UNIVERSITY OF MANNHEIM
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Data Mining

Exercise 4: Classification

4.1. Learning a classifier for the Iris Data Set – Part II

Last exercise, you have learned lazy classification models for the Iris dataset. Now try a Decision Tree based approach with 10-fold cross-validation.

1. Discretise the Iris data set into three bins. Then use the DecisionTreeClassifier with a 10-fold stratified cross validation and compute the accuracy. Afterwards plot the decision tree.
2. Remove the discretization and adjust the max_depth parameter of DecisionTreeClassifier to increase the accuracy. Does the accuracy change? Compare the complexity of the two models. Which model should be preferred according to Occam's razor?

4.2. Who should get a bank credit?

The German credit data set from the UCI data set library (http://archive.ics.uci.edu/ ml/index.html) describes the customers of a bank with respect to whether they should get a bank credit or not. The data set is provided as *credit-g.arff* file in ILIAS.

1. Plot ROC curves for k-NN (different k values), Decision Tree and Naïve Bayes classification (you can use the given avg_roc function). Which classification approach looks most promising to you?
2. For the two most promising classification approaches, compute the accuracy and confusion matrix in a 10-fold cross-validation setup (use cross_val_predict function). Which level of accuracy do you reach?
3. What do the precision and recall values for the class "bad" customer tell you? Try to improve the situation by increasing the number of "bad" customers in the training set (in the cross-validation!). How do precision and recall change if you apply this procedure?
4. To model a use-case specific evaluation, as observed in the previous example, compute the cost of all misclassifications. Set up your cost matrix by assuming that you will lose 1 unit if you refuse a credit to a good customer, but that you lose 100 units if you give a bad customer a credit. Re-run the experiments from 4.2 and evaluate the results.
5. As the creation of training data is mostly a manual task and humans tend to be fallible, training data might include noise. Simulate this behavior by using the *Add Noise* function and change the parameter "percentage" from 0% over 10% to 20%. Is your preferred classification approach still feasible for this situation? How does the performance of the other classifiers evolve?

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ChatGPT Bonus Exercises

Reminder: Do not take the answers of ChatGPT at face value! Always cross-check with lecture slides, literature and/or the teaching staff!

C.1. Discuss Evaluation Setups/Metrics

- Use ChatGPT to discuss the various evaluation setups you learned about. What would be reasons to choose holdout validation over cross-validation? What are the pitfalls you should look out for when doing any kind of dataset splitting for evaluation and how can you avoid them?
- You want to use k-fold cross-validation for model evaluation. Discuss with ChatGPT what a good value for k is and what factors would influence the optimal choice of k. What problem could you run into when setting k too high?

C.2. Learn about more ways for handling class imbalance in Python

- Ask ChatGPT about more sophisticated methods for handling class imbalance available in the imbalanced learn package and have it explain them to you. Finally, let ChatGPT generate some code for an advanced method and apply it to the credit data set from exercise 4.2. and compare to the results you achieved with simple over-/undersampling.
- Ask ChatGPT about additional methods for handling class imbalance that are not based on changing the data distribution in the training set. Select a promising method, let ChatGPT generate code for it and use it to compare to your previous results on the credit data set.

C.3. Self-Assessment

- Ask ChatGPT to create a pen and paper exercise for you that lets you practice the calculation of the evaluation metrics Precision, Recall and F1. Instruct ChatGPT to provide a confusion matrix for three classes and subsequently calculate the measure for each class.
- Ask ChatGPT to create an exam exercise for graduate students relating to the effect of overfitting in Decision Tree classifiers and solve the exercise. Get the answer from ChatGPT and critically evaluate it.
- Ask ChatGPT to create three multiple choice questions for graduate students about choosing the best evaluation metrics for example classification tasks and solve them.