ABSTRACT - Team FINDING_MEMO

Predicting Neurological Outcomes in Comatose Cardiac Arrest Patients Using Transformer Neural Networks with EEG Data

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Introduction - Cardiac arrest often results in comas, and EEG-derived coma scale is a valuable prognosis indicator. Building an AI tool for accurate EEG-based prognosis is vital.

Proposition - Deep learning, notably Transformers, holds promise in medical domains. Transformers excel in capturing long-term dependencies in sequential data, which is ideal for EEG analysis. Our team, FINDING_MEMO, aims to train a generalized Transformer model for EEG data analysis as our entry in the 2023 PhysioNet Challenge.

Method - Among all available channels, only the EEG channels were used and 14 unique bipolar referencing are performed among these channels, employing anatomical proximity as the basis. Signal processing techniques, like bandpass filtering and resampling, are used to enhance data quality. For each patient, only the latest 24 hours of available EEG data were selected and used as inputs, along with the clinical data, to two parallel Transformers—one for outcome prediction and another for Cerebral Performance Category (CPC). The Transformer architecture originally comprises an encoder and decoder block, but here, only the encoder block is employed. The decoder, mainly used for embedding decoding, is omitted. Both models include an embedding layer, which uses a linear transformation to transform the input into lower-dimensional representation, a Transformer encoder, which incorporates the self-attention mechanism and feedforward neural networks to capture contextual information and relationships within the input embedding, and a fully-connected layer, which is responsible for generating the final predictions.

Results - Post-training with the complete dataset of 607 samples, cross-validation yields an average of 0.2590 challenge score, 0.7185 accuracy, 0.7685 AUROC, 0.8362 AUPRC, 0.7898 F1-Score for outcomes, and 3.5340 MSE, 1.3604 MAE for CPC prediction. Evaluating the model using a concealed validation set improves the challenge score significantly to 0.40. Such promising results showcase the models' generalizability and clinical potential, particularly for comatose cardiac arrest prognosis.

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