EEG signal processing using neural networks

Project Work II.

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ELTE TTK

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Background of the project

- The aim of this project is to explore and improve the processing and analysis of EEG data using advanced machine learning models.
- EEG signal processing is a crucial aspect of brain research, offering insights into the brain's electrical activity and functioning.
- Joint work within the ELTE AI Research Group.

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- Typically, researchers have mostly used **classical machine learning methods** for tasks such as seizure detection and sleep stage classification.
- There haven't been many attempts to use **deep learning models**, but some early results in the area look promising.
- In this project, we aim to use deep learning techniques to analyze EEG data.

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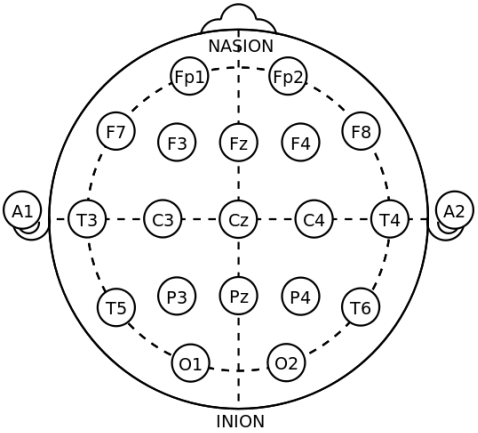

Figure: Sample electrode positions

Figure: Raw EEG data (from Wikipedia)

Available datasets

TUH EEG dataset

- Large and publicly available EEG dataset compiled by Temple University Hospital.

Movie dataset

- Faculty of Education and Psychology, ELTE.
- EEG recordings from 34 individuals, with each person undergoing two recording sessions. Each session corresponds to a different version of a short film: one with a consistent narrative and another with an inconsistent narrative.
- 33 channels, 512 Hz.
- Each session lasts approximately 10 minutes.

Current objectives

- The primary question driving the research is narrative-based classification.
- Currently, our focus is on whether we can classify EEG data based on the films shown.

Our current task involves binary classification based on segments of a given length.

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Attempts:

- LSTM.
- Transformer.
- Fourier coefficients (preprocessing).
- Channel selection.

Results

- Promising early results even with simple models.

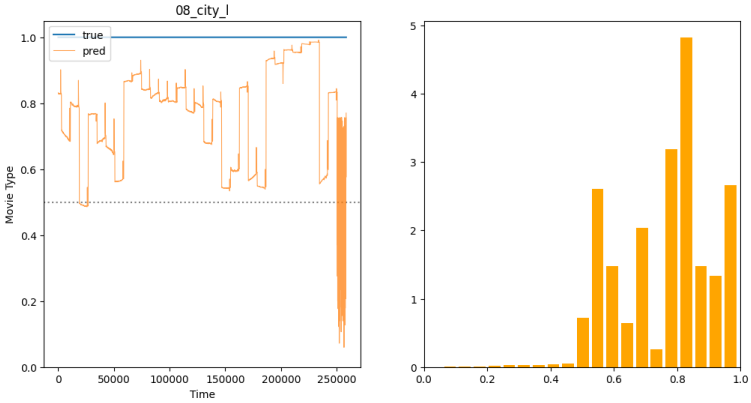

Figure: Sample evaluation of a test file. (The predictions showed on the left are averaged from the corresponding windows.)

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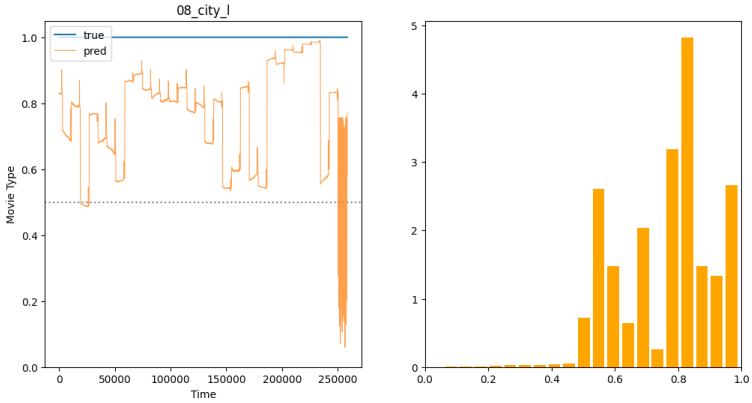

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- Problem: 'Status' channel, as it contains human annotations. Without it, we were unable to achieve a significantly better model than a random one.

Further research

- Model without the Status channels.
- Our long-term goals beyond this smaller task involve leveraging the TUH EEG dataset.
- We aim to explore how we can use this dataset for tasks similar to our current project or how the experience gained from this project can be applied to identify epileptic seizures.

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Thank you for your attention!