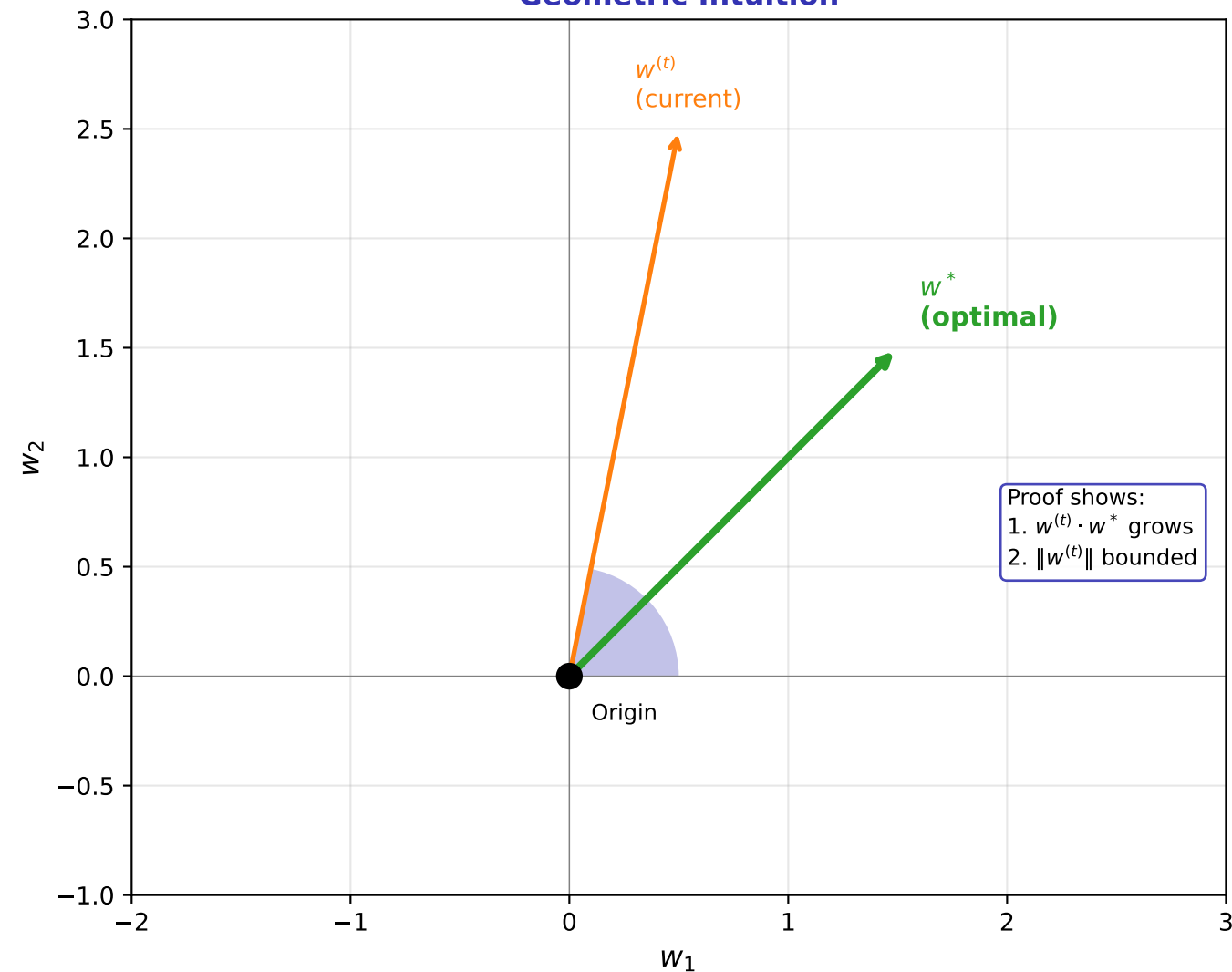


# Perceptron Convergence: Why It Always Works (for Separable Data)

## 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