

Image Recognition

With Convolutional Neural Networks
using Keras and CoreML



Hi There!
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WHAT IS MACHINE LEARNING?

A very brief history

“

“Field of study
that gives
computers the
ability to learn
without being
explicitly
programmed”

- Arthur Samuel, 1959





Modern Definition

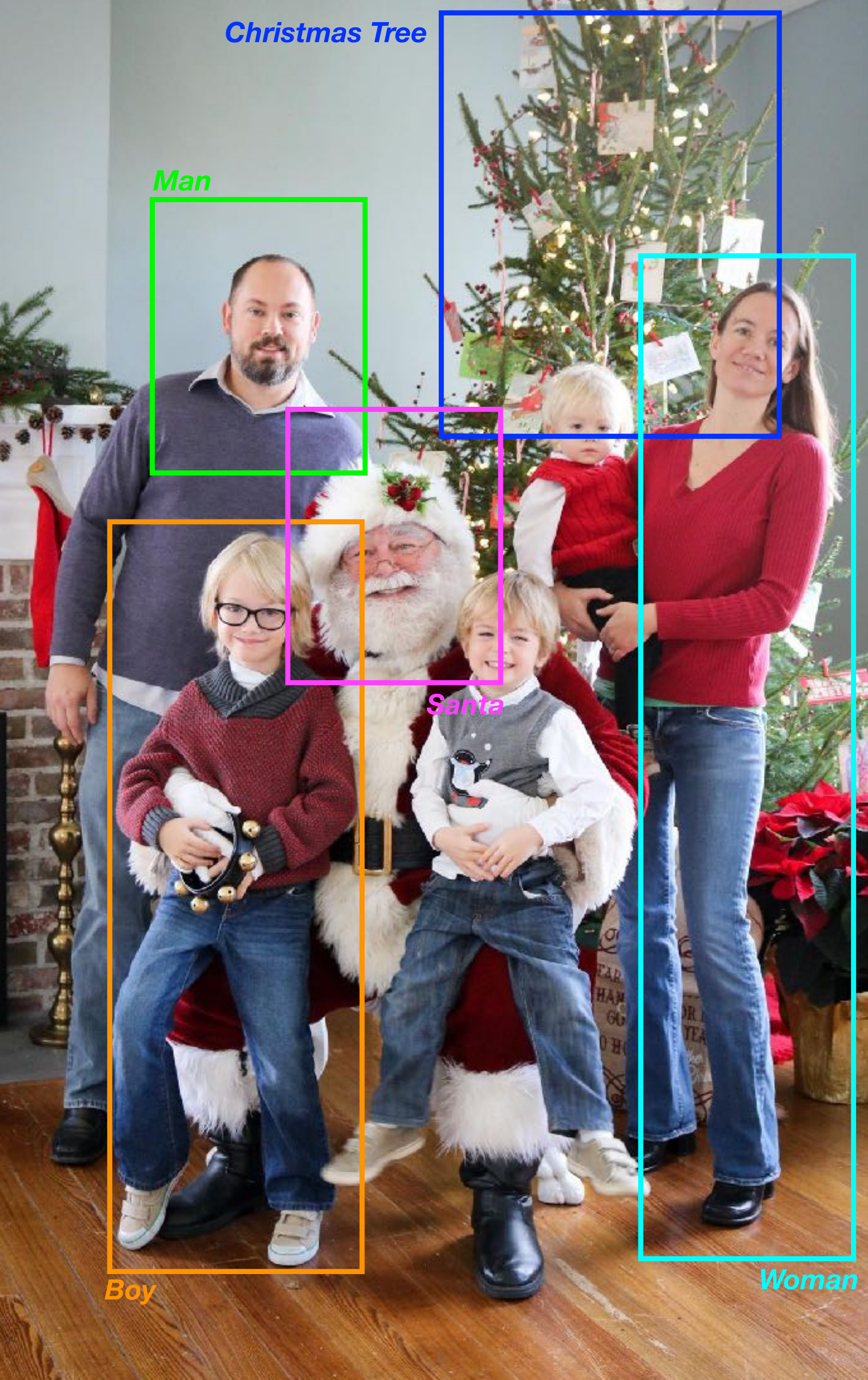
“

“A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T , as measured by P , improves with experience E .”

- Tom Mitchell

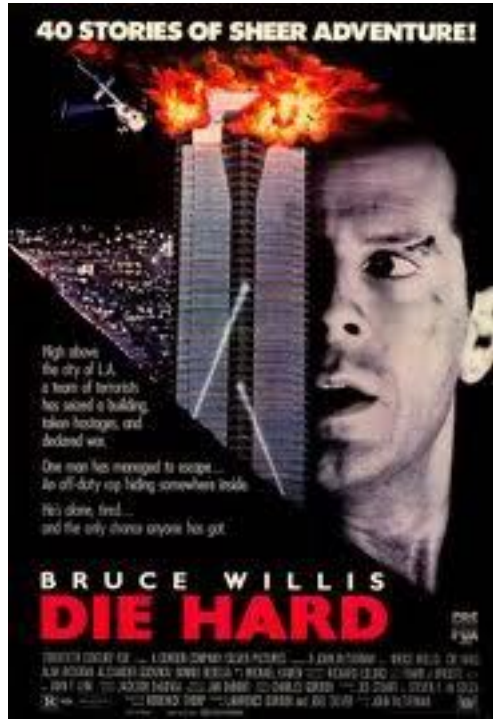
WHY MACHINE LEARNING?

Solving a new class of problems



A New Class of Problems Image Recognition

Who/What is in the photograph?
Easy for a human but how would I write an
algorithm for it?



Actor: Bruce Willis
Genre: Action
Year: 1988



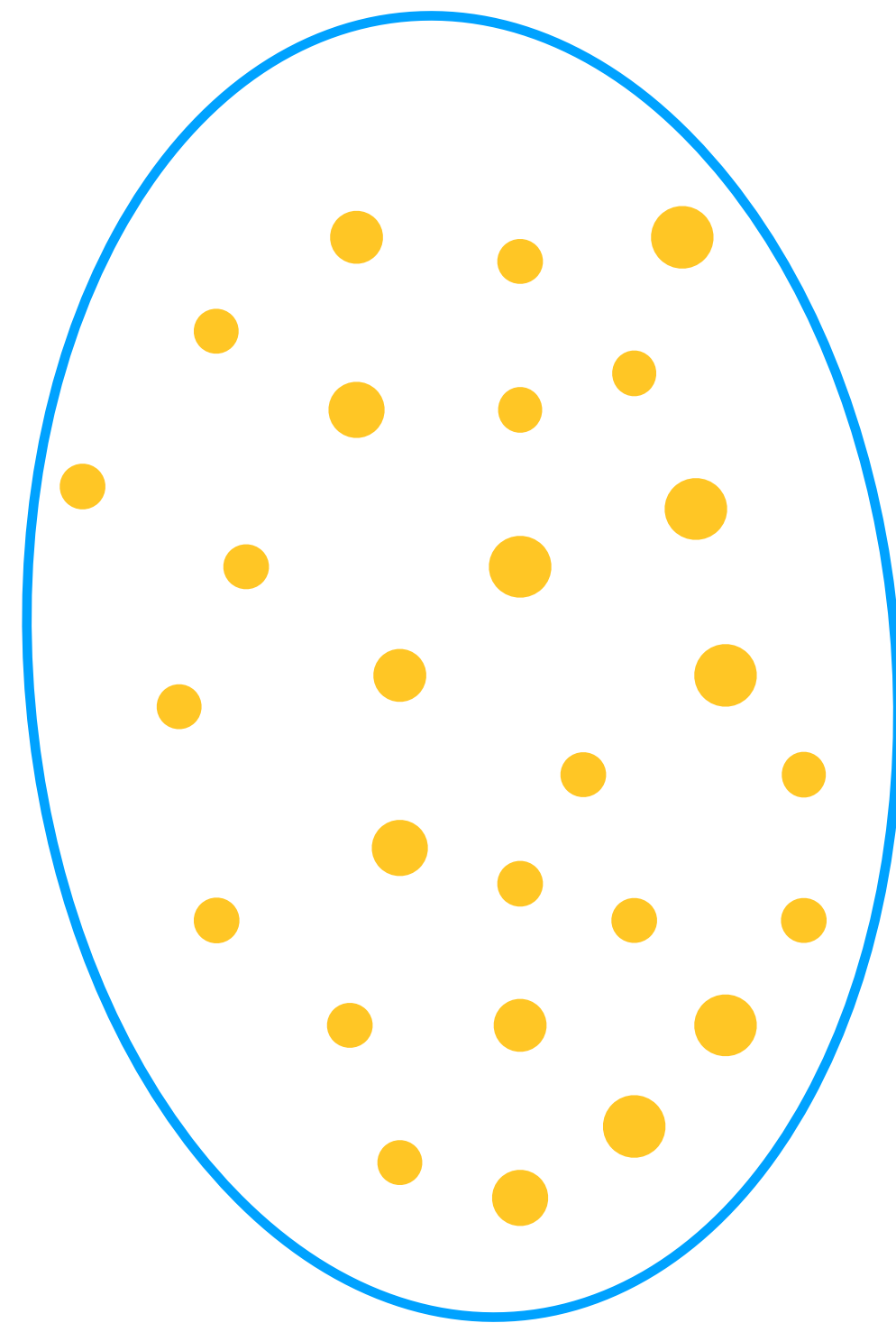
A New Class of Problems Recommendation System

What movies/restaurants/etc might I like?

A New Class of Problems

Anomaly Detection

Does this image show signs of cancer?
How is my data center health?



- *Normal Activity*
- *Abnormal Activity*

Modified National Institute of Standards and Technology (MNIST)

Large set of handwritten digits

- 60,000 training images
- 10,000 testing images
- Written by
 - American Census Workers
 - High School Students

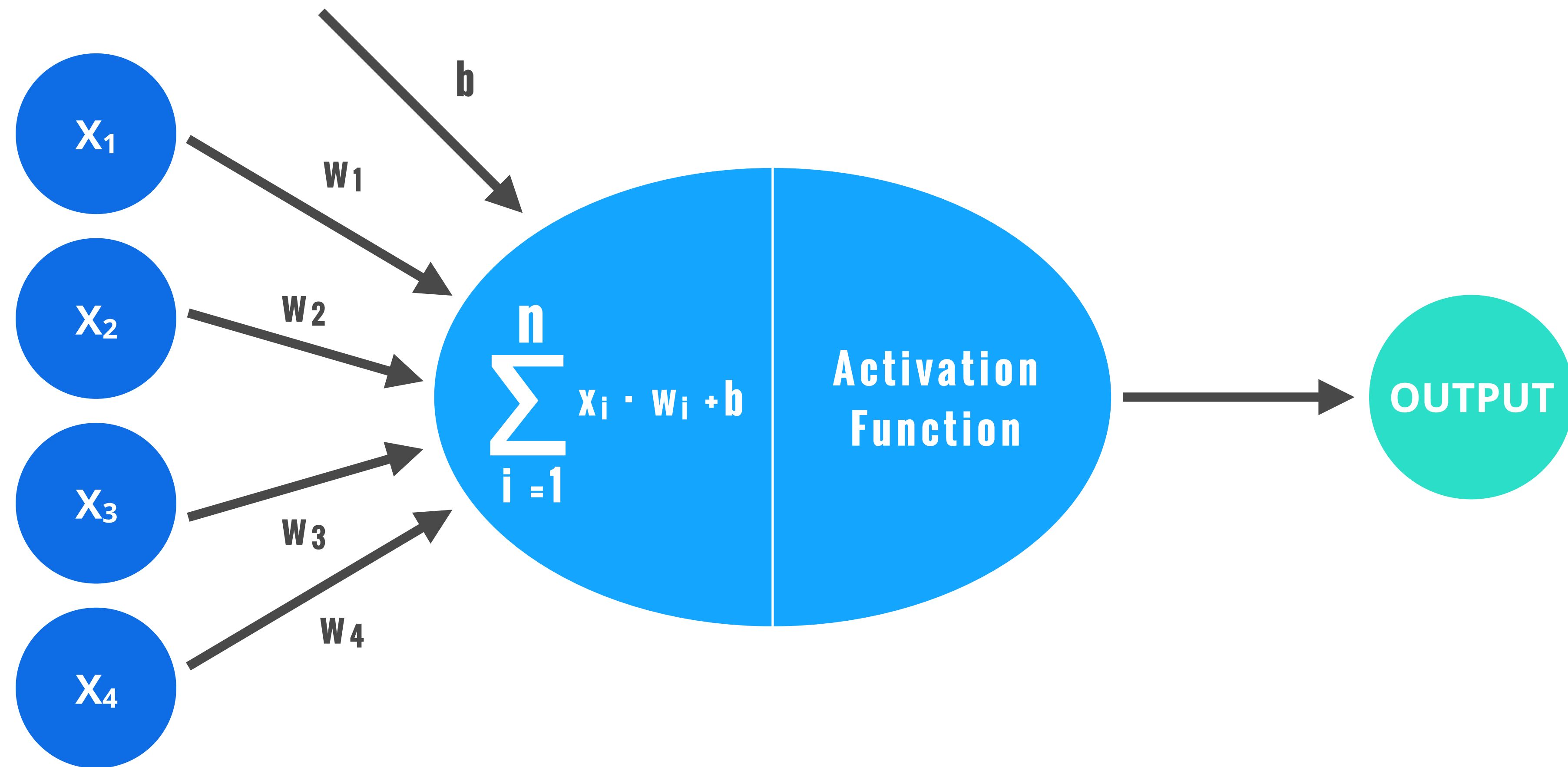
Remix of Original NIST dataset

- Original data all training data was Census Workers, all testing High School Students
- Black and White images
- Images were anti-aliased
- Normalized to fit 20x20
- Centered in 28x28 bounding box (784 pixels)

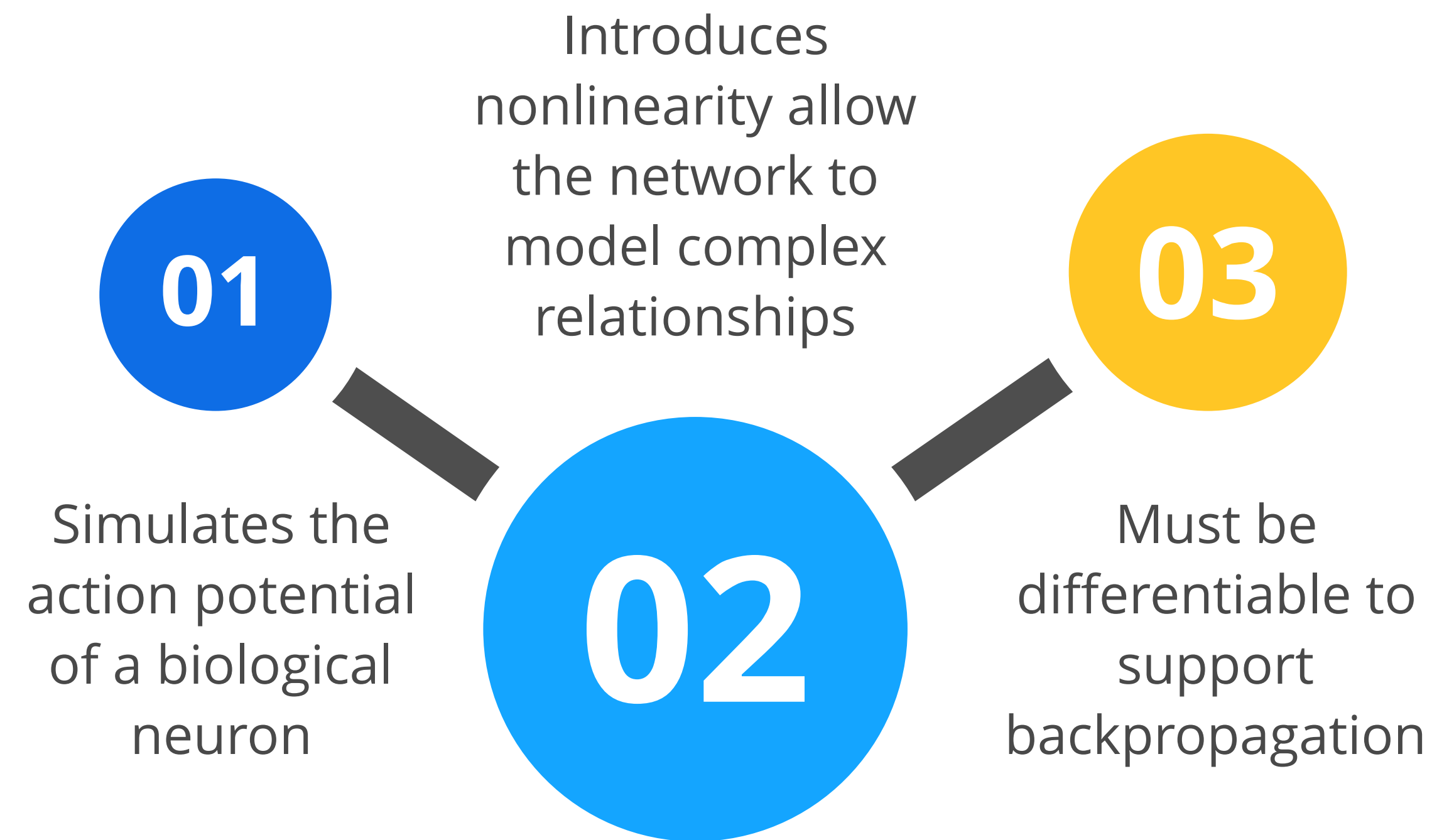
ARTIFICIAL NEURAL NETWORK

Biologically inspired machine learning system

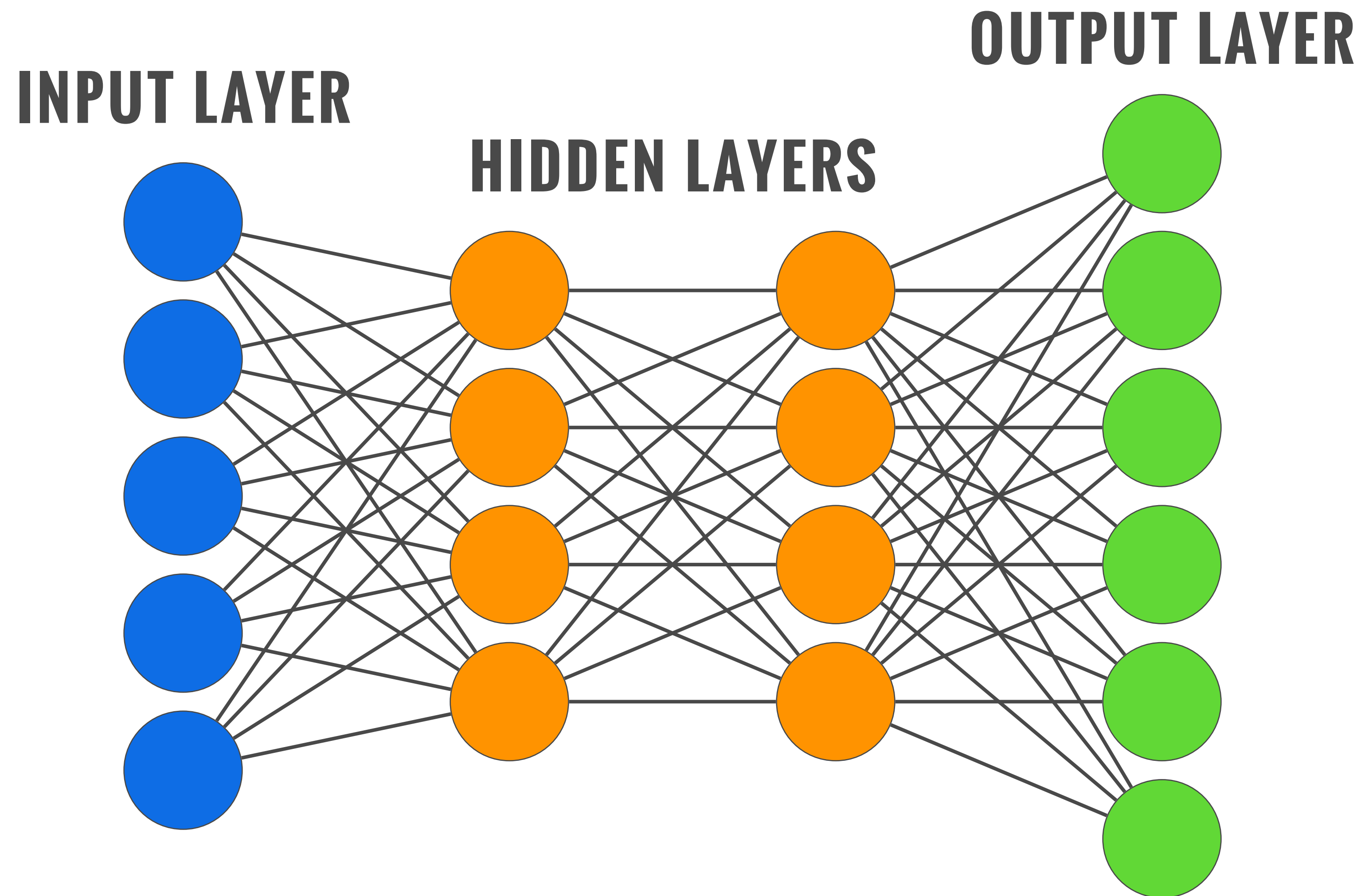
ARTIFICIAL NEURON



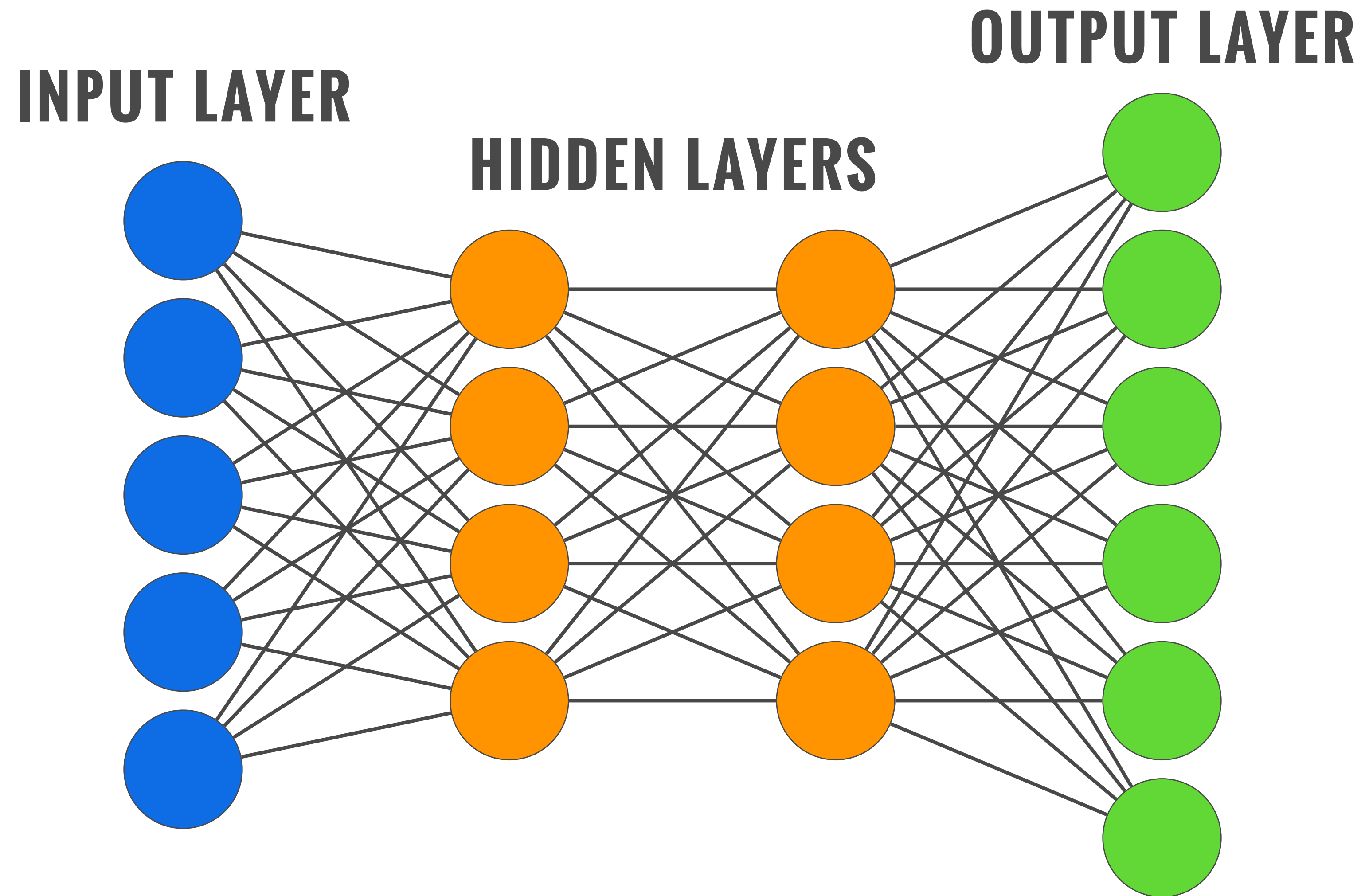
ACTIVATION FUNCTION



NEURAL NETWORK



NEURAL NETWORK



CONVOLUTIONAL NEURAL NETWORK

Specialized machine learning system

CONVOLUTION

35	40	21	46	15
6	11	43	25	27
31	42	7	5	17
26	37	44	39	23
4	9	24	38	49

*

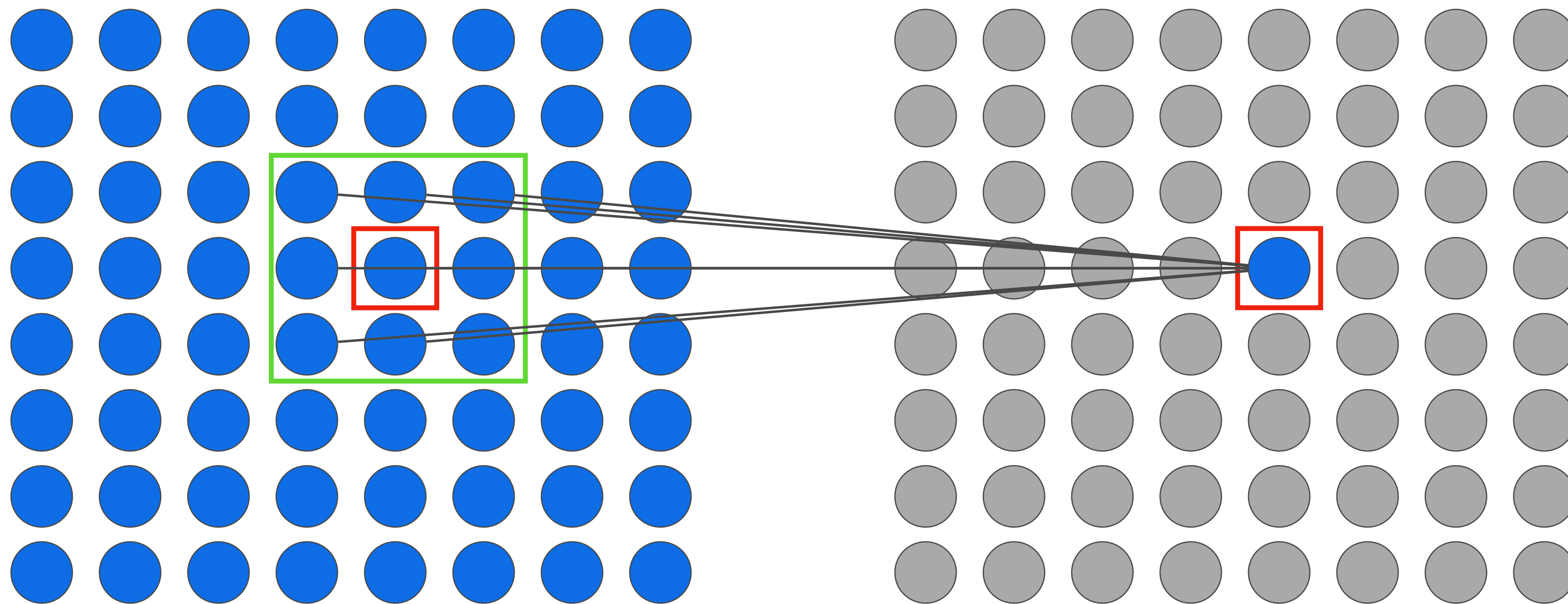
1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

=

35	40	21	46	15
6	11	43	25	27
31	42	28	5	17
26	37	44	39	23
4	9	24	38	49

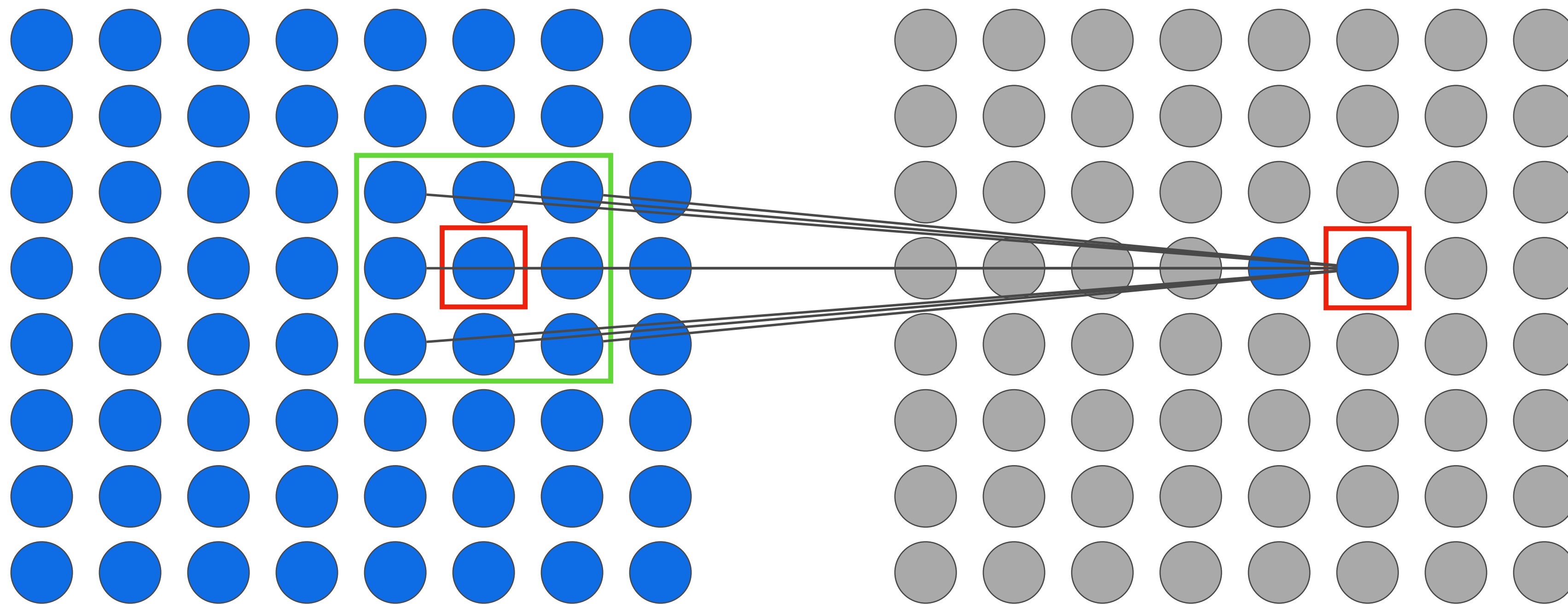
$$(11+43+25+42+7+5+37+44+39) / 9 \sim = 28$$

RECEPTIVE FIELD



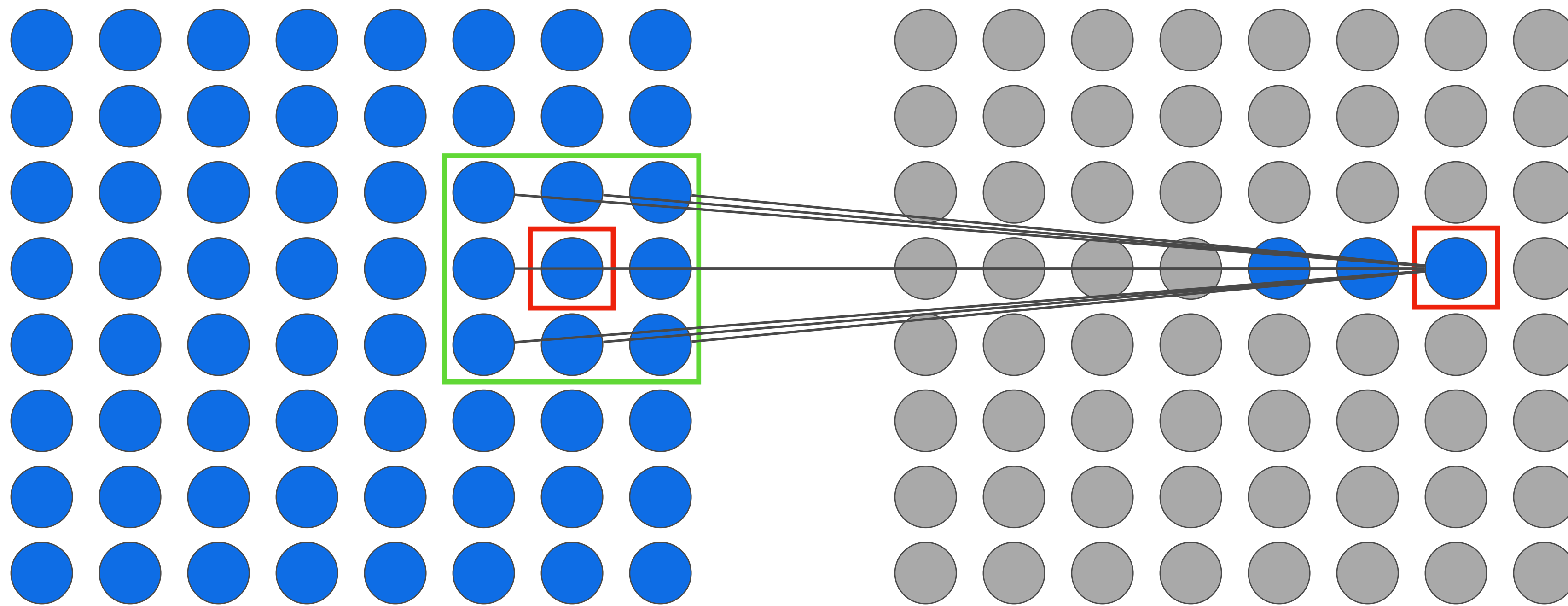
3 x 3 filter size

RECEPTIVE FIELD



3 x 3 filter size
stride 1

RECEPTIVE FIELD



3 x 3 filter size
stride 1

FEATURE MAP

Output of Convolution

The output of the convolution is known as the feature map. It is known as the feature map as it represents the features extracted by the filter. Alternatively, it is called an activation map as it represents the activation of the neurons in the network.

One Per Filter

Each filter in our layer produces a feature map. That is, we get a feature map for each filter in our layer. So a 32 filter layer will produce 32 feature maps.

Stacked to Create Output

The individual feature maps are stacked to form the output volume, which becomes the input for the next layer in the network.

POOLING LAYER

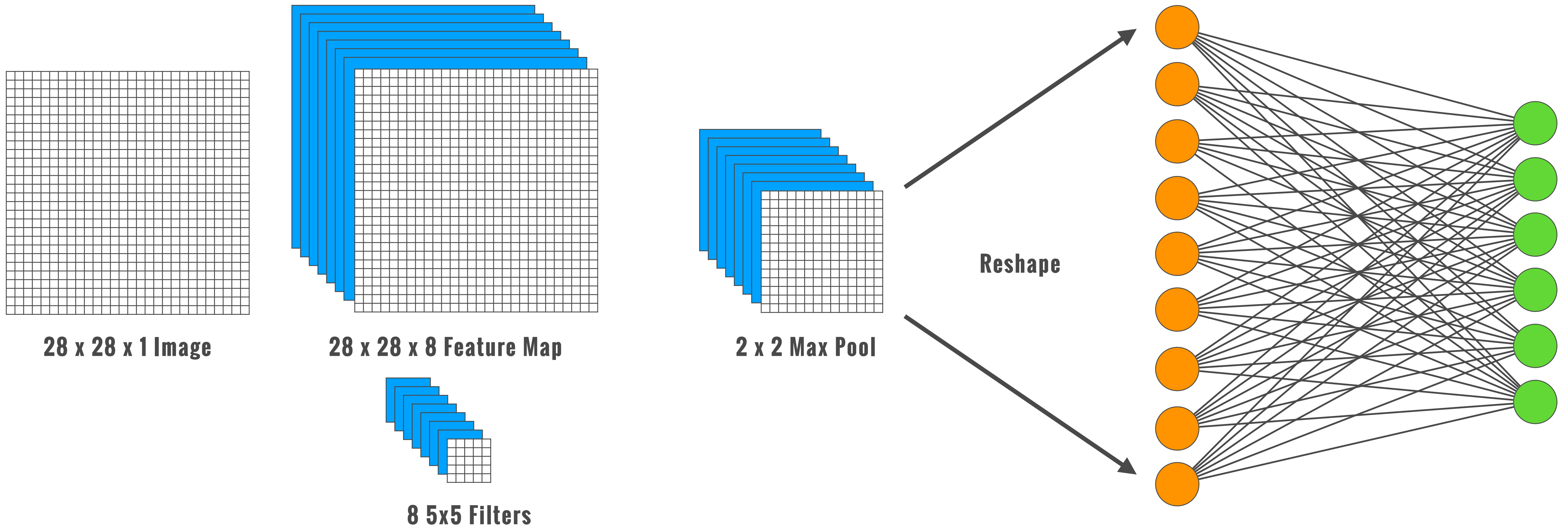
1	4	12	6	3	13
7	10	20	2	17	33
9	10	19	1	13	31
8	15	12	26	27	15
4	11	12	20	24	20
3	9	10	15	20	19

2x2 filter
stride 2

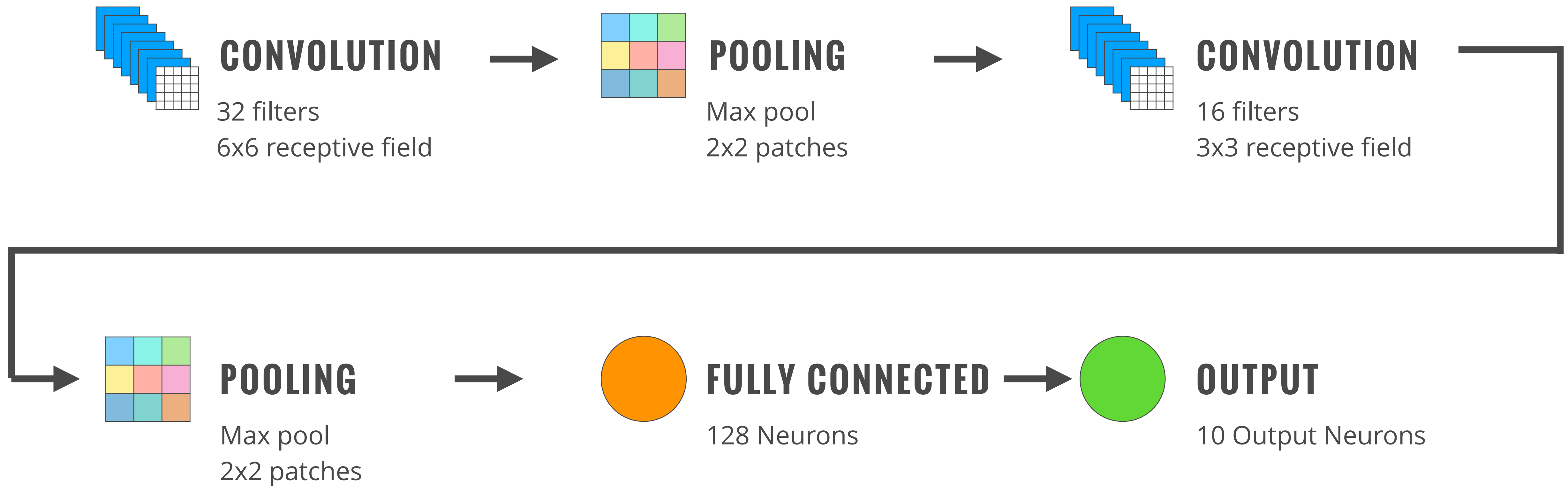
10	20	33
15	26	31
11	20	24

CONVOLUTIONAL NEURAL NETWORK

INPUT LAYER → CONVOLUTION LAYER → POOLING LAYER → FULLY CONNECTED LAYER → OUTPUT LAYER



MNIST CONVOLUTIONAL NEURAL NETWORK



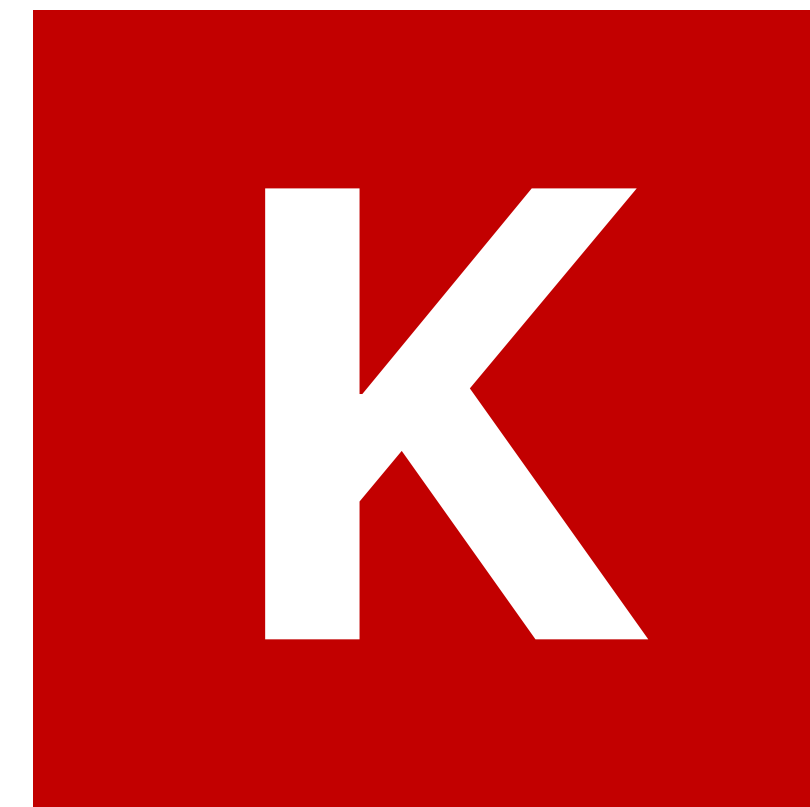
KERAS

What

- High Level Neural Network API
- Written in Python
- Runs on top of TensorFlow, CNTK, Theano

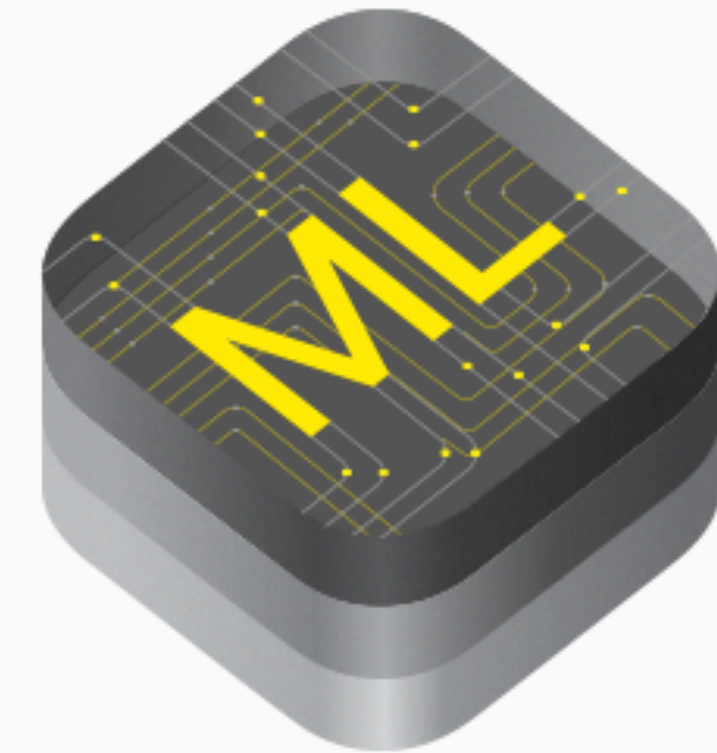
Why

- Easy and Fast prototyping
- Supports CNN
- Runs on CPU and GPU
- CoreMLTools support



COREML

- iOS Machine Learning SDK
- Supports Neural Networks (including CNN)
- Optimized for on-device performance
 - Memory
 - Power
- No training





iPhone App Demo

Itself is what the end-user derives value from
also can refer to the information



Thanks!

Any questions?

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Slides/Code: <https://github.com/timle8n1/codemash2018>

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