Prediction of short-term success of electrical cardioversion

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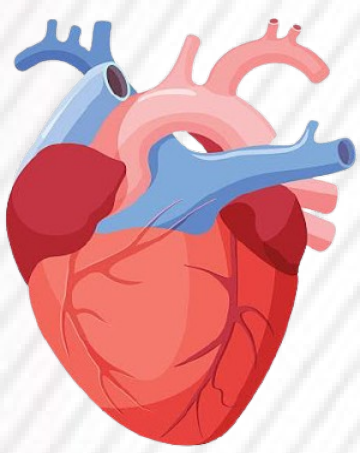
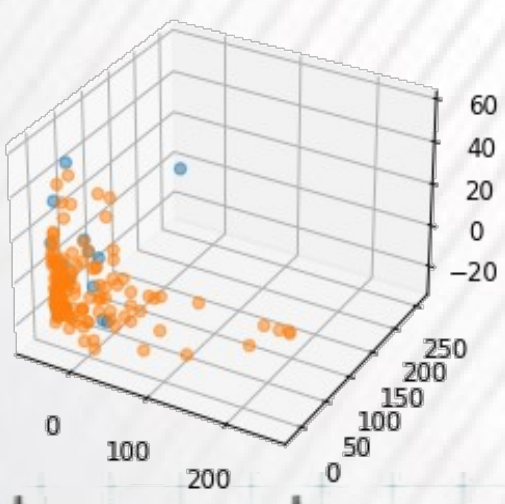
Introduction

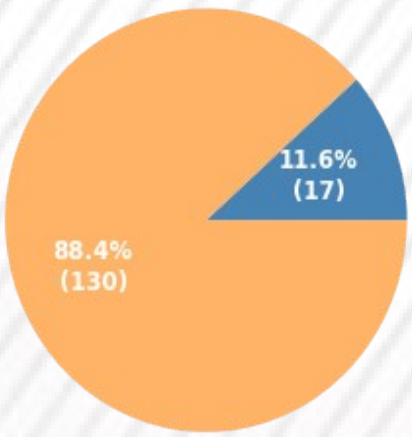
Electrical cardiversion is a medical technique that uses synchronized electrical shocks to restore normal sinus heart rhythm in people with persistent arythmia. We aimed to create a classification model that accurately predicts whether the procedure will be successful in the short term, based on data on the clinical picture, other indications and drug therapy prescribed to patients ubdergoing it.



About data

Dataset, obtained from Pacemaker Center of Clinical Center of Serbia, consist of 147 unique instances. Even though the recurrence rate of atrial fibrillation is very high, most cardioversions are initially successful. Successful procedures, marked as class True, make up 88,4% of the dataset and unsuccessful, marked as class False only 11.6%. Accordingly, dataset is imbalanced with concern to the target class, so we used train-test split with augmented train partition. Based on PCA and UMAP we noticed that the classes are almost unseparable.





Used techniques

The focus was initially on Bayesian network. They, however, proved inferior to other methods of clasifcation and machine learning.
Decision tree was overfitted and tree prunng couldn't help obtaining better model.
Random Forest, Complement Naive Bayes and Support Vector Machine was mutually similar and they showed better performance then previous two.
Multilayer Perceptron individualy showed best performance.

Finally, it was posible to combine some models into one and get new and best of all model. One way to do so is by using voting ensembles. It's best to favorize important unsuccessful procedures, so decision function on an ensemble is conjuction of all input estimators: if either one of inputs is False then output is False.

Results

Predicting short-term success (immediate outcome) of electrical cardiversion isn't an easy task, but we managed to get some acceptable model. A voting ensemble made of multilayer perceptron and complement naïve Bayes turned out the best, with full 100 % specificity, recall of the important class False, while maintaining a relatively high F1 score of 63 % on the same class. Accuracy was 87 %, while balanced (macro-average) accuracy was 92 %. Precision on class False was not that good 46 %, but still the best.