**L₂ Norm (Euclidean Norm)**

\[ ||w||₂ = \sqrt{w_1^2 + w_2^2 + \ldots + w_n^2} \]

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**SUM**

Hyperplane will lie exactly halfway between the nearest positive point and nearest negative point.

Margin:

\[ \text{WIDTH} = (x_+ - x_-) \cdot \frac{w}{||w||} = \frac{2}{||w||} \]

\[ wX_+ + b = 1 \]
\[ wX_- + b = -1 \]

\[ \max \frac{2}{||w||} \sim \max \frac{1}{||w||} \sim \min ||w|| \sim \min \frac{1}{||w||} \]

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**Maximum Likelihood**

\[ g(P) = 3 \log P + \log (1 - P) \]

\[ \frac{\partial}{\partial P} g(P) = 3 \cdot \frac{1}{P} + \frac{1}{1-P} \cdot (-1) = 0 \iff 3(1-P) - P = 0 \]
\[ 3 - 4P = 0 \]
\[ P = \frac{3}{4} \]

\[ \frac{\partial^2}{\partial P^2} g(P) = 3 \cdot \frac{-1}{P^2} + \frac{-1}{(1-P)^2} < 0 \]

\[ \frac{d}{dP} \left( \frac{d}{dP} g(P) \right) \]
\[ \hat{y} = wx + b \]

If \( y \) is positive,

\[ w' = w + x \]
\[ b' = b + 1 \]

\[ \hat{y}' = w'x + b' \]
\[ = (w + x)x + (b + 1) \]
\[ = \frac{wx + b + x^2 + 1}{\hat{y}} \geq 1 \]