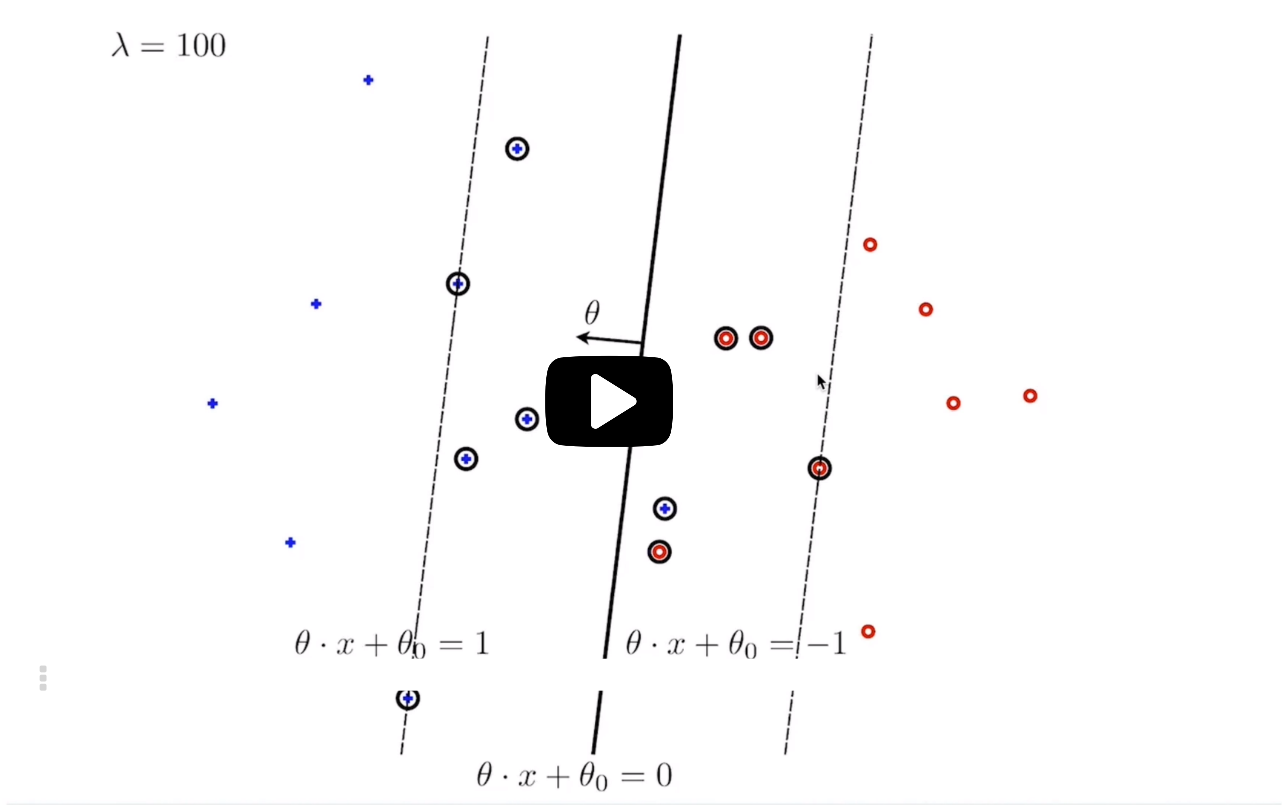
2. Review and the Lambda parameter

Introduction and Review



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so some of the margin constraints are violated.

So I will incur losses on some of those points already here.

As I start increasing the value of the regularization parameter

lambda, the solution starts changing as before,

being guided more by where the bulk of the points

are similar to before.

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Distance from a line to a point in terms of components

1/1 point (graded)

In a 2 dimensional space, a line L is given by $L : ax + by + c = 0$, and a point P is given by $P = (x_0, y_0)$. What is d, the shortest distance between L and P? Express d in terms of a, b, c, x_0, y_0.

abs(a*x_0+b*y_0+c)/sqrt ✔ **Answer:** abs(a*x_0 + b*y_0 +c) / sqrt(a^2 + b^2)

STANDARD NOTATION

Solution:

Use the projection equation. Here θ is $[a, b]$, θ_0 is c and the point is $[x_0, y_0]$.

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Answers are displayed within the problem

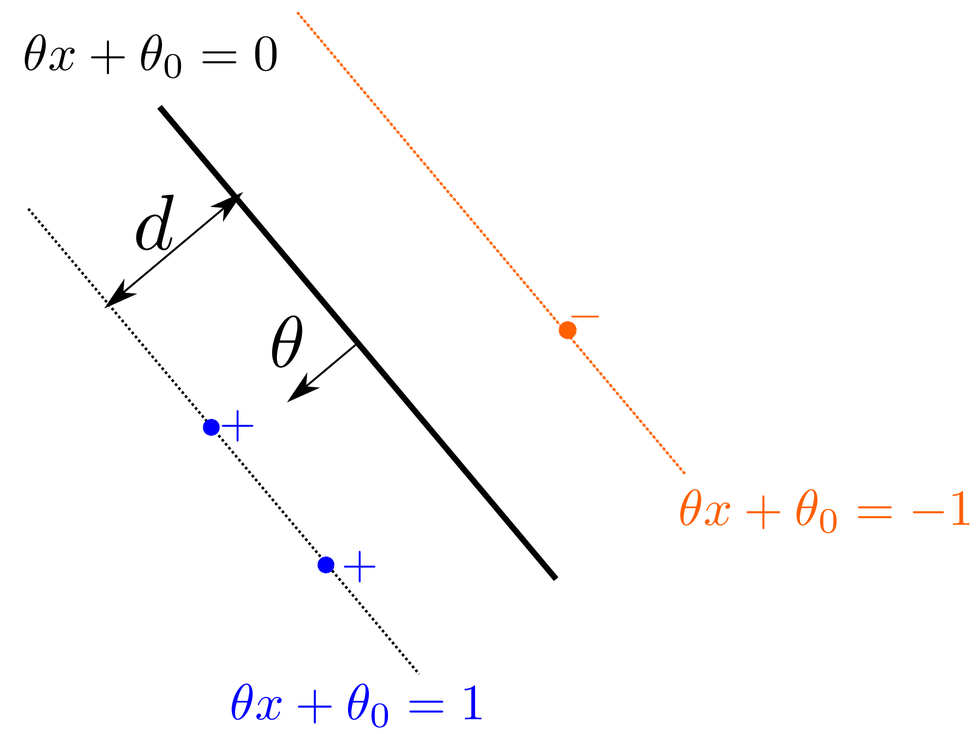
Varying Lambda in the Geometric Sense

1/1 point (graded)

Remember that the objective

$$J(\theta,\theta_0) = \frac{1}{n}\sum_{i=1}^{n} \text{Loss}_h\left(y^{(i)}\left(\theta\cdot x^{(i)}+\theta_0\right)\right)+\frac{\lambda}{2}\,||\,\theta\,||^2.$$

In the picture below, what happens to d, the distance between the decision boundary and the margin boundary, as we increase λ?



- d decreases
- d increases ✔
- d converges to λ

Hint: You can answer with your intuition in this question. To see whether d converges to λ, think of a simple setting where we are working in 1 dimension with just two points with labels $x_1 = -1, x_2 = 2, y_1 = -1, y_2 = 1$and assume that λ is large enough where it dominates the loss function and pushes θ close enough to 0 where all points are margin violators.

Solution:

Increasing λ means we put more weight on maximizing the margin. Thus d increases.
It is not true that d always converges to λ as λ increases. Here is a counter example:
Consider a simple setting where we are working in 1 dimension with just two points with labels $x_1 = -1, x_2 = 2, y_1 = -1, y_2 = 1$and assume that λ is large enough where it dominates the loss function and pushes θ close enough to 0 where all points are margin violators.

$$\begin{aligned} J &= \frac{1}{2}[(1-\theta+\theta_0)+(1-2\theta-\theta_0)]+\frac{\lambda}{2}\theta^2 \\ &= \frac{2-3\theta}{2}+\frac{\lambda}{2}\theta^2. \end{aligned}$$

Solve this explicitly by taking $\dfrac{\partial J}{\partial \theta} = 0$:

$$\begin{aligned} \frac{-3}{2}+\lambda\theta &= 0 \\ \theta &= \frac{3}{2\lambda} \\ d &= \frac{1}{\theta} = \frac{2}{3}\lambda. \end{aligned}$$

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