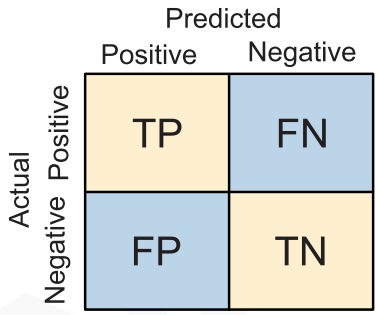
Evaluation Metrics for Classification

We have the following commonly used evaluation metrics that helps us assess the performance of our model.

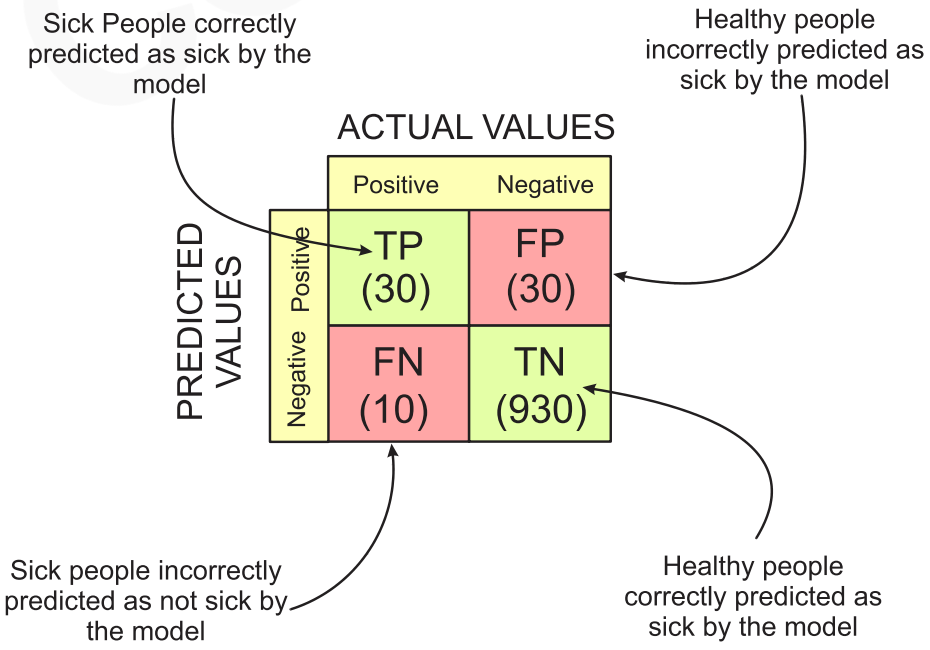
1. **Confusion Matrix**: It's a table used to evaluate the performance of a classification model by comparing actual labels with predicted labels.



In Confusion Matrix (CM):

- **True Positive (TP):** Model correctly predicts the positive class
- **True Negative (TN):** Model correctly predicts the negative class
- **False Positive (FP):** Model predicts positive but actual is negative (Type I error)
- **False Negative (FN):** Model predicts negative but actual is positive (Type II error)

Let's take an **example** of a model predicting if a person is sick or not, the CM looks something like this:



Why does CM matter?

Measuring accuracy alone for a model can be misleading. So, CM shows what types of errors the model is making.

- **Type I Error** Is more important when false alarms are costly or dangerous, so we try to avoid FP.
  - *Examples* - email spam detection, loan approval, judicial system etc.
  - **Precision** controls Type I Errors
- **Type II Error** Is more important when missing a positive case is costly or dangerous, so we try to avoid FN.
  - *Examples* - medical diagnosis, fraud detection, fire alarms etc.
  - **Recall** controls Type II Errors

1. **Accuracy: Accuracy** provides the proportion of correctly classified instances.

$$\text{Accuracy} = \frac{\text{True Positives} + \text{True Negatives}}{\text{Total}}$$

2. **Precision: Precision** focuses on the accuracy of positive predictions.

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$$

3. **Recall (Sensitivity or True Positive Rate): Recall** measures the proportion of correctly predicted positive instances among all actual positive instances.

$$\text{Recall} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$$

4. **F1 Score: F1 score** is the harmonic mean of precision and recall.

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

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

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}$$

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

Keep Learning & Keep Exploring!