

Improving Cell Assembly Categories by Fatigue
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Human concepts are represented by neural circuits called Cell Assemblies (CAs). We have a simulator based on neurons that are fatiguing leaky integrators, with Hebbian learning rules to modify synaptic strength. Using this simulator we have implemented several categorisation tasks including Hierarchical categories, standard categorisation benchmarks, and Information retrieval tasks. However, these tasks have all had to cope with the problem of incorrectly recruited neurons.

A neuron is recruited into a CA by having its synaptic weight both to and from the CA increased. This causes the neuron to fire whenever the CA is ignited, and this supports the increased synaptic strength. If a neuron never occurs in the pattern, it may still be incorrectly recruited into a CA via spontaneous neural activation or overlapping CAs. So the neuron is incorrectly recruited into the CA.

A compensatory learning mechanism reduces the likelihood of this problem occurring, but does not erase it. We need to find a mechanism that allows incorrectly recruited neurons to eventually leave a CA.

One way to do this is to reduce the amount of energy that is retained. Unfortunately, this reduces the persistence of a CA. Another way is to modify the fatigue mechanism. Prior to this we have merely increased fatigue by a constant when a neuron fires, and reduce it by a constant when the neuron does not fire. By modifying this so that the fatigue is reduced proportionally to its current fatigue levels, we reduce the likelihood that an incorrectly recruited neuron fires. In the long run, this reduces the synaptic strength between it and the CA. When combined with the compensatory learning mechanism, this allows the ready removal of the neuron from the CA. Additionally, this plays a part in the creation of hierarchical categories from existing categories. We will describe our simulator and the simulations that show our solution to the incorrectly recruited neuron problem.