Deep Learning HW-2

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Option chosen - Training

I have chosen 3 models from the provided GitHub link
1. CNNNet1
2. AlexNet
3. MLP

Additionally, to fulfill the requirements, I went ahead and chose **EfficientNetB0** from PyTorch Vision and made 4 changes to it to make it CustomEfficientNet which are -

1. Replaced the top layer with fully connected layer to adapt the dataset.
2. Replaced the output layer as we are using this for Binary Classification.
3. Added dropouts for Regularization.
4. Added transformations layer for dataset to be more augmented and different.

Dataset - Cats Vs Dogs
Observations:

CNN_model1
- Test Loss: 0.6932
- **Accuracy**: Cats 0%, Dogs 100%, Overall 50%

AlexNet
- Test Loss: 0.6932
- **Accuracy**: Cats 100%, Dogs 0%, Overall 50%

MLP
- Test Loss: 0.7030
- **Accuracy**: Cats 73.2%, Dogs 39%, Overall 56.1%

EfficientNet
- Test Loss: 0.1144
- **Accuracy**: Cats 96.2%, Dogs 94.8%, Overall 95.5%

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Summary:
EfficientNet significantly outperforms the other models, achieving the highest accuracy for both cats and dogs with a substantially lower test loss, indicating superior ability to generalize on unseen data. The MLP model shows a balanced but less accurate performance. Both CNN_model1 and AlexNet display extreme bias towards one class, resulting in 50% overall accuracy, which is effectively no better than random guessing.

Plots:

Training and Validation Loss

Overall Accuracy by Model
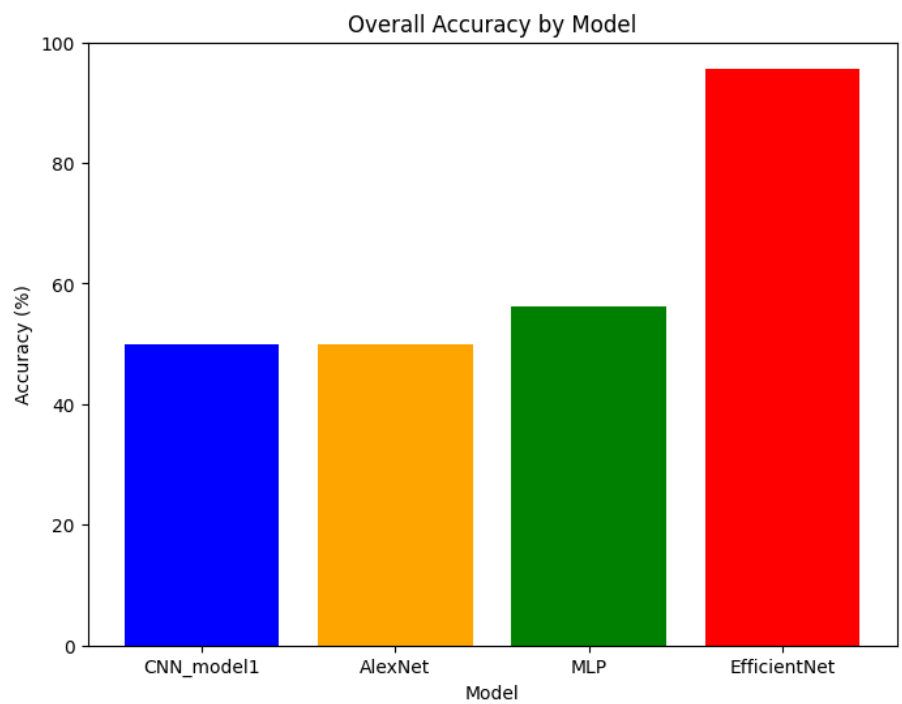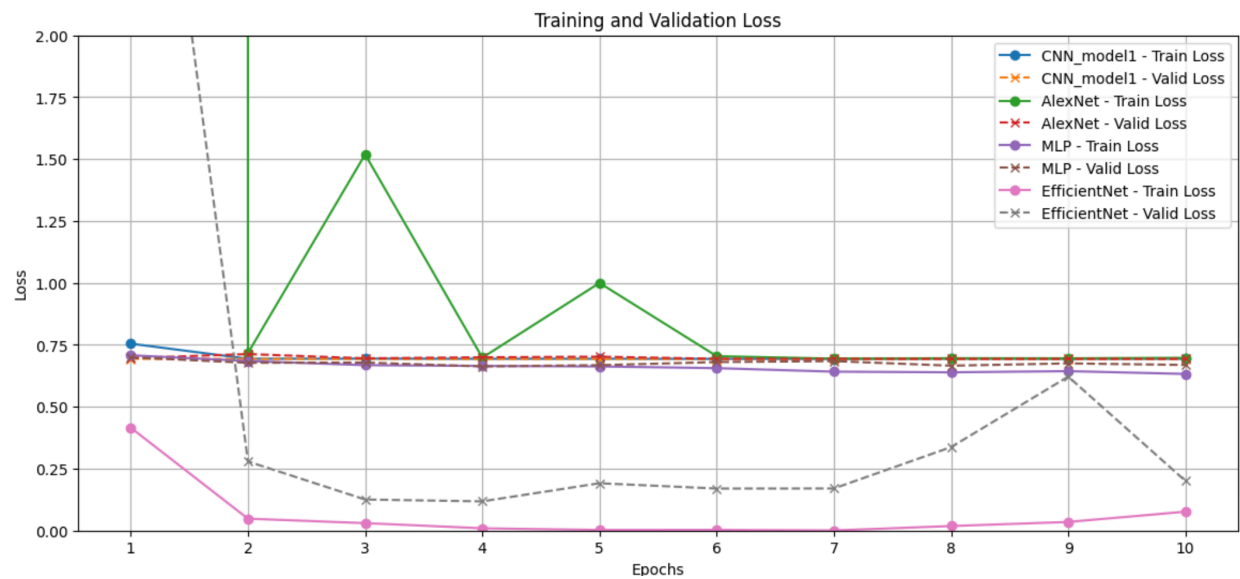
Dataset - WildFire

I made lot of changes to the input layers and output layers of the models to accept the wildfire dataset.

Observations:
CustomEfficientNet
- Final Train Loss: 0.0253
- Final Valid Loss: 0.0007
- Final Train Accuracy: 99.2%
- Final Valid Accuracy: 100%

CNNNet1
- Final Train Loss: 0.2114
- Final Valid Loss: 0.2795
- Final Train Accuracy: 91.3%
- Final Valid Accuracy: 85.3%

AlexNet
- Final Train Loss: 2.6669
- Final Valid Loss: 0.5668
- Final Train Accuracy: 73.0%
- Final Valid Accuracy: 76.5%

MLP
- Final Train Loss: 0.1275
- Final Valid Loss: 5.4646
- Final Train Accuracy: 99.4%
- Final Valid Accuracy: 97.1%

Summary:
- **CustomEfficientNet** shows the best performance with the lowest loss values and highest accuracy, indicating it's highly effective for the wildfire dataset.
- **CNNNet1** has moderate performance with reasonable loss and accuracy, suggesting it's somewhat effective but could benefit from further optimization.
- **AlexNet** struggles with higher loss and lower accuracy compared to CustomEfficientNet and CNNNet1, indicating less effective learning and generalization.
- **MLP** demonstrates excellent training performance with a very high accuracy, but the high validation loss suggests potential overfitting or issues with generalization to unseen data.

Plots: