UNIVERSITY OF BIRMINGHAM

Deep Learning for Handwriting Recognition – BEAR Challenge 2018

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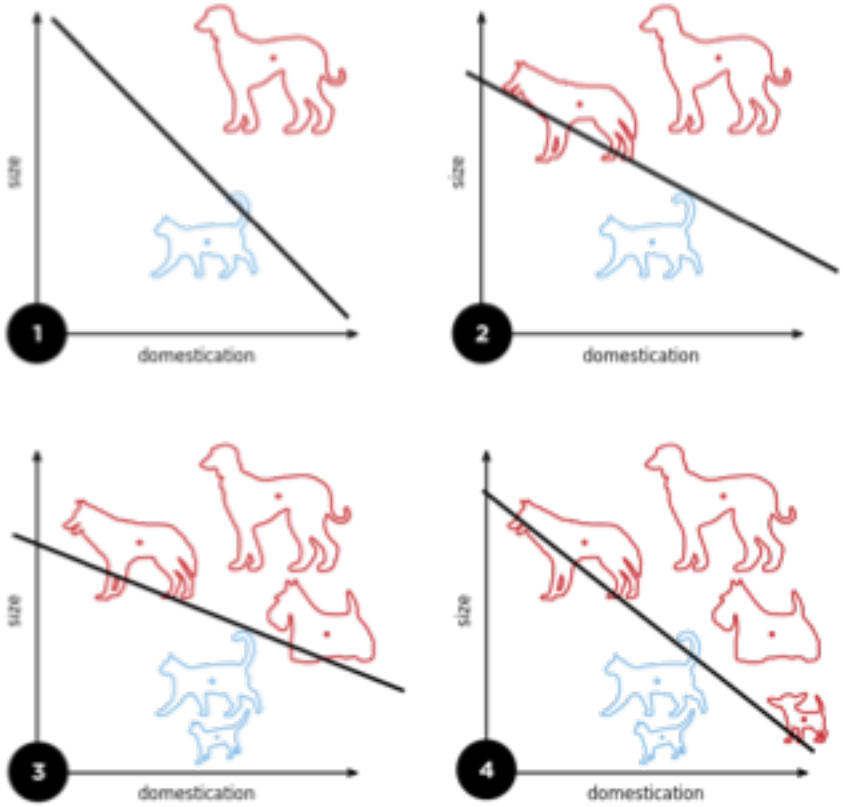
The artificial neuron, building block of Neural Networks

- The perceptron:

$$f(x) = \begin{cases} 1 & \text{if } \mathbf{w} \cdot \mathbf{x} + b > 0 \\ 0 & \text{otherwise} \end{cases}$$

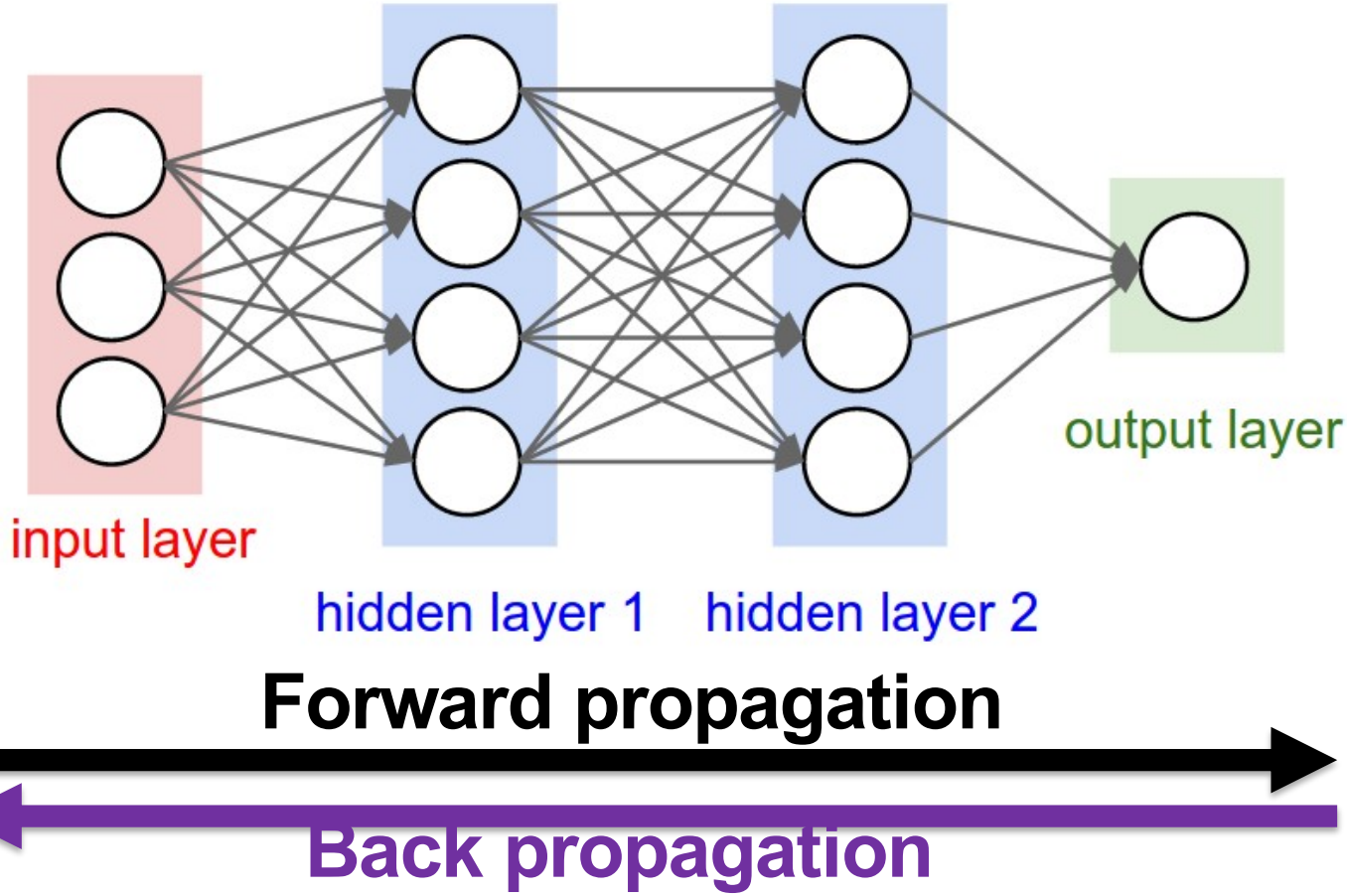
- Focusing on CNNs for image classification – other types of Neural Networks are available™

The perceptron, building block of Convolutional Neural Networks

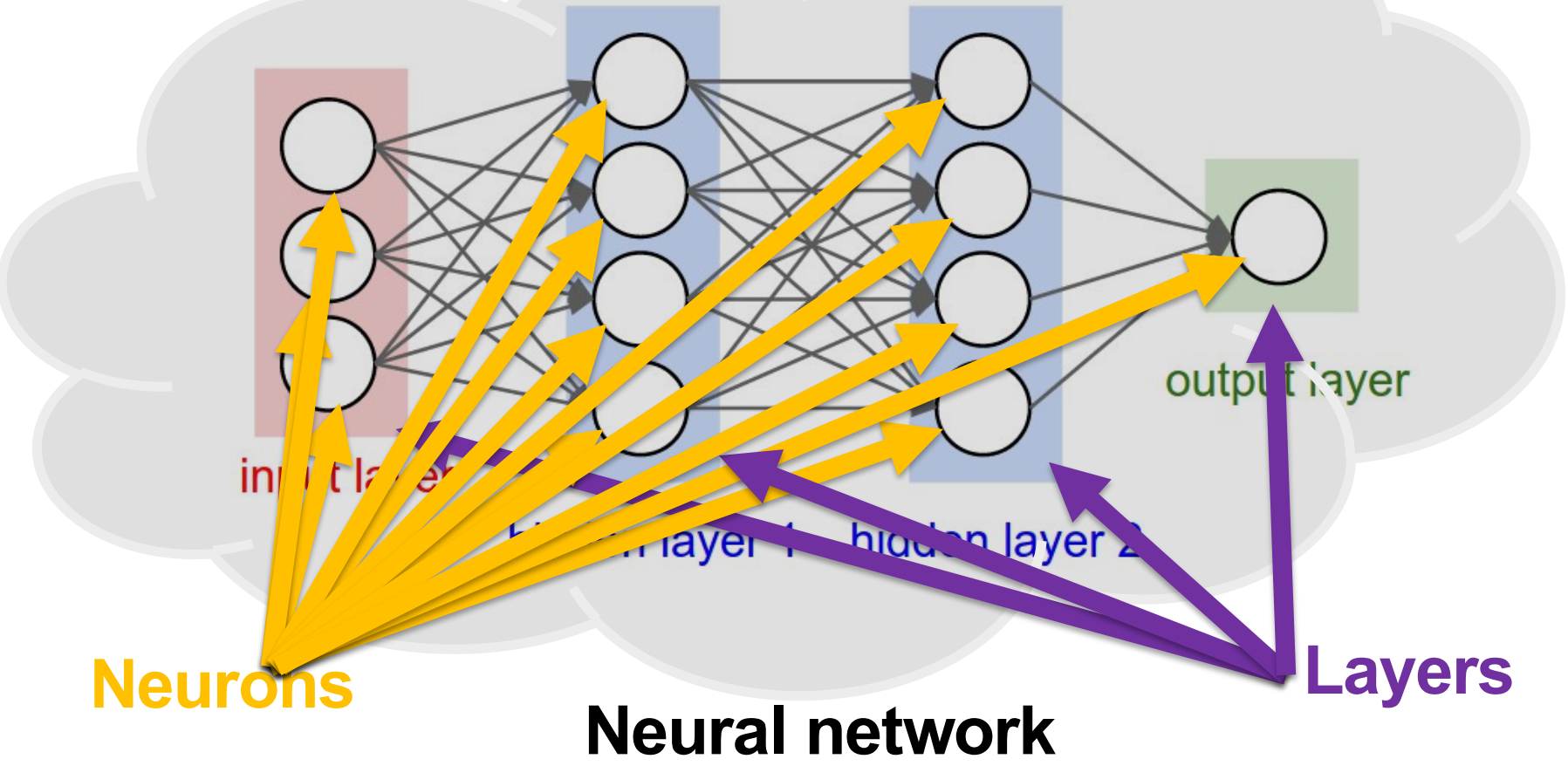


Source:
https://commons.wikimedia.org/wiki/File:Perceptron_example.svg

How DL works in practice



“Neural networks”? “Layers”? “Neurons”? What are they?



Types of layers

- Convolutional layers
  - Feature detection
- Pooling layers
  - Downsize image (reduce complexity, and hence processing requirements)
- Dense (fully connected) layers
  - Performs classification

Parameters & Hyper-parameters

- There are two types of parameter you can change in a neural network:
  - Parameters
  - Hyper-parameters

Improving performance

Source:
https://www.flickr.com/photos/42988571@N08/13158300104

- There are 3 main ways to improve network performance:
  - More training (number of epochs)
  - More training data

    https://github.com/fsix/mnist/blob/master/utils/perturbations.py
  - Adjusting the network:
    - Hyperparameters

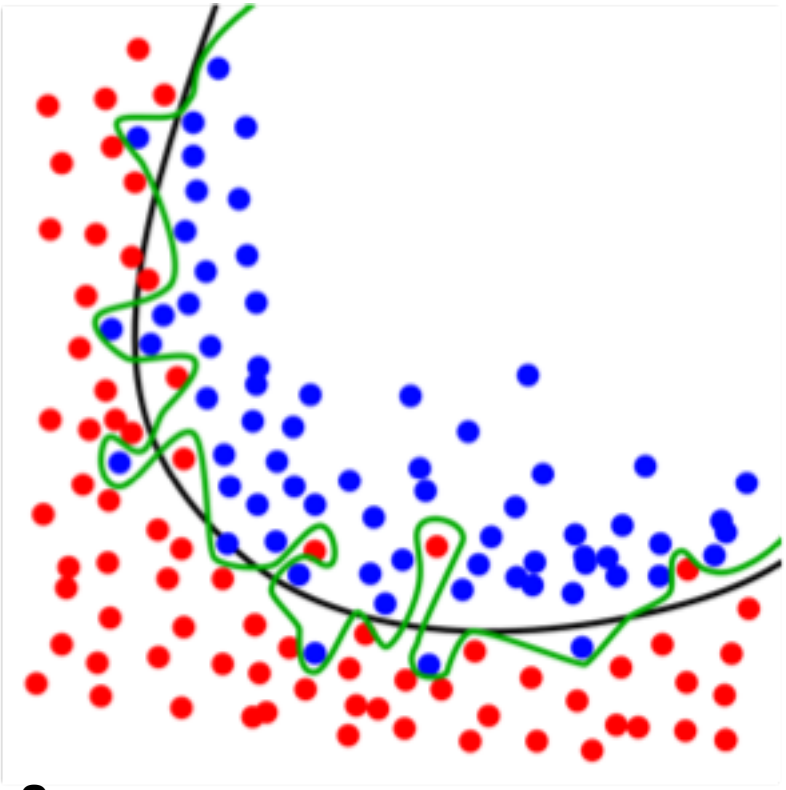
```
112     if mode == tf.estimator.ModeKeys.TRAIN:
113       optimizer = tf.train.GradientDescentOptimizer(learning_rate=0.001)
114       train_op = optimizer.minimize(
```

https://www.tensorflow.org/api_docs/python/tf/train/exponential_decay

    - Changing the network itself (last resort!)

Overfitting

- (subtitle: sometimes you can perform too well!)



Source: https://commons.wikimedia.org/wiki/File:Overfitting.svg