Various ways to check the performance of our machine learning algorithm are –

1. Confusion matrix
2. Accuracy
3. Precision
4. Recall
5. Specificity
6. F1 score
7. Precision-Recall or PR curve
8. ROC (**R**eceiver **O**perating **C**haracteristics) curve

True positives (TP): Predicted positive and are actually positive.

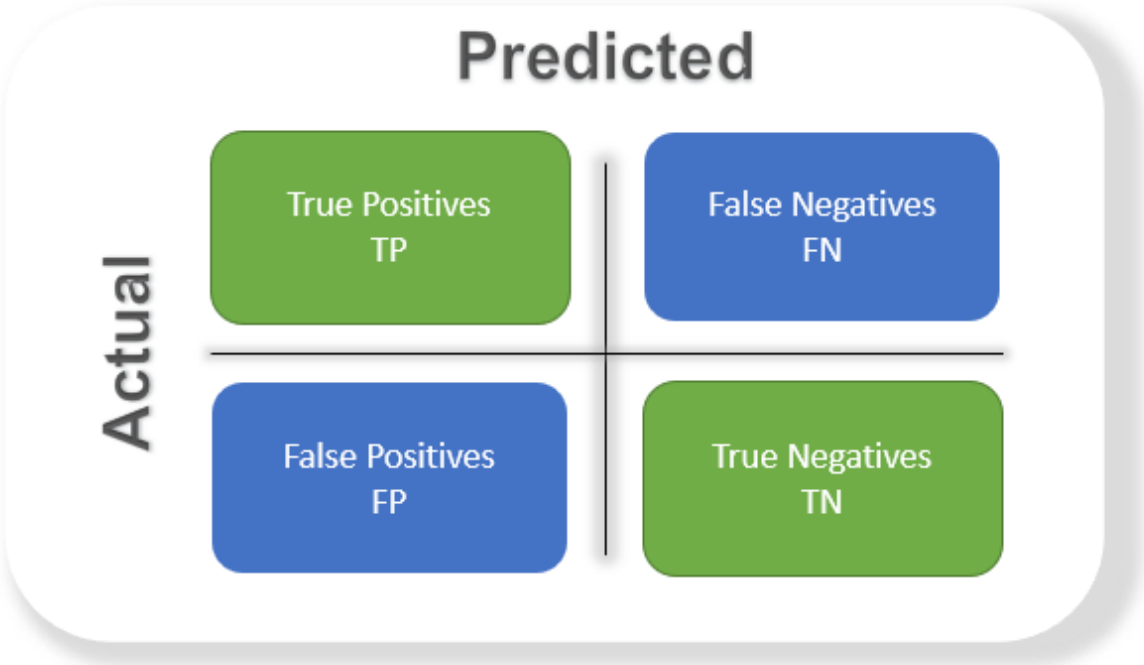
False positives (FP): Predicted positive and are actually negative.

True negatives (TN): Predicted negative and are actually negative.

False negatives (FN): Predicted negative and are actually positive.

Confusion matrix

It’s just a representation of the above parameters in a matrix format. Better visualization is always good :)



Accuracy

The most commonly used metric to judge a model and is actually not a clear indicator of the performance. The worse happens when classes are imbalanced.

$$\frac{TP + TN}{TP + FP + TN + FN}$$

Take for example a cancer detection model. The chances of actually having cancer are very low. Let’s say out of 100, 90 of the patients don’t have cancer and the remaining 10 actually have it.

Precision

Percentage of positive instances out of the ***total predicted positive*** instances. Here denominator is the model prediction done as positive from the whole given dataset. Take it as to find out '*how much the model is right when it says it is right*'.

$$\frac{TP}{TP + FP}$$

Recall/Sensitivity/True Positive Rate

Percentage of positive instances out of the ***total actual positive*** instances. Therefore denominator (*TP + FN)* here is the *actual* number of positive instances present in the dataset. Take it as to find out '*how much extra right ones, the model missed when it showed the right ones*'.

$$\frac{TP}{TP + FN}$$

Specificity

Percentage of negative instances out of the ***total actual negative*** instances. Therefore denominator (*TN + FP)* here is the *actual* number of negative instances present in the dataset. It is similar to recall but the shift is on the negative instances. *Like finding out how many healthy patients were not having cancer and were told they don't have cancer*. Kind of a measure to see how separate the classes are.

$$\frac{TN}{TN + FP}$$

F1 score

It is the harmonic mean of precision and recall. This takes the contribution of both, so higher the F1 score, the better. See that due to the product in the numerator if one goes low, the final F1 score goes down significantly. So a model does well in F1 score if the positive predicted are actually positives (precision) and doesn't miss out on positives and predicts them negative (recall).

$$\frac{2}{\frac{1}{precision} + \frac{1}{recall}} = \frac{2 * precision * recall}{precision + recall}$$

$$True\ Positive\ Rate\ (TPR) = RECALL = \frac{TP}{TP+FN}$$

$$False\ Positive\ Rate\ (FPR) = 1 - Specificity = \frac{FP}{TN+FP}$$