Using Examples for Classification  
A Simple Algorithm

Suppose we model a class by its average example and predict the class of \( \mathbf{x} \) by testing which average is closest.

\[
\mathbf{c}_+ = \sum_{y_i=1} \mathbf{x}_i / m_+ \quad \mathbf{c}_- = \sum_{y_i=-1} \mathbf{x}_i / m_-
\]

\( m_+ \) and \( m_- \) are respectively the number of positive and negative examples.

The class of \( \mathbf{x} \) is predicted by:

\[
\text{sign} \left( \| \mathbf{c}_- - \mathbf{x} \|^2 - \| \mathbf{c}_+ - \mathbf{x} \|^2 \right)
\]

\[
\text{sign} \left( \| \mathbf{c}_- - \mathbf{x} \|^2 - \| \mathbf{c}_+ - \mathbf{x} \|^2 \right) \\
= \text{sign} \left( 2(\mathbf{x} \cdot \mathbf{c}_+) - 2(\mathbf{x} \cdot \mathbf{c}_-) \\
+ (\mathbf{c}_- \cdot \mathbf{c}_-) - (\mathbf{c}_+ \cdot \mathbf{c}_+) \right) \\
= \text{sign} \left( \frac{2 \sum_{y_i=1} (\mathbf{x} \cdot \mathbf{x}_i)}{m_+} - \frac{2 \sum_{y_i=-1} (\mathbf{x} \cdot \mathbf{x}_i)}{m_-} + b \right)
\]

where \( b = (\mathbf{c}_- \cdot \mathbf{c}_-) - (\mathbf{c}_+ \cdot \mathbf{c}_+) \). Like a SVM, the decision function has the form:

\[
\text{sign} \left( b + \sum_i \alpha_i y_i k(\mathbf{x} \cdot \mathbf{x}_i) \right)
\]
Example 1 of Simple Algorithm

Example 2 of Simple Algorithm
Example 3 Using Gaussian Kernel

Example 3 Decision Boundary
Comparison to Properties of SVMs

SVMs also represent decision boundaries as a linear combination of examples.

SVMs weights ($\alpha_i$) will range between 0 and a specified constant $C$.

SVMs use zero weights for correctly classified examples “far away” from the decision boundary.