Sleep quality has a vital effect on good health and well-being throughout a lifetime. Getting enough sleep at the right times can help protect mental health, physical health, quality of life, and safety.

Sleep is characterized by continuous changes in respiration and heartbeat rate, eye movement, muscle movements, and brain activity. Traditional polysomnographic (PSG) records different types of physiological data including the electroencephalogram (EEG), electrooculogram (EOG), electromyogram (EMG), and electrocardiogram (ECG) to measure sleep quality. The PSG recording then divides into the 30-sec sequence of non-overlapping time windows (segments) based on the American academy of sleep medicine (AASM) manual recommendation. Each segment is subsequently classified to one of the five sleep stages: 1) wakefulness (W), 2) rapid eye movement (REM), 3) stage 1 (S1); 4) stage 2 (S2); and 5) deep sleep, or slow wave sleep (SWS = S3+S4). Sleep stage scoring is the gold standard for analyzing human sleep which helps to identify the sleep stages that are vital in diagnosing and treating sleep disorders.

The sleep quality can be measured using three criteria: 1) sleep latency, 2) sleep efficiency, and 3) percentage of deep sleep. Specifically, sleep latency is the time that it takes to fall asleep after going to bed. Sleep efficiency is the ratio of the amount of time spent asleep to the total amount of time in bed. The percentage of deep sleep is the ratio of deep sleep to all sleep stages.

In order to calculate these parameters only three sleep categories need to be distinguished: wakefulness, light sleep + REM (S1, S2, REM), and deep sleep (S3, S4).

In this project, we use sleep dataset from SC Sleep-EDF Database [Expanded] that is freely available through Physionet at "https://physionet.org/physiobank/ database /sleep-edfx/" for training and evaluation purposes.

The extracted 15 features from the brain signals of 8 subjects along with the sleep category are attached to the email.

SC1 includes the values of the features for the light sleep + REM category

SC2 includes the values of the features for the deep sleep category

SC3 includes the values of the features for the awake category

SC1-label includes the labels for the light sleep + REM category

SC2-label includes the labels for the deep sleep category

SC3-label includes the labels for the awake category

The number of data for each sleep category is 800. So the available data in each category is 800 by 15. (800 observations, 15 features)

The plan is to compare the performance of the 6 different classifiers: Naïve Base, Decision Tree, Random Forest, Linear discriminate analysis, Quadratic discriminate analysis, and Multilayer Perceptron using 10-fold cross-validation starting from having only one feature and increasing the number of features to two (the first two features), then three (the first three features), then four (the first four features),…. until all 15 features are used.

Provide the curve that compares the accuracy of all methods versus the number of features and indicate in a table the best number of features for each method and the corresponding accuracy. Then, provide the test performance and calculate the confusion matrix, **accuracy, sensitivity, specificity, F1-score, false positive rate, and false negative rate** for each class using the best number of features for that class**.**

Which classifier has the best performance with less number of features?

All the results should be shown with Tables and Figures in the PowerPoint presentation.