Phase 4 : Feature importance and reduction

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December 1, 2023

The Overleaf link for this report is here
The video description of this Phase is here

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1 Feature Importance Analysis

As we have a pretty good idea of which model to use, the number of epochs, and a reasonable validation set to use for the network architecture. The next step is to find out which input features is redundant or insignificant.

1.1 Forward Selection with Check pointing

After selecting the appropriate model, number of epochs and validation set, the next step is to determine the importance of individual input features
Feature 0 - Mean of the integrated profile,
Feature 1 - Standard deviation of the integrated profile,
Feature 2 - Excess kurtosis of the integrated profile,
Feature 3 - Skewness of the integrated profile,
Feature 4 - Mean of the DM-SNR curve,
Feature 5 - Standard deviation of the DM-SNR curve,
Feature 6 - Excess kurtosis of the DM-SNR curve Skewness of the DM-SNR curve.

Feature 7 - Skewness of the DM-SNR curve.
A graph illustrating the performance of the model with respect to these features is provided below.
The code performs feature importance analysis and reduction. It trains single-feature models and calculates their validation accuracies. The validation accuracies are plotted to determine the significance of each input feature. Based on the plot, five input features have a small impact on the overall accuracy of the model. Then, the unimportant features are removed and the validation accuracy of the reduced-feature models are compared.
The plot shows the validation accuracy versus the number of removed features. The feature reduction technique used is forward selection, where features are removed one by one based on their significance.
The accuracy of each feature when built individually

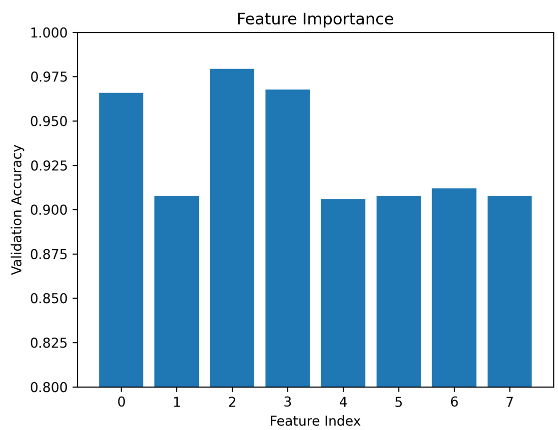

Figure 1: Significance of each feature

Performance after removing each feature one by one

1.2 Feature Reduction using LIME and SHAP

Two well-liked methods for elucidating machine learning model predictions are SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations). While SHAP is based on the idea of game theory and provides global explanations by attributing the contribution of each feature to the final prediction, LIME is a model-agnostic method that produces local explanations for individual predictions. These methods offer insightful information about the features that matter most and how a model generates its predictions.
Two methods are used in the code to implement feature importance analysis: individual feature importance and SHAP. The code trains multiple single-feature models and assesses each one's validation accuracy to determine the importance of each individual feature. The code ranks the features using SHAP values after training an XGBoost model. The validation accuracy of gradually lowering the number of top features in the model is then compared by the code. Plotting the validation accuracy for each method is the last step.
After that, eliminate features that aren't necessary, and evaluate the reduced feature models' validation accuracy. Features were removed iteratively in decreasing order of significance after

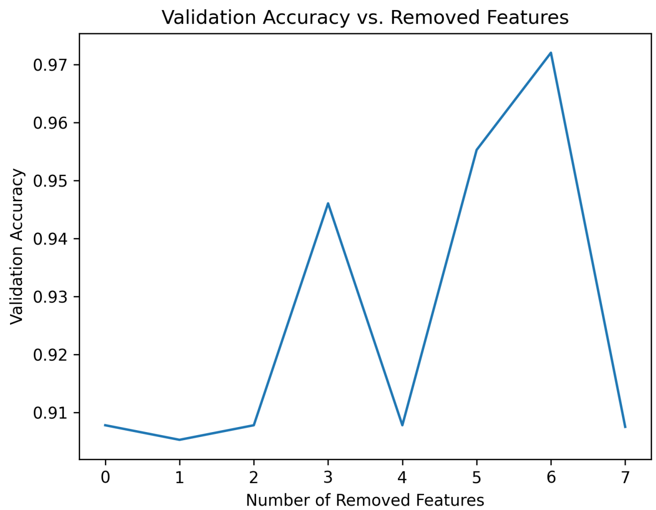

Figure 2: Graph between validation accuracy and each feature

being sorted according to their SHAP importance scores. Train a single-layer neural network with each reduced feature set, then assess the network's accuracy using the validation set.
In order to identify the ideal number of top features to include in the model, we lastly plotted the validation accuracy for each reduced feature set.

Feature Importance based on SHAP values

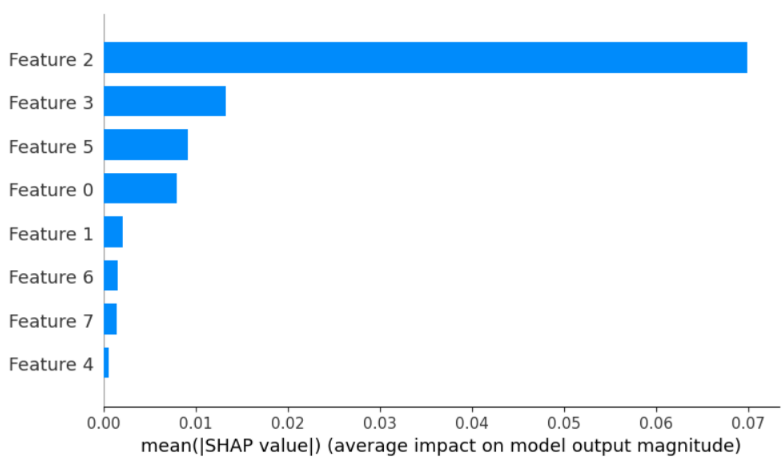

Figure 3: The figure shows the "Excess kurtosis of the integrated profile" is the most important input feature when compared with other input feature.

Performance after removing less important feature

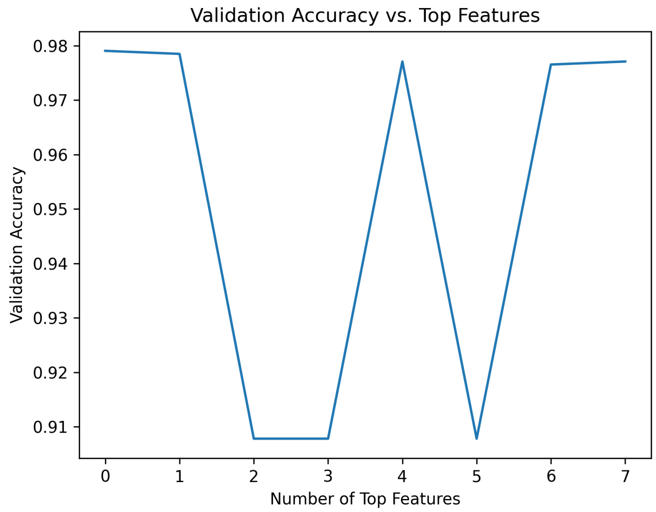

Figure 4: Performance after removing each least important feature