Unnormalized product of MVN

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Abstract

MVN or multivariate Gaussian distribution is a generalization of the univariate normal distribution that we all love and dread. While taking a computational data science class, we had to find the unnormalized product of two joint normal distributions (MVN). There doesn't seem to be much literature on that; I wanted to write down how we can approach the problem and test my mathjax to its limits.

Solution

We know that MVN has the PDF form

$$\mathcal{N}(\vec{x}|\vec{\mu},\Sigma)=(2\pi)^{-\frac{D}{2}}||\Sigma||^{-\frac{1}{2}}\exp(-\frac{1}{2}(\vec{x}-\vec{\mu})^{\top}\Sigma^{-1}(\vec{x}-\vec{\mu})) \tag{1}$$