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Machine Learning with Python-From Linear Models to Deep Learning

9. Gaussian Generative models

Exercises due Apr 19, 2023 08:59 -03 Completed

Gaussian Generative Models

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Multivariate Gaussian Random Vector

A random vector $\mathbf{X} = \left(X^{(1)}, \ldots, X^{(d)}\right)^T$ is a **Gaussian vector** , or **multivariate Gaus**
, if any linear combination of its components is a (univariate) Gaussian variable or a con
variable with zero variance), i.e., if $\alpha^T \mathbf{X}$ is (univariate) Gaussian or constant for any co
$\alpha \in \mathbb{R}^d$.

The distribution of $\mathbf{X}$, the d**-dimensional Gaussian or normal distribution** , is complet
vector mean $\mu = \mathbf{E}[\mathbf{X}] = \left(\mathbf{E}\left[X^{(1)}\right], \ldots, \mathbf{E}\left[X^{(d)}\right]\right)^T$ and the $d \times d$ covariance mat
then the pdf of $\mathbf{X}$ is

$$f_{\mathbf{X}}(\mathbf{x}) = \frac{1}{\sqrt{(2\pi)^d \det(\Sigma)}} e^{-\frac{1}{2}(\mathbf{x}-\mu)^T \Sigma^{-1}(\mathbf{x}-\mu)}, \quad \mathbf{x} \in \mathbb{R}^d$$

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