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Acquisition and Analysis of Neuronal Data

For these exercises please download data set *features_lecture_adaptiveBCI.mat* (material) from
`https://ml01.zrz.tu-berlin.de/wiki/Main/SS09_AnalysisOfNeuronalData`.
During this experiment the subject performed left hand and right foot motor imagery according to visual cues.

Exercises

1. **Plot distributions of train and test data (2 points)**
   Plot the feature distributions of train and test data as in sheet 10. The features are already pre-processed, so you do not need any further calculation. Calculate the FDA classifier using the training features (from sheet 10). Calculate the FDA classifier using the pooled mean and pooled covariance matrix and compare the weights and bias of both classifiers (the weights and bias of one classifier should be proportional to the ones of the other).

   Plot the hyperplane of any of the classifiers (they should be the same), as in sheet 10. Obtain the error rate in the test features according to both classifiers (validation). Check that the classification error is the same with both FDA classifiers.

2. **Update the classifier (3 points)**
   For this exercise, you can choose to adapt the classifier in one of the two following ways. If you implement both versions correctly, you will have a plus of 3 points, adding up to 9 points instead of 6. However, this is NOT compulsory.
   General information: The adaption procedure works trial by trial, so iteratively. First, compute initial conditions for the adaption using the training features. The initial conditions depend on the version you choose. Use an update coefficient of UC=0.01.
   Version 1, using usual inverse covariance matrix and mean estimators: Calculate initial conditions (initial FDA from first exercise, please use the new FDA version, inverse covariance matrix, pooled mean). Then iteratively, calculate the classification output of one trial of the test features, update the inverse of the covariance matrix and the pooled mean. Update the classifier. Repeat until the last trial of the test features.
   Version 2, using inverse of extended covariance matrix estimator: Calculate initial conditions (initial FDA from first exercise, please use the new FDA version, inverse extended covariance matrix). Then iteratively, calculate the classification output of one trial of the test features, update the inverse of the extended covariance matrix. Update the classifier. Repeat until the last trial of the test features.

   Remember: first classify the test feature and then use it to update the elements of the classifier. You should not update first and then classify.

3. **Calculate updated error (1 point)**
   With the classification output that you obtained during the adaption, calculate the new error rate. Plot the classification boundary of the classifier you obtained after the adaption. Note that no class information is used to estimate the new classifier.

 Please submit your solutions by email until Wed, July 22nd.