# Minimum-Distance Classifiers

Template matching can easily be expressed mathematically. Let $\mathbf{x}$ be the feature vector for the unknown input, and let $\mathbf{m}_1$, $\mathbf{m}_2$, ..., $\mathbf{m}_c$ be templates (i.e., perfect, noise-free feature vectors) for the c classes. Then the error in matching $\mathbf{x}$ against $\mathbf{m}_k$ is given by

$$\| \mathbf{x} - \mathbf{m}_k \| .$$

Here $\| \mathbf{u} \|$ is called the **norm** of the vector $\mathbf{u}$. A minimum-error classifier computes $\| \mathbf{x} - \mathbf{m}_k \|$ for k = 1 to c and chooses the class for which this error is minimum. Since $\| \mathbf{x} - \mathbf{m}_k \|$ is also the distance from $\mathbf{x}$ to $\mathbf{m}_k$, we call this a **minimum-distance** classifier. Clearly, a template matching system is a minimum-distance classifier.
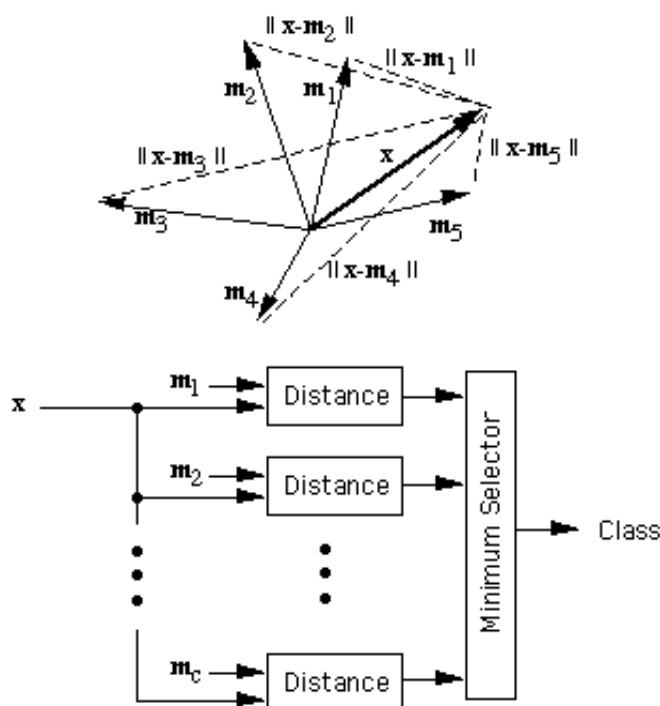
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