29. KNN + Confusion Matrix

Three phases of using KNN for classification:

1. Training Phase: Training different models
   - Different K values can represent different KNN models
   - References
     - K-NN step-by-step example
2. Evaluation Phase
   - Objective
     - Finding the K value representing the best model.
   - How? -- This is the homework you need to do.
     - Using Pick an Evaluation Metric: Confusion Matrix
     - For example, for credit card assessment
       - There are two classes in this example, "+" (credit approval) and "-" (credit denial).

K=3		**K=5**	
Correct Assessment	Predicted Assessment	Correct Assessment	Predicted Assessment
-	-	-	-
-	+	-	-
+	+	-	+
-	-	+	-
-	-	+	-
+	+	-	+
+	+	-	+
-	-	+	-
-	-	-	-
+	+	-	+
-	-	-	-
+	-	+	-
+	+	-	-
+	+	+	+
-	-	-	-
-	-	+	-
-	-	+	-
+	+	-	+
+	+	-	-
+	+	+	+
+	+	+	-
-	-	-	+
+	+	-	+
+	+	+	+
-	-	-	-

   - If the objective is to determine the "+" class, please fill this table

K=	TP	FN	FP	TN	Precision	Accuracy	Recall	F1 score
3								
5								

- Which K value represents the better model? Please explain your assessment.

3. Test Phase
   - Using the best model selected in Evaluation Phase
   - References
1. Training, Validation, and Test

Answer

Deriving the Confusion Matrix for the "+" class for both K = 3 and K = 5

For K = 3

	Predict = +	Predict = -
Actual = +	True Positive (+ -> +) Actual credit card approval that were correctly classified as credit card approval **12**	False Negative (+ -> !+) Actual credit card approval that were incorrectly classified as credit card denial. **1**
Actual = -	False Positive (!+ -> +) Actual credit card denial that were incorrectly classified as credit card approval **1**	True Negative (!+ -> !+) Actual credit card denial that were correctly classified as credit card denial **11**

For K = 5

	Predict = +	Predict = -
Actual = +	True Positive (+ -> +) Actual credit card approval that were correctly classified as credit card approval **3**	False Negative (+ -> !+) Actual credit card approval that were incorrectly classified as credit card denial. **7**
Actual = -	False Positive (!+ -> +) Actual credit card denial that were incorrectly classified as credit card approval **7**	True Negative (!+ -> !+) Actual credit card denial that were correctly classified as credit card denial **8**

From the table above,

Precision = TP/(TP+FP)

A better way to estimate performance than Accuracy.

For K = 3,

Precision = 12/(12+1) = 12/13 = 0.923

For K = 5,

Precision = 3/(3+7) = 3/10 = 0.3

Accuracy = (TP+TN)/(TP+TN+FP+FN)

Accuracy is the ratio of the number of correct labels to the total number of labels.

Accuracy is the probability that your model gets the right answer.

Accuracy is not a good metric of success, because the “everything looks good” model, or equivalently the “nothing looks fraudulent” model, is dumb but has good accuracy.

For K = 3,

Accuracy = (12+11)/(12+1+11+1) = 23/25 = 0.92

For K = 5,

Accuracy = (3+8)/(3+7+7+8) = 11/25 = 0.44

Recall = TP/(TP+FP)

A better way to estimate performance than Accuracy.

For K = 3,

Recall = 12/(12+1) = 23/25 = 0.92

For K = 5,

Recall = 3/(3+7) = 3/10 = 0.3

F1 Score = 2TP/(2TP+FP+FN)

For K = 3,

F1 Score = 2*12/(2*12+1+1) = 24/26 = 0.923

For K = 5,

F1 Score = 2*3/(2*3+7+7) = 6/20 = 0.3

K	TP	FN	FP	TN	Precision	Accuracy	Recall	F1 Score
3	12	1	1	11	0.923	0.92	0.92	0.923
5	3	7	7	8	0.3	0.44	0.3	0.3

As per observation, the model with K=3 has high Accuracy compared to model with K=5.
It is said that Accuracy is not a good metric for success, so let us compare the Precision and Recall.

The Precision and Recall values of the model with K=3 is so much better than values of the model with K=5 and so is the F1 Score.

Thus, K=3 represents the better model.