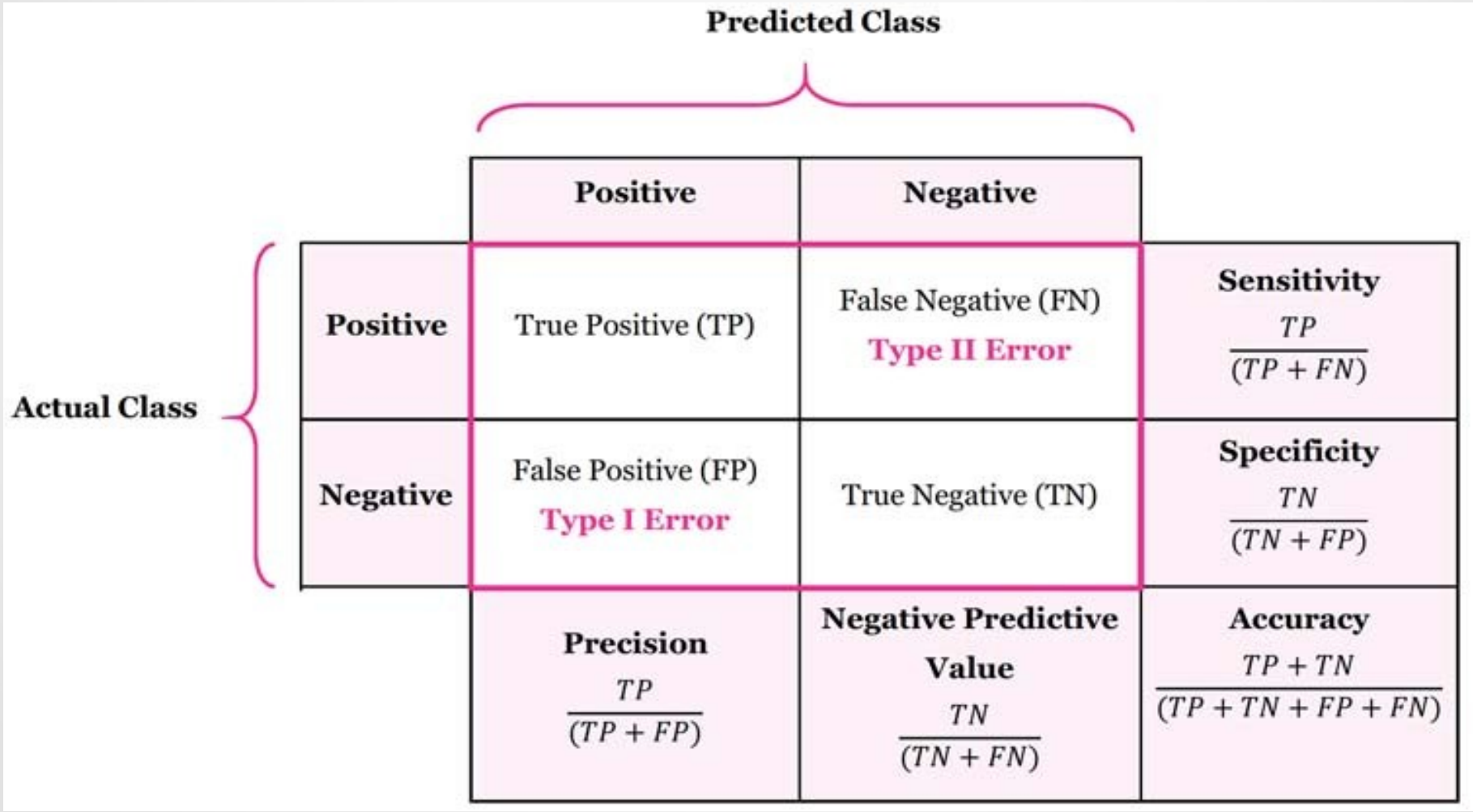
CONFUSION MATRIX

What is Confusion Matrix ?

- Confusion Matrix is a tool to determine the performance of a classifier.
- It contains information about actual and predicted classifications.

Cont...


Predicted Class
Positive
Negative
Actual Class
Positive
True Positive (TP)
False Negative (FN)
Type II Error
Sensitivity
$\frac{TP}{(TP + FN)}$
Negative
False Positive (FP)
Type I Error
True Negative (TN)
Specificity
$\frac{TN}{(TN + FP)}$
Precision
$\frac{TP}{(TP + FP)}$
Negative Predictive Value
$\frac{TN}{(TN + FN)}$
Accuracy
$\frac{TP + TN}{(TP + TN + FP + FN)}$

Cont...

- **True Positive (TP)** is the number of correct predictions that an example is positive which means positive class correctly identified as positive.
- **False Negative (FN)** is the number of incorrect predictions that an example is negative which means positive class incorrectly identified as negative.
- **False positive (FP)** is the number of incorrect predictions that an example is positive which means negative class incorrectly identified as positive.
- **True Negative (TN)** is the number of correct predictions that an example is negative which means negative class correctly identified as negative.

Cont...

- Consider a dataset contains 100 samples, 65 are Spams and 35 are non-spams.

		Predicted Class: Spam	Predicted Class: Non-Spam
Actual Class	Spam	TP=45	FN=20
	Non-Spam	FP=5	TN=30

Cont...

- **Sensitivity** (**True Positive Rate or Recall**): It is measure of positive examples labeled as positive by classifier. It should be higher. For instance, proportion of emails which are spam among all spam emails.
- Sensitivity = 45/(45+20) = 69.23%
- The 69.23% spam emails are correctly classified and excluded from all non-spam emails.
- **Specificity (True Negative Rate)**: It is measure of negative examples labeled as negative by classifier. There should be high specificity. For instance, proportion of emails which are non-spam among all non-spam emails.
- Specificity = 30/(30+5) = 85.71% .
- The 85.71% non-spam emails are accurately classified and excluded from all spam emails.

Cont...

- **Precision** is ratio of total number of correctly classified positive examples and the total number of predicted positive examples.
- Precision = 45/(45+5)= 90%
- The 90% of examples are classified as spam are actually spam.
- **Accuracy** is the proportion of the total number of predictions that are correct.

Cont..

- **F1 score** is a weighted average of the recall (sensitivity) and precision. F1 score might be good choice when you seek to balance between Precision and Recall.

$$\text{F1 Score} = 2 \times \frac{Precision \times Recall}{Precision + Recall}$$