

Project 16: Hebbian plasticity as principal component analysis

1) Implement the learning rule described in Oja (1982) and illustrate how it extracts the first principal component for synaptic inputs sampled from a 2D Gaussian with an anisotropic covariance matrix.

2) What does the “forgetting” term imply about the relationship between postsynaptic activity and synaptic plasticity? Use this to explain why blocking activity reduces synaptic strength (Turrigiano et al., 1998). Show a simulation of this phenomenon.

3) Turrigiano observed that the data were consistent with multiplicative scaling of synaptic strength. Is Oja’s rule consistent with this? Show a simulation and compare it to the data.

References:

Oja, E. (1982). Simplified neuron model as a principal component analyzer. *Journal of Mathematical Biology*, 15, 267-273.

Turrigiano, G. G., Leslie, K. R., Desai, N. S., Rutherford, L. C., & Nelson, S. B. (1998). Activity-dependent scaling of quantal amplitude in neocortical neurons. *Nature*, 391, 892-896.