PRML by Bishop, chapter 1, Section 1.2.4 - The Gaussian Distribution - Equation 1.54, Pg. 27

Log-likelihood Function of data drawn from a Gaussian Distribution

$$p(\underline{x} \mid \mu, \sigma^2) = \prod_{n=1}^{N} N(x_n \mid \mu, \sigma^2) - (1.53)$$

$$= \prod_{n=1}^{N} \left(\frac{1}{\sqrt{2\pi\sigma^2}}\right) \exp\left[-\frac{(x_n-\mu)^2}{2\sigma^2}\right] - (a)$$

$$= \left[(2\pi)^{\frac{-N}{2}} (\sigma^2)^{\frac{-N}{2}}\right] \prod_{n=1}^{N} \exp\left[-\frac{(x_n-\mu)^2}{2\sigma^2}\right] - (b)$$

$$\Rightarrow \ln\left[p(\underline{x} \mid \mu, \sigma^2)\right]$$

$$= \frac{-1}{2\sigma^2} \sum_{n=1}^{N} (x_n-\mu)^2 - \frac{N}{2}\ln(\sigma^2) - \frac{N}{2}\ln(2\pi)$$

$$\hookrightarrow (1.54)$$