# Sleep Analysis Challenge #2

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# Problem/Goal

- Sleep is crucial for health
  - Stronger immune system + heart health
- Sleep disorders such as insomnia apnea can lead to increased risks for cardiovascular issues and chronic diseases
- Classification of physiological signals into stages of sleep to help diagnose disorders

# Steps

**Initial model architecture: three Conv1d, ReLU, MaxPool1D blocks, flatten and linear layer**

```python
import torch.nn as nn
model = nn.Sequential(
    nn.Conv1d(7, 8, 9),
    nn.ReLU(),
    nn.MaxPool1d(8),


    nn.Conv1d(8, 16, 7),
    nn.ReLU(),
    nn.MaxPool1d(16),


    nn.Dropout(0.2),


    nn.Conv1d(16, 32, 5),
    nn.ReLU(),
    nn.MaxPool1d(32),


    nn.Conv1d(32, 64, 1),
    nn.ReLU(),
    nn.AdaptiveMaxPool1d(2),


    nn.Flatten(),
    nn.Linear(128,5)
)
```

Overfitting

```python
import torch.nn as nn


torch.manual_seed(42)
np.random.seed(42)
random.seed(42)


model = nn.Sequential(
    nn.Conv1d(7, 8, 9),
    nn.ReLU(),
    nn.MaxPool1d(8),


    nn.Conv1d(8, 16, 7),
    nn.ReLU(),
    nn.MaxPool1d(16),


    nn.Conv1d(16, 32, 5),
    nn.ReLU(),
    nn.MaxPool1d(32),


    nn.Dropout(0.2),


    nn.Flatten(),
    nn.Linear(64,5),
    nn.Softmax()
)
```

Final Model

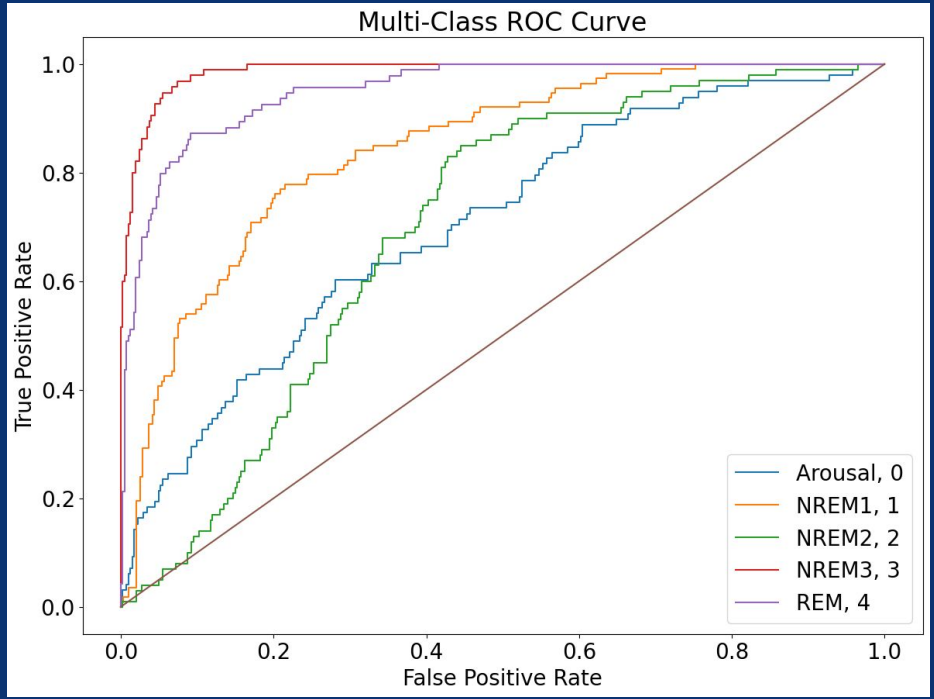
```python
import torch
import torch.nn as nn

torch.manual_seed(42)
np.random.seed(42)
random.seed(42)

model = nn.Sequential(
    nn.Conv1d(7, 8, 9),
    nn.ReLU(),
    nn.MaxPool1d(8),
    nn.BatchNorm1d(8),

    nn.Conv1d(8, 16, 7),
    nn.ReLU(),
    nn.MaxPool1d(16),
    nn.BatchNorm1d(16),
    nn.Dropout(0.3),

    nn.Conv1d(16, 32, 5),
    nn.ReLU(),
    nn.MaxPool1d(32),
    nn.BatchNorm1d(32),
    nn.Dropout(0.3),

    nn.Flatten(),
    nn.Linear(64, 5)
)
```

# Tuning Hyperparameters

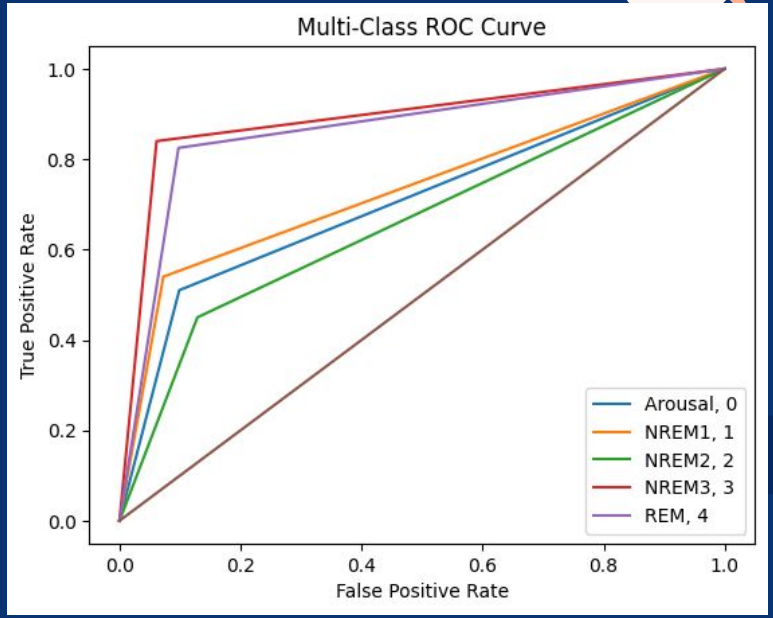
- Increased the learning rate - helps model make larger updates to weights
  - Speed up convergence
- Increased number of layers and size of layers
- Tuned dropout probability - settled on 0.3 to prevent overfitting
- Added Batchnorm for faster training (normalizes inputs of each layer so they have zero mean and unit variance per batch)

# Results

**Epoch #98 Training Loss: 0.15 Training Accuracy: 0.97 Validation Loss: 0.90 Validation Accuracy: 0.68**




0.8625349999999999 0.3246412488677787




0.770625 0.4272525505330625

# Challenges

Model Architecture

Computing Power

Time

# Future Improvements

Optimized Architecture

MORE POWER!