Training Data $= \{\mathbf{x}_i\}_{i=1}^{K}$

$$\boldsymbol{\mu} = \sum_{k=1}^{K} \mathbf{x}_k \quad\Rightarrow\quad \Sigma = \sum_{k=1}^{K} (\mathbf{x}_k - \boldsymbol{\mu})(\mathbf{x}_k - \boldsymbol{\mu})^t \quad\Rightarrow\quad$$ Find eigenvectors of Σ

Sort eigenvalues according to the descending order of eigenvalues

Choose the first N eigenvectors $\mathbf{e}_1, \mathbf{e}_2, \ldots, \mathbf{e}_N$

Transformation Matrix

$$T = \begin{bmatrix} e_{1,1} & e_{2,1} & \cdots & e_{N,1} \\ e_{1,2} & e_{2,2} & \cdots & e_{N,2} \\ \vdots & \vdots & \ddots & \vdots \\ e_{1,256} & e_{2,256} & \cdots & e_{N,256} \end{bmatrix}$$

$\mathbf{e}_1 \quad \mathbf{e}_2 \quad\quad \mathbf{e}_N$

Reduce Dimension from 256 to N for testing data

$$\mathbf{y}_i = \begin{bmatrix} y_{i,1} \\ y_{i,2} \\ \vdots \\ y_{i,N} \end{bmatrix} = T^t(\mathbf{x}_i - \boldsymbol{\mu}) = T^t \begin{bmatrix} x_{i,1} - \mu_1 \\ x_{i,2} - \mu_2 \\ \vdots \\ x_{i,256} - \mu_2 \end{bmatrix}$$

New data

Original data

$$\text{MLE}: \boldsymbol{\mu}_y = \sum_{i=1}^{K} \mathbf{y}_i, \ \Sigma_y = \frac{1}{K-1}\sum_{i=1}^{K}(\mathbf{y}_i - \boldsymbol{\mu}_y)(\mathbf{y}_i - \boldsymbol{\mu}_y)^t$$

Bayesian Classifier