Image Classification with Neural Networks

Bruce Liu
Computer Engineering

Advisor
Prof. Xifeng Yan, Ph.D
Mentor
Fangqiu Han

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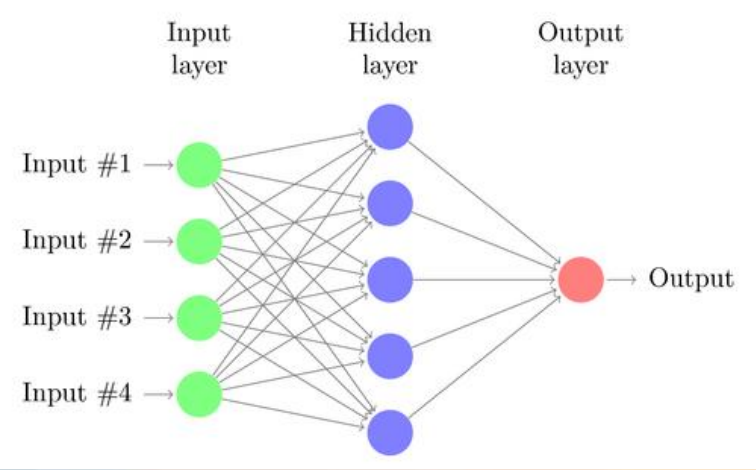
Neural Networks

- What is a neural network?

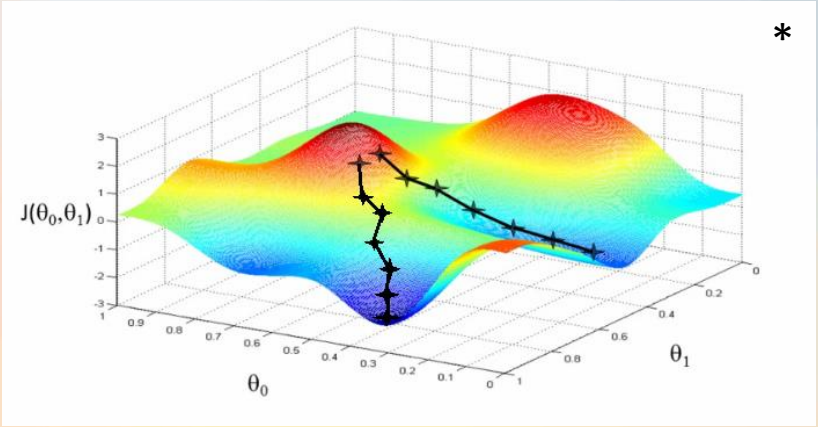


- Image Classification

- Applications
  - Search
  - Autonomous Driving
  - Speech Recognition
  - Artificial Intelligence

Building a Neural Network

- Using MATLAB
  - Use gradient descent
  - Learn backpropagation algorithm



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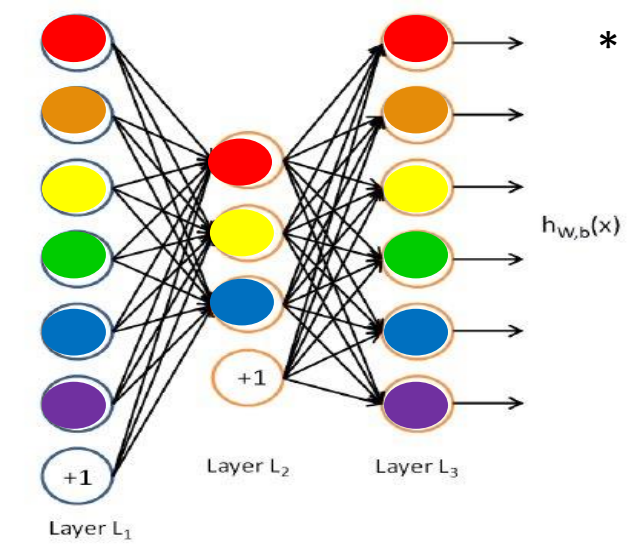
- Build a Sparse Autoencoder



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*Source: Machine Learning, Coursera.org, Andrew Ng

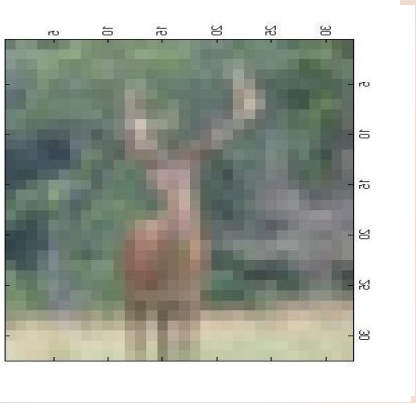
Image Classification

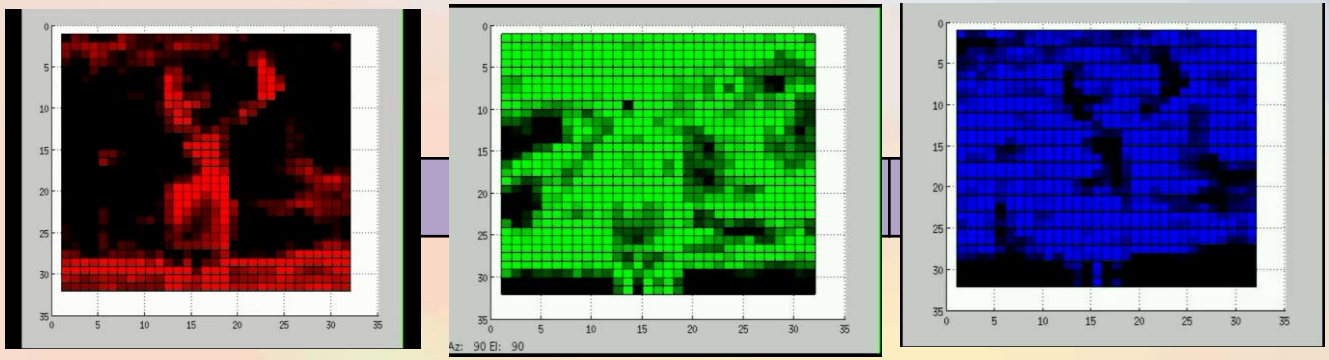
Label **Data**

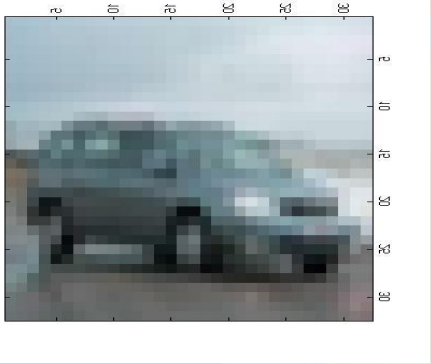
y	x_1	x_2	...	x_n
0	a_{11}	a_{12}	...	a_{1n}
0	a_{21}	a_{22}	⋮	⋮
⋮	⋮	⋮	⋮	⋮
0	a_{m1}	a_{m2}	...	a_{mn}

y	x_1	x_2	...	x_n
1	b_{11}	b_{12}	...	b_{1n}
1	b_{21}	b_{22}	⋮	⋮
⋮	⋮	⋮	⋮	⋮
1	b_{m1}	b_{m2}	...	b_{mn}

Image Data







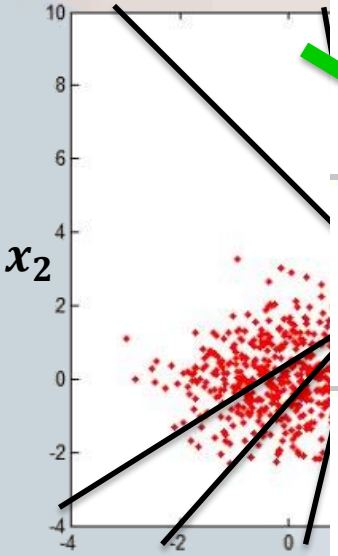
x_2

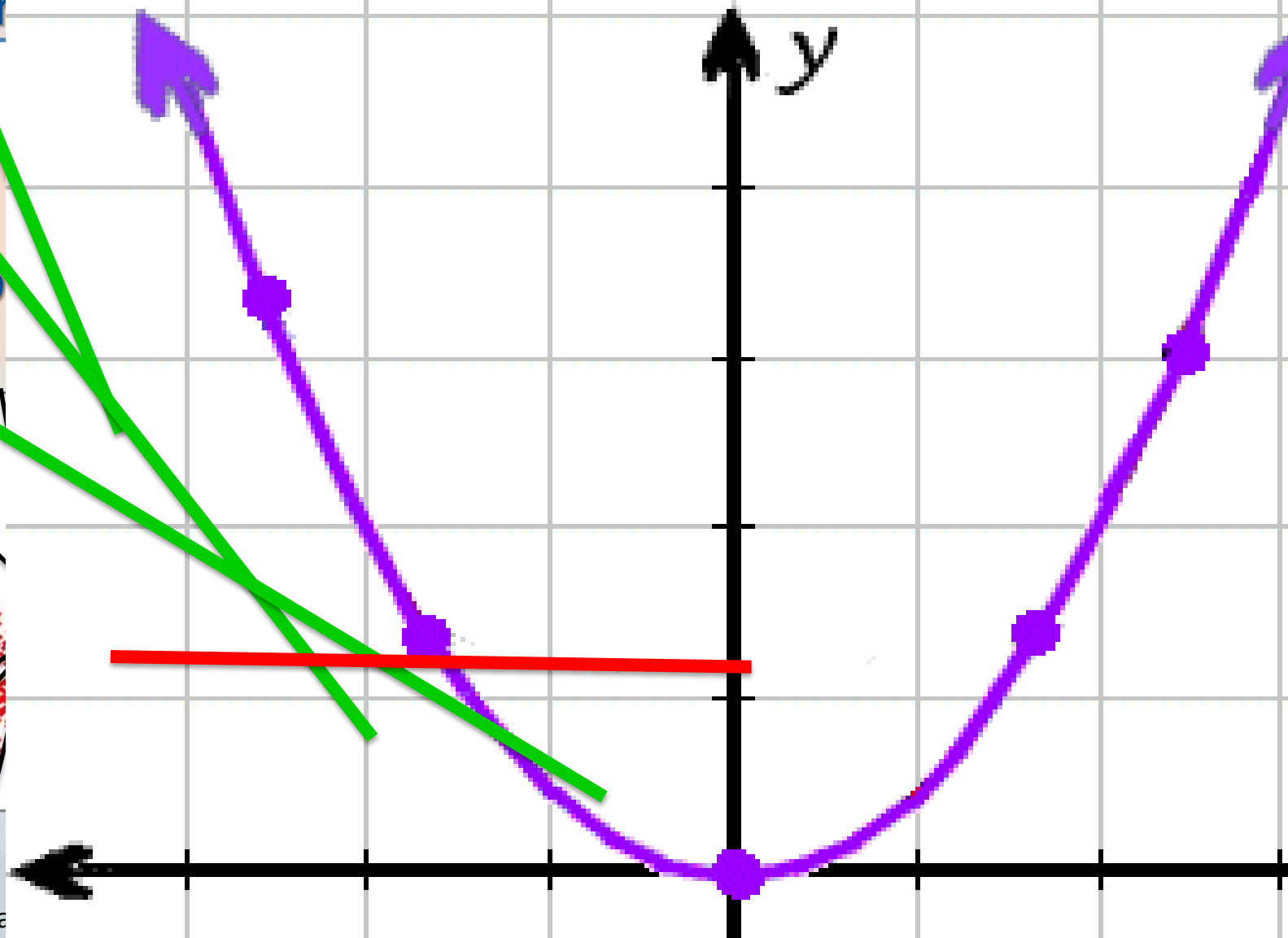
Calculations

Cost Fun

$$J(\theta) =$$

Rep





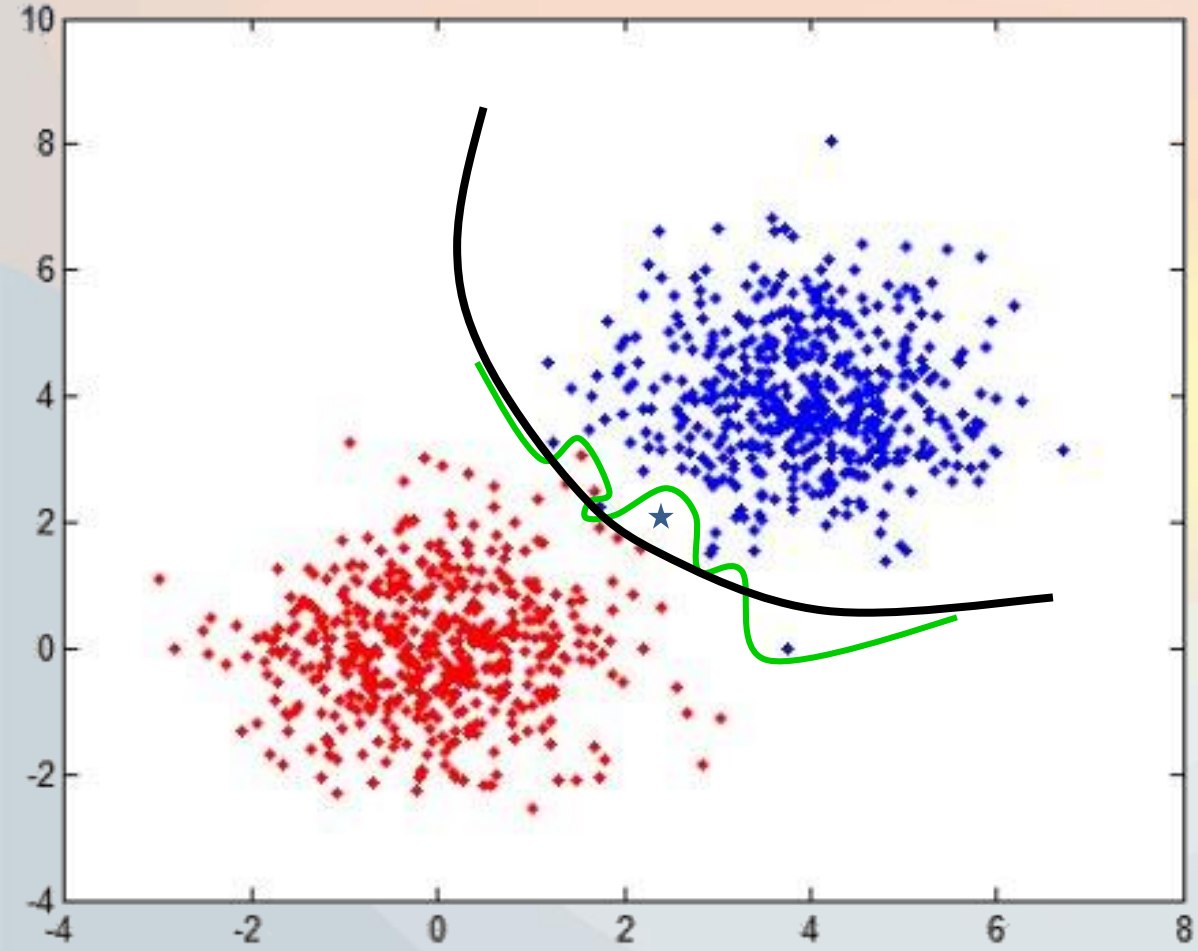
*Source: Machine Lea

Overfitting and Regularization

Gradient Descent

$$\theta_0 + \theta_1 x_1 + \theta_2 x_2^2 + \theta_3 x_3^3 + \theta_4 x_4^4 + \ldots + \theta_n x_n^n$$

0 0 0

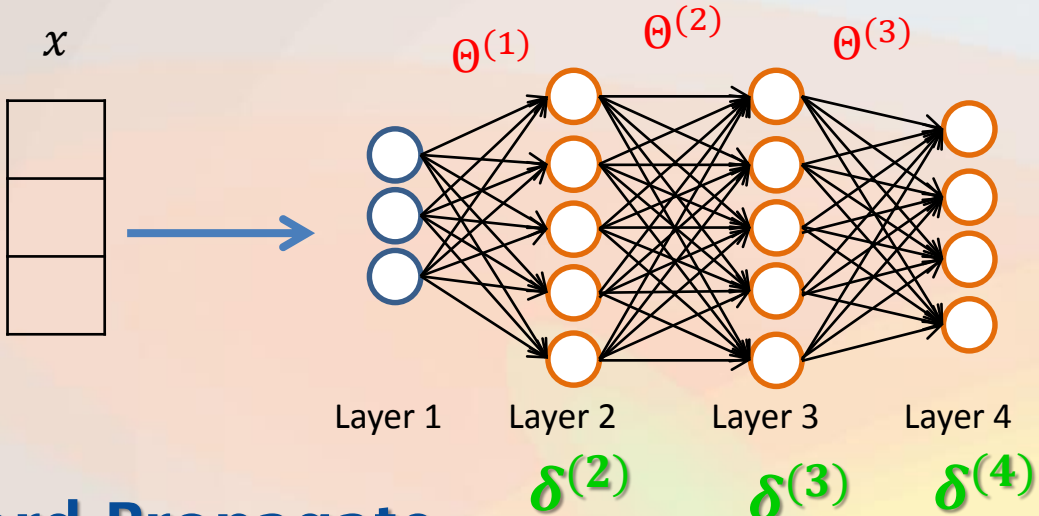


Modify Cost Function

$$J(\theta) \quad + \frac{\lambda}{2m} \sum_{i}^{m} {\theta_j}^2$$

Gradient Descent

Multi-layer Network



Want:

$$\delta^{(L)} = \frac{\partial}{\partial \theta} J(\theta)$$

Forward Propagate

$$a^{(1)} = x$$
$$z^{(2)} = \Theta^{(1)} a^{(1)}$$
$$a^{(2)} = g\left(z^{(2)}\right)$$
$$z^{(3)} = \Theta^{(2)} a^{(2)}$$
$$a^{(3)} = g\left(z^{(3)}\right)$$
$$z^{(4)} = \Theta^{(3)} a^{(3)}$$
$$a^{(4)} = g\left(z^{(4)}\right)$$

Back Propagate

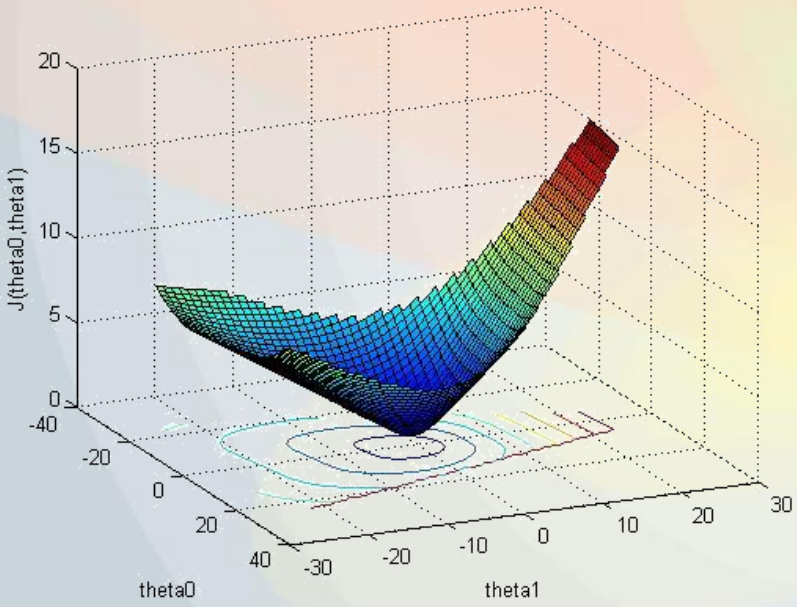
$$\delta^{(4)} = a^{(4)} - y$$

$$\delta^{(3)} = \left(\Theta^{(3)}\right)^T \delta^{(4)} .* g'\left(z^{(3)}\right)$$

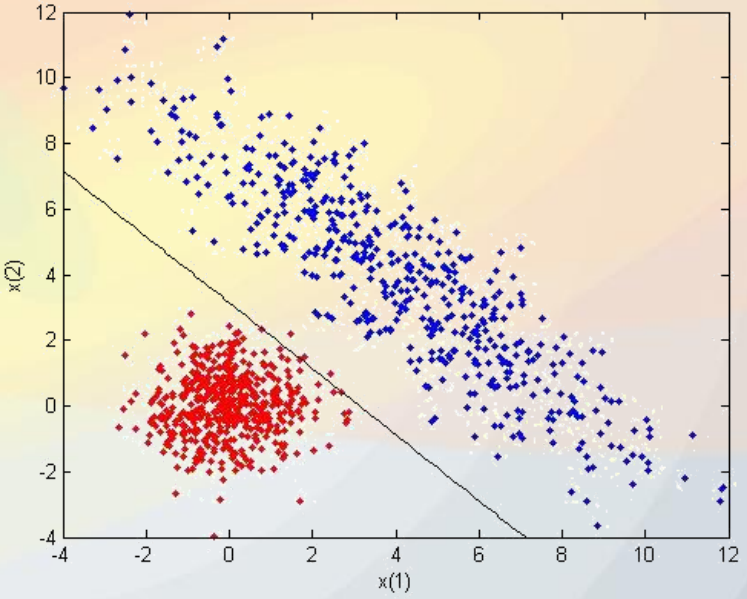
$$\delta^{(2)} = \left(\Theta^{(2)}\right)^T \delta^{(3)} .* g'\left(z^{(2)}\right)$$

Progress

Cost Function



Logistic Regression



Some Conclusions..

- Management of data
- Choosing good parameters
- A long way to go…

Plans for the future

- Building and training different types of neural networks
- Enhance the accuracy

Acknowledgements

Advisor
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