Programming Assignment 2

Click this link to download the Univariate Gaussian Winery notebook and then complete problems 1-7.

Click this link to download the Experiments with Bivariate Gaussian notebook and then complete problems 8-10.

Click this link to download the Bivariate Gaussian Winery Classification notebook and then complete problem 11.

Questions 1-7 correspond to the Winery classification using a one-dimensional Gaussian notebook.

Problem 1

3/3 points (graded)

For this problem, you need to first complete the Winery Classification Using a One-Dimensional Gaussian notebook.

In the `Wine` test set, how many points are there from each of the three classes?

a) Class 1

16

16

b) Class 2

17

17

c) Class 3

15

15

Submit

Problem 2

1/1 point (graded)
For which feature (0-12) does the distribution of (training set) values from winery 1 have the lowest standard deviation?

7

7

Submit

Problem 3

1/1 point (graded)
For which feature do the densities for class 1 and 3 overlap the most?

2

2

Submit

Problem 4

1/1 point (graded)

For which feature is class 3 the most spread out (relative to the other two classes)?

9

9

Submit

Problem 5

0 points possible (ungraded)

For which feature do the three classes seem the most separated?

6

6

Submit

Problem 6

3/3 points (graded)

Which three features (0-12) yield the smallest training error? List them in order of best first.

Feature with smallest training error:

6

6

Feature with second smallest training error:

12

12

Feature with third smallest training error:

9

9

Submit

Problem 7

3/3 points (graded)

Which three features (0-12) yield the smallest test error? List them in order, best first.

Feature with smallest test error:

6

6

Feature with second smallest test error:

9

9

Feature with third smallest test error:

10

10

Submit

Problem 8

1/1 point (graded)

For this problem you need to first complete the Experiments with Bivariate Gaussian notebook.
Problems 8-10 are about two-dimensional Gaussians centered at the origin, with covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_1^2 & c \\ c & \sigma_2^2 \end{pmatrix}$$

Here σ_1^2 and σ_2^2 are the variances of the first and second features, respectively, and c is the covariance between the two features.

Under what conditions does the Gaussian necessarily have contour lines that are perfectly circular?

- Condition A: $\sigma_1 = \sigma_2$
- Condition B: $c = 0$

- ( ) If condition A holds
- ( ) If condition B holds
- (•) If both A and B hold
- ( ) If either A or B holds

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Problem 9

1/1 point (graded)

Problems 8-10 are about two-dimensional Gaussians centered at the origin, with covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_1^2 & c \\ c & \sigma_2^2 \end{pmatrix}$$

Here σ_1^2 and σ_2^2 are the variances of the first and second features, respectively, and c is the covariance between the two features.

Under what conditions is the Gaussian titled downwards?

Condition A: $\sigma_1 > \sigma_2$

Condition B: $\sigma_1 < \sigma_2$

Condition C: $c < 0$

- ○ If condition A holds
- ○ If condition B holds
- ● If condition C holds
- ○ If condition C holds, as well as either A or B

✔

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Problem 10

1/1 point (graded)

Problems 8-10 are about two-dimensional Gaussians centered at the origin, with covariance matrix

$$\Sigma = \begin{pmatrix} \sigma_1^2 & c \\ c & \sigma_2^2 \end{pmatrix}$$

Here σ_1^2 and σ_2^2 are the variances of the first and second features, respectively, and c is the covariance between the two features.

Suppose the Gaussian has no tilt, and the contour lines are stretched vertically, so that the vertical stretch is twice the horizontal stretch. What can we conclude about the covariance matrix? (Assume the first feature is plotted along the horizontal dimension and the second feature along the vertical dimension.) Check all that apply.

- [ ] $\sigma_1 = 2\sigma_2$
- [ ] $\sigma_1^2 = 2\sigma_2^2$
- [x] $\sigma_2 = 2\sigma_1$
- [ ] $\sigma_2^2 = 2\sigma_1^2$
- [x] $c = 0$

✔

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Problem 11 corresponds to the Winery classification using the bi-variate Gaussian notebook.

Problem 11

3/3 points (graded)

For this problem you must first complete the Winery Classification Using the Bivariate Gaussian notebook.

What is the smallest achievable test error? Just give the **number** of errors, out of 48.

3

3

Which pair of features achieves this error?

Feature 1:

9

9

Feature 2:

6

6

Submit