Over-fitting and Confusion Matrix

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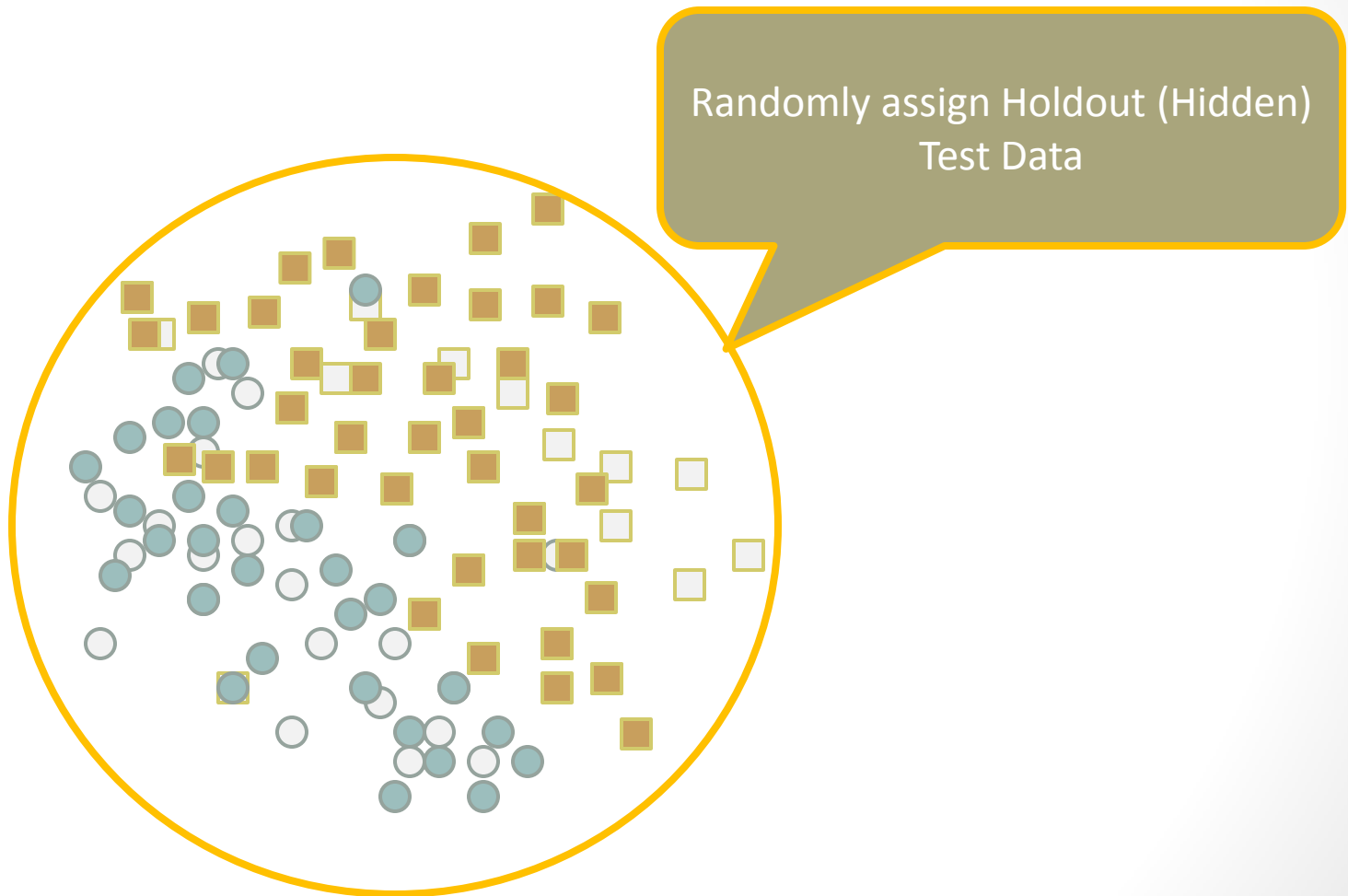
Skype: ernst.predixion

Evaluate Model

- Use an over-fitting example to explain the following concepts:
  - Modeling Data
    - Training Data
    - Test Data
  - Model (Hypothesis)
  - Over-fitting
  - Model Accuracy
  - Confusion Matrix (Classification Matrix)
    - True Positive
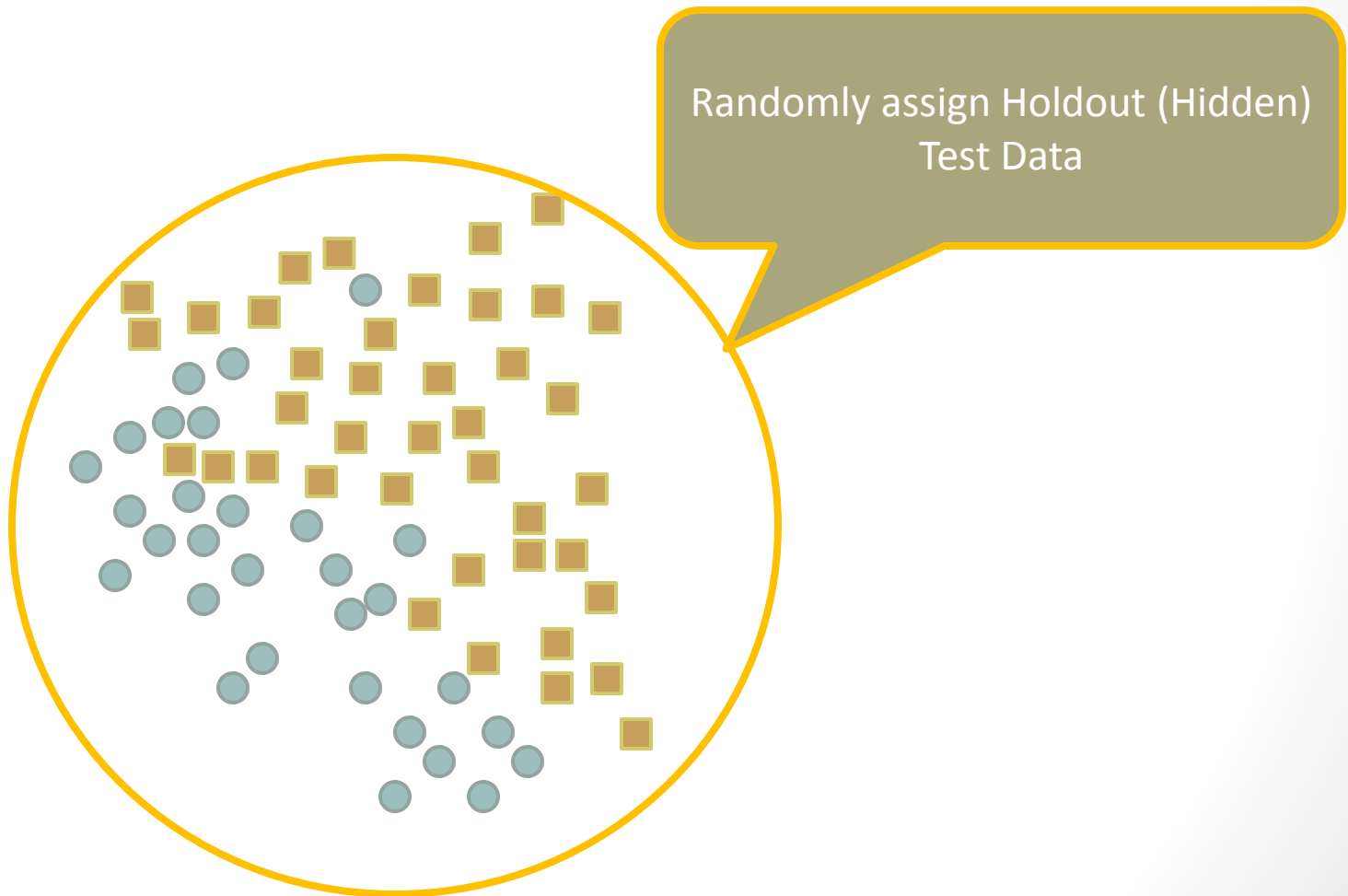   - False Positive
    - True Negative
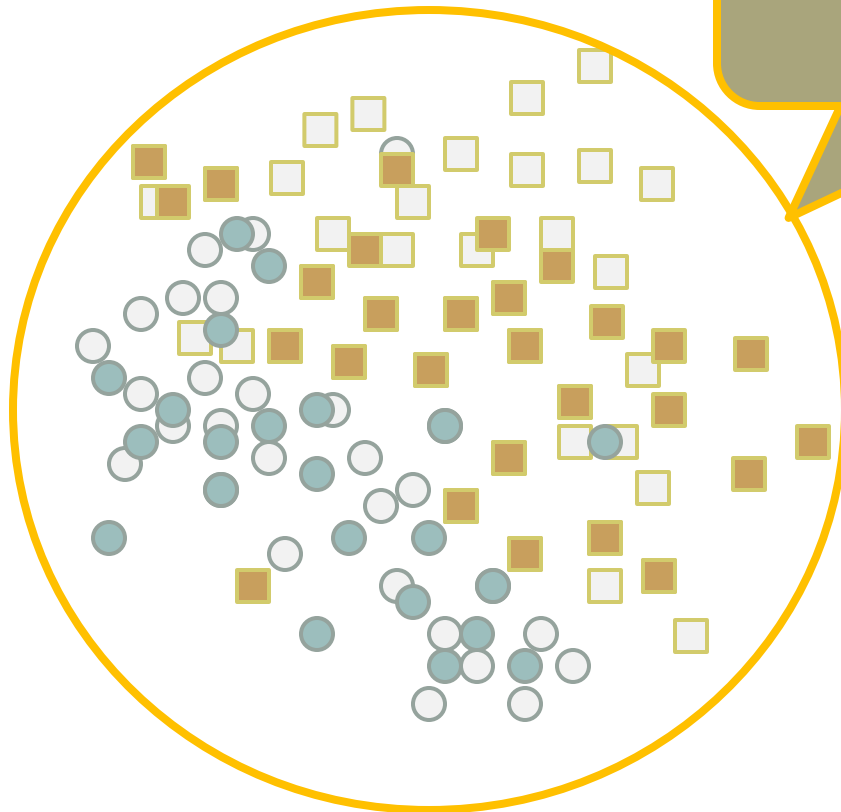   - False Negative

Evaluate Model: All Data

All Data
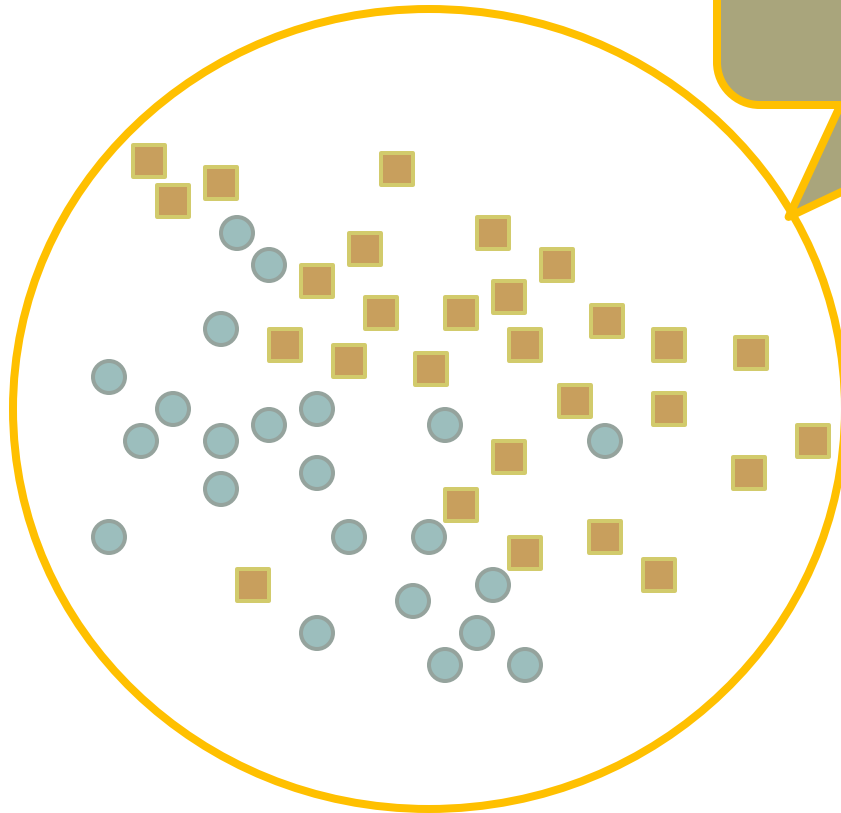
Evaluate Model: Test Data

Evaluate Model: Test Data

Evaluate Model: All Data

All Data

Evaluate Model: Training Data

The Data that is not Test Data is used for Training
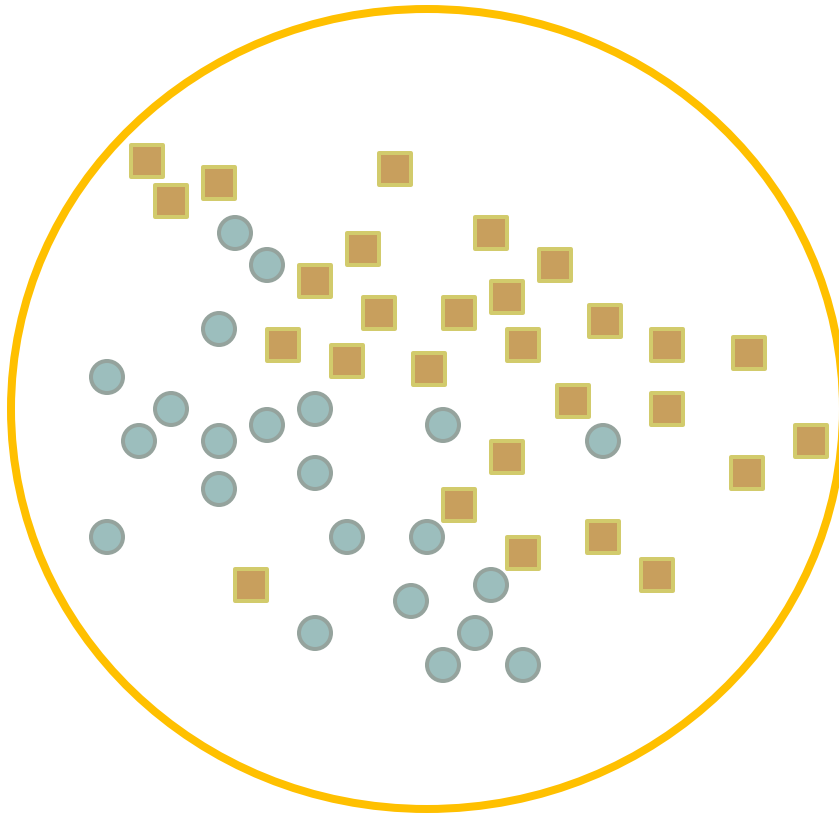
Evaluate Model: Training Data

Evaluate Model: Training
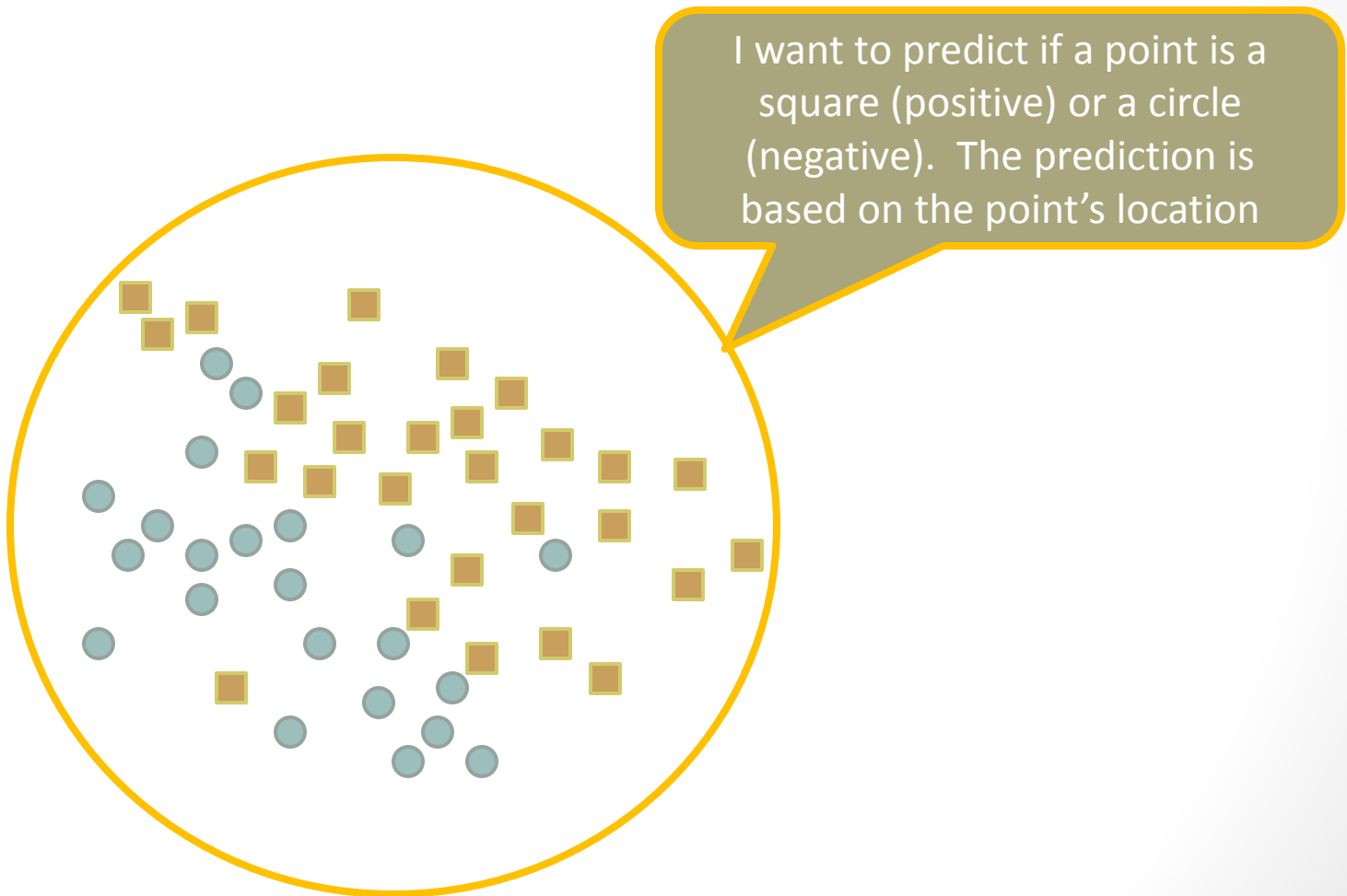
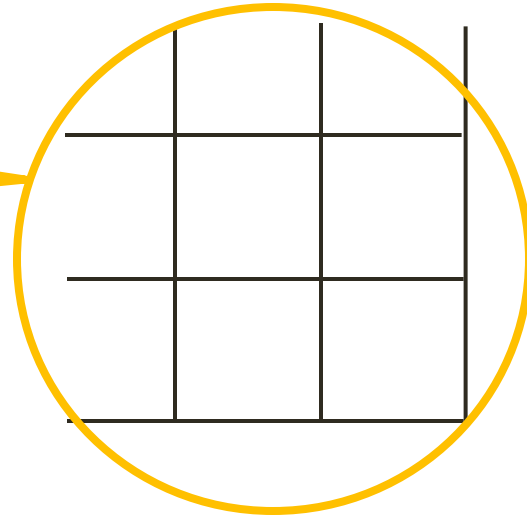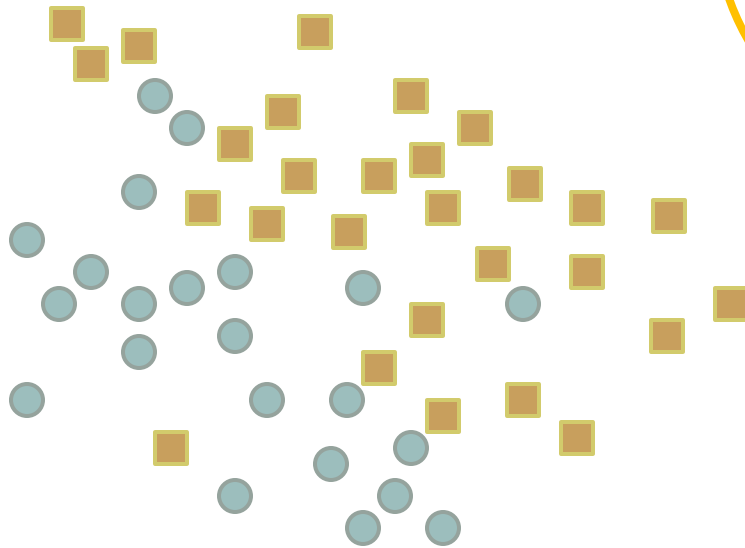# Evaluate Model: Training
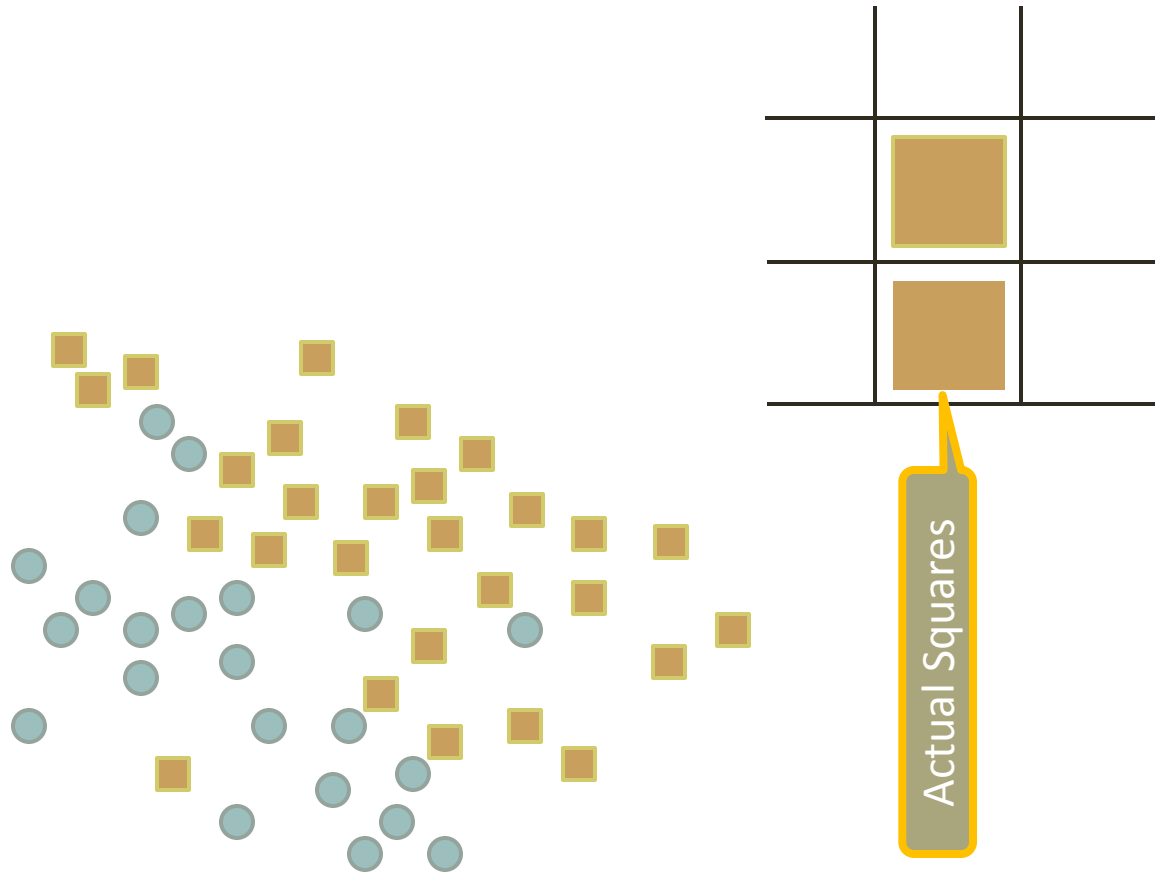

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

Confusion Matrix (Classification Matrix): Compare Squares and Circles with Predicted Squares and Circles
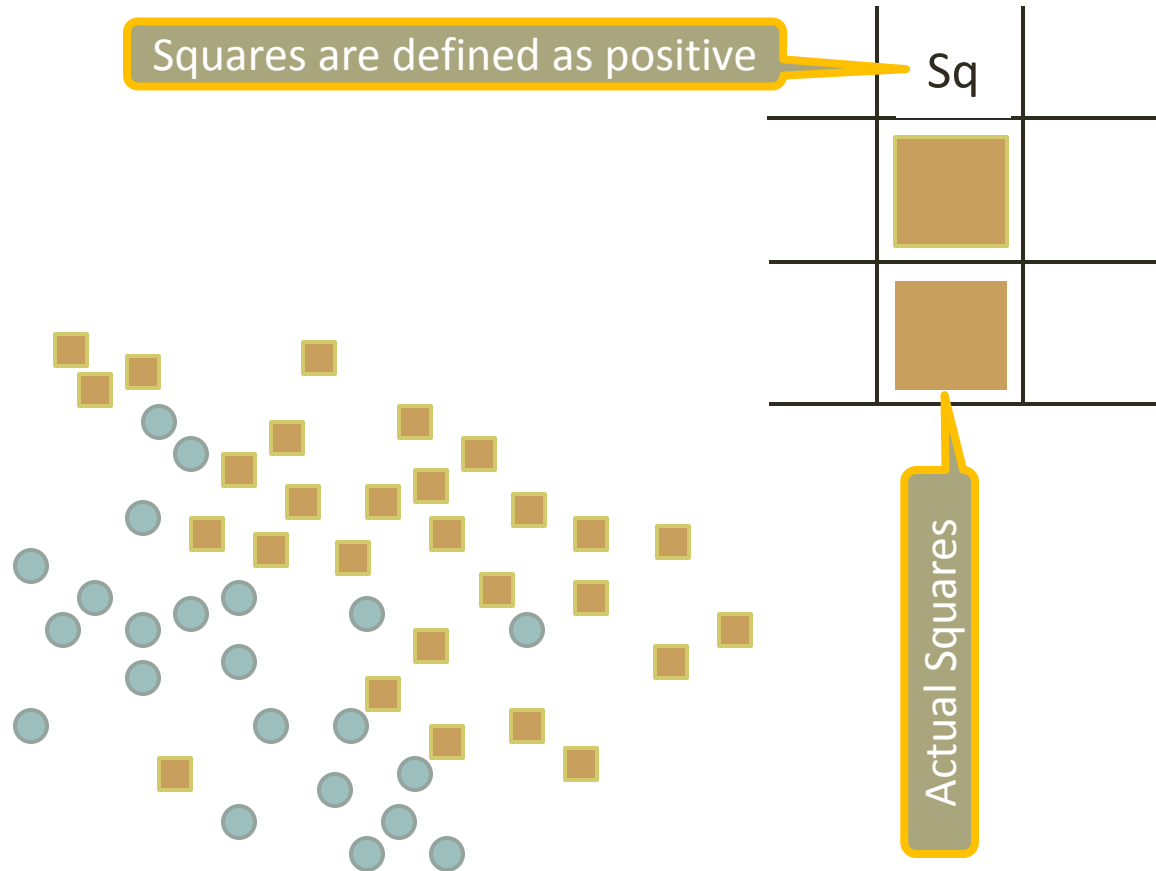
isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

Actual Squares

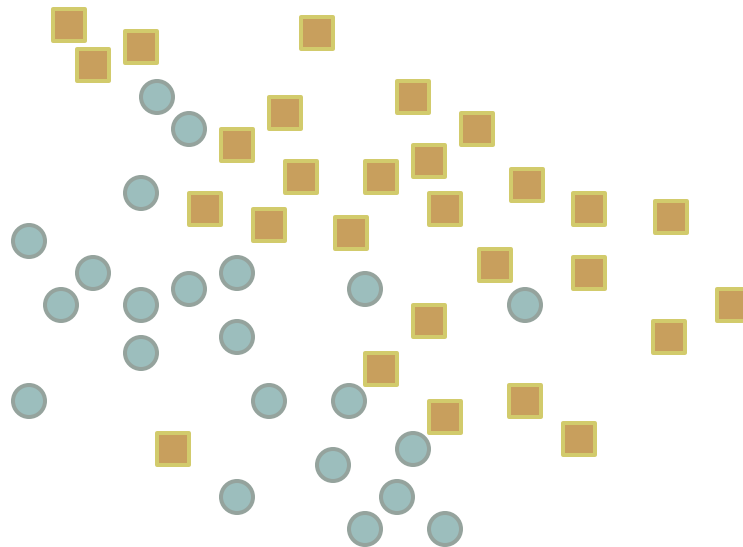isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

Squares are defined as positive

Sq

Actual Squares

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

Circles are defined as negative

	Sq	Ci

Actual Circles

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

	Sq	Ci
P		
N		

Predictions define Positive and Negative

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

	Sq	Ci
P		
N		

Correct Predictions are True Positives and True Negatives
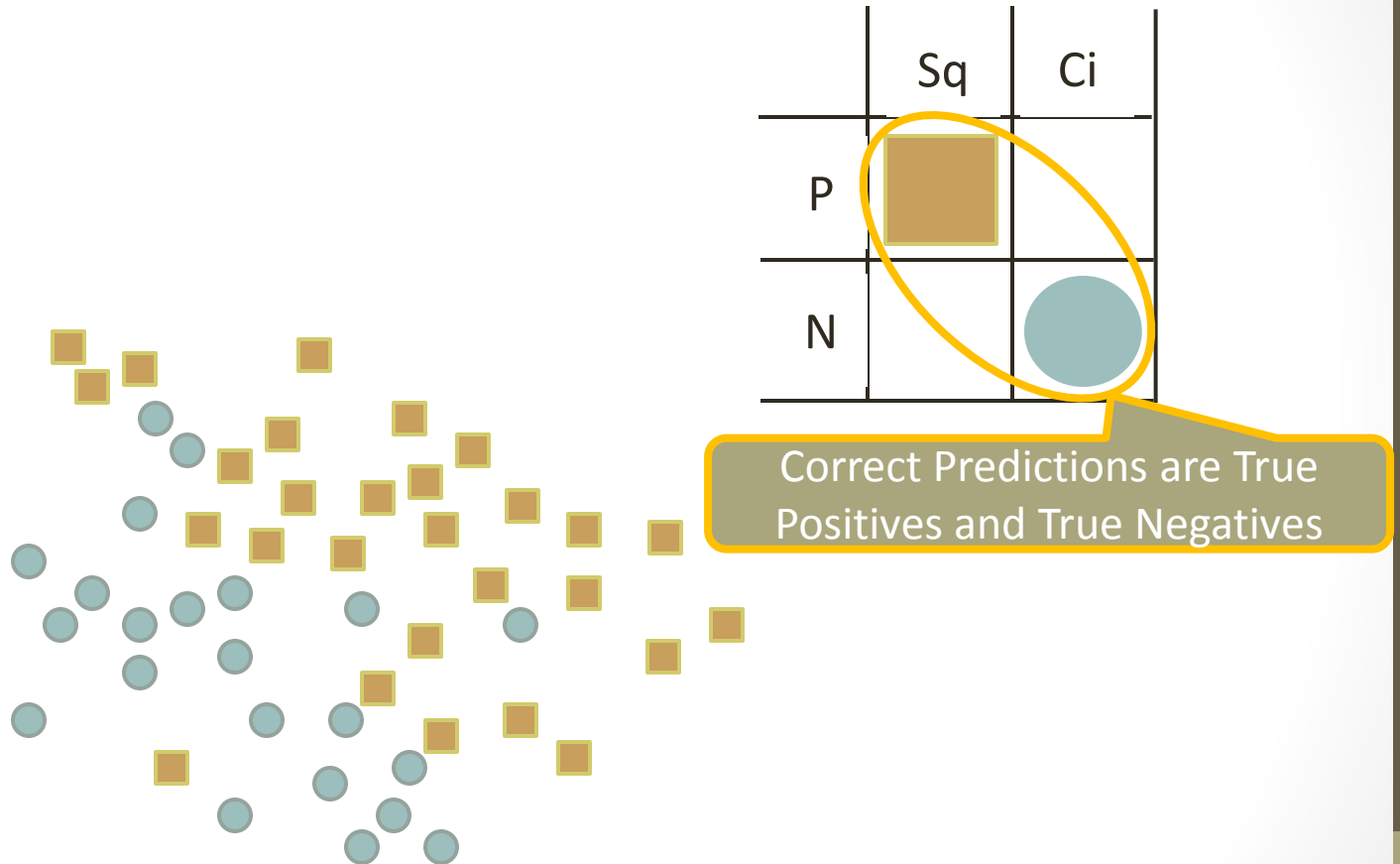
isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix
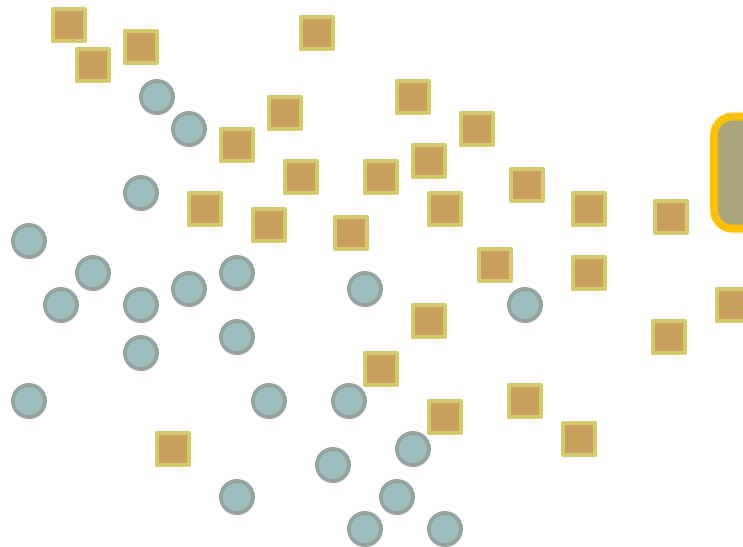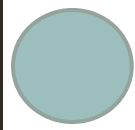
	Sq	Ci
P		●
N	■	

Incorrect Predictions are False Positives and False Negatives

isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix

Confusion Matrix (Classification Matrix):
Vertical are actual classes
Horizontal are predicted classes

	Sq	Ci
P		
N		
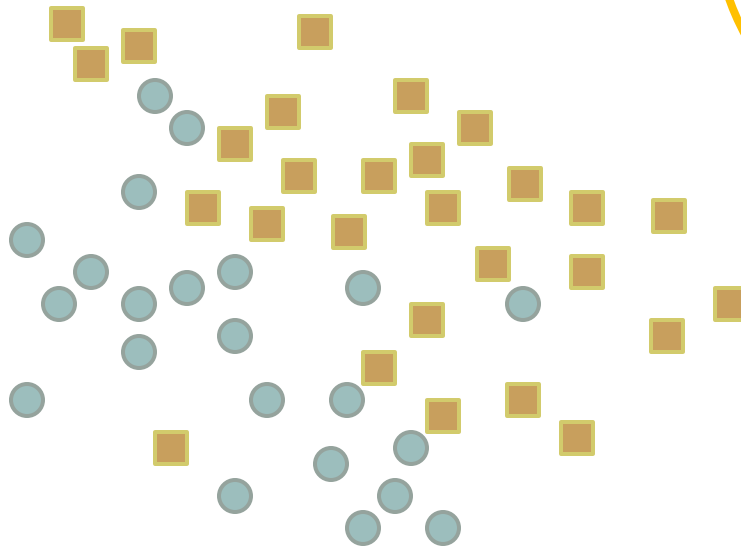
isSquare ~ xLocation + yLocation

Evaluate Model: Confusion Matrix
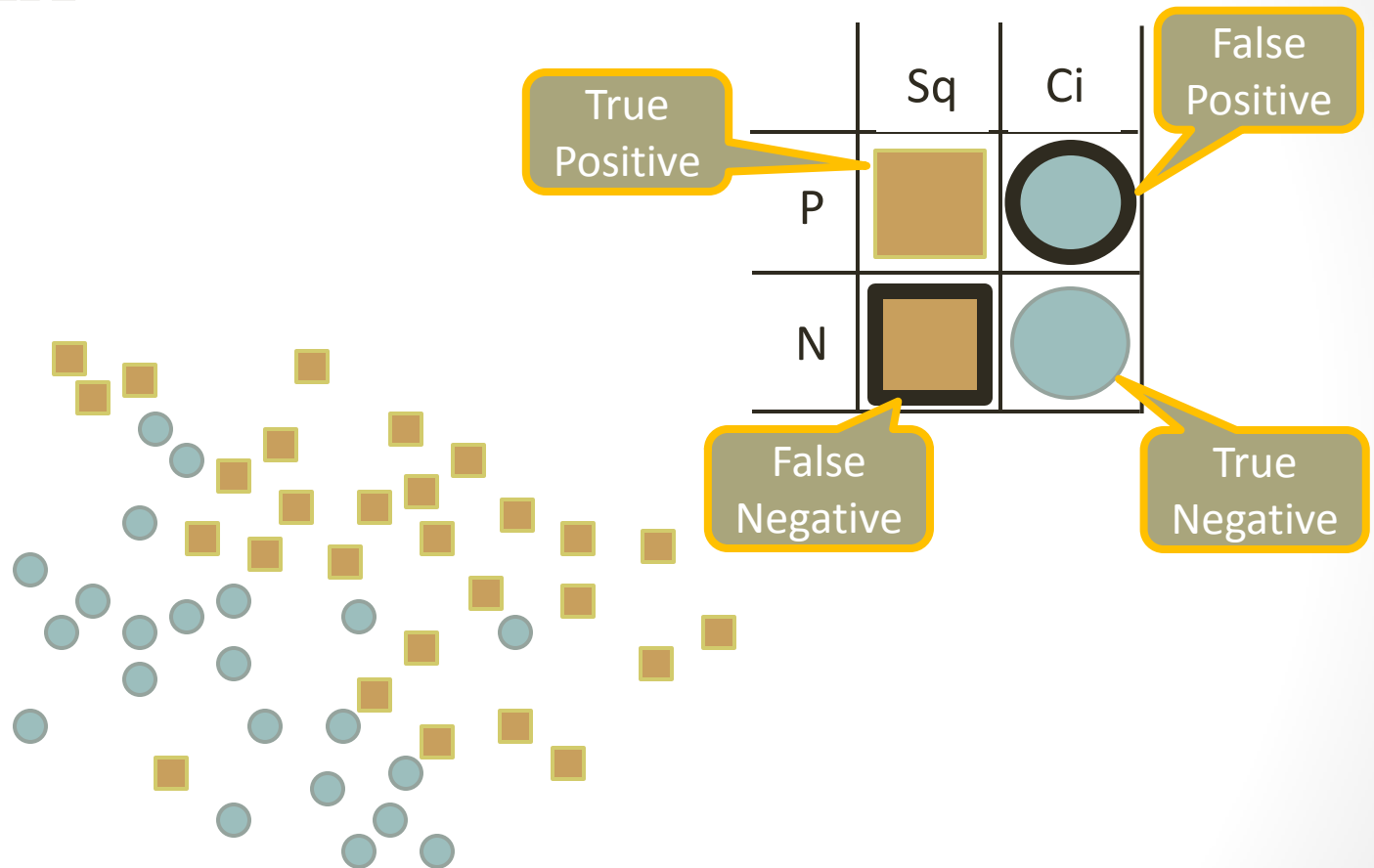
isSquare ~ xLocation + yLocation

Evaluate Model : Train Model 1

	Sq	Ci
P	36	4
N	4	26
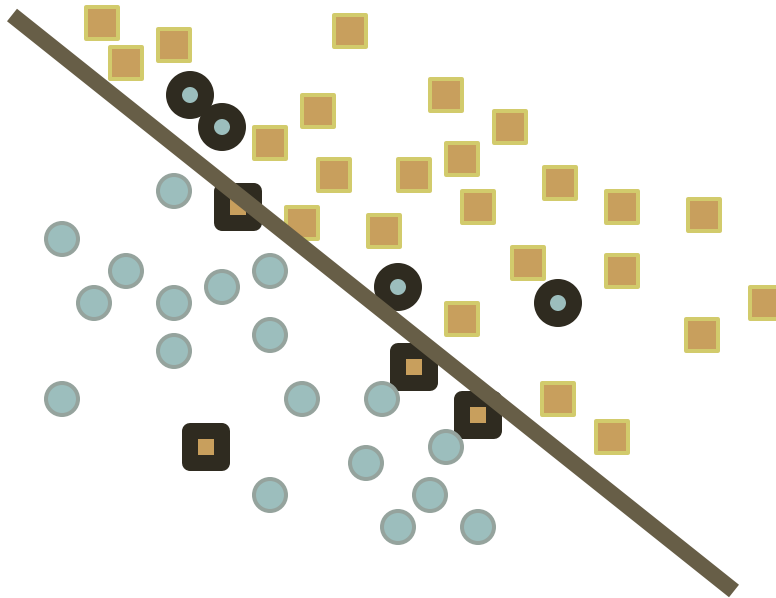
isSquare ~ xLocation + yLocation

Evaluate Model : Train Model 2

	Sq	Ci
P	39	1
N	1	29
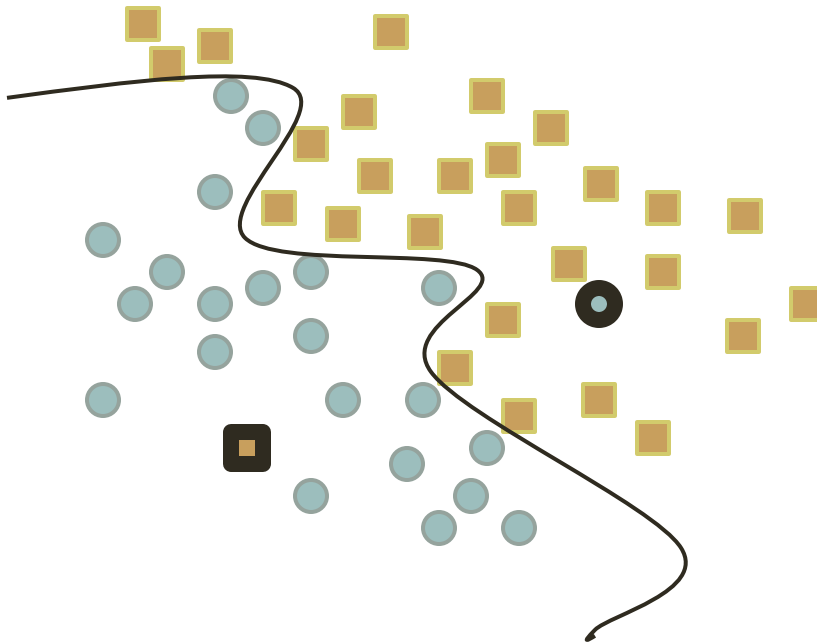
isSquare ~ xLocation + yLocation

Evaluate Model : Train Model 3

	Sq	Ci
P	40	0
N	0	30

isSquare ~ xLocation + yLocation

Evaluate Model : 3 Models

These models are based on training data. In these cases, models are called hypotheses.
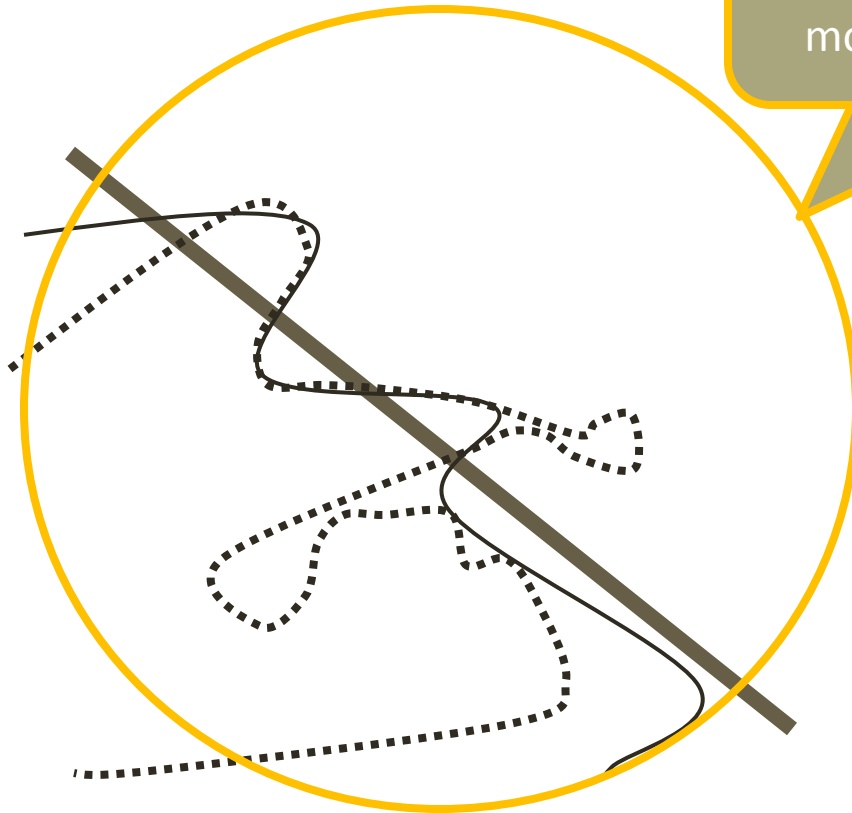
isSquare ~ xLocation + yLocation

Evaluate Model : All Data
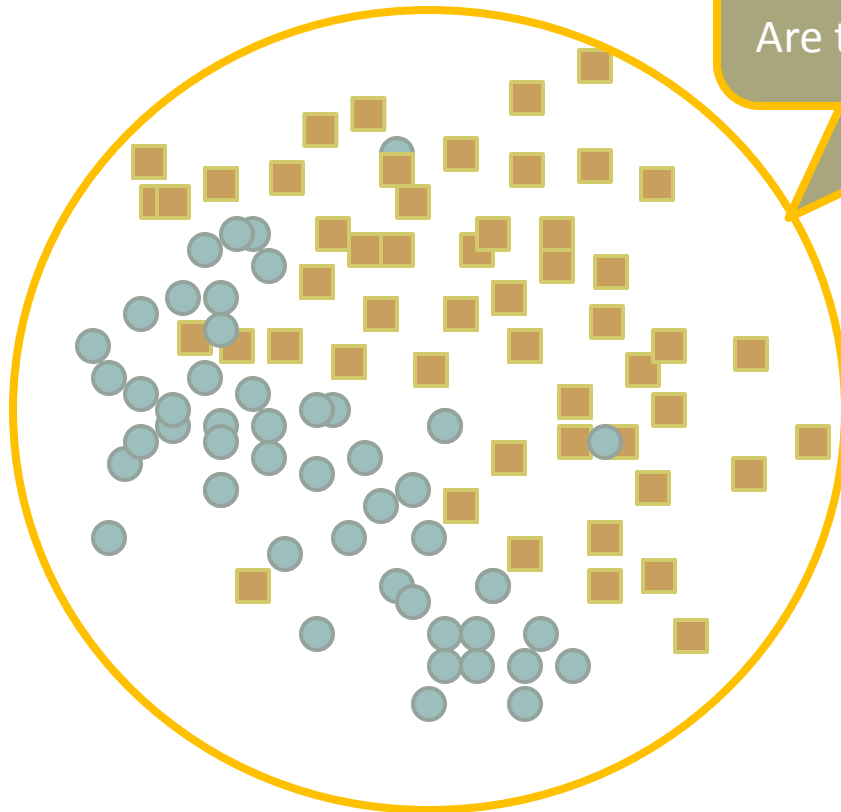
Training data overlaid on test data.
Visual comparison of data sets.
Are the distributions comparable?

isSquare ~ xLocation + yLocation

Evaluate Model : Training Data

Training Data

isSquare ~ xLocation + yLocation
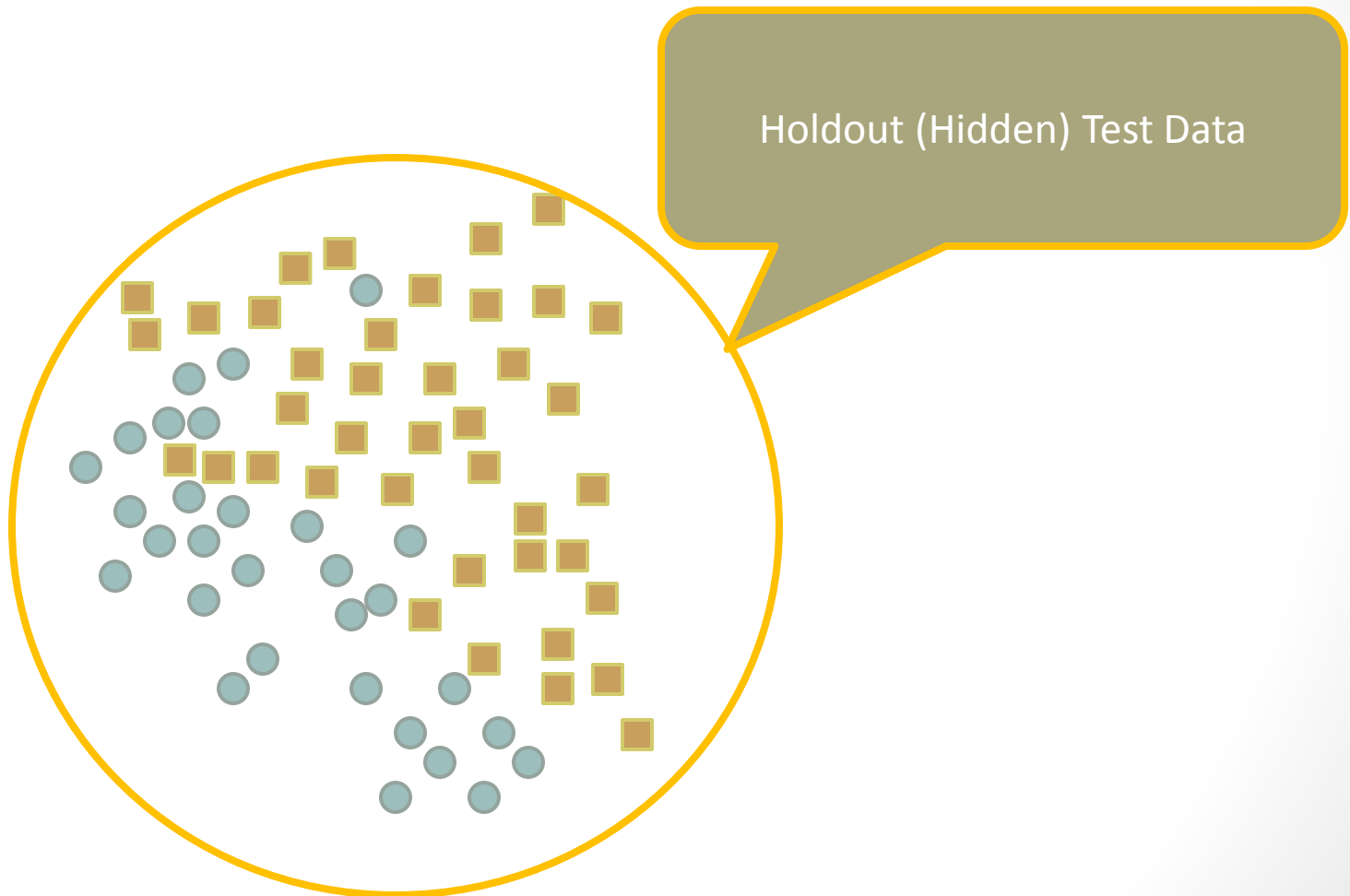
Evaluate Model : Test Data

Evaluate Model : Test Data
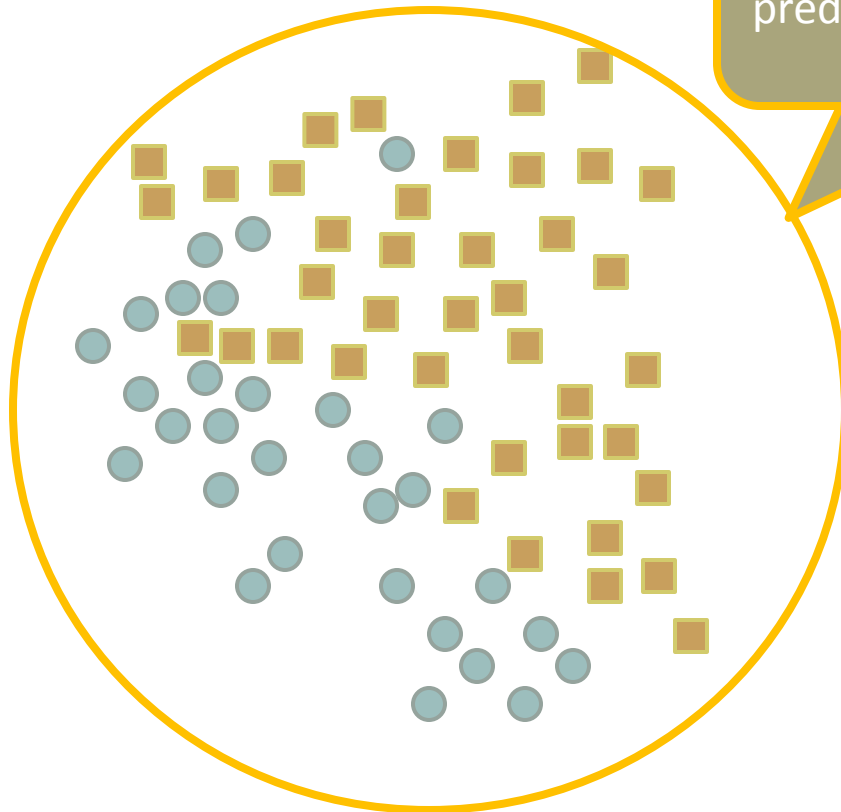
In the test data set:
I want to test if a square is predicted as positive and if a circle is predicted as negative

isSquare ~ xLocation + yLocation

Evaluate Model : Test Data

	Sq	Ci
P	True Positive	False Positive
N	False Negative	True Negative
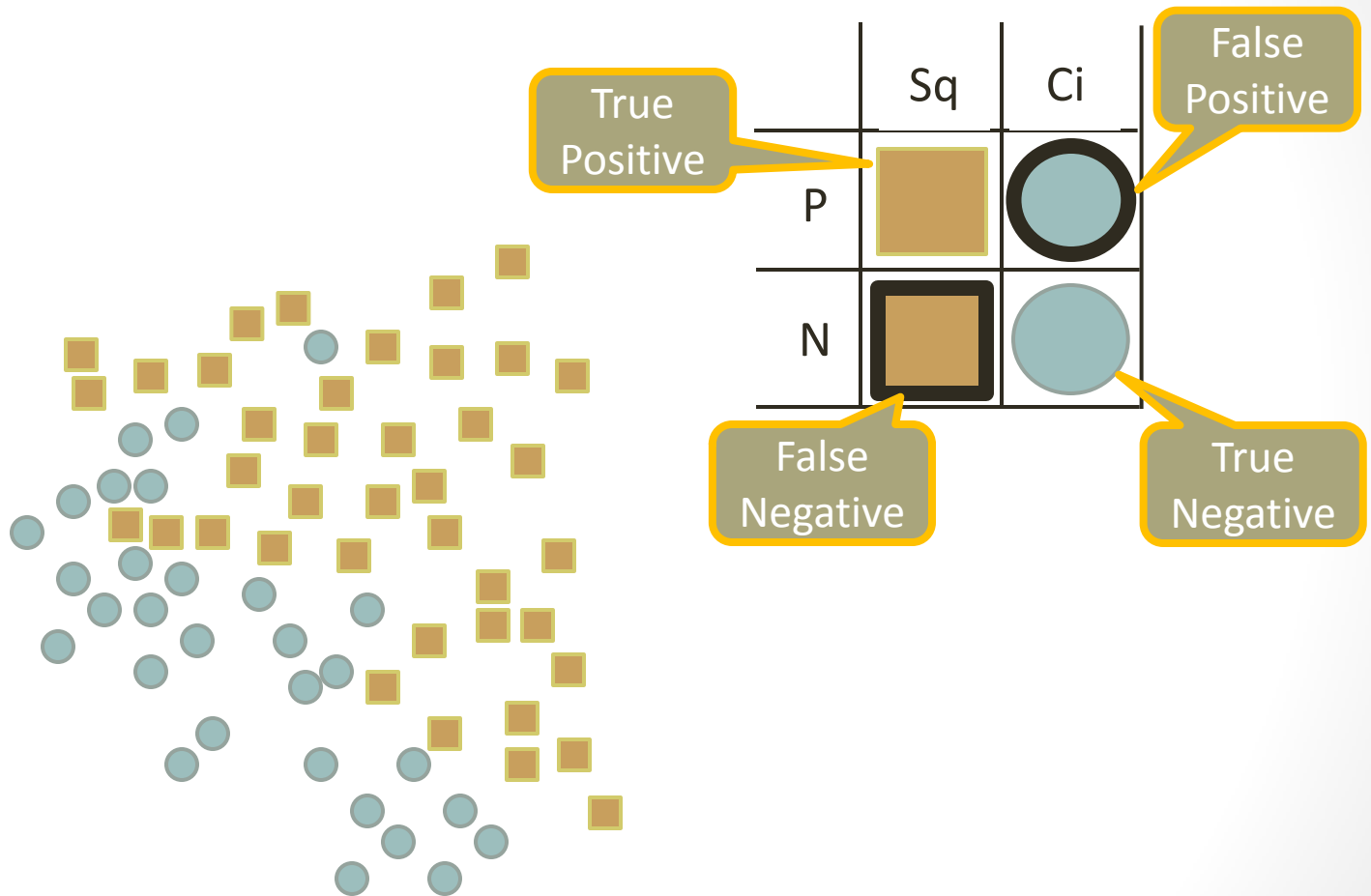
isSquare ~ xLocation + yLocation

Evaluate Model : Test Model 1
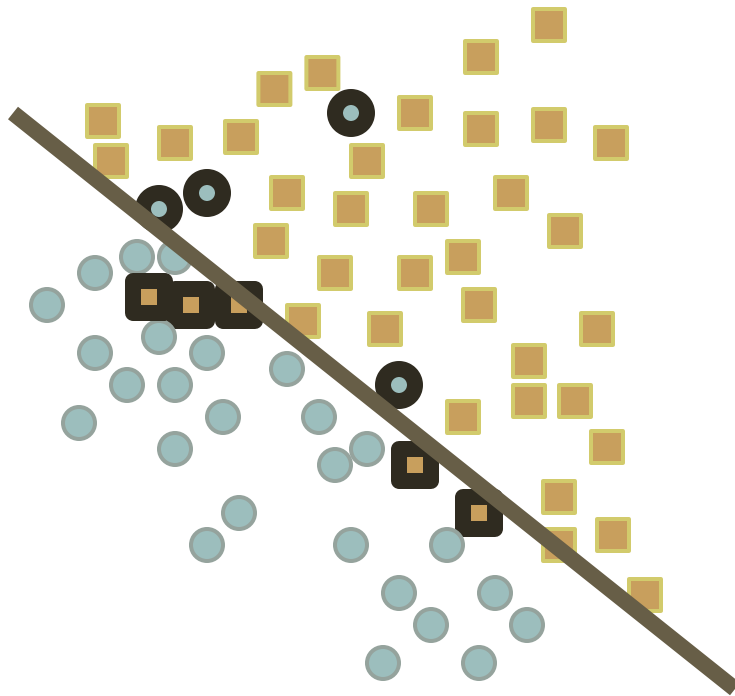
	Sq	Ci
P	35	4
N	5	26

isSquare ~ xLocation + yLocation

Evaluate Model : Test Model 2
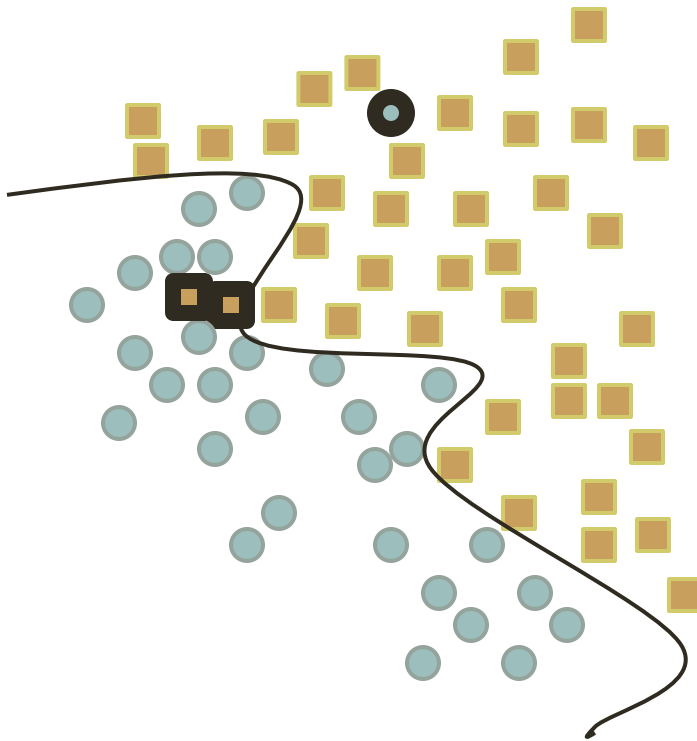
	Sq	Ci
P	38	1
N	2	29

isSquare ~ xLocation + yLocation

Evaluate Model : Test Model 3

	Sq	Ci
P	36	7
N	4	23
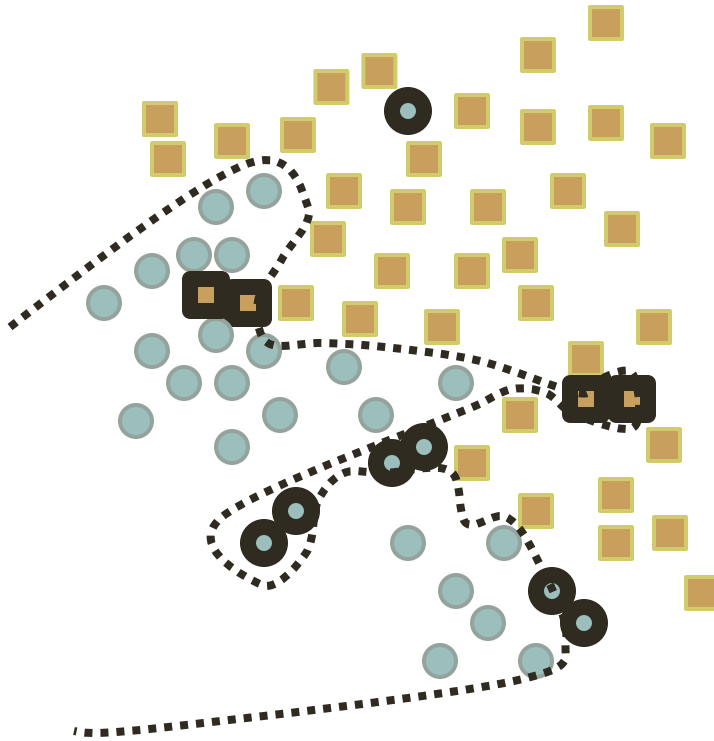
isSquare ~ xLocation + yLocation

Relate a Confusion Matrix with an ROC chart

- Optional exercise in Predixion Insight: Open up a synced Classification (Confusion) Matrix and ROC chart.
  - Set the threshold of the Classification Matrix to 0, 0.5, and 1. How do these thresholds compare to the FPR and TPR on the ROC chart?
  - Set the FPR on the ROC chart to 0, 0.5, and 1. What are the TPR on the ROC chart? How does the threshold of the classification matrix change?
  - Open up a cost chart. Set the readmission penalty to 3X the cost of the intervention cost. What is the optimal threshold? What is the FPR?

Assignment (1)

1. Why are performance metrics better on training data than on test data?
2. How do you determine which data are training data and which data are test data?
3. Beware, this problem contains irrelevant data while some important numbers are not explicitly presented. A model was trained on *300* individuals where *149* had the cold and *151* were healthy. The model was tested on **100** individuals where **10** were ill. The model correctly predicted that **85** of the healthy individuals were indeed healthy and correctly predicted that **7** of the ill individuals were indeed ill. The other predictions were incorrect. Consult Wikipedia: http://en.wikipedia.org/wiki/Precision_and_recall and construct a confusion matrix and then calculate the following:
   a) Sensitivity
   b) Specificity
   c) Accuracy
   d) Precision
   e) Recall

Assignment (2)

4. The probability threshold for a classification varies in an ROC chart from 0 to 1.

    a) What point of the graph corresponds to a threshold of zero?
    b) What point of the graph corresponds to a threshold of one?
    c) What point of the graph corresponds to a threshold of 0.5? (trick question)

5. A Classification is tested on 1000 cases. In the middle of its ROC chart, where the false positive rate is 0.4, the true positive rate is 0.8. The accuracy is 0.7.

    a) What does the confusion matrix look like?
    b) What can you say about the probability threshold at that point? (trick question)

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