ETH
Eidgenössische Technische Hochschule Zürich
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Distributed Computing

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Biomedical Data Generation using GANs

In the last few years Generative Adversarial Networks (GANs) have shown outstanding performance in different generative tasks, most notably in image synthesis. One very relevant problem in which GANs can be applied is biomedical data generation. Generating synthetic biomedical data is a challenging task that has a great interest due to the fact that collecting real data is costly and sharing it has important privacy concerns. In particular, generating high-quality synthetic Electroencephalogram (EEG) signals can alleviate the need for real labeled data and improve the machine-learning-based systems for detection and treatement of different neurological conditions such as epilepsy.

In this project we are interested in investigating convolutional and self-attention architectures to tackle the problem of EEG generation. The final goal of this project is to generate realistic EEG signals that could be used to train algorithms for epilepsy detection. Before attaining this final goal, a number of intermediate steps need to be completed, including the implementation of a measure of the quality of the syntehtic signals. If this sounds interesting to you, do not hesitate to contact us.

Requirements: Knowledge in Deep Learning, or solid background in Machine Learning. Implementation experience with TensorFlow is an advantage. The student should be able to work independently on this topic!

Interested? Please contact us for more details!

Contacts

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Detailed Project Outline

We denote the following primary tasks mandatory (on the right side you find a rough estimate for the time that we allocate to the respective task):

- Literature research. ($\star$)
- Download, clean and store the EEG database into an easily usable format. ($\star\star$)
- Implement in python power feature extraction from EEG samples and a Random Forest classifier. ($\star\star$)
- Implement the SAGAN architecture for generation of EEG signals. ($\star\star\star$)
- Improve the architecture so as to increase the quality of the generated signals. ($\star\star$)
- Use transfer learning to generate epileptic seizures instead of plain EEG. ($\star\star\star$)
- Write the report and prepare presentation. ($\star\star$)

Extensions

Apart from these requirements, we can explore other directions to possibly extend the project:

- Use a transformer-like architecture to generate long EEG signals in an auto-regressive manner.
- Implement a convolutional neural network to classify epileptic seizures using a synthetic dataset.