TensorFlow and you

A very incomplete intro to neural networks

Carlos de Lannoy - TechTalk - March 21st 2018

WAGENINGEN
UNIVERSITY & RESEARCH

Overview

- The what, why and how
- Simple to intricate networks
- Tensorflow: a short intro and building your first NN
- Other flavors of NN

In short: the what, why and how

https://xkcd.com/1838/

In short: the what, why and how

WHAT

- A universal approximator

WHY

- You have (a lot of) data and a problem
- Relationship exists but is unclear
- You just want something that works

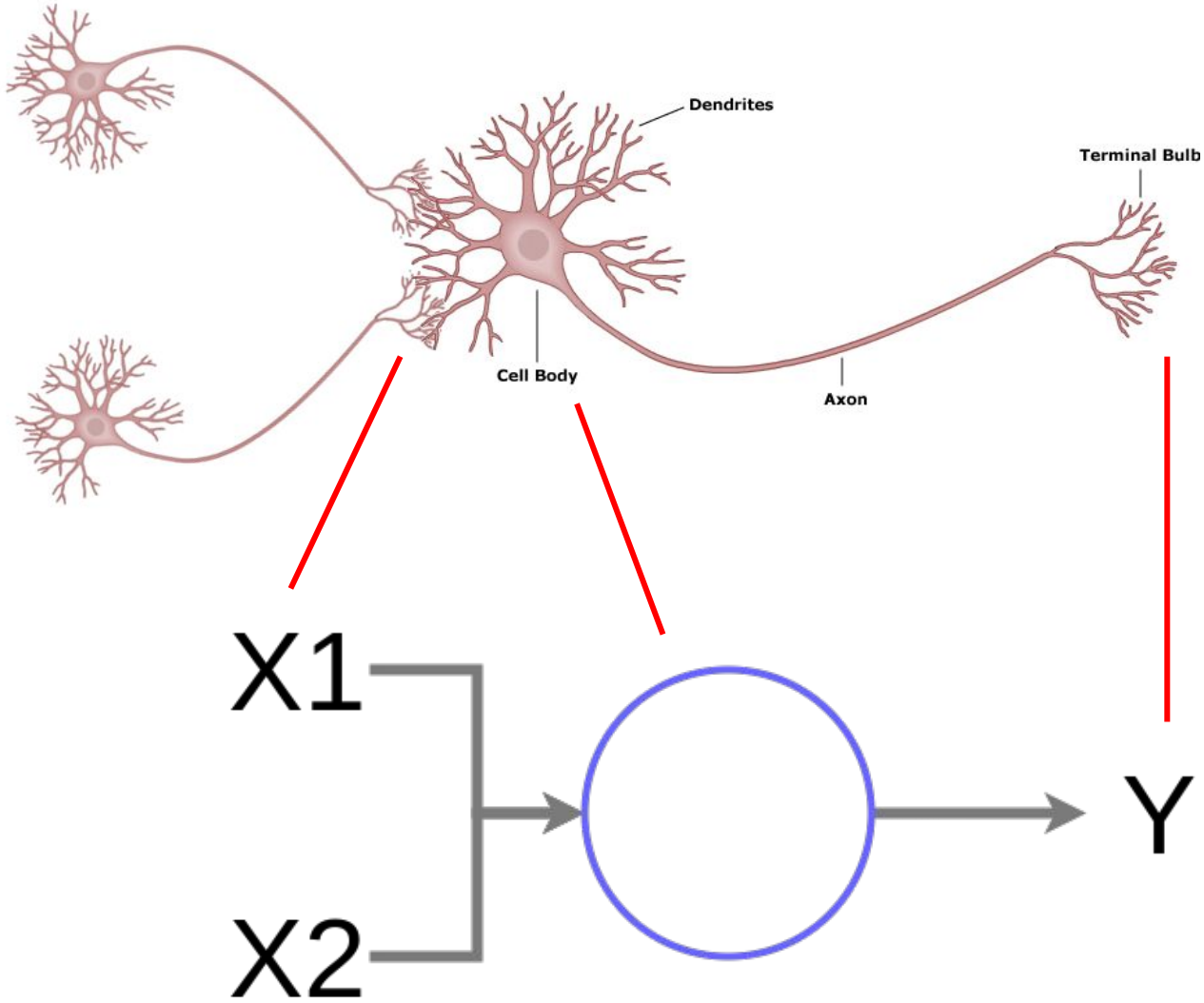
HOW

- Weighted linear combinations, non-linear transformations (and some tricks…)

The why not

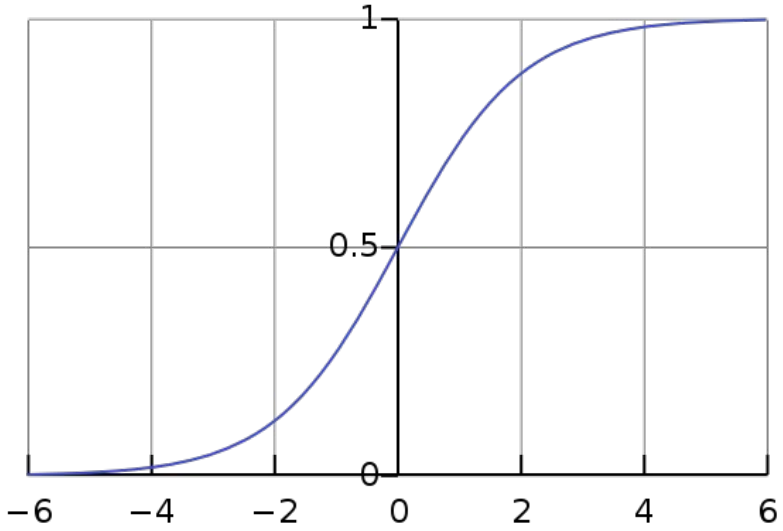
- You don’t have heaps of well-annotated data
- You want an easily understandable model
- You want a one-button solution

A single neuron

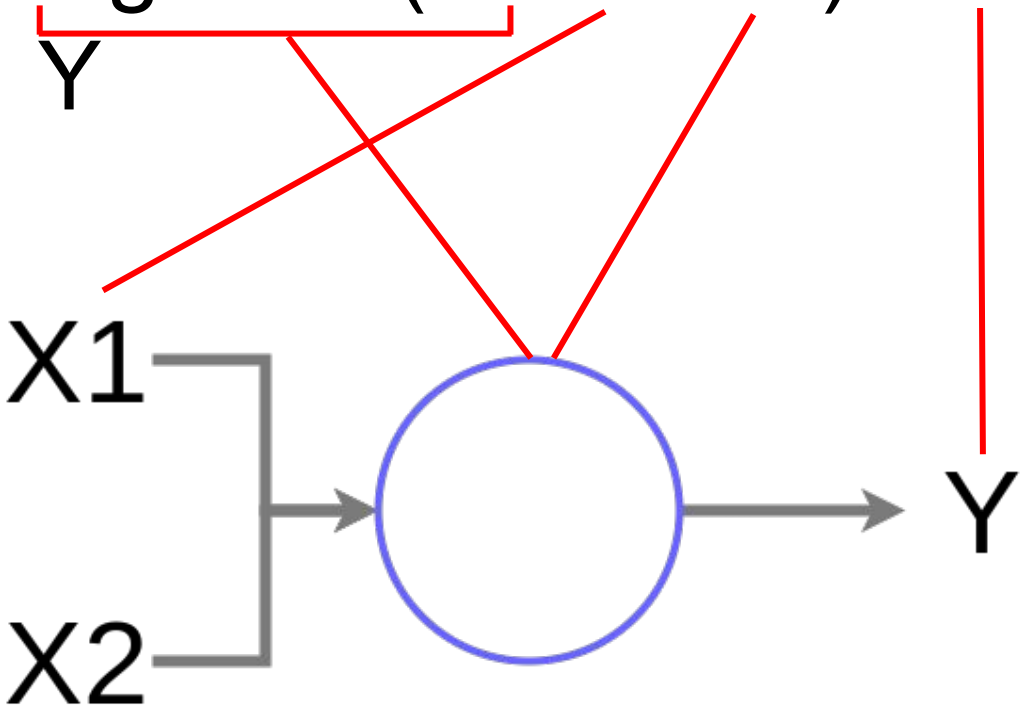


A single neuron

$$\text{sigmoid}(x) = \frac{e^x}{e^x + 1}$$



$$\text{sigmoid}(A \cdot \mathbf{X} + b) = Y$$

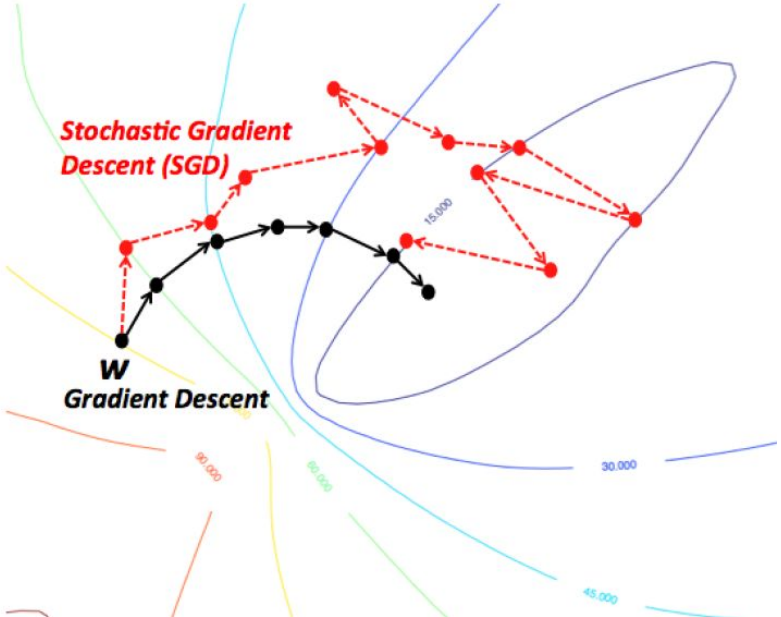


A single neuron

Stochastic = choose a random (subset of) example(s) each training step

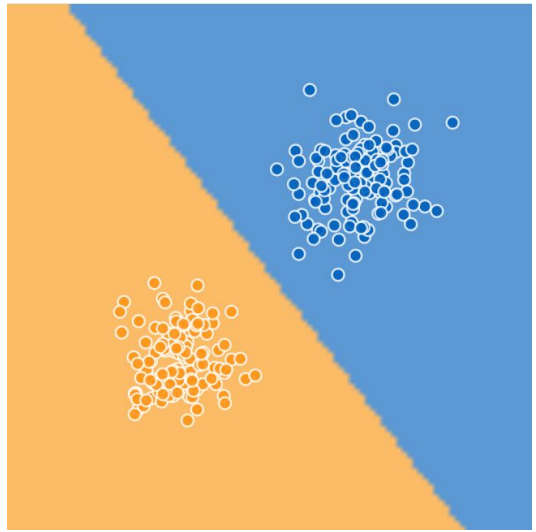
Gradient = determine the behavior of the quality measure around current value

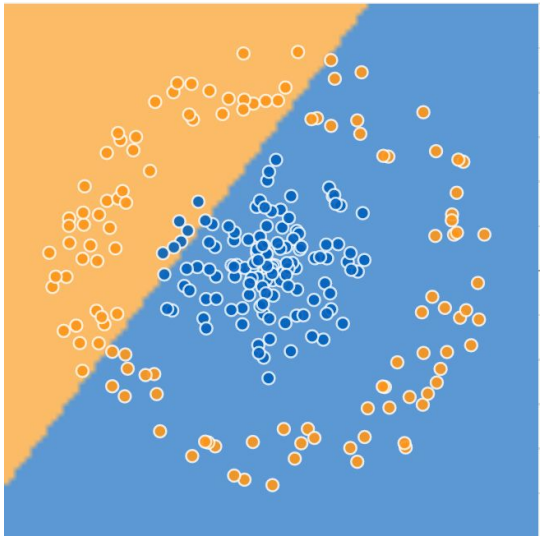
Descent = move in the direction that will net the most improvement

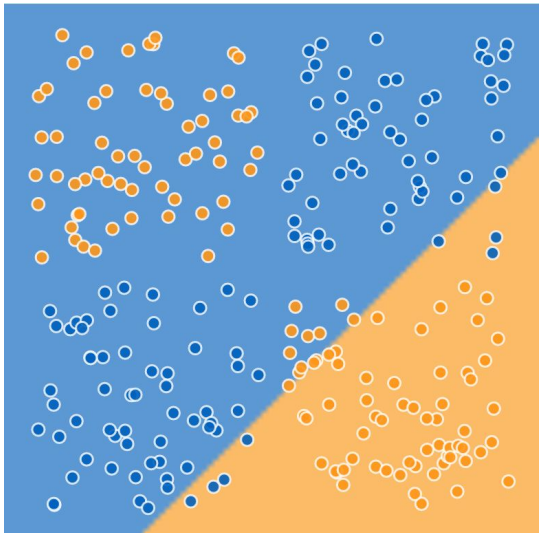


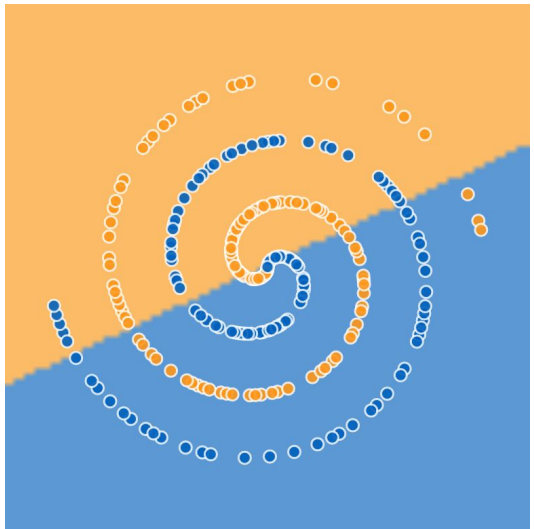
www.bogotobogo.com/python/scikit-learn/images/Batch-vs-Stochastic-Gradient-Descent/

A single neuron



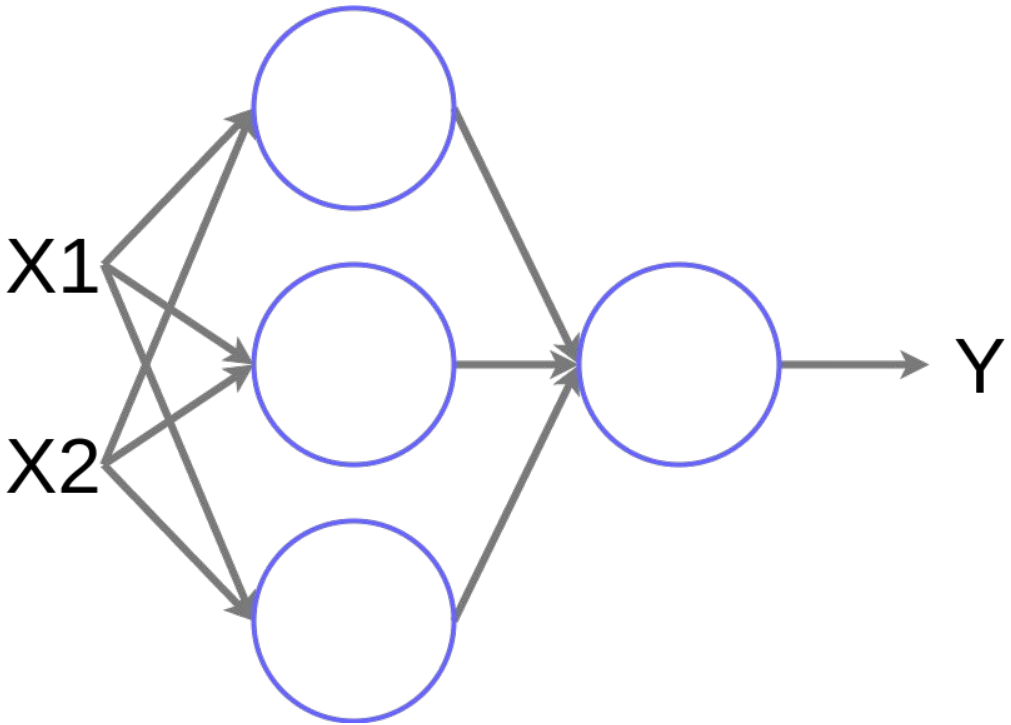




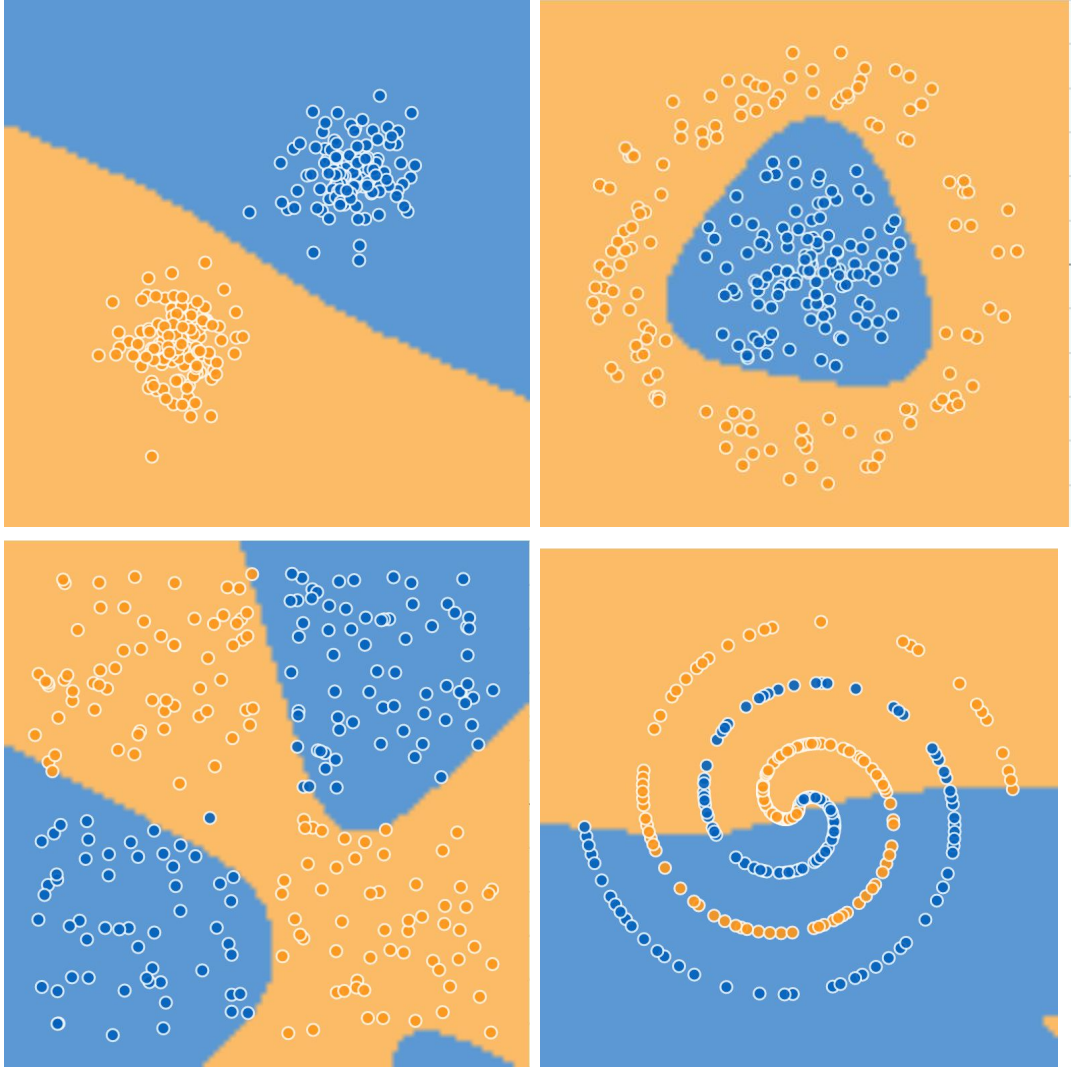


playground.tensorflow.org

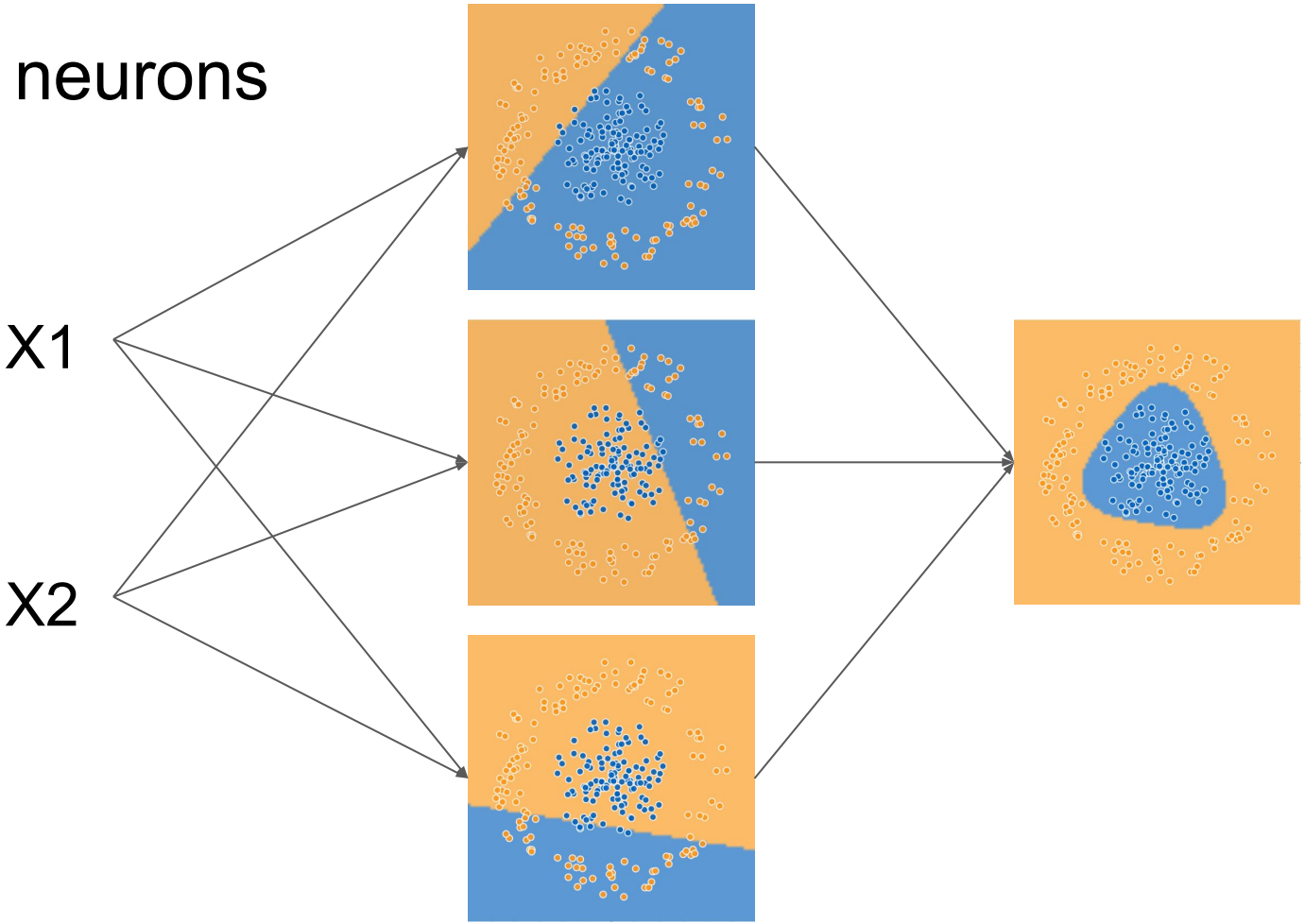
3 + 1 neurons



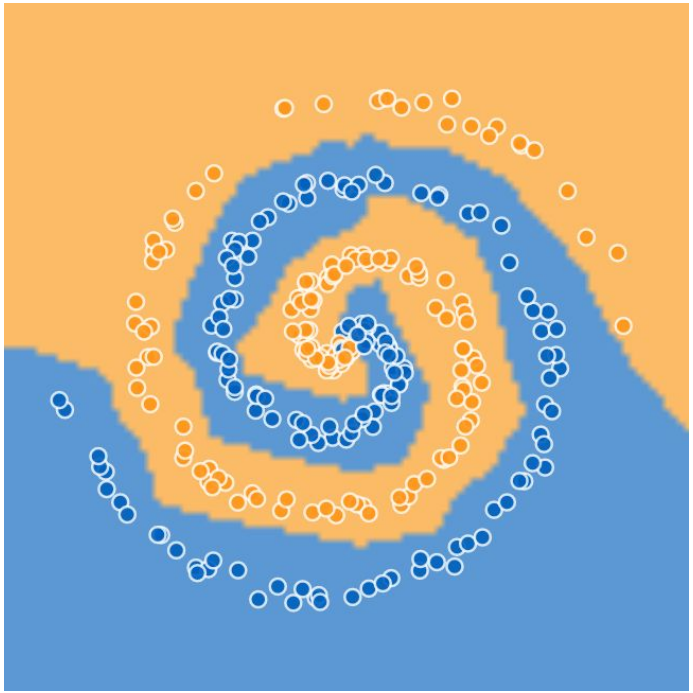
3 + 1 neurons



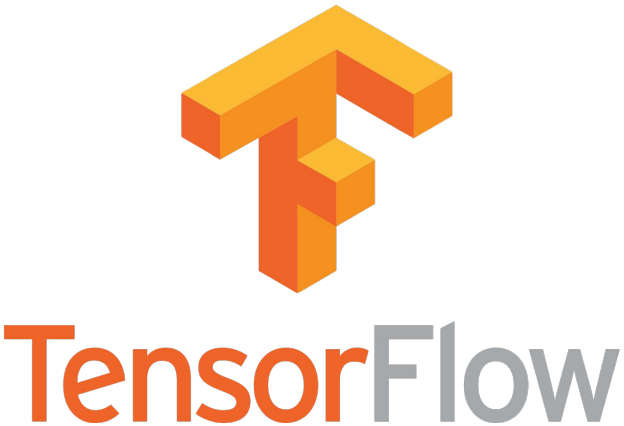
3 + 1 neurons



8 + 8 + 8 + 8 + 8 + 8 neurons



TensorFlow


TensorFlow

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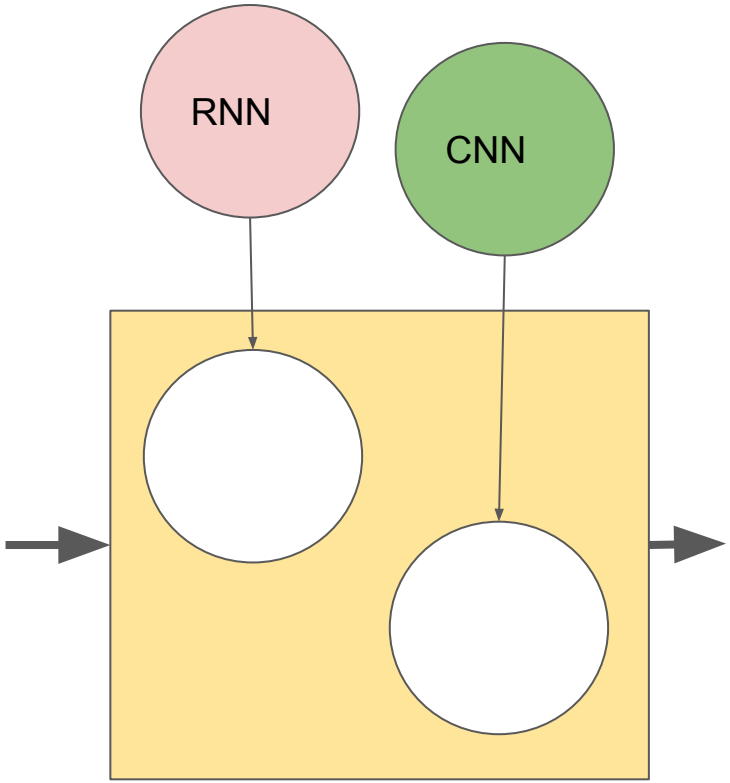
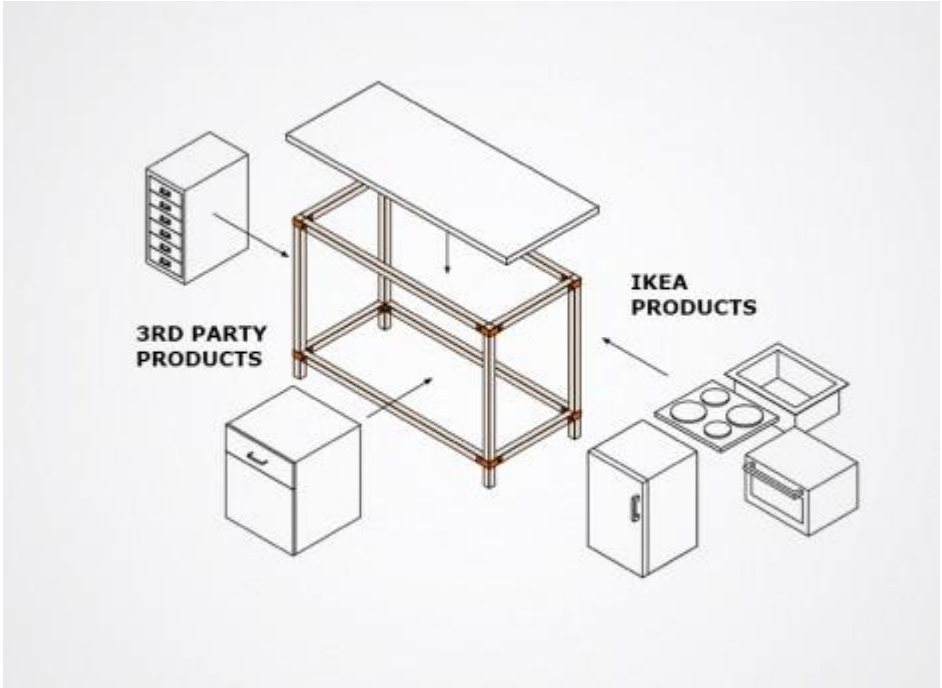
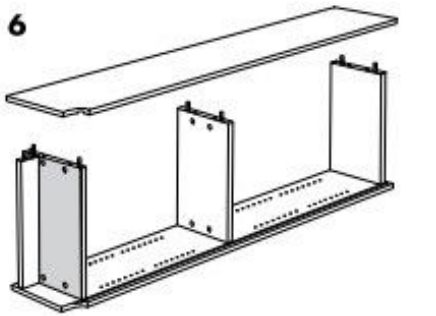
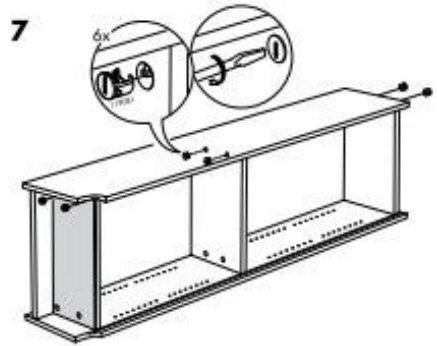
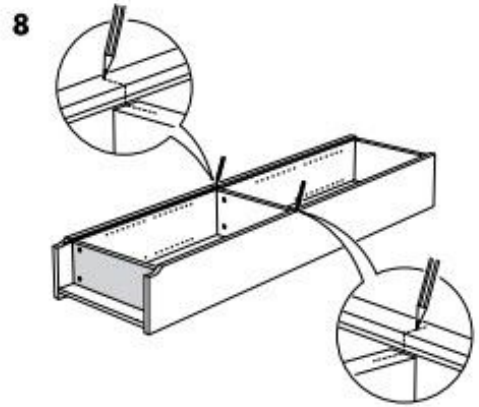
IKEA


RNN
CNN


3RD PARTY
PRODUCTS
IKEA
PRODUCTS


6


7
6x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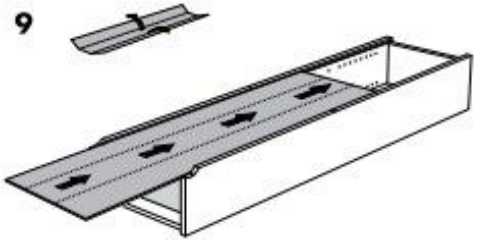
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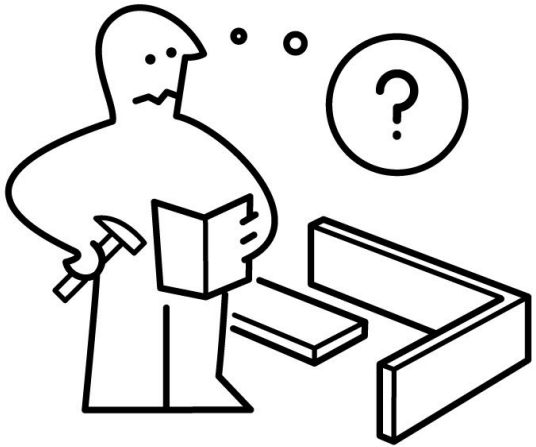
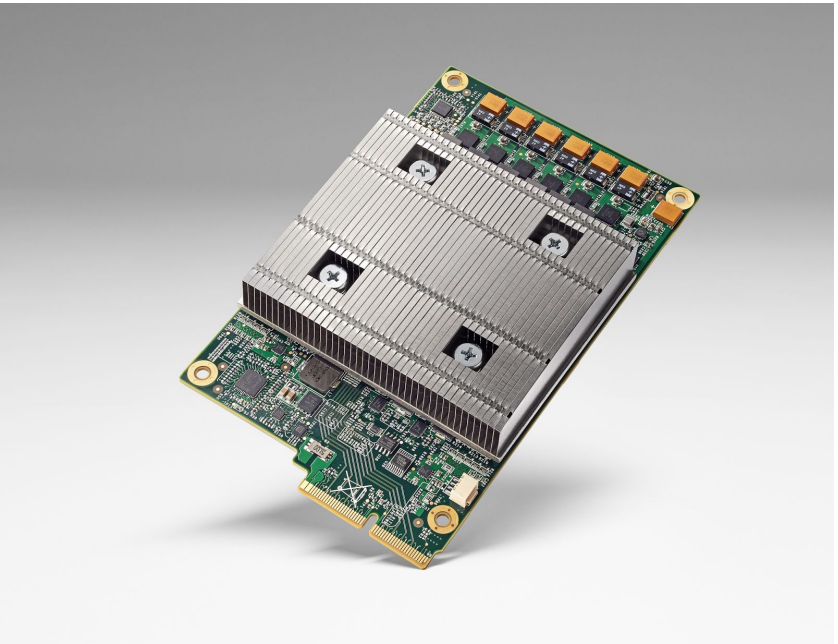

?

stackoverflow

GitHub

Library	Compile (s)	Train (µs)	Forward only (µs)
Theano	4.36	275.2	102.2
Torch	0.05	288.2	114.6
TensorFlow	1.62	349.7	218.4

RNN benchmark:
https://github.com/glample/rnn-benchmarks
Batch size 32 - Hidden Size 512



An NN in TensorFlow

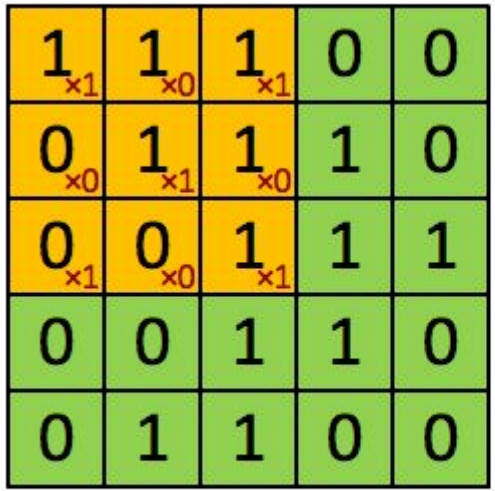
1. Define placeholders for things that go in and out
2. Define variables for things that should vary
3. Define what to optimize and how
4. Start a session

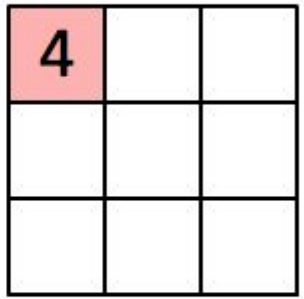
To the notebook!

Chair, bed, wardrobe: different flavors of NNs

- Convolutional Neural Networks
  - tf.nn.conv2d
- Recurrent Neural Networks
  - tf.contrib.rnn.BasicLSTMCell + tf.contrib.rnn.MultiRNNCell

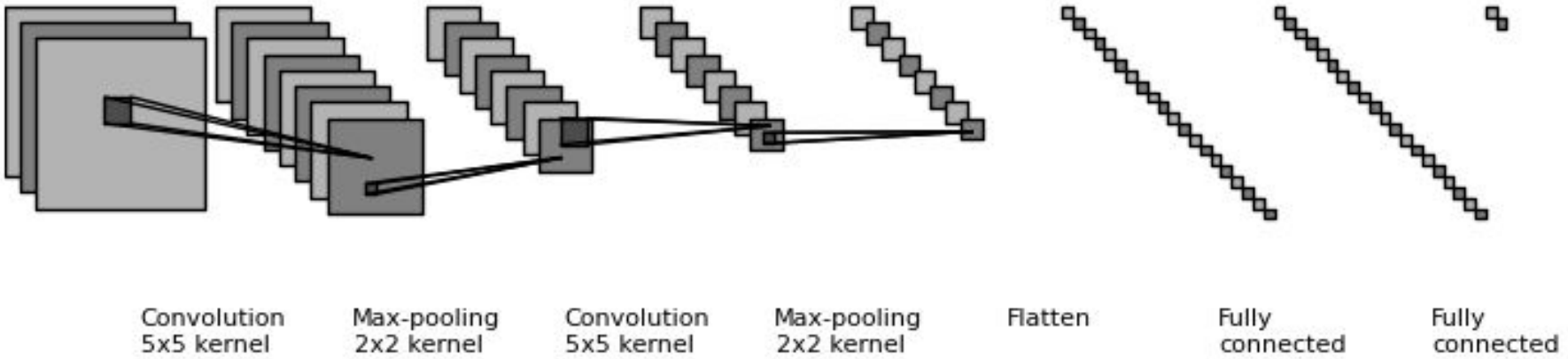
Convolutional Neural Networks



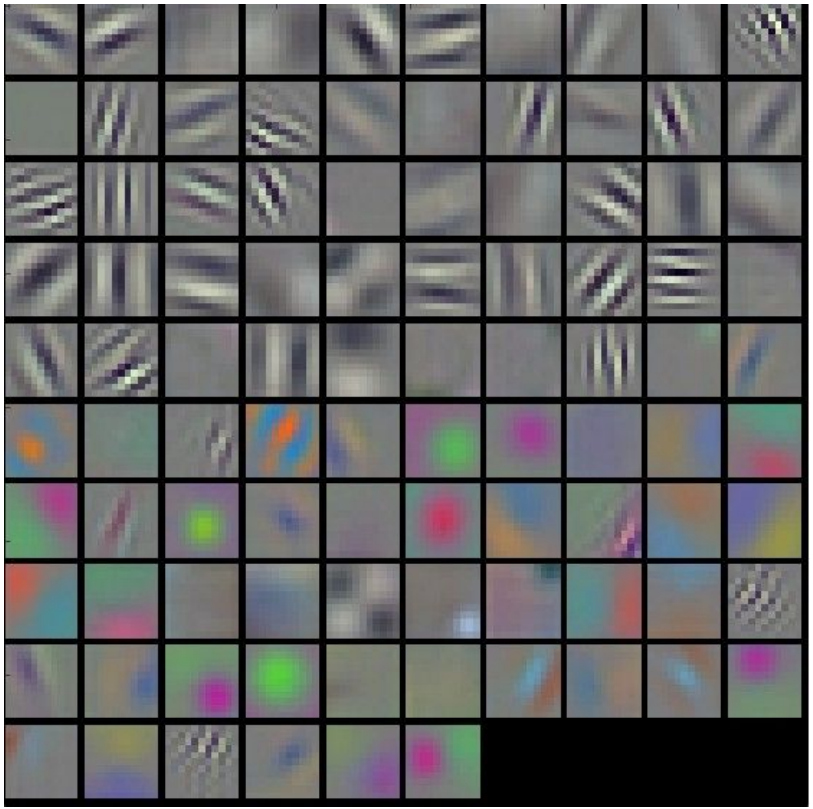


1	0	1
0	1	0
1	0	1

http://deeplearning.stanford.edu/wiki/index.php/Feature_extraction_using_convolution

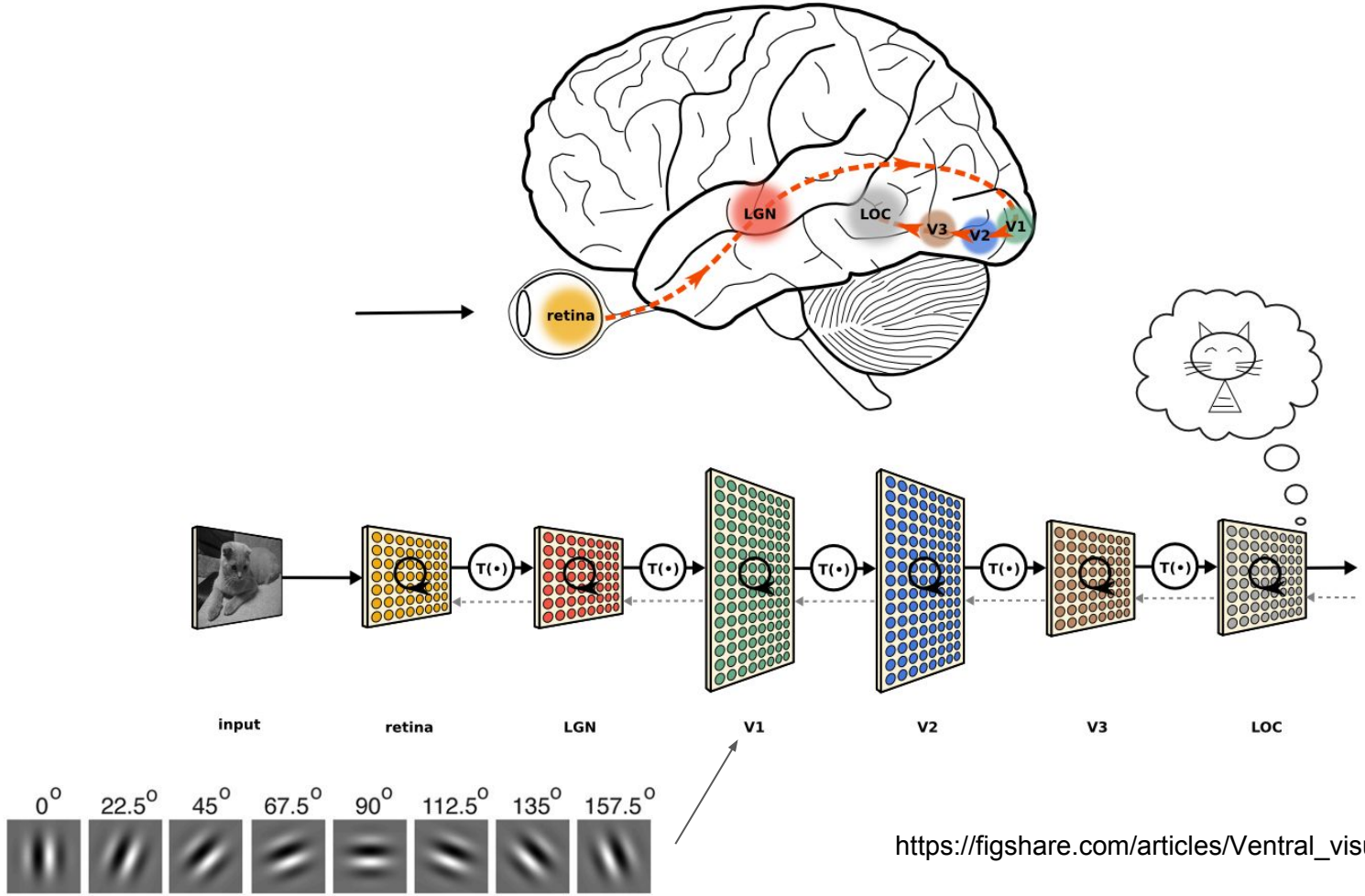


https://github.com/gwding/draw_convnet



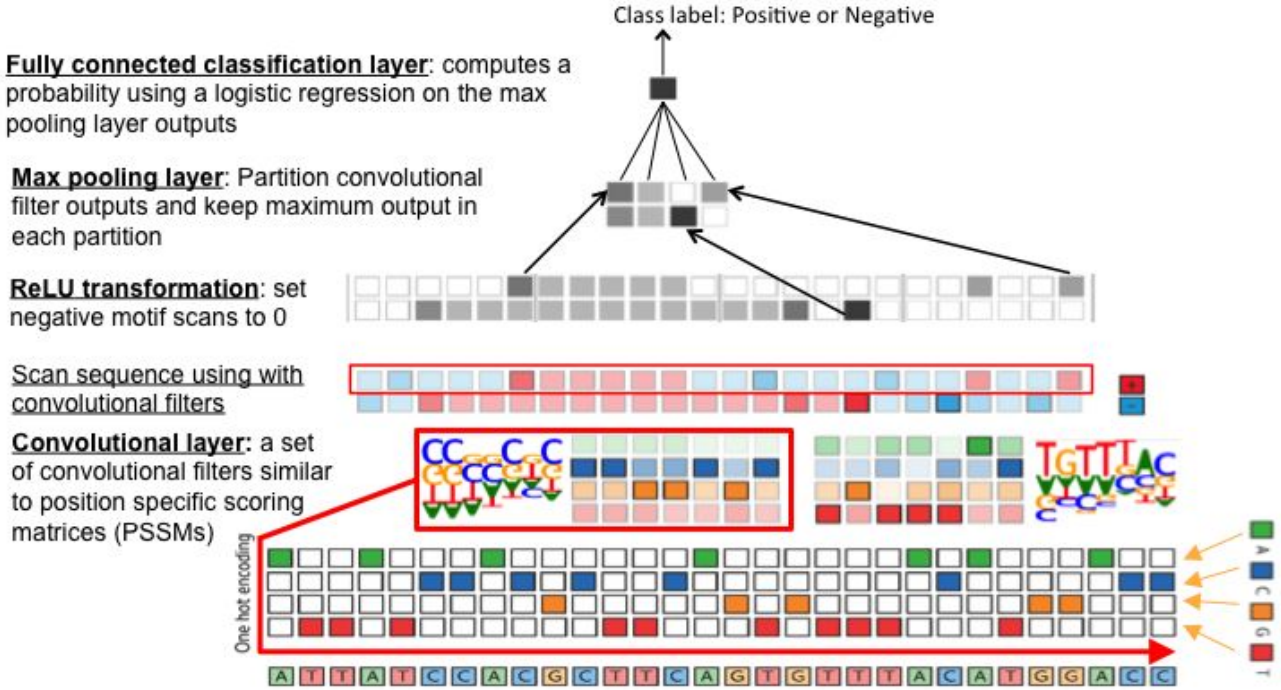
http://cs231n.github.io/understanding-cnn/

https://youtu.be/QzkMo45pcUo



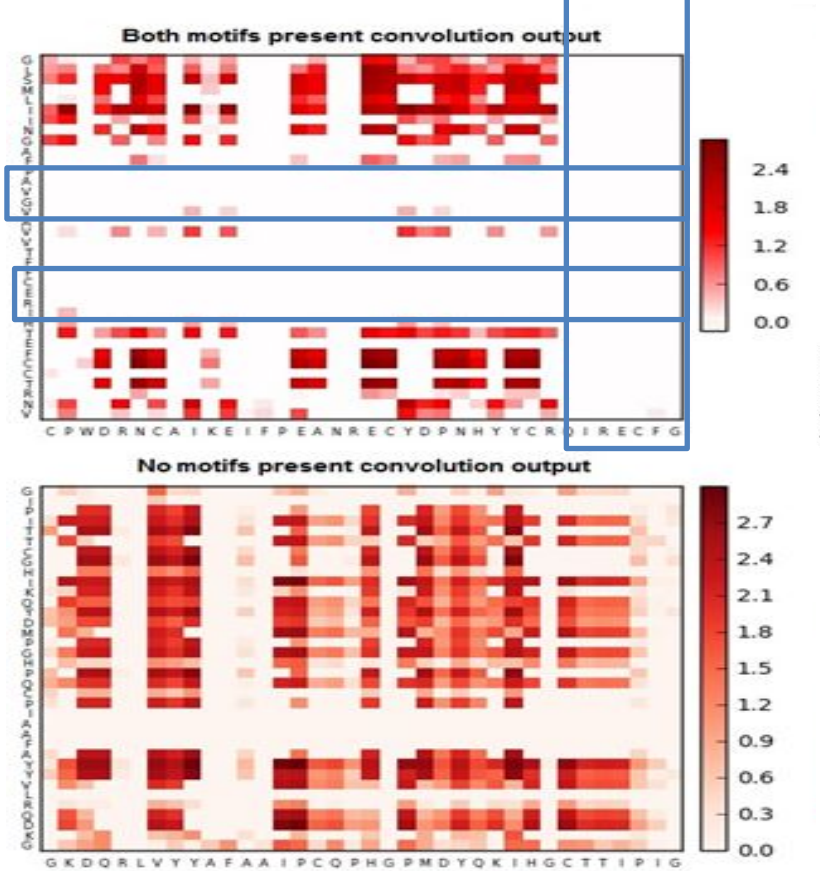
https://figshare.com/articles/Ventral_visual_stream/106794

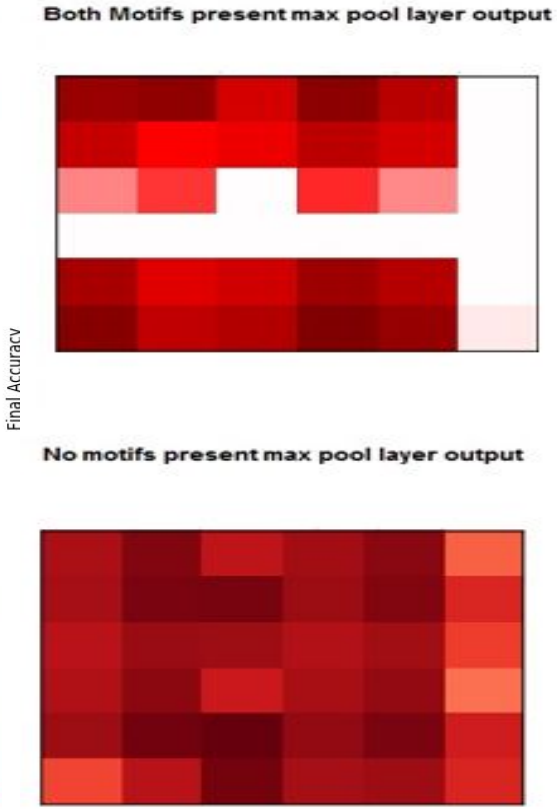
Protein-protein interaction prediction



https://github.com/kundajelab/dragonn/blob/master/examples/tutorial_images/dnn_figure.png

Filter Interpretation





Filter Size: 4

Single case motifs:

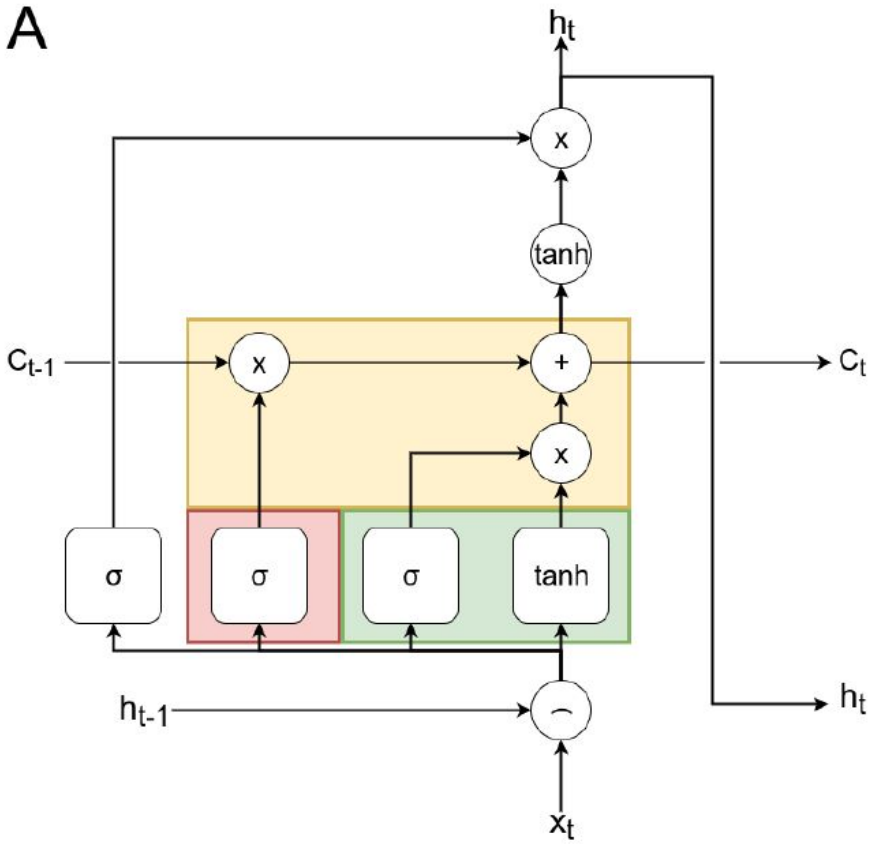
I R E C F

+

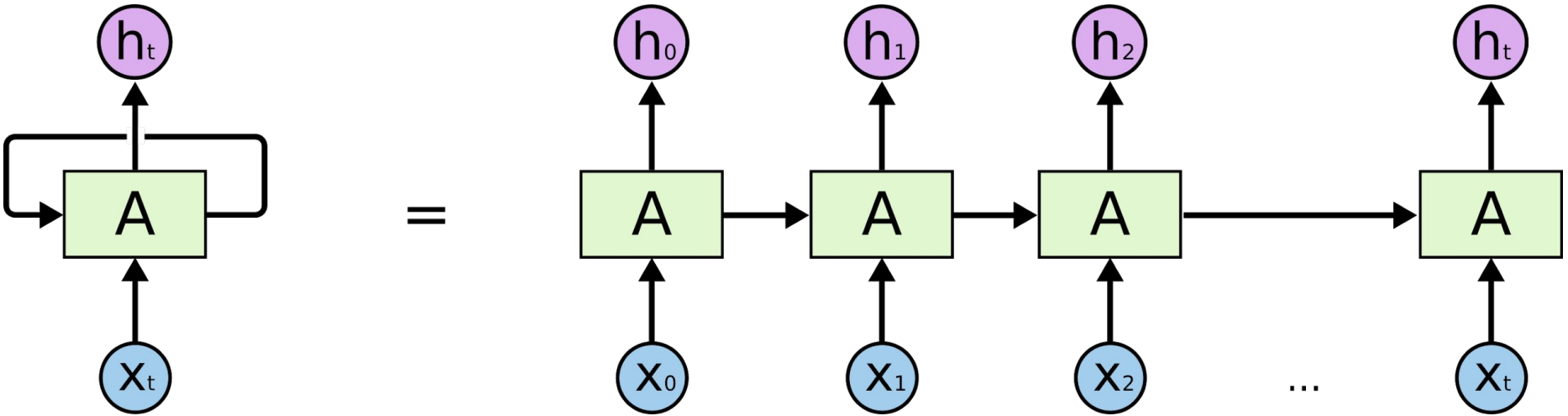
V G V A P

Ronald de Jongh

Recurrent Neural Networks



Recurrent neural networks



http://colah.github.io/posts/2015-08-Understanding-LSTMs/

An example: MinION signal classification