EEG-based Seizure Detection using Convolutional Neural Network

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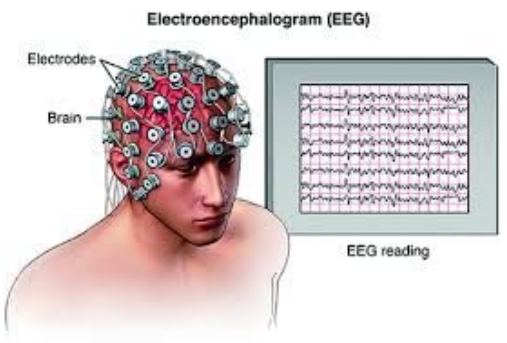
Background

Seizure

- A seizure is a sudden, uncontrolled electrical disturbance in the brain - 2nd most common disease after migraine
- Automatic seizure detection generally relies on hand-crafted feature extraction from EEG data - a difficult and time-intensive process.
- Applying Machine learning techniques could potentially do away with hand-crafted features, in favor of learned features.

EEG

- EEG is a monitoring method to record electrical activity of the brain.
- EEG signal is a dynamic time series signal across multiple electrodes on the scalp.



Dataset

- Taken from UCI Machine Learning Repositary [1]
- 11500 rows; 179 attributes
- 5 different classes
- Recording of brain activity of 500 individuals for 23.5 sec
- Test set: 9200 ; Train set: 2300
- Binary classification task (class 1 - 4 no seizure activity ; class 5 - recording of seizure activity)

Convolutional Neural Network (CNN)

- CNN can exploit the hierarchical structure found in natural signals.
- Recent publications [2] showed that advancements in deep learning can help decoding motor imagery EEG signal, and proposed follow up research on different EEG decoding tasks.signals.

Classification

```
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_4 (Conv1D)            (None, 169, 10)           110
_________________________________________________________________
max_pooling1d_4 (MaxPooling1 (None, 166, 10)           0
_________________________________________________________________
dropout_4 (Dropout)          (None, 166, 10)           0
_________________________________________________________________
lstm_8 (LSTM)                (None, 166, 128)          71168
_________________________________________________________________
lstm_9 (LSTM)                (None, 64)                49408
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 65
=================================================================
Total params: 120,751
Trainable params: 120,751
Non-trainable params: 0
_________________________________________________________________
```

Preliminary Results

- Pre-Processing to shape data for input formulation
- Convert data for binary classification
- 1d fully connected Convolutional Neural Network
  - Max Pooling
  - Relu as Activation Function
  - Adam as optimizer
- Accuracy: 97%

Remarks

Bibliography

1. https://archive.ics.uci.edu/ml/datasets/Epileptic+Seizure+Recognition
2. Schirrmeister RT, Springenberg JT, Fiederer LD, Glasstetter M, Eggensperger K, Tangermann M, Hutter F, Burgard W, Ball T. Deep learning with convolutional neural networks for EEG decoding and visualization. Human brain mapping . 2017 Nov; 38 11 5391 420

Technologies

python™ NumPy TensorFlow