Emotion Decoding From Electroencephalogram Data using Neural Networks

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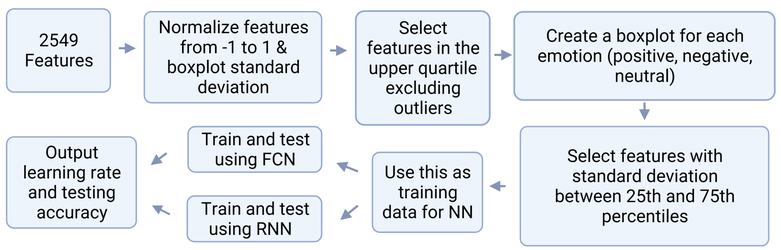
MOTIVATION

- Autonomously detecting positive, negative, and neutral emotional states through electroencephalogram (EEG) data is useful for brain-machine interaction [1]
- A problem with using EEG data to map these emotion states is the large amount of data needed to describe these mental states.
- Since the EEG data is non-linear and random by nature Neural Networks can be used to detect patterns and classify the data into mental states [1]
- **The goal of this study is to decode emotions from EEG data using neural networks and compare the performace of RNN and FCN Networks**.

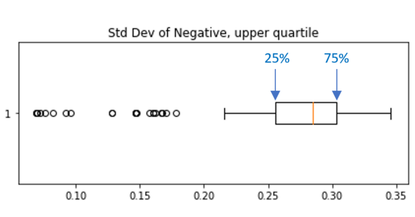
METHOD

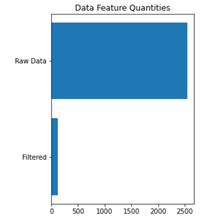


RESULTS

•Shown here is the boxplot of the standard deviation for the negative emotion data. Similar boxplots were created for positive and neutral emotions. These were used to narrow down the number of features.

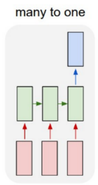
•After extracting the upper quartile of the initial data, features were selected that appeared in the inner quartile of all three emotional states. Using this approach, the **number of features was reduced from 2549 to 119**.

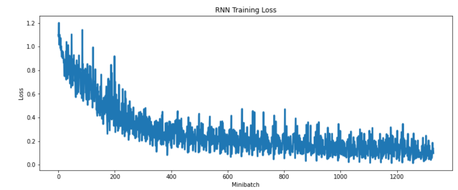




• A **many to one RNN architecture** was used and the training loss function is shown on the right.

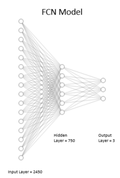
• **The testing accuracy was 93.5%.**

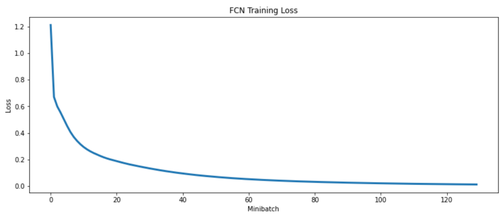




• A **FCN architecture** was used and the training loss function is shown on the right.

• **The testing accuracy was 93.5%.**





CONCLUSION

- Using Deep Learning we achieved an emotion classification testing accuracy of 93.5%.
- The testing accuracy was the same for both RNN and FCN.
- This is higher than what was reported in a similar dataset using a Random Forest Classifier and OneR feature Selection [1]

ACKNOWLEDGEMENT

[1] J. J. Bird, L. J. Manso, E. P. Ribiero, A. Ekart, and D. R. Faria, “A study on mental state classification using eeg-based brain-machine interface,”in9th International Conference on Intelligent Systems, IEEE, 2018.

All NN models made in PyTorch