CSE 445/L-08/23.06.2025/

✱

Prediction
- Correct ⇒ True
- Incorrect ⇒ False

Classifying data label
- Positive Class
- Negative Class

For binary classification.

✱

If accuracy = 100%.

Then,

accuracy = precision = recall = F1 score = 1

✱ Confusion Matrix:

Predicted / Actual	Negative	Positive
Negative	TN	FP
Positive	FN	TP

Precision

Recall

✱ For spam detection

Predicted / Actual	Normal/ Not Spam	Spam
Normal Email	Not spam	Normal Email detected as spam
Spam Email	Spam not detected	Spam

Precision	Recall	F1
65%	65%	65%
85%	65%	73.67%
65%	85%	73.67%
95%	45%	61.07%

Difference Matter

⊛ **Precision:** How many of them are actually positive class.

Recall: How accurately it can detect the positive class.

⊛
$$FPR = \frac{FP}{FP + TN}$$

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

⊛ Precision : ↑, ~~do~~ will not lose normal email.

Recall : ↑, some spam may come to inbox.

L-09/25.06.2025

⊛ FPR ⇒ Fall Out ⇒ $\frac{FP}{FP+TN}$

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

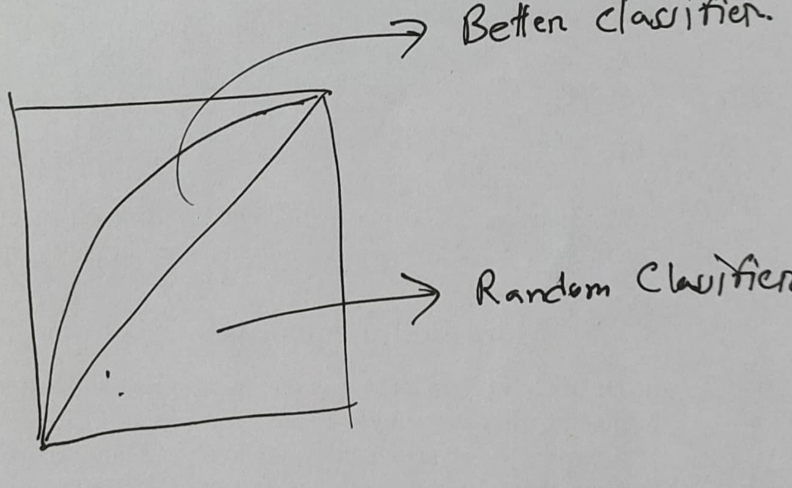
$$TPR \Rightarrow Recall \Rightarrow \frac{TP}{TP + FN}$$

⊛ Receiver Operating Characteristic (ROC) Curve

$\Rightarrow$ TPR vs FPR

Predicted / Actual	Spam	Normal
Spam	TN	FP
Normal	FN	TP

Recall $\Rightarrow$ Passing spam as normal email.



⊛ F1 score is average of mean, harmonic mean.

$$\Rightarrow \frac{1}{m_1} + \frac{1}{m_2} = \frac{m_1 + m_2}{2m_1 m_2}$$

$$\text{inverse} = \frac{2m_1 m_2}{m_1 + m_2}$$

⊛ Parametric knowledge

⊛ knowledge distillation.

L-10/30.06.2025/

$Y = mx + c$

$Y = WX + \epsilon$ → error term

$W = 0 \ldots$

$Y = n \times 1$

$X = n \times m$

$$MSE = \frac{1}{n} \sum_{i=1}^{n} (\hat{Y}_i - Y_i)^2$$

→ Predicted

→ Actual

$L(W) = |Y - XW|^2$

→ Loss function.

$L(W) = \epsilon^2 = |Y - WX|^2$

$$\frac{dL}{dW} = -2X(Y - WX)$$

More solution is shared in a pdf.

RA, office time

STMW ⇒ 10 am → 1 pm

RA ⇒ 12 pm - 5 pm

L-11/02.07.2025/

$L(W) = ||(Y - WX)^2||$

$= (Y - WX)^T (Y - WX)$

$= (Y^T - W^T X^T)(Y - WX)$

$= YY^T - WXY^T - YW^T X^T + WW^T XX^T$

$WXY^T = YW^T X^T$

$$\therefore L(W) = YY^T - 2WX^TY + \cancel{WX(WX)^T}\; W^2XX^T$$

$$\Rightarrow \frac{d}{dW} L(W) = 0 - 2X^TY + 2WXX^T$$

$$\Rightarrow \quad 0 = -2X^TY + \cancel{2WXX^T}\; 2WXX^T$$

$$\Rightarrow \quad 2WXX^T = 2X^TY$$

$$\therefore W = (XX^T)^{-1}X^TY$$

(*) $$X^+ = (XX^T)^{-1}X^T$$

$$\therefore W = \hat{\theta} = X^+Y$$

Left singular vector

$$\Rightarrow X = U\Sigma V^T$$

$$\Rightarrow X^+ = U\Sigma^+V^T$$

Right singular vector

$U = m \times m$

$V = n \times n$

$\Sigma = m \times n$

$$\therefore \frac{d}{dw} L(w) = -2YX^T + 2WXX^T$$

L-12 / 07.07.2025 /

* **Overfitting:**
  - good ~~at~~ on train ~~sen~~ set
  - bad on validation set
  - start with zero error on train set.
* **Under-fitting:**
  - bad on both train and validation set.
  - start with high error on train set

L-13 / 09.07.2025 /

* **Bias:**
  - Polynomial degree of data is 10
  - but model trained as 5 or less then 10.
  - the less the degree is, the ~~bias~~ higher the bias is.
* **Variance:**
  - if the model is train with a degree which is higher than the data.
* Soft-margin ⇒ can ignore outlier

  SVM

  Hard-margin ⇒ can't ignore, count each data.

Variance, Bias

Overfitting, Underfitting

One question must in viva

Midterm

23.07.2025

Lecture 1-6

- Math derivation
- Precision accuracy math
- True-False
- MCQ

L-14 / 14.07.2025

Decision Tree:

- work without pre-processing.
- Root node is decided by the lowest GINI score.
  - One question important for midterm related to GINI score.

L-15/16.07.2025/

$$h = W^T x + b$$

$$W = \{\theta_1, \theta_2, \theta_3 \dots \theta_n\}$$

* Why kernel tricks?
* What is variance?
* Calculate Confusion Matrix.

important for midterm

- 3 derivation
- logical math

midterm

* YouTube - for more learning:

$\boxed{\text{StatQuest with Josh Starmer}}$ ***

L-16/21.07.2025/

* Ensamble Method:

  - train 50%. data first.
  - then use the pre trained model ~~wit~~ for the rest 50%. of data.
    - it will ~~hyper~~ tuned the hyper parameter learned on first step.
    - speed up the training process.

* Different Category of Ensamble. important for midterm.

$\boxed{\text{Midterm upto this.}}$