Homeostatic Recognition Circuits of Recognition Emulating Network-wide Bursting

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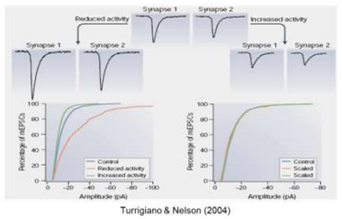
Homeostatic Plasticity

Evidence

↑ Frequency → → ↓ Synaptic Strength
↓ Frequency → → ↑ Synaptic Strength
Frequency x Strength = Baseline



Turrigiano & Nelson (2004)

Hypothesis:
real time balance

Pre-Synaptic Regulatory Feedback

Model:

Outputs: y_A

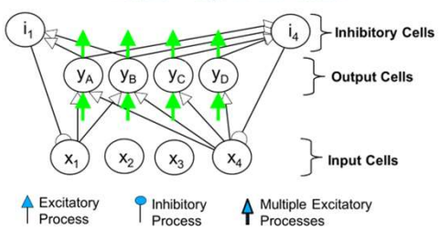
Stabilization
In Real Time

M M

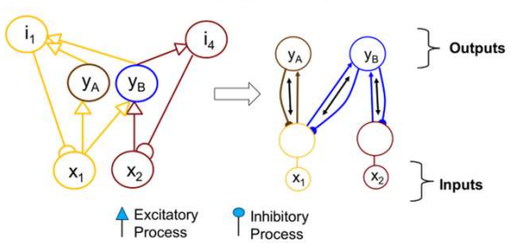
e_1

Inputs: x_1

Hypothesized Homeostatic Regulatory Feedback Model
Feedback Loops are Intermeshed



Rewritten to be simpler & simplest circuit



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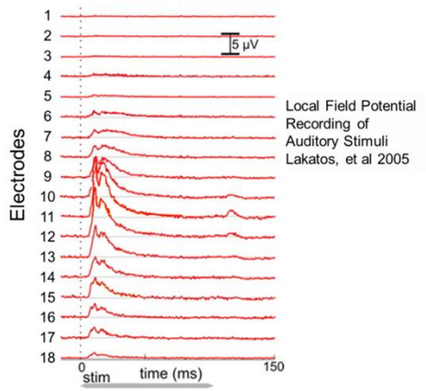
Network Wide Bursting

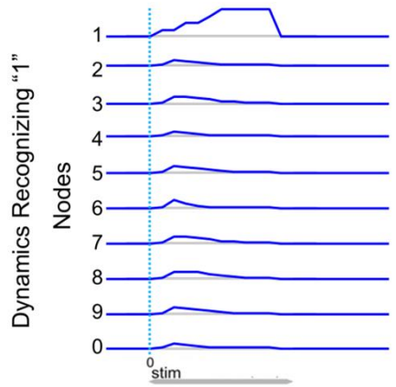
Brain activation increases quickly then decreases slowly towards baseline



Local Field Potential Recording of Auditory Stimuli Lakatos, et al 2005

Ubiquitous in every type of organism, isolated dissections & neurons grown in a dish

Homeostatic Regulatory Feedback Network

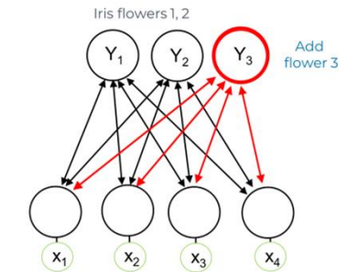


MNIST Digit Recognition Data Example

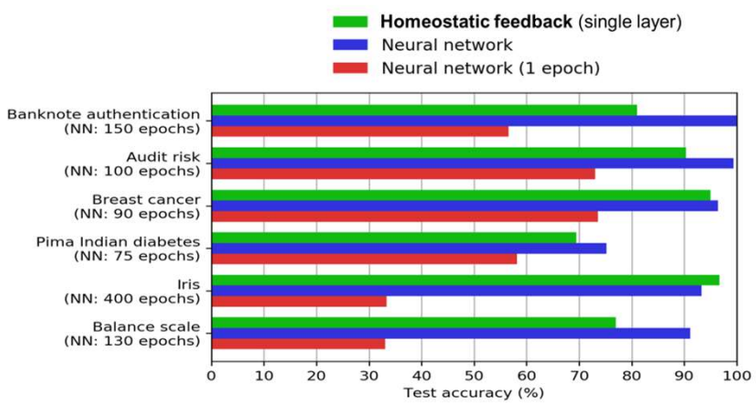
One Shot : Adding Node Without Retraining

Iris Example

1. Train on 2 Iris flowers
2. Test accuracy on test set for 2 flowers (99-100%)
3. Designate new node for flower 3
4. Train on flower 3 data and node Only
5. Test updated network on test data (97-100% no loss in performance)



Benchmark Tests Comparing Learning with Quick Learning



Summary	**Homeostatic**	**Neural Net**	**Bayesian**	**Brain**
Recognition Method:	Input ⇄ Output Homeostatic Feedforward-Feedback	Input → Output Y=WX Feedforward	$= \frac{P(X\|Y)*P(Y)}{P(X)}$ Bayes Rule	? Unknown
Connectionist:	Yes	Yes	No	Yes
Priors:	Yes	No	Yes	Yes
Likelihoods:	Yes $w=\mu(\vec{X}\|\vec{Y})$	No	Yes	Yes
Distributions:	Estimated during recognition	Set by rehearsal during training	Explicitly Calculated	?
Easier Learning & Update:	Yes	No	No	Yes
Network-Wide Bursting:	Yes	No	No	Yes