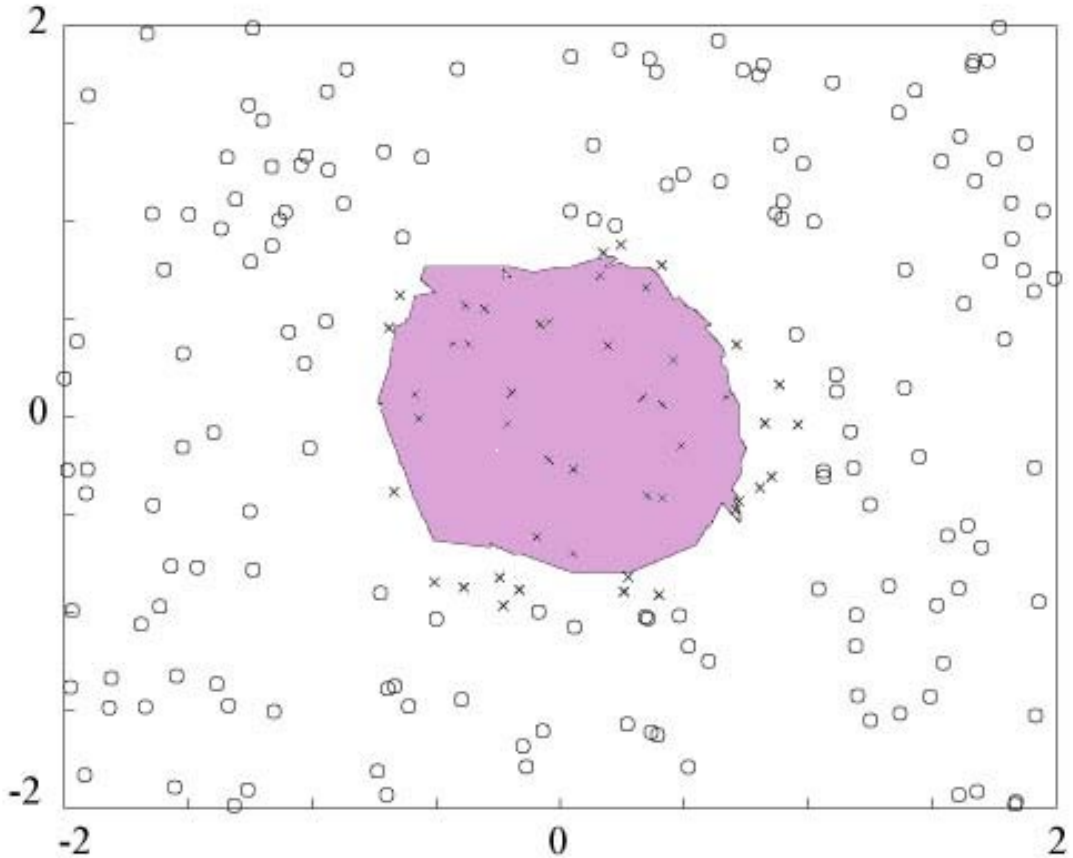
Multilayer Perceptrons (MLPs)

Example - Circle Network (nonlinear decision boundary)

- learning by using back-propagation
- an 80 hidden unit sigmoidal network
- to classify points inside (output 1) and outside (output 0) of a circle of radius 1 around the origin



Architectural graph of a multilayer perceptron with two hidden layers.

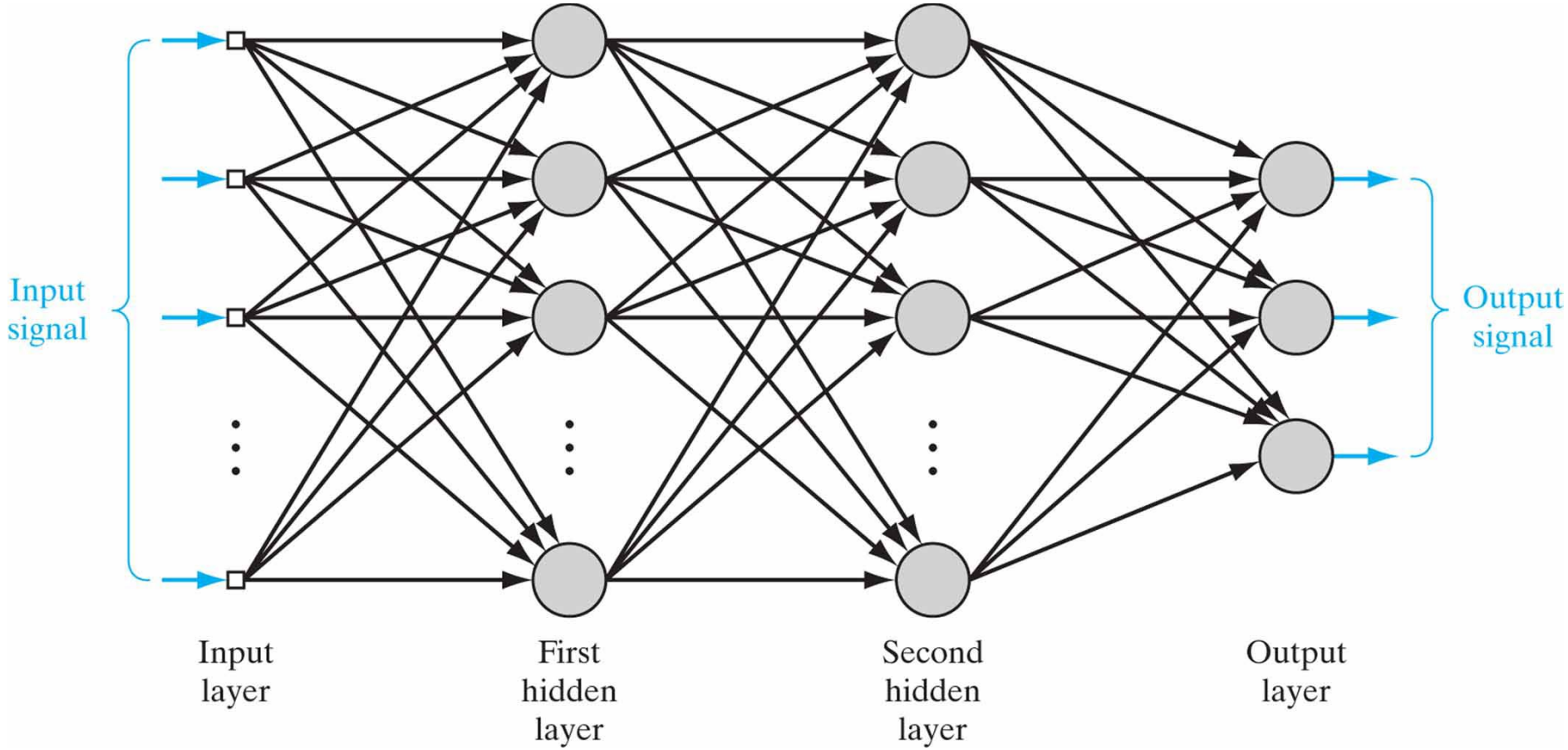
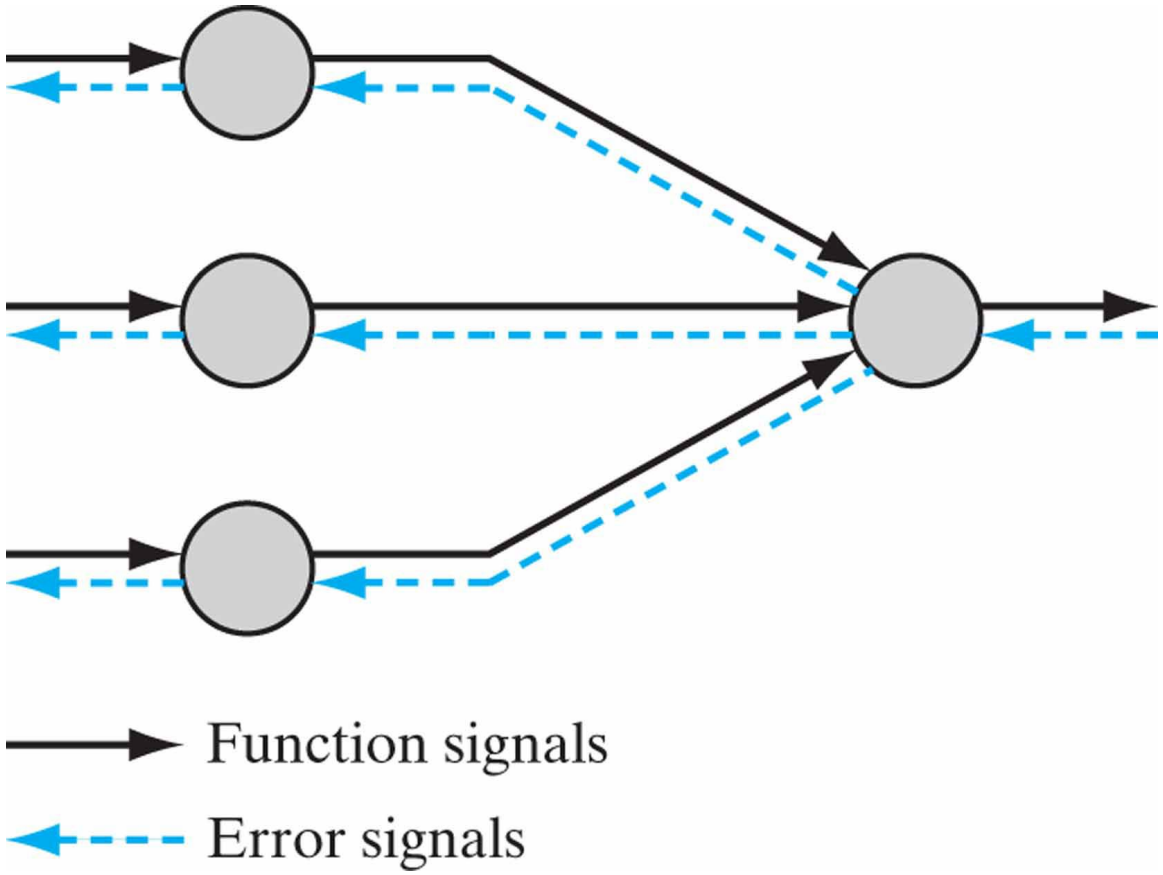
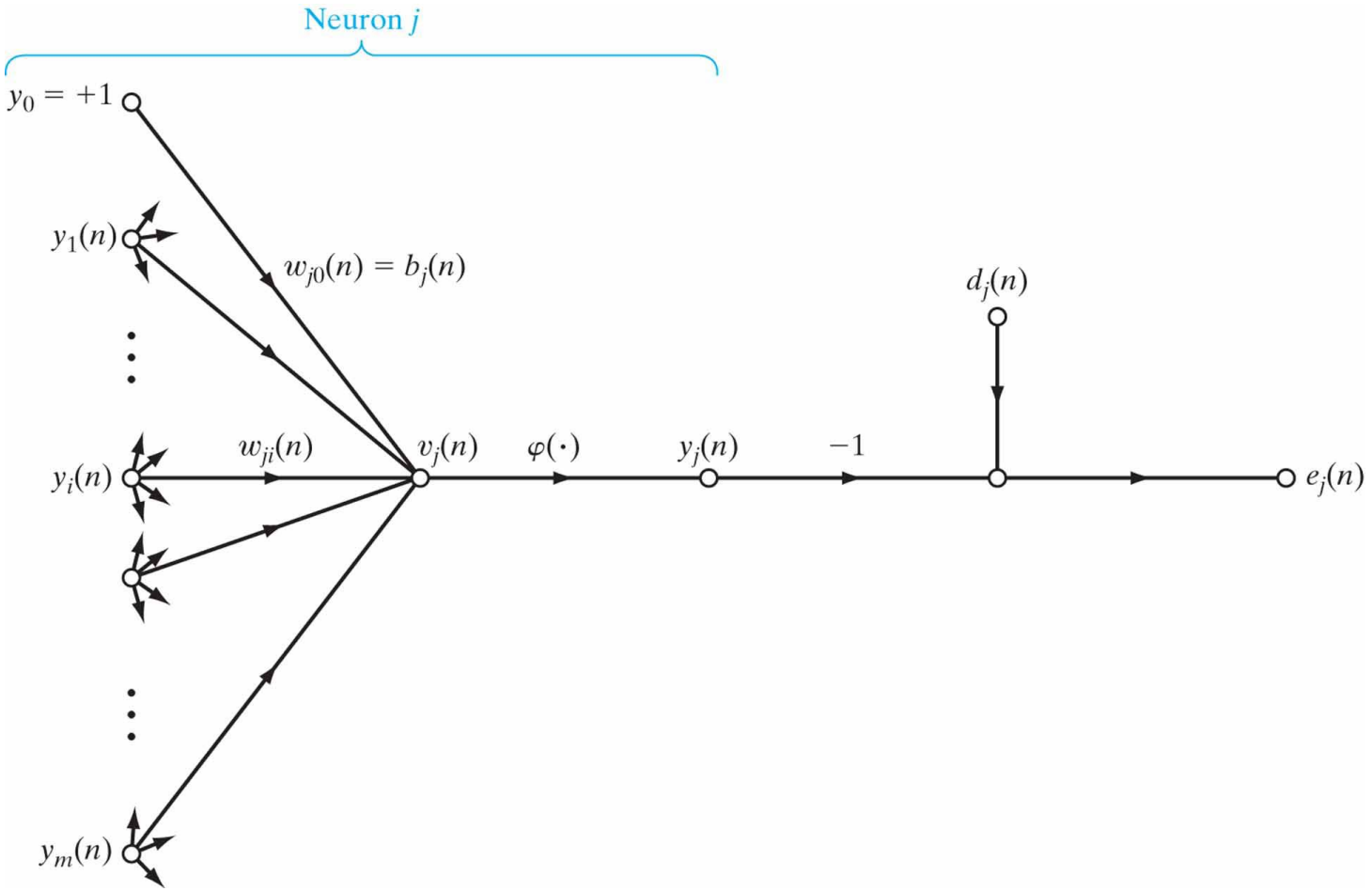


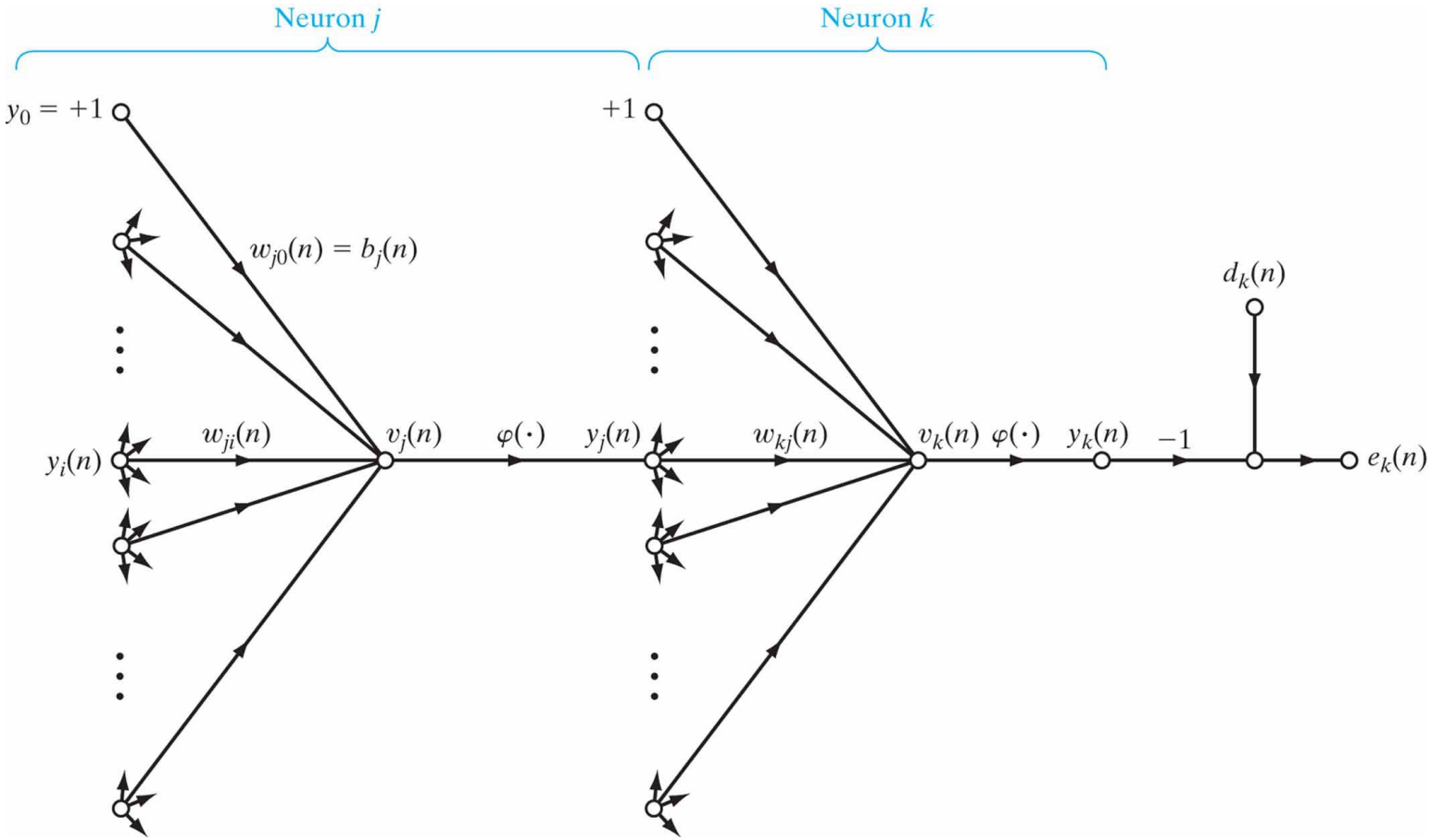
Illustration of the directions of two basic signal flows in a multilayer perceptron: forward propagation of function signals and back propagation of error signals.



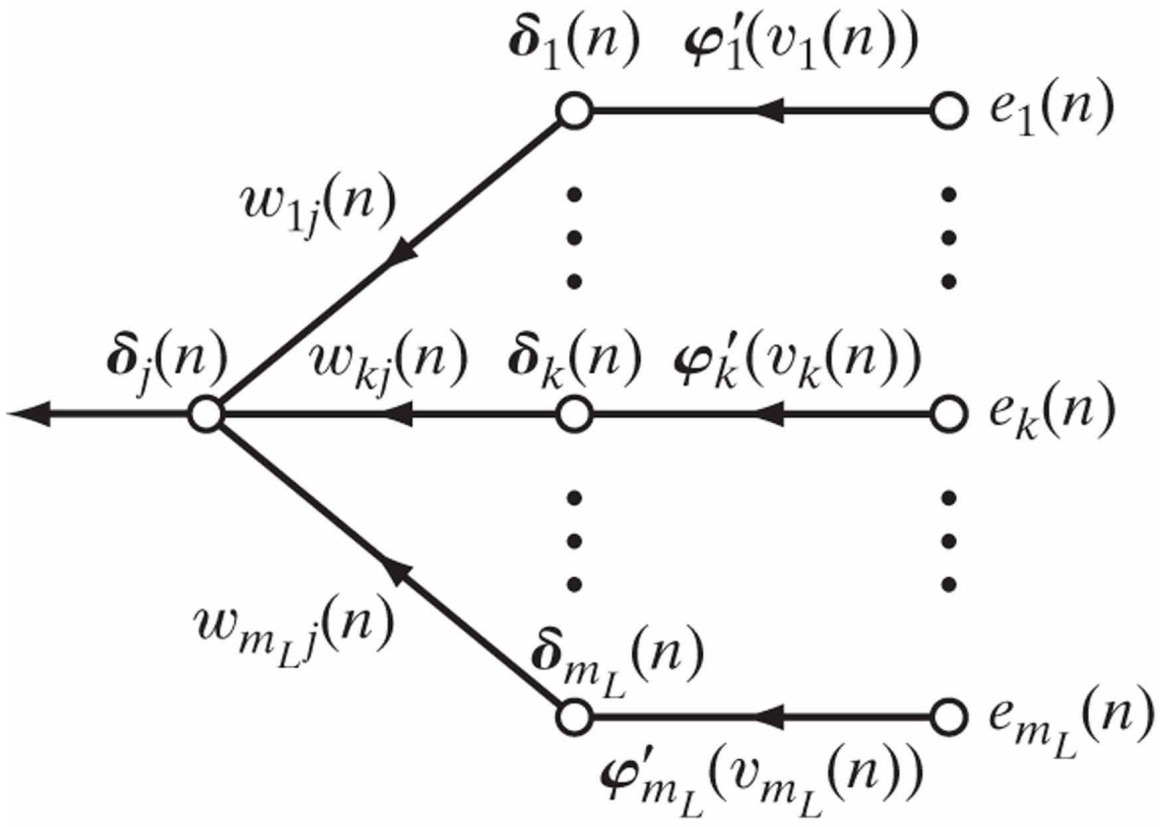
Signal-flow graph highlighting the details of output neuron *j*.



Signal-flow graph highlighting the details of output neuron *k* connected to hidden neuron *j*.



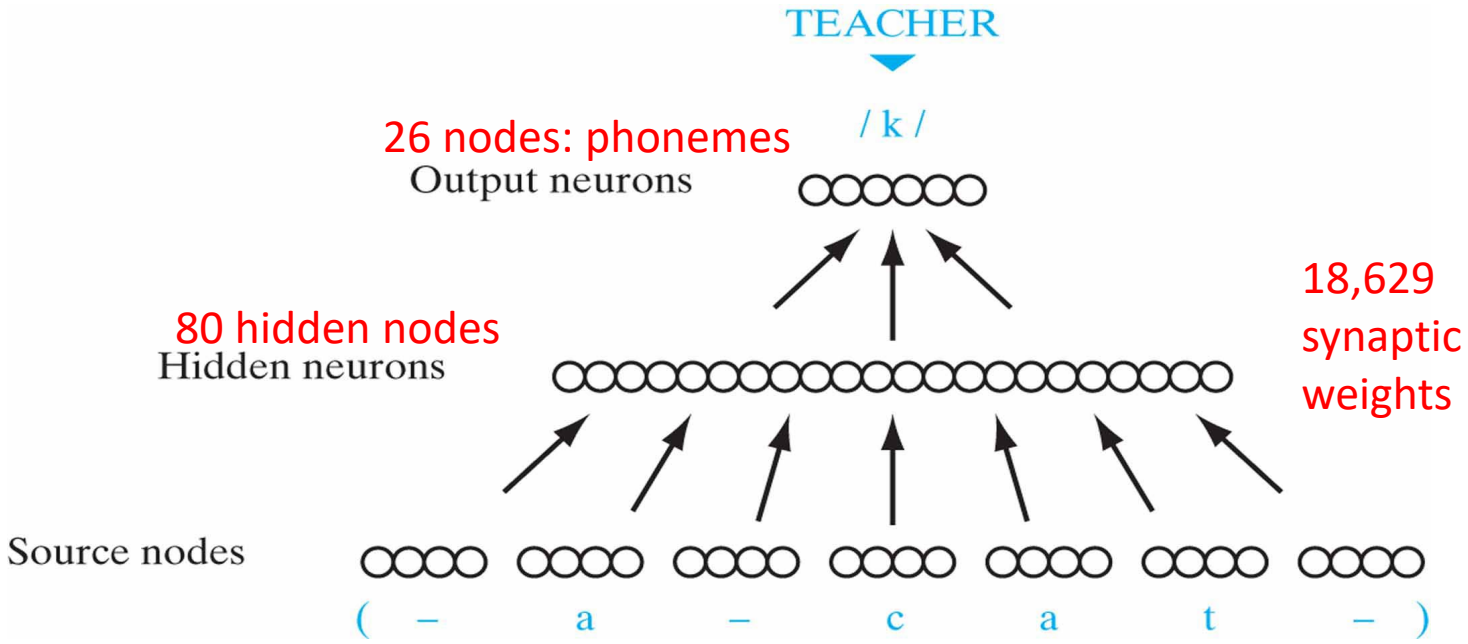
Signal-flow graph of a part of the adjoint system pertaining to back-propagation of error signals.



MLP Applications

Schematic diagram of the NETtalk network architecture

Sejnowski, Terrence J., and Charles R. Rosenberg. "NETtalk: A parallel network that learns to read aloud." Neurocomputing: foundations of research. 1988. 661-672.

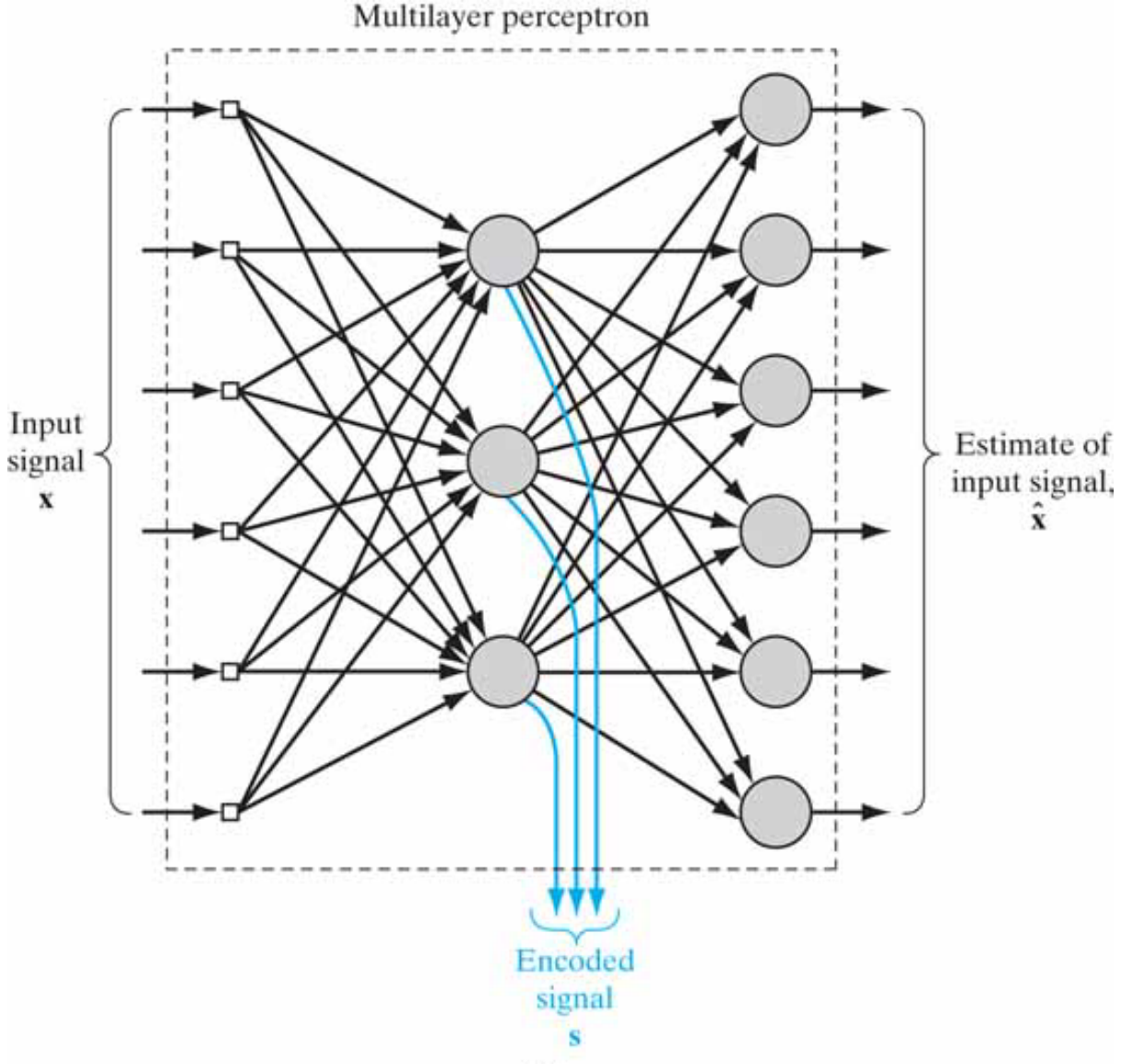


203 input nodes: 7 groups, each group for a letter

- Sigmoid nonlinearity in the hidden layer
- Trained by back-propagation
- More experience leads to better generalization
- Performance robust to synaptic damages
- Re-learning faster than from scratch

Replicator network (identity map) with a single hidden layer used as an encoder

Hecht-Nielsen, Robert. "Replicator neural networks for universal optimal source coding." Science 269.5232 (1995): 1860-1863.



Hinton, Geoffrey E., and Ruslan R. Salakhutdinov. "Reducing the dimensionality of data with neural networks." science 313.5786 (2006): 504-507.

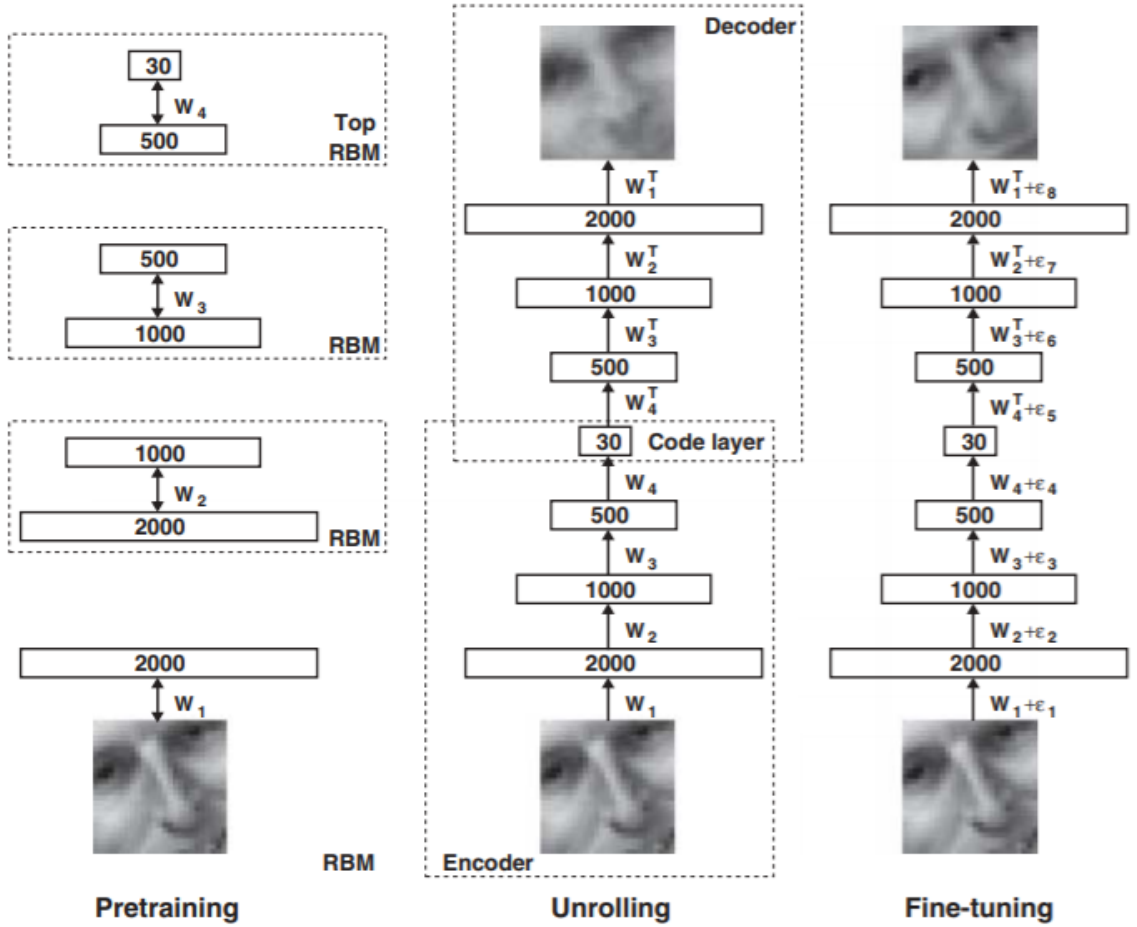


Fig. 1. Pretraining consists of learning a stack of restricted Boltzmann machines (RBMs), each having only one layer of feature detectors. The learned feature activations of one RBM are used as the "data" for training the next RBM in the stack. After the pretraining, the RBMs are "unrolled" to create a deep autoencoder, which is then fine-tuned using backpropagation of error derivatives.

Convolutional network for image processing such as handwriting recognition

Le Cun, Yann, et al. "Handwritten digit recognition with a back-propagation network." Proceedings of the 2nd International Conference on Neural Information Processing Systems. 1989.