Analysis For Exercise 3.2: Posterior Probabilities With LDA And QDA

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I completed this exercise myself.

2. Differences Between LDA And QDA

LDA1 and QDA1: Describe distinct source files

# This is code for Linear Discriminant Analysis

# This is code for Quadratic Discriminant Analysis

LDA{34,35} and QDA{34,35}: Define distinct classes

class LDA:

"""Creates a class for Linear Discriminant Analysis

class QDA:

"""Creates a class for Quadratic Discriminant Analysis

LDA{71,72} and QDA{71,72}: Initialize a mean covariance matrix versus initialize a dictionary for class-specific covariance matrices

# compute the mean covariance matrix

self.cov = np.zeros([self.num\_cols, self.num\_cols])

# compute the covariance matrix of each class

self.covs = dict()

LDA{74,75} and QDA74: Calculate mean covariance matrix versus calculate class-specific covariance matrix

self.cov = self.cov + self.num\_obs[name] \* np.cov(np.transpose(self.data[self.data\_labels == name, :]))

self.cov = self.cov / self.num\_rows

self.covs[name] = np.cov(np.transpose(self.data[self.data\_labels == name, :]))

LDA92 and QDA91: Construct multivariate Gaussian Probability Density Function with mean covariance matrix versus class-specific covariance matrix

likelihoods[idx] = multivariate\_gaussian\_pdf(x, self.means[name], self.cov)

likelihoods[idx] = multivariate\_gaussian\_pdf(x, self.means[name], self.covs[name])

LDA94: Remove of blank line

LDA{99,100} and QDA{97,98}: Change described model

print('LDA Predicted Class: ' + self.class\_names[indices\_sorted[0]])

print('LDA Class Likelihoods:')

print('QDA Predicted Class: ' + self.class\_names[indices\_sorted[0]])

print('QDA Class Likelihoods:')

LDA112 and QDA110: Changed model name and constructor

model\_lda = LDA('iris\_data.csv')

model\_qda = QDA('iris\_data.csv')

LDA115 and QDA 113: Changed use of model

model\_lda.compute\_likelihoods(Iris\_setosa\_observation)

model\_qda.compute\_likelihoods(Iris\_setosa\_observation)

LDA{122,123} and QDA{120,121}: Changed use of model

model\_lda.compute\_probabilities(Iris\_setosa\_observation, uninformative\_priors)

print(model\_lda)

model\_qda.compute\_probabilities(Iris\_setosa\_observation, uninformative\_priors)

print(model\_qda)

3. In both Exercise3.2\_Linear\_Discriminant\_Analysis.py and Exercise3.2\_Quadratic\_Discriminant\_Analysis.py,

    def compute\_probabilities(self, x, priors):

        likelihoods = self.compute\_likelihoods(x)

        number\_of\_classes = len(priors)

        array\_of\_prior\_probabilities = np.zeros(number\_of\_classes)

        index = 0

        for class\_name in self.class\_names:

            array\_of\_prior\_probabilities[index] = priors[class\_name]

            index += 1

        joint\_probabilities = np.multiply(likelihoods, array\_of\_prior\_probabilities)

        total\_and\_marginal\_probability = np.sum(joint\_probabilities)

        posterior\_probabilities = joint\_probabilities / total\_and\_marginal\_probability

        indices\_that\_sort\_posterior\_probabilities = np.argsort(posterior\_probabilities)[::-1]

        print('LDA Predicted Class:' + self.class\_names[indices\_that\_sort\_posterior\_probabilities[0]])

        print('LDA Class Posterior Probabilities:')

        for index in range(0, len(indices\_that\_sort\_posterior\_probabilities)):

            print(self.class\_names[indices\_that\_sort\_posterior\_probabilities[index]] + ': ' + str(posterior\_probabilities[indices\_that\_sort\_posterior\_probabilities[index]]))

        return posterior\_probabilities

4. Predicted Classes And Posterior Probabilities For Carl's Observations, LDA And QDA, And Uninformative Priors

Predicted Classes And Posterior Probabilities For Carl's Observations, LDA, And Uninformative Priors

Carl's First Observation:

LDA Predicted Class:Iris-versicolor

LDA Class Posterior Probabilities:

Iris-versicolor: 0.9999970568617268

Iris-virginica: 2.94313827322853e-06

Iris-setosa: 1.0221808316494076e-17

Carl's Second Observation:

LDA Predicted Class:Iris-versicolor

LDA Class Posterior Probabilities:

Iris-versicolor: 0.5602348418832768

Iris-virginica: 0.43976515811672334

Iris-setosa: 2.4269307963452403e-28

Predicted Classes And Posterior Probabilities For Carl's Observations, QDA, And Uninformative Priors

Carl's First Observation:

QDA Predicted Class:Iris-versicolor

QDA Class Posterior Probabilities:

Iris-versicolor: 0.9999701265523081

Iris-virginica: 2.9873447691956454e-05

Iris-setosa: 2.71126344764457e-52

Carl's Second Observation:

QDA Predicted Class:Iris-virginica

QDA Class Posterior Probabilities:

Iris-virginica: 0.5648248061588751

Iris-versicolor: 0.4351751938411249

Iris-setosa: 2.7265939261013007e-103

5. Predicted Classes And Posterior Probabilities For Carl's Observations, LDA And QDA, And Informative Priors

Predicted Classes And Posterior Probabilities For Carl's Observations, LDA, And Informative Priors

Carl's First Observation:

LDA Predicted Class:Iris-versicolor

LDA Class Posterior Probabilities:

Iris-versicolor: 0.9999896990918361

Iris-virginica: 1.0300908163807187e-05

Iris-setosa: 5.110866553279631e-18

Carl's Second Observation:

LDA Predicted Class:Iris-virginica

LDA Class Posterior Probabilities:

Iris-virginica: 0.7331468987640914

Iris-versicolor: 0.2668531012359085

Iris-setosa: 5.780022600099131e-29

Predicted Classes And Posterior Probabilities For Carl's Observations, QDA, And Informative Priors

Carl's First Observation:

QDA Predicted Class:Iris-versicolor

QDA Class Posterior Probabilities:

Iris-versicolor: 0.9998954507411951

Iris-virginica: 0.00010454925880481221

Iris-setosa: 1.355530487899472e-52

Carl's Second Observation:

QDA Predicted Class:Iris-virginica

QDA Class Posterior Probabilities:

Iris-virginica: 0.8195837457481516

Iris-versicolor: 0.18041625425184843

Iris-setosa: 5.651997976619851e-104