

Supervised Learning Framework:

Unknown Target
function $f: X \rightarrow Y$

$(x_1, y_1), \dots, (x_n, y_n)$
Training Ex.

Classifier

Learning Algo.

ID3
PLA
BPA
SVM

Hypothesis Set, \mathcal{H}

DT

NN

Hyper plane

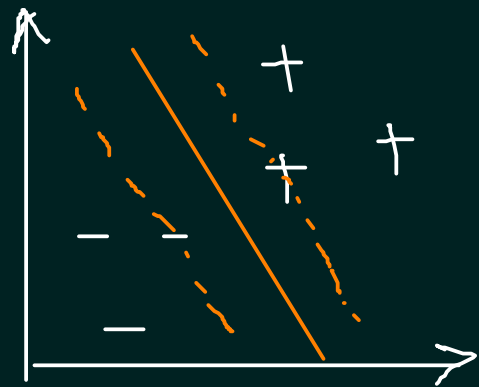
Evaluate

KNN

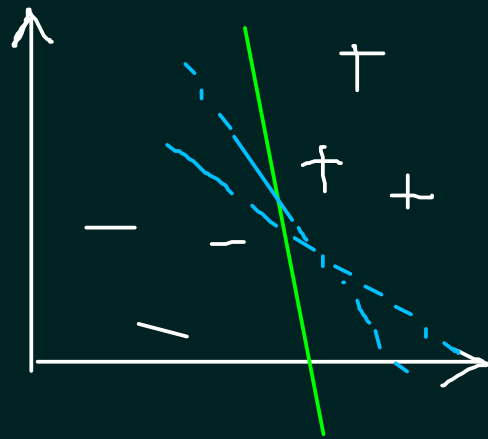
NN

(Linear)
PLA

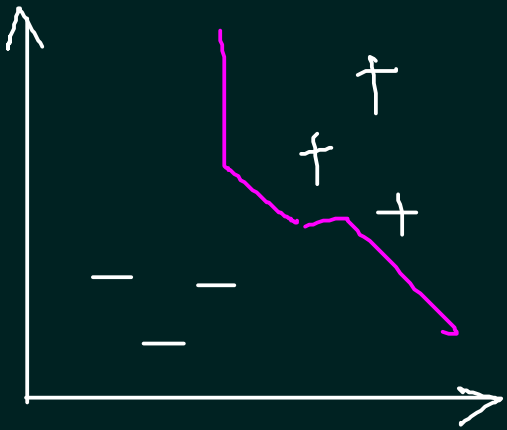
DT



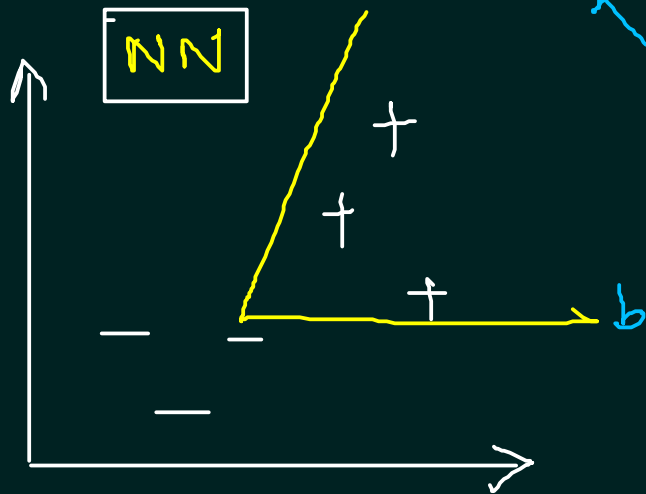
SVM



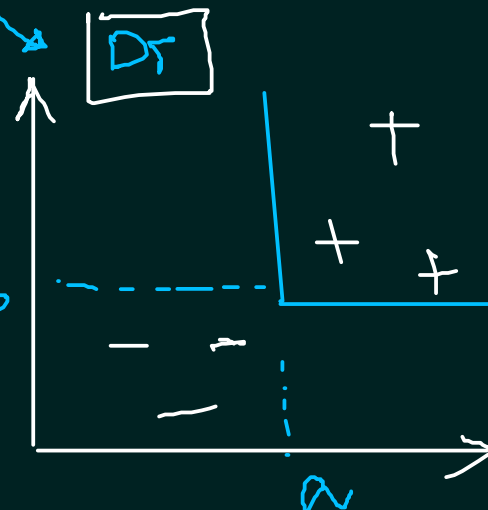
(Linear)
PLA



KNN



NN



DT

Measures of Evaluating

- Performance Metrics
- Estimate (Metric)/Methods
- Compare Model



▷ Accuracy: $\frac{\sum \text{diag}}{M} = \frac{|TP| + |TN|}{M}$

Ex: $\begin{cases} 9990 \rightarrow +ve \\ 10 \rightarrow -ve \end{cases}$ Your Classifier \Rightarrow +ve all

∴ Accuracy \rightarrow 99.9% (Fallacy!)

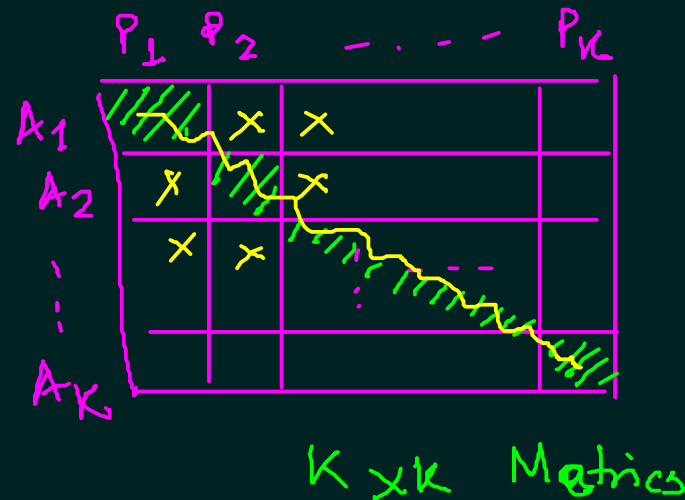
soln. \Rightarrow Distributions (+ve, -ve) matter!

▷ Precision: $\frac{|TP|}{|TP| + |FP|} = p \iff$ recall, $r = \frac{|TP|}{|TP| + |FN|}$

Confusion Metric

Actual class	Yes	→	$\begin{matrix} \text{Yes} \\ \text{No} \end{matrix}$	$\begin{matrix} \boxed{TP} \text{ } a \\ \boxed{FN} \text{ } b \end{matrix}$
	NO	→	$\begin{matrix} \text{Yes} \\ \text{No} \end{matrix}$	$\begin{matrix} \boxed{FP} \text{ } c \\ \boxed{TN} \text{ } d \end{matrix}$

$|TP| + |FN| + |FP| + |TN| = M$



F-score: $\frac{1}{F} = \frac{1}{2} \left(\frac{1}{P} + \frac{1}{R} \right) \Rightarrow F = \frac{2PR}{P+R}$

▷ Biased:

$\Rightarrow F = \frac{2 |TP|}{|TP| + |FN| + |FP|}$

↳ Precision is biased TP, FP

↳ Recall is biased TP, FN

↳ F-score ----- TP, FN, FP

TN totally ignored

▷ Solution: Weighted Accuracy

$WA = \frac{w_1 |TP| + w_2 |TN|}{w_1 |TP| + w_2 |FN| + w_3 |FP| + w_4 |TN|}$

Precision: $w_1 = w_3 = 1$
 $w_2 = w_4 = 0$

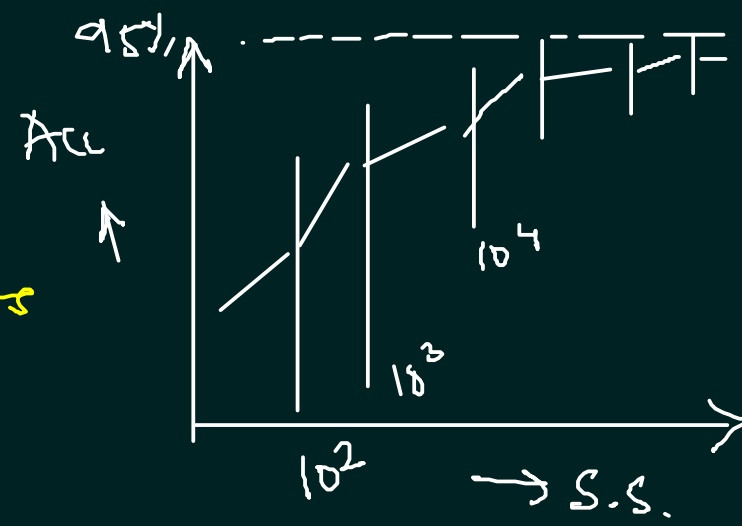
Recall: $w_1 = w_2 = 1$
 $w_3 = w_4 = 0$ | $F = ?$

② Associate Cost with CM.

Cost (Y|Y) → TP
 Cost (Y|N) ← FP

Cost (N|Y) → FN
 Cost (N|N) → TN

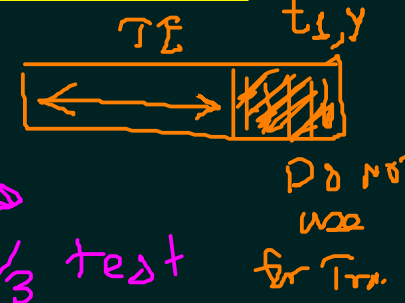
Methods of Estimation:



- Class distribution
- Size of training and test sets
 - Bias estimate
 - Variance estimate
- Cost of misclassification

VS

Learning Curve



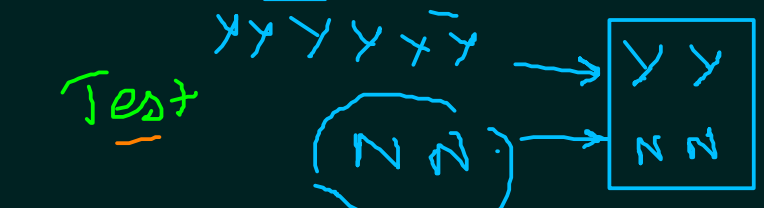
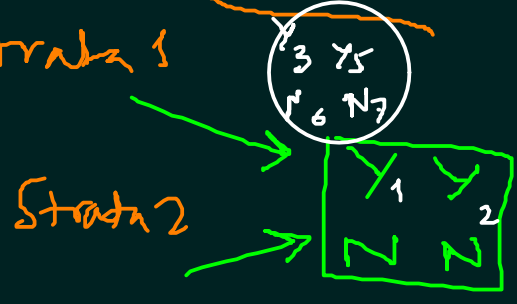
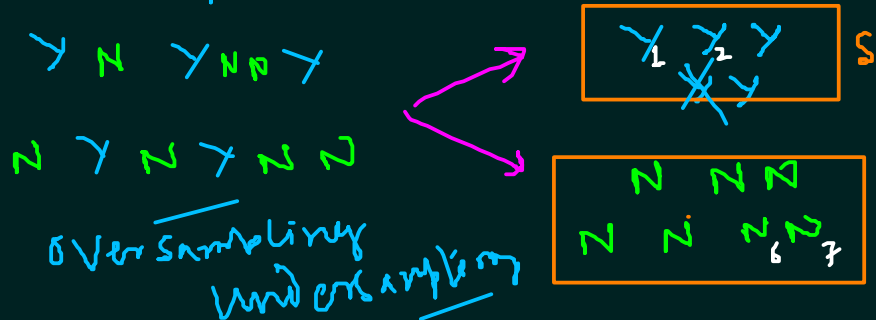
W, X, Y, Z



Methods:

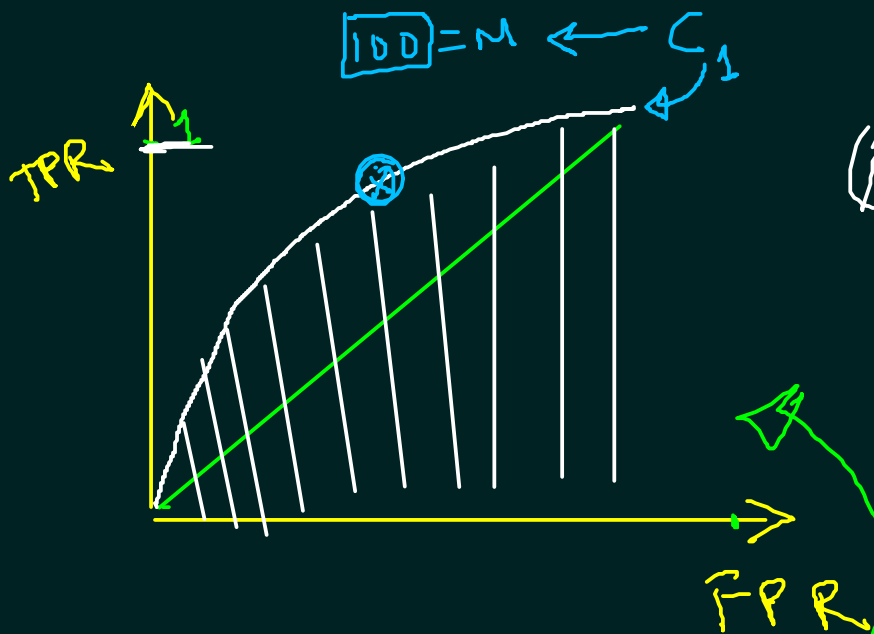
- 2/3 train, 1/3 test (HOLD OUT)
- k partition → (k-1) train, k test (CROSS VALIDATION)
- RANDOM SUBSAMPLING
- BOOTSTRAPING

STRATIFIED SAMPLE



Model Comparison :

ROC (Receiver Operation Characteristics)



$$TPR = \frac{|TP|}{|TP| + |FN|} \quad (\gamma)$$

← +ve TD

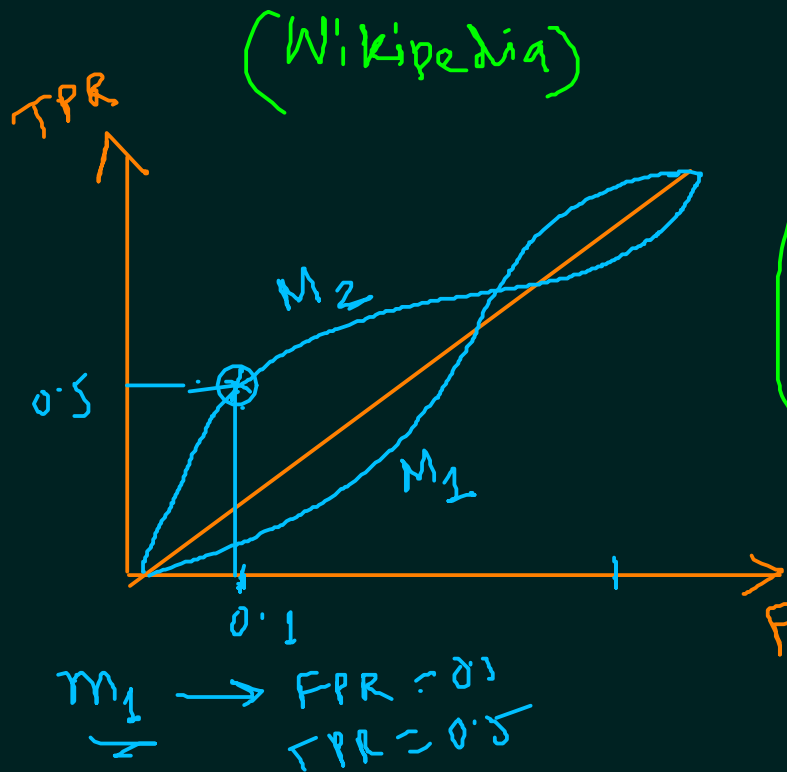
$$FPR = \frac{|FP|}{|FP| + |TN|}$$

(AUC)

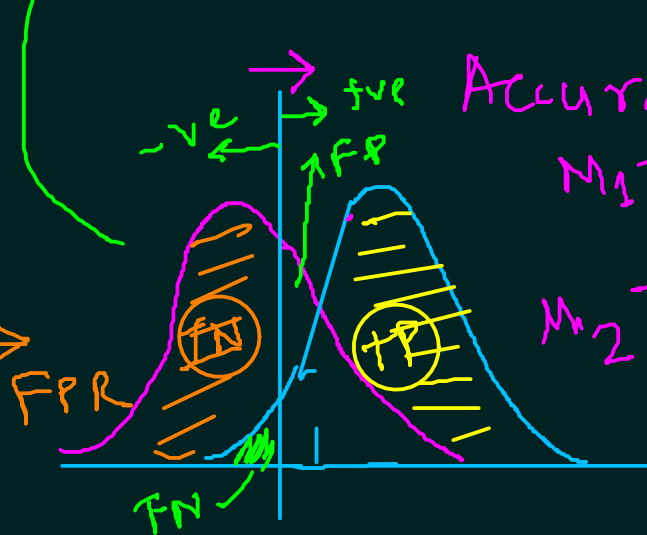
Area under curve

1 = ideal

0.5 = Random/Coin-flip



→ FPR vs TPR (M₁ vs M₂)



Accuracy

85% → 30 TD

75% → 1000 TD

M₁ ? M₂