Assignment 4: Classification

Due: December 4 11:59PM

Two datasets (Golf, Car) are provided. In each dataset, each row corresponds to a record. The last column corresponds to the class label, and the remaining columns are the attributes. README presents the meanings of the attributes in these two datasets.

In this assignment, you are asked to implement Decision Tree algorithm. Template (*decisionTree_template.py*) is for Python 3. In the template, you are asked to fill in two functions: *chooseBestFeature* and *stopCriteria*. In *chooseBestFeature*, you need to use Gini index as the impurity measure to decide the best feature to split. In *stopCriteria*, you need to check whether the stopping criteria are satisfied, and return the class label assigned to the leaf node.

The attributes in the provided datasets are either nominal or ordinal. Multi-way split strategy should be adopted in this assignment.

Do not directly call a function or package that implements Decision Tree algorithm. You need to implement the algorithm by yourself. If you are not sure about whether it is OK to use a certain function, please post your question on Piazza.

Please take the following steps:

1. Decision Tree algorithm works as follows:

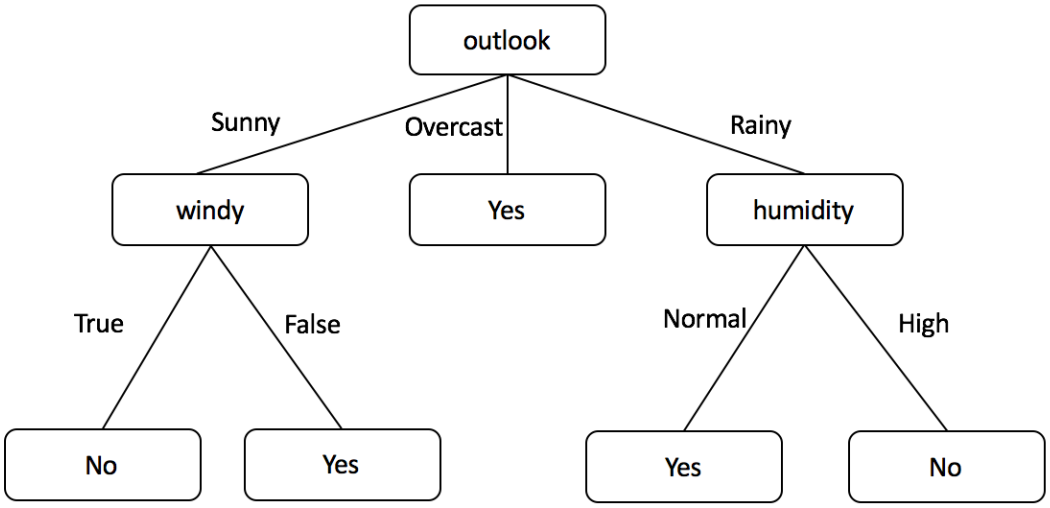
DTree(*records*, *attributes*) returns a tree
    If stopping criterion is met, return a leaf node with the assigned class.
    Else pick an *attribute* F based on Gini Index and create a node *R* for it
        For each possible value *v* of *F*:
            Let *Sv* be the subset of records that have value *v* for *F*
            call DTree(*Sv*, *attributes* – {*F*}) and attach the resulting tree as the subtree to the current node.
        Return the subtree.

The implementation of the algorithm is provided with two functions to be filled: 1) *stopCriteria* and 2) *chooseBestFeature*. The corresponding pseudo codes can be found below:

```
stopCriteria(dataset)
    assignedLabel = None
    if all class labels are the same
        assignedLabel = label
    else if no more features to split
        assignedLabel = majority(labels)
```

chooseBestFeature(dataset)
    for each feature i in the dataset
        calculate gini index on dataset
        for each $value$ of the feature
            subset = splitData(dataset, i, $value$)
            calculate gini index on the subset
        calculate Gain for feature i
    Find the bestGain and the corresponding feature id

2. Test your Decision Tree algorithm on Golf dataset. Based on your output, you can use the provided *treeplot.py* file to automatically draw the tree. Using multi-way split, the resulting tree for the Golf dataset should look like:



To draw the tree, you can use the provided *treeplot.py* file, or just draw the tree using Excel or PowerPoint, or draw the tree on a piece of paper and include a scanned copy of the tree in the report.

3. If you get the correct tree, then apply your algorithm on the Car dataset and draw the tree.

4. Prepare your submission. Your final submission should be a zip file named as Assignment4.zip. In the zip file, you should include:

- A folder "Code", which contains all the codes used in this assignment.
- Report: A WORD or PDF file named as Assignment4.docx or Assignment4.pdf. The report should consist of the following parts: 1) The tree drawn based on the output obtained from the Car Dataset using your algorithm. 2) The code of the two functions that you implement.

5. Submit the zip file under Assignment 4 on Brightspace.

Please refer to Course Syllabus for late submission policy and academic integrity policy. This assignment must be done independently. Running your submitted code should be able to reproduce the results in the report.