

Neural Networks

Concept behind NN: How is the brain wired?

Small part of human neocortex, showing cells and connections \Rightarrow
(part of brain that handles most of our cognitive functions)

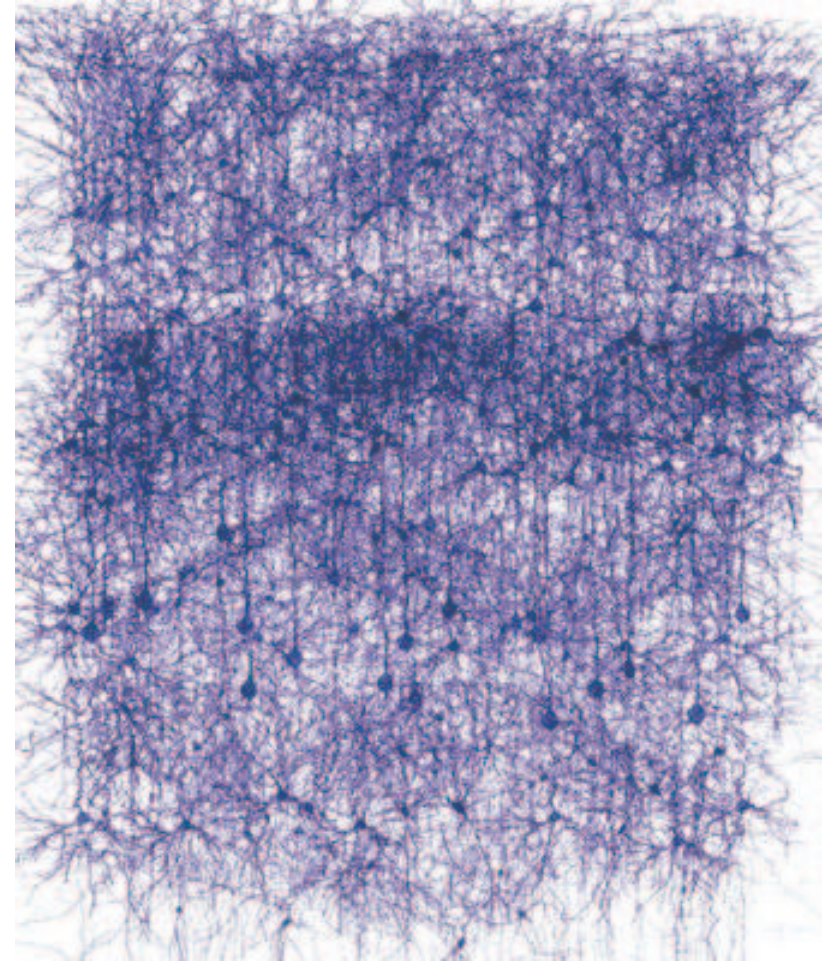
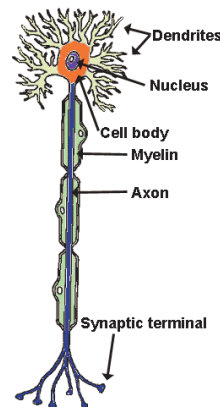
About 10^{11} neurons; each with connections to $10^3 - 10^4$ others. \Downarrow

Signal speed up to about 100 m/s
(cf. speed of light 299,792,458,000 m/s)

Very complicated responses (such as evasive actions when driving) may go through only 10 - 30 'layers', but vast parallelism.

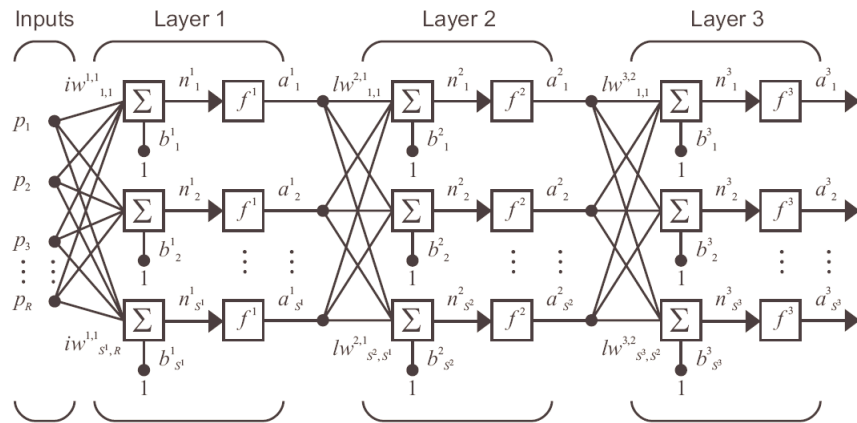
Exceedingly complex neuron connection pattern is NOT in the genetic code, evolves in each case, as does subsequent learning / cognition.

World's largest present computer system - IBM Blue Gene - matches component number (10^{11}), but these are about 10^9 times faster.



Can brain development, cognitive learning, and behavior be reproduced in a computer?

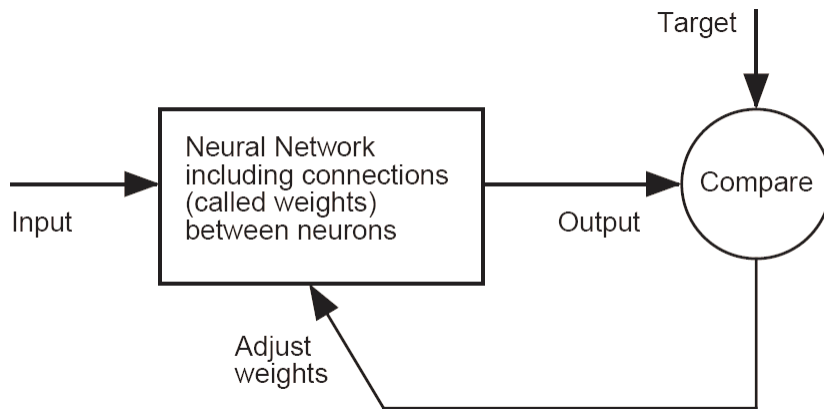
Neural Networks: Concept illustrations based on Matlab's tool box__



Schematic of a 'feed forward' network

Data enters at left; output at right

All properties defined by weights and transfer functions

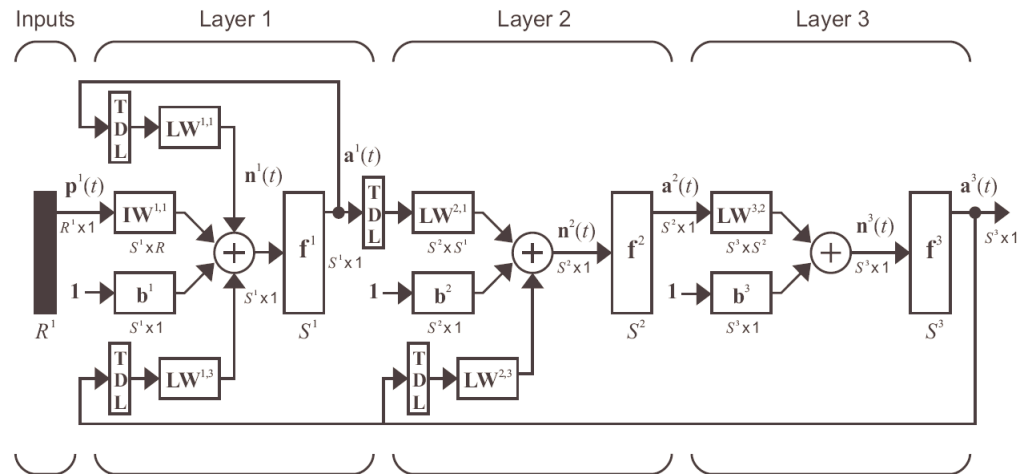


Key issue: how to adjust weights so network output best matches actual data

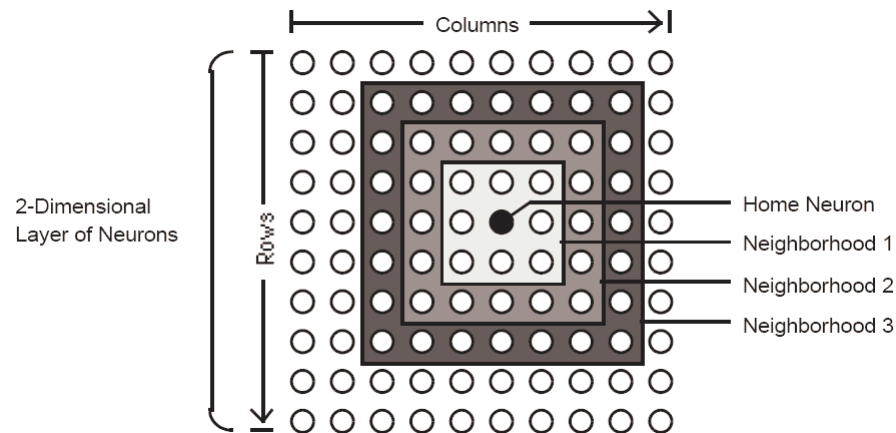
In unsupervised learning, no target. Network weights can be updated so that it 'conceptualizes' by itself.

Basic concept (in case of supervised learning)

Many variations are inspired by brain features



More compact notation of a network that also includes time delays and feedbacks.



Layout need not be logically a 1-dimensional sequence of layers.
 Connection pattern itself (not only weights) can evolve during learning.