Lab 02: Decision Tree with scikit-learn

In this assignment, you are going to *build a decision tree on the UCI Connect-4 Dataset*, with the support from *scikit-learn library*.

About the Connect-4 dataset from UCI Machine Learning Repository

This dataset contains all legal 8-ply positions in the game of Connect-4 in which neither player has won yet, and in which the next move is not forced. There are *67557 samples*, each of which is characterized by *42 attributes* (each corresponding to one connect-4 square) and *classified to win, draw, or loss*.

You can download the data files from here.

Assignment requirements

You are asked to write a Python program, with appropriate calls of scikit-learn functions, to fulfill the following tasks. Although there is no strict rule on how to organize the code, each task should be noted carefully.

Preparing the datasets

This task prepares the training sets and test sets for the incoming experiments.

You need to organize the Connect-4 dataset into four subsets:

- `feature_train`: a set of training examples, each of which is a tuple of 42 attribute values (target attribute excluded).
- `label_train`: a set of labels corresponding to the examples in `feature_train`.
- `feature_test`: a set of test examples, it is of similar structure to `feature_train`
- `label_test`: a set of labels corresponding to the examples in `feature_test`.

You need to shuffle the data before splitting and the data is split in a stratified fashion. Other parameters (if there is any) are left by default.

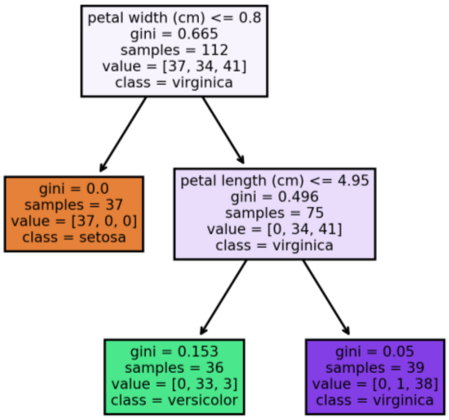
There will be experiments on training sets and test sets of different proportions, including `(train/test) 40/60, 60/40, 80/20,` and `90/10`, and thus you need `16` subsets.

Building the decision tree classifiers

This task conducts experiments on the designated train/test proportions listed above.

You need to fit an instance of `sklearn.tree.DecisionTreeClassifier` (with ***information gain***) to each training set and visualize the resulting decision tree using `graphviz`.

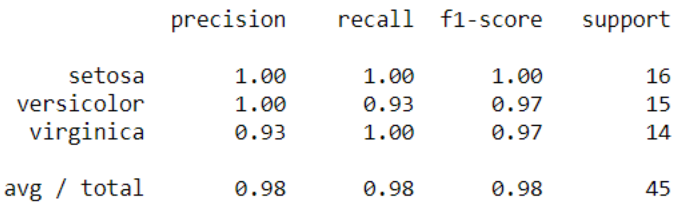
The aside figure gives an example of a decision tree built on the Iris dataset (3 classes).



Evaluating the decision tree classifiers

For each of the above decision tree classifiers, predict the examples in the *corresponding test set*, and make a report using `classification_report` and `confusion_matrix`.

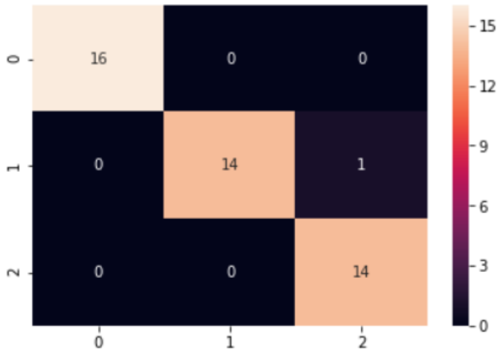
The following figure gives an example of classification report and confusion matrix for a classifier on the Iris dataset (3 classes).



```
             precision    recall  f1-score   support

     setosa       1.00      1.00      1.00        16
 versicolor       1.00      0.93      0.97        15
  virginica       0.93      1.00      0.97        14

avg / total       0.98      0.98      0.98        45
```



How do you interpret the classification report and the confusion matrix? From that, make your own comments on the performances of those decision tree classifiers.

The depth and accuracy of a decision tree

This task works on the *80/20 training set and test set*. You need to consider how the decision tree's depth affects the classification accuracy.

You can specify the maximum depth of a decision tree by varying the parameter `max_depth` of `sklearn.tree.DecisionTreeClassifier`.

You need to try the following values for parameter `max_depth`: `None, 2, 3, 4, 5, 6,` and `7`. And then,

- Provide the decision tree drawn by `graphviz` for each `max_depth` value
- Report to the following table the `accuracy_score` (on the test set) of the decision tree classifier when changing the value of parameter `max_depth`.

max_depth	None	2	3	4	5	6	7
Accuracy							

- Make your own comment on the above statistics.

References

[1] Scikit-learn decision trees: https://scikit-learn.org/stable/modules/tree.html

[2] Analysis and classification of Mushrooms: https://www.kaggle.com/haimfeld87/analysis-and-classification-of-mushrooms

Grading

No.	Specifications	Scores (%)
1	Preparing the datasets	20
2	Building the decision tree classifiers	20
3	Evaluating the decision tree classifiers	
	Classification report and confusion matrix	20
	Comments	10
4	The depth and accuracy of a decision tree	
	Trees, tables, and charts	20
	Comments	10
Total		**100**

Notice

- This is an **INDIVIDUAL** assignment.
- Your program should be programmed in **Python.** Write down your report on a **PDF File.**
- If you use Google Colab, please make sure that the notebook is shared with full access to both Ms. Tuyen (htttuyen@gmail.com) and Mr. Thanh (lnthanh@fit.hcmus.edu.vn). Furthermore, you must not modify the notebook after the deadline.
- A program with syntax/runtime error(s) will not be accepted.