- Objective: maximize the geometric "margin" between the separating hyperplane and the points that lay closest to that plane.
- Key concepts:

1. A hyperplane can be characterized by a vector, , that is orthogonal to it, and a bias, , expressing its distance from the origin, .

2. The distance, , from any point, , to has a nice closed form solution.

Linear SVM: problem formulation

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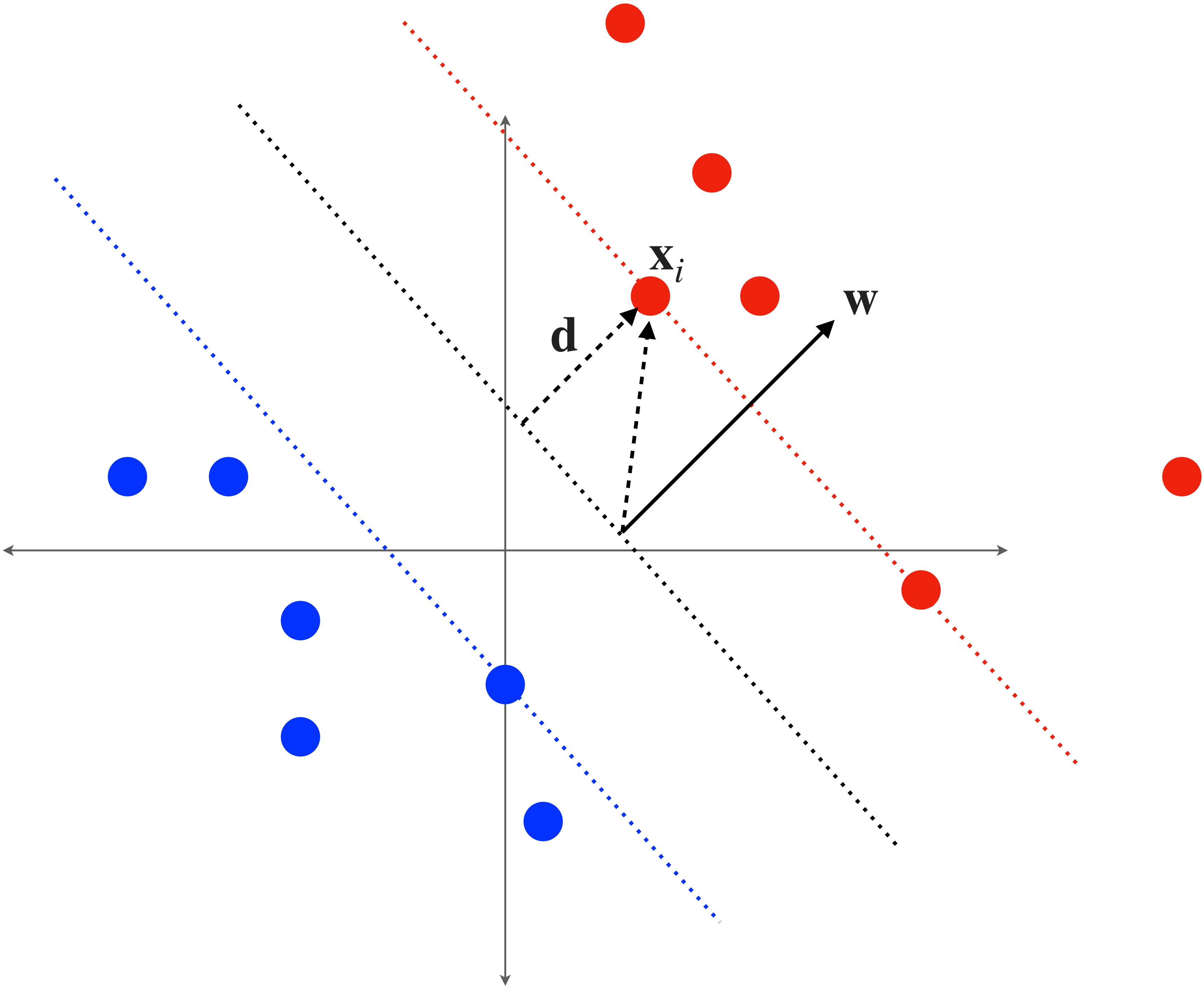


$\mathbf{x}_i$
$\mathbf{w}$
$\mathbf{d}$

$$\|\mathbf{d}\|_2$$

$$\mathbf{X}_i$$

W

distance from any point $\mathbf{x}_i$ to the hyperplane $\mathbf{w}$

$$\|\mathbf{d}\|_2 = \frac{\mathbf{w}^T\mathbf{x} + b}{\|\mathbf{w}\|_2}$$

W

we wish to maximize $\|\mathbf{d}\|_2$ for $\mathbf{x}_i$ closest to $\mathbf{w}$

b

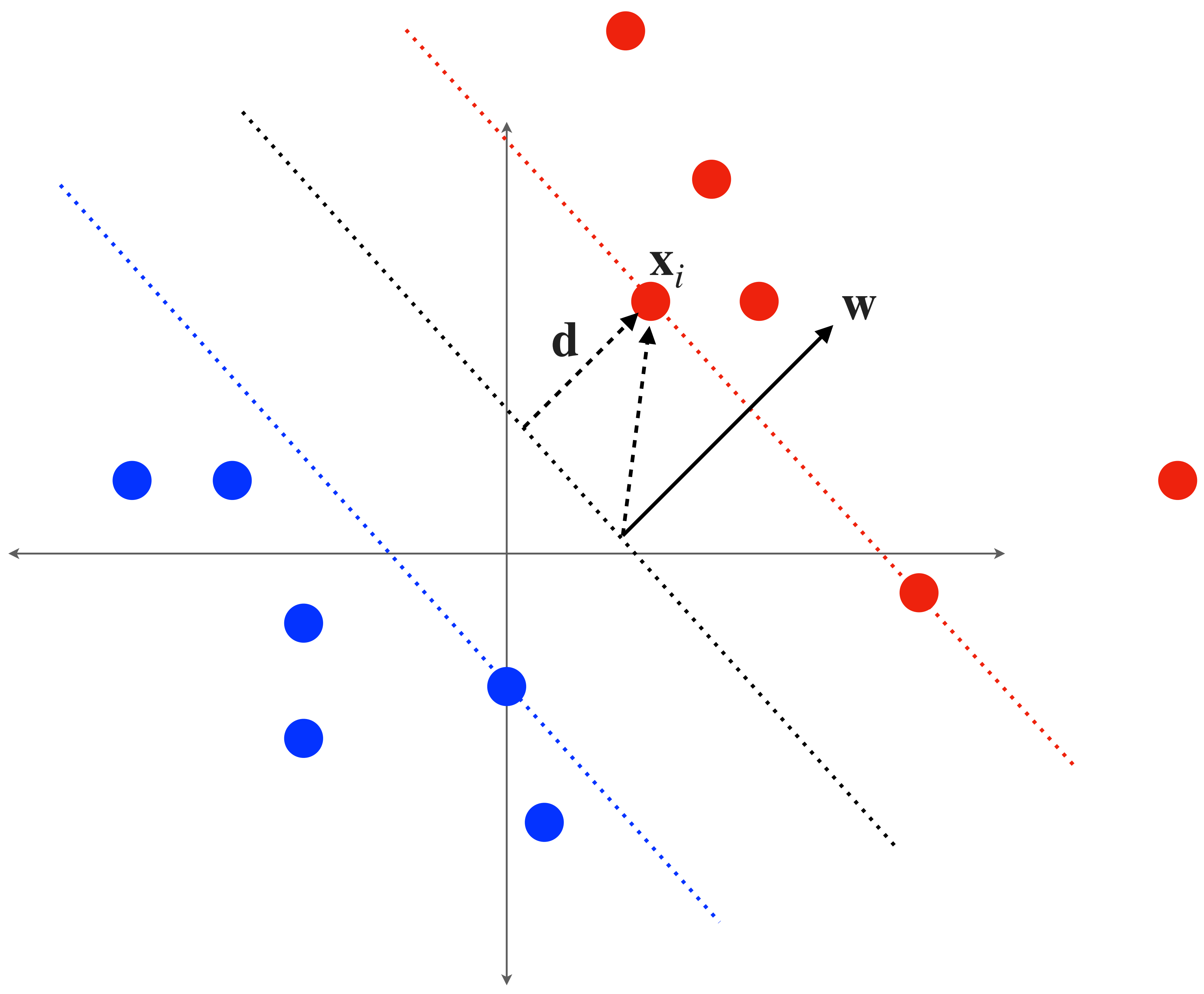
0

Linear SVM: problem formulation

- Objective: maximize the geometric "margin" between the separating hyperplane and the points that lay closest to that plane.
- Key concepts:

  1. A hyperplane can be characterized by a vector, $\mathbf{w}$, that is orthogonal to it, and a bias, b, expressing its distance from the origin, $\mathbf{0}$.

  2. The distance, $\|\mathbf{d}\|_2$, from any point, $\mathbf{x}_i$, to $\mathbf{w}$ has a nice closed form solution.



distance from any point $\mathbf{x}_i$ to the hyperplane $\mathbf{w}$

$$\|\mathbf{d}\|_2 = \frac{\mathbf{w}^T\mathbf{x} + b}{\|\mathbf{w}\|_2}$$

we wish to maximize $\|\mathbf{d}\|_2$ for $\mathbf{x}_i$ closest to $\mathbf{w}$

Linear SVM: objective

starting objective: $$\gamma_{\mathbf{w},b} = \min_{\mathbf{x}_i \in \mathbf{X}} \frac{|\,\mathbf{w}^T\mathbf{x}_i + b\,|}{\|\mathbf{w}\|_2}$$