



Visual Studio **LIVE!**
EXPERT SOLUTIONS FOR .NET DEVELOPERS

SQL Server **LIVE!**
TRAINING FOR DBAs AND IT PROS

TECHMENTOR

Artificial
Intelligence **LIVE!**
AI FOR DEVELOPERS AND DATA SCIENTISTS

Office &
SharePoint **LIVE!**
ON-PREMISE, CLOUD & CROSS-PLATFORM TRAINING

Modern Apps **LIVE!**
MOBILE, CROSS-DEVICE & CLOUD DEVELOPMENT

Practical AI for the Working Software Engineer

David Smith @revodavid
Cloud Advocate, AI/ML
Microsoft
Level: Intermediate

The Ultimate Education Destination

2018
Orlando

AIF01 Workshop Outline

0800 – 1000 Part 1: Setup & Intro; Pre-trained AI

1000 – 1030 Break

1030 – 1300 Part 2: Customizing Pre-trained AI

1200 – 1300 Lunch

1300 – 1500 Part 3: Bespoke AI

1500 – 1530 Break

1530 – 1615 Part 4: Other topics; Wrap up & Q&A

About David Smith

Data Scientist

Cloud Advocate (AI & ML), Microsoft

Co-author, *Introduction to R*

Editor, *Revolutions* blog blog.revolutionanalytics.com

davidsmi@microsoft.com

@revodavid

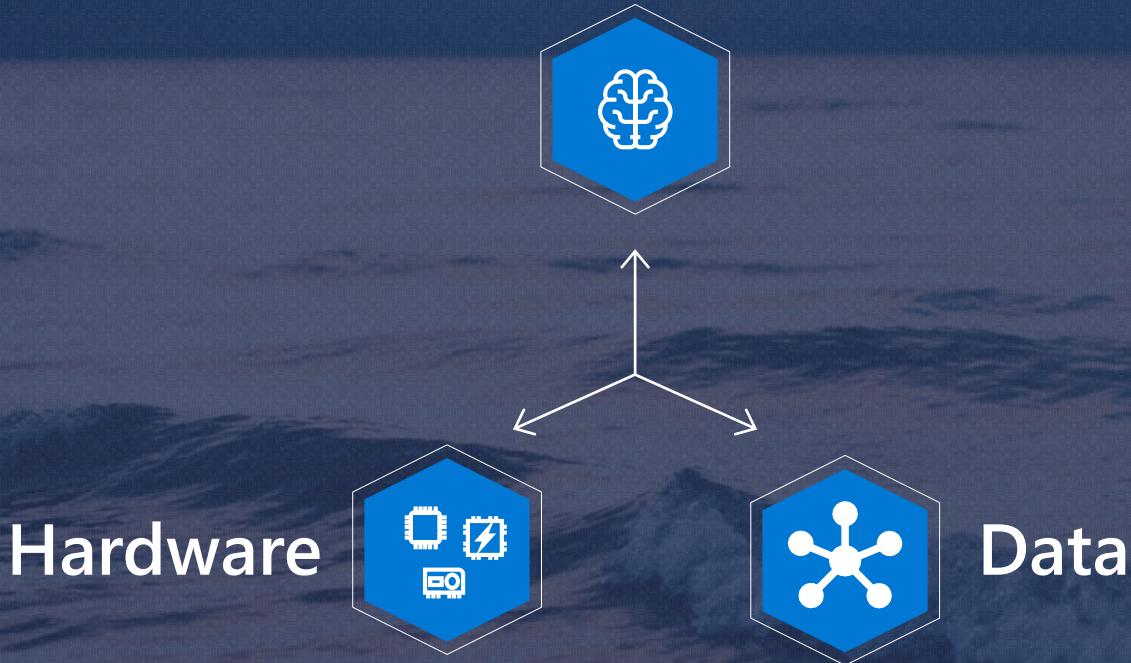


Part 1

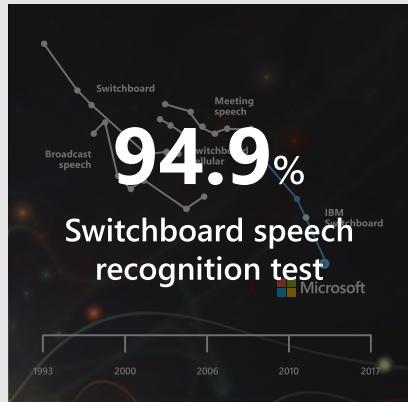
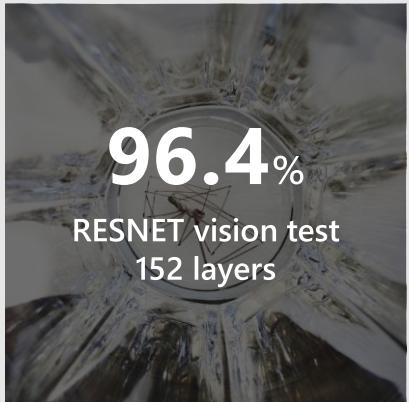
INTRODUCTION

Artificial Intelligence

Algorithms



AI can be as good as humans



2016

Object recognition
Human parity

2017

Speech recognition
Human parity

January 2018

Machine reading comprehension
Human parity

March 2018

Machine translation
Human parity

Values and principles for AI

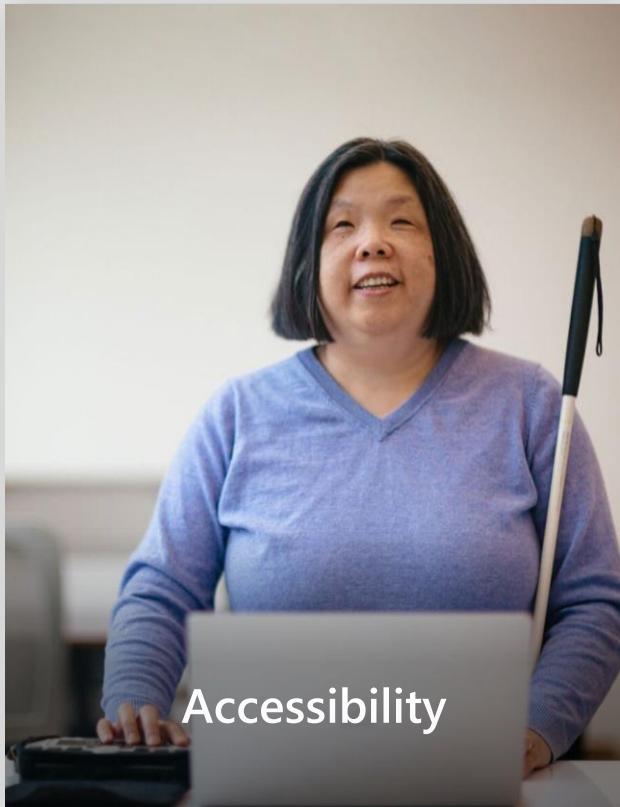
 Enable people

 Inclusive

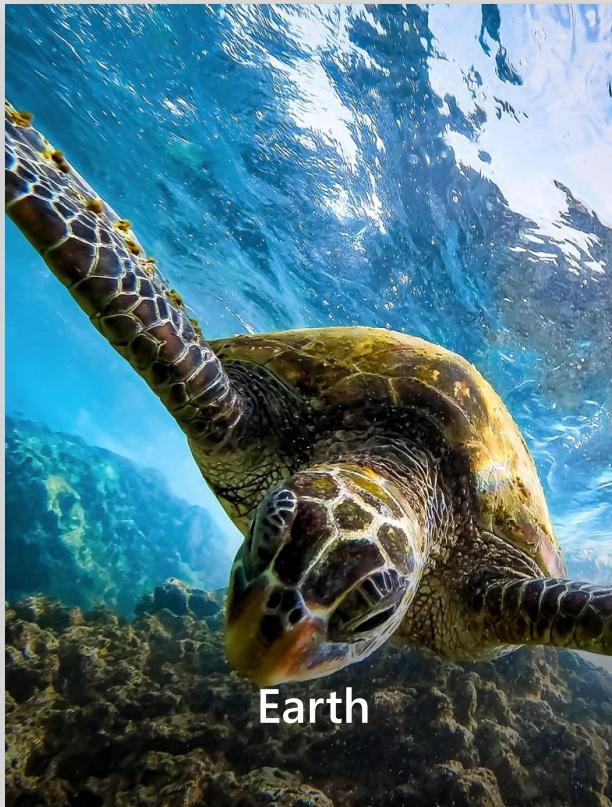
 Ethical



AI for Good



Accessibility



Earth



Humanitarian
Action

The AI Journey

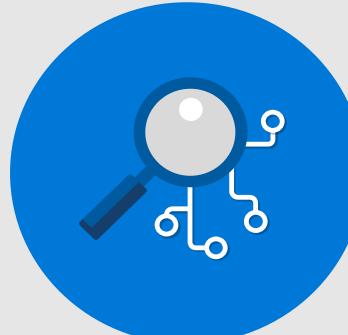
Pre-Trained AI



Cognitive Services
Developer APIs

Data for inference

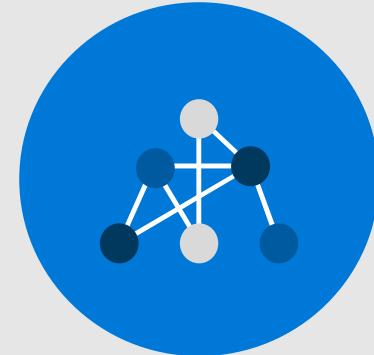
Enhanced AI



Pre-Trained models
Transfer Learning

Some training data

Bespoke AI



Developer Tools
Frameworks

Extensive training data

Part 1

SETUP



Home > My Projects > Practical AI Workshop

Practical AI Workshop

Clone

0

Star

0

Practical AI for the Working Software Engineer

Cloned from <https://github.com/revodavid/practicalai>

Status: Running

Project Settings

Download Project

Share

notebooks.azure.com/davidsmi/libraries/practicalai

(optional) Sign up for Azure: cda.ms/kT
[new accounts get \$200 free credits]

Part 1

PRE-TRAINED AI

AI for Accessibility

Inclusion through intelligent technology

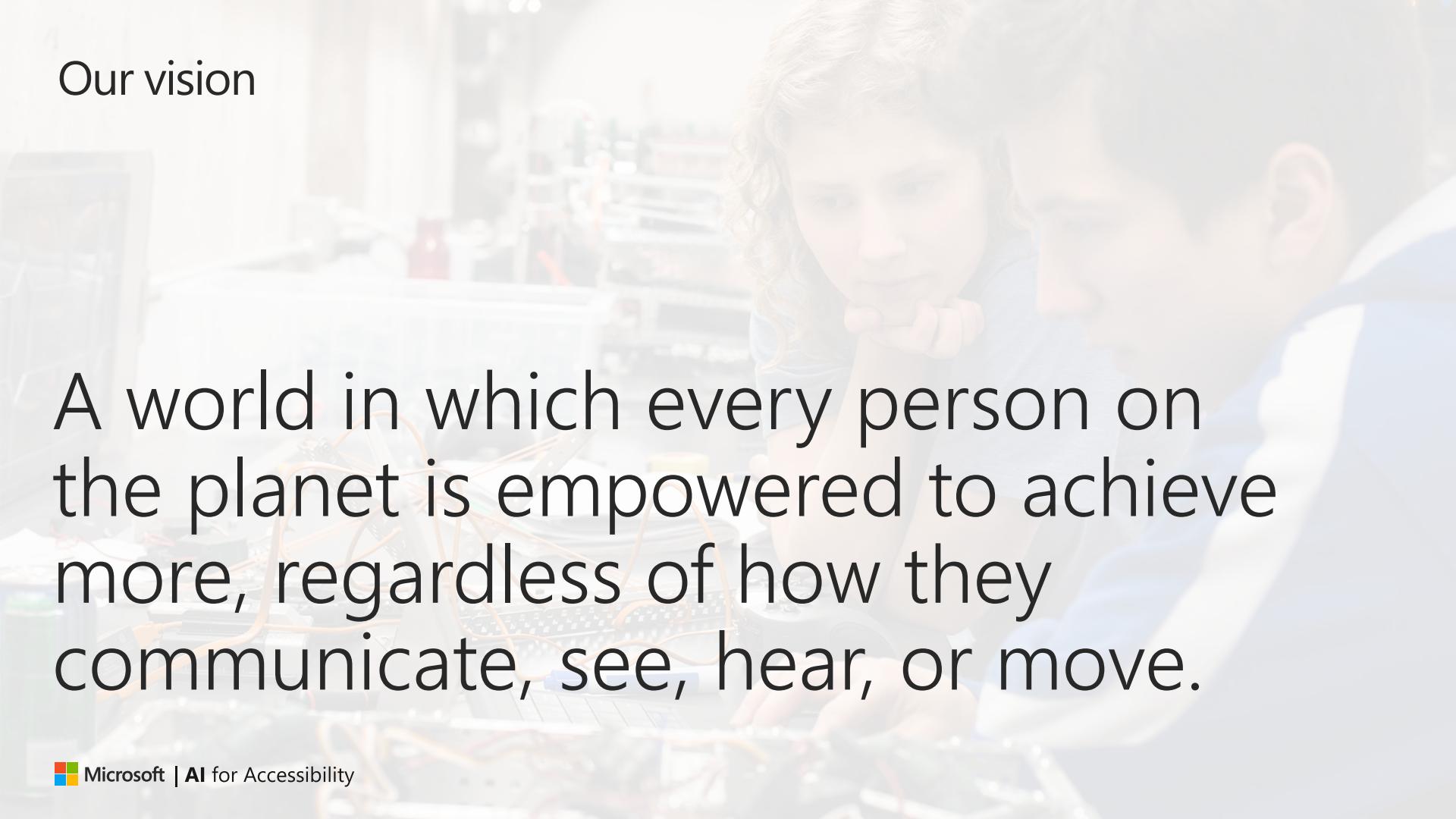


Microsoft AI for Accessibility



Empowering people with disabilities
with tools that support independence,
inclusion, and productivity.

Our vision

A blurred background image of a woman with curly hair smiling and working on a computer keyboard. She is wearing a blue hoodie. The background is a soft-focus photograph of an office or workshop environment.

A world in which every person on the planet is empowered to achieve more, regardless of how they communicate, see, hear, or move.



Accessible technology has the potential to drive innovation with more intuitive and personal experiences.

AI in action

AI is already being used today to deliver meaningful and contextually relevant experiences.



Seeing AI

Turning the visual world
into an audible experience

Designed for the blind and low vision community, this research project harnesses the power of AI to describe people, text, and objects.

Demonstrates the practical value of computer vision.

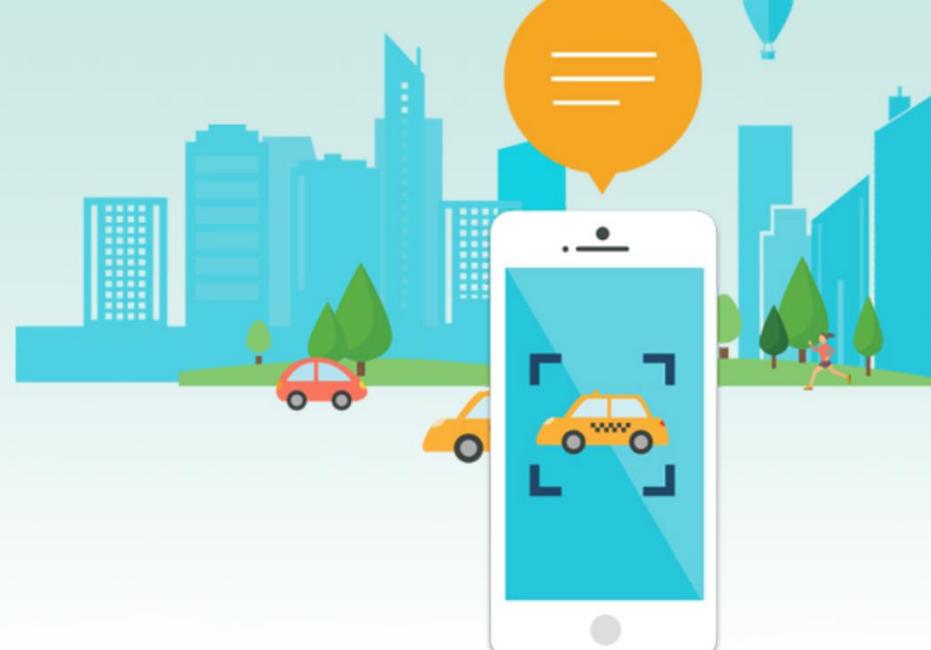


Seeing AI

A free app that narrates the world around you. Designed for the low vision community, this research project harnesses the power of AI to describe people, text and objects

[DOWNLOAD FOR IOS >](#)

[WATCH VIDEO >](#)



Short Text

Speaks text as soon as it appears in front of the camera



Documents

Provides audio guidance to capture a printed page, and recognizes the text, along with its original formatting



Products

Gives audio beeps to help locate barcodes and then scans them to identify products



Person

Recognizes friends and describes people around you, including their emotions



Scene

An experimental feature to describe the scene around you



Currency

Identify currency bills when paying with cash.
(Coming soon)

Microsoft Cognitive Services

Give your apps a human side



Speech

Speak to and hear your users, filtering environmental noise.
Use with **Language** for max results



Vision

From objects to faces and feelings, enable your apps to analyze still images and video



Language

Analyze text to extract user feeling and intent.
Extract knowledge from existing sources and make it easily accessible to users
Translate between 60+ languages and growing



Search

Access billions of web pages, images, videos, and news with the power of Bing

Face Recognition

Face detection

Detect faces and their attributes within an image

Face verification

Check if two faces belong to the same person

Similar face searching

Find similar faces within a set of images

Face grouping

Organize many faces into groups

Face identification

Search which person a face belongs to





Computer Vision

Analyze an image

Understand content within an image

OCR

Detect and recognize words within an image

Generate thumbnail

Scale and crop images, while retaining key content

Recognize celebrities

Thanks to domain-specific models, ability to recognize 200K celebrities from business, politics, sports, and entertainment around the world



Unified Speech

Combine speech recognition, text-to-speech, customized voice models, and translation service

Speech to text

Convert continuous human speech to text that can be used as inputs

Text to speech

Convert text to audio files of natural-sounding speech

Speech translation

Use text or speech to provide translations of speech to other languages



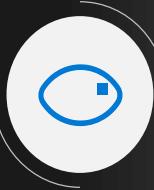
The AI behind Seeing AI

1. The AI behind Seeing AI.ipynb
2. Computer Vision API with R.ipynb



Cognitive Services

Infuse your apps, websites, and bots with human-like intelligence



Vision

- Image Tagging, Thumbnails
- OCR, Handwriting recognition
- Customized image recognition
- Face detection
- Emotion recognition
- Video insights - people detection, visual search, keyframe detection, object recognition
- Image and video moderation



Speech

- Speech to text (Speech Transcription)
- Customized speech Transcription (complex word, noisy environment)
- Text to speech
- Speaker ID and authentication
- Real-time speech translation



Language

- Contextual language understanding – customized intent analysis
- Sentiment analysis, key phrase detection
- text translation up to 60+ languages
- Text Moderation
- Spell checking



Knowledge

- Customized decision making with reinforcement learning
- Q&A service and bot training with personality



Search

- Visual Search with object detection
- Comprehensive news, image, and video results
- Custom Search
- Tailored and customized search experiences
- Automatic search suggestions
- Entity information augmentation

Connecting people to their environment and to each other

Hear
Interactive



Understand
Location aware
Situationally relevant



See
Screen-less Visual



Speak
Multi-lingual
Conversational

Feel
Sentiment personalization

Part 2

CUSTOMIZING PRE-TRAINED AI

The AI Journey

Pre-Trained AI



Cognitive Services
Developer APIs

Data for inference

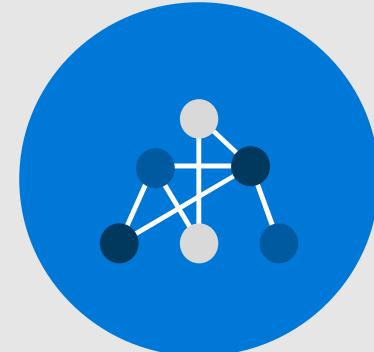
Enhanced AI



Pre-Trained models
Transfer Learning

Some training data

Bespoke AI



Developer Tools
Frameworks

Extensive training data

Limitations of pre-trained AI

The model is pre-defined:

- Pre-defined set of objects that can be recognized by Vision API
- Pre-defined set of words that can be understood by Translation API
- Voices / accents / intonations that don't work with Speech API

Re-training the model can take hours or days, and requires expensive compute resources.

Without re-training, can we extend pre-trained AI to:

- work with input data it wasn't trained for?
- detect new classes it wasn't trained to recognize?

Part 2

TRANSFER LEARNING WITH CUSTOMVISION.AI

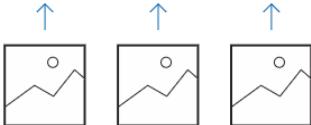
Microsoft Cognitive Services

Custom Vision



Visual Intelligence Made Easy

Easily customize your own state-of-the-art computer vision models that fit perfectly with your unique use case. Just bring a few examples of labeled images and let Custom Vision do the hard work.



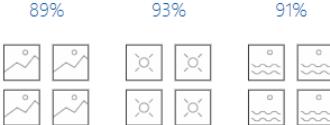
Upload Images

Bring your own labeled images, or use Custom Vision to quickly add tags to any unlabeled images.



Train

Use your labeled images to teach Custom Vision the concepts you care about.



Evaluate

Use simple REST API calls to quickly tag images with your new custom computer vision model.

How Computer Vision Works

TASKS

<

< PREV

RANDOM

NEXT >

>



IN CS, IT CAN BE HARD TO EXPLAIN
THE DIFFERENCE BETWEEN THE EASY
AND THE VIRTUALLY IMPOSSIBLE.

<

< PREV

RANDOM

NEXT >

>

PERMANENT LINK TO THIS COMIC: [HTTPS://XKCD.COM/1425/](https://xkcd.com/1425/)

IMAGE URL (FOR HOTLINKING/EMBEDDING): [HTTPS://IMG.S.XKCD.COM/COMICS/TASKS.PNG](https://imgs.xkcd.com/comics/tasks.png)

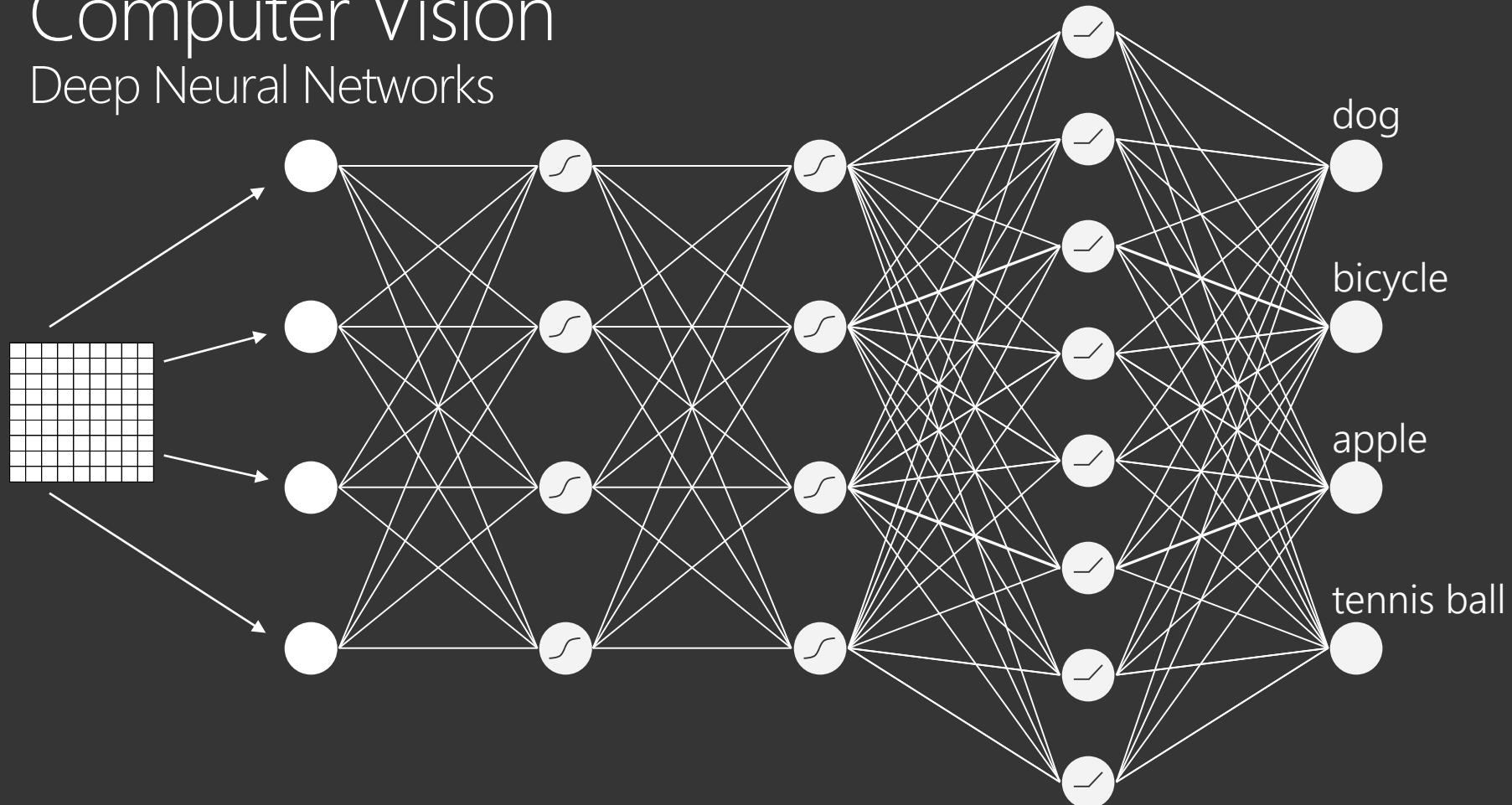
How neural networks work

Brandon Rohrer

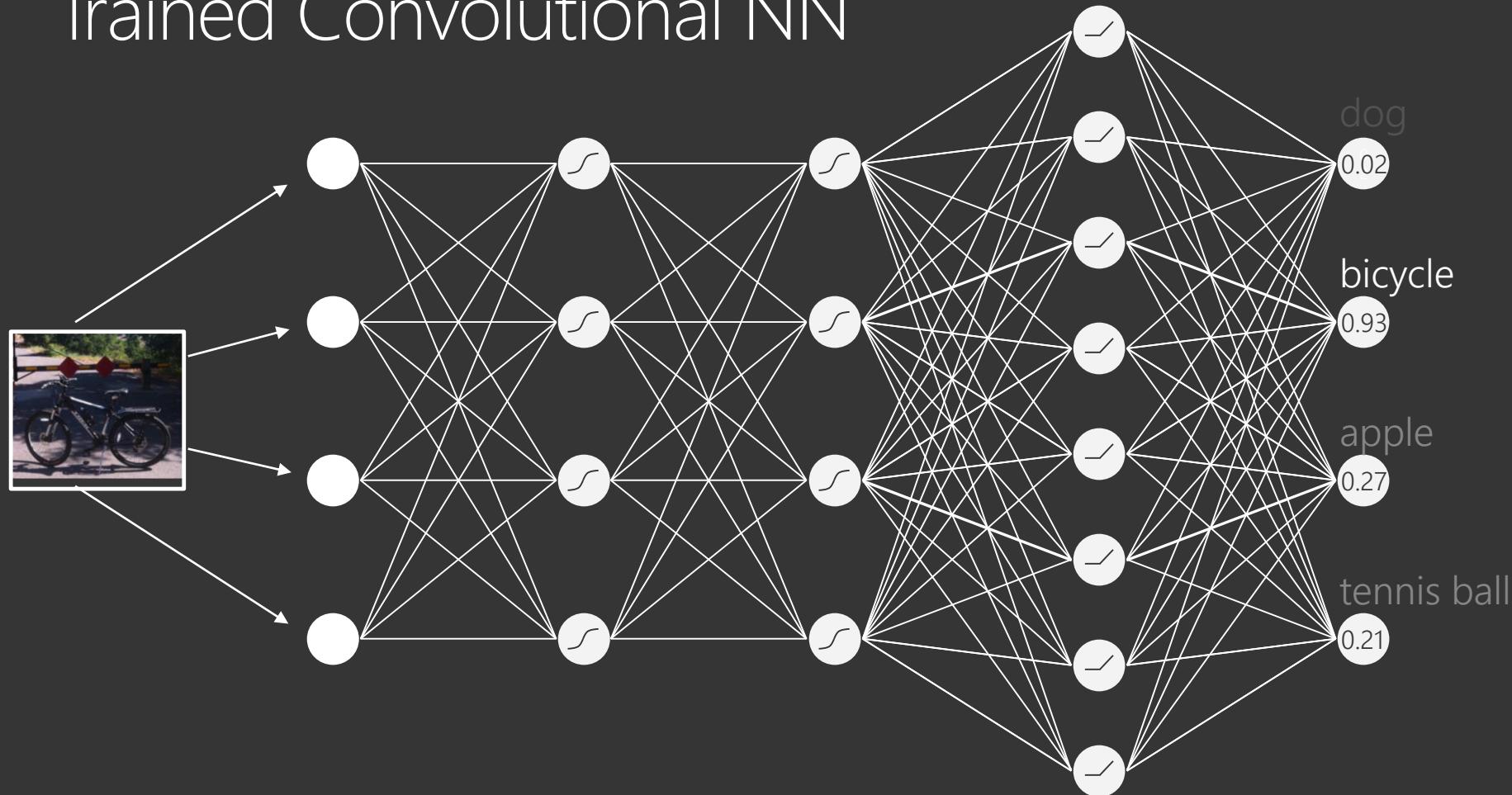
brohrer.github.io/blog.html

Computer Vision

Deep Neural Networks



Trained Convolutional NN



Filters

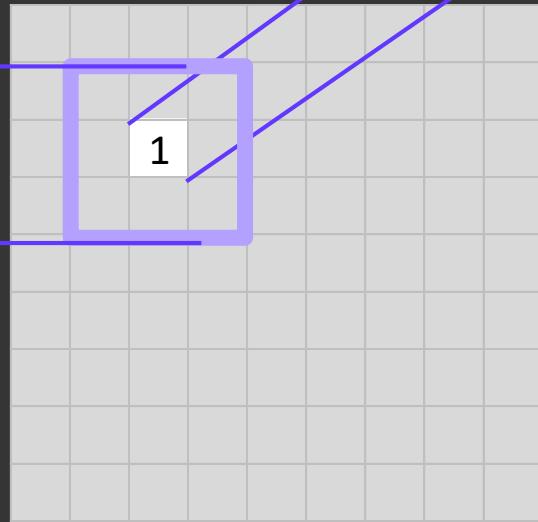
Filters

1	-1	-1
-1	1	-1
-1	-1	1

1	1	1
1	1	1
1	1	1

$$\frac{1 + 1 + 1 + 1 + 1 + 1 + 1 + 1}{9} = 1$$

-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	1	-1	-1	-1	1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	-1	-1	-1	1	-1	-1	-1	-1
-1	-1	-1	-1	1	-1	-1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1



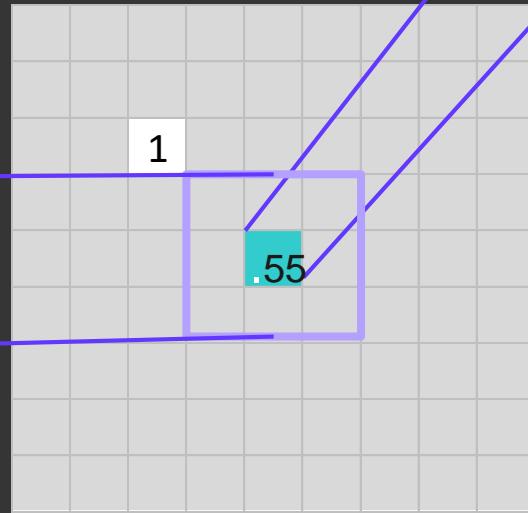
Filters

1	-1	-1
-1	1	-1
-1	-1	1

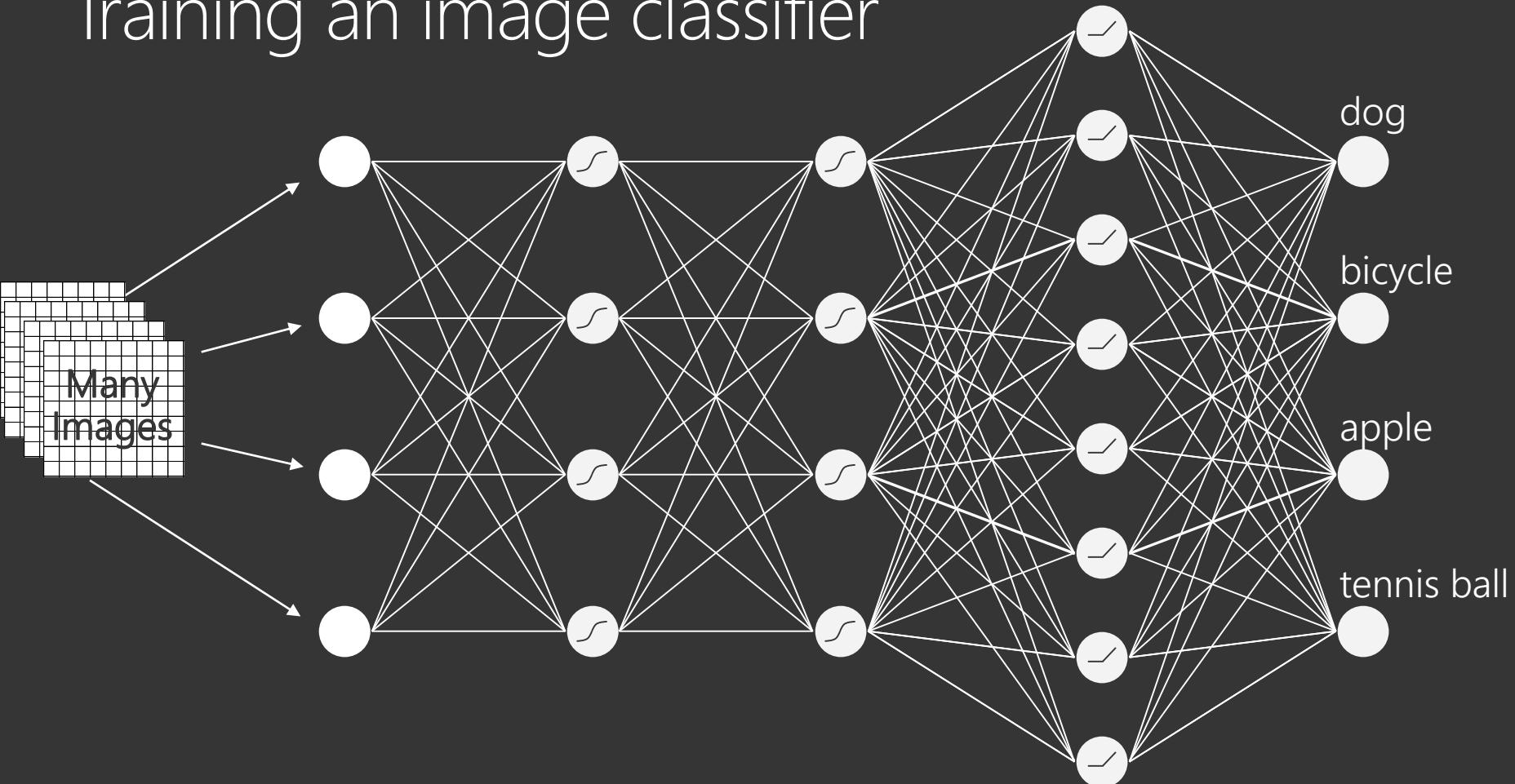
1	1	-1
1	1	1
-1	1	1

$$\frac{1 + 1 - 1 + 1 + 1 + 1 - 1 + 1 + 1}{9} = .55$$

-1	-1	-1	-1	-1	-1	-1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	1	-1	-1	-1	1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	-1	-1	-1	1	-1	-1	-1	-1
-1	-1	-1	1	-1	1	-1	-1	-1
-1	-1	1	-1	-1	-1	1	-1	-1
-1	1	-1	-1	-1	-1	-1	1	-1
-1	-1	-1	-1	-1	-1	-1	-1	-1



Training an image classifier



Learning

$$W_1 := W_0 - \alpha \nabla_w J(W_1, b)$$

updated W

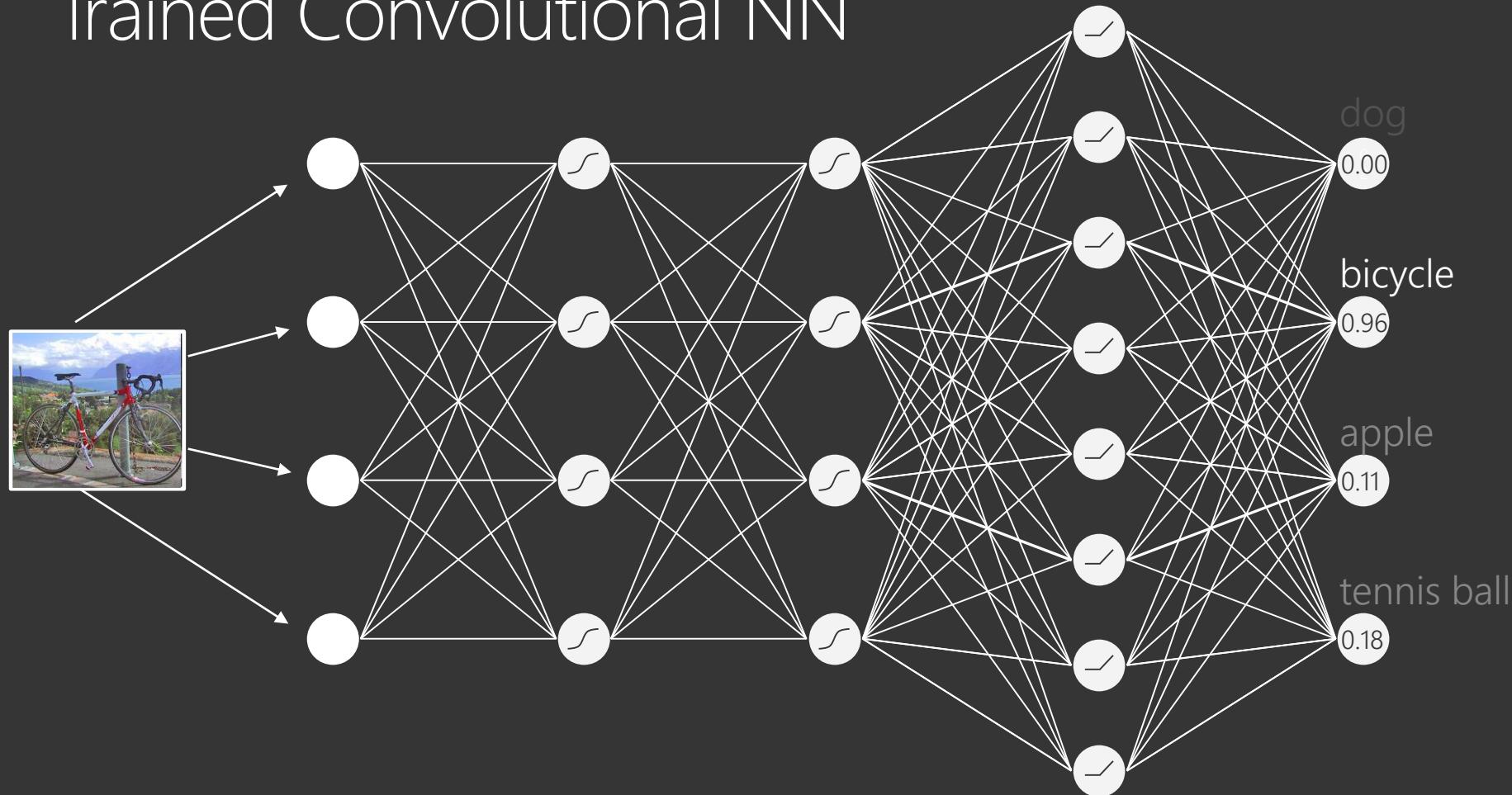
current W

learning
rate

gradient of
cost function

$$\frac{1}{n} \sum [(w^T x + b) - y] \cdot x$$

Trained Convolutional NN



“Not Hotdog” custom image recognizer

- 🌐 Collect images of hotdogs
ImageNet



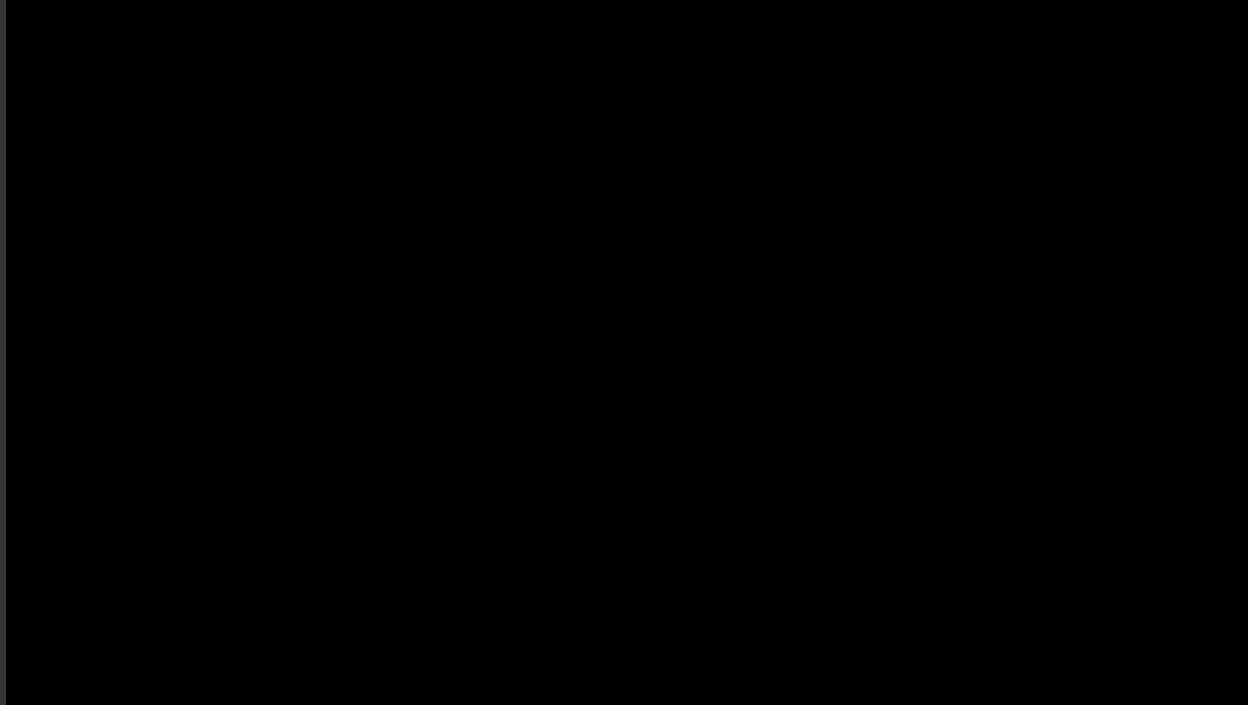
“Hotdog”

- ⚙️ Train image recognizer
Transfer learning



“Not Hotdog”

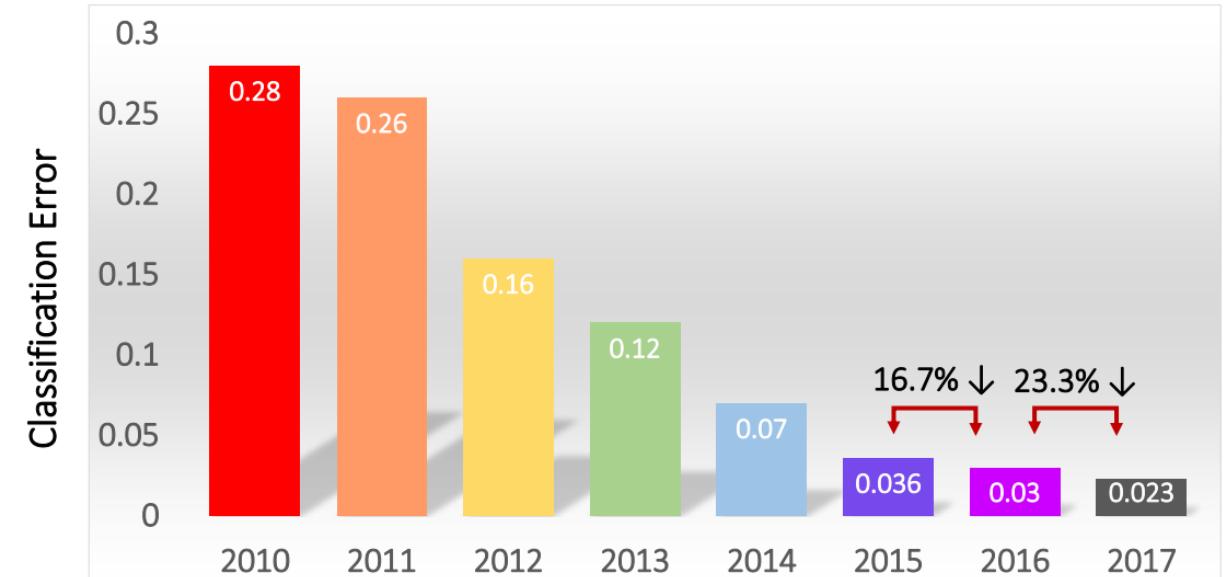
- 💡 Classify new images
Shiny app



Silicon Valley Season 4, Episode 4. © HBO

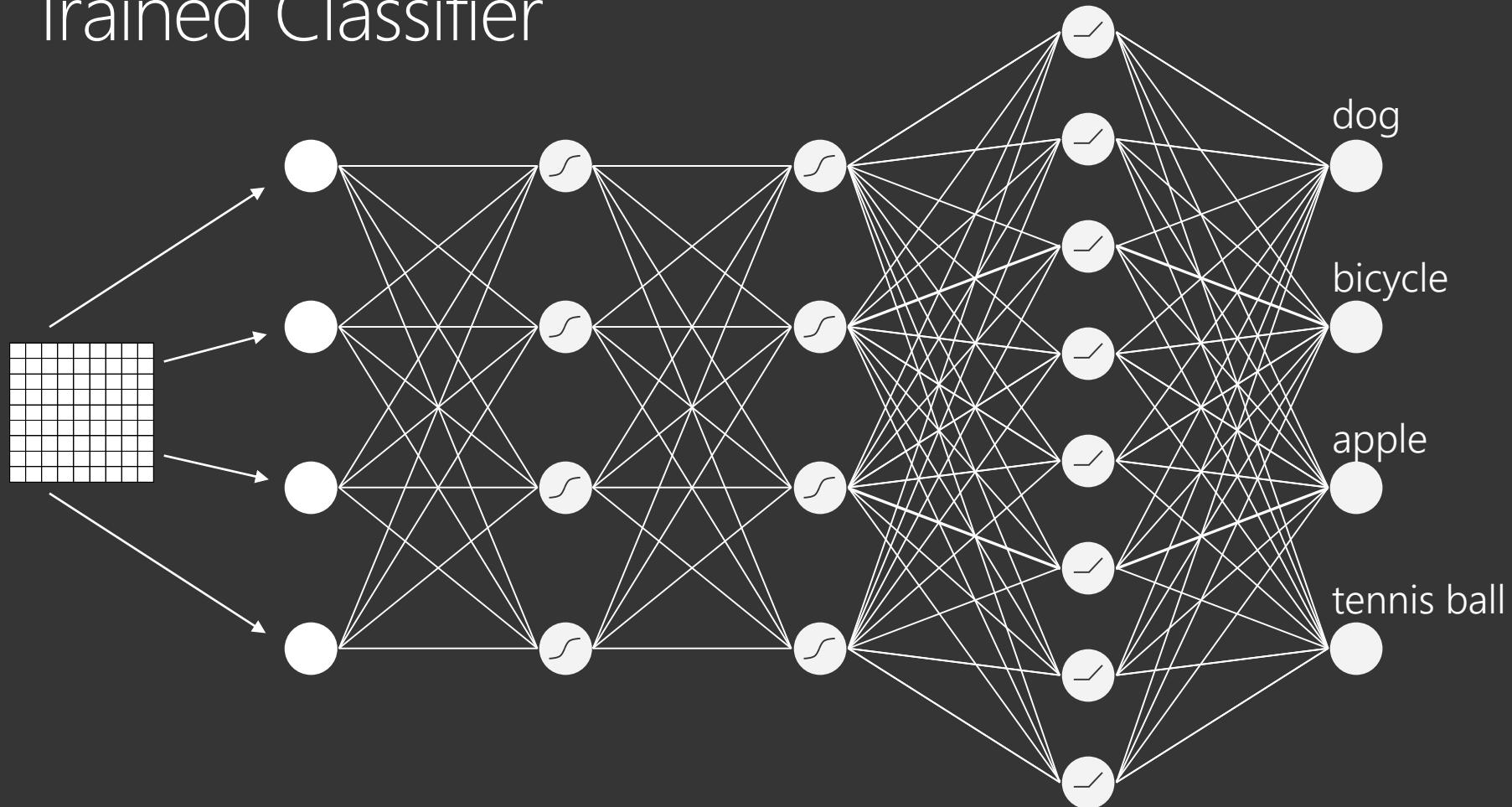
ImageNet Challenge Winners

Classification Results (CLS)

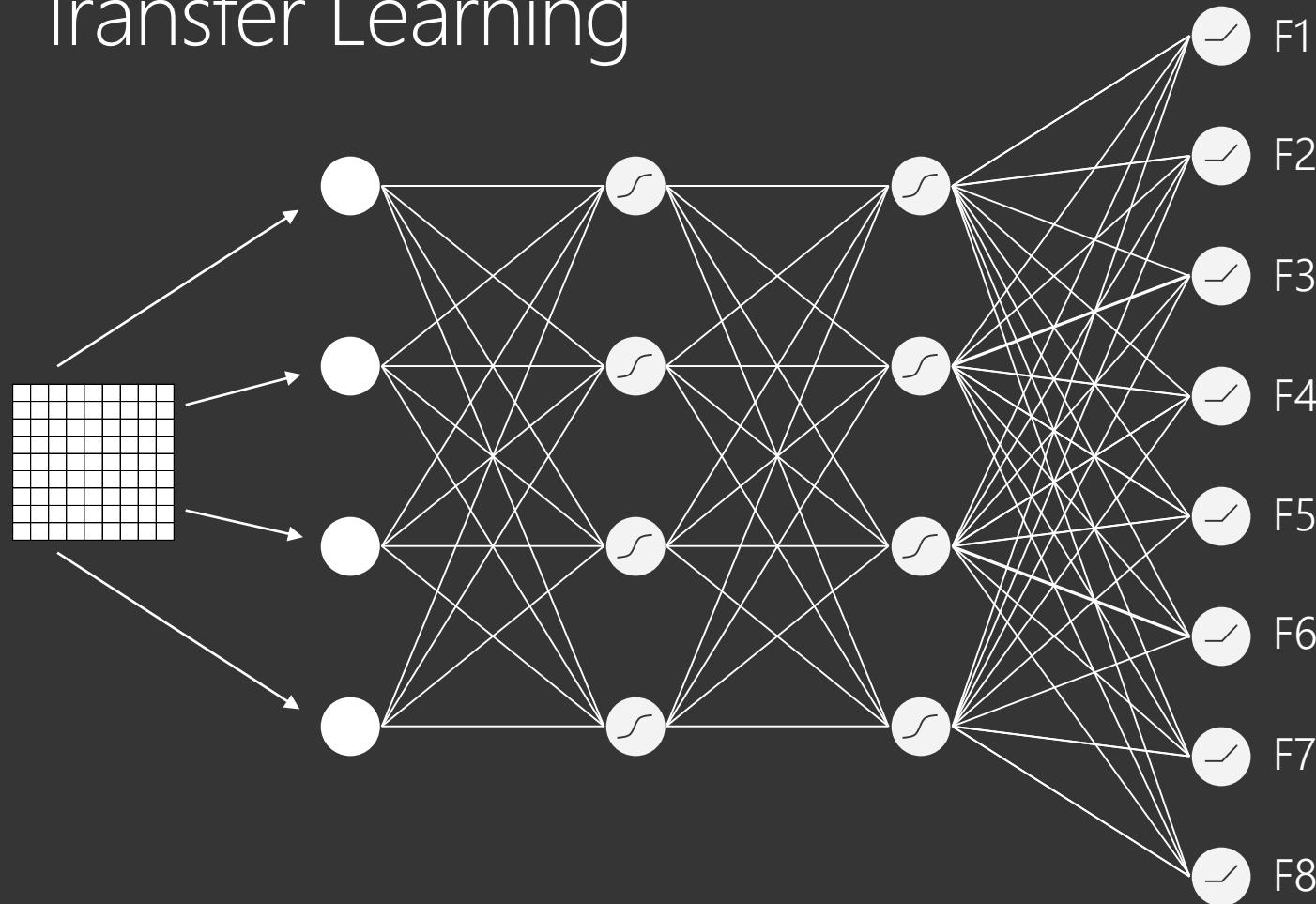


Park et al, ILSVRC 2017

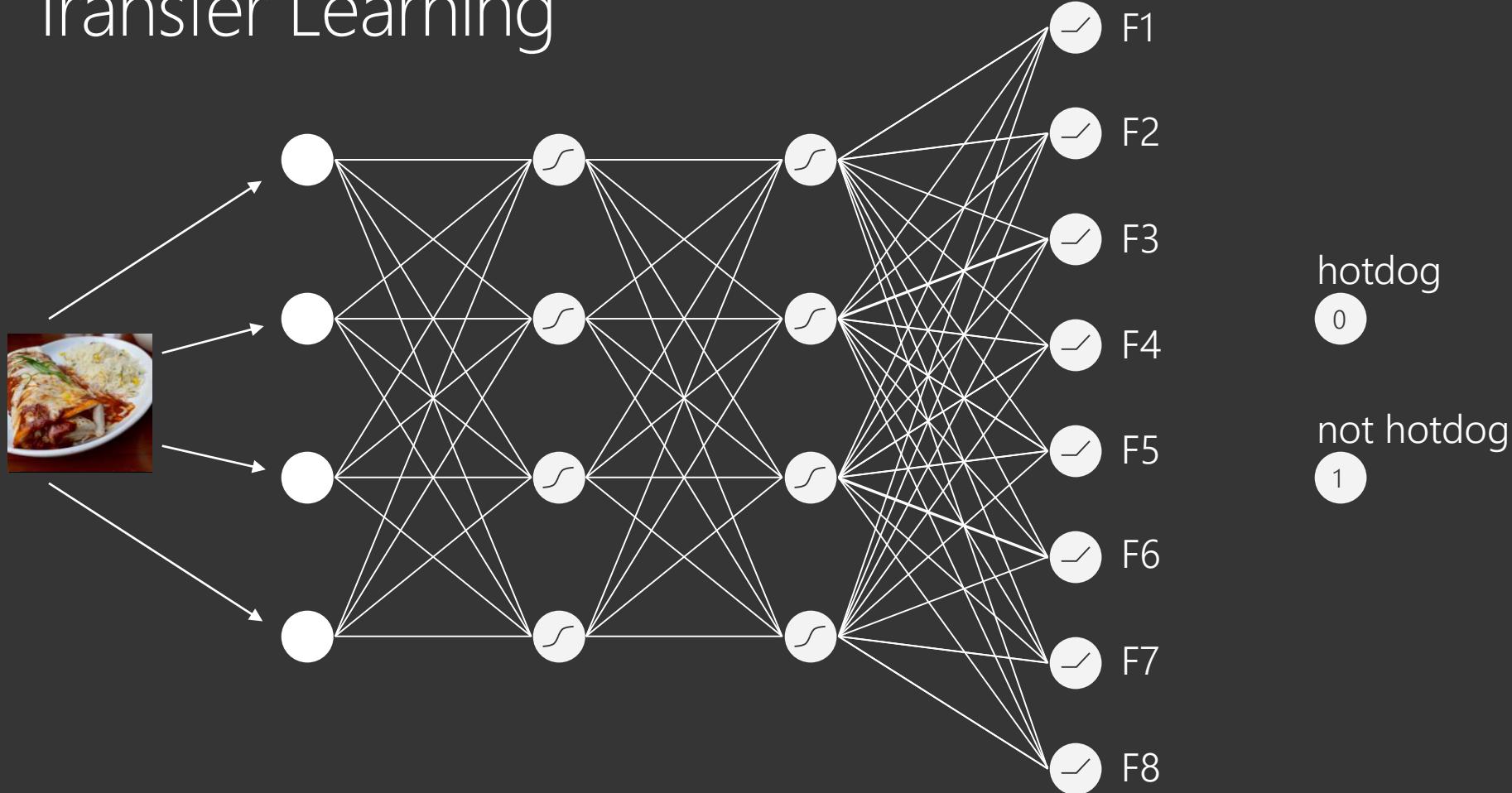
Trained Classifier



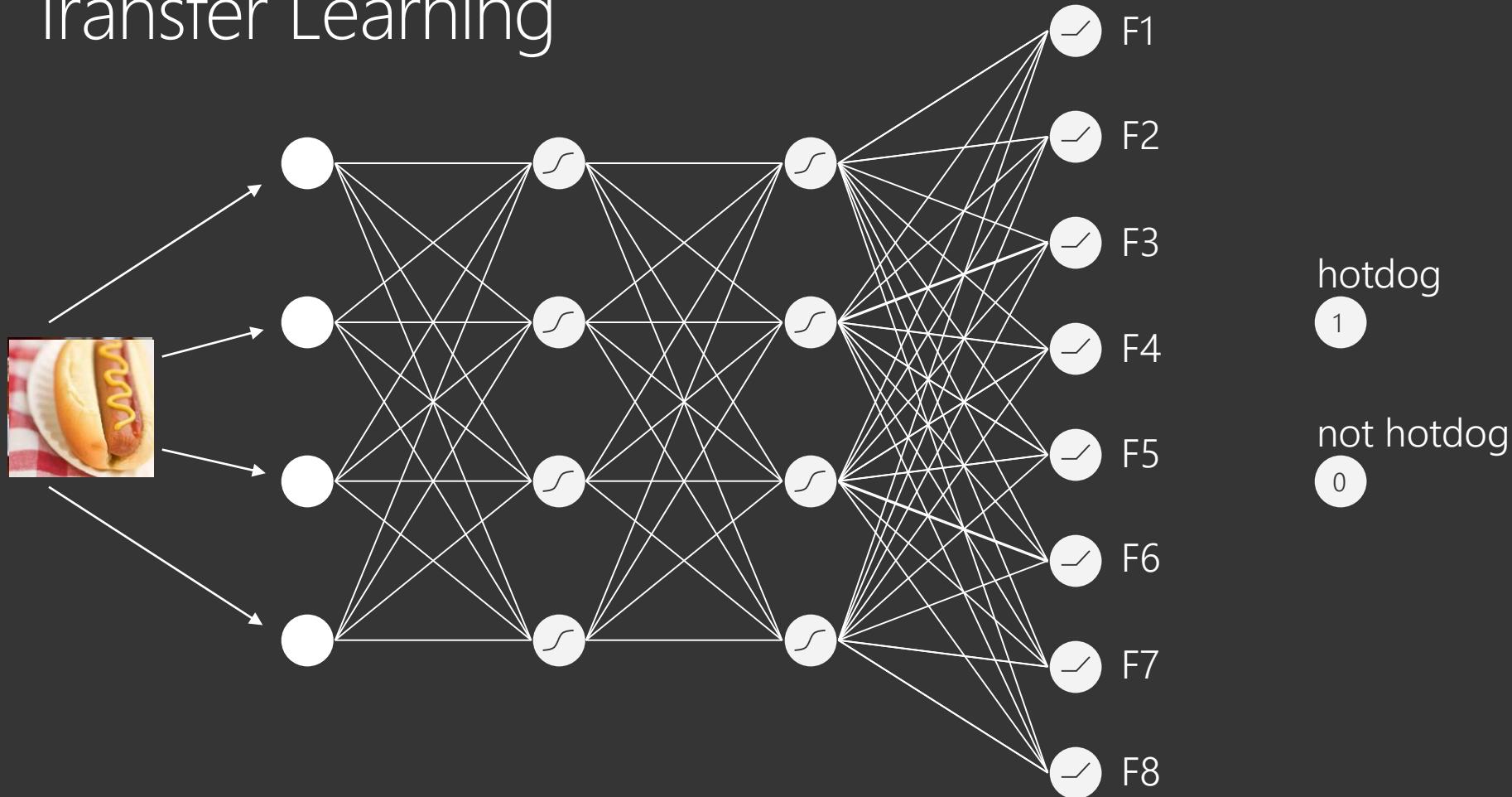
Transfer Learning



Transfer Learning



Transfer Learning



Transfer Learning

3. Custom Vision with R.ipynb



Custom Vision: nohotd X +

https://customvision.ai/projects/31dd2331-9ca0-4428-8660-9662b00de315#/manage

nohotdogapp Training Images Performance Predictions

Filter

Iteration

Workspace

Tags



Tagged

Untagged

Showing: all tagged images

Search for

hotdog 61



nohotdog 78



Select all



1

2

3



Get started

ImageNet Explorer: image-net.org

IMAGENET
14,197,122 images, 21841 synsets indexed

SEARCH Home About Explore Download

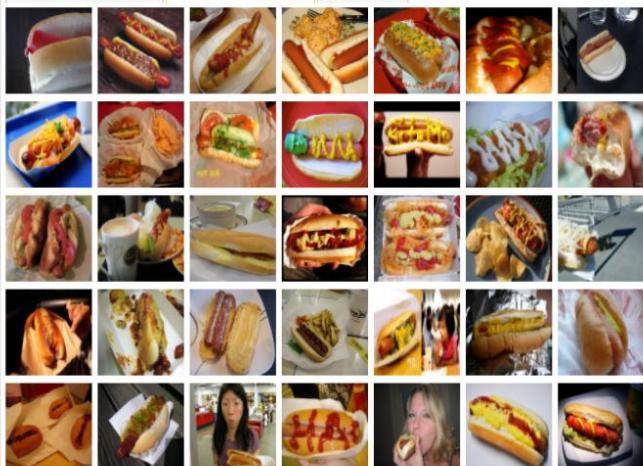
Not logged in. [Login](#) | [Signup](#)

Hotdog, hot dog, red hot
A frankfurter served hot on a bun

1257 pictures 91.27% Popularity Percentile Wordnet IDs

Numbers in brackets: (the number of synsets in the subtree.)

- ImageNet 2011 Fall Release (32326)
 - plant, flora, plant life (4486)
 - geological formation, formation (17)
 - natural object (1112)
 - sport, athletics (176)
 - artifact, object (10504)
 - fungus (308)
 - person, individual, someone, some
 - animal, animate being, beast, brute
 - Misc (20400)
 - julienne, julienne vegetable (0)
 - raw vegetable, rabbit food (0)
 - pulse (0)
 - goa bean (0)
 - kidney bean (0)
 - navy bean, pea bean, white bean (0)
 - pinto bean (0)
 - frijole (0)
 - black bean, turtle bean (0)
 - snap bean, snap (0)
 - string bean (0)
 - Kentucky wonder, Kentucky wond
 - scarlet runner, scarlet runner be
 - haricot vert, haricots verts, Fren
 - green bean (5)
 - wax bean, yellow bean (0)
 - Fordhooks (0)
 - lima bean (1)
 - sieva bean, butter bean, butterf
 - fava bean, broad bean (0)



*Images of children synsets are not included. All images shown are thumbnails. Images may be subject to copyright.

Prev 1 2 3 4 5 6 7 8 9 10 ... 39 40 Next

nohotdogs-good.txt - Notepad

File Edit Format View Help

http://simplyrecipes.com/photos/hamburger.jpg
http://i114.photobucket.com/albums/n272/joninewman/Food%20Porn/Taco
http://farm4.static.flickr.com/3138/3028328486_f7d14e0766.jpg
http://www.openrice.com/UserPhoto/photo/0/R9/005DYL156FD5D9FAE4B5E2
http://farm5.static.flickr.com/4011/4206813414_a805835cc7.jpg
http://farm3.static.flickr.com/2295/1746109294_2c985c71b2.jpg
http://farm3.static.flickr.com/2495/3715666247_4760f495e6.jpg
http://farm1.static.flickr.com/206/512088225_2865c29ca0.jpg
http://farm4.static.flickr.com/3461/3903134870_4e095b4ea2.jpg
http://farm4.static.flickr.com/3538/3522659735_a23d556145.jpg
http://bp2.blogger.com/_miEjNZfTIUs/SD4aY3qXvWI/AAAAAAAAYA/nfJ7wJX
http://farm4.static.flickr.com/3574/3454109844_3de70d4035.jpg
http://farm4.static.flickr.com/3207/2685591809_0f0f405292.jpg
http://shopateatsleep.com/wp-content/uploads/2009/09/fords-hamburger-
http://forums.egullet.org/uploads/1114450278/gallery_2_1139_10935.j
http://farm4.static.flickr.com/3415/3525577412_ab053e4bfd.jpg
http://farm4.static.flickr.com/3252/2977920712_45f3867d2a.jpg
http://farm3.static.flickr.com/2657/4058455181_55ddf3724a.jpg
http://farm4.static.flickr.com/3464/3371511478_18f7588146.jpg
http://www.arturosdinining.com/images/Taco-Salad-018.jpg
http://farm4.static.flickr.com/3073/2850220192_101a6967ce.jpg
http://www.foodgps.com/wp-content/uploads/2009/11/the-best-fish-tac
http://farm2.static.flickr.com/1221/1372506207_b77035e1bc.jpg
http://www.feedyourkids.com/taco.jpg
http://farm1.static.flickr.com/203/535965582_5def97b90d.jpg
http://farm1.static.flickr.com/151/437001889_66eab19f42.jpg
http://farm1.static.flickr.com/42/113681248_ef1cf57f66.jpg
http://farm4.static.flickr.com/3658/3310498478_040725f62e.jpg

Upload images for training

- Download lists of URLs from ImageNet
 - List 1 (2310 URLs): "hotdogs" + "frankfurter buns"
 - List 2 (2569 URLs): "tacos" + "hamburgers"
- Sample 100 URLs from each: **hotdogs**, **nohotdogs**
- Upload to Custom Vision service
 - **cvision_id**: "Custom Vision (preview)" key in Azure

```
uploadURLs(cvision_id, tags["hotdog"], hotdogs)
```

```
uploadURLs(cvision_id, tags["nohotdog"], nohotdogs)
```

"Hotdogs"

flickr



This photo is no longer available



Manually review images at customvision.ai

nohotdogapp

Training Images Performance Predictions Train Quick Test ?

Filter Add images Delete Tag images Unselect all

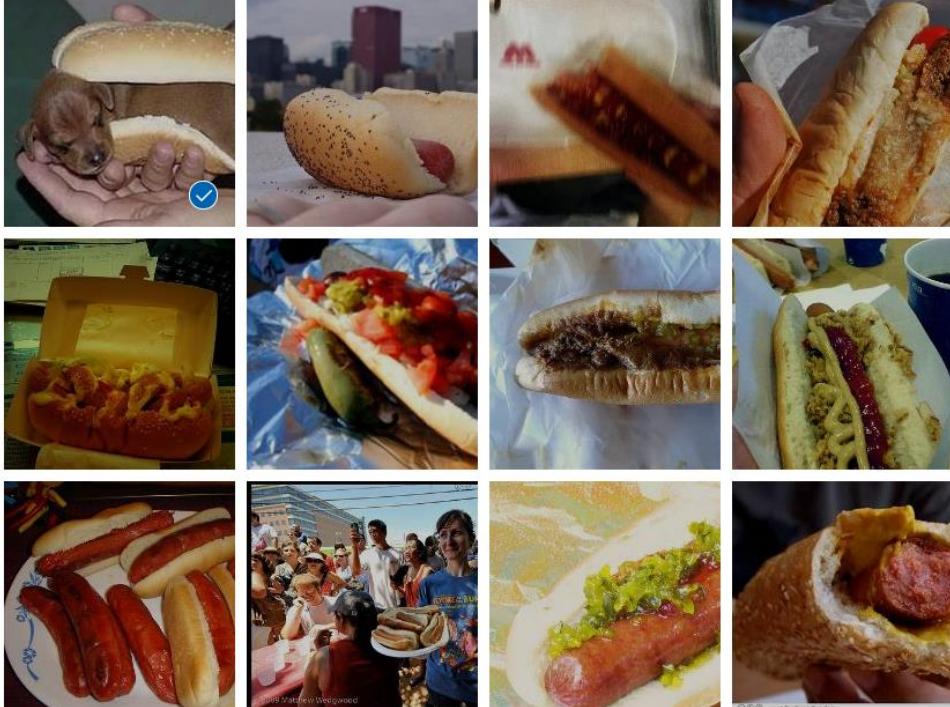
Iteration: Workspace

Tags: Tagged Untagged

Showing: all tagged images

Search for:

hotdog 46 ...
 nohotdog 0 ...



61 Hotdogs



78 Not Hotdogs



Transfer Learning: Training

- With images tagged in Custom Vision Service
- Choose a “domain”: Generic, Food, Landmarks, Retail, Adult
- Train the model

```
library(httr)
APIresponse = POST(url = trainURL, content_type_json(),
                    add_headers(.headers= c('Training-key' = cvision_api_key)),
                    body="", encode="json")

train.id <- content(APIresponse)$Id

## Training is asynchronous. Check until the status is "Completed"
iterStatus(train.id)
```

Inspecting the model: customvision.ai

Iterations Prediction URL Make default Delete Export

Probability Threshold: 70% (0)

Iteration 1

Finished training on 9/7/2018, 10:53:25 AM using Food domain
Classification type: Multilabel (Multiple tags per image)

Precision ⓘ Recall ⓘ

99.1% 87.0%

Performance Per Tag

Tag	Precision	Recall
nohotdog	100.0%	94.9%
hotdog	97.8%	77.1%

Impact of
false positives

Impact of
false negatives

Predicting from the trained model

```
hotdog_predict <- function(imageURL, threshold = 0.5) {  
  predURL <- paste0(cvision_api_endpoint_pred, "/", cvision_id,"/url?",  
                     "iterationId=",train.id,  
                     "&application=R"  
  )  
  
  body.pred <- toJSON(list(Url=imageURL[1]), auto_unbox = TRUE)  
  
  APIresponse = POST(url = predURL,  
                      content_type_json(),  
                      add_headers(.headers= c('Prediction-key' = cvision_pred_key)),  
                      body=body.pred,  
                      encode="json")  
  
  content(APIresponse)$Predictions  
}
```



```
> hotdog_predict("http://www.hot-dog.org/hot-dogs-on-the-grill-sm.jpg")
   hotdog      nohotdog
0.9938008000 0.0004244138
```



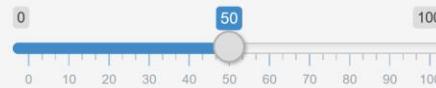
```
> hotdog_predict("https://upload.wikimedia.org/Burrito_with_rice.jpg")
   hotdog  nohotdog
0.1011873 0.7967834
```

Not Hotdog

Image URL

0534b1db25970b01774451bcc0970d-800wi

Identification threshold (%)



Some examples to try

Hotdogs

- Plain hotdog
- Hotdog
- Many hotdogs
- Hotdog sandwich
- Grilled hotdogs

Not Hotdogs

- Naughty dog
- Jam roll
- burrito
- Sausage roll
- Spring roll
- Croissant

Hotdog prediction

Not Hotdog (conf: 0%)



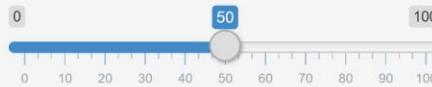
Type here to search

Not Hotdog

Image URL

s/2016/10/Recipe_Hot-dog-sandwich.jpg|X

Identification threshold (%)



Some examples to try

Hotdogs

[Plain hotdog](#)
[Hotdog](#)
[Many hotdogs](#)
[Hotdog sandwich](#)
[Grilled hotdogs](#)

Not Hotdogs

[Naughty dog](#)
[Jam roll](#)
[burrito](#)
[Sausage roll](#)
[Spring roll](#)
[Croissant](#)

Hotdog prediction

Hotdog



Not Hotdog

127.0.0.1:7451/

Not Hotdog

Image URL

`content/uploads/2017/09/Spring-Rolls-6.jpg`

Identification threshold (%)

0 50 100

Some examples to try

Hotdogs

- Plain hotdog
- Hotdog
- Many hotdogs
- Hotdog sandwich
- Grilled hotdogs

Not Hotdogs

- Naughty dog
- Jam roll
- burrito
- Sausage roll
- Spring roll

Hotdog prediction

Hotdog

A close-up photograph of a golden-brown spring roll being dipped into a white bowl filled with a dark, glossy dipping sauce. Another spring roll lies next to the bowl on a light-colored surface.

Type here to search

07:51 11/9/2018

Not Hotdog

127.0.0.1:7451/

Not Hotdog

Image URL

content/uploads/2017/09/Spring-Rolls-6.jpg

Identification threshold (%)

0 60 100

Some examples to try

Hotdogs

- Plain hotdog
- Hotdog
- Many hotdogs
- Hotdog sandwich
- Grilled hotdogs

Not Hotdogs

- Naughty dog
- Jam roll
- burrito
- Sausage roll
- Spring roll

Hotdog prediction

Not Hotdog (conf: 52%)

A close-up photograph of a golden-brown spring roll being dipped into a small white bowl filled with a dark, glossy dipping sauce. Another spring roll is visible in the background, slightly out of focus.

Save API calls with reactive Shiny elements

Custom vision predictions:

- Free tier: Limited to 2 predictions per second
- Paid tier: 0.1¢ per prediction

```
hotPred <- reactive({  
  hotdog_preds(input$url)  
})
```

Summary: Custom Vision

- Building a custom image classifier is easy!
- Relatively few labeled images required
- Training is fast (minutes, not days)
- Predictions via REST API, or via offline export
- Easy to drive from any language
 - we used R and the **httr** package
 - but you could use Python, C#, Java ...

github.com/revodavid/nothotdog

<https://customvision.ai>

David Smith

davidsmi@microsoft.com

@revodavid



Announcing AI for Humanitarian Action

AI for Humanitarian Action leverages AI to support disaster recovery, address the needs of children, protect displaced people, and promote human rights.

► Watch AI in action

AI for Humanitarian Action

Disaster relief

Improve resiliency, response, and recovery programs designed for those affected by humanitarian emergencies.

- Forecast and detect early signs of coming disasters,
- Help responders better target their aid, and
- Engage beneficiaries at time of crisis.



Needs of children

Equip organizations to ensure the safety and wellbeing of children around the world.

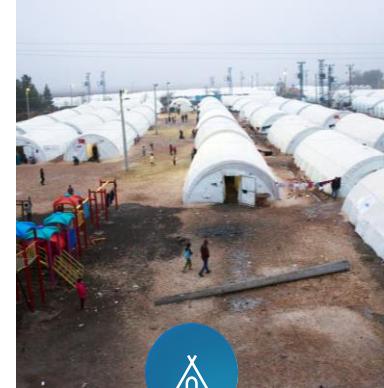
- Identification and support services
- Provision of basic health and nutritional services
- Enhancement of educational opportunities



Protecting refugees & displaced people

Optimize the delivery of aid, supplies and services to refugees and displaced persons as well as scale an organization's ability to communicate and understand needs.

- Livelihoods support
- Family reunification
- Monitoring and detection of needs



Promoting respect for human rights

Accelerate breakthrough solutions to help monitor, detect and prevent human rights abuses.

- Human trafficking
- War crimes identification
- Right to fair trial



Disaster Search and Rescue: AirSim

TOD 09:20:07:15
GPS 41.642029-100.128409

DEBRIS

TOD 09:20:07:15
GPS 41.642029-100.128409

DEBRIS

ITEM ID TK235

ITEM ID TK457

TOD 09:20:07:15
GPS 41.642029-100.128409

DEBRIS

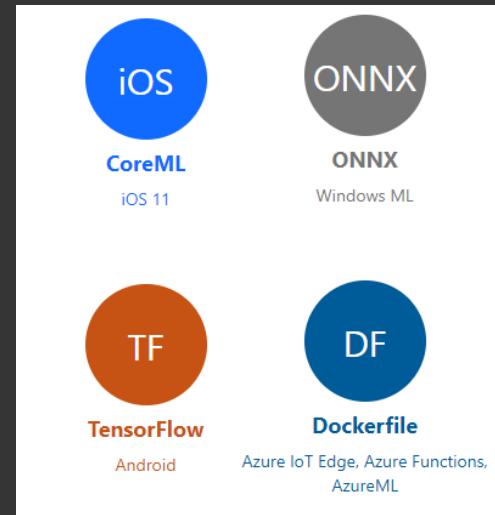




Building Apps w/ Custom Vision

Offline classification

- Export to CoreML, Tensorflow, ONNX or Dockerfile
- Fast, no internet roundtrip required
- Limited to “compact”



Online classification

- REST API

If you have an image URL:

```
https://southcentralus.api.cognitive.microsoft.com/customvision/v2.0/Prediction/c1:
```

Set `Prediction-Key` Header to : [REDACTED]

Set `Content-Type` Header to : `application/json`

Set Body to : `{"Url": "https://example.com/image.png"}`

If you have an image file:

```
https://southcentralus.api.cognitive.microsoft.com/customvision/v2.0/Prediction/c1:
```

Set `Prediction-Key` Header to : [REDACTED]

Set `Content-Type` Header to : `application/octet-stream`

Set Body to : <image file>



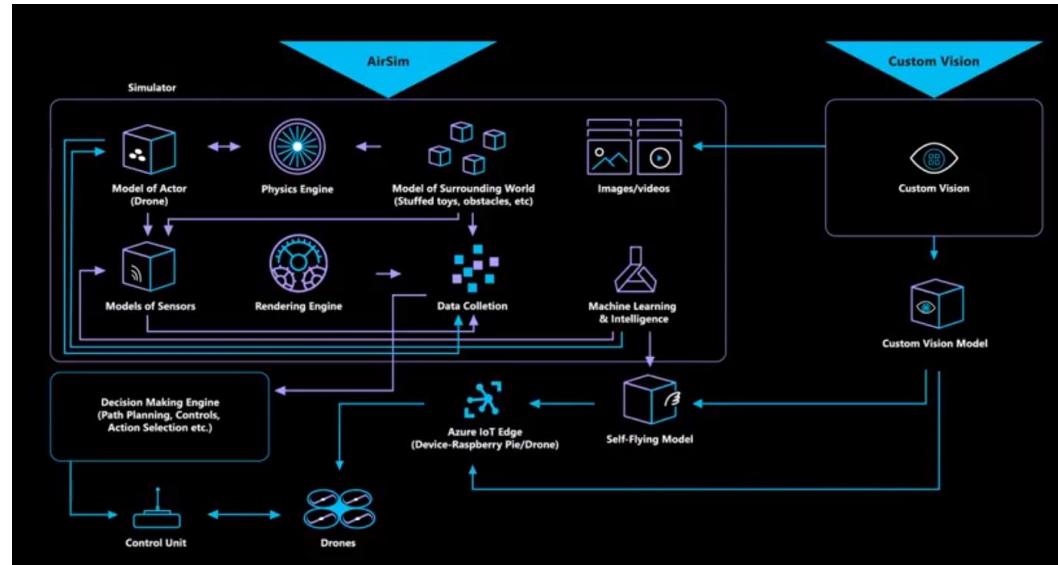
Drones: Search and Rescue training with AirSim

Goal: train AI-powered drones to recognize targets for search-and-rescue.

Train recognizer using real objects in controlled environment with Custom Vision.

Simulate training data for drone control with AirSim (simulator based on Unreal).

<https://github.com/Microsoft/AirSim>



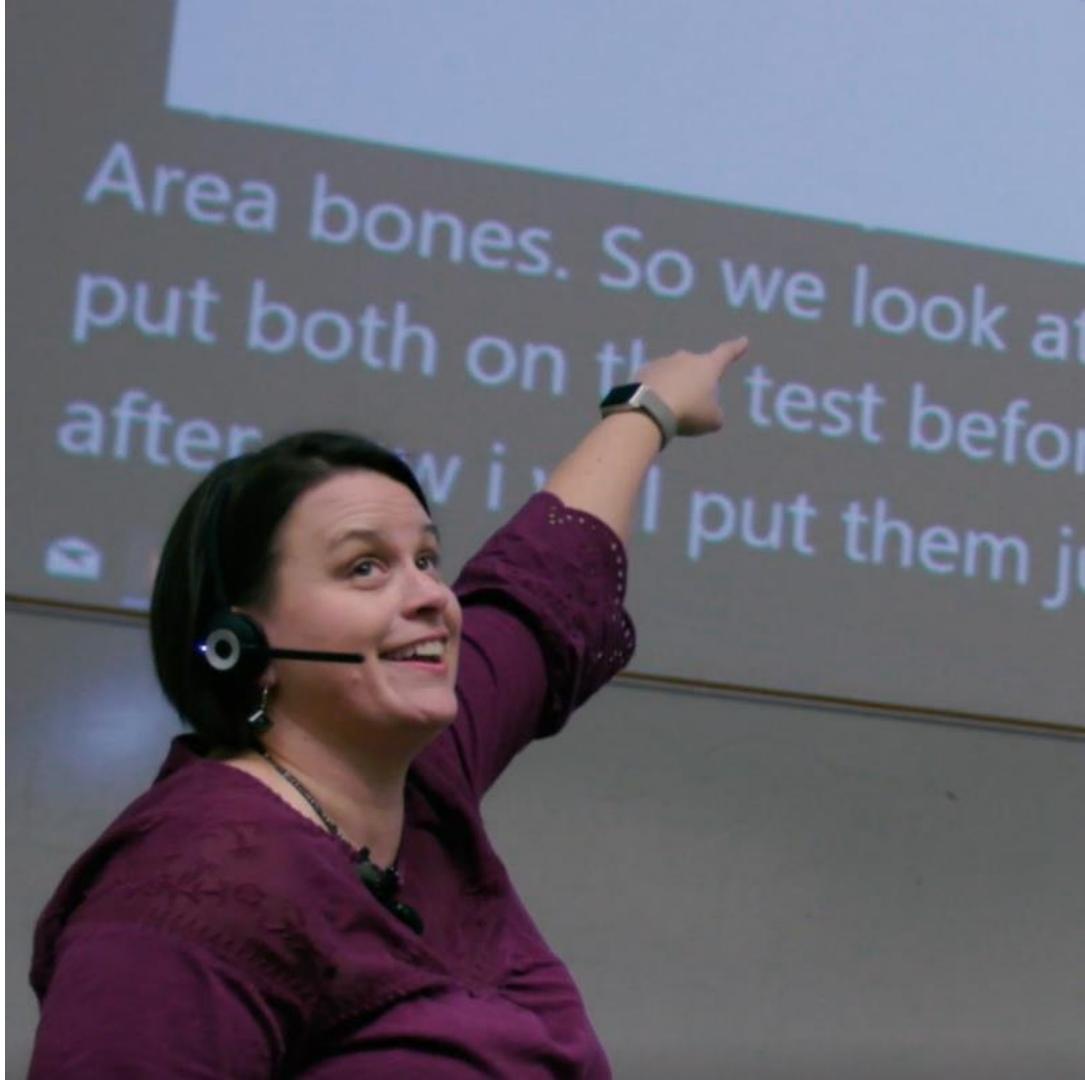
Custom Speech

Microsoft Translator

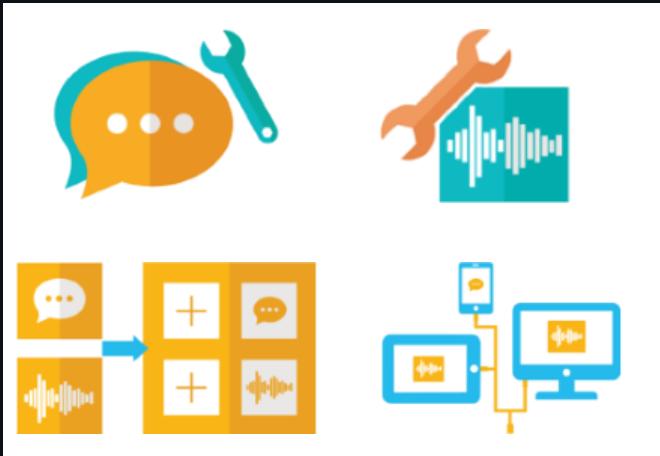
Breaking the language barrier
at home, at work, anywhere.

Translated conversations
across devices, for
one-on-one chats and for
larger group interactions.

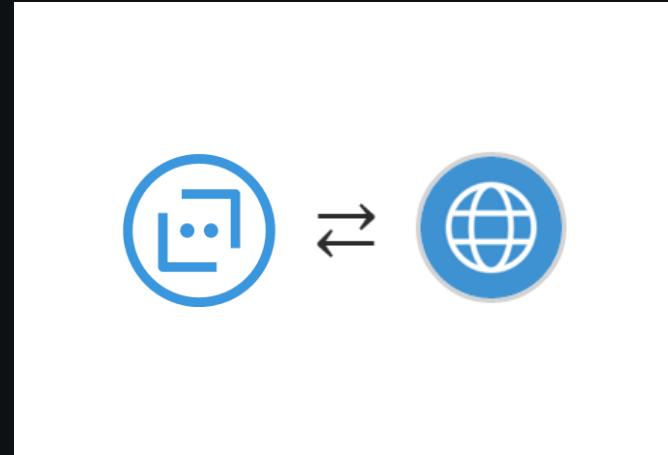
Designed for one audience,
built for many.



Microsoft translator and custom speech



Custom Speech Model



Microsoft Translator



Presentation Translator demo: deaf voice adapted English- Chinese real-time speech translation

Brian Trager

Associate Director, Center on Access Technology
Assistant Professor, Information & Computing Studies
Rochester Institute of Technology
National Technical Institute for the Deaf
www.ntid.rit.edu



We collaborated with Microsoft and started using presentation translator last September.

www.translate.it/JQPXD



Harry

Yes.

We've just seen exciting results in the video.

Brian

One half.

and the very, well, we focused on non deaf

Part 3

BESPOKE AI

The AI Journey

Pre-Trained AI



Cognitive Services
Developer APIs

Data for inference

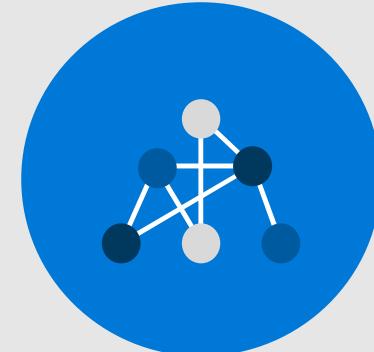
Enhanced AI



Pre-Trained models
Transfer Learning

Some training data

Bespoke AI



Developer Tools
Frameworks

Extensive training data

When pre-trained AI doesn't cut it

- Problem: specialized applications
 - New types of data
- Data: AI application lifecycle
 - Re-train to solve problems (data as code)
- Execution: real-world limitations
 - Latency / internet connectivity (on-device)
 - Devices (restrictions/benefits of hosting hardware)

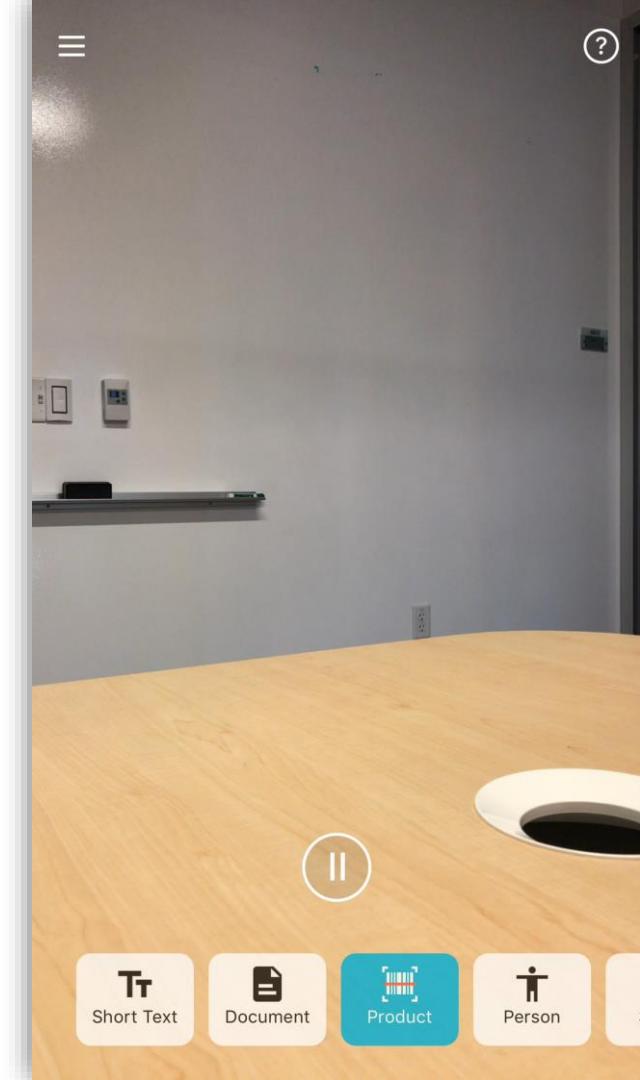


Barcode recognition from Seeing AI

Aim : Help blind users identify products using barcode

Issue : Blind users don't know where the barcode is

Live	Guide user in finding a barcode with audio cues
With Server	Decode barcode to identify product
Tech	MPSCNN running on coreML + barcode library
Metrics	40 FPS (~25 ms) on iPhone 7

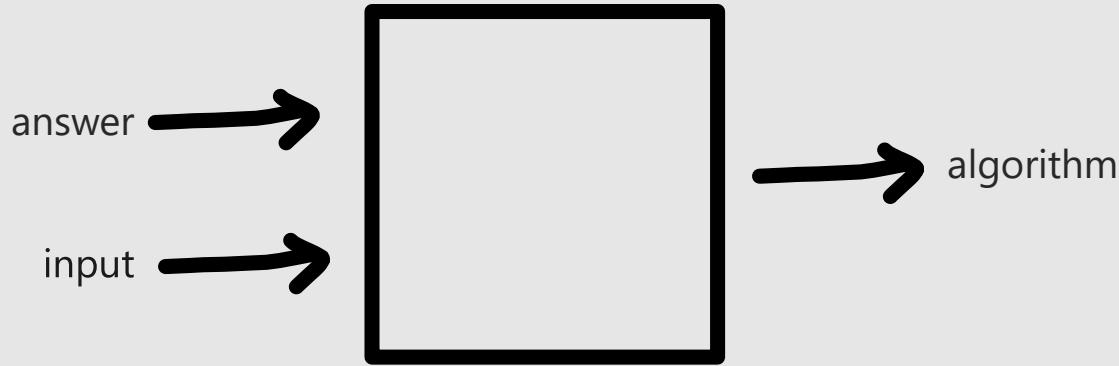


some thoughts on machine learning

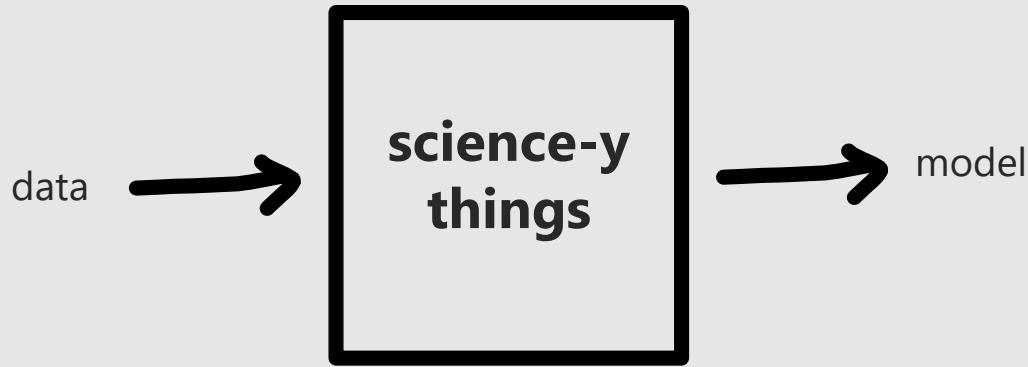
programming



machine learning



machine learning



ML and Deep Learning Frameworks

Open Source Toolkits



TensorFlow



PyTorch



Scikit-Learn



MXNet

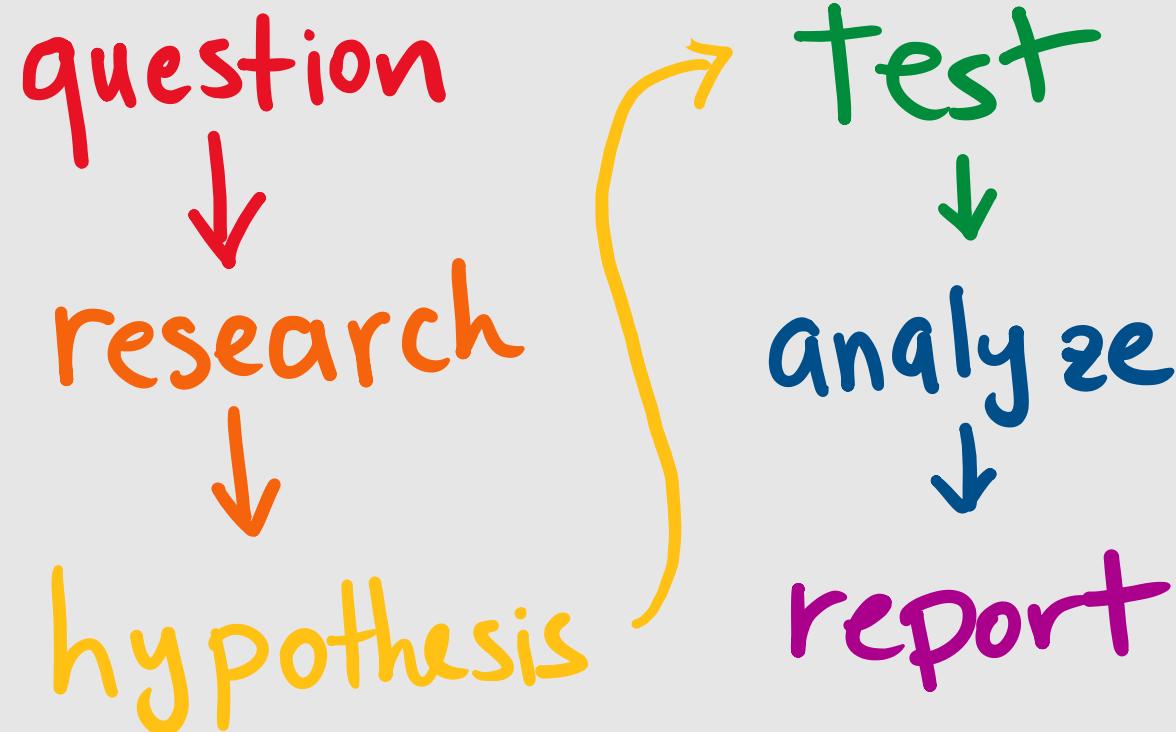


Chainer



Keras

science



science

question



research



hypothesis



Test



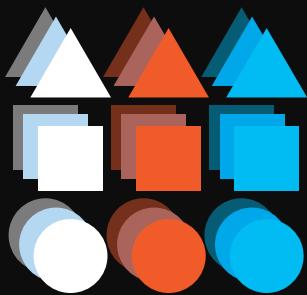
analyze



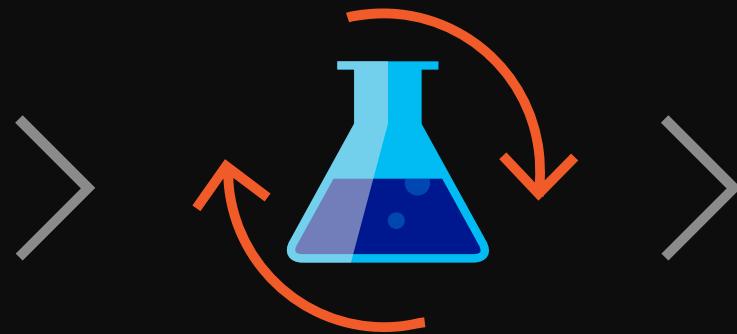
report

Bespoke AI

Creating your own AI applications from scratch



Prepare Data



Build & Train



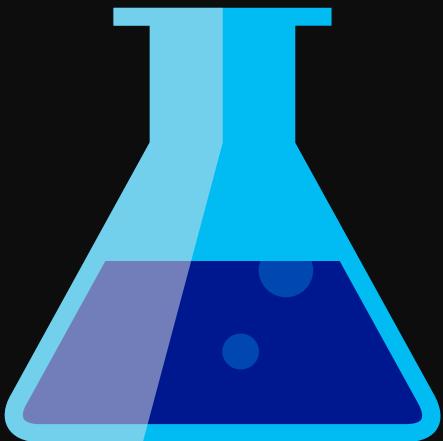
Deploy

working with others



NEW!

Azure Machine Learning Services



Build and Deploy Custom ML

Simplify ML with automated machine learning

Identify suitable algorithms and hyper-parameters faster

Increase productivity with DevOps for machine learning

Integrated CI/CD, ML pipelines, model management

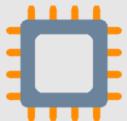
Tool agnostic Python SDK

Use your favorite Python environment and ML framework

the team workspace - logical



Workspace



compute



models



experiments



images



data stores



deployment

the team workspace - physical



workspace



storage



container
registry



key vault



application
insights

Prepare

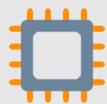


Prepare Data

Experiment



Build model
(your favorite
IDE)



Train & Test
Model



Register and
Manage Model



Build Image



Deploy
Service
Monitor
Model



Part 3

TRAINING AND TESTING MODELS

Let's start with a simple problem: MNIST

OBJECTIVE

- Identify handwritten digits as numbers

TRAINING DATA

- MNIST handwritten digits database
- 60,000 examples of handwritten digits
- 28x28 pixel grayscale images, with labels 0-9 for actual digit
- Collected by the US National Institute of Standards and Technology

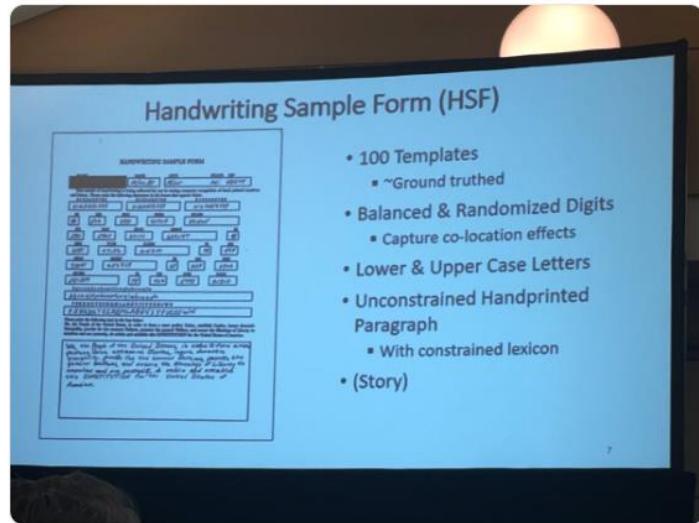
The MNIST dataset



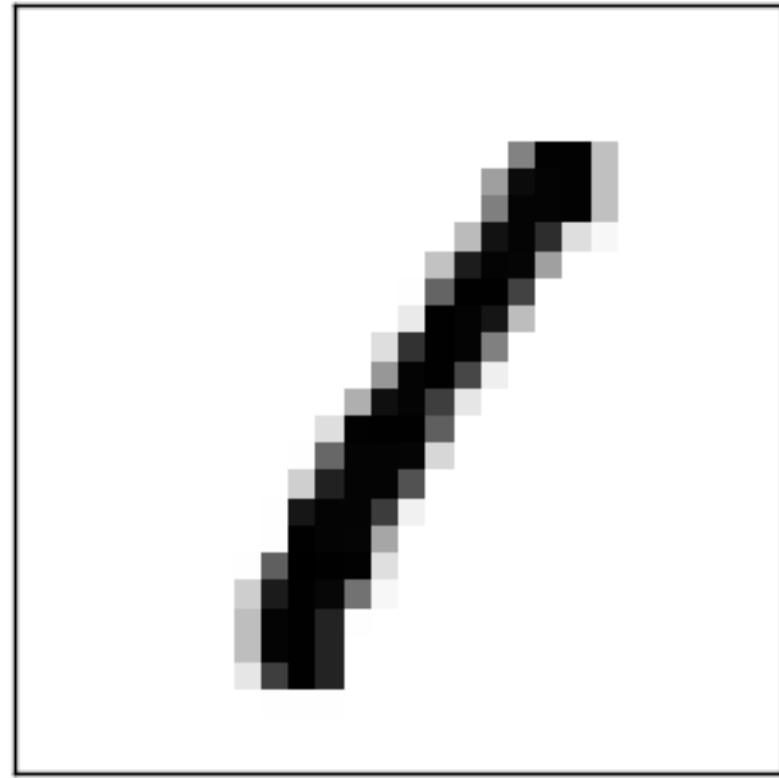
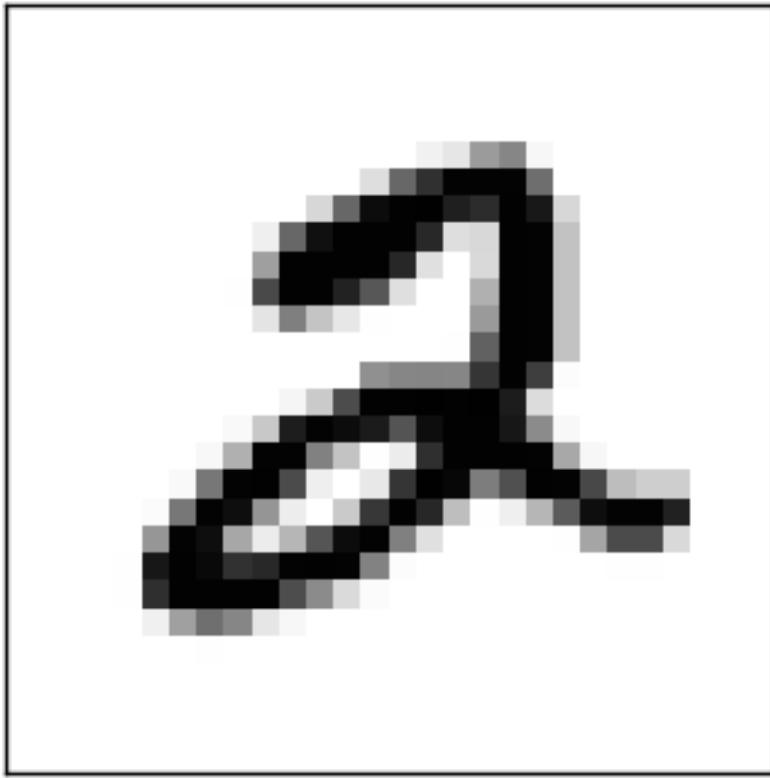
[David Smith](#)

@revodavid

Source of the original MNIST data: this form, completed by census workers across the US. Great history lesson from Michael Garris at [#rstatsdc](#)



1:37 PM - 9 Nov 2018





/Docs alert

Tutorial: Train a model with the MNIST data

<https://cda.ms/K6>

Azure / Machine Learning / Service

Feedback Edit Share Dark Sign in

Filter by title

Azure Machine Learning Documentation (Preview)

Overview

- What is Azure Machine Learning service?
- How the service works
- What's happening to Workbench?

Quickstarts

Tutorials

Train models: Part 1

Deploy models: Part 2

Train automated ML models

Samples

Download PDF

Tutorial #1: Train an image classification model with Azure Machine Learning service

11/20/2018 • 13 minutes to read • Contributors  all

In this tutorial, you train a machine learning model both locally and on remote compute resources. You'll use the training and deployment workflow for Azure Machine Learning service (preview) in a Python Jupyter notebook. You can then use the notebook as a template to train your own machine learning model with your own data. This tutorial is part one of a two-part tutorial series.

This tutorial trains a simple logistic regression using the [MNIST](#) dataset and [scikit-learn](#) with Azure Machine Learning service. MNIST is a popular dataset consisting of 70,000 grayscale images. Each image is a handwritten digit of 28x28 pixels, representing a number from 0 to 9. The goal is to create a multi-class classifier to identify the digit a given image represents.

Learn how to:

- ✓ Set up your development environment
- ✓ Access and examine the data
- ✓ Train a simple logistic regression locally using the popular scikit-learn machine learning library

In this article

- Get the notebook
- Set up your development environment
- Explore data
- Train a local model
- Train on a remote cluster
- Monitor a remote run
- Register model
- Clean up resources
- Next steps

Experimentation

- Leverage service side capture of run metrics, output logs and models
- Use leaderboards, side by side run comparison and model selection
- Manage training jobs locally, scaled-up or scaled-out
- Run distributed TensorFlow, PyTorch or MPI training jobs
- Conduct a hyperparameter search on traditional ML or DNN
- Use your favorite IDEs, editors, notebooks, and frameworks

USE ANY FRAMEWORK OR LIBRARY



USE ANY TOOL



USE THE MOST POPULAR INNOVATIONS

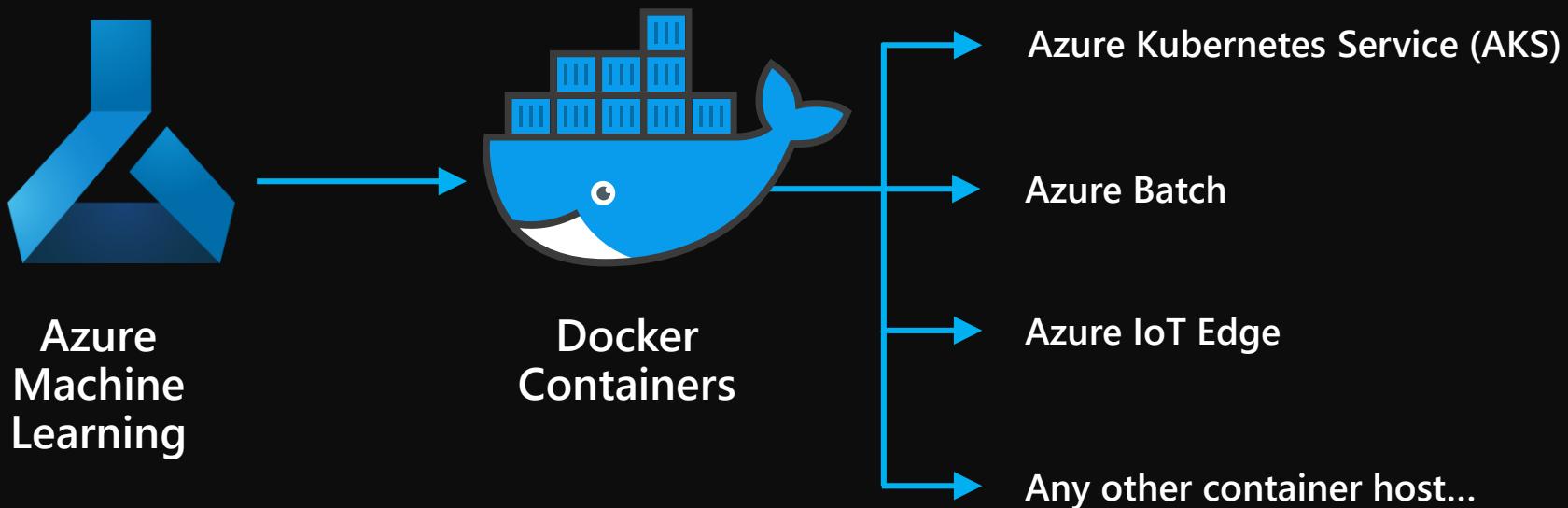


Training Models

4. MNIST with scikit-learn/
01. train-models.ipynb



Deploying your own AI models

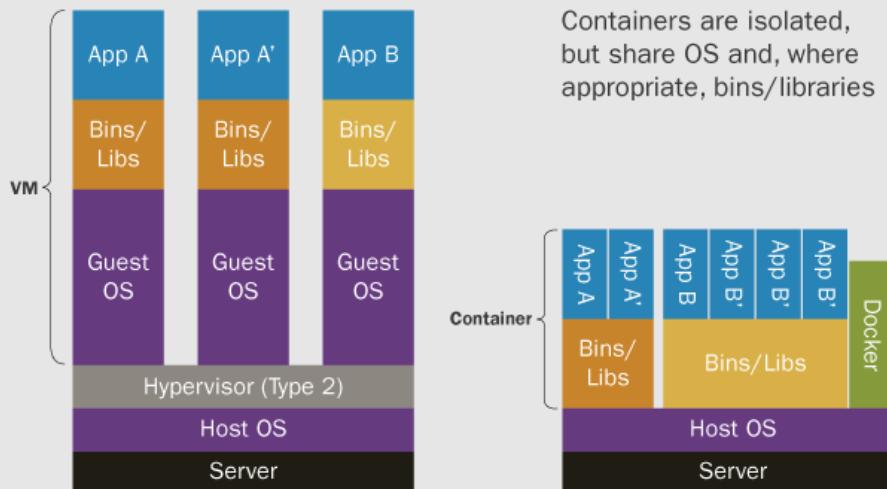


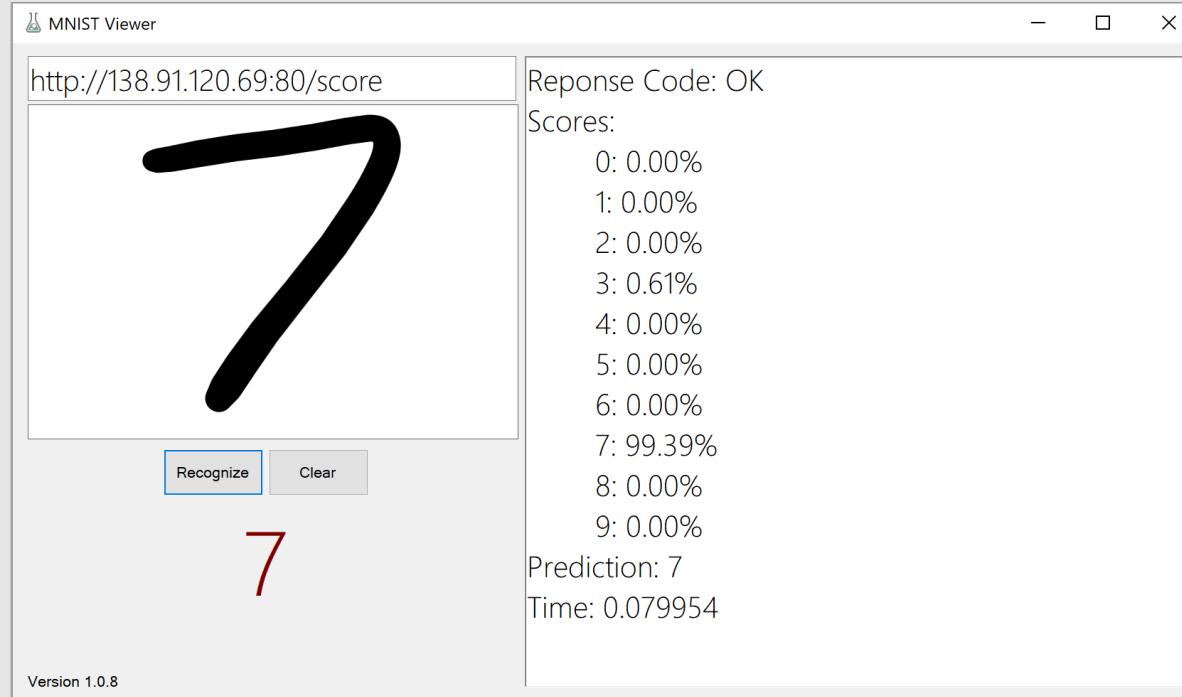
Containers

Like lightweight Virtual Machines:

- Fast to build
- Fast to launch
- Easy to share
- Reproducible
- Moddable
- Designed to deploy a service
- Run 1: Container Instances
- Run 1000: Kubernetes Service

Containers vs. VMs





github.com/sethjuarez/MNISTViewer

Deploying Models

Preview

4. MNIST with scikit-learn/
02. deploy-models.ipynb

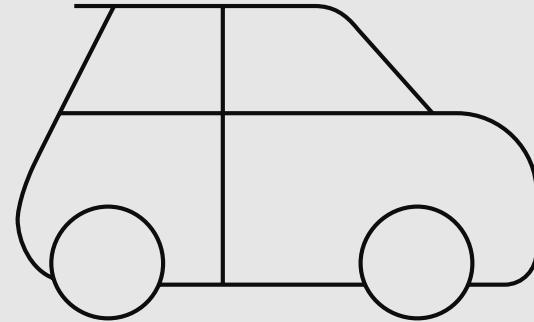


Part 3

AUTOMATED MACHINE LEARNING

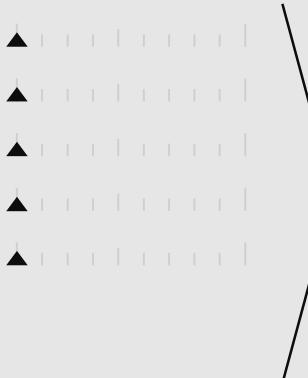
Azure Machine Learning

Automated machine learning



How much is this car worth?

Model creation is typically a time consuming process

Which features?	Which algorithm?	Which parameters?	
Mileage	Gradient Boosted	Parameter 1	
Condition	Nearest Neighbors	Parameter 2	
Car brand	SVM	Parameter 3 Split	
Year of make	Bayesian Regression	Parameter 4 Leaf	
Regulations	LGBM	Others	
...	...		

30%
Model

Model creation is typically a time consuming process

Which features?

Mileage
Condition
Car brand
Year of make
Regulations
...

Which algorithm?

Gradient Boosted
Nearest Neighbors
SVM
Bayesian Regression
LGBM
...

Which parameters?

Neighbors
Weights
Min Samples Split
Min Samples Leaf
Others

30%
Model



Iterate

Model creation is typically a time consuming process

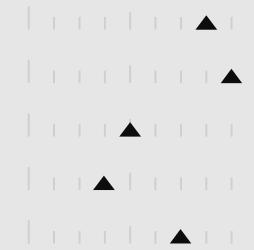
Which features?



Which algorithm?



Which parameters?



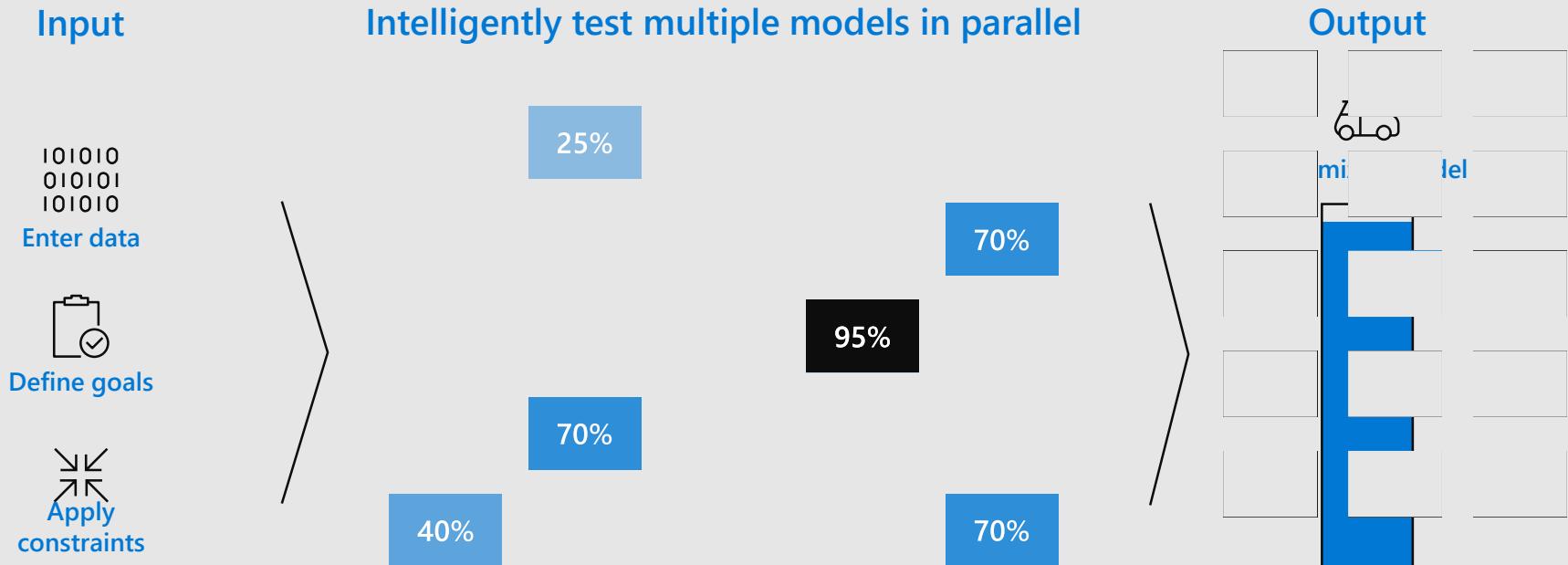
30%

15%

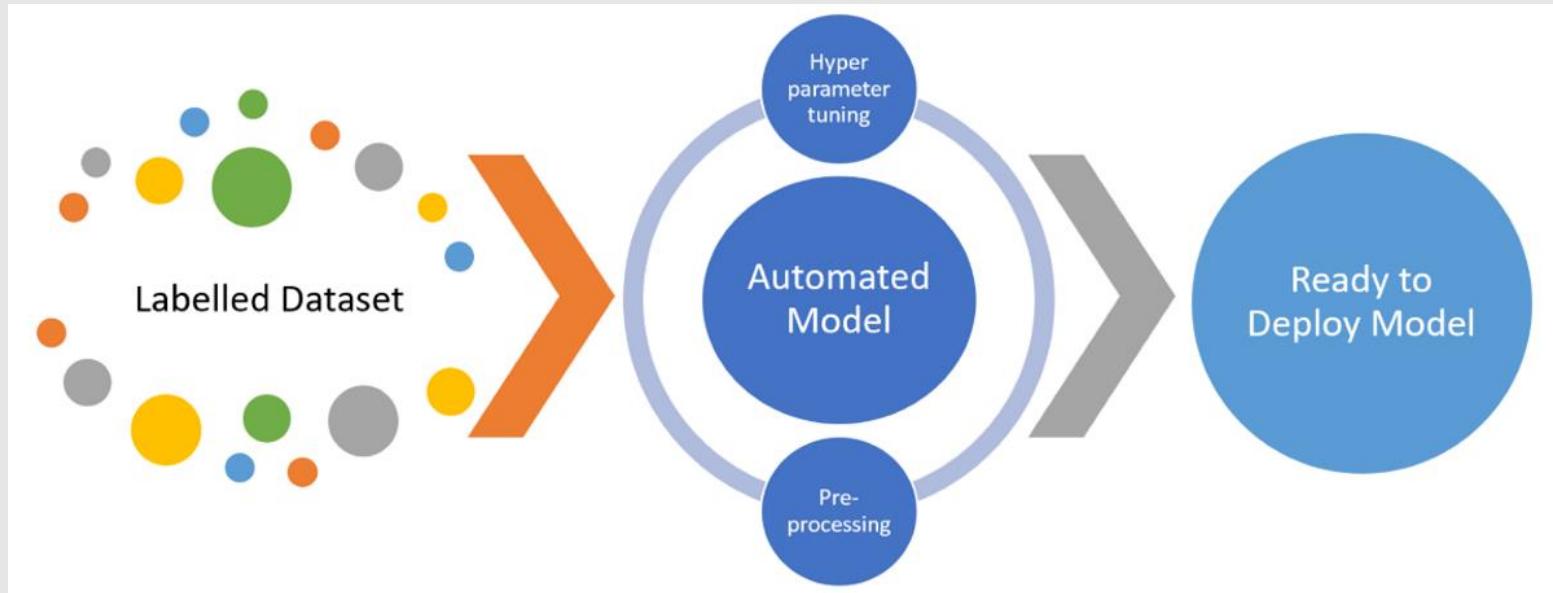


Iterate

Automated Machine Learning accelerates model development



Automatic Machine Learning



Training Models

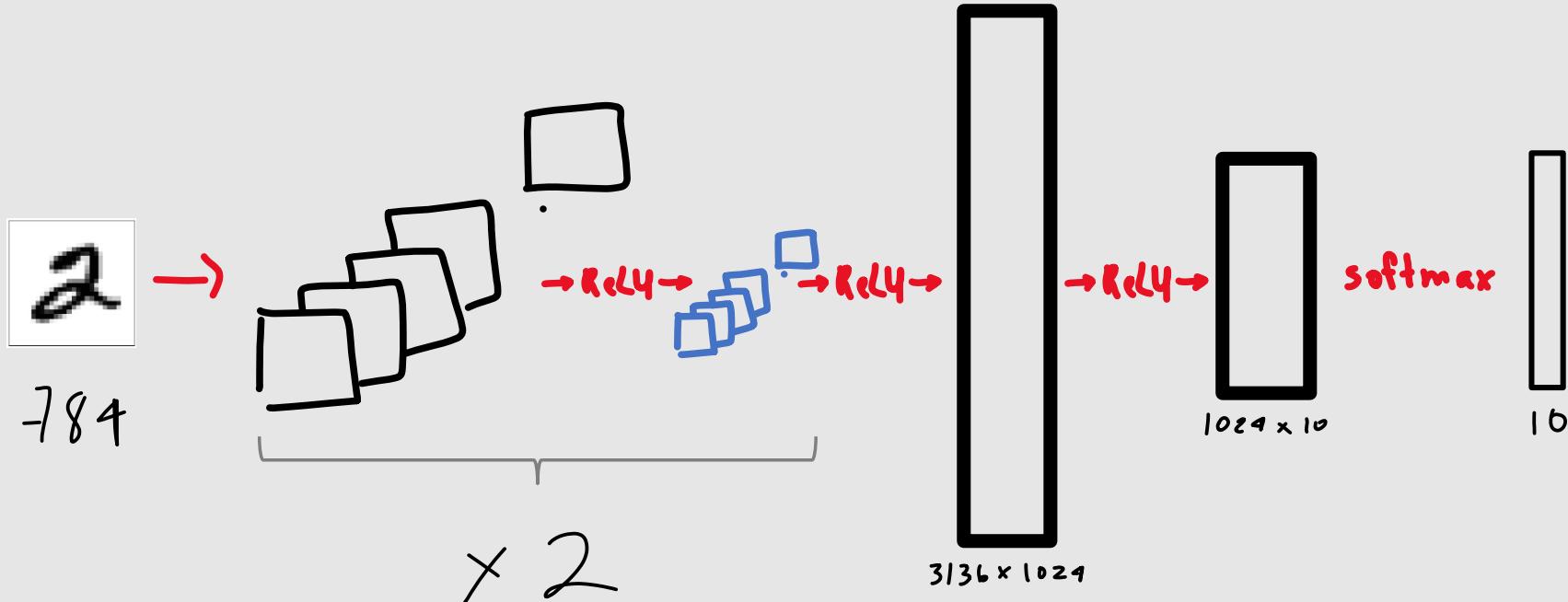
4. MNIST with scikit-learn/
03.auto-train-models.ipynb



Part 3

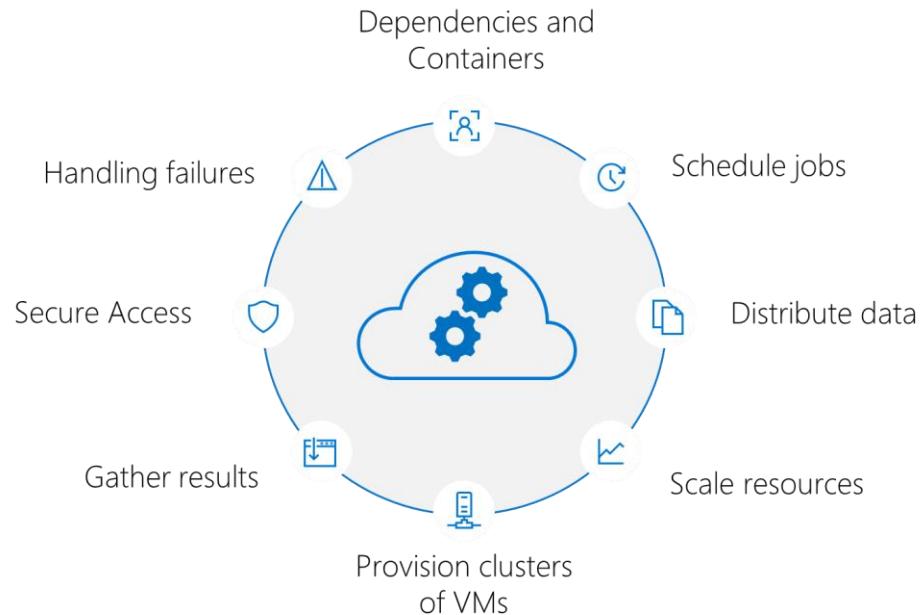
OPTIMIZING DEEP LEARNING WITH HYPERDRIVE

CNN: 2 dense layers



Training Infrastructure

- Do distributed training at cloud scale using a framework of choice
- Leverage system managed Azure Machine Learning Compute or bring your own compute (VM, Databricks/HDI cluster)
- Manage resources across subscription and share them within a workspace
- Autoscale resources to only pay while running a job
- Use the latest NDv2 series VMs with the NVIDIA V100 GPUs



optimizing machine learning

- hyperparameter optimization

```
if __name__ == "__main__":
    parser = argparse.ArgumentParser(description='CNN Training for Image Recognition.')
    parser.add_argument('-d', '--data', help='directory to training and test data', default='data')
    parser.add_argument('-e', '--epochs', help='number of epochs', default=10, type=int)
    parser.add_argument('-b', '--batch', help='batch size', default=100, type=int)
    parser.add_argument('-l', '--lr', help='learning rate', default=0.001, type=float)
    parser.add_argument('-g', '--logs', help='log directory', default='logs')
    parser.add_argument('-o', '--outputs', help='output directory', default='outputs')
    args = parser.parse_args()
```

optimizing machine learning

- hyperparameter optimization

```
if __name__ == "__main__":
    parser = argparse.ArgumentParser(description='CNN Training for Image Recognition.')
    parser.add_argument('-d', '--data', help='directory to training and test data', default='data')
    parser.add_argument('-e', '--epochs', help='number of epochs', default=10, type=int)
    parser.add_argument('-b', '--batch', help='batch size', default=100, type=int)
    parser.add_argument('-l', '--lr', help='learning rate', default=0.001, type=float)
    parser.add_argument('-g', '--logs', help='log directory', default='logs')
    parser.add_argument('-o', '--outputs', help='output directory', default='outputs')
    args = parser.parse_args()
```

automatic machine learning

```
def linear_model(x):
    with tf.name_scope("Model"):
        pred = tf.layers.dense(inputs=x, units=10,
                               activation=tf.nn.softmax)
    return tf.identity(pred, name="prediction")
```

Optimizing Tensorflow

5. MNIST Tensorflow



Part 3

DEPLOYING DEEP LEARNING FOR PRODUCTION

Prepare

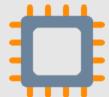


Prepare Data

Experiment



Build model
(your favorite
IDE)



Train & Test
Model

Register and
Manage Model

Deploy



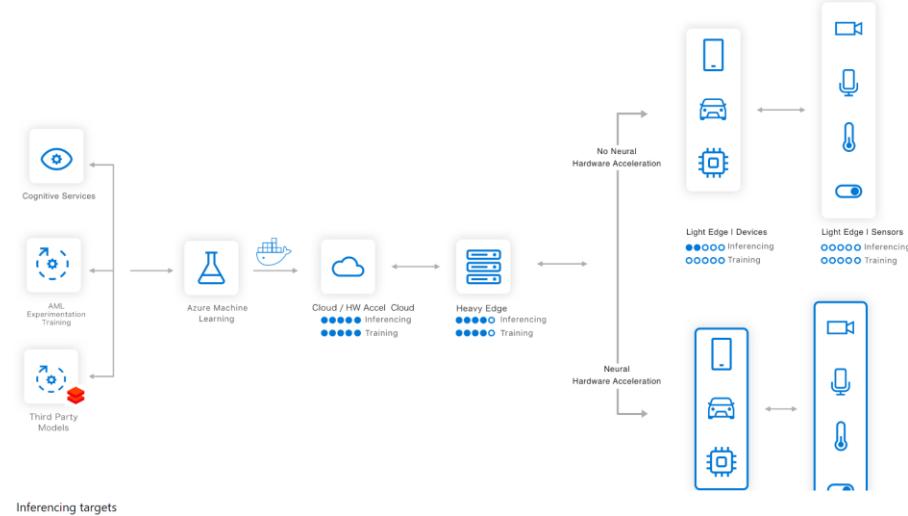
Build Image



Deploy Service
Monitor Model

Model management and deployment

- Manage and track model versions with a central model registry
- Deploy models to Azure Kubernetes service with automatic scaling capability
- Container-based hosting for improved time to market
- Deploy models to the cloud, on-premises, to IoT edge and to FPGAs
- Management and monitoring of deployments through Azure AppInsights
- Enable DevOps with full CI/CD integration with VSTS
- Automatically optimize models to take advantage of new hardware accelerators in edge devices



The Problem

- A hardware retailer needs to monitor store shelves to make sure they are stocked correctly
 - Are the right products on the shelf?
 - Are they in the right place?
- We have developed a computer vision system to:
 - Observe a store shelf
 - Detect stock objects and their locations
 - Confirm the right products are stocked and in the right places
- In this session, we'll show how to deploy it as an application





2051.jpg



2053.jpg



2054.jpg



2057.jpg



2059.jpg



2061.jpg



2062.jpg



2063.jpg



2064.jpg



2065.jpg



2066.jpg



2067.jpg



2070.jpg



2071.jpg



2072.jpg



2075.jpg



2076.jpg



2078.jpg



2081.jpg



2082.jpg



2085.jpg



2086.jpg



2088.jpg



2090.jpg



2094.jpg



2095.jpg



2097.jpg



2099.jpg



2100.jpg



2101.jpg



2102.jpg



2104.jpg



2105.jpg



2110.jpg



2111.jpg



2113.jpg



2115.jpg



2116.jpg



2117.jpg



2118.jpg



2119.jpg



2120.jpg



2121.jpg



2123.jpg



2124.jpg



2125.jpg



2126.jpg



2127.jpg



2129.jpg



2130.jpg



2131.jpg



2132.jpg



2133.jpg



2134.jpg



2135.jpg



2136.jpg



2137.jpg



2138.jpg



2139.jpg



2141.jpg



2143.jpg



2144.jpg



2146.jpg



2148.jpg



2149.jpg



2150.jpg



2151.jpg



2152.jpg



2153.jpg



2154.jpg



2155.jpg



2157.jpg



/Learn alert

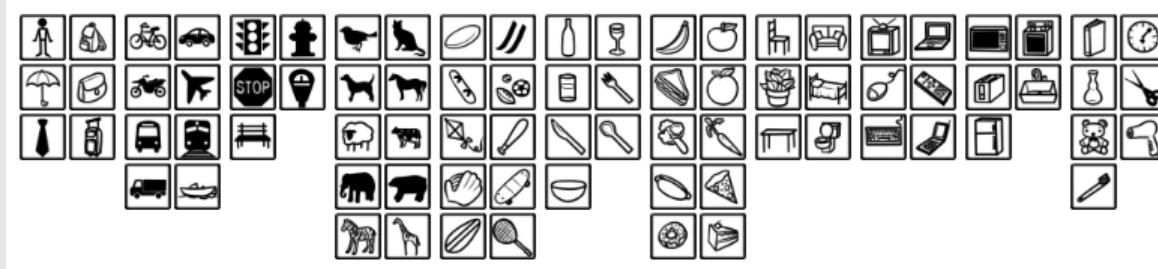
Interactive deep learning with Jupyter,
Docker and PyTorch

<https://aka.ms/AA3dxsc>

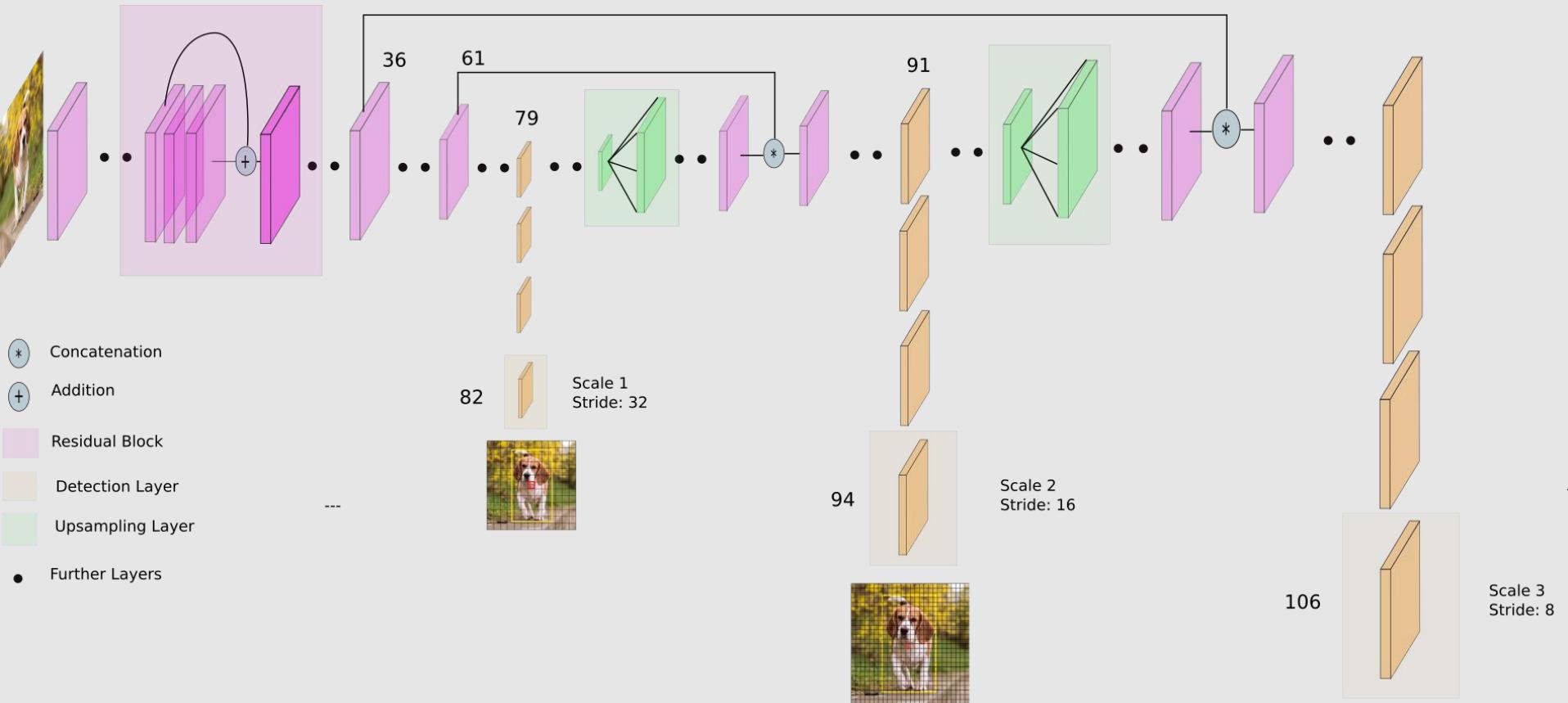
The screenshot shows the Microsoft Learn homepage. At the top, there's a navigation bar with the Microsoft logo, 'Learn', 'Azure', 'Business Applications', 'About', 'Browse All', 'Certifications', 'All Microsoft', and a search bar. Below the navigation is a breadcrumb trail 'Docs / Learn'. On the left, there's a sidebar with a 'WELCOME TO Microsoft Learn' section, 'Introducing a new approach to learning', and a message about earning points, levels, and achievements. It also mentions 'More coming soon!' and features icons for AI, ML, and data. In the center, there's a large 'Introduction to Azure' module card with a 'Start learning for free' button. At the bottom, there are three tabs: 'Learning paths', 'Hands-on learning', and 'Learn for free'. To the right, there's a 'Start a learning path' section with a dropdown menu 'Select your role'. Below that is a 'Learn Azure' section with a link to 'Explore more advanced Azure topics with online courses'. A decorative graphic of interconnected icons representing various Microsoft services like Azure, Power BI, and SharePoint is positioned on the right side.

YOLO: You Only Look Once

- For the shelf vision problem, we used YOLO v3
 - By Joseph Redmon: <https://pjreddie.com/darknet/yolo/>
 - Detects a fixed set of object types and their location in an image
- Trained on the COCO dataset: cocodataset.org



- PyTorch code and data (Erik Linder-Norén):
 - github.com/eriklindernoren/PyTorch-YOLOv3



YOLOv3: An Incremental Improvement

Joseph Redmon & Ali Farhadi

pjreddie.com/media/files/papers/YOLOv3.pdf

register model



Register folder as YOLOv3 model

```
model_file = './model'  
m = Model.register(ws, model_name='YOLOv3', model_path=model_file)  
m
```

```
Registering model YOLOv3  
<azureml.core.model.Model at 0x1a33aaaf7710>
```

```
print(m.name, m.id, m.version, sep='\n')
```

```
YOLOv3  
YOLOv3:5  
5
```

register model



YOLOv3

[Back to Models](#)  Delete

[Details](#) [Deployments](#)

ATTRIBUTES

Version 5

ID YOLOv3:5

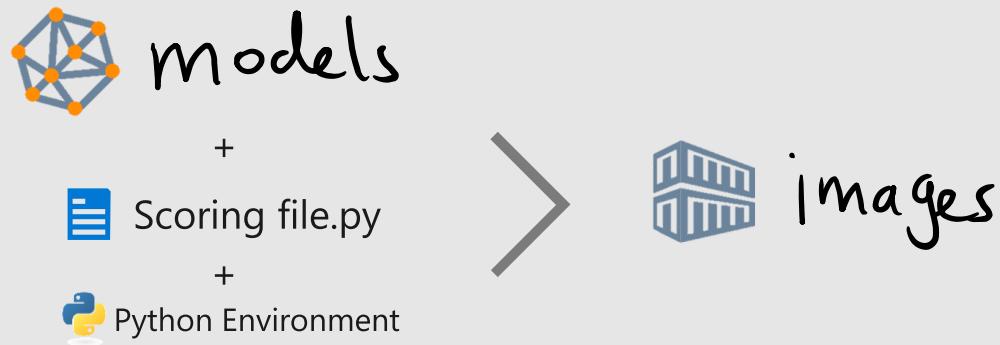
Date Registered 11/21/2018, 7:40:53 AM UTC

Location 

Description

Tags

Create images



Scoring File

```
1 import os
2 import json
3 import time
4 import torch
5 import requests
6 import datetime
7 import numpy as np
8 from PIL import Image
9 from models import *
You, 13 days ago
10 from io import BytesIO
11 from torch.autograd import Variable
12 from skimage.transform import resize
13 from utils.utils import load_classes, load_params, non_max_suppression
14
15 from azureml.core.model import Model
16
17 def init():
18     global model, cuda, classes, img_size
19     global use_cuda, conf_thres, nms_thres
20
21     try:
22         model_path = Model.get_model_path('YOLOv3')
23     except:
```

Environment File

```
1 # Conda environment specification. The dependencies defined in this file will
2
3 # be automatically provisioned for runs with userManagedDependencies=False.
4
5
6 # Details about the Conda environment file format:
7
8 # https://conda.io/docs/user-guide/tasks/manage-environments.html#create-env-file-manually
9
10
11 name: project_environment
12 dependencies:
13     # The python interpreter version.
14
15     # Currently Azure ML only supports 3.5.2 and later.
16
17 - python=3.6.2
18
19 - pip:
20     # Required packages for AzureML execution, history, and data preparation.
21
22 - azureml-defaults
23 - scikit-image
24 - numpy
25 - torch>=0.4.0
26 - torchvision
27 - pillow
28 - matplotlib
29
```

Create the Image

```
from azureml.core.image import ContainerImage, Image
image_config = ContainerImage.image_configuration(execution_script="score.py",
                                                 runtime="python",
                                                 conda_file="yolov3.yml",
                                                 dependencies=['./models.py', './utils'], )

image = Image.create(ws, 'yolov3', [m], image_config)
```

Creating image

```
imgs = ws.images['yolov3']
print(imgs.image_build_log_uri)
```

https://icebatcheastus.blob.core.windows.net/logs/ha15192063154_f4074dd90e0c42ad83ee67d1d8384199.txt?sp=r&sr=b&sv=2017-04-17&se=2018-12-21T07%3A45%3A53Z&sig=YxcuwpdgTgx5uSqaHgcJgvSNAPyLNmZ9D%2BTc5vFFH4k%3D

Images

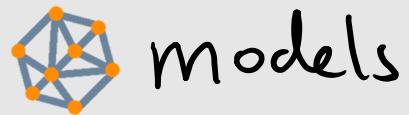
yolov3

[Back to Images](#) [Create Deployment](#) [Delete](#)

[Details](#) [Models](#) [Deployments](#)

ATTRIBUTES	
Description	yolov3:11
ID	yolov3:11
Date Registered	11/21/2018, 7:41:16 AM UTC
Version	11
Location	hal5192063154.azurecr.io
Environment	
Type	Docker
Status	Succeeded
Tags	

Deploy image



models

+



Scoring file.py

+



Python Environment



images

+



Azure
Kubernetes
Service (AKS)
or



Azure Container
Instance



deployment

Deploy image

Deploying AI Models

[github.com/sethjuarez/
PyTorch-YOLOv3](https://github.com/sethjuarez/PyTorch-YOLOv3)



Part 3

OTHER TOPICS

Azure AI

AI apps & agents



Azure Bot Service
Azure Cognitive Services

Machine learning



Azure Databricks
Azure Machine Learning

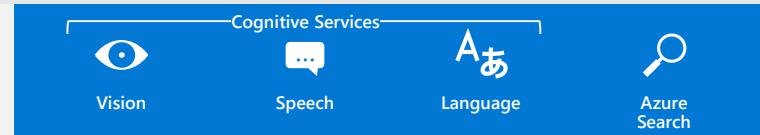
Knowledge mining



Azure Cognitive Search

Machine Learning on Azure

Sophisticated pretrained models
To simplify solution development



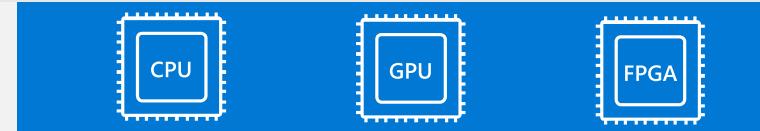
Popular frameworks
To build advanced deep learning solutions



Productive services
To empower data science and development teams



Powerful infrastructure
To accelerate deep learning



Flexible deployment
To deploy and manage models on intelligent cloud and edge



Machine Learning Service and Databricks



Integrated data science & data engineering teams

Desktop solutions not adequate

Need a unified big data & ML solution



+



Azure Databricks

Azure Machine Learning



Individual data scientist

Develop models on local machine or cloud VM

Need cloud for scale-out compute needs



Machine Learning VM

Model Deployment with ONNX

Use your favorite deep learning frameworks



TensorFlow



PyTorch



Scikit-Learn



MXNet



Chainer



Keras

without getting locked into one framework



ONNX

Community project created by Facebook and Microsoft

Use the best tool for the job. Train in one framework
and transfer to another for inference



Hardware-Accelerated AI

Accelerate deep learning



CPUs

General purpose machine learning

D, F, L, M, H Series



GPUs

Deep learning

N Series



FPGAs

Specialized hardware accelerated deep learning

Project Brainwave



Optimized for flexibility

Optimized for performance



FPGA NEW UPDATES:

Support for image classification and recognition scenarios
ResNet 50, ResNet 152, VGG-16, SSD-VGG, DenseNet-121

AI for Good



AI for Earth

AI for Accessibility

AI for
Humanitarian Action

www.microsoft.com/en-us/ai/ai-for-good

Summary

In this session we learned:

- About pre-trained models in Cognitive Services
- How computer vision works
- Transfer learning with Custom Vision
- Building, training and deploying with Azure Machine Learning
- Automatic Machine Learning
- Hyperdrive optimization for deep learning models
- Deploying models to containers

Try Azure ML Services for free

2 Experimentation Users

20 Managed Models

2 Deployed Models (4 cores)

**free with every Azure
subscription**



Learning Resources

Get started with Azure ML Services and the Python SDK

<https://aka.ms/AA3dxsp>

Tutorials and other resources for Cognitive Services

<https://aischool.microsoft.com/>

VS Code Tools for AI overview and tutorials:

<https://github.com/Microsoft/vscode-tools-for-ai>

Thank you!

github.com/revodavid/practicalai

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