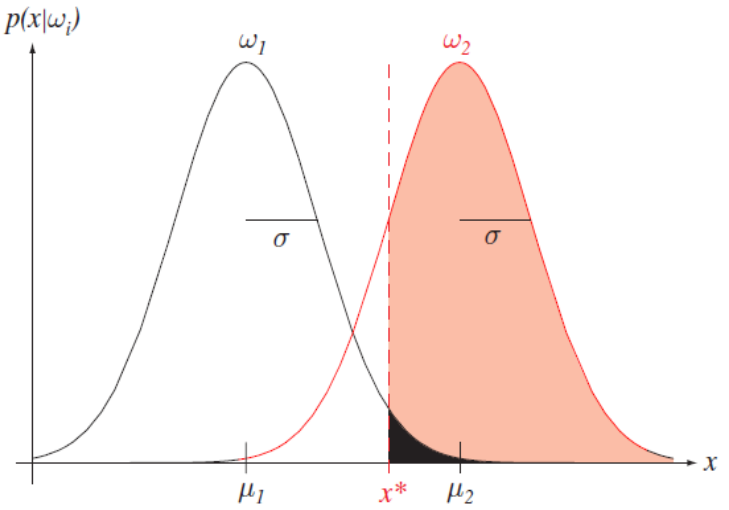
Classification measures (binary case)

2 types of truth and errors

- Predicting the possession of a disease by genetic diagnosis.
- In the figure below, if we use separating hyperplane marked by x*, then we get the two types of truth;
  - Predicting a sick person as sick.
  - Predicting a healthy person as healthy.
- In the figure below, if we use separating hyperplane marked by x*, then we get the two types of truth;
  - Predicting a sick person as healthy.
  - Predicting a healthy person as sick.



example

The following table is often called as contingency table.

		actual: Yes	actual: No
prediction	Yes	80 **(True Positive)**	20 **(False Positive)**
	No	10 **(False Negative)**	90 **(True Negative)**

Evaluating classifier performance based on Contingency Table

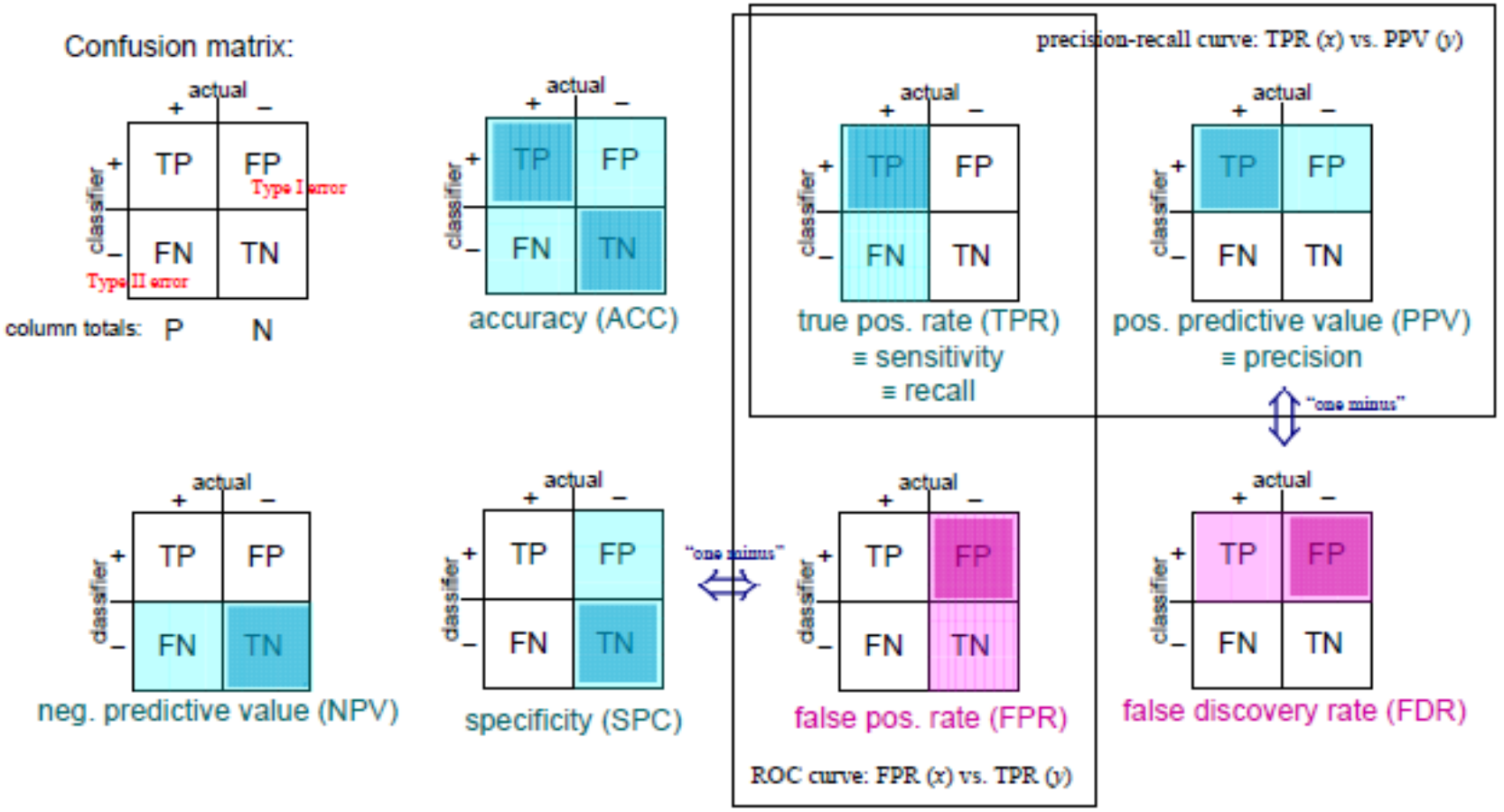
actual

prediction	Yes(Class1)	No(Class2)
Yes(Class1)	80 **(True Positive)**	20 **(False Positive)**
No(Class2)	10 **(False Negative)**	90 **(True Negative)**

Accuracy: ACC = (TP+TN)/(TP+FP+TN+FN) = (TP+TN) / All = 170/200
False Positive Rate : FPR = FP/(FP+TN) = 20/110
True Positive Rate(a.k.a. sensitivity, recall): TPR = TP/(TP+FN)=80/90
Positive Predictive Value(a.k.a. precision): PPV = TP/(TP+FP)=80/100

Other measures

"Cheat sheet" on accuracy, precision, recall, TPR, FPR, specificity, sensitivity, ROC, and all that stuff!
William H. Press, ver 1.0, 3/29/08



value (between 0 and 1) = numerator / denominator
numerator = dark color shade
denominator = dark + light color shade
blue: value 1 is good
pink: value 0 is good

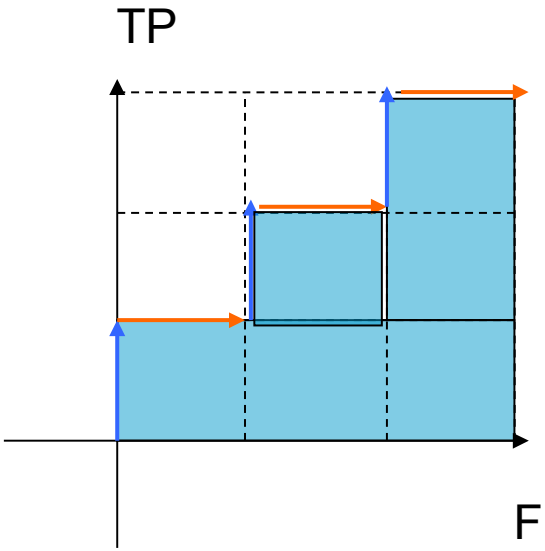
Map points from ROC to Precision-Recall or vice-versa: (TPR same values in both)

$$PPV = \frac{P\ TPR}{P\ TPR + N\ FPR} \quad \textit{(ROC to P-R)}$$

$$FPR = \frac{P\ (1 - PPV)\ TPR}{N\ PPV} \quad \textit{(P-R to ROC)}$$

Receiver Operator Characteristic (ROC) and Area Under the Curve (AUC)

- ROC curve takes FPR as x-axis, and TPR as y-axis.
- AUC is an area under the ROC curve



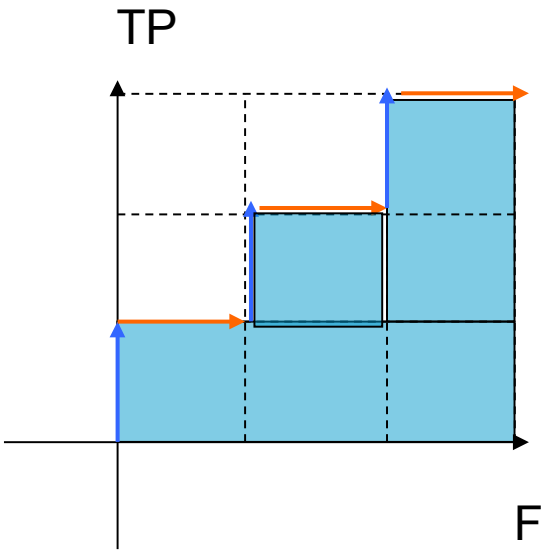
AUC = 6/9 = 0.66

(0 <= AUC <= 1)

Computing AUC

- Sort the prediction results in a descending order.
- By looking at score from the top one by one, then move rightward if FP, and upward if TP.
- Calculate the relative area under the ROC curve.

Predicted score	True Class	FP	TP
0.9	+	0	1
0.7	-	1	1
0.3	+	1	2
-0.1	-	2	2
-0.4	+	2	3
-0.6	-	3	3

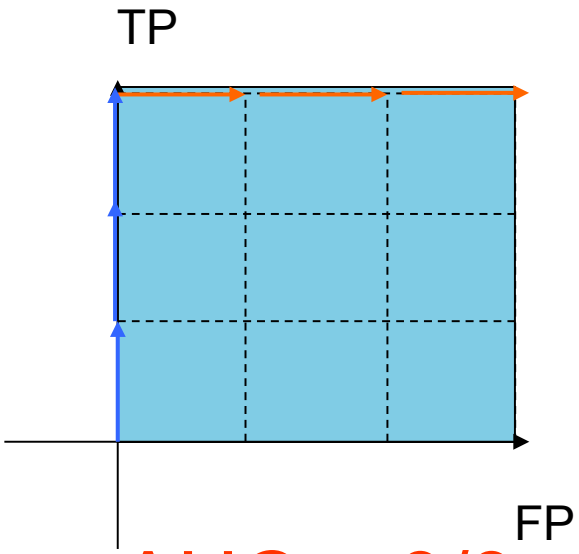


AUC = 6/9 = 0.66

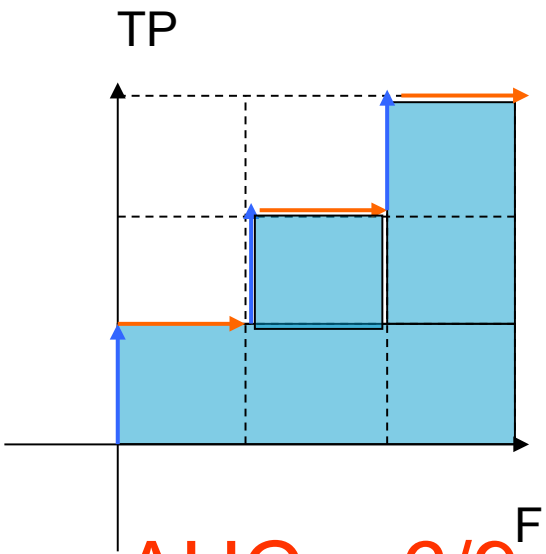
(0 <= AUC <= 1)

AUC(Area Under the Curve)

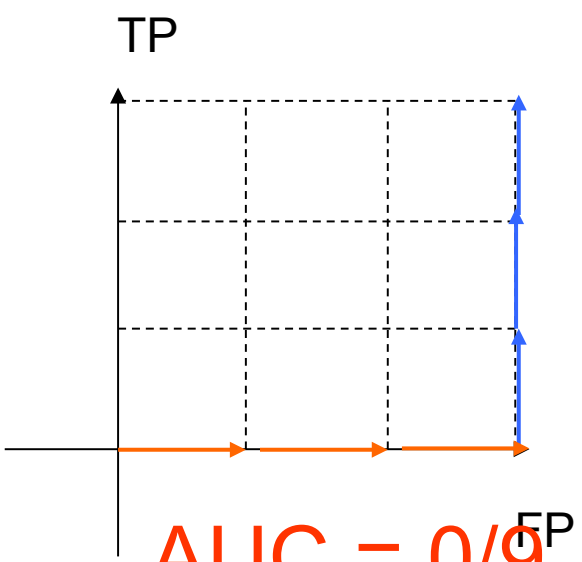
- 0<=AUC<=1
- AUC curve located above the other AUC curves suggests better performance.



AUC = 9/9



AUC = 6/9



AUC = 0/9

Ex. 2

- Compute Accuracy, Sensitivity, Specificity, Recall, Precision, and FDR from the following table.

		actual	
		Yes(Class1)	No(Class2)
prediction	Yes(Class1)	300	15
	No(Class2)	50	1000

Ex. 3

- Calculate AUC score from the following table.

Prediction	True Class
1.0	+
0.8	+
0.5	+
0.3	-
0.1	+
-0.1	-
-0.2	+
-0.6	-
-0.9	-
-1.0	-

(Ex. 4) previous exercise revisited.

- Complete the following table by evaluating all the digits drawn by 200 people in test set T.
- Which digit is often misclassified ? To which digit ?

actual

prediction	1	2	3	4	5	6	7	8	9	0
1	199	0	0	0	1	0	0	0	0	0
2	0	169	8	8	1	2	4	8	0	0
3										
4										
5										
6										
7										
8										
9										
0										