Signal Processing in Practice - Assignment

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1 Part (A): Training on 20 Classes

Trained a ResNet18 model on a dataset containing 20 randomly selected classes. The model achieved the following performance:

- **Training Accuracy**: 95.53%
- **Test Accuracy on 20 Classes**: 60.80%

Observation: The model learned the training set well, but test accuracy was significantly lower, indicating some overfitting.

2 Part (B): Incremental Learning on 17 New Classes

Modified the ResNet18 classifier to accommodate 37 classes and finetuned the model using only the 17 new classes. The results were:

- **Training Accuracy (17 classes)**: 97.12%
- **Test Accuracy on Full 37-Class Dataset**: 3.40%
- **Test Accuracy on Old 20 Classes**: 4.38%
- **Test Accuracy on New 17 Classes**: 70.21%

Observation: The model adapted well to new classes but exhibited severe catastrophic forgetting, as accuracy on the old 20 classes dropped from 60.80% to 4.38%.

3 Part (C): Mitigating Forgetting with Replay

To reduce forgetting, applied **replay training**, where 10% of old class images were included while finetuning on the 17 new classes. The feature extractor (F0) was frozen, and only the classifier (G1) was updated. The improved results were:

- **Training Accuracy**: 62.41%
- **Test Accuracy on Full 37-Class Dataset**: 5.30%
- **Test Accuracy on Old 20 Classes**: 55.73%
- **Test Accuracy on New 17 Classes**: 58.41%

Observation: Catastrophic forgetting was significantly reduced, as accuracy on old classes improved from 4.38% (Part B) to 55.73%. However, accuracy on new classes dropped slightly due to balancing.