

Aprendizagem 2023  
Homework I – Group 28

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**Part I: Pen and Paper**

Consider the partially learnt decision tree from the dataset  $D$ .  $D$  is described by four input variables – one numeric with values in  $[0, 1]$  and 3 categorical – and a target variable with three classes.

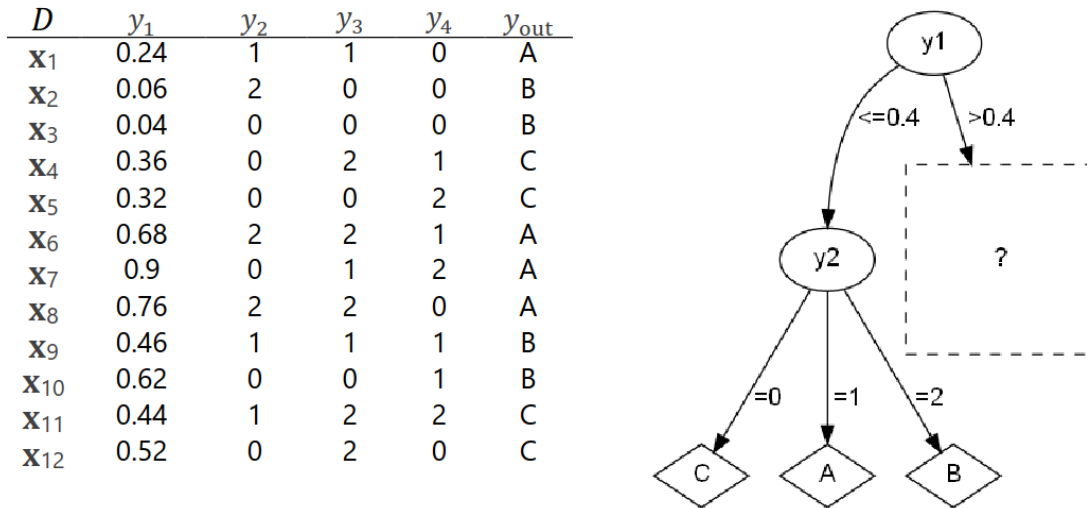


Figure 1: Partially Learnt Decision Tree and Dataset  $D$  from Part I

1. Complete the given decision tree using Information gain with Shannon entropy ( $\log_2$ ). Consider that: i) a minimum of 4 observations is required to split an internal node, and ii) decisions by ascending alphabetic order should be placed in case of ties.

Blah

2. Draw the training confusion matrix for the learnt decision tree.

Blah

3. Identify which class has the lowest training F1 score.

Blah

4. Considering  $y_2$  to be ordinal, assess if  $y_1$  and  $y_2$  are correlated using the Spearman coefficient.

Blah

5. Draw the class-conditional relative histograms of  $y_1$  using 5 equally spaced bins in  $[0, 1]$ . Find the root split using the discriminant rules from these empirical distributions.

Blah

## Part II: Programming

Consider the `column_diagnosis.arff` data available at the homework tab, comprising 6 biomechanical features to classify 310 orthopaedic patients into 3 classes (normal, disk hernia, spondylolisthesis).

1. Apply `f_classif` from `sklearn` to assess the discriminative power of the input variables. Identify the input variable with the highest and lowest discriminative power. Plot the class-conditional probability density functions of these two input variables.

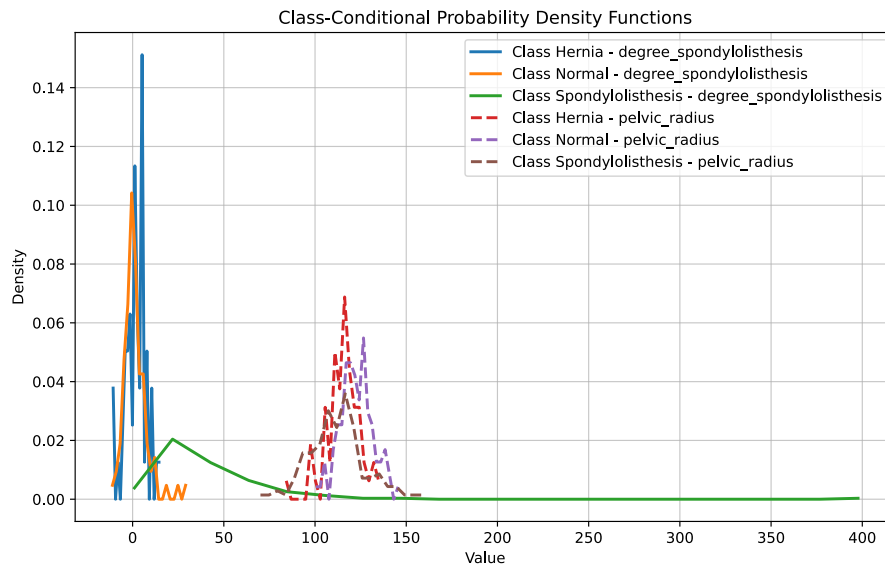


Figure 2: Class-conditional probability density functions of the highest and lowest discriminative power variables.

2. Using a stratified 70-30 training-testing split with a fixed seed (`random_state=0`), assess in a single plot both the training and testing accuracies of a decision tree with depth limits in  $\{1, 2, 3, 4, 5, 6, 8, 10\}$  and the remaining parameters as default.

*[Optional]* Note that split thresholding of numeric variables in decision trees is non-deterministic in sklearn, hence you may opt to average the results using 10 runs per parameterization.

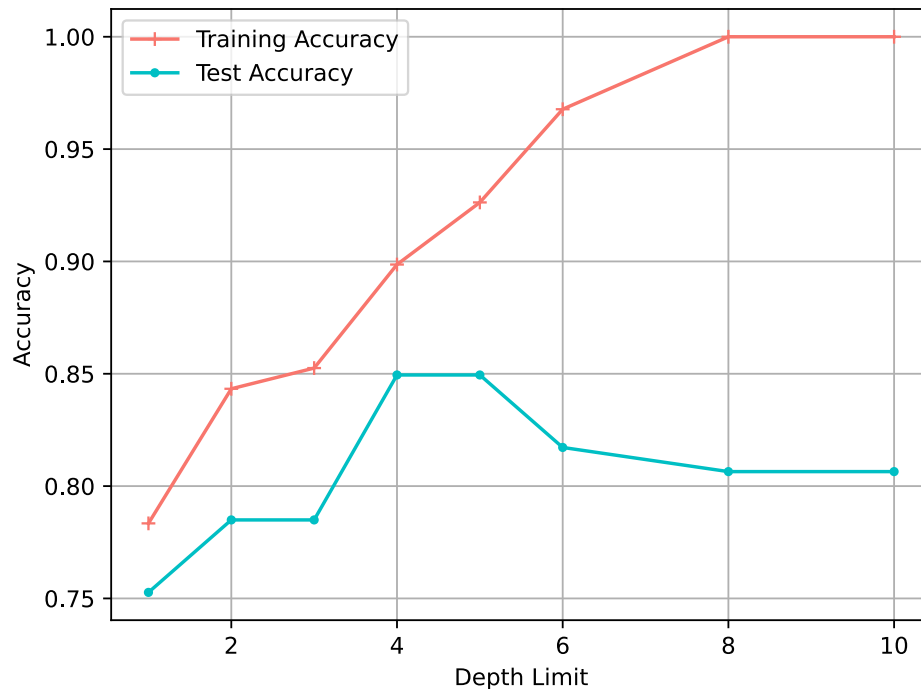


Figure 3: Accuracy of trained decision tree, applied to both a test and training sets, for varying depth limits.

3. Comment on the results, including the generalization capacity across settings.

Blah

4. To deploy the predictor, a healthcare team opted to learn a single decision tree (`random_state=0`) using *all* available data as training data, and further ensuring that each leaf has a minimum of 20 individuals in order to avoid overfitting risks.

- (a) Plot the decision tree.

Blah

- (b) Characterize a hernia condition by identifying the hernia-conditional associations.

Blah

END