ECG-based Emotion Recognition Project Pipeline

Resource:

DREAMER[i] is a biophysical signal database, composed of both Electrocardiogram (ECG) and Electroencephalogram (EEG) signals recorded during affect elicitation by audio-visual stimuli. 23 participants were recorded along with the participants self-assessment of their affective state. Total 18 different stimuli were done participant-wisely. The signal was recorded by Shimmer, and one lead ECG signal will be applied in this project.

Background:

ECG records the electrical activity of heart over a period of time. Although it is a time-series data, deep learning for ECG is not restricted on RNN. Both 1D CNN[ii] and 2D CNN[iii] have been reported to be applied for ECG classification. Moreover, CRNN is also used in deep learning classification of ECG with feature extracted by CNN.[iv]

Plan:

1. Exploratory Data Analysis
    - Data visualization of ECG of different annotations
    - Feature Extraction for RNN Model
    - Data preprocessing for CNN Model (e.g. transformed into image)
    - Data augmentation
2. Building Models
    - Implement different architectures and tuning hyperparameters
    - Compare different models' performance
    - Model ensembling
3. Conclusion and Insights

Goals:

- Get used to PyTorch and practice more on it.
- Learn how to operate a deep learning project
- Beat the baseline SVM algorithm
- Learn to implement architectures from literatures
- Try to get insights from comparing different architectures of neural network

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[i] Katsigiannis, S., & Ramzan, N. (2018). DREAMER: a database for emotion recognition through EEG and ECG signals from wireless low-cost off-the-shelf devices. *IEEE journal of biomedical and health informatics*, *22*(1), 98-107.

[ii] Kiranyaz, S., Ince, T., & Gabbouj, M. (2016). Real-time patient-specific ECG classification by 1-D convolutional neural networks. *IEEE Transactions on Biomedical Engineering*, *63*(3), 664-675.

[iii] Rajpurkar, P., Hannun, A. Y., Haghpanahi, M., Bourn, C., & Ng, A. Y. (2017). Cardiologist-level arrhythmia detection with convolutional neural networks. *arXiv preprint arXiv:1707.01836*.

[iv] Zihlmann, M., Perekrestenko, D., & Tschannen, M. (2017). Convolutional recurrent neural networks for electrocardiogram classification. *Computing*, *44*, 1.