

Hacker's Guide to Neural Networks a. k. a.

Data Driven Code - 101

Anoop Thomas Mathew

@atmb4u



WHAT WE WILL NOT COVER

- Recent developments in
 - United States of America! ;)
 - Deep Learning, CNN, RNN, DCGAN etc.
 - Frameworks like TensorFlow, Theano, Keras etc.
- Advanced concepts of neural networks

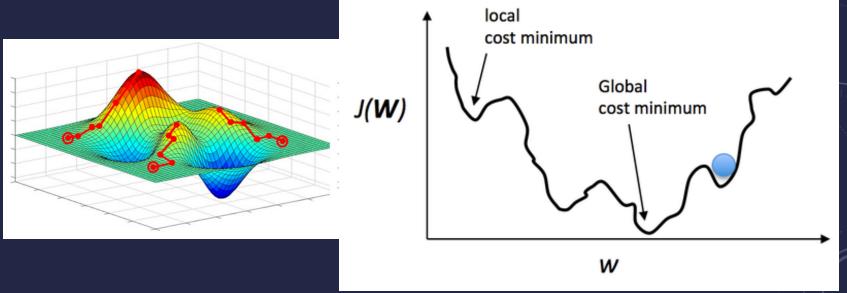


WHAT WE WILL COVER

- Basic Concepts of
 - Parameter Optimization
 - Entropy (Sparse Coding)
- Little bit of Mathematics
 - Linear Algebra Matrix Multiplication
 - Differential Calculus Sigmoid Function (2 equations only)
- (Try to) Build a 2 layer neural network
- Way Forward



PARAMETER OPTIMIZATION



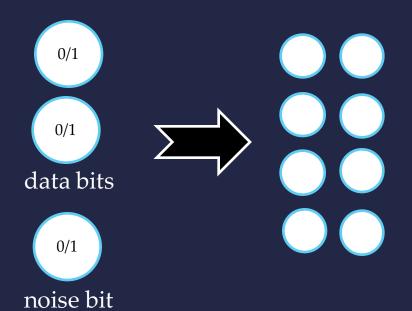
- Infinite Monkey Theorem
- Any problem is fundamentally a parameter optimization problem

$$ax^3 + bx^2 + cx + d = 0$$



ENTROPY

Sparse Coding



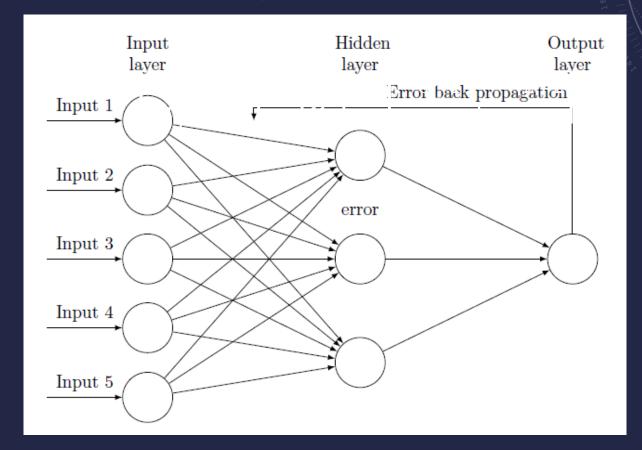
28 = 256

Imagine:

- divided into 4 spaces
- each bit a feature
- generalize data bits
- attenuates noise bit



LITTLE LINEAR ALGEBRA





LITTLE LINEAR ALGEBRA (matrix multiplication)

$$\begin{bmatrix} w_1 & w_2 \\ w_3 & w_4 \end{bmatrix} \times \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} w_1 x_1 + w_2 x_2 \\ w_3 x_1 + w_4 x_2 \end{bmatrix}$$



ACTIVATION FUNCTION (differential calculus part)

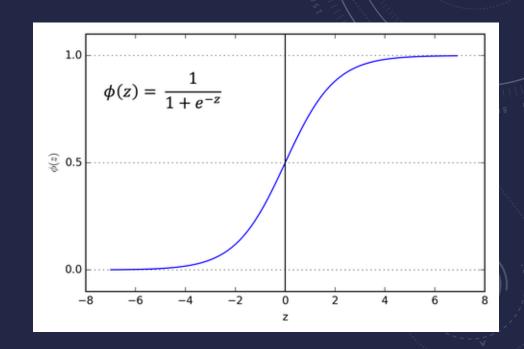
$$O(x) = \frac{1}{1 + e^{-x}}$$

(Sigmoid Function)

$$\frac{d \, \partial \sigma(x)}{dx} = \sigma(x) \times (1 - \sigma(x))$$

(Derivative of Sigmoid Function)

Stochastic Gradient Decent





QUICK RECAP

- Activation Function (combining inputs to a representation)
- Layers (Weight Matrices)
- Network (collection of weight matrices)
- Dataset (inputs and expect outputs)
- Features (patterns in dataset)
- Sparse Encoding (room for error)
- Backpropagation (learn from past mistakes)
- Parameter Optimization (correct values into weight matrix)



LET'S MAKE ONE NOW!

CODE + DATA = MAGIC

(Teach machine **XOR** truth table)



XOR GATE

Table 5.8: Truth table for XOR Gate

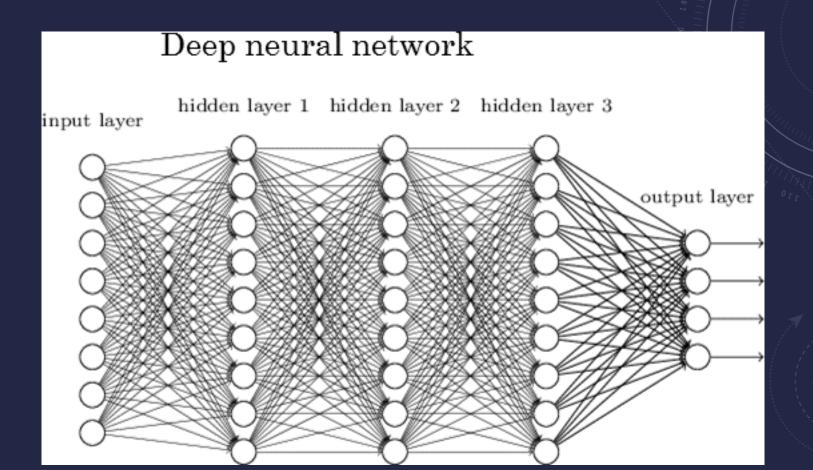
INPUTS		OUTPUTS
Α	В	Y=A⊕B
0	0	0
0	1	1
1	0	1
1	1	0



SHOW ME THE CODE

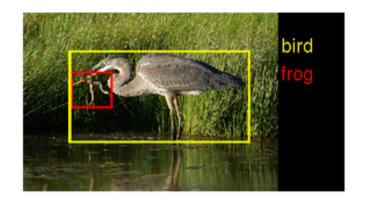
```
from numpy import array, random, dot, exp
    inputs = array([[0, 0], [0, 1], [1, 0], [1, 1]])
    outputs = array([[0], [1], [1], [0]])
 5
 6
    def learn(X, y):
        l1_w = 2 * random.random((X.shape[1], 16)) - 1
         12 w = 2 * random.random((16, 1)) - 1
 8
        for j in xrange(10000):
             l1 = 1 / (1 + exp(-(dot(X, l1_w))))
10
11
             l2 = 1 / (1 + exp(-(dot(l1, l2_w))))
12
             l2_{delta} = (y - l2) * (l2 * (1 - l2))
13
             l1\_delta = l2\_delta\_dot(l2\_w.T) * (l1 * (1-l1))
             l2 w += l1.T.dot(l2 delta)
14
15
             l1_w += X.T.dot(l1_delta)
16
         return (l1 w, l2 w)
17
    xor weights = learn(inputs, outputs)
18
19
    def predict(X, weights):
20
21
        l1 = 1/(1 + exp(-(dot(X, weights[0]))))
        l2 = 1/(1+exp(-(dot(l1, weights[1]))))
22
23
        return 12
24
25
    test_set = [[0, 0], [0, 1], [1, 0], [1, 1]]
26
    for test_item in test_set:
        xor_prediction = predict(test_item, xor weights)
27
        print str(test_item)+"\t"+str(xor_prediction)
28
```

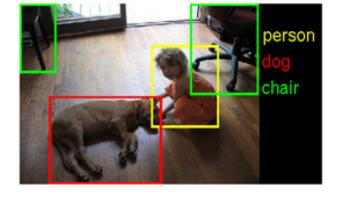


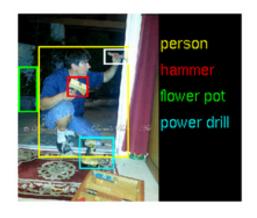


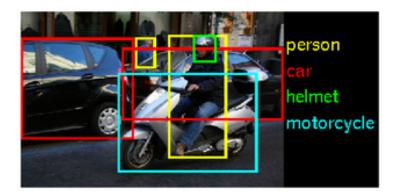


DEEP LEARNING



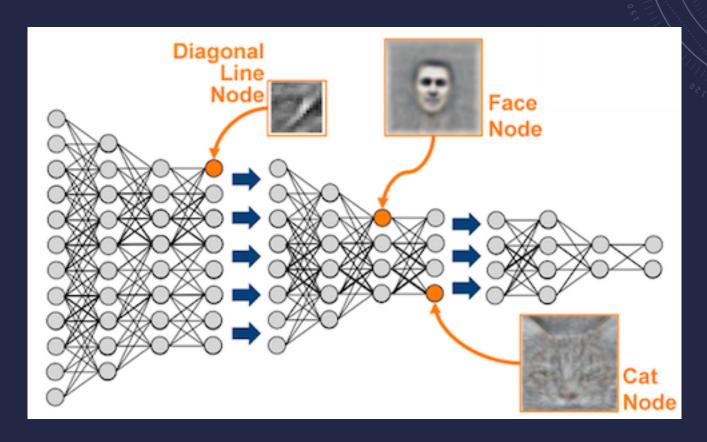








DEEP LEARNING





WAY FORWARD

Play with Neural networks in the browser

http://playground.tensorflow.org/

Comprehensive list of resources available online on Deep Learning

https://github.com/ChristosChristofidis/awesome-deep-learning

Very active online Machine Learning Community https://www.kaggle.com/



REFERENCE LINKS / IMAGE COURTESY

- https://medium.com/technology-invention-and-more/how-to-build-a-simple-neural-network-in-9-lines-of-python-code-cc8f23647ca1
- https://medium.com/technology-invention-and-more/how-to-build-a-multi-layered-neural-network-in-python-53ec3d1d326a#.dis92by0e
- http://iamtrask.github.io/2015/07/12/basic-python-network/
- http://iamtrask.github.io/2015/07/27/python-network-part2/
- http://sebastianraschka.com/faq/docs/logisticregr-neuralnet.html



THANK YOU // atm@infiniteloop.in

- Code https://github.com/atmb4u/data-driven-code
- Slides https://slideshare.net/atmb4u/data-driven-code
- Medium https://medium.com/@atmb4u/data-driven-code-101-17003f7b88ec

