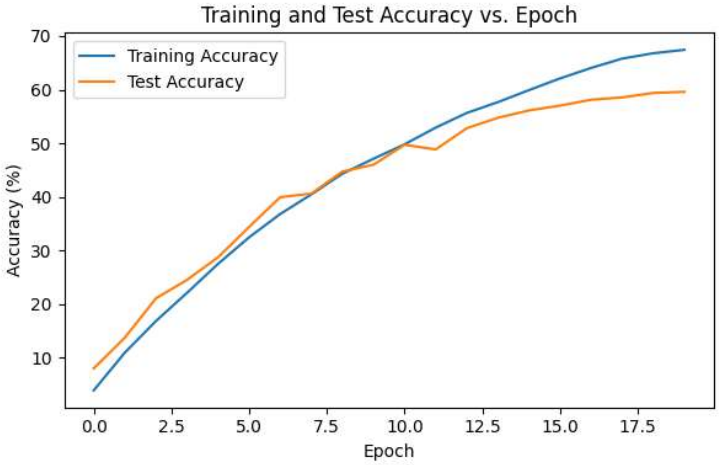




- **CIFAR-100 Results:**







- **Comparison to AlexNet:** the VGGNet model seemed to be better for the ciphar-10 dataset in all metrics, but the ciphar-100 results were not that different for both models.

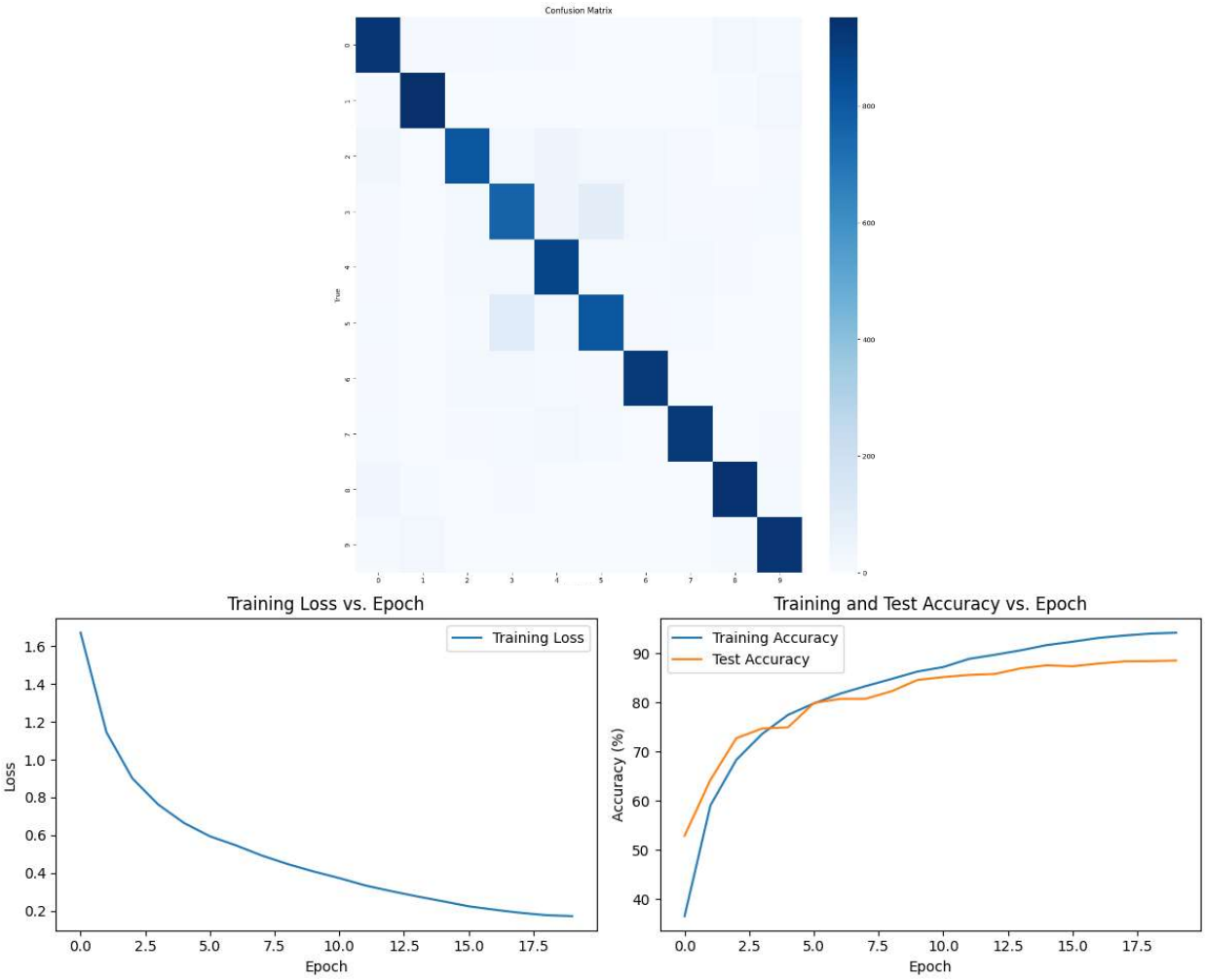
Problem 3 (40 pts)

Question:
The baseline model we did in lectures is called ResNet-11. Build a new version of ResNet (ResNet-18). Train it on CIFAR-10 and CIFAR-100 datasets. Plot the training loss, validation loss, and validation accuracy. Compare the classification accuracy and model size across the two versions of ResNet (11, 18). How does the complexity grow as you increase the network depth?

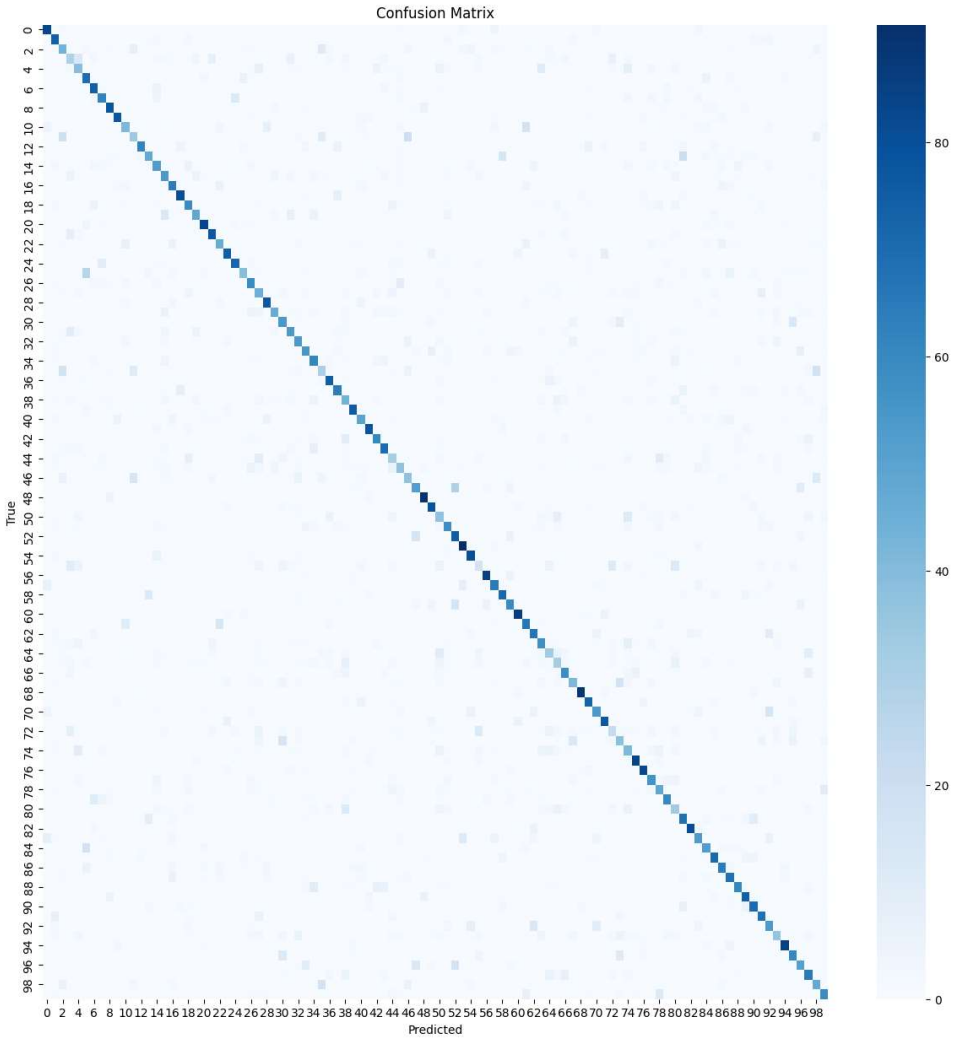
Explore the dropout option for the two networks and report your training results and validation accuracy. Also, compare the results between CIFAR-10 and CIFAR-100.

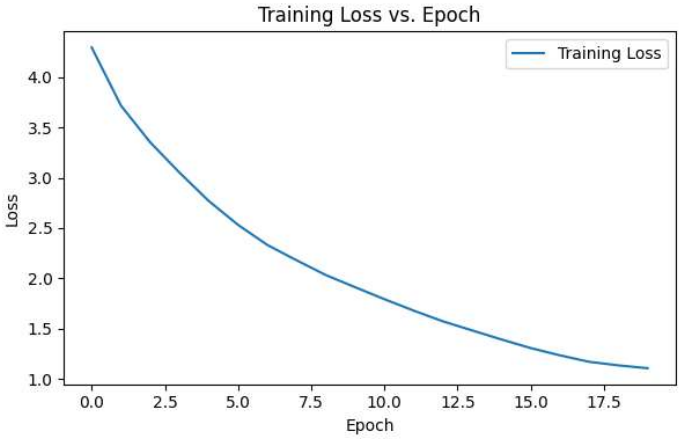
Result:

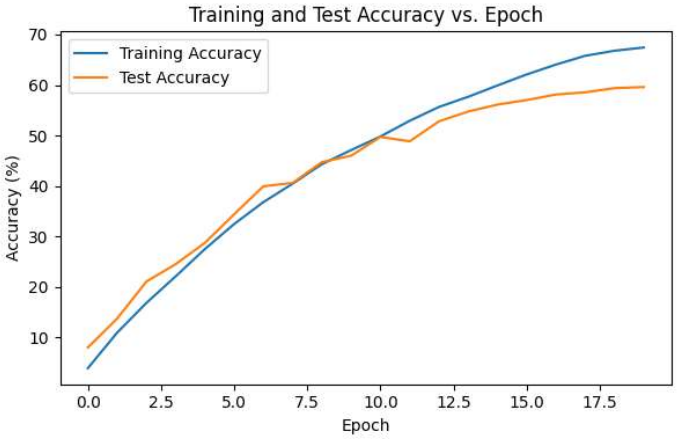
- **ResNet-11 vs. ResNet-18 Training Comparison:**
    - ResNet-18 was trained on CIFAR-10 and CIFAR-100 and compared against ResNet-11.
    - The number of parameters for ResNet-18 is larger than ResNet-11, reflecting its increased complexity.
    - ResNet-11 is a shallower network, with fewer layers and a lower number of parameters while ResNet-18 has deeper layers and an increased number of parameters, allowing for better feature extraction.
- **CIFAR-10 Results:**



- **CIFAR-100 Results:**







- **Comparison Between ResNet-11 and ResNet-18:**
    - **Model Complexity:** ResNet-18 has more parameters than ResNet-11, leading to increased computational requirements.
    - **Accuracy Trends:** the difference between 11 and 18 can be seen in cifar-100 more than in cifar-10. Due to the increased computational power that is required for resnet 18 as opposed to resnet 11, resnet-18 would be worth using for cifar-100 while resnet-11 is good enough for cifar-10 in the case of limited computational power.
    - **Dropout Impact:** Dropout helps reduce overfitting, especially for ResNet-18, which has a larger number of parameters. 0.5 dropout was used. Without dropout some overfitting was observed. After adding dropout better generalization, slightly lower training accuracy but improved validation accuracy was seen.

Github Link:

https://github.com/Eskdagoat/4106/blob/main/NicolaAndrew_801136465_HW2.ipynb