

## Lecture-4 (Performance Measures)

Friday, 11 August 2023 4:30 PM

Actual	Predicted	
	+	-
+	TP	FN
-	FP	TN

$$\text{Precision (P)} = \frac{TP}{TP+FP}$$

$$\text{Recall (R)} = \frac{TP}{TP+FN}$$

- $0 < P < 1, 0 < R < 1$
- Precision is undefined:  $TP+FP=0$   
→ Classifier predicts everything as -
- Recall is undefined:  $TP+FN=0$   
→ Samples are from - class only
- $P=1 \Rightarrow \frac{TP}{TP+FP} = 1 \Rightarrow TP = TP+FP \Rightarrow FP=0$
- $R=1 \Rightarrow FN=0$
- ~~$\frac{P+R}{2}$~~   $F1\text{-score} = \frac{2PR}{P+R} = \frac{TP}{TP + \frac{1}{2}(FP+FN)}$

## Multi-Class Classification - Performance Measures

Predicted		Actual		
		Urgent	Normal	Spam
	Urgent	8	10	1
	Normal	5	60	50
	Spam	3	30	200

Confusion matrix

1-vs-rest

Predicted		Actual	
		Urgent	Not Urgent
	Urgent	8	11
Predicted	Not Urgent	8	340

$$P_{\text{Urgent}} = \frac{8}{8+11} = \frac{8}{19}$$

$$R_{\text{Urgent}} = \frac{8}{8+8} = \frac{8}{16}$$

Predicted		Actual	
		Spam	Not Spam
	Spam	200	33
Predicted	Not Spam	51	83

$$P_{\text{Spam}} = \frac{200}{233} \approx 0.91$$

$$R_{\text{Spam}} = \frac{200}{251} \approx 0.88$$

Predicted		Actual	
		Normal	Not Normal
	Normal	60	55
Predicted	Not Normal	40	212

$$P_{\text{Normal}} = \frac{60}{115} = 0.52$$

$$R_{\text{Normal}} = \frac{60}{100} = 0.6$$

## macro score

$$P_{\text{macro}} = \frac{P_{\text{Urgent}} + P_{\text{Normal}} + P_{\text{Spam}}}{3} = \frac{\sum_{i=1}^{N_c} P_i}{N_c}$$

- .10d

Actual	3
+	-

pooled

Pred	268	99
-	99	35

$P_{\text{micro}} = \frac{268}{268 + 99}$   
 $FP = FN$

✓ FP GT Pred  
 Normal Spam

$F1_{\text{macro}} = \frac{\sum_{i=1}^{N_c} F_i}{N_c}$   
 scikit-learn  
 ALT  $\rightarrow \frac{2 P_{\text{macro}} R_{\text{macro}}}{P_{\text{macro}} + R_{\text{macro}}}$

$F1_{\text{micro}} = \frac{2 P_{\text{micro}} R_{\text{micro}}}{P_{\text{micro}} + R_{\text{micro}}}$

$$F1\text{-score} = \frac{TP}{TP + \frac{1}{2}(FP + FN)}$$

$$F1\text{-score}_{\text{micro}} = \frac{\sum_{i=1}^N TP_i}{\sum_{i=1}^N TP_i + \frac{1}{2}(\sum_{i=1}^N FP_i + \sum_{i=1}^N FN_i)}$$

sample-centric

TP	FP	Prec	
1	1	0.5	$Prec_{\text{macro}} \approx 0.62$

