Formula for the unbiased sample variance

$$f_1 \quad = \quad f_1 \begin{bmatrix} x_{11} \\ x_{21} \\ x_{31} \end{bmatrix} \quad f_2 = \begin{bmatrix} x_{12} \\ x_{22} \\ x_{32} \end{bmatrix} \quad f_3 = ... \quad means = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} \quad cov.matrix = \begin{bmatrix} \sigma_{11} & \sigma_{21} & \sigma_{31} \\ \sigma_{12} & \sigma_{22} & \sigma_{32} \\ \sigma_{13} & \sigma_{23} & \sigma_{33} \end{bmatrix}$$

$$\begin{aligned} \sigma_{ij} &= E\left[\sum_{n=1}^{N}(x_{in} - \mu_i)(x_{jn} - \mu_j)\right] \\ &= \frac{\sum_{n=1}^{N}(x_{in} - \mu_i)(x_{jn} - \mu_j)}{N-1} \end{aligned}$$

ML estimation of the variance would be the same formula, but then normalized by N instead. A feature vector consists of measurements of different features from one object. Therefore the resulting covariance matrix is a 3x3 matrix.