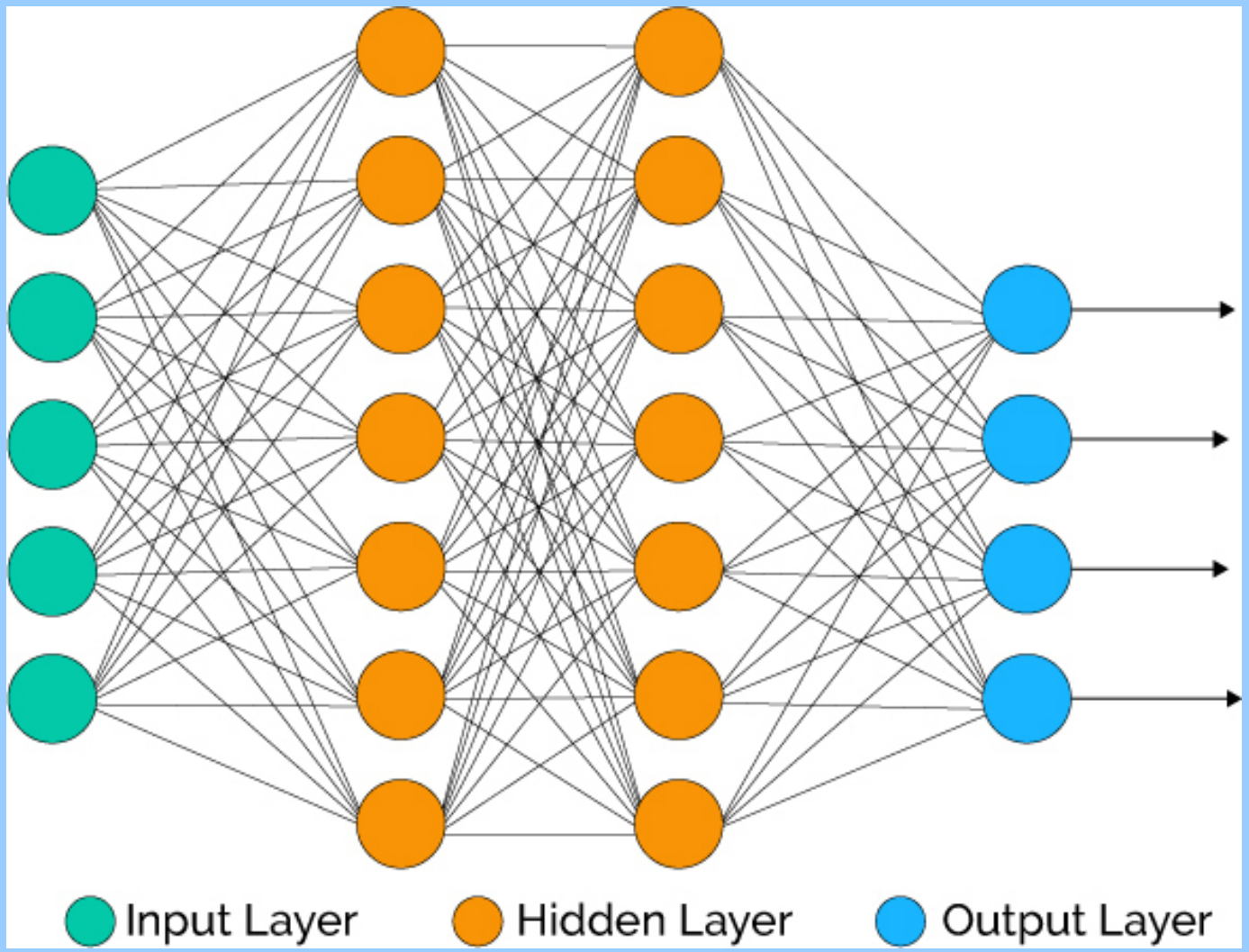
Recurrent Neural Networks

Setup

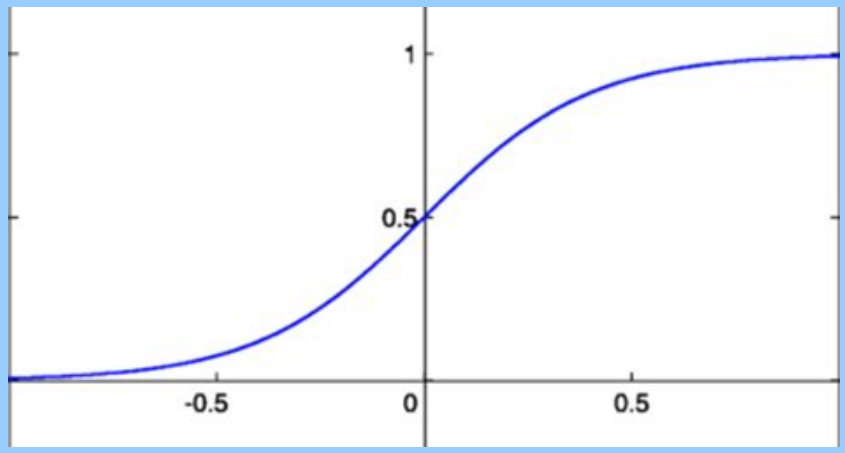
- **If you want to look at the code locally (and edit) while we go through it then:**
- Download git: https://git-scm.com/
- git clone github.com/CryptoSoc/JokeNet

- **Otherwise, if you just want to learn:**
- You can look at all the resources used here:
- RNN Code: github.com/CryptoSoc/JokeNet
- Workshop 1:

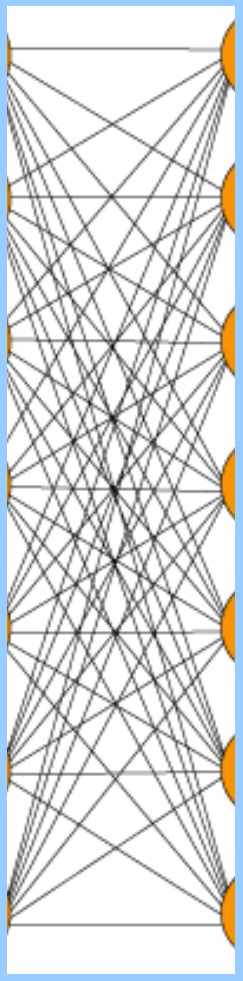
- Neural networks



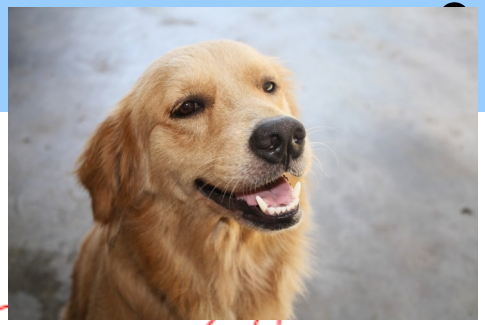
Neurons



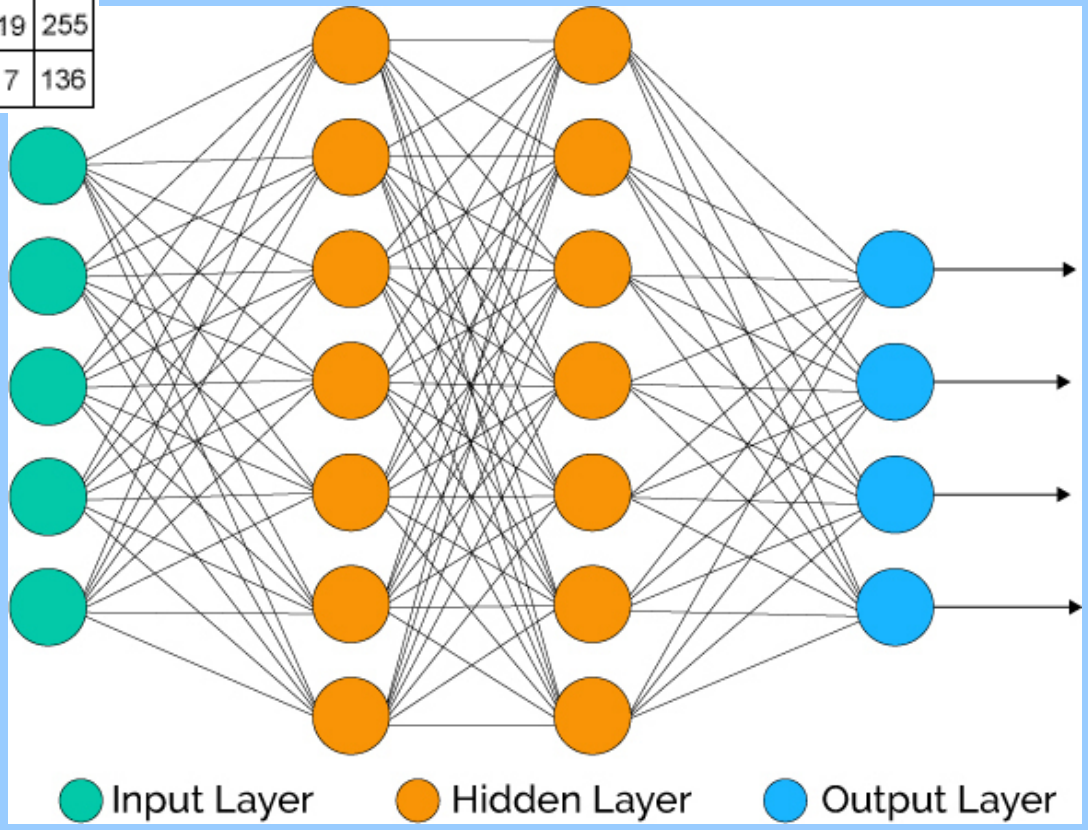
Weights



Neural networks



170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136



Dog

Cat

Mouse

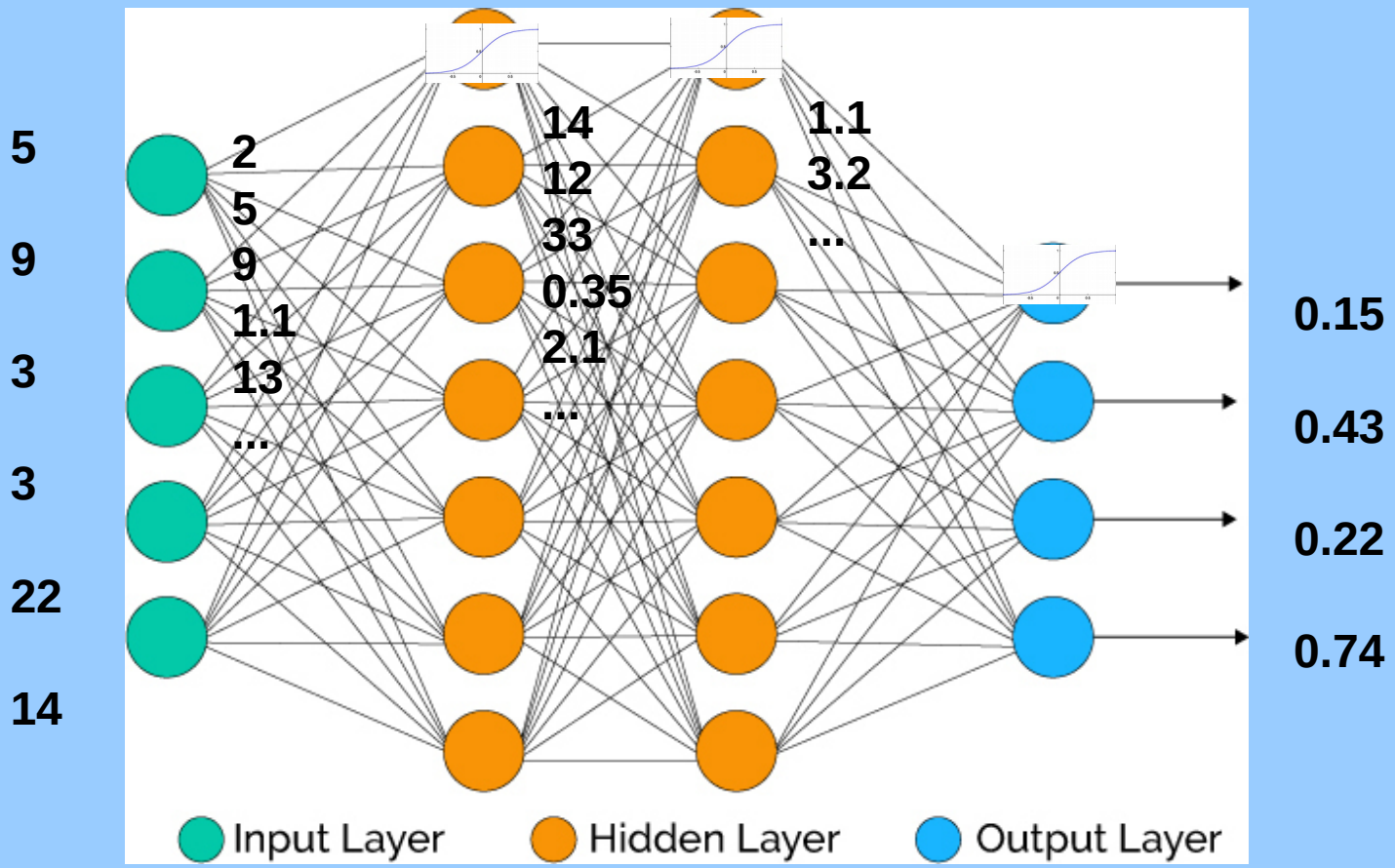
...

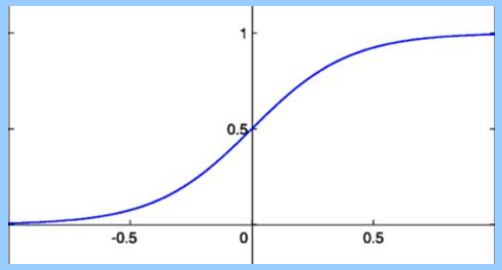
Forward Propagation

- Done with matrices
- Take input, multiply by weights, activate, repeat
- In the output layer, the highest valued is our predicted output
- Fairly easy

```
def forwardProp:
    for i in numLayers:
        nodes[i+1] = activate(dotProduct(weights[i], nodes[i]))
```

• Neural networks



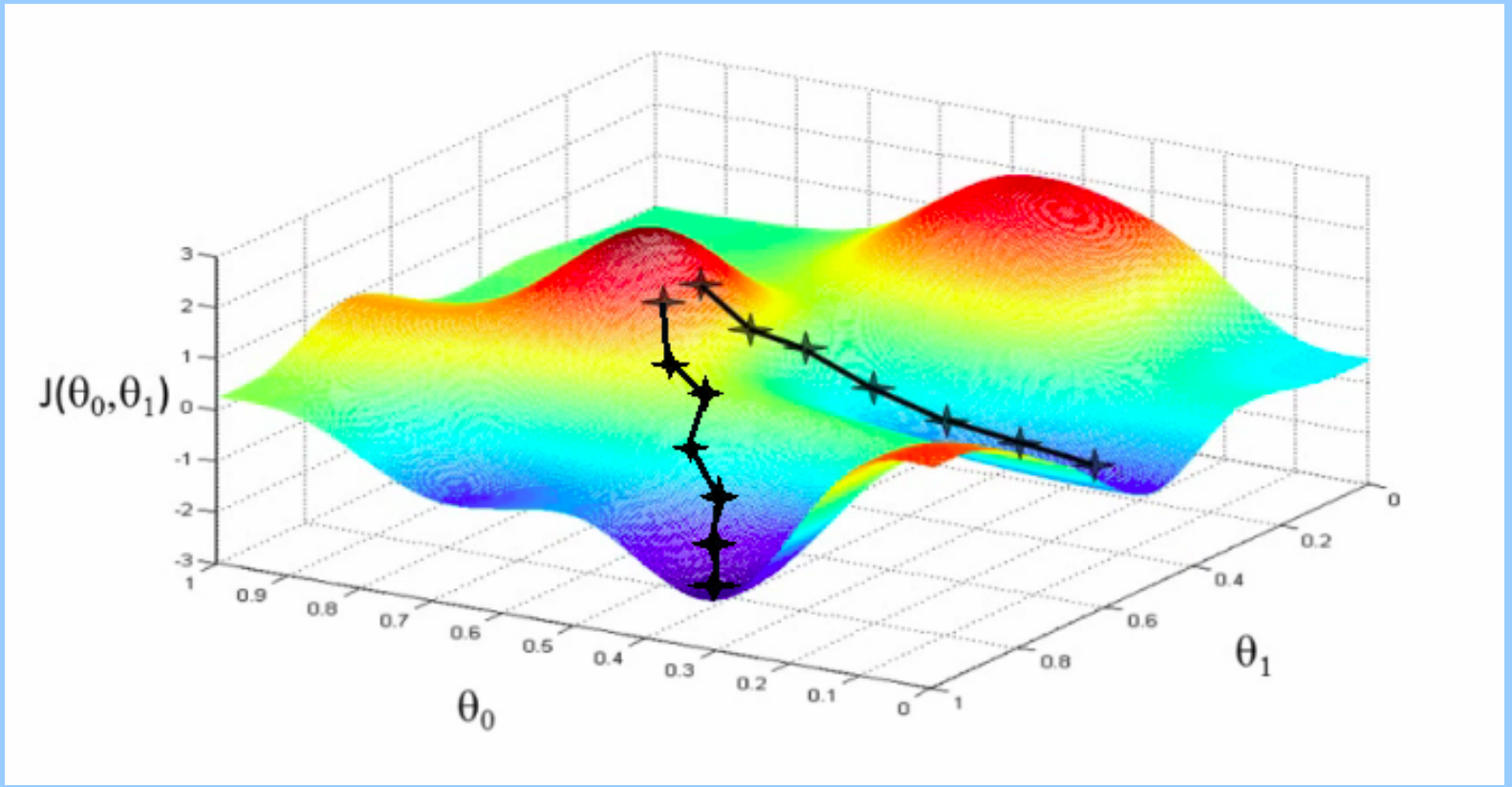


Backward Propagation

- Given a labelled piece of data, train the model by moving backwards and adjusting the weights
- Harder to compute
- Have to iterate over lots of data for good results

```
def backwardProp:
    outputError = labels - predictedOut
    for i in numLayers:
        expectedPreviousOutput = outputError * weights[numLayers - i]
        outputError = expectedPreviousOutput - nodes[numLayers – i]
        nodes[numLayers – i] -= learningRate*derivative(outputError)
```

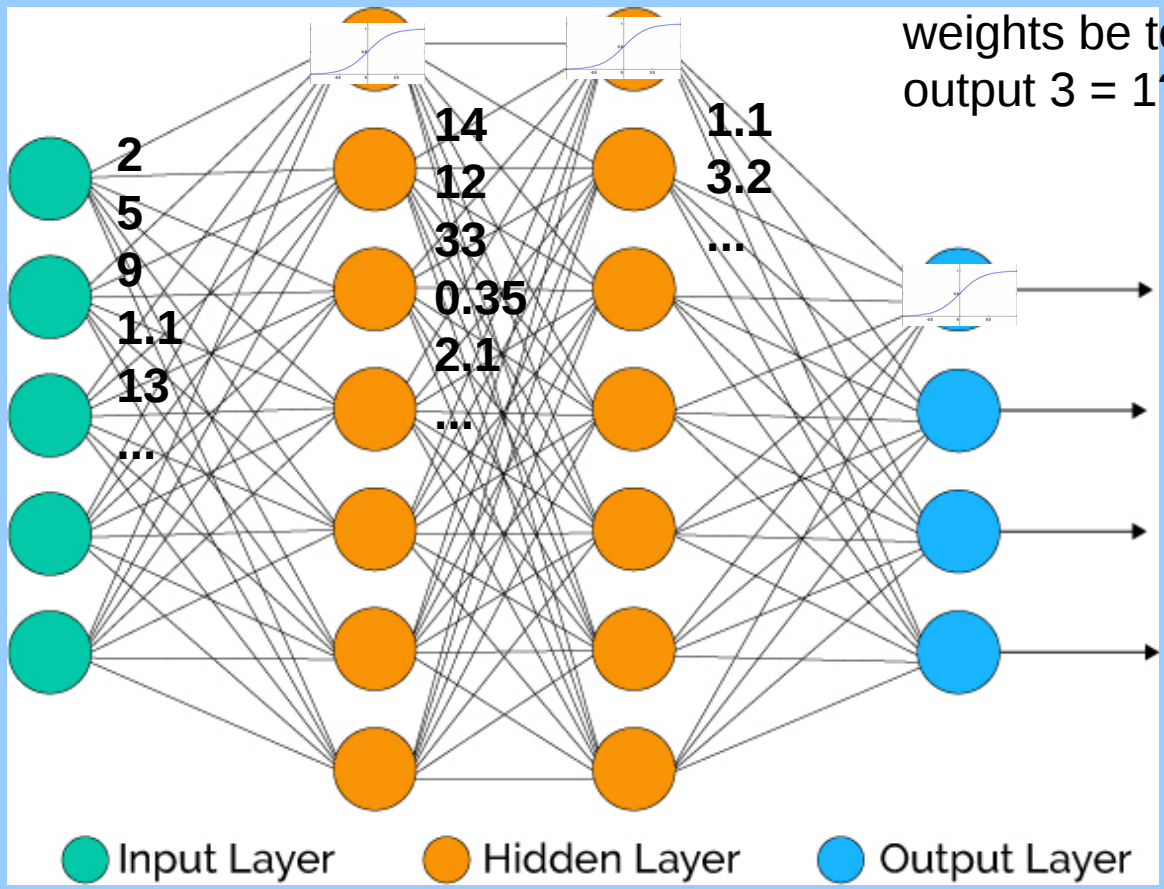
Why subtract the derivative?



• Neural networks

What should these weights be to make output 3 = 1?

5
9
3
3
22
14

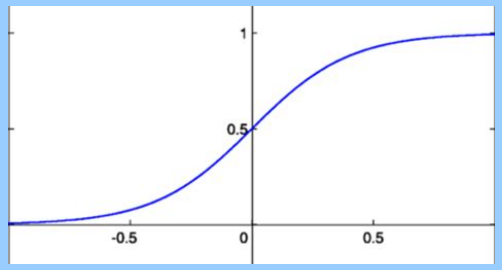


.15 - 0

0.43 - 0

0.22 - 1

0.74 - 0



And that’s all the math!

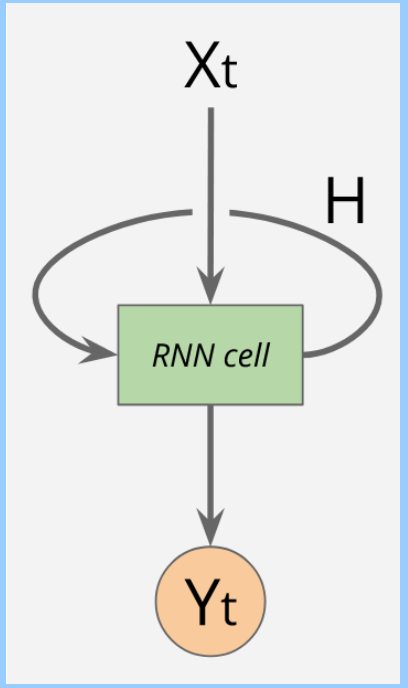
Recurrent Neural Networks

- Have “memory”
- Trained and operated in sequential steps

```
class RNN:
  # rest of the RNN

  def step(x):

      # forward propagation with memory
      h = tanh(dotProduct(Weight_h, hiddenNode) + dotProduct(memW, activation))

      # compute the output vector
      y = dotProduct(Weight_y, hiddenOutputNode)

      return y
```

LSTM

- Long Short Term Memory
- A type of RNN
- Mathematically: an internal weight applied to itself
- i.e. given the neuron was on, should it stay on?



Examples: Generating Shakespeare

PANDARUS:
Alas, I think he shall be come approached and the day
When little srain would be attain'd into being never fed,
And who is but a chain and subjects of his death,
I should not sleep.

Second Senator:
They are away this miseries, produced upon my soul,
Breaking and strongly should be buried, when I perish
The earth and thoughts of many states.

DUKE VINCENTIO:
Well, your wit is in the care of side and that.

Second Lord:
They would be ruled after this chamber, and
my fair nues begun out of the fact, to be conveyed,
Whose noble souls I'll have the heart of the wars.

Clown:
Come, sir, I will make did behold your worship.

VIOLA:
I'll drink it.

Examples: Generating Piano Music

Examples: Google Duplex

“At the core of Duplex is a recurrent neural network (RNN) designed to cope with these challenges”

To The Code!

Results

- s, "Well, I don't give a shit alhal " wau t aote tntaen t
- cabbages sliding down the hill anlet aoeneng

Consider the source of your data. Not only will it make or break your algorithm, it also will impart its own biases into your predictions.

Results – 128100000 iterations

An elderly man walks into a bar and says, "I was a man with a shit on the bathroom."

The man says "I was so sorry to make a bus to the bathroom. I would like the chicken and I was starting to see her."

The man says, "I would like a book about this and I have the bathroom to my friend and she started to cry to his buddy and a son who wouldn't help her to the conductor and said "I would have a strange street the other day to this morning."

The man responded, "I was a man."

The man said, "What are you doing to do?" The bartender said, "I don't know how many stars does it take to change a light bulb?"
The man says, "Well you aren't sure that's a monkey but I don't have a child."

The manager says, "Why don't you think you went to his bathroom?" The man replied "Well you are so bad, I'm a strange son."

The man replied, "I'll be a bit of here."

Then he said, "I didn't have to go out."

Results – Iteration 148805970

What did the blonde say when she was standing out on his pants and says, "Well I wish I was a problem."

"What about your son?" she said.
"I want to be an arm and then I was so bad at this part of my bedroom with the world."

Improvements?

- Algorithm
- Data
- Visualisation
- Philosophical
- Look in the README on github for suggestions
- Join in and make your own improvements on github: github.com/CryptoSoc/JokeNet

Feedback

- https://goo.gl/77aNp1

(and possibly CryptoSoc tokens)