

Confusion Matrix

&

Metrics

Predicted

Confusion Matrix

		Actual	
		1	0
1	1	TP	FP
	0	FN	TN

Type 1 Error

Type 2 Error



WHAT IS A CONFUSION MATRIX?

- Confusion matrix is a tool in machine learning to evaluate the performance of classification model
- Table that describes performance of a classification model by comparing the actual labels with the predicted labels

		Actual	
		1	0
1	1	TP	FP
	0	FN	TN

Type 1 Error →

Type 2 Error ←

HI!

Confusion Matrix

		Actual	
		1	0
Predicted	1	TP	FP
	0	FN	TN

Type 1 Error →

← Type 2 Error

Confusion Matrix

		Actual	
		1	0
Predicted	1	TP	FP
	0	FN	TN

True Positive

Type 2 Error

Type 1 Error

Confusion Matrix

		Actual	
		1	0
Predicted	1	TP	FP
	0	FN	TN

Type 1 Error →

← Type 2 Error

True Negative

False Positive

Confusion Matrix

		Actual	
		1	0
Predicted	1	TP	FP
	0	FN	TN

Type 2 Error

False Negative

True Positive

THE NUMBER OF INSTANCES CORRECTLY PREDICTED AS POSITIVE.

False Positive

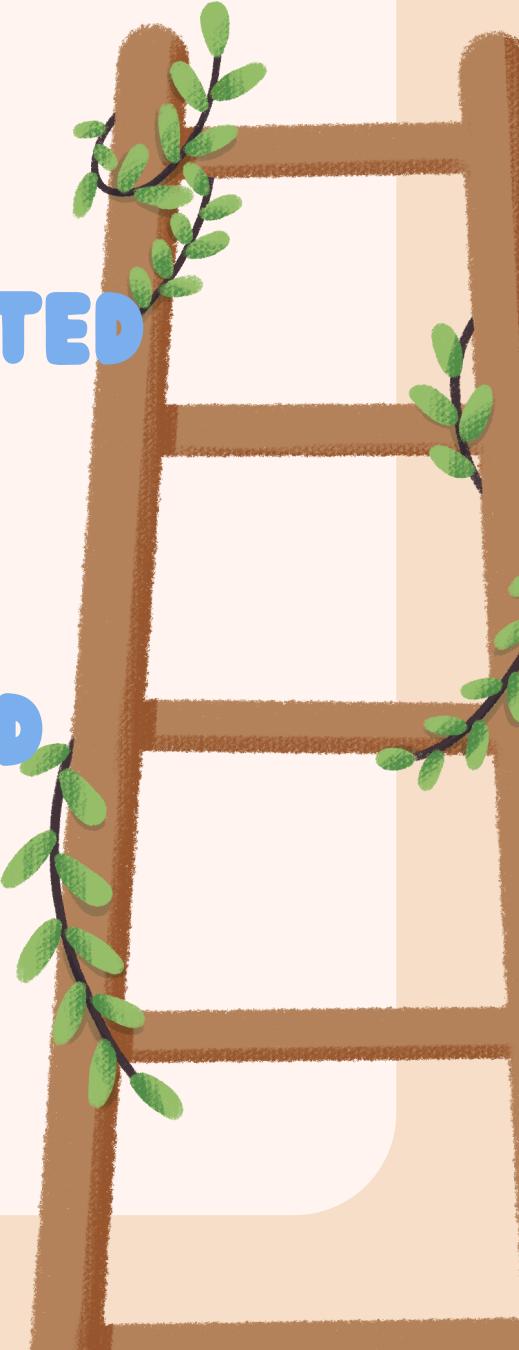
THE NUMBER OF INSTANCES INCORRECTLY PREDICTED AS POSITIVE (TYPE I ERROR)

False Negative

THE NUMBER OF INSTANCES INCORRECTLY PREDICTED AS NEGATIVE (TYPE II ERROR).

True Negative

THE NUMBER OF INSTANCES CORRECTLY PREDICTED AS NEGATIVE.



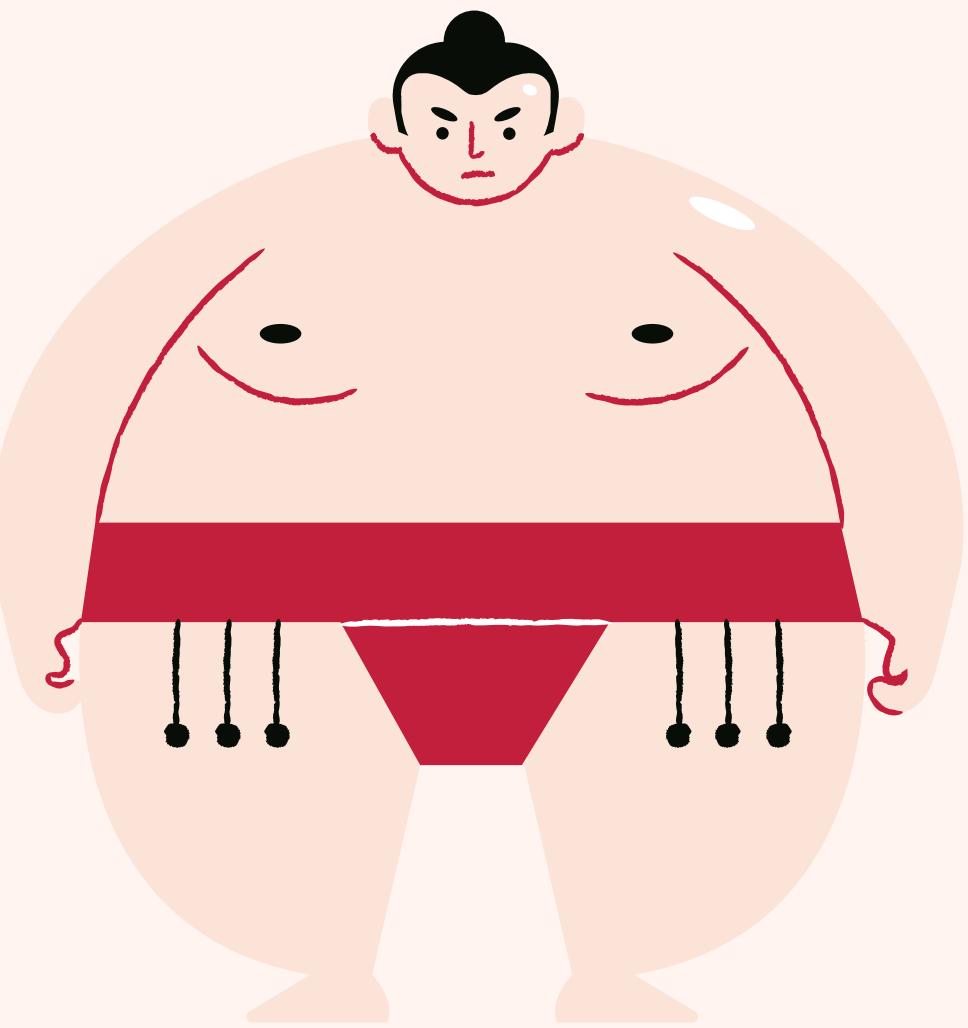
True Positive

YOU ARE
PREGNANT



False Positive

YOU ARE
PREGNANT



False Negative

YOU ARE
NOT
PREGNANT



True Negative

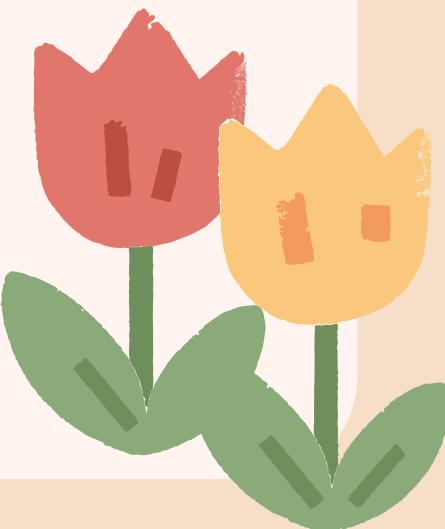
YOU ARE
NOT
PREGNANT



Accuracy

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

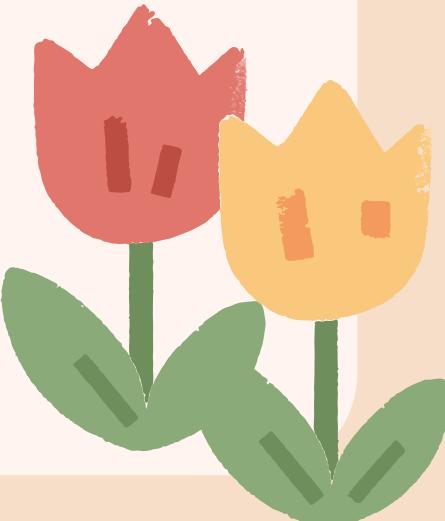
- **Use Case:** Suitable when the classes are balanced means balanced datasets
- Can be **inadequate** in cases of **imbalanced classes** or when the **cost of errors** varies. Metrics like **precision**, **recall**, and **F1 score** provide more nuanced insights



Precision

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

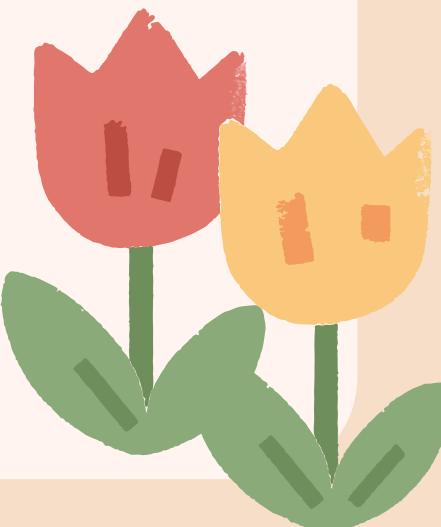
- **Use Case:** Important when the **cost of false positives** is high (e.g., spam detection).
- In Medical diagnosis where immuno-suppressive drugs or other drug are prescribed
- here cost of false positive is very high



Recall

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

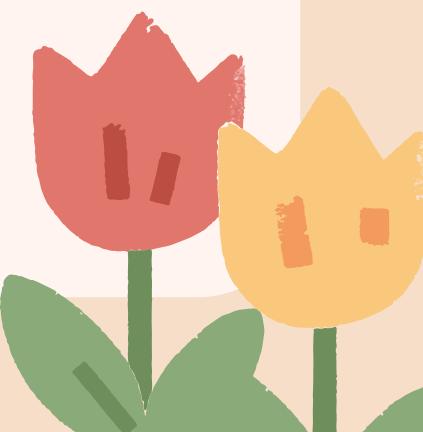
- **Use Case:** Crucial when the cost of false negatives is high (e.g., cancer screening).
- Detecting as many survivors as possible.
- Missing a survivor (**false negative**) could be catastrophic,
- so the operation will aims for high recall,
- even if it means more false alarms (**false positives**).



F1-Score

$$\frac{2 * \text{PRECISION} * \text{RECALL}}{\text{PRECISION} + \text{RECALL}}$$

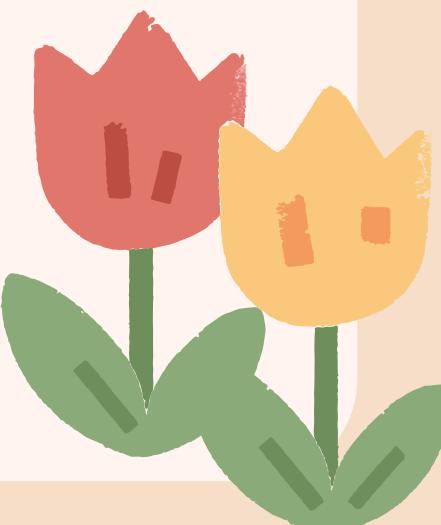
- Use Case: F1-score provides a **harmonic mean** of **precision** and **recall**,
- offers a single metric that **balances** the two.
- This is useful when **both false positives and false negatives carry significant consequences** and you need a balance between the two



specificity

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

- **Use Case:** Important in medical diagnostics where identifying **true negatives** is crucial.
- Variant of recall for undesired label or prediction

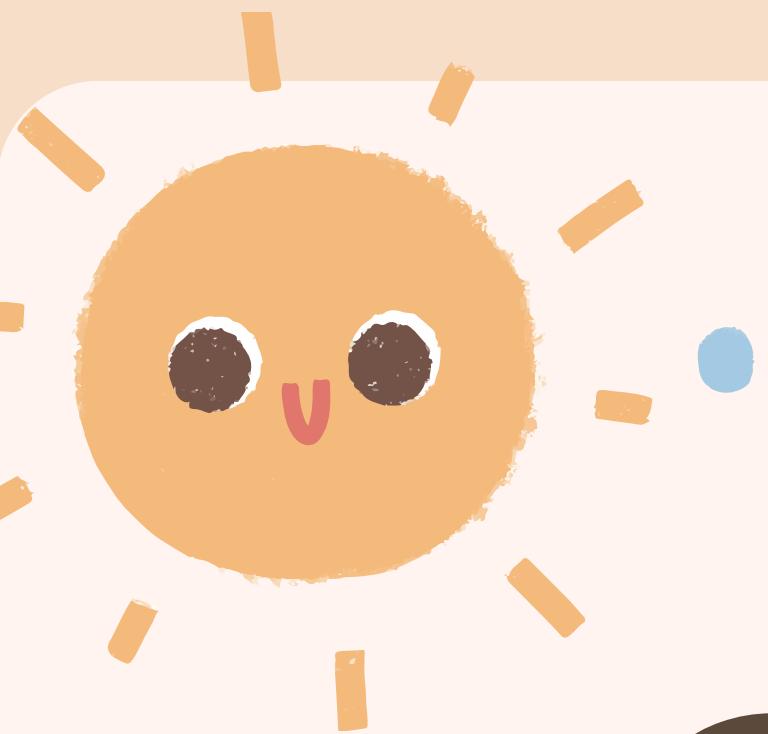


TYPE 1 ERROR

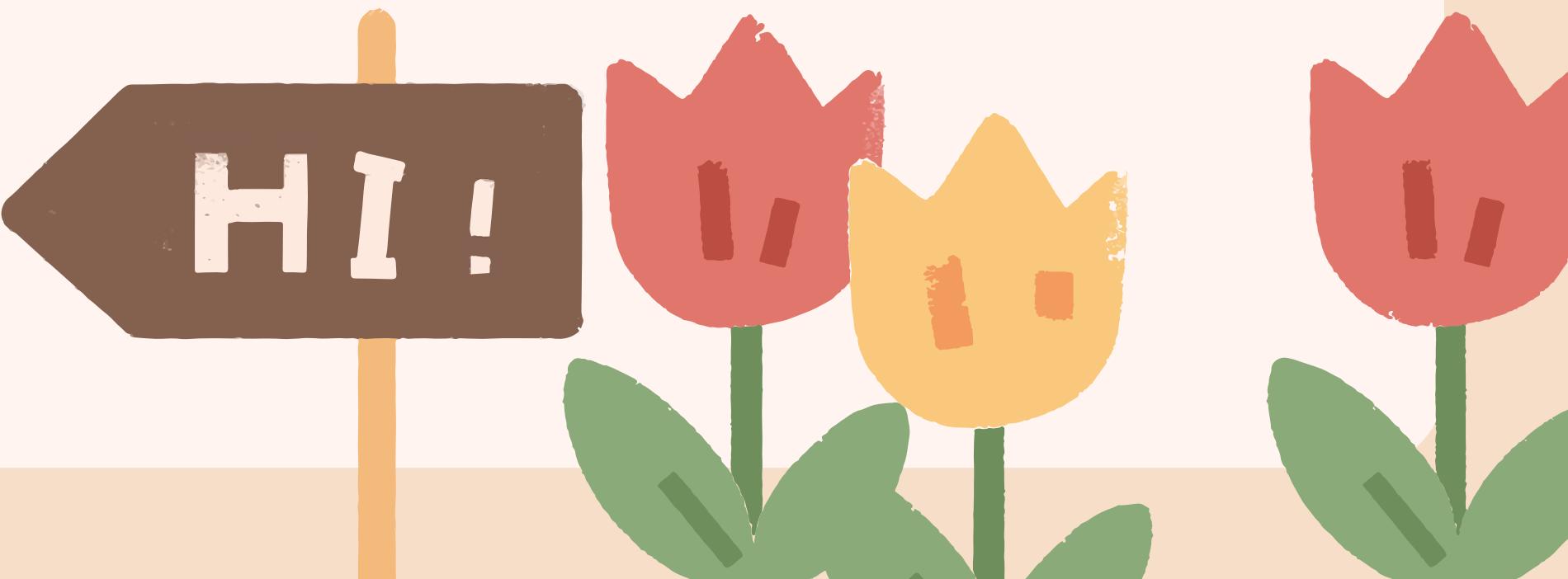
$$\frac{FP}{TP+FP}$$

TYPE 2 ERROR

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



Thank you!



HI!