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A NEURAL NETWORK MODEL OF CHEMOTAXIS IN SIMPLE NERVOUS SYSTEMS.

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Some properties of neural circuits can be predicted by training a model network to reproduce the activity of input and output neurons in the biological network. However, in most systems, more is known about the animal's behavior than about the activity of individual neurons. Using chemotaxis as a model behavior, we trained neural networks in which the desired output was the movement of the animal. The gradient was a one-dimensional gaussian-shaped distribution of an attractant. The network had two sensory units and two motor units. The velocity and position of the animal were represented by two additional units. Activation of the sensory units was determined by the position of the animal. Sensory units were separated in space, allowing the animal to compute the local gradient. Sensory units excited motor units which determined the animal's velocity up or down the gradient. The position unit integrated the activity of the velocity unit. This network could be trained successfully using recurrent backpropagation to find and remain at the center of the gradient from arbitrary initial positions. The model can be made more realistic by including interneurons and known connections. Additional constraints on the neural circuit should allow the model to predict the contribution of real neurons to observed behaviors.