Machine Intelligence Lab(UE21CS352A)

Decision Tree Classifier

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Decision Trees stand out as one of the most user-friendly and popular classification algorithms, known for their ease of understanding and interpretability. The ultimate goal behind utilizing a Decision Tree is to create a training model that can effectively predict the target variable's class or value. This is achieved by learning simple decision rules derived from historical data.

The crucial part in implementing a Decision Tree lies in determining which attributes to use as the root node at each level—a task referred to as attribute selection. An attribute selection algorithm picks as root the attribute that can most effectively predict the value of the target variable. ID3 an attribute selection algorithm employs a top-down greedy search approach through the potential branches without backtracking. At each step, it chooses the option that seems most promising.

In ID3, attribute selection involves the following steps:

1. Compute Entropy: Measure dataset disorder to assess impurity before and after attribute-based splits.
2. Calculate Information Gain: Find the difference between entropies before and after splitting to quantify attribute's contribution to reducing uncertainty.
3. Select Best Attribute: Choose attribute with highest information gain as the root node for that level, ensuring accurate predictions.

By iteratively applying these steps, ID3 constructs a Decision Tree that learns from training data, predicting target variables for new instances.

Task:

Complete code for functions whose skeleton has been provided.

You are provided with the following files:

1. DecisionTree.py
2. Test.py

DecisionTree.py

This file contains the following functions:

Function name	Input	Output
get_entropy_of_dataset	tensor: `torch.Tensor`, tensor representing the given dataset	dataset_entropy: `int/float`, entropy of the entire dataset
get_avg_info_of_attribute	1. tensor: `torch.Tensor`, tensor representing the given dataset 2. attribute: `int`, number representing the attribute	avg_info: `int/float`, average Information of that attribute
get_information_gain	1. tensor: `torch.Tensor`, tensor representing the given dataset 2. attribute: `int`, number representing the attribute	information_gain: `int/float`, information gain of that attribute
get_selected_attribute	tensor: `torch.Tensor`, tensor representing the given dataset	result: tuple(information_gains,selected_attribute) where information_gains: python dictionary with key as attribute number and value as its information gain selected_attribute : `int`, attribute number of chose attribute

Complete above functions to implement attribute selection

Test.py

1. This will help you check your code.
2. Rename DecisionTree.py file to CAMPUS_SECTION_SRN_Lab1.py
3. Run the command `python3 Test.py --ID CAMPUS_SECTION_SRN_Lab1`

Sample dataset used in Test.py

Outlook	Temperature	Humidity	Windy	PlayTennis
Sunny	Hot	High	False	**No**
Sunny	Hot	High	True	**No**
Overcast	Hot	High	False	**Yes**
Rainy	Mild	High	False	**Yes**
Rainy	Cool	Normal	False	**Yes**
Rainy	Cool	Normal	True	**No**
Overcast	Cool	Normal	True	**Yes**
Sunny	Mild	High	False	**No**
Sunny	Cool	Normal	False	**Yes**
Rainy	Mild	Normal	False	**Yes**
Sunny	Mild	Normal	True	**Yes**
Overcast	Mild	High	True	**Yes**
Overcast	Hot	Normal	False	**Yes**
Rainy	Mild	High	True	**No**

Important Points

1. **Do not make changes to the function definitions** that are provided to you. Use the skeleton as it has been given.
2. **Do not make changes to the test file provided to you**. Run as is.
3. Do not hardcode values. You are designing a module that has helper functions to run the ID3 algorithm for any kind of dataset. The functions must be designed to be independent of the schema of the dataset.
4. In the dataset provided, the last column has the target variable. The previous columns are explanatory variables.

5. You may write additional helper functions.
6. You **can use built-in modules**.
7. You **must use PyTorch**

Submission Guidelines

You are to submit two files:

1. The python solution: CAMPUS_SECTION_SRN_Lab1.py
2. Screenshot of Test cases (Single screenshot of all testcases in terminal): CAMPUS_SECTION_SRN_Lab1.png (or jpg)

The google form link for submission will be provided

- You wont be able to resubmit, so kindly check your files.
- Remove all print statements.
- Resubmitting from different mail will lead to zero marks.
- Failing some hidden cases will lead to partial marks.
- Test cases provided to you are for reference only, hidden test cases will be similar