

# Finding the Eigenvectors and Eigenvalues

# What are Eigenvectors?

$$\text{Cov } Z = \lambda Z$$

Covariance  
matrix



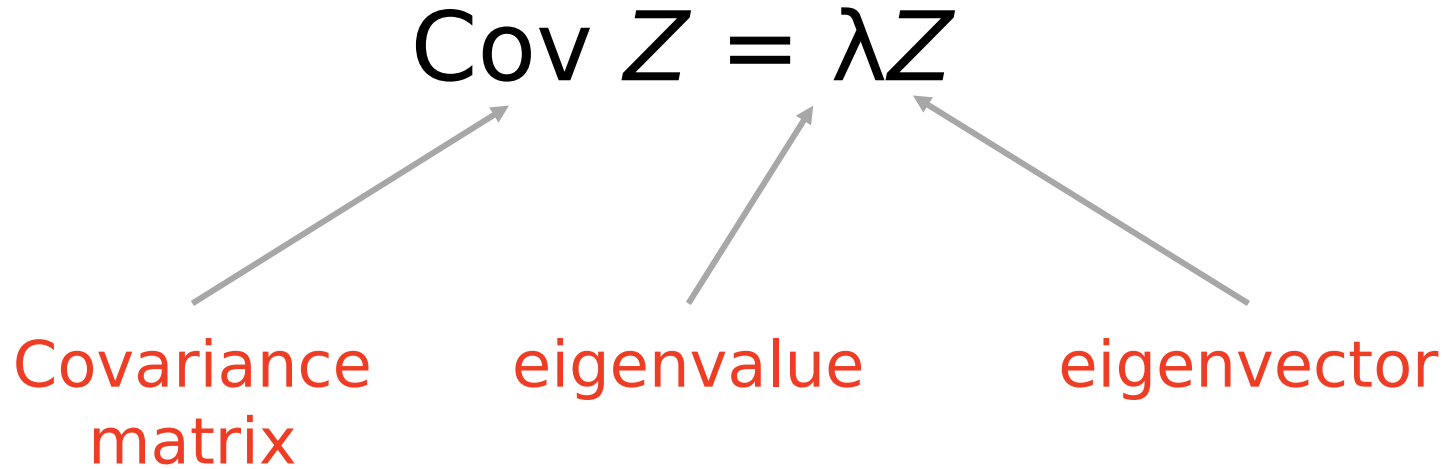
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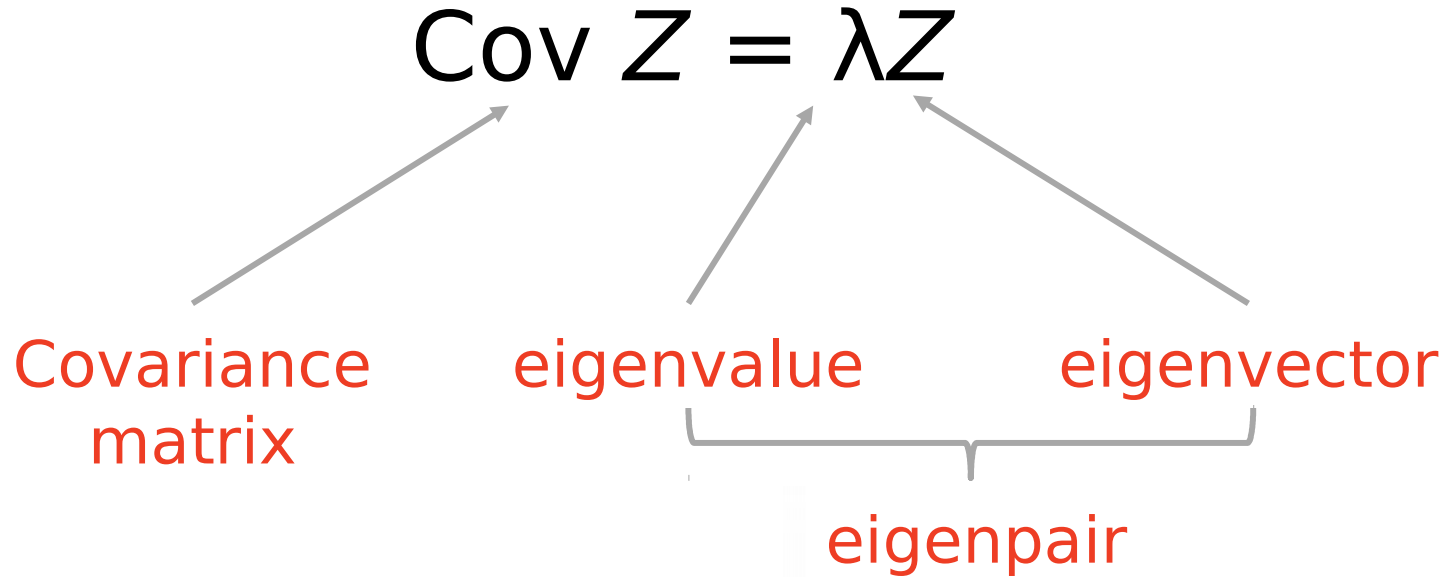
Covariance  
matrix

eigenvector

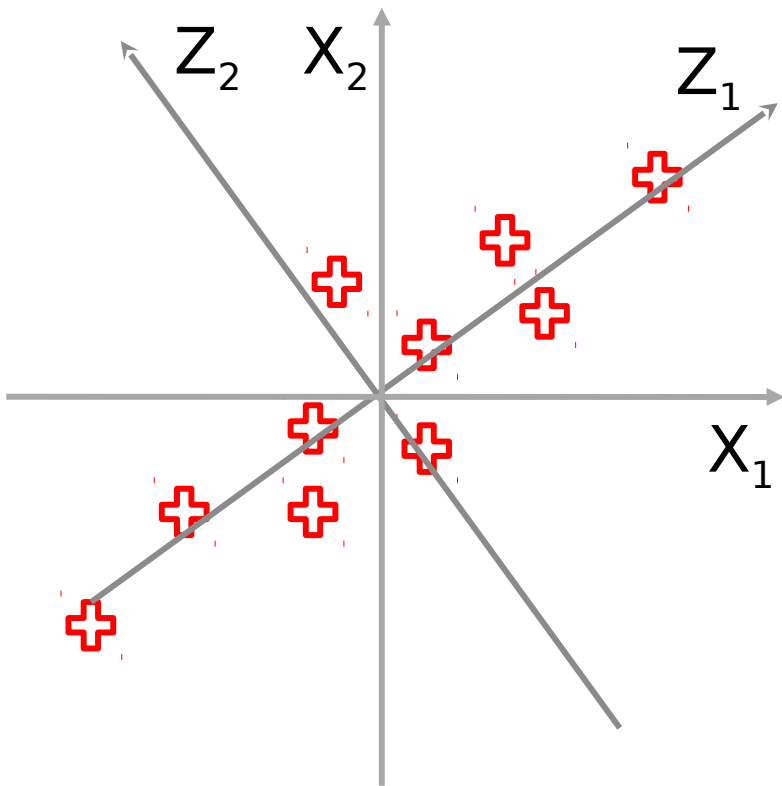
# What are Eigenvectors?



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# Why find Eigenvectors?



$Z_1$  and  $Z_2$  are eigenvectors

$Z_1$	$\lambda_1$
$Z_2$	$\lambda_2$
...	...
$Z_n$	$\lambda_n$

# Selecting the Principal Components

# Selecting the Principal Components

$$C = \begin{bmatrix} 5 & -1 & 0 \\ -1 & 8 & 3 \\ 0 & 3 & 1 \end{bmatrix}$$

$$\lambda_1 = 4.82,$$

$$\lambda_2 = -0.13,$$

$$\lambda_3 = 9.31$$

$$V_1 = \begin{bmatrix} - \\ 0.919 \\ 0.176 \\ - \\ 0.353 \end{bmatrix}$$

$$V_2 = \begin{bmatrix} - \\ 0.332 \\ 0.138 \\ 0.933 \end{bmatrix}$$

$$V_3 = \begin{bmatrix} 0.213 \\ 0.974 \\ - \\ 0.069 \end{bmatrix}$$



# Selecting the Principal Components

Step 1: Arrange the magnitudes of eigenvalues in decreasing

$$\begin{array}{lll} \text{order} & \lambda_1 = 4.82, & \lambda_2 = -0.13, & \lambda_3 = 9.31 \\ & |\lambda_1| = 4.82, & |\lambda_2| = 0.13, & |\lambda_3| = 9.31 \\ & |\lambda_3| > |\lambda_1| > |\lambda_2| \end{array}$$

# Selecting the Principal Components

Step 2: Calculate the percentage of variance explained by each eigenvector

$$|\lambda_3| = 9.31, \quad |\lambda_1| = 4.82, \quad |\lambda_2| = 0.13$$

$$|\lambda_1| + |\lambda_2| + |\lambda_3| = 14.26 = \text{sum}$$

$$|\lambda_3|/\text{sum} = 0.65,$$

$$|\lambda_1|/\text{sum} = 0.34,$$

$$|\lambda_2|/\text{sum} = 0.01$$

# Selecting the Principal Components

Step 3: Choose the top k eigenvectors as the Principal

Components

$ \lambda_3 /\text{sum} = 0.65$	} 99% 100%
$ \lambda_1 /\text{sum} = 0.34$	
$ \lambda_2 /\text{sum} = 0.01$	

Choose  $V_3$  and  $V_1$  as the Principal Components

Thank  
You!