

UNIT – 4 CLASSIFICATION

Binary classification:

Binary classification is a supervised learning algorithm that categorizes new observations into one of **two** classes.

The following are a few binary classification applications, where the 0 and 1 columns are two possible classes for each observation:

Application	Observation	0	1
Medical Diagnosis	Patient	Healthy	Diseased
Email Analysis	Email	Not Spam	Spam
Financial Data Analysis	Transaction	Not Fraud	Fraud
Marketing	Website visitor	Won't Buy	Will Buy
Image Classification	Image	Hotdog	Not Hotdog

Quick example

In a medical diagnosis, a binary classifier for a specific disease could take a patient's symptoms as input features and predict whether the patient is healthy or has the disease. The possible outcomes of the diagnosis are **positive** and **negative**.

Evaluation of binary classifiers

If the model successfully predicts the patients as positive, this case is called *True Positive (TP)*. If the model successfully predicts patients as negative, this is called *True Negative (TN)*. The binary classifier may misdiagnose some patients as well. If a diseased patient is classified as healthy by a negative test result, this error is called *False Negative (FN)*.

Similarly, If a healthy patient is classified as diseased by a positive test result, this error is called *False Positive(FP)*.

We can evaluate a binary classifier based on the following parameters:

- True Positive (TP): The patient is diseased and the model predicts "diseased"
- False Positive (FP): The patient is healthy but the model predicts "diseased"
- True Negative (TN): The patient is healthy and the model predicts "healthy"
- False Negative (FN): The patient is diseased and the model predicts "healthy"

After obtaining these values, we can compute the **accuracy score** of the binary classifier as follows:

$$\text{ACCURACY} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{TN} + \text{FN}}$$

The following is a *confusion matrix*, which represents the above parameters:

		PREDICTED	
		Positive	Negative
ACTUAL	Positive	True Positive (TP)	False Negative (FN)
	Negative	False Positive (FP)	True Negative (TN)

In machine learning, many methods utilize binary classification. The most common are:

- Support Vector Machines
- Naive Bayes
- Nearest Neighbor
- Decision Trees
- Logistic Regression
- Neural Networks