

Machine Learning

Lab 3: Linear Learning Model Perceptron

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What is Perceptron?

The perceptron is an algorithm for supervised learning of binary classifiers (functions that can decide whether an input, represented by a vector of numbers, belongs to some specific class or not). It is a type of linear classifier, i.e. a classification algorithm that makes its predictions based on a linear predictor function combining a set of weights with the feature vector.

How does a Perceptron work?

The perceptron has a set of weights for every attribute of the input dataset given to it. Dot product is performed on the weight vector and the value vector of each row of the input dataset. The scalar value is then compared with a threshold value. $\text{Sign}(\text{scalar} - \text{threshold})$ is used to classify the binary classifiable dataset.

If the predicted class is correct, then the next value is taken. If wrongly predicted, the weights are adjusted on the basis of the learning rate and the magnitude of error.

More the no of time the perceptron runs through the train dataset (epoch), more will be accuracy. But after a certain level, the accuracy won't change if the dataset is not linearly separable.

Experiment:

1. On Iris dataset.

The Perceptron class defined has three functions: fit, predict and activation_fn.

Fit function trains the perceptron i.e. it finalizes the weights of the perceptron by going through n epochs and has the least error (highest accuracy)

Predict function is used to perform the dot product of the weights and input value and based on the scalar value, the activation function classifies the data into one of the two categories.

When we used pairplot on the iris dataset, the setosa and versicolor were completely linearly separable on the basis of petal_width and petal_length. Therefore when we use perceptron to separate setosa and versicolor on the basis of petal_width and petal_length, we get an accuracy of 100%.

In the python notebook, I have tried to use the perceptron to classify versicolor and virginica on the basis of petal_width and petal_length and successfully found out the weights of the perceptron.

I have also implemented the same using the Perceptron from sklearn module. The accuracy is about 90%.

2. On Big Mart Sales dataset

Using pairplot, we found that that 'Outlet_location_type' is linearly separable using the attributes 'Item_Visibility' and 'Outlet_Establishment_Year'.

I extracted the rows from the dataset with class label 'Tier 1' and 'Tier 2' (to make it binary classification).

Using LabelEncoder class of the sklearn preprocessing module, I mapped the string values of the dataset to integers for the sklearn perceptron to work with.

After training for 40 epochs, the accuracy was around 49%. But with increasing value of epoch, the accuracy increased. At 1000 epochs, the accuracy reached around 90% and the model was good enough to make predictions.

Conclusion:

Perceptron is the base for most of the machine learning algorithms and is the simplest linear decision making model that can make binary decisions with high accuracy provided the data is linearly separable.