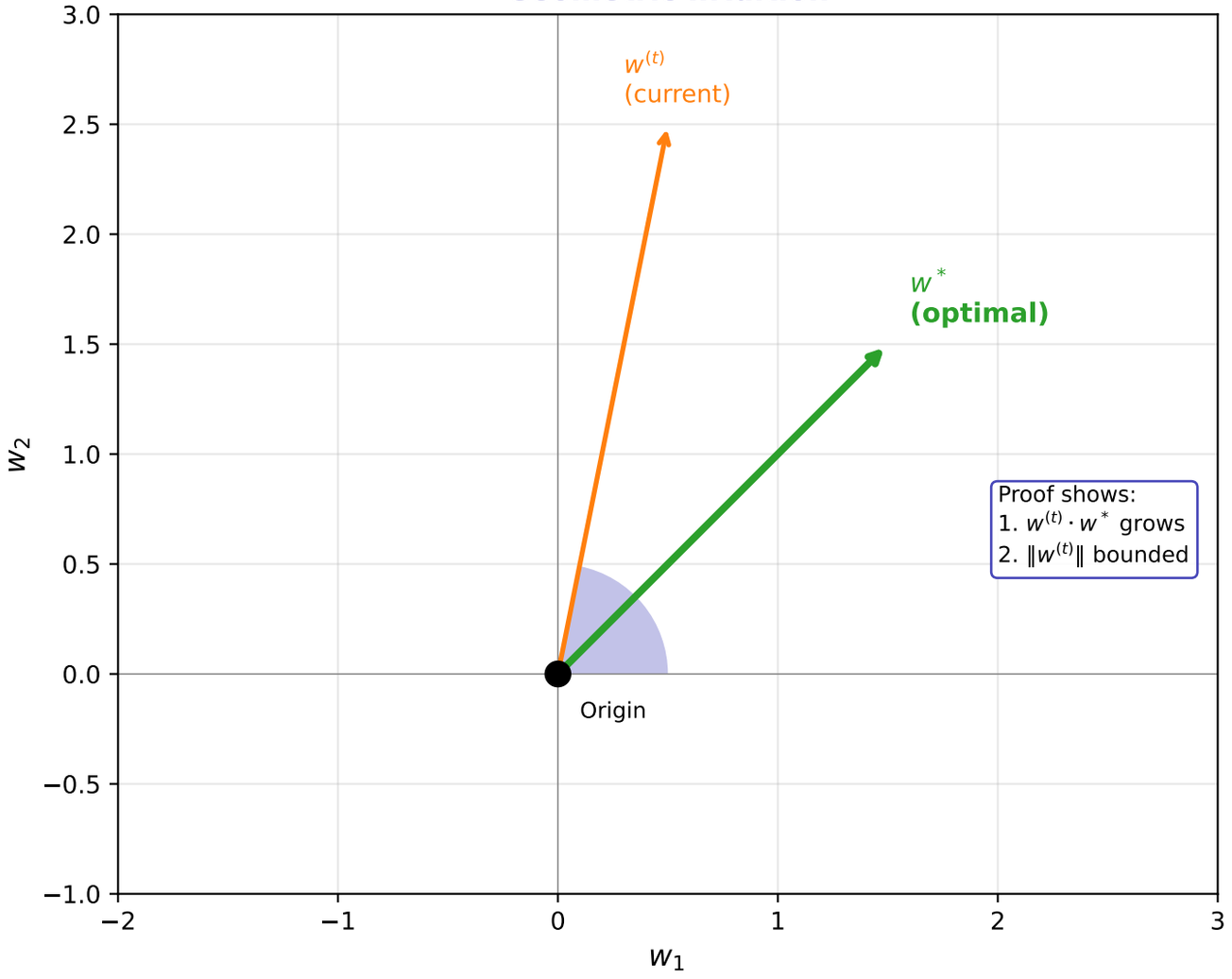
Perceptron Convergence: Why It Always Works (for Separable Data)

Geometric Intuition



Perceptron Convergence Theorem

Theorem (Novikoff, 1962):

If training data is linearly separable with margin gamma > 0, then the perceptron learning algorithm makes at most

(R / gamma)^2

mistakes before converging.

Where:
- R = maximum norm of any input
- w* = any separating hyperplane
- gamma = margin (minimum distance to boundary)

Implications:
- Convergence is GUARANTEED for separable data
- Number of mistakes is FINITE
- Bound depends on data geometry (margin)
- Does NOT guarantee finding optimal solution