✳ calculate classification evaluation metrics :-

- ## confusion matrix :-

$$\text{predicted}\begin{cases}\end{cases}\quad\begin{array}{cc}\overbrace{\text{Actual}}\\ TP & FN \\ FP & TN\end{array}$$

- ## precision :-

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

e.g ① A model predicts predictious and predicts 120 examples as belong to minority class, 90 of which are correct and 30 of which are incorrect. calcwatel the precision for above.

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

$$= \frac{90}{(90+30)} = \frac{90}{120} = 0.75$$

② consider the same dataset, where model predicts 50 examples belonging to minority classes, 45 owd of which are True positive and five owd of which are false positive. calcwate the precision for above model.

$$\text{precision} = \frac{TP}{TP+FP} = \frac{45}{45+5} = \frac{45}{50} = \frac{9}{10} = 0.90$$

- ## Recall :-

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

e.g. A model makes predichous 90 of the positive class predichous correctly and 10 incorrectly. calcwated the Recall for above :

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{90}{(90+10)} = \frac{90}{100} = 0.9 = \boxed{90\%}$$

- ## F1 measure :-

$$F_1 = \frac{2 \times \text{precision} \times \text{Recall}}{(\text{precision} + \text{Recall})}$$

Example: Consider a model that predicts 150 Examples for the positive class, 95 are correct (TP) meaning five (FN) were missing and 55 are incorrect. (FP)

Solution: To calculate f_1 measure we need to calculated precision and Recall.

$$\text{precision} = \frac{TP}{TP+FP} = \frac{95}{(95+55)} = 0.633 = 63\%$$

$$\text{Recall} = \frac{TP}{TP+FN} = \frac{95}{(95+5)} = \frac{95}{100} = 95\%$$

$$f_1 \text{ measure} = \frac{(2 * \text{precision} * \text{Recall})}{(\text{precision} + \text{Recall})}$$

$$= \frac{(2 * 0.63 * 0.95)}{(0.63 + 0.95)} = \frac{1.202}{1.583}$$

$$\boxed{F_1 = 0.759}$$

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

✳ * calculate acuuracy for following confusion matrix values.

Actual

predicted		cancer	No-cancer
	Cancer	45	18
	No-cancer	12	25

$TP = 45$, $TN = 25$, $FP = 18$, $FN = 12$

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

$$= \frac{45+25}{45+25+18+12} = 0.7 = 70\%$$

$$\boxed{\text{Accuracy} = 70\%}$$

* Practice problems *

① consider a model predicts 200 Examples for positive class. 100 out of which are correct (TP), 25 are incorrect (FP) meaning 75 (FN) were missing. calculated f1 score for above model.

② calculated Accuracy and f1 score for below confusion matrix.

Total 165 Records	Actual positive	Actual Negative	f1 = 0.87
predicted positive	50	10	Accuracy = 0.9090 **90%**
predicted Negative	5	100	

③ consider the confusion matrix given below for binary classifier predicting the presence of a disease. calculate precision, Recall, f1 score and Accuracy

total ~~record~~ 150 Records	Actual ~~predicted~~ yes	Actual ~~predicted~~ No
predicted yes	TP = 95	FN = 5
predicted No	FP = 5	TN = 45

Accuracy = 93% = ?

~~precision = 0.95%~~   f1 = ?

~~Recall = 95%~~