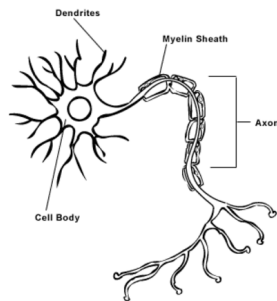


Intro to neural nets

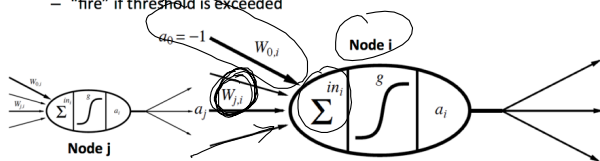
Friday, September 30, 2016 8:49 AM

Neural Networks

- Neuron
- Brain information processing emerges from networks of neurons



- McCulloch & Pitts (1943)
 - Linear combination of inputs
 - “fire” if threshold is exceeded



Nodes are neurons

There is a link from j to i

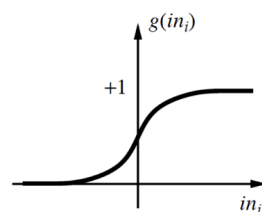
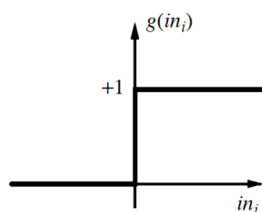
j sends a signal of strength a_j i receives it with weight W_{ji} Additionally, each node has a bias, a_0 , $W_{0,i}$

Looks like a matrix lookup

	1	2	3	4	5	6	7
1							
2							
3							
4							
5							
6							
7							

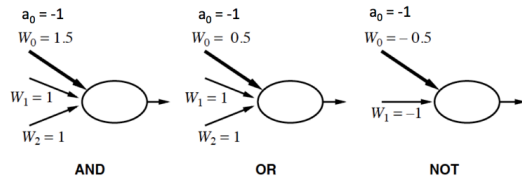
- Input to a node: $in_i = \sum_{j=0}^n W_{ji} a_j$
- Output of a node: $a_i = g(in_i)$
- What is g ?

- A function that computes near 1.0 when the “right” inputs are given and computes near 0.0 when the “wrong” inputs are given
- $W_{0,i}$ sets the threshold – actual inputs must overcome bias



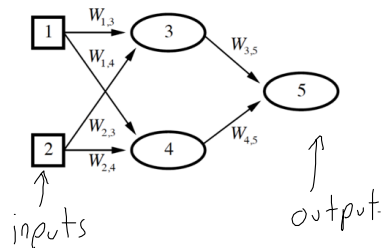
Comparison to logic

- Can replicate logic gates with nodes
- Can compute any boolean logic statement with neural network



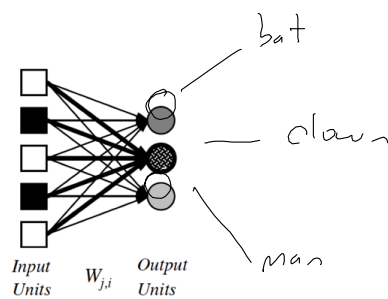
Network structures

- Feed-forward network
 - Represents a function of current inputs
 - No internal state other than weights
 - Output is the result of the function

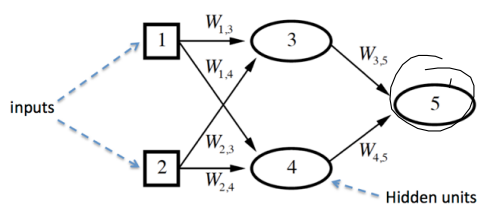


Network structures

- Multiple outputs



A simple network



$$\sigma_5 = g(W_{3,5} \cdot a_3 + W_{4,5} \cdot a_4)$$

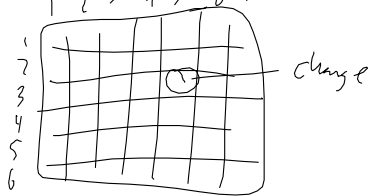
$$= g(W_{3,5} \cdot g(W_{1,3} \cdot a_1 + W_{2,3} \cdot a_2) + W_{4,5} \cdot g(W_{1,4} \cdot a_1 + W_{2,4} \cdot a_2))$$

- Adjusting the weights changes the function that the network represents
- This is how learning occurs

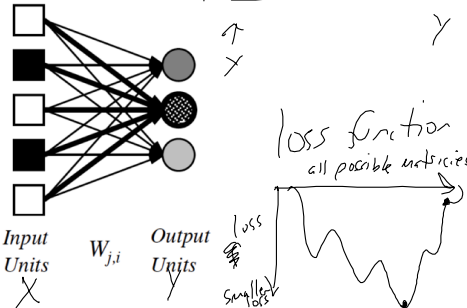
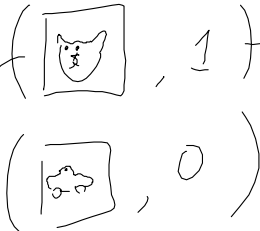
Perceptron learning

- Want the network to learn to replicate some function
- Adjust the weights of the network to minimize error on the training set
 - Optimization search in weight space
 - How to measure error:
 - sum of squared errors

W
matrix



Examples. answer

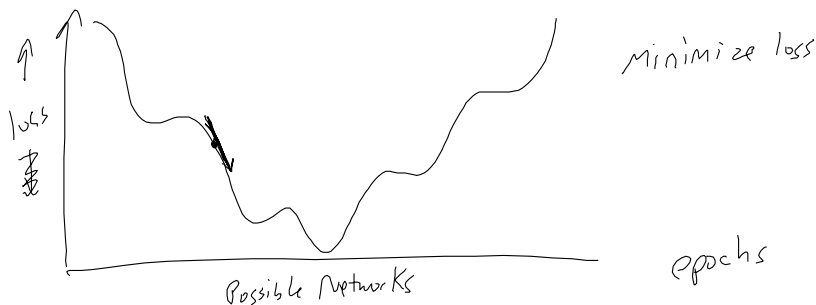
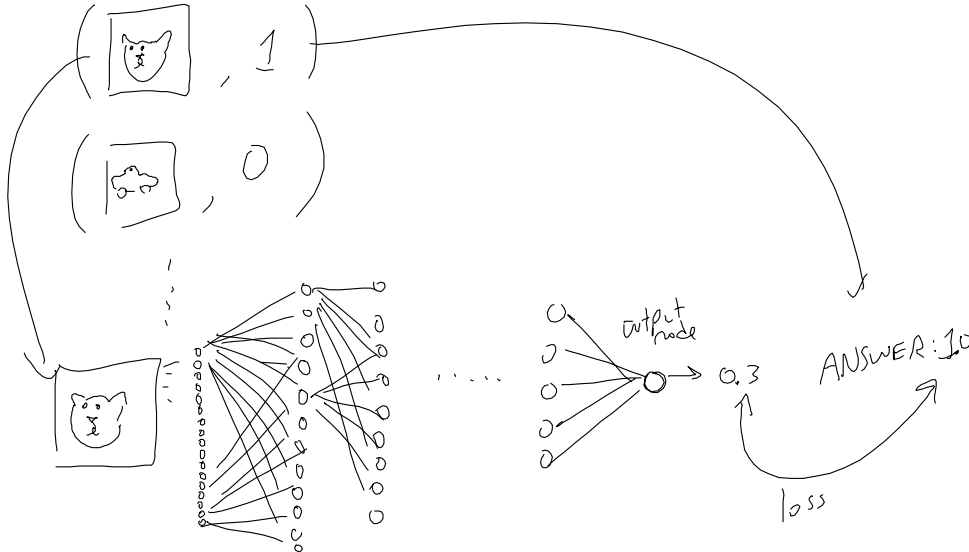


PROS:

- Approx lots of fns
- accurate

CONS:

- need a lot of data
- Need a lot of compute horsepower



continuous problem \Rightarrow gradient descent
backpropagation

Deep Learning

of layer

2+

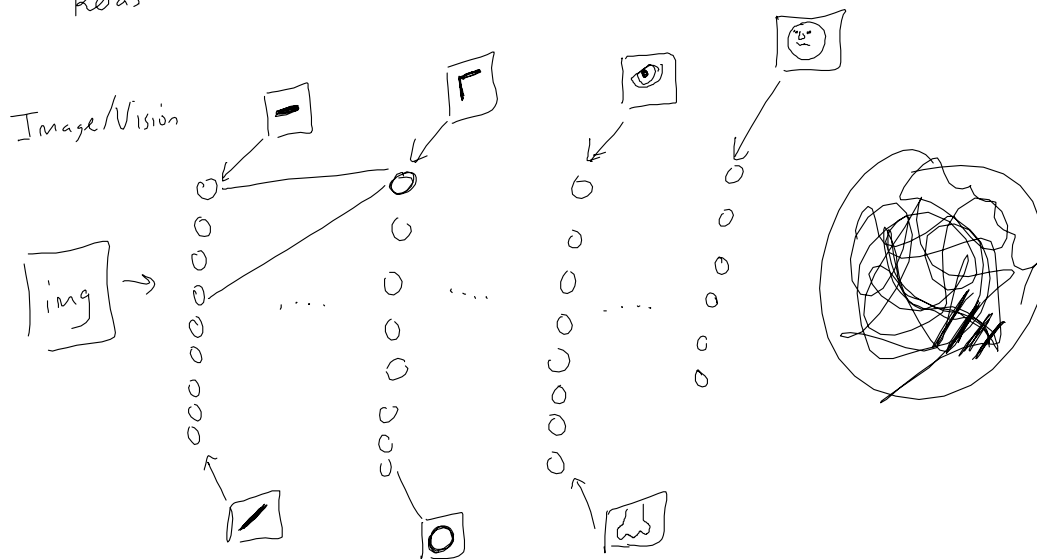
Image Rec \rightarrow 100+ layers

NN are parallelizable

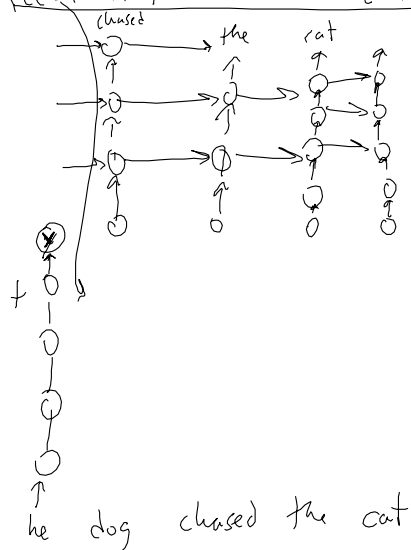
TensorFlow

Theano

Keras



Recurrent Neural Nets (RNN) — time sequences



Intro

Monday, October 03, 2016 10:50 AM

Machine Learning

- Supervised

- Unsupervised

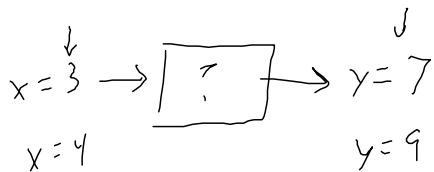
You have a set of data (x) (examples)

You have a set of answers (y)

Train mechanism to map $x \rightarrow y$

Don't have the answers

NN - Guess a function



$$\begin{aligned} &\cancel{y = x + 4} \\ &y = 2x + 1 \end{aligned}$$

NN is a technique for learning / guessing a function

$$x \rightarrow y$$

NN can approximate a large number of types of functions