TensorFlow Workshop

HELLO!

I am Tim Shur

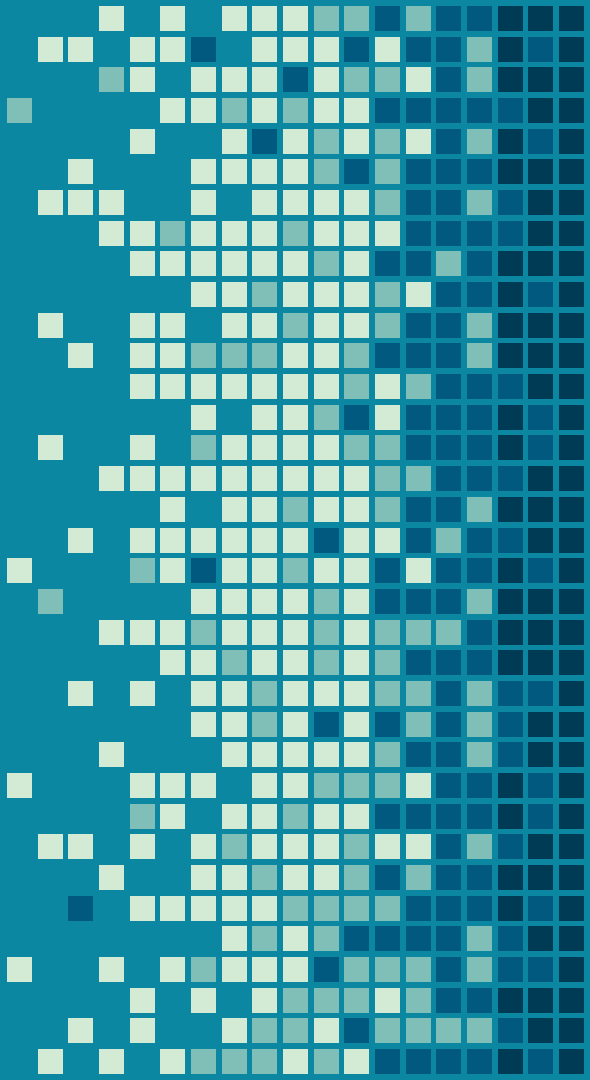
COEN/MATH major experimenting with this stuff ~

Disclaimer:

I'm not an expert (yet!)

“...what we want is a machine that can learn from experience.

- Alan Turing, 1947



TODAY'S WORKSHOP OUTLINE

0. INSTALLING LIBRARIES

Letting other people write our code for us since the beginning.

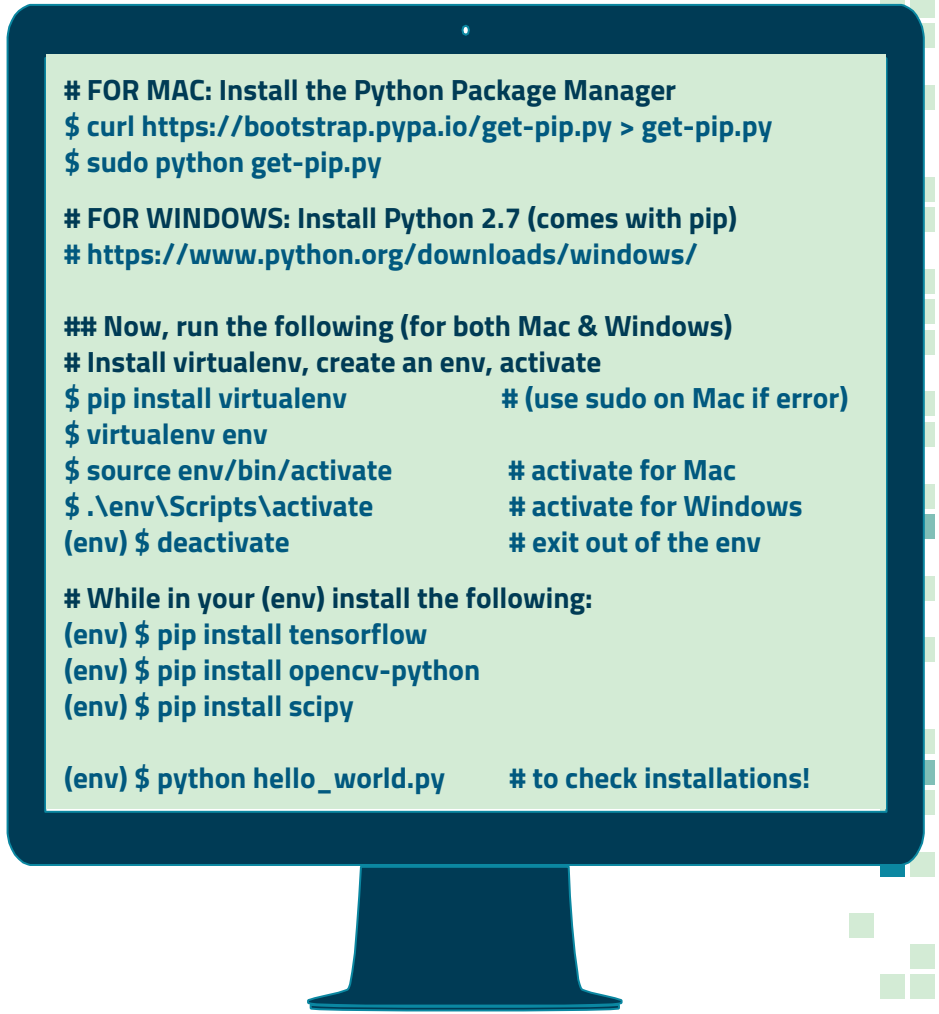
CLONE / DOWNLOAD THE REPO

- https://github.com/SCUACM/tensorflow-tutorial/
- Clone the repository onto your computer
- Or, download the repository as a ZIP

INSTALLATION INSTRUCTIONS

Our goal:

1. Get Python 2.7
2. Install pip
3. Install and activate virtualenv
    a. Install TensorFlow
    b. Install OpenCV
    c. Install SciPy



1. THE BASICS

What is machine learning and what are neural networks?

MACHINE LEARNING

A field of computer science that gives computers the ability to learn without being explicitly programmed.

Machine learning ⊆ artificial intelligence

ARTIFICIAL INTELLIGENCE

Design an intelligent agent that perceives its environment and makes decisions to maximize chances of achieving its goal.
Subfields: vision, robotics, machine learning, natural language processing, planning, …

MACHINE LEARNING

Gives "computers the ability to learn without being explicitly programmed" (Arthur Samuel, 1959)

SUPERVISED LEARNING

Classification, regression

UNSUPERVISED LEARNING

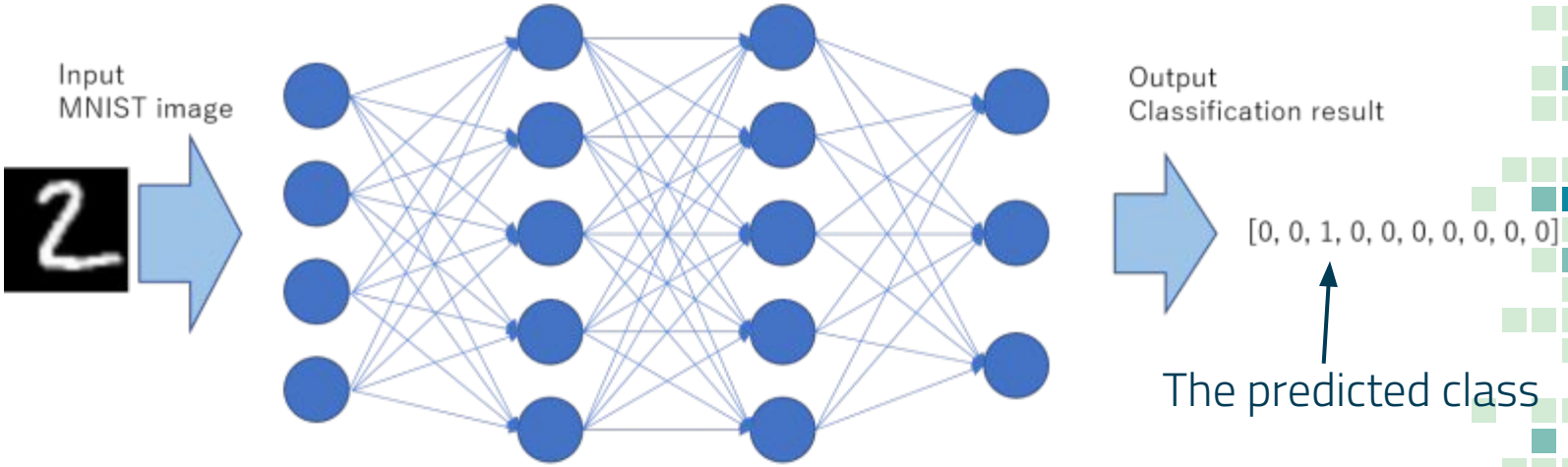
Clustering, dimensionality reduction, recommendation

REINFORCEMENT LEARNING

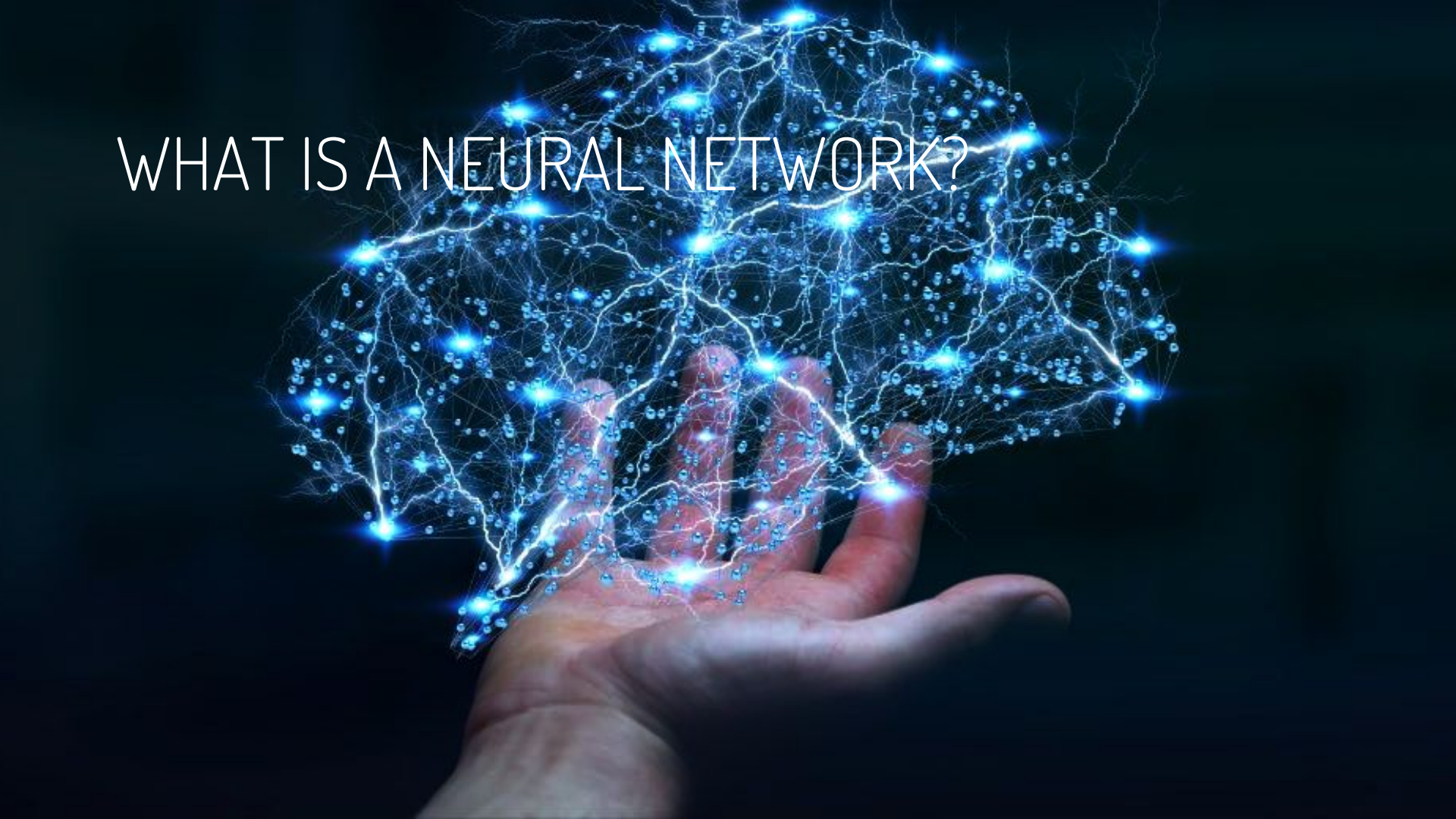
Reward maximization

That's us!

WE ARE 'CLASSIFYING' OUR INPUTS

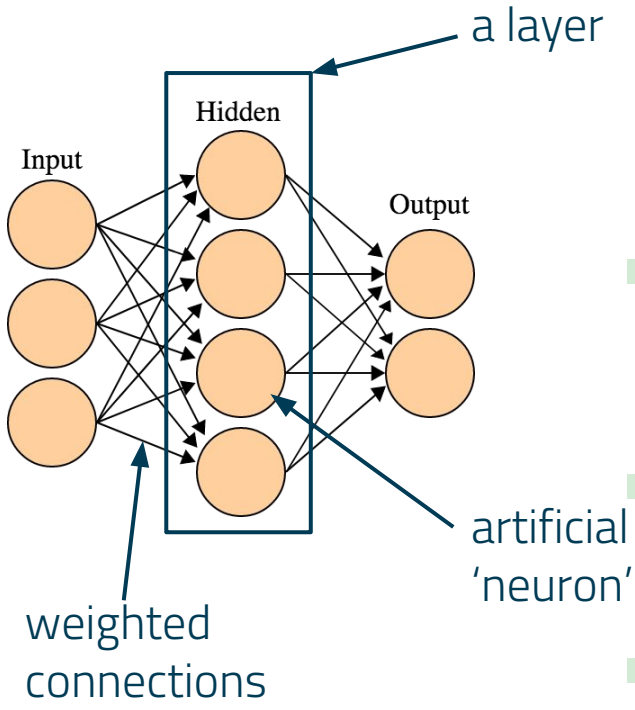


WHAT IS A NEURAL NETWORK?



MORE ON NEURAL NETWORKS?

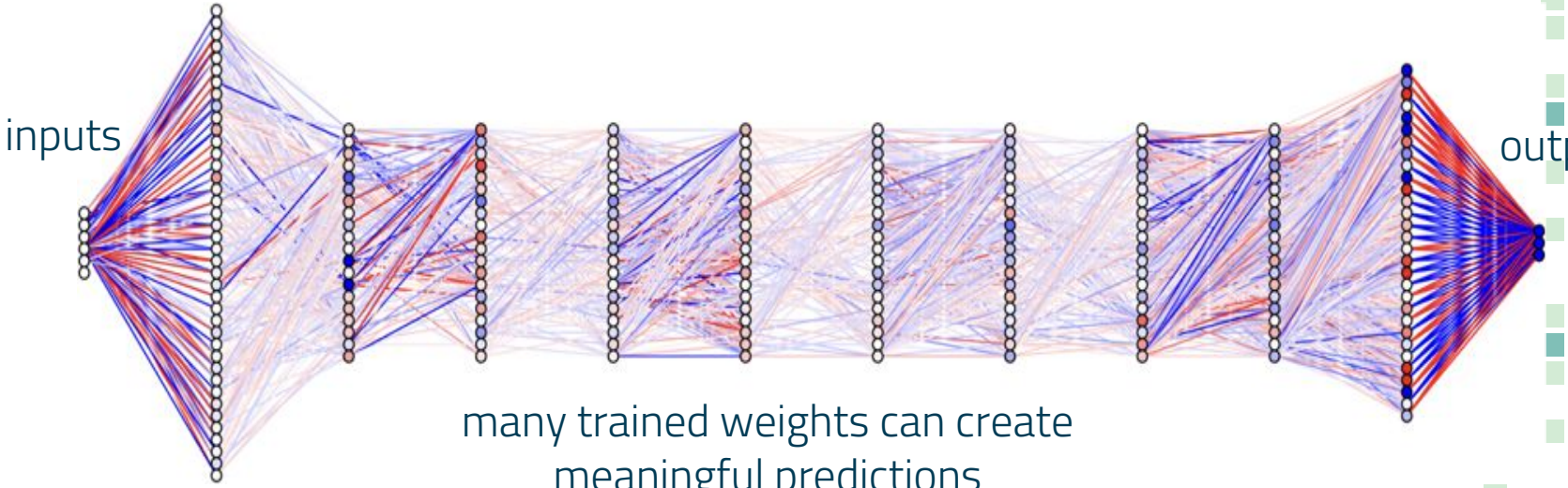
- Trainable network
- Can learn how to map inputs to outputs
- Many layers can accomplish more complex tasks



AN EXAMPLE:

TensorFlow Playground!

DEEP LEARNING:
A NEURAL NET WITH MANY LAYERS



many trained weights can create
meaningful predictions

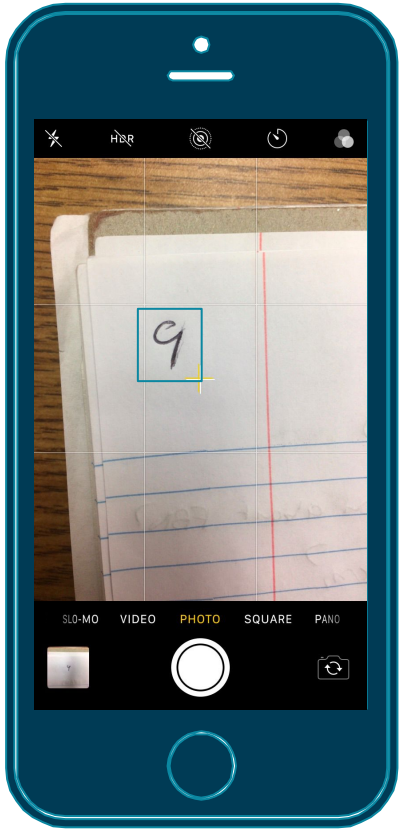
2. THE TASK

What is the problem we are trying solve?

ULTIMATE GOAL

Look at an image of a digit (raw pixels) and print the pictured digit.

(we will create the brains behind this but not the app)



→ '9'


This is the data
we are working with

55,000 digits

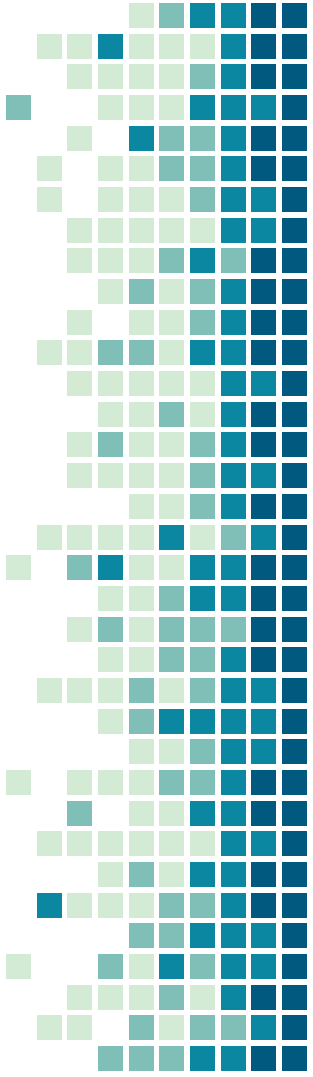
In the training set

10,000 digits

In the test set

99.79% accuracy

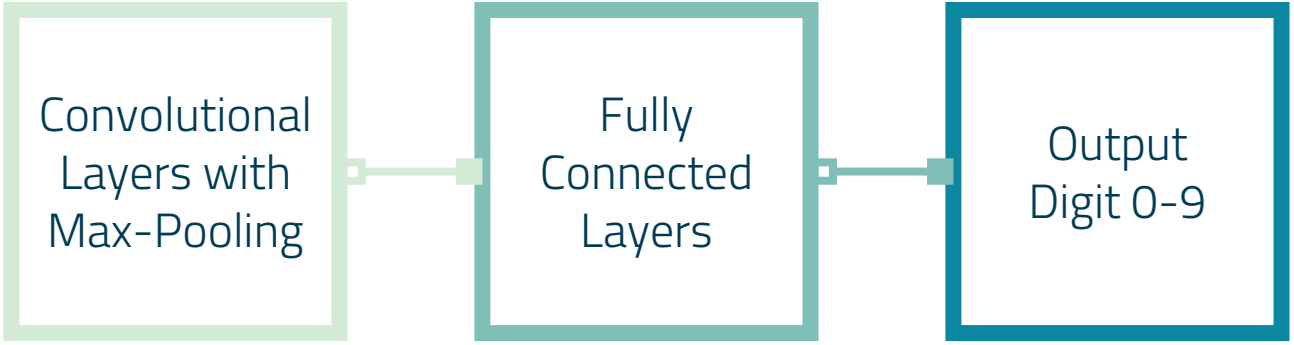
For state of the art algorithms



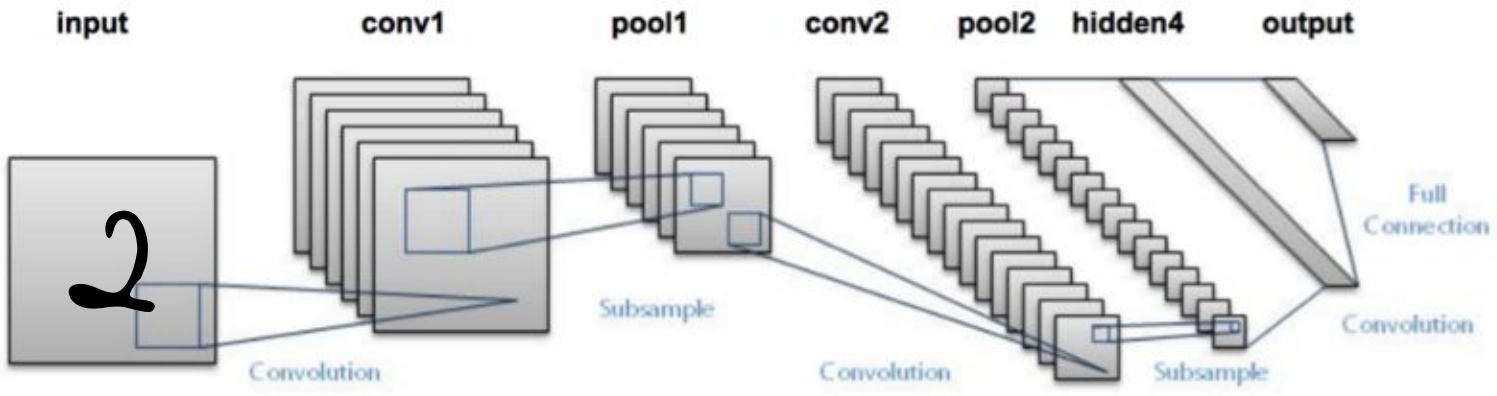
3. THE SOLUTION

How can we use TF to train a neural network to interpret handwritten digits?

What will our model look like?



WE WILL BE BUILDING A 'LeNet'

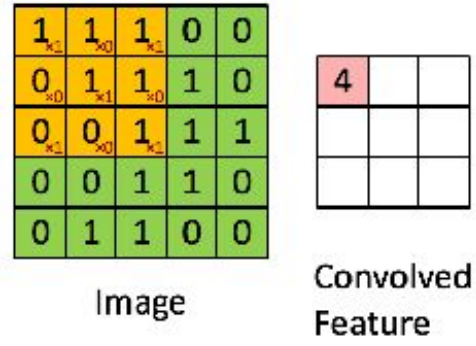


AN EXAMPLE:

Keras.js MNIST CNN Example!

WHAT IS A CONVOLUTIONAL LAYER?

- Applying a filter across an image to transform it
- Many convolutional layers can extract features from an image



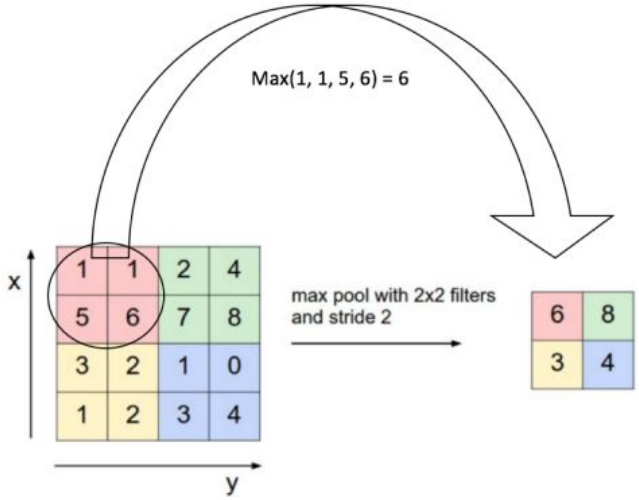
Here are some examples of filters you might recognize

Operation	Filter	Convolved Image
Identity	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	
Edge detection	$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$	
	$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$	
	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$	
Sharpen	$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	
Box blur (normalized)	$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$	
Gaussian blur (approximation)	$\frac{1}{16}\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$	

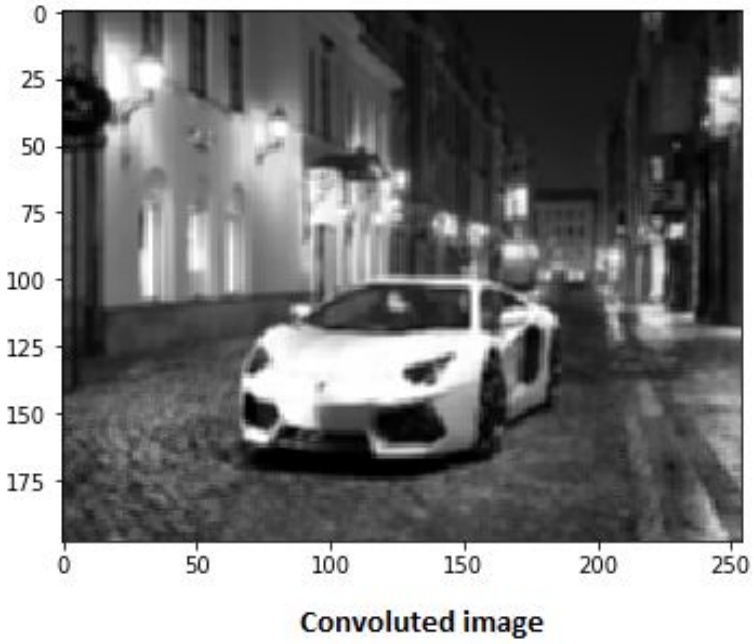
And here is an animation of applying a filter to an image:

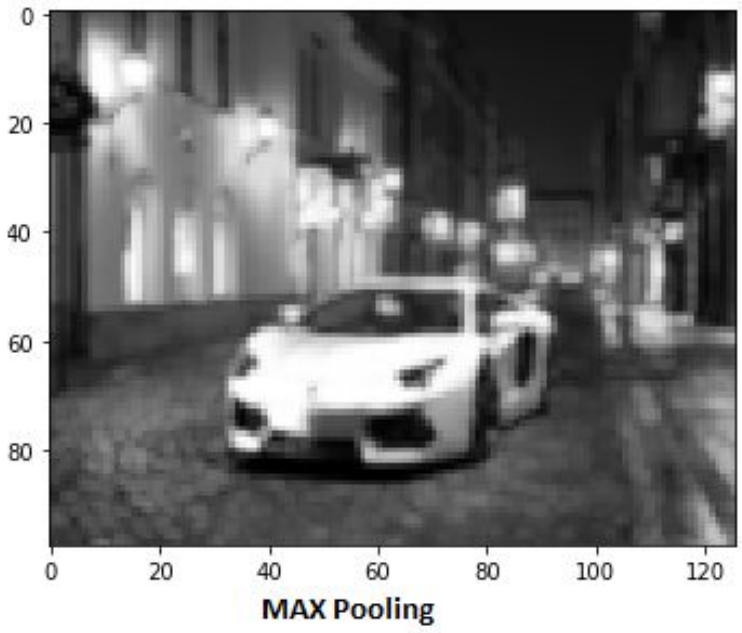
WHAT IS MAX-POOLING?

- Used to reduce the size of our data; downsampling
- Reduce each 2x2 square to a single pixel by taking the maximum value



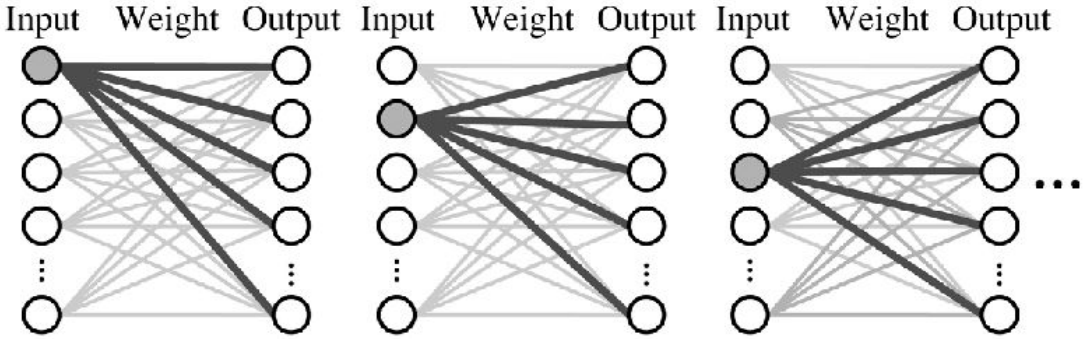
Applying max-pooling to an image...





WHAT IS A FULLY-CONNECTED LAYER?

- The bulk of the actual classification is done here
- Every input connected to every output



NOW LET'S BUILD THIS THING

THANKS!

Any questions?

Please fill out the following survey:

- https://tinyurl.com/yaxas3jh

Contact:

- scuacm.slack.com (I'm @tshur)
- santaclara.acm@gmail.com

SOME HELPFUL RESOURCES (on GitHub)

- https://www.coursera.org/learn/machine-learning
- https://ujjwalkarn.me/2016/08/11/intuitive-explanation-convnets/
- https://www.safaribooksonline.com/library/view/learning-tensorflow/9781491978504/ch04.html
- Datasets to play with: Street View House Numbers (SVHN), ImageNet, Google Open Images, and more at: https://deeplearning4j.org/opendata, kaggle.com, modelzoo