

# SUPPORT VECTOR MACHINES

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## 1. FINAL OUTPUTS

- (1) Support Vectors:  $set([0, 2, 4])$
- (2) Slack Vectors:  $set([4, 6])$

## 2. EXPLANATION

The code first finds the weight function given the input points. This is calculated as:

$$\mathbf{w} = \sum_i^n \alpha_i y_i \mathbf{x}_i$$

Using the primal weight vector I can calculate the gammas as follows:

$$\gamma_j = \left| \frac{\mathbf{w}^T \mathbf{x}_j + b}{\|\mathbf{x}\|} \right|$$

If the gamma value of the point is within the specified tolerance of the minimum gamma value, then the vector is considered a support vector. The support vectors are the points that lie on the edge of our margin. We use a tolerance since floating point numbers don't produce exact answers when computed. The point is a slack vector if it fails to meet the following condition:

$$y_j * \mathbf{w}^T \mathbf{x}_j + b \geq 1$$

The slack vectors are the points that are misclassified by our data.