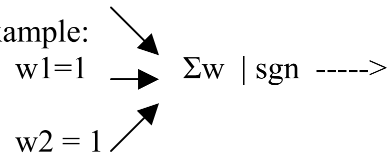
Perceptrons/Perceptron Learning

Sign function $g(x) = sgn(x) = \{1 \text{ if } x > 0, -1 \text{ if } x < 0\}$

Sigmoid function $1/(1 + e^{-x})$

Example:



Always take a0 = 1 (w0 = -1.5)

a1	a2	out	
1	1	1	$1*(-1.5) + 1 * 1 + 1 = .5$ $sgn(.5) = 1$
1	-1	-1	$(-1.5) + 1 – 1 = -1.5$ $sgn(-1.5) = -1$
-1	1	-1	
-1	-1	-1	This is an AND gate

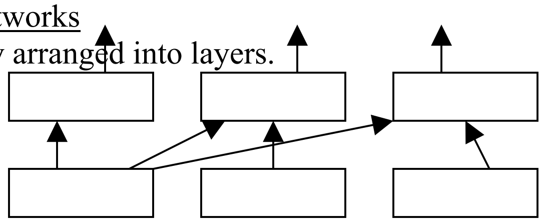
Types of neural nets

Feed Forward Neteworks – Compute some function of a fixed input. (Graph of net has no cycles).

Recurrent networks – allowed to feed outputs of network back in as inputs. Graph of network allowed to have cycles.

Feed Forward Networks

are usually arranged into layers.



All nodes in a given layer have inputs from the previous layer. Paths from input to a layer i neuron are always length i.

Single Layer Networks

What kinds of things can a single layer neural network learn?

Notice in a given neuron, the threshold operation is applied to a function like $\Sigma\, w_i\, x_j$ (from j = 0 to n) and we typically output 1 if this is bigger than 0

i.e. , let w = <w0, …, wn>
let x = <x0, …, xn> then what we are checking is W.X > 0 (dot product of w, x)

Consider equation W . X = 0 The values of X that satisfy the equation form a hyperplane in n dimensional space.
So what satisfies W.X > 0 are points in the upper half space above this hyperplane.

Although perceptrons cannot computer every function efficiently, there are good learning algorthims for perceptrons which generalize to the multilayer case.