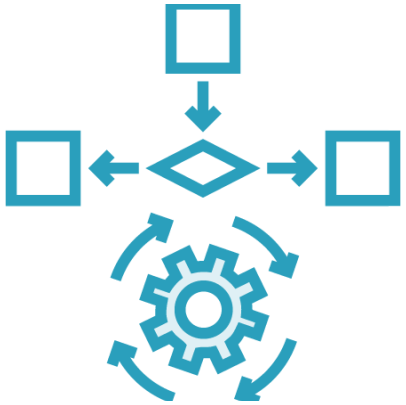
Leveraging Convolutional Neural Networks for Feature Detection

David Tucker
TECHNICAL ARCHITECT & CLOUD CONSULTANT
@_davidtucker_ davidtucker.net

Types of Computer Vision Approaches



Non-learning

Configurable algorithms

Learning

Neural networks

Overview

Review neural networks

Examine convolutional neural networks for image analysis

Import and analyze an image data set for deep learning

Create a convolutional neural network for image classification

Predict image classification for images with a compiled model

Neural Network Overview

Neural Network

Computing system that is modeled after the way that human brains function in which the system can **learn** to perform tasks based on example data without configuring a specific set of rules to follow.

Use Cases

Data forecasting

Natural language processing

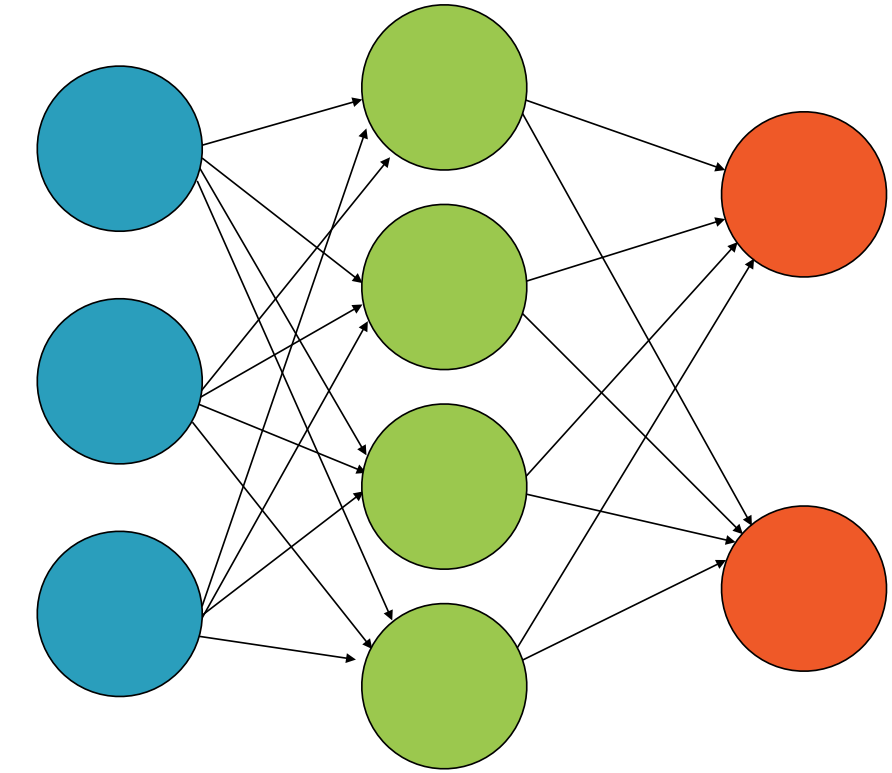
Autonomous vehicles

Media metadata extraction

Disease diagnosis

Content recommendations

Neural Network



Input Layer Hidden Layer Output Layer

Types of Learning with Neural Networks

Supervised

Utilize a neural network to find known patterns within the data

Unsupervised

Utilize a neural network to find unknown patterns within the data

Processing Data Sets in a Neural Network

Batch Size

The amount of data samples passed through per iteration

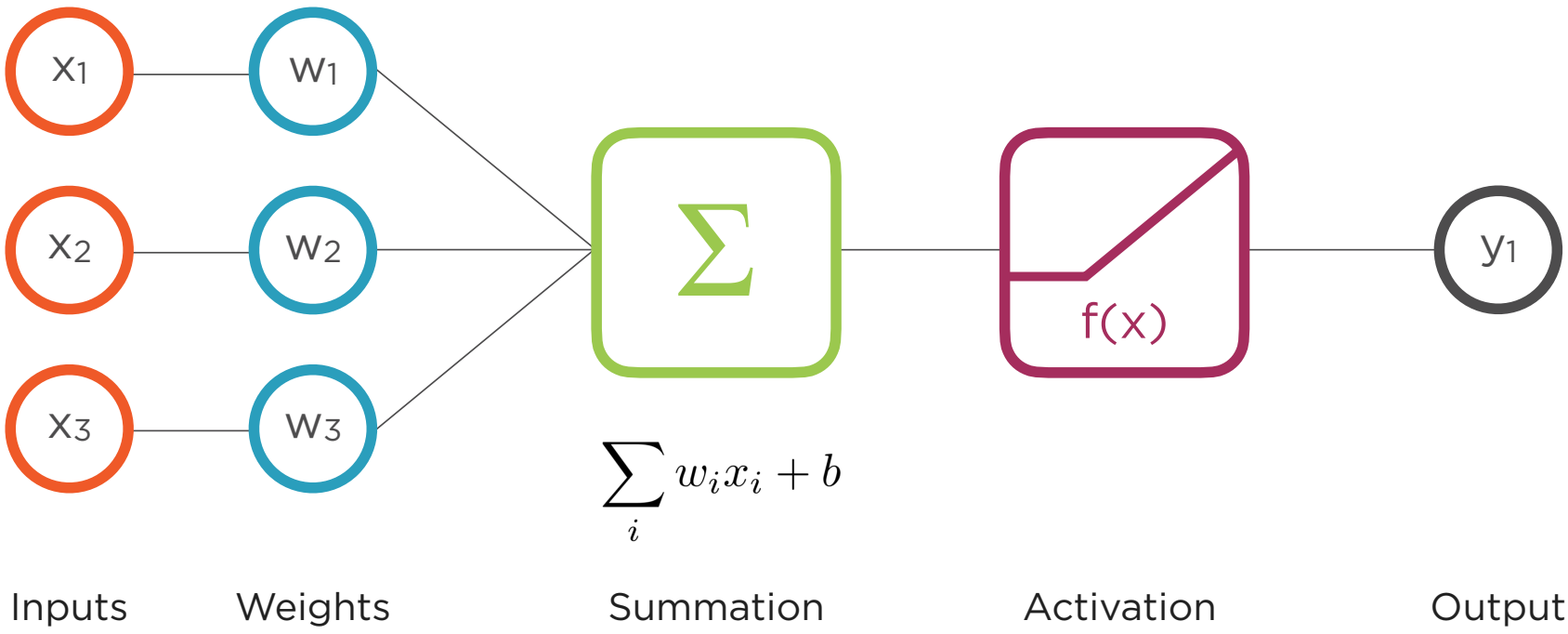
Iteration

A single pass of a batch through the network with specific weights & biases

Epoch

A full pass of the entire data set through the network

Neural Network Neuron



Neural Network Metrics

Accuracy

The percentage of correct predictions of the data in supervised learning

Loss

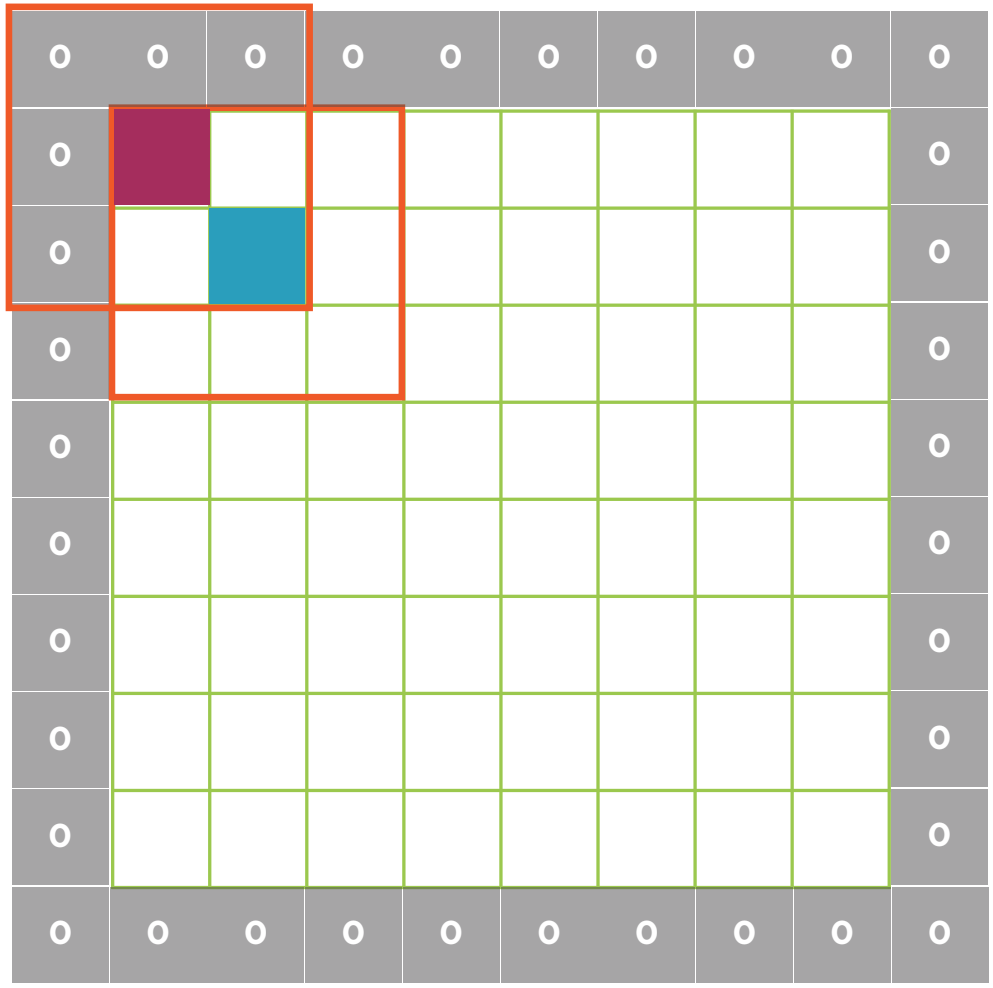
The sum of the difference between the correct and actual predictions for the data set

Convolutional Neural Network Overview

"**Convolutional neural networks** are simply neural networks that use convolution in place of general matrix multiplication in at least one of their layers."

Wikipedia

Convolutional Layer



Input Size 8x8x1

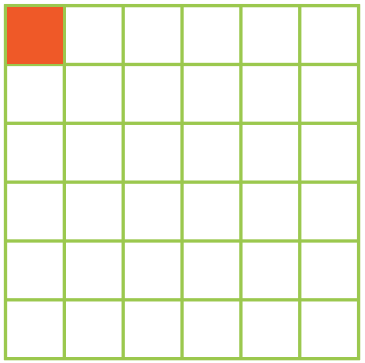
Kernel Size 3x3

Filters 1

Padding valid (no padding)

Stride 1 (both directions)

Output Size 6x6x1



Pooling Layer

A layer that downsamples features within a region of the image. The reduction will decrease the complexity of parameters, and it has the potential to reduce the risk of overfitting.

Model Deficiencies

Overfitting

Model is fit too closely to training data in a manner that makes it less accurate for inference

Underfitting

Model has a too simplistic view of the data, and cannot describe the underlying trend

Pooling Layer Types

Max Pooling

Average Pooling

Weighted Average Pooling

L2-norm Pooling

Max Pooling Layer

1	3	0	3	1	1
2	5	1	1	1	1
3	3	4	2	2	1
1	5	6	0	2	1
2	1	2	0	3	1
4	2	2	0	3	0

Input Size 6x6

Pool Size 2x2

Padding valid (no padding)

Stride 2 (both directions)

Output Size 3x3

5	3	1
5	6	2
4	2	3

Other Layer Types Used in CNN's

Dense

Fully-connected layer with a configurable number of neurons

Flatten

Inputs are flattened into a single dimension

Dropout

Specified rate of neurons are ignored to protect against overfitting

Common Activation Functions

- **Rectified Linear Unit (ReLU)**
- **Sigmoid**
- **Tanh**
- **Softmax**

Classification Best Practices

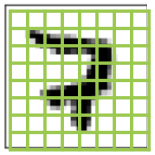
Output layer needs to be a dense layer

Output layer needs to have a neuron for each class in the data set

If there are more than two possible classes, use softmax activation

Flatten layer should be leveraged before a dense layer if data is multi-dimensional

Example Convolutional Neural Network



Input 8x8x1

2D Convolutional Layer

Stride 1,1
Padding valid
Kernel 3x3
Filters 32
Activation relu
Output 6x6x32

Max Pooling Layer

Stride 2,2
Padding valid
Pool Size 2x2
Output
3x3x32

Flatten Layer

Output
288x1

Dense Layer

Neurons 128
Activation relu
Output 128x1

Dense Layer

Neurons 10
Activation
softmax
Output 10x1

Working with MNIST

Demo

Upload the CNN demo notebook to Azure Machine Learning

Import the MNIST data set with Keras

Visualize the data provided in the data set

Creating a CNN for Classification

Demo

Preprocess data for use in the CNN

Create and visualize the layers of the CNN

Compile and evaluate the CNN model

Predict data based on the compiled CNN model

Summary

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