✓ **Congratulations! You passed!**

Grade received 100%   To pass 80% or higher

[Go to next item]

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1. Compute the covariance matrix for the following dataset

$$\mathcal{D} = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 5 \\ 4 \end{bmatrix} \right\}$$

Here, every column vector represents a data point.

Do the exercise using pen and paper.

1 / 1 point

● $\begin{bmatrix} 4 & 2 \\ 2 & 1 \end{bmatrix}$

○ $\begin{bmatrix} 2 & 2 \\ 4 & 1 \end{bmatrix}$

○ $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$

✓ **Correct**
Good job!

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2. Consider a data set $\mathcal{D}$ with covariance matrix $\begin{bmatrix} 3 & 2 \\ 2 & 4 \end{bmatrix}$.

What is the covariance matrix if we multiply every vector in $\mathcal{D}$ by 2?

1 / 1 point

● $\begin{bmatrix} 12 & 8 \\ 8 & 16 \end{bmatrix}$

○ $\begin{bmatrix} 3 & 2 \\ 2 & 4 \end{bmatrix}$

○ $\begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$

○ $\begin{bmatrix} 16 & 8 \\ 8 & 12 \end{bmatrix}$

✓ **Correct**
Yes, every element in the covariance matrix is multiplied by 4.

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3. Consider the data set $\mathcal{D} = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 7 \\ 4 \end{bmatrix} \right\}$ with covariance matrix $\begin{bmatrix} 9 & 3 \\ 3 & 1 \end{bmatrix}$.

Compute the new covariance matrix when we add $\begin{bmatrix} 2 \\ 2 \end{bmatrix}$ to each element in $\mathcal{D}$.

1 / 1 point

○ $\begin{bmatrix} 11 & 5 \\ 5 & 3 \end{bmatrix}$

● $\begin{bmatrix} 9 & 3 \\ 3 & 1 \end{bmatrix}$

○ $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

✓ **Correct**
Well done. The covariance will not change.

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4. Provide a valid 2x2 covariance matrix by replacing the -1 entries in the code below.

1 / 1 point

```
1   def covariance_matrix():
2       """Return a valid 2x2 covariance matrix"""
3       covariance_matrix = np.array([[9, 3],
4                                     [3, 1]])
5       return covariance_matrix
6
7   print(covariance_matrix())
```

[Run]
[Reset]

```
[[9 3]
 [3 1]]
```

✓ **Correct**
Good job!

5. We are looking at a data set $\mathcal{D}$ where every element in $\mathcal{D}$ consists of an x and y coordinate. The data covariance matrix is given by

$$\begin{bmatrix} 1 & 0.8 \\ 0.8 & 1 \end{bmatrix}$$

Which of the following statements is correct?

- ⦿ x and y are positively correlated, i.e., when x increases then y increases on average, and vice versa.
- ○ x and y are negatively correlated, i.e., when x increases then y decreases on average, and vice versa.
- ○ x and y are uncorrelated, i.e., when x increases then y does not change on average (and vice versa).

✓ **Correct**
   Well done!