

Deep Learning with Segregated Dendrites

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Presentation Abstract Summary Deep learning in multilayer neural networks has revolutionized artificial intelligence (AI). The key to deep learning is assigning credit to each neuron for its role in producing behavior. In AI, credit assignment is done using the backpropagation algorithm. However, backpropagation requires a separate feedback pathway with neurons that communicate error derivatives via symmetric weights, and there is no experimental evidence for this type of feedback in the brain. Here, we show that an algorithm that utilizes multi-compartment neurons can perform credit assignment without a separate error pathway. Like pyramidal neurons, neurons in our model receive bottom-up sensory information and top-down feedback in electrotonically segregated dendritic compartments. Thanks to this segregation, neurons in different layers can be assigned credit for their contribution to behavior. As a result, multilayer versions of the network can learn to categorize images better than single layer versions. This work demonstrates that biologically feasible deep learning is possible using segregated dendritic compartments, which may help to explain the morphology of neocortical pyramidal neurons.

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