Neural Networks

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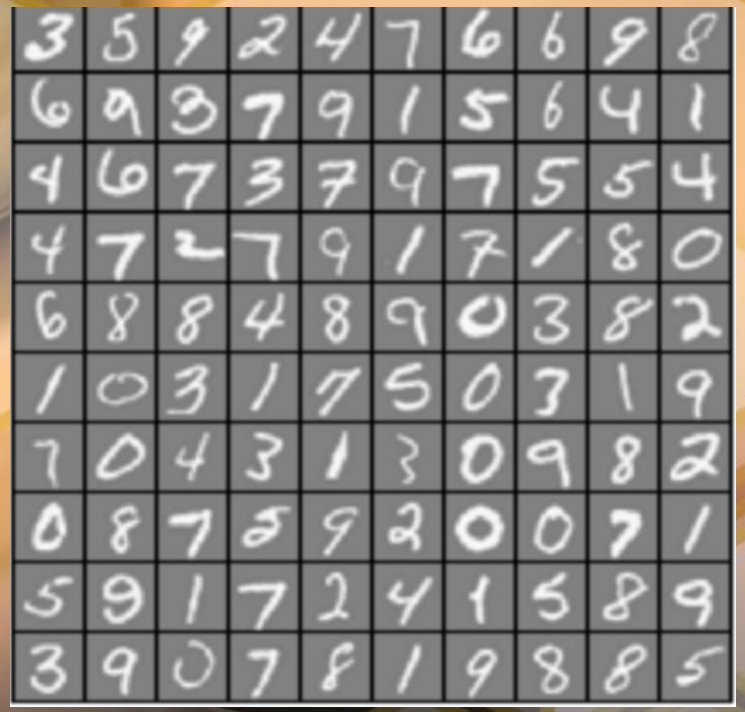
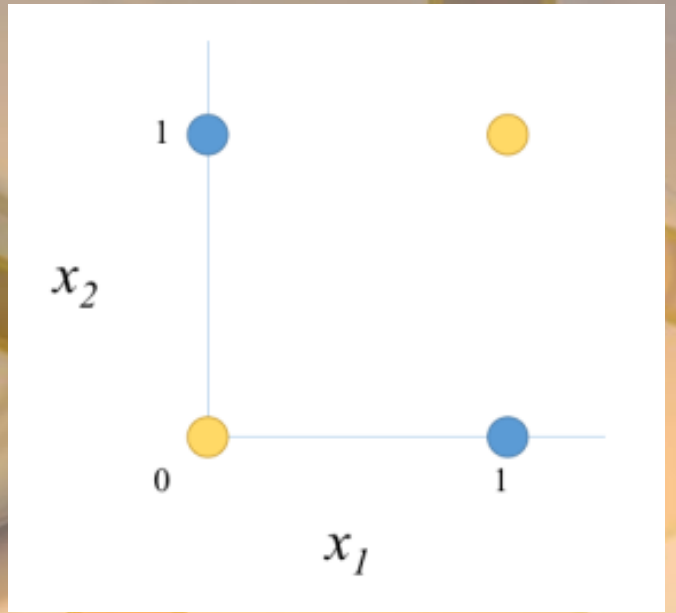


XOR problem

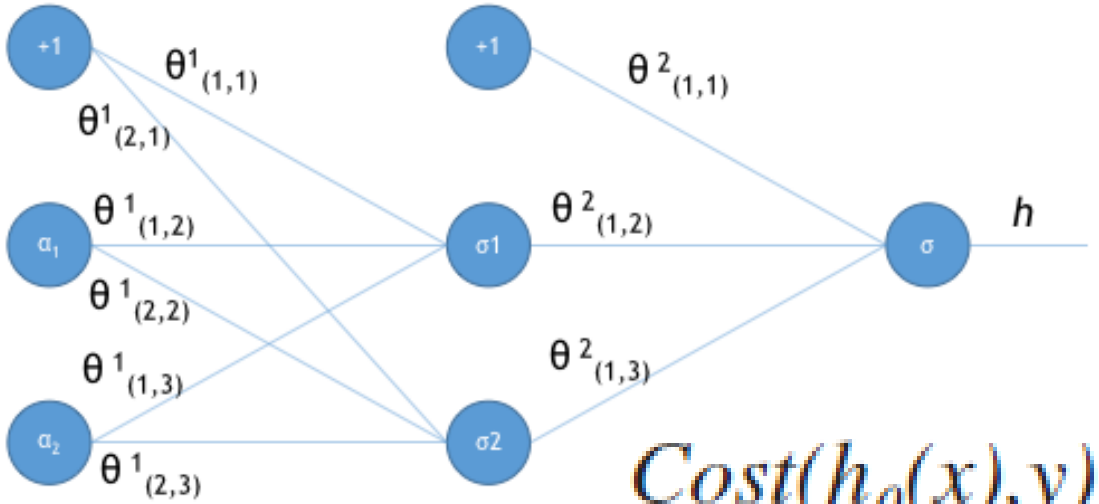
- AIM: Build a neural network that can successfully learn to produce the correct output given the four different inputs in the table.



Given this input		Produce this output
x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	0

Introduction to Neural Networks

- Configuration
- Cost Function
- Learn from Errors



$$Cost(h_\theta(x),y) = \begin{cases} -log(h_\theta(x)) & if \quad y=1 \\ -log(1-h_\theta(x)) & if \quad y=0 \end{cases}$$

$$Cost(h_\theta(x),y) = -ylog(h_\theta(x))-(1-y)log(1-h_\theta(x))$$

Results of XOR problem

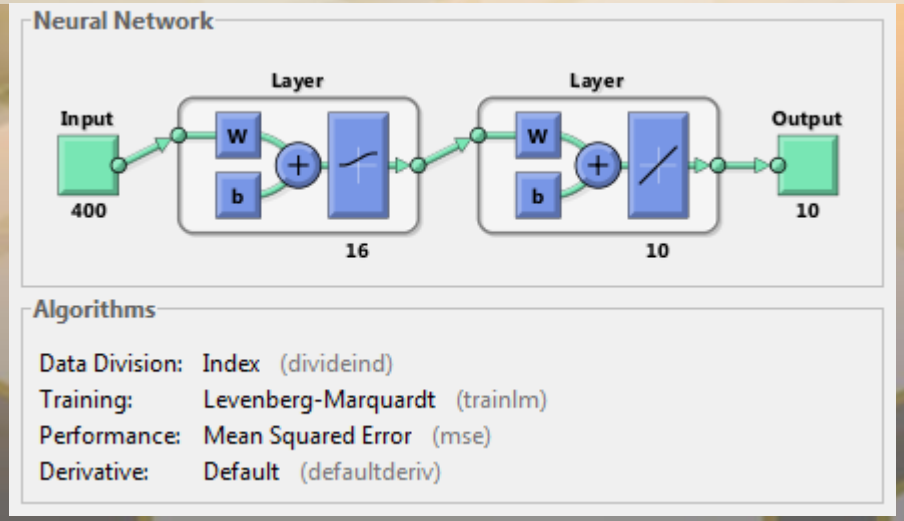
Iterations	Result of 0,0	Deviation J
1000	0.47689	0.69423
68000	0.026558	0.037856
100000	0.019090	0.025859

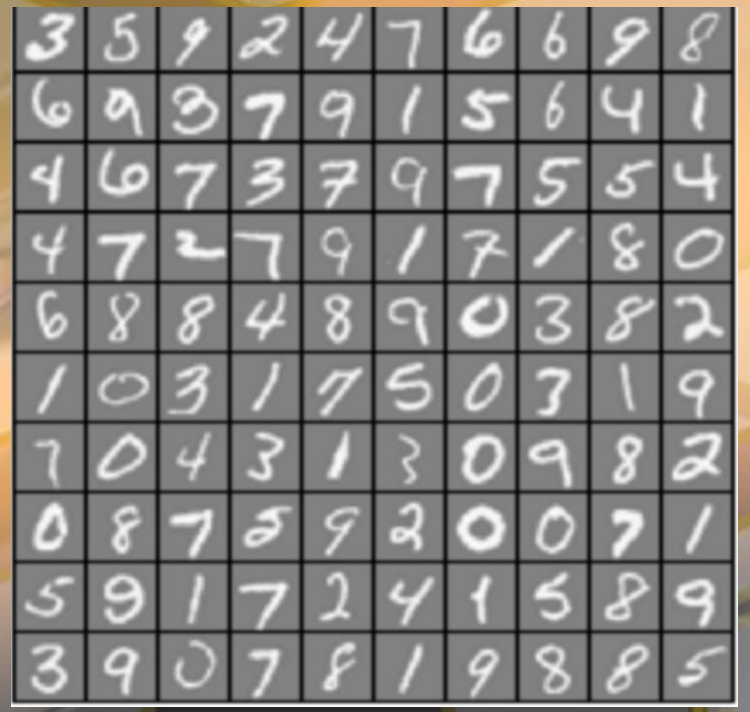
```
Iteration :
 99000
Hypothesis for
    0    0
is
 0.019508
Hypothesis for
    0    1
is
 0.97161
Hypothesis for
    1    0
is
 0.97153
Hypothesis for
    1    1
is
 0.028313
J:
 0.026528
Iteration :
 100000
Hypothesis for
    0    0
is
 0.019090
Hypothesis for
    0    1
is
 0.97231
Hypothesis for
    1    0
is
 0.97223
Hypothesis for
    1    1
is
 0.027530
J:
 0.025859
>>
```

- Network guesses small numbers (close to 0) for the first and last XOR examples and high (close to 1) for the two middle examples
- Result is more accurate when Iterations is larger.
- Successfully trained!

Handwritten Digits Recognition

- AIM: Build a neural network that can successfully learn to produce the correct output given the MNIST handwritten digits.





Results of Handwritten Digits Recognition

Accuracy	Samples	Hidden Neruons
23.3%	120	4
66.7%	120	16
95.5%	5000	25

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TRAINLM, Epoch 0/200, MSE 0.902926/0, Gradient 600.48/1e-010
TRAINLM, Epoch 21/200, MSE 0.0738405/0, Gradient 0.0262333/1e-010
TRAINLM, Validation stop.


SIMULATION...

Training Set Accuracy: 23.333333
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- Training set accuracy is around 63% with the small sample (120) and small hidden neurons (16).
- While, larger sample (5000), and more hidden neurons (25) yields 95%.
- Sucessfully Trained!