Cognitive Load Assessment and Feature Extraction Analysis

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Abstract

Cognitive load refers to the amount of mental effort being used in the working memory.

In our study, we evaluated and classified cognitive load levels using physiological data from **electroencephalogram (EEG)**, **galvanic skin response (GSR)**, and **photoplethysmography (PPG)**. We developed a generalized **feature extraction module** to capture significant cognitive state changes.

We employed five classification algorithms— **Support Vector Machine (SVM)**, **K-Nearest Neighbors (KNN)**, **Multilayer Perceptron (MLP)**, **Decision Trees (DT)**, and **Random Forest (RF)**—to predict induced cognitive load levels across two public cognitive load datasets: **CL-Drive** and **CLAS**. Additionally, we used SHAP package to analyze **feature importance**.

Framework

Unimodal Cognitive Load Assessment (CL-Drive)

CL-Drive (EEG Data) → Feature Extraction (15 Total) → Classification Modeling → Cognitive Load Prediction (Low, Med, or High)

Multimodal Cognitive Load Assessment (CLAS)

CLAS (PPG + GSR) → Aggregated Feature Extraction (10 Total) → Classification Modeling → Cognitive Load Prediction (Low or High)

Analysis/Results

Fig. 1 : The most informative EEG features for each of the 4 electrode channels **(Unimodal)**
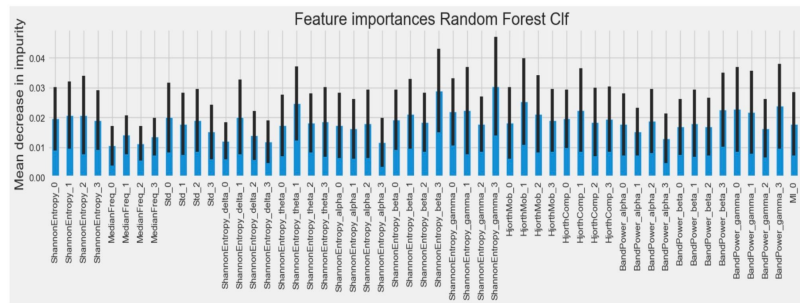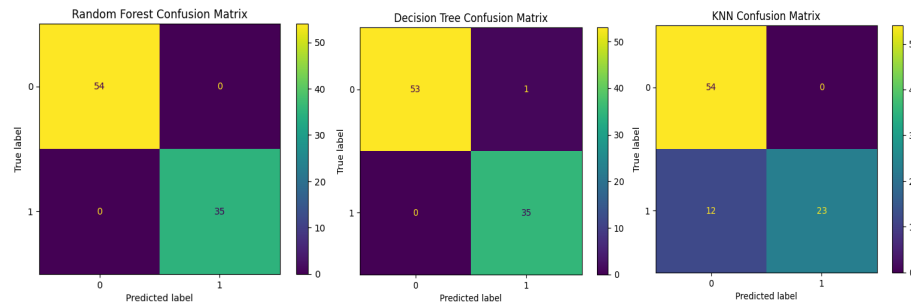

Fig. 2: Classifiers performance for ternary classification **(Unimodal)**

Fig. 3 : Confusion matrices for the three best performing classifiers **(Multimodal)**

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