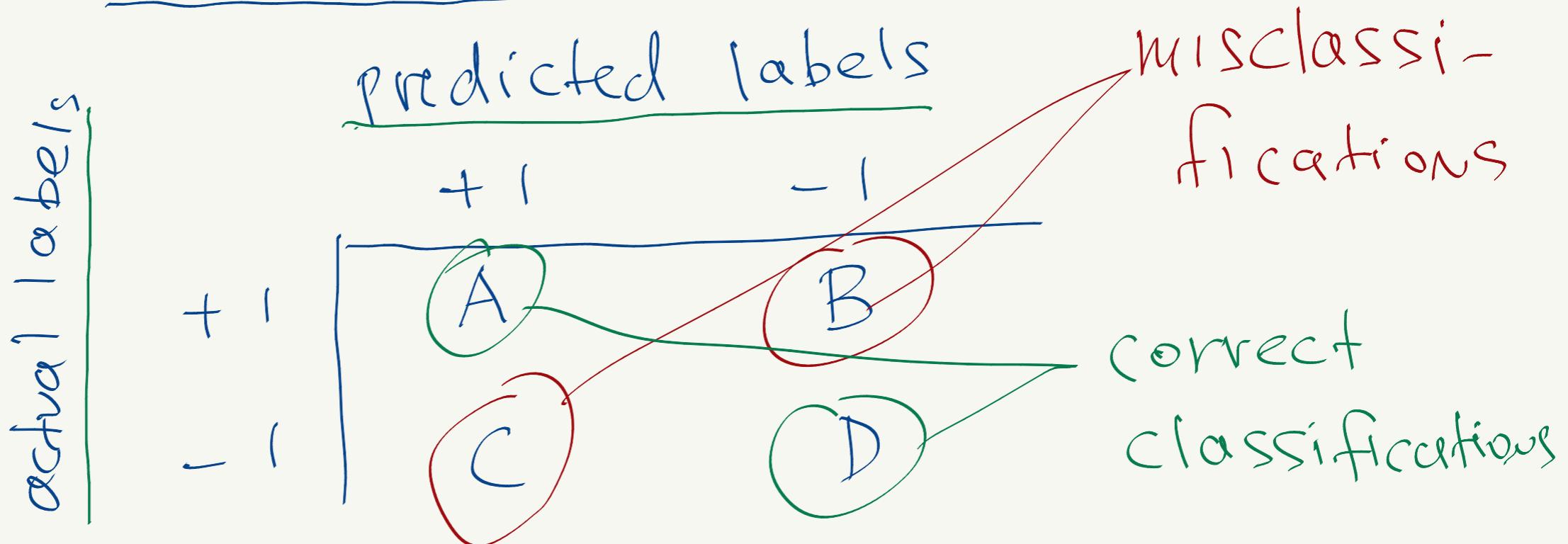


5/1/20

Confusion Matrix



$$A = 1 - \frac{B+C}{A+B+C+D} = \frac{A+D}{A+B+C+D}$$

per class accuracy

$$A_{+1} = 1 - \frac{B}{A+B} = \frac{A}{A+B}$$

$$A_{-1} = 1 - \frac{C}{C+D} = \frac{D}{C+D}$$

Retrieval Problem

precision : relevant instances
among the retrieved ones
[0, 1]

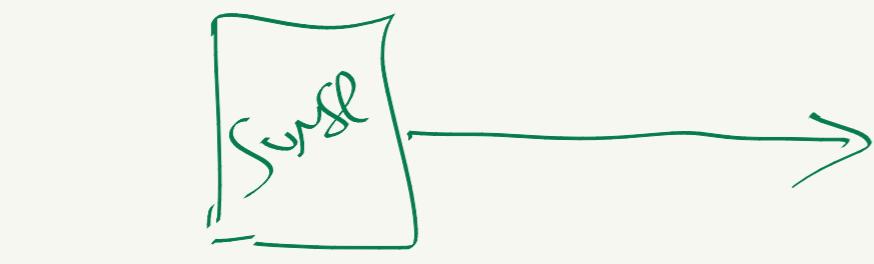
$$= \frac{|\{\text{relevant}\} \cap \{\text{retrieved}\}|}{|\{\text{retrieved}\}|}$$

recall : fraction of the total
(sensitivity) amount of relevant
instances retrieved

$$= \frac{|\{\text{relevant}\} \cap \{\text{retrieved}\}|}{|\{\text{relevant}\}|}$$

$$\text{precision} = \frac{92}{100} = 92\%$$

$$\text{recall} = \frac{92}{150} = \checkmark$$

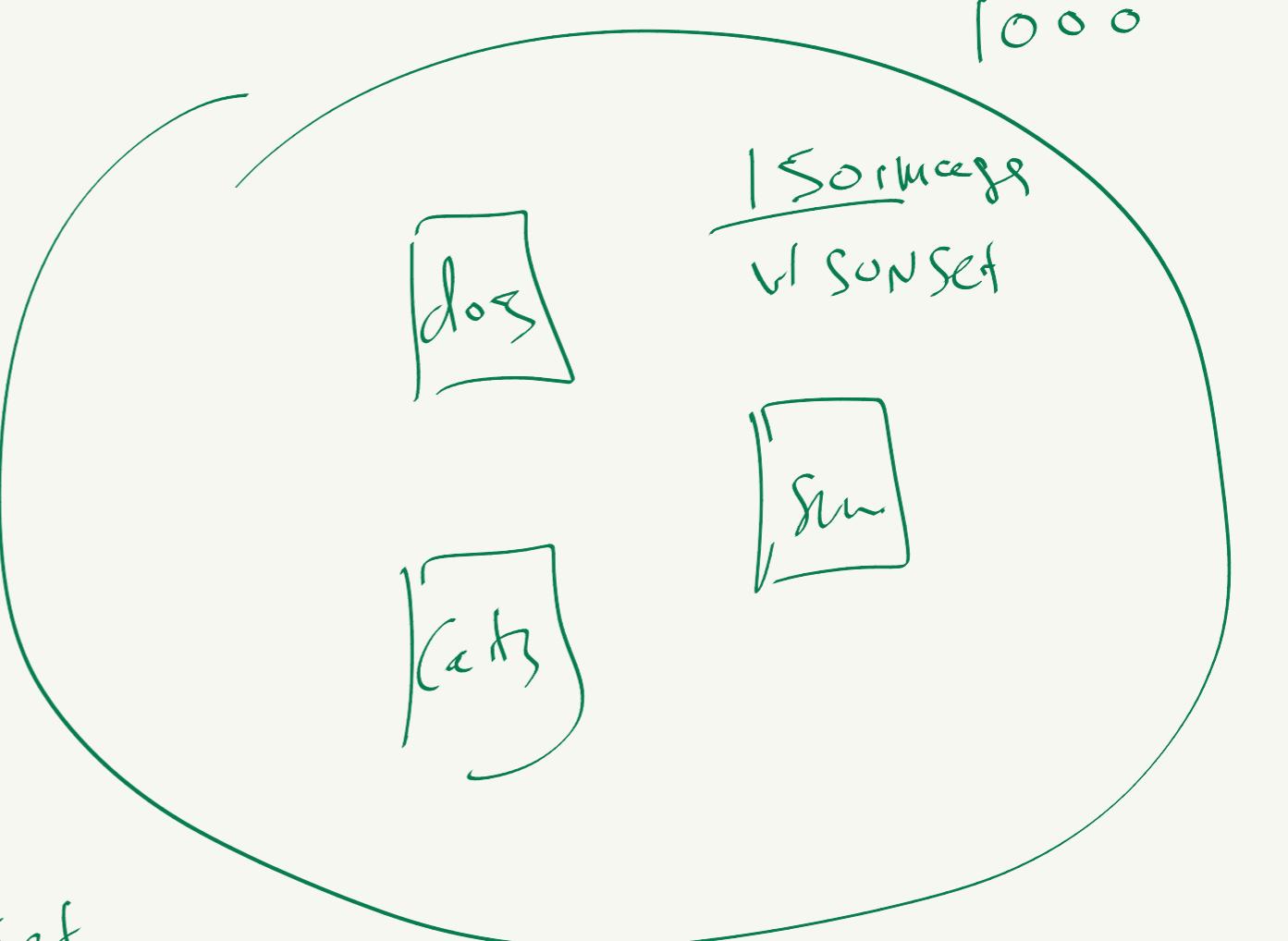


100 images

↓

92 sunset

8 non-sunset



Return to Confusion matrix

		Predicted labels	
		+	-
Actual labels	+	TP	FN
	-	FP	TN

↓ Precision

$$\text{Precision} = \frac{\text{TP}}{\text{predicted positive conditions}} = \frac{\text{TP}}{\text{TP+FP}} .$$

recall / sensitivity / true positive rate (TPR)

$$= \frac{\text{TP}}{\text{Condition positive}} = \frac{\text{TP}}{\text{TP+FN}} .$$

Specificity / true negative rate (TNR)

$$= \frac{\text{TN}}{\text{Condition negative}} = \frac{\text{TN}}{\text{TN+FP}}$$

$$\text{F}_1 \text{ score} = \frac{2}{\text{Precision} + \text{recall}} = 2 \frac{\text{Precision} \cdot \text{recall}}{\text{Precision} + \text{recall}}$$

harmonic mean

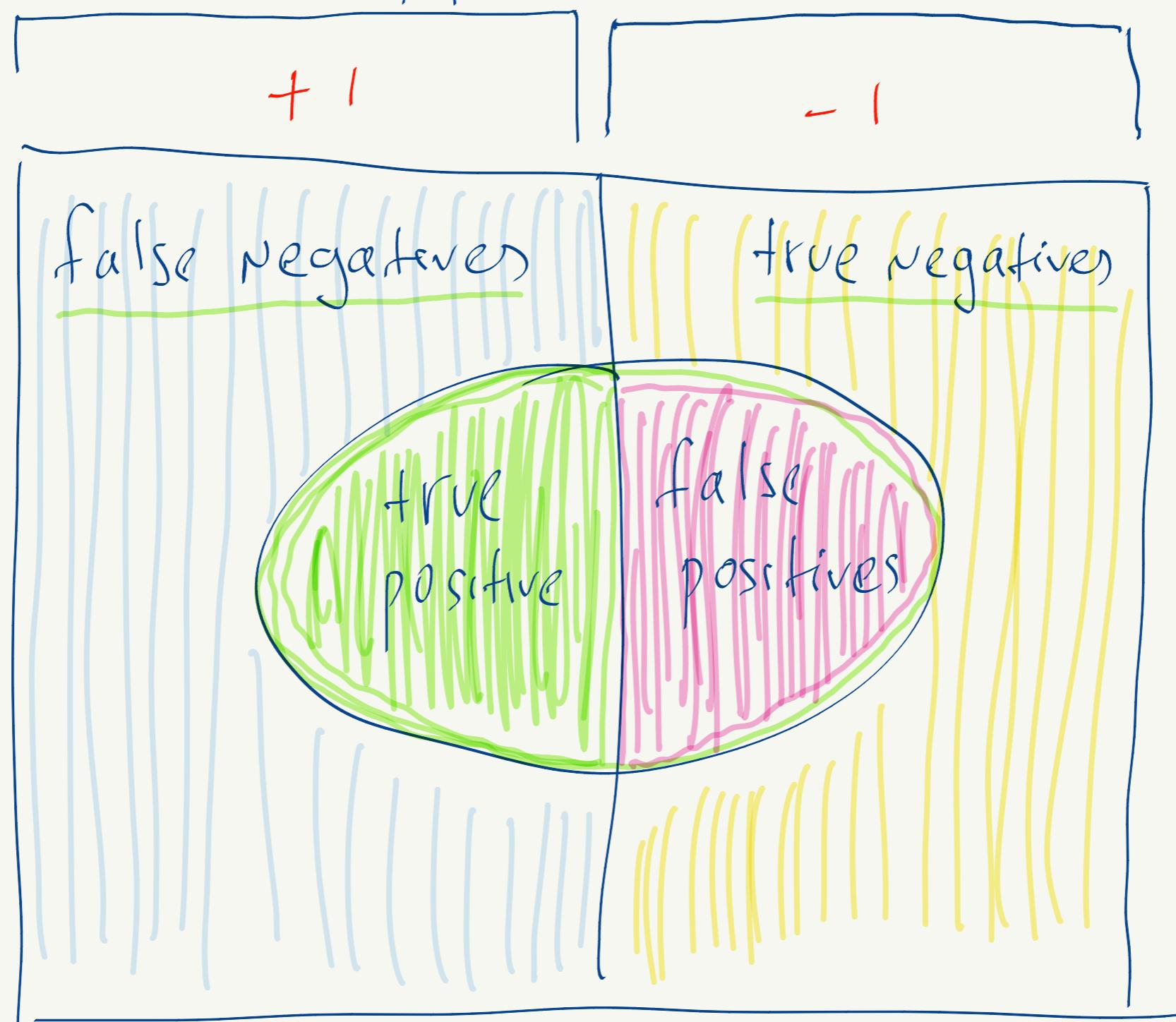
Dice similarity coefficient

$A_{+1} \rightarrow \text{recall} / \text{TPR}$

$A_{-1} \rightarrow \text{specificity} / \text{TNR}$

$$A_{\text{balanced}} = \frac{\text{recall} + \text{specificity}}{2}$$
$$= \frac{\text{TPR} + \text{TNR}}{2}$$

relevant elements



Precision = $\left(= \frac{TP}{TP+FP} \right)$

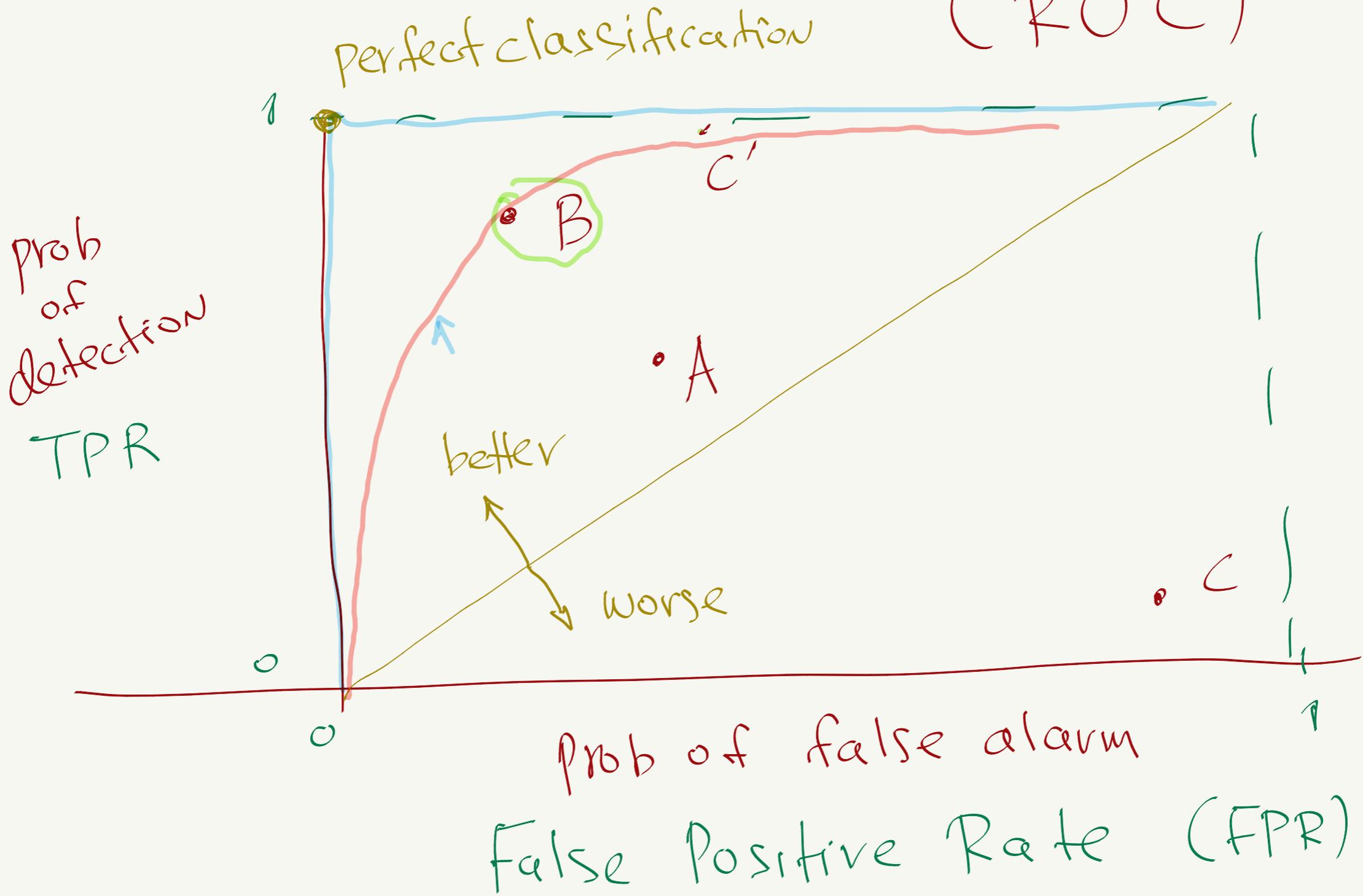
Recall = $= \text{sensitivity} \left(= \frac{TP}{TP+FN} \right)$

specificity = $\left(= \frac{TN}{TN+FP} \right)$

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Receiver Operating Characteristics (ROC)

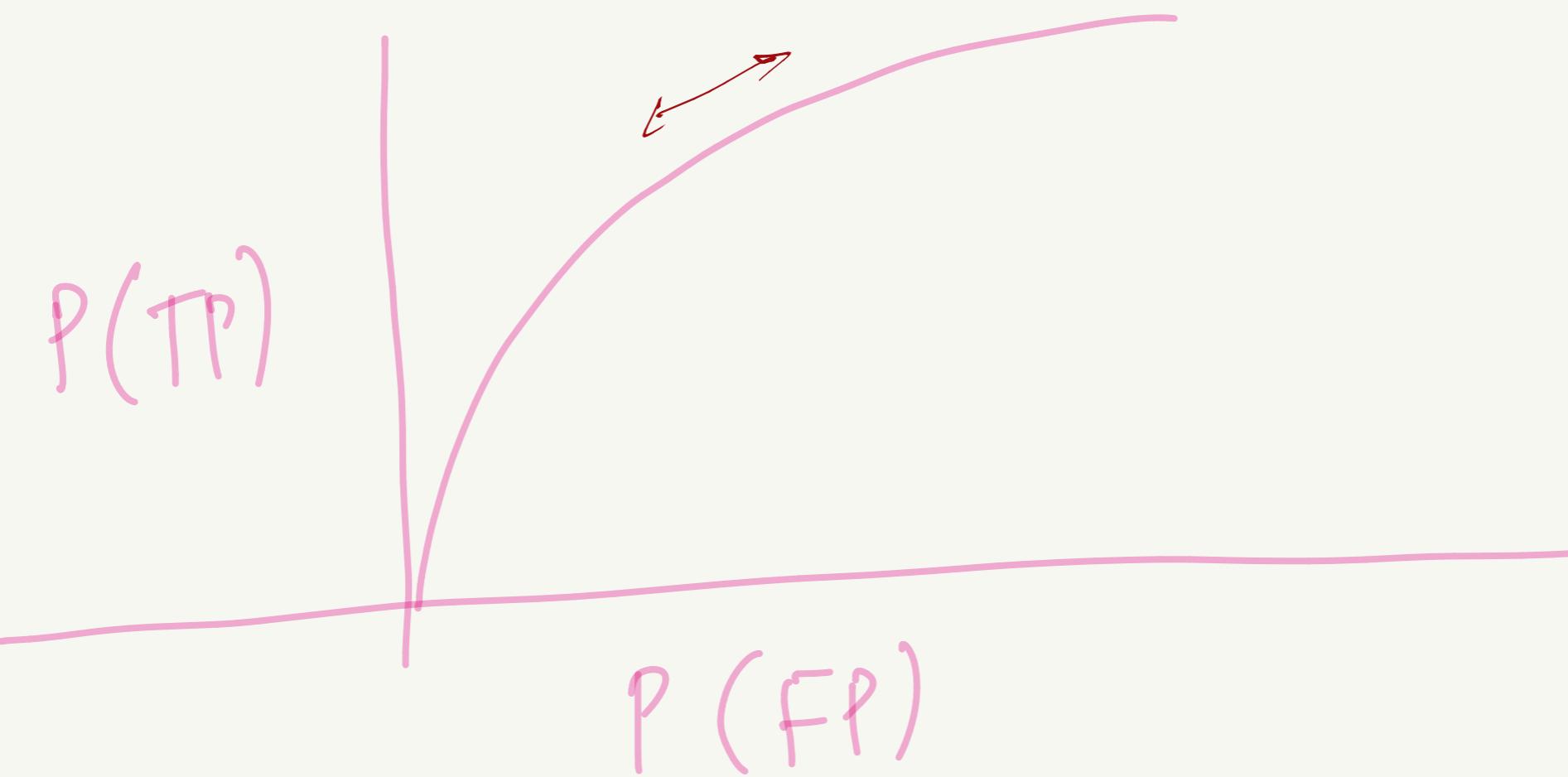
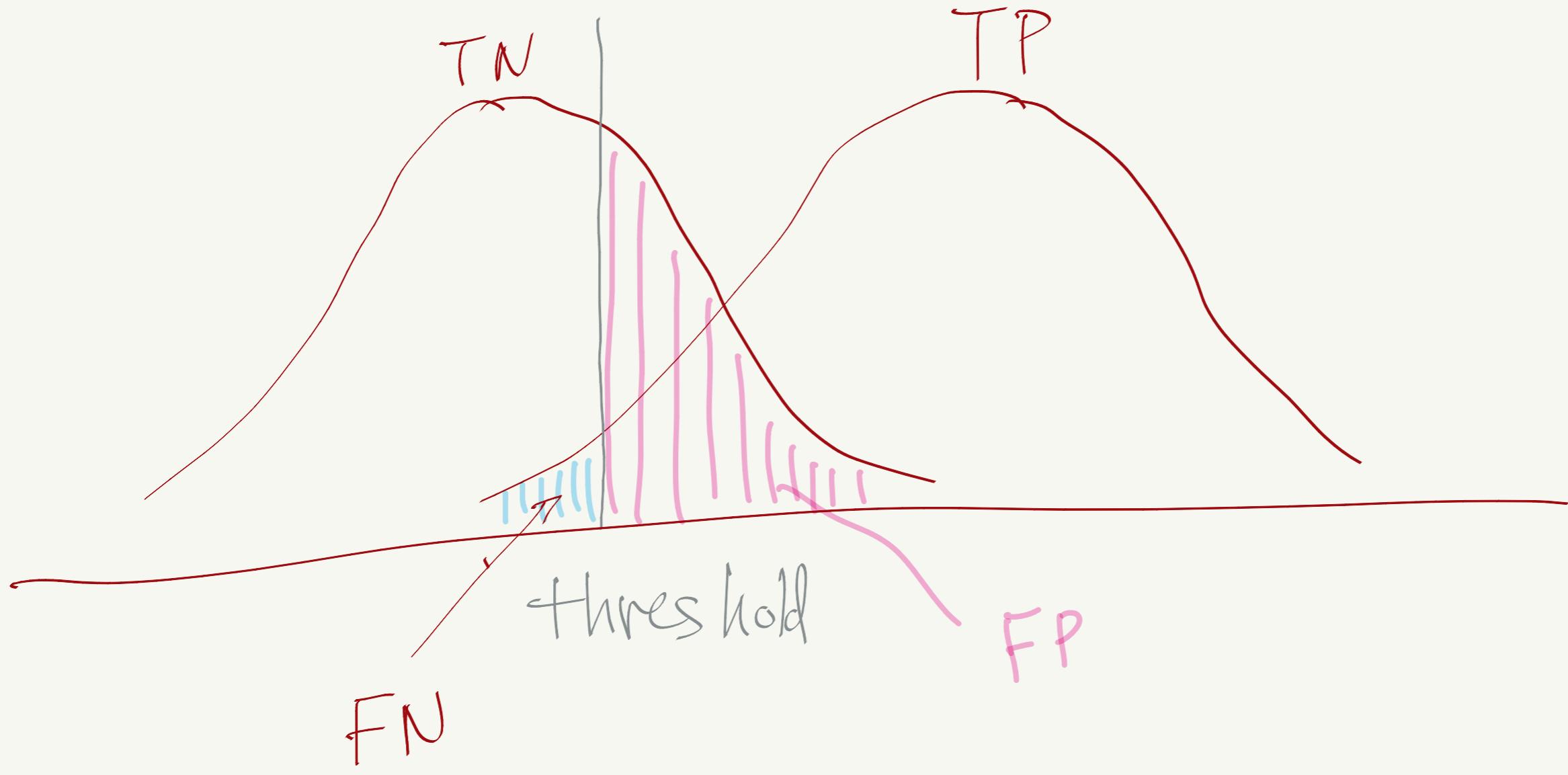


$$TPR = \frac{TP}{TP+FN}$$

$$FPR = 1 - \text{Specificity} = 1 - \frac{TN}{TN+FP} = \frac{FP}{TN+FP}$$

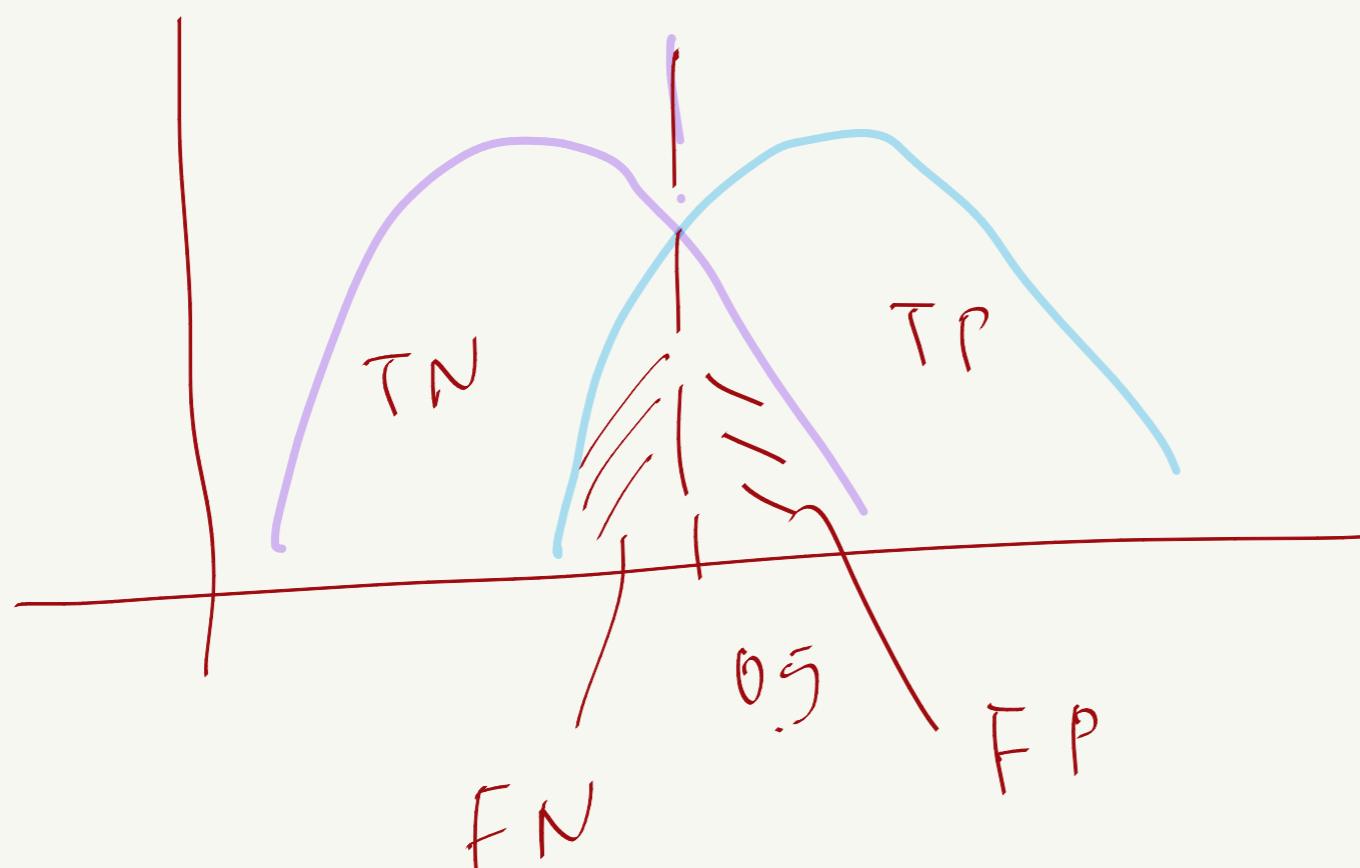
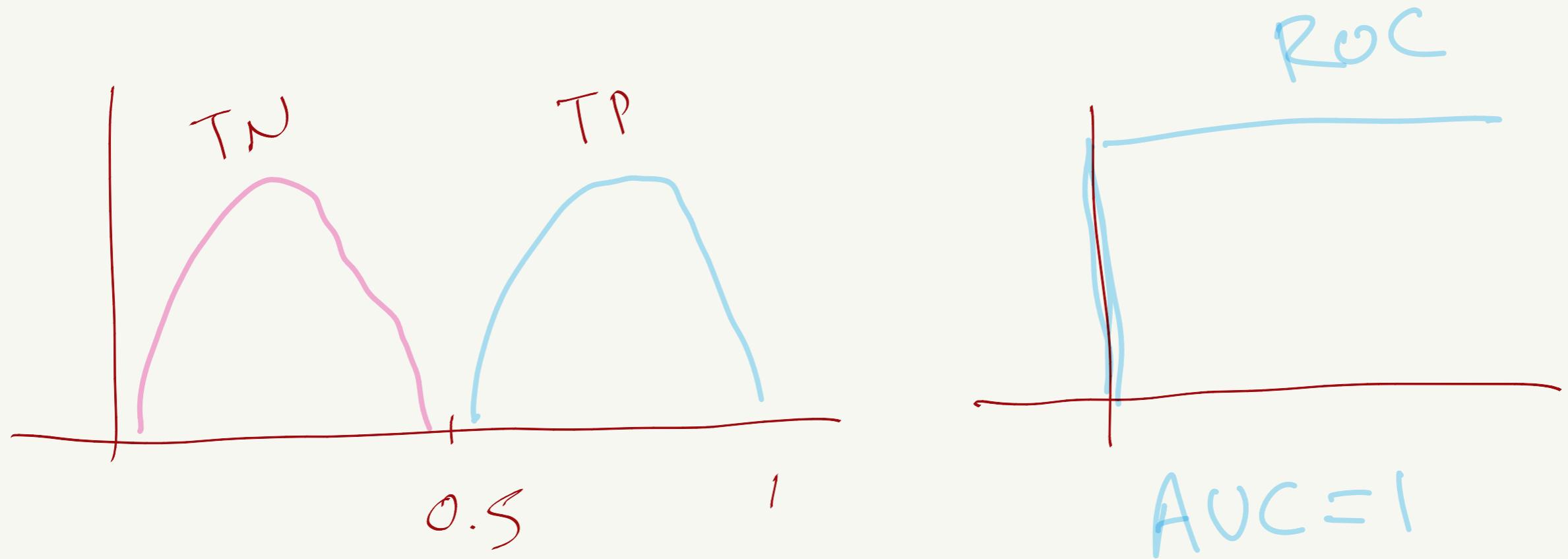
- points on diagonal represent random chance
- each prediction result or instance of a confusion matrix represents a point in the ROC space

Example



AUC

area under curve



$AUC = 0.8$
 \Rightarrow there is 80%
chance the model
will be able to
distinguish
between ± 1

Weighted 2-class classification

$$g(\tilde{w}) = \frac{1}{P} \sum_{p=1}^P b_p \log \left(1 + e^{-y_p \text{model}(\tilde{x}_p, \tilde{w})} \right)$$

$\left\{ \begin{array}{l} \# \text{ of times} \\ (\tilde{x}_p, y_p) \text{ appears} \end{array} \right. \quad \left. \begin{array}{l} \text{"confidence" per} \\ \text{point} \\ (0 \leq b_p \leq 1) \end{array} \right\}$

class imbalance

$$b_{+1} \propto \frac{1}{|\mathcal{S}_+|}$$

$$b_{-1} \propto \frac{1}{|\mathcal{S}_-|}$$

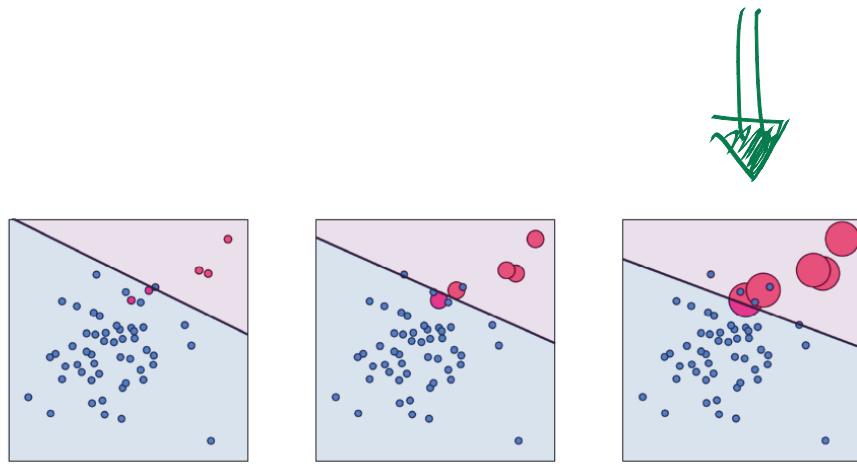


Figure 6.25 Figure associated with Example 6.12. See text for details.

\uparrow
 3 mis
 unbalanced $A = 95\%$
 balanced $A = 79\%$

\uparrow
 4 mis
 unbalanced $A = 93\%$
 balanced $A = 96\%$

\uparrow
 $A_{red} = 1$
 $A_{blue} < 1$

red + $\rightarrow FN = 0$

blue - $\rightarrow \underline{FP} \neq 0$