



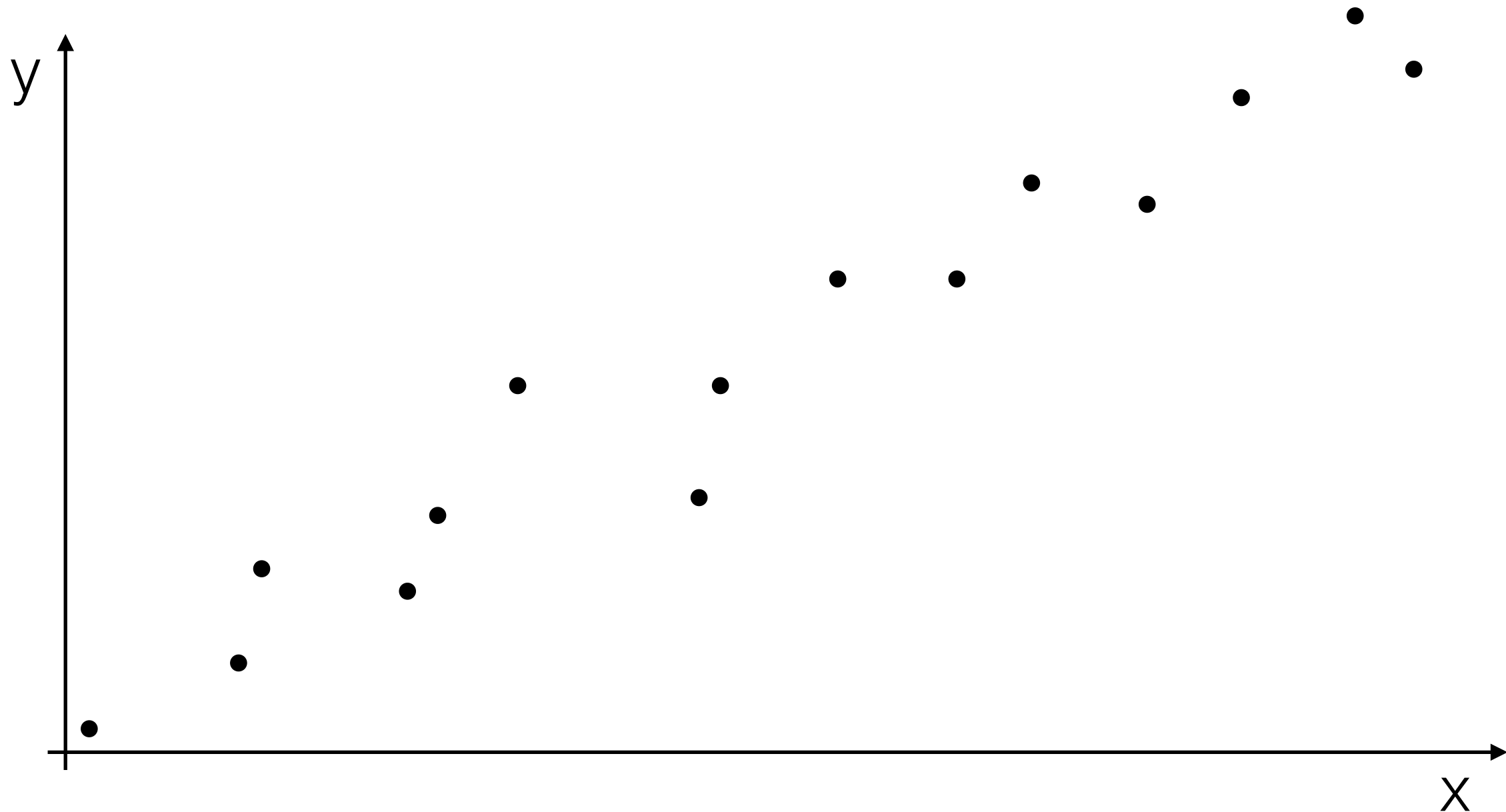
# Machine Learning with Python

Cheltenham Geek Night Talk

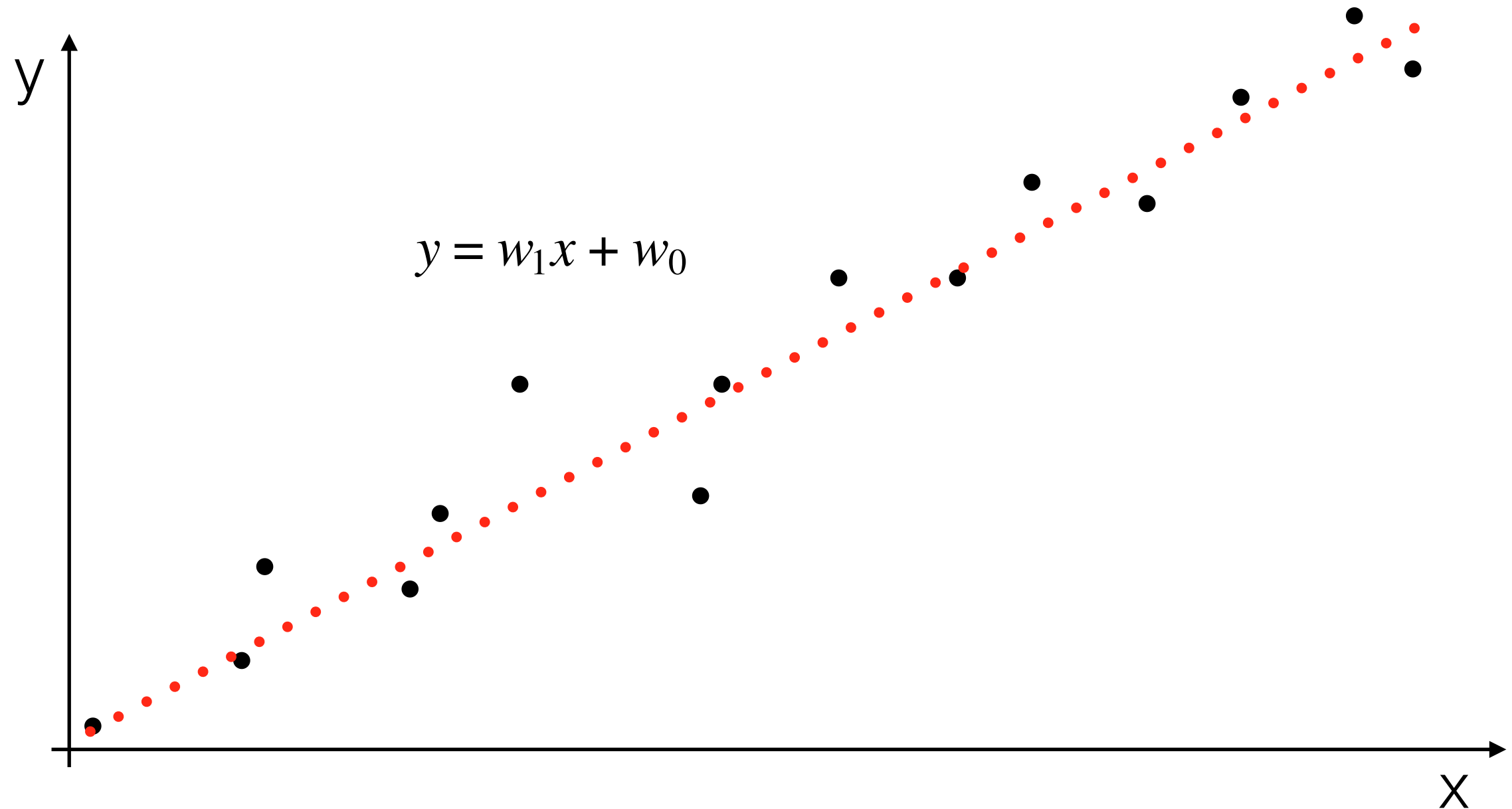
# Plan

1. Linear Regression
2. Python Machine Learning Stack
3. Classification
4. Break
5. Neural Networks

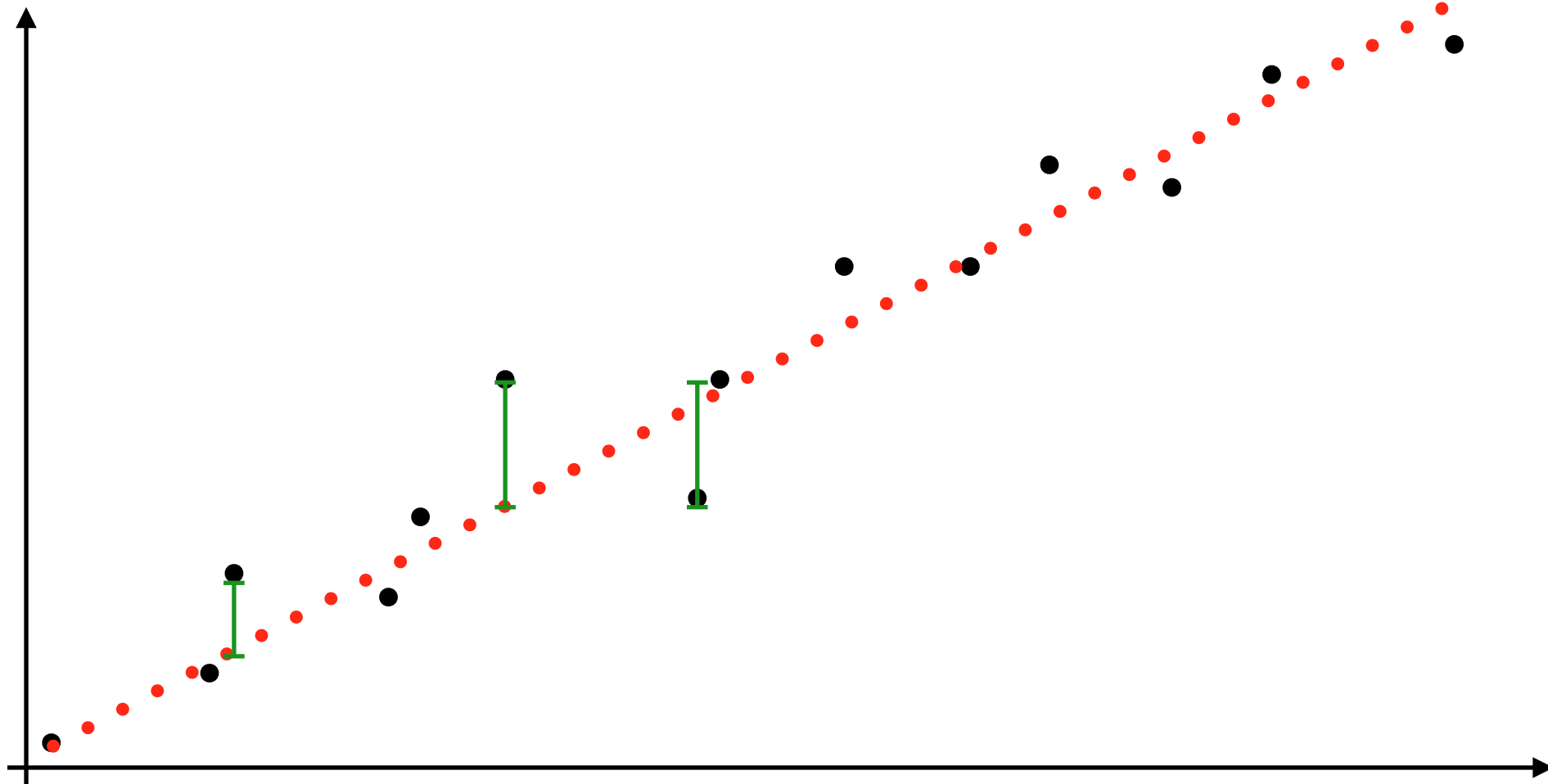
# Linear Regression



# Linear Regression



# Linear Regression



Error Function

$$E(w) = \frac{1}{2} \sum_i (y_i - (w_1 x_i + w_0))^2$$

Find Minimum!

# Linear Regression Example

# Python ML Stack

Python

Fortran: BLAS & LAPACK

numpy: *Matrices, vectors, fast linear algebra*

scipy: *Stats, stats, stats...*

scikit-learn: *Machine learning*

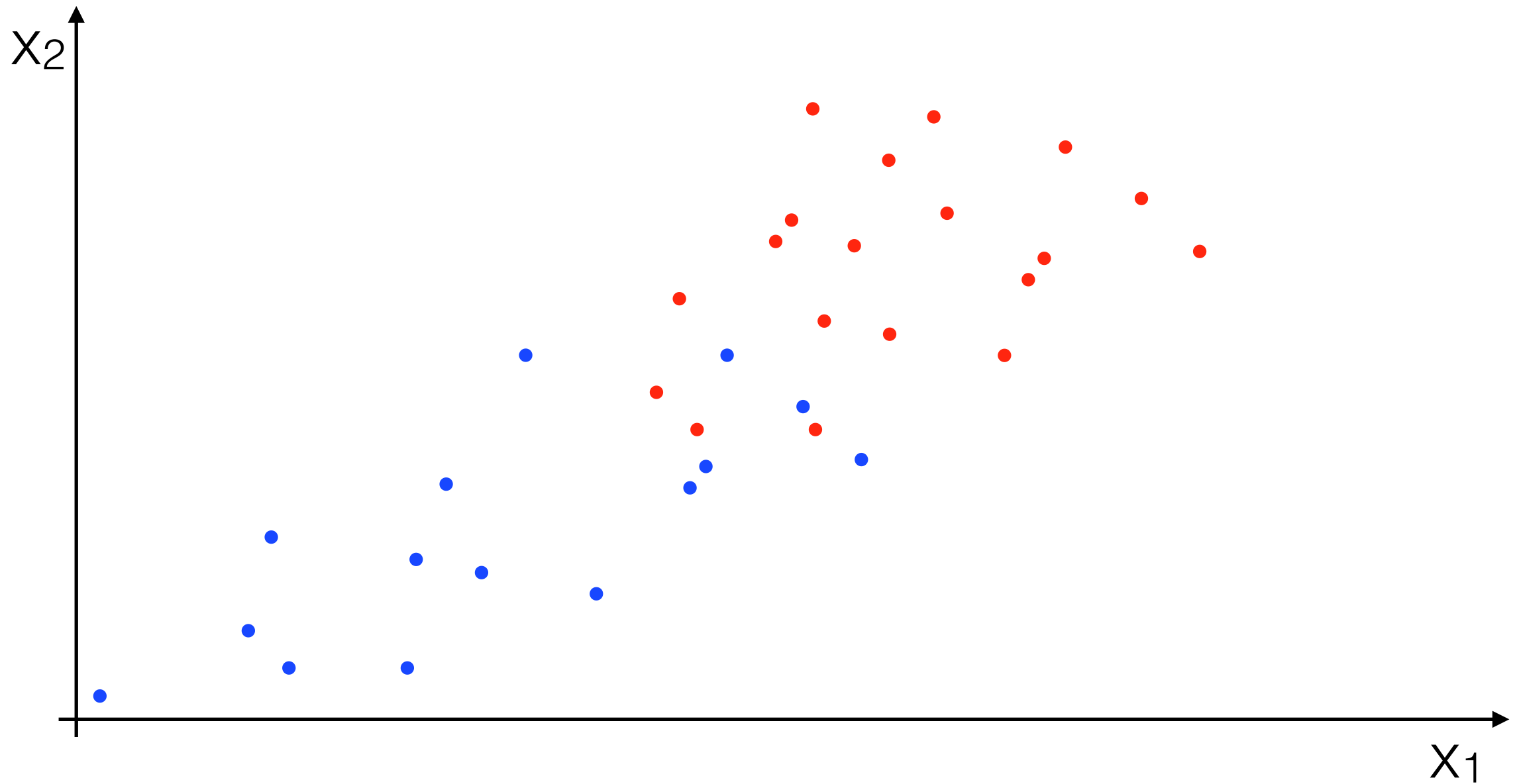
matplotlib: *Graphing and plotting*

iPython: *Interactive Web GUI*

[Install Instructions](#)

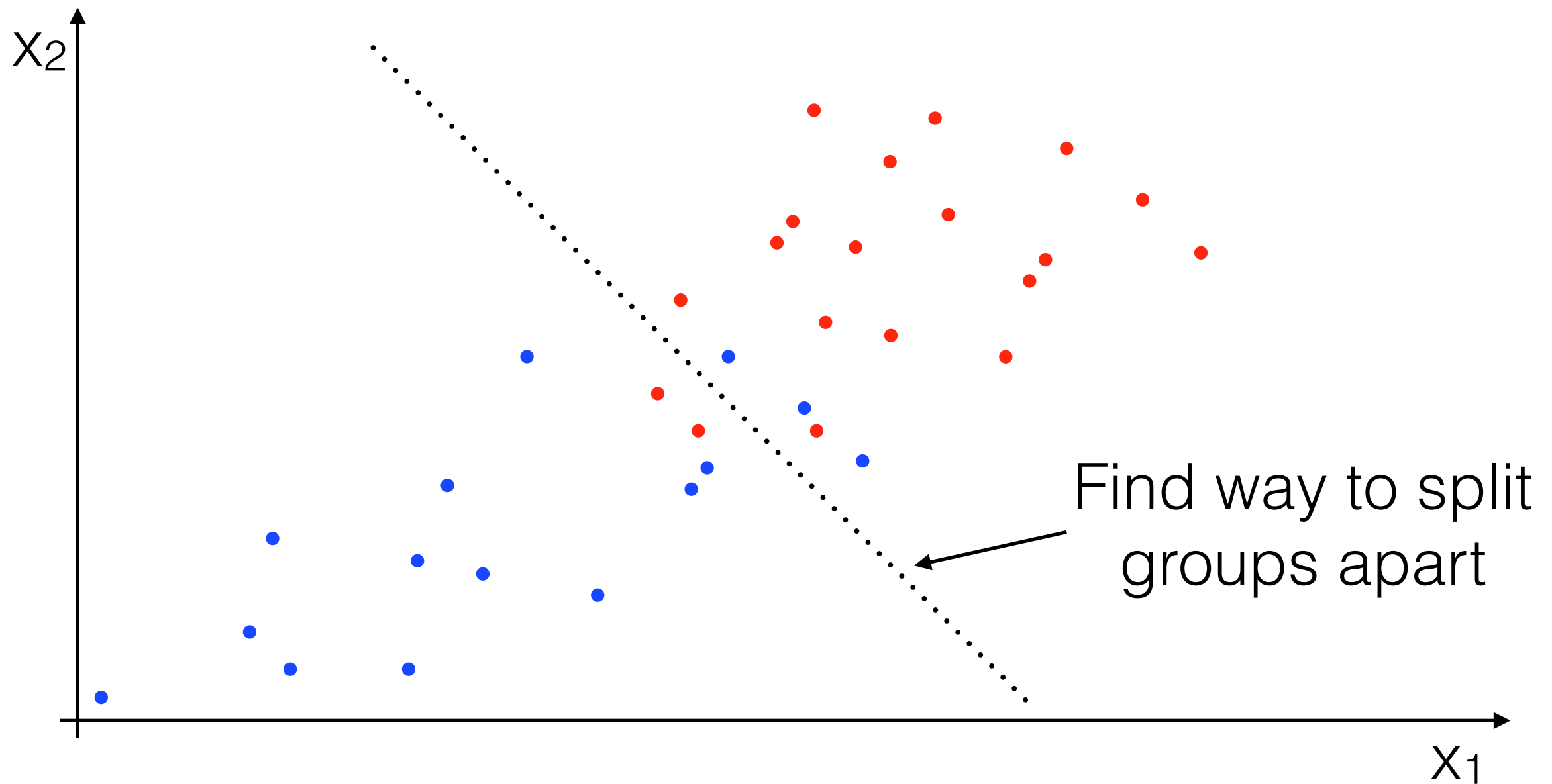


# Classification





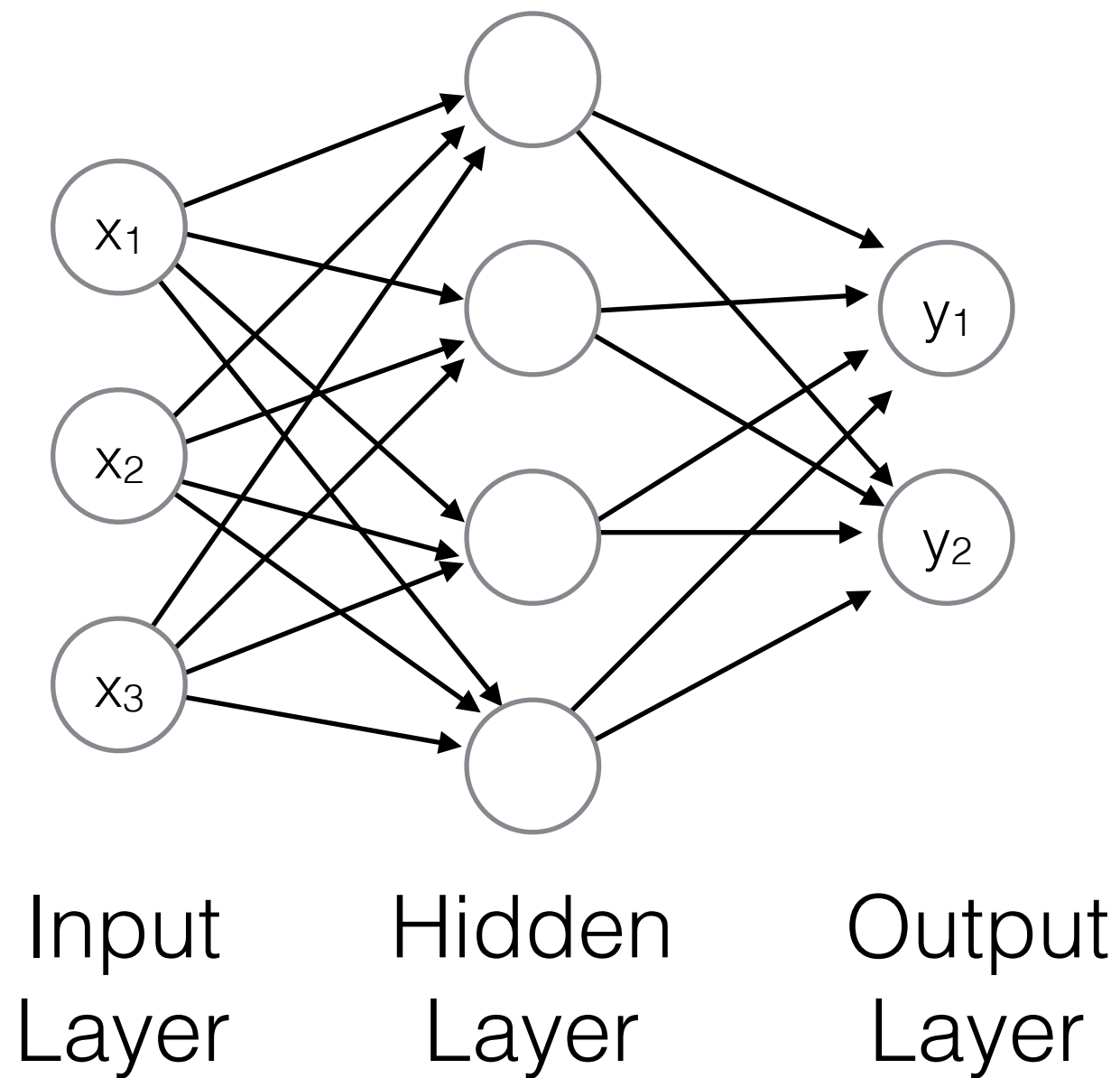
# Classification



# Classification Example

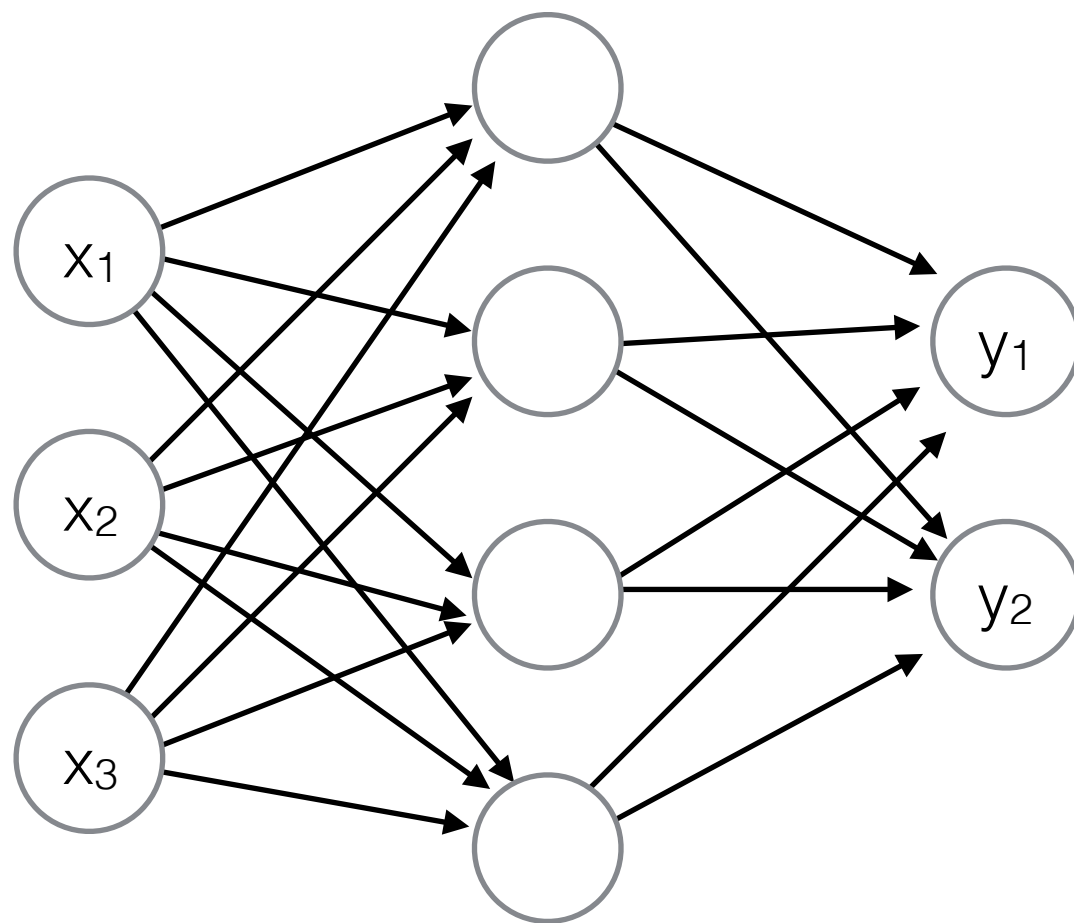
Break!

# Artificial Neural Networks



# Artificial Neural Networks

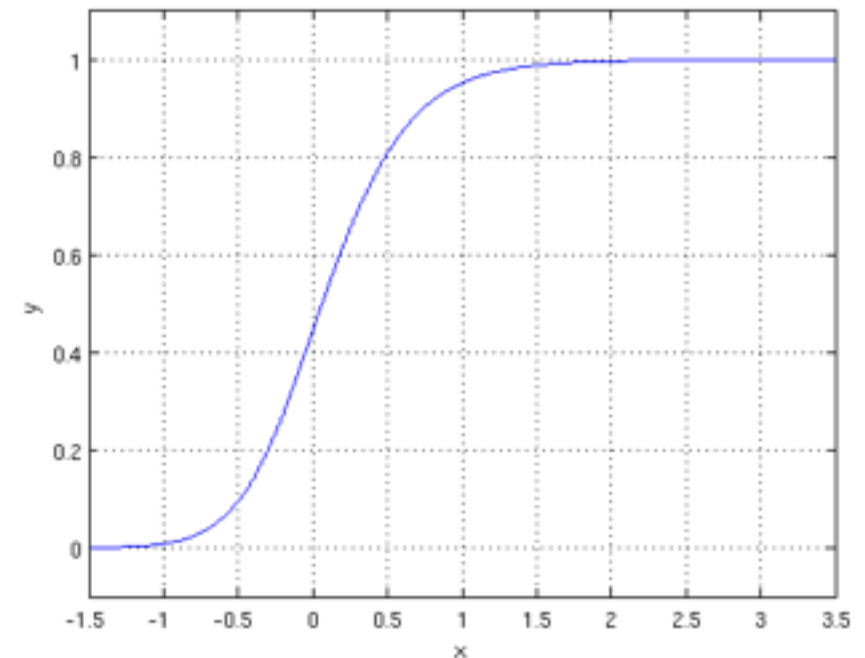
$$f(x) = G(b^{(2)} + W^{(2)}(s(b^{(1)} + W^{(1)}x))),$$



Input  
Layer

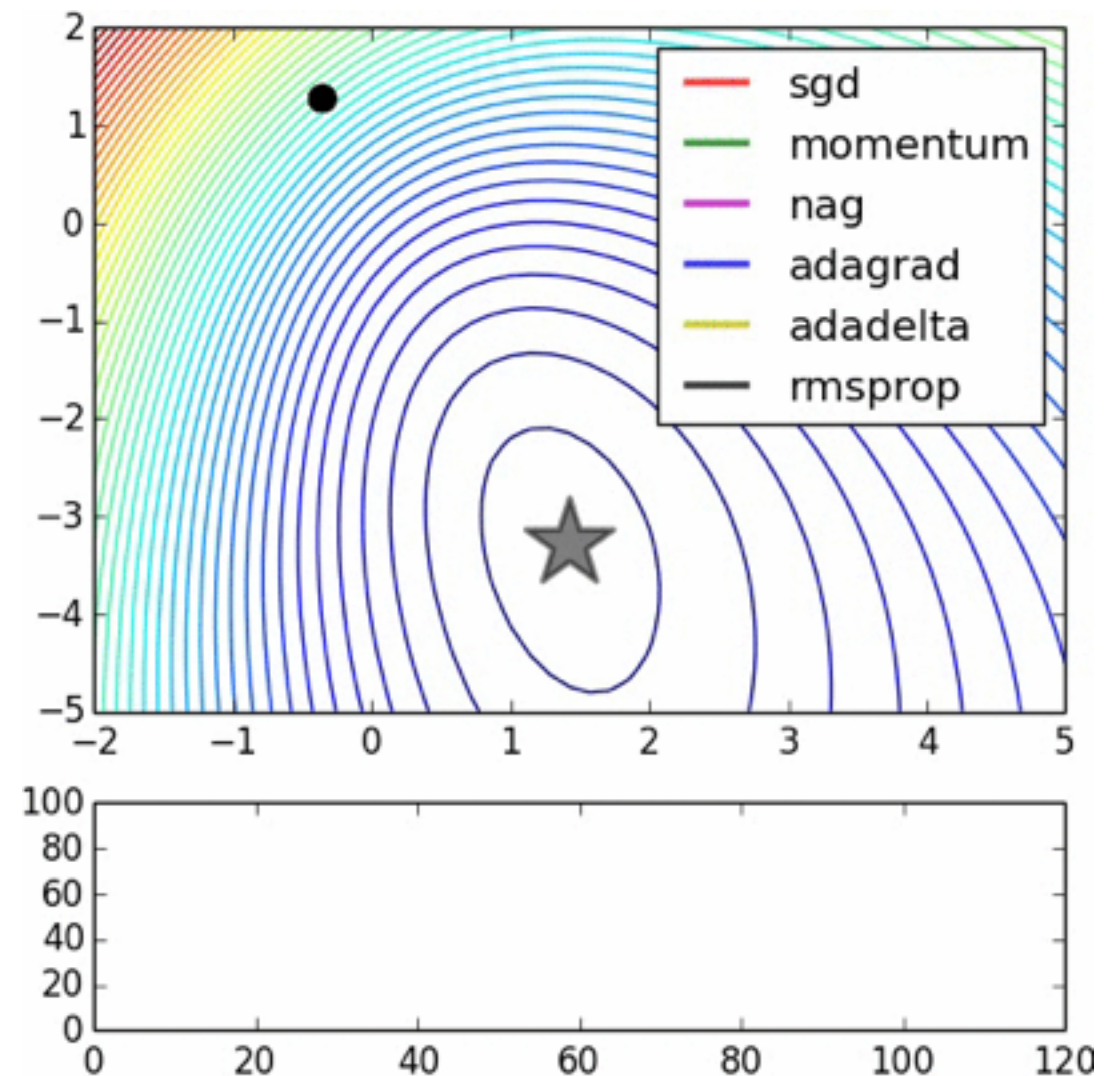
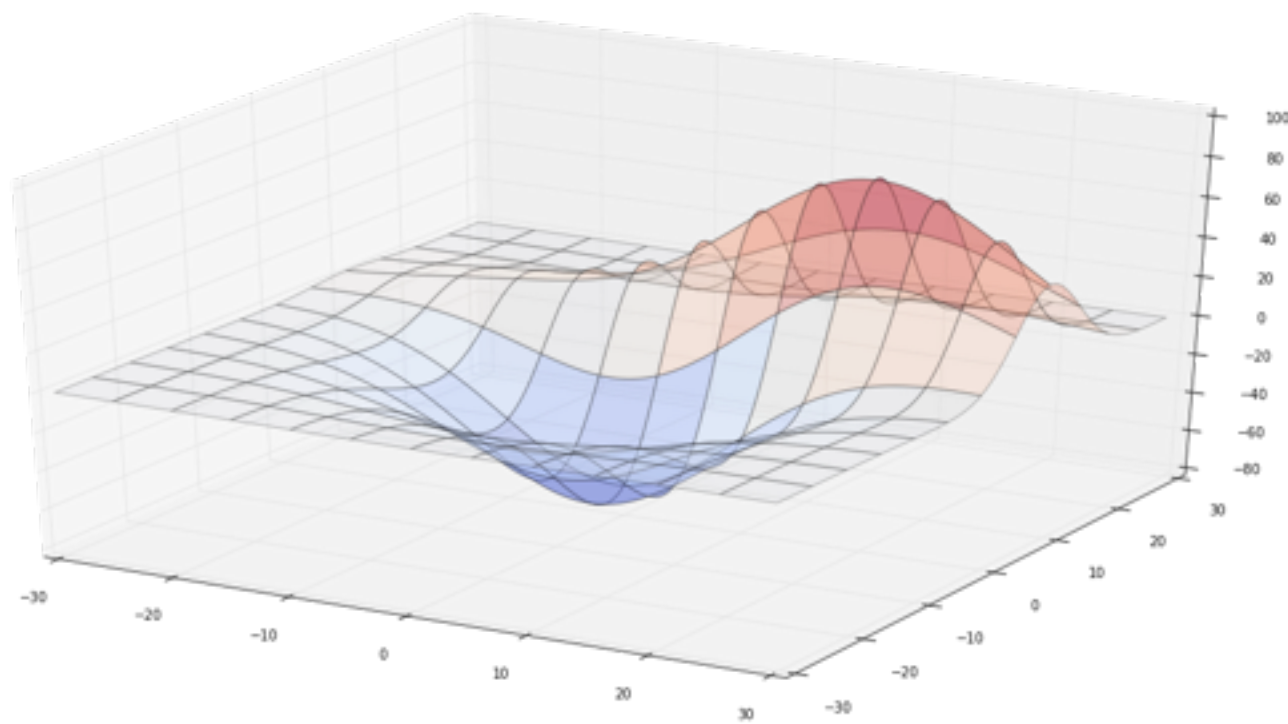
Hidden  
Layer(s)

Output  
Layer



# Artificial Neural Networks

## Training



animation by Alec Radford

# Neural Nets in Python

Zillions of libraries...

## **Lower Level Libraries**

**Theano** - University of Montreal

**TensorFlow** - Google open-sourced this last month

**Torch** - Facebook backed (actually Lua interface)

## **Higher Level Libraries**

**Keras** - Builds on both Theano and TensorFlow

**Blocks** - Builds on Theano

**Lasagne** - Builds on Theano



# Artificial Neural Networks

## MNIST Dataset

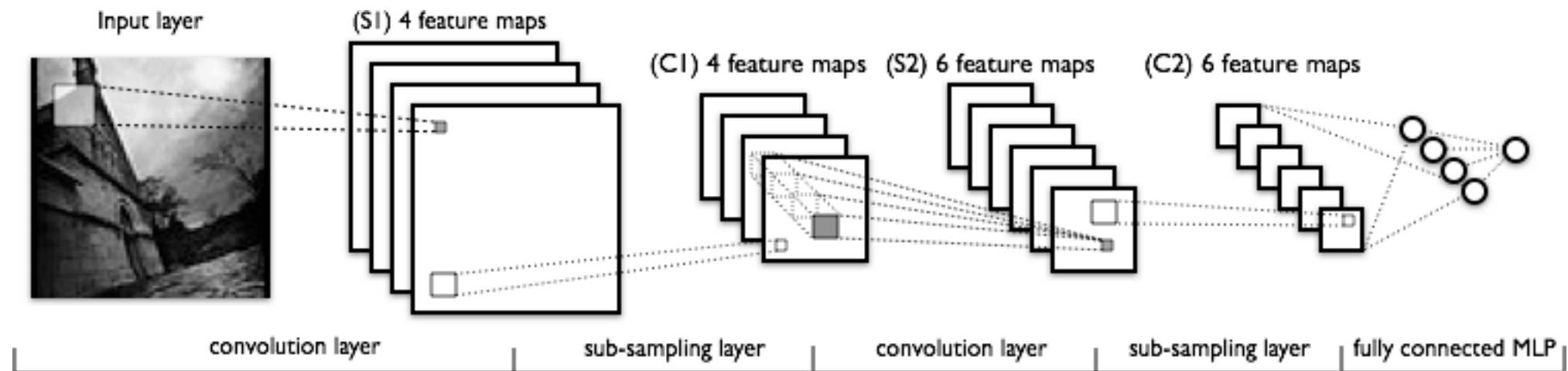


60k training samples & 10k test samples



# Artificial Neural Networks

## Convolutional Neural Networks



0.91% Error on MNIST (LeNet, Yan LeCun 1998)

**91 wrong in 10,000!**

*Latest record is 0.21% error (Li Wan 2013)*

Image taken from Theano documentation

Great but...

# Artificial Neural Networks

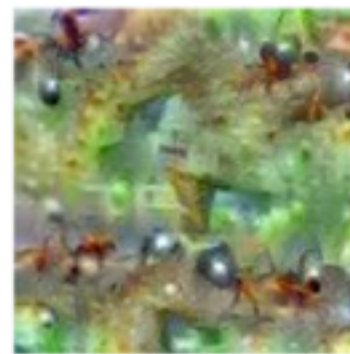
What's Going On?



Hartebeest



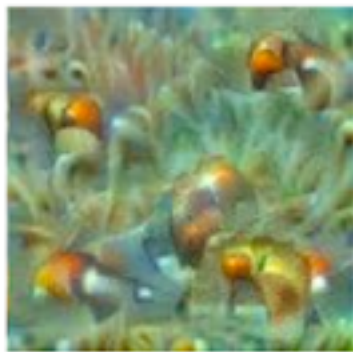
Measuring Cup



Ant



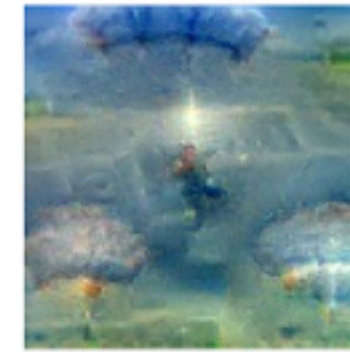
Starfish



Anemone Fish



Banana



Parachute



Screw

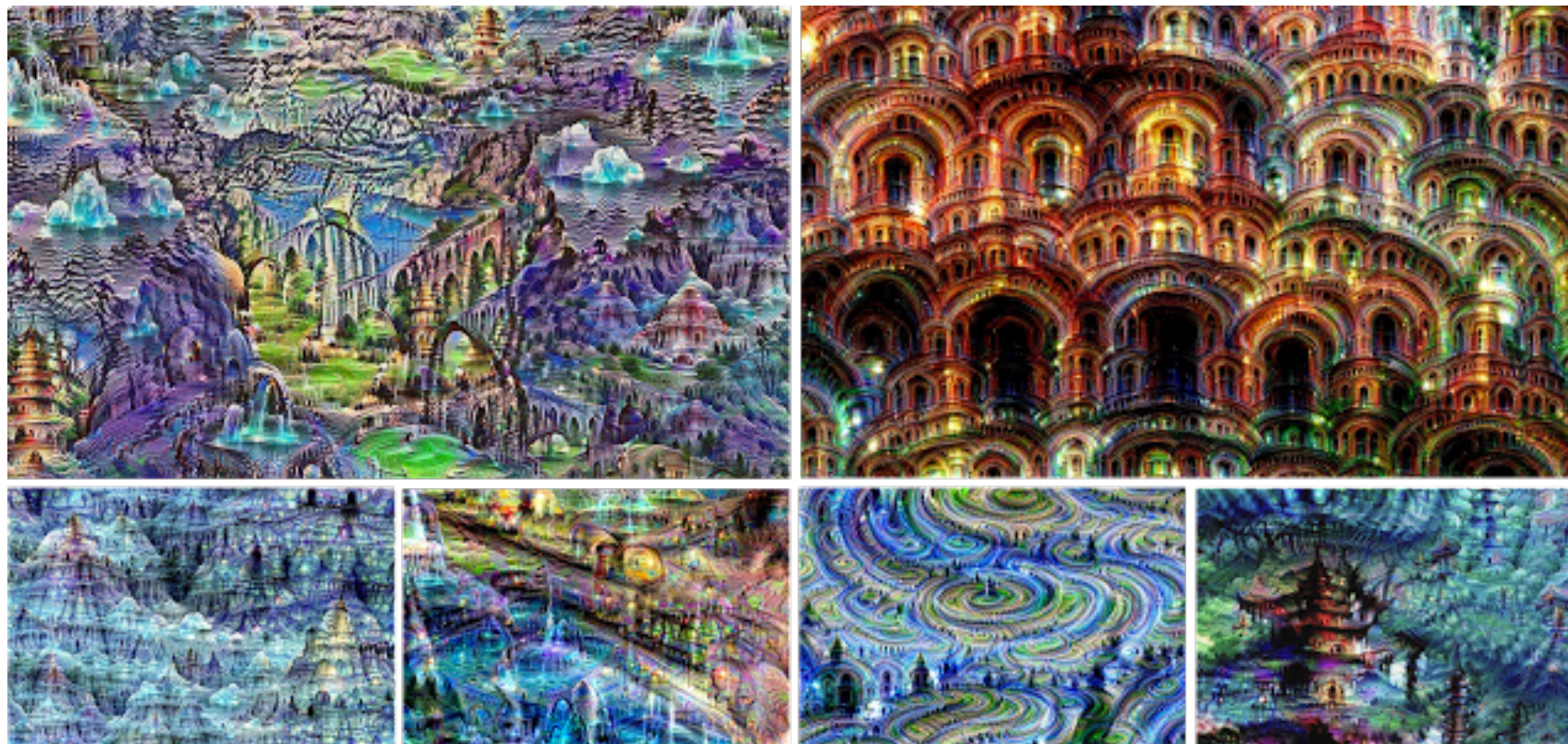
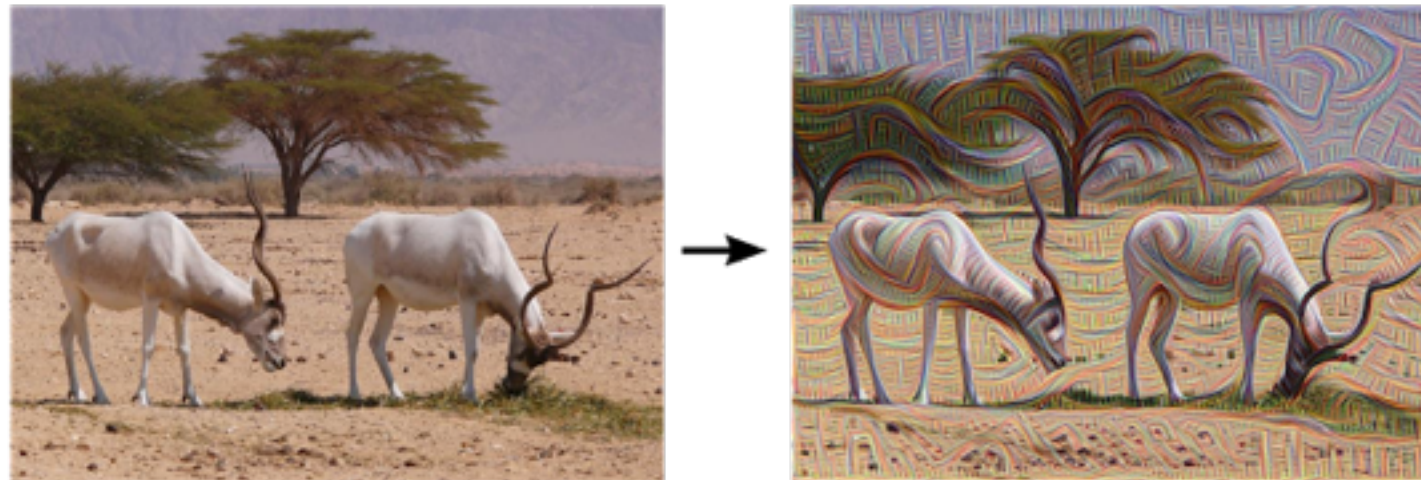


Taken from: <http://googleresearch.blogspot.co.uk/2015/06/inceptionism-going-deeper-into-neural.html>



# Artificial Neural Networks

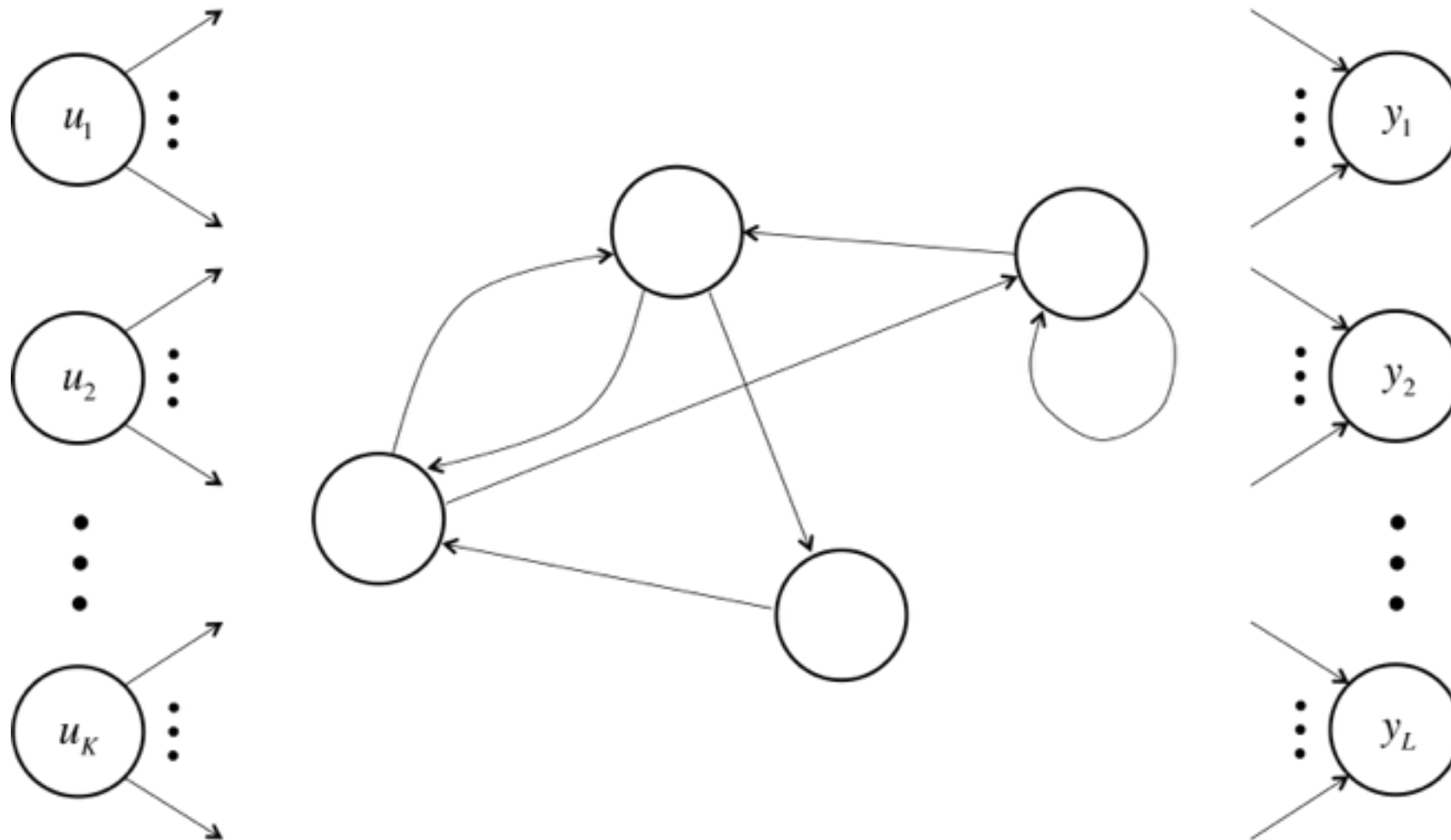
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# Artificial Neural Networks

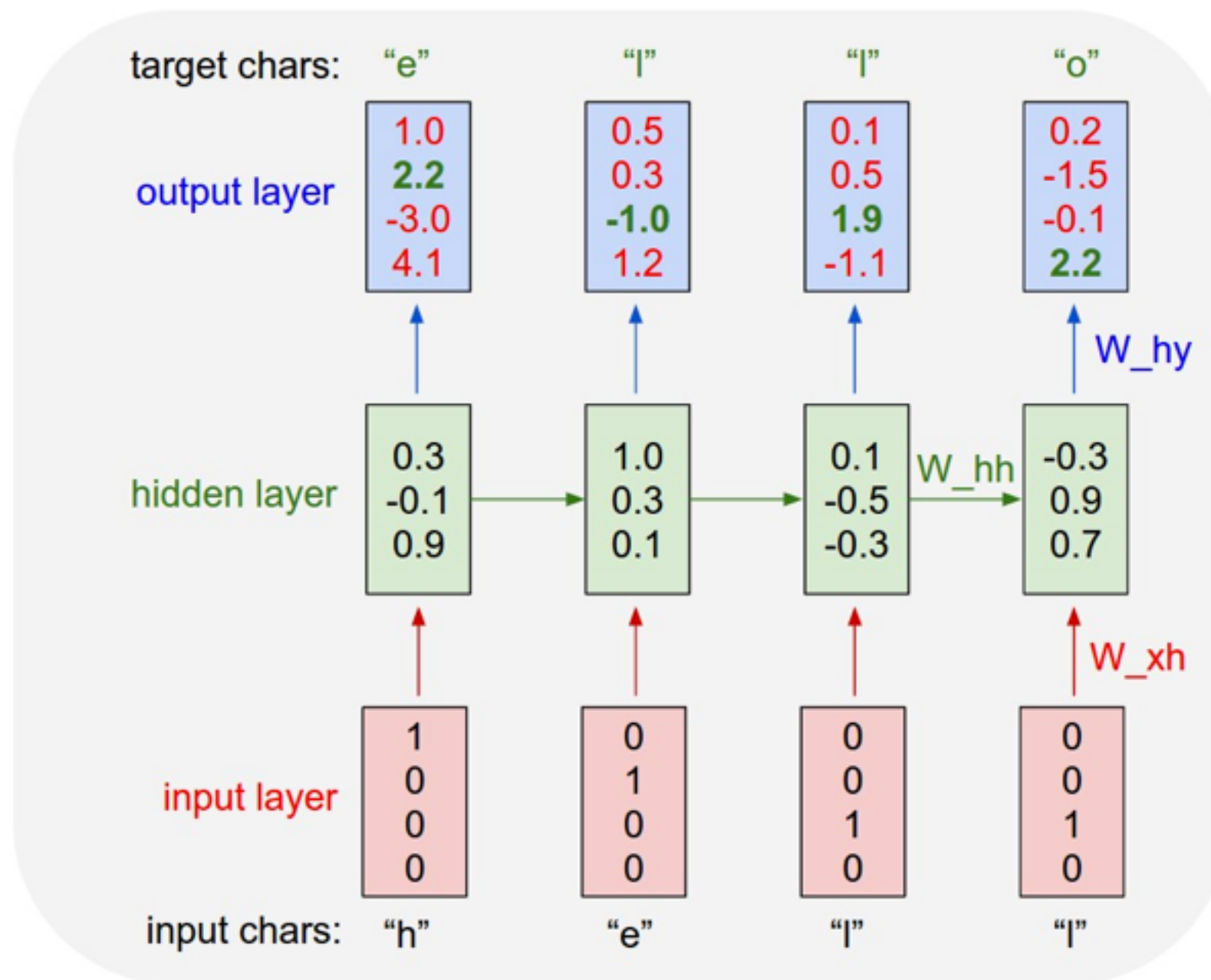
## Recurrent Neural Networks





# Artificial Neural Networks

## Recurrent Neural Networks



Taken from: <http://karpathy.github.io/2015/05/21/rnn-effectiveness/>

# Artificial Neural Networks

## Recurrent Neural Networks

### Shakespeare Generated by RNN

KING TOM: What ho geek nighten  
was, and with thee?

PRINCE EDWARD:  
I think by the world and light  
shout with him;  
Since, make the stepling of the  
igle what  
Thou kust poit, do it. To mean for  
that?

Provost:  
'Tis word, the rotter shun that  
dear nearn'd.

Third Citizen:  
What I have well in sleeps not in  
the rose.

KING EDWARD IV:  
From her hence viltocion, good  
for our worse,  
Thy friends the morning hath let's  
used it be  
As the beloved is, which well blow  
to feel death, but  
sight, is very heart, yet-est  
trans for thy fight,  
And Northumberland of Pisa of  
runs,  
And then let me doth a former it.

Second LutAN:  
It may not hate you and said? that  
back  
loves off a quiet, in my  
friartime,  
Proud hours, or nothing but to put

# Reinforcement Learning

[https://  
www.youtube.com/  
watch?v=V1eYniJ0Rnk](https://www.youtube.com/watch?v=V1eYniJ0Rnk)



# Learning More

- Andrew Ng's Machine Learning Course - Coursera
- Geoff Hinton Neural Network Course - Coursera
- Python: Scikit-learn & Theano documentation
- Many books; e.g. Pattern Recognition and Machine Learning by Chris Bishop

Questions?