

NYCU Pattern Recognition, Homework 3

[Student ID], [Name]

Part. 1, Coding (60%):

(20%) Adaboost

1. (10%) Show your accuracy of the testing data ($n_estimators = 10$)
2. (5%) Plot the AUC curves of each weak classifier.
3. (5%) Plot the feature importance of the AdaBoost method. Also, you should snapshot the implementation to calculate the feature importance.

(20%) Bagging

4. (10%) Show your accuracy of the testing data with 10 estimators. ($n_estimators=10$)
5. (5%) Plot the AUC curves of each weak classifier.
6. (5%) Plot the feature importance of the Bagging method. Also, you should snapshot the implementation to calculate the feature importance.

(15%) Decision Tree

7. (5%) Compute the gini index and the entropy of the array [0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1].
8. (5%) Show your accuracy of the testing data with a $max_depth = 7$
9. (5%) Plot the feature importance of the decision tree.

(5%) Code Linting

10. Show the snapshot of the flake8 linting result.

Part. 2, Questions (40%):

1. (10%) We have three distinct binary classifiers, and our goal is to leverage them in creating an ensemble classifier through the majority voting strategy to make decisions.
Assuming each individual binary classifier operates independently of the others with an accuracy of 60%, what would be the accuracy of the ensemble classifier?
Write or type your answer here.
2. (15%) For the decision tree algorithm, we can use the “pruning” technique to avoid overfitting. Does the random forest algorithm also need pruning?
Please explain in detail.
Write or type your answer here.

3. (15%) Activation functions are core components of neural networks. They need to be differentiable to ensure backpropagation works correctly. Please calculate the derivatives of the following commonly used activation functions.

(For questions 1. and 2., consider the cases where $x > 0$ and $x \leq 0$)

1. $f(x) = \text{relu}(x)$,	$df(x)/dx = ?$
------------------------------	----------------

2. $f(x) = \text{leaky_relu}(x)$ with $\text{negative_slope}=0.01$,	$df(x)/dx = ?$
--	----------------

3. $f(x) = \text{sigmoid}(x)$,	$df(x)/dx = ?$
---------------------------------	----------------

4. $f(x) = \text{silu}(x)$,	$df(x)/dx = ?$
------------------------------	----------------

5. $f(x) = \text{tanh}(x)$,	$df(x)/dx = ?$
------------------------------	----------------

Write or type your answer here.