

CUB-200 Bird Species Classification using MobileNetV2

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Abstract

In this project, we developed a deep learning pipeline for classifying bird species using the Caltech-UCSD Birds 200 (CUB-200) dataset. A pretrained MobileNetV2 model was fine-tuned on the dataset, achieving a test accuracy of **70.18%** after 30 epochs. This work was done as part of the Season of Codes 2025 under the mentorship of Jay Rathod.

1 Dataset and Preprocessing

We used the **CUB-200-2011** dataset, which contains 11,788 images of 200 bird species. The dataset was split into training and testing sets (80/20 split). Data augmentation such as resizing, random cropping, and normalization was applied to improve generalization.

2 Model Architecture

We used the **MobileNetV2** architecture pretrained on ImageNet, modifying its final classifier layer to output 200 classes. The model is lightweight and ideal for fine-tuning on specialized datasets.

Changes Made

- Replaced the final classification head to match the 200 output classes.
- Used `weights=MobileNet_V2_Weights.DEFAULT` instead of deprecated `pretrained=True`.

3 Training Details

- **Loss Function:** CrossEntropyLoss
- **Optimizer:** Adam
- **Learning Rate:** 0.001
- **Batch Size:** 32
- **Epochs:** 30
- **Hardware:** CPU training

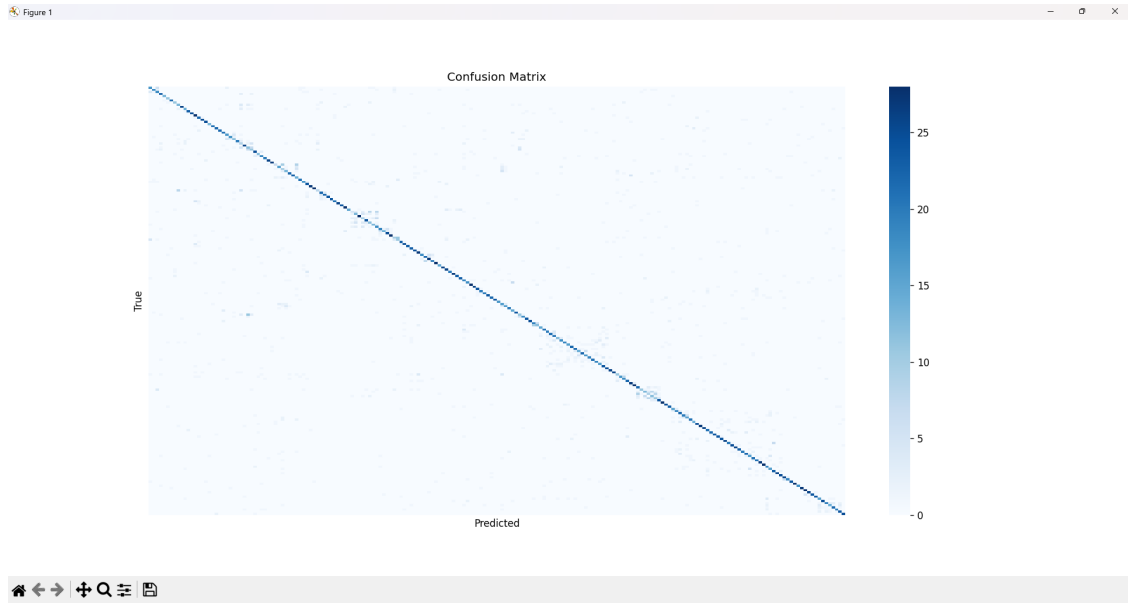


Figure 1: Train vs Test Accuracy over Epochs

Training Curves

4 Results and Evaluation

The best model checkpoint achieved:

- **Test Accuracy:** 70.18%
- **Train Accuracy:** 99.85%

Overall Evaluation Metrics

- **Accuracy:** 70.2%
- **Macro Avg F1-score:** 0.704
- **Weighted Avg F1-score:** 0.702

Sample Classification Report (10 classes)

Class ID	Precision	Recall	F1-Score
0	0.548	0.567	0.557
1	0.783	0.600	0.679
4	0.929	0.929	0.929
9	0.897	0.867	0.881
13	0.609	0.933	0.737
26	0.225	0.300	0.257
41	1.000	0.767	0.868
74	1.000	0.852	0.920
122	0.688	0.733	0.710
199	0.833	0.833	0.833

Note: The full classification report over all 200 bird species is available in the project repository.

5 Conclusion

Our model performs reasonably well for a challenging 200-class classification task using a lightweight architecture like MobileNetV2. Further improvements could be achieved with data balancing, longer training, or ensemble methods.

6 Acknowledgments

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