Title：

Ensemble methods and LSTM outperformed other eight machine learning classifiers in an EEG-based BCI experiment

Abstract：

We review eight machine learning classification algorithms to analyze Electroencephalographic (EEG) signals in order to distinguish EEG patterns associated with five basic educational tasks. There is a large variety of classifiers being used in this EEG-based Brain-Computer Interface (BCI) field. While previous EEG experiments used several classifiers in the same experiments or reviewed different algorithms on datasets from different experiments, our approach focuses on review eight classifier categories on the same dataset, including linear classifiers, non-linear Bayesian classifiers, nearest neighbour classifiers, ensemble methods, adaptive classifiers, tensor classifiers, transfer learning and deep learning. Besides, we intend to find an approach which can run smoothly on the current mainstream personal computers and smartphones. The empirical evaluation demonstrated that Random Forest and LSTM (Long Short-Term Memory) outperform other approaches. We used a data set which users were conducting five frequently-conduct learning-related tasks, including reading, writing, and typing. Results showed that these best two algorithms could correctly classify different users with an accuracy increase of 5% to 9%, use each task independently. Within each subject, the tasks could be recognized with an accuracy increase of 4% to 7%, compared with other approaches. This work suggests that Random Forest could be a recommended approach (fast and accurate) for current mainstream hardware, while LSTM has the potential to be the first-choice approach when the mainstream computers and smartphones can process more data in a shorter time.