



STUDENT DEVELOPER PROGRAM

ARTIFICIAL



INTELLIGENCE

HOW TO ACTUALLY BUILD A NEURAL NETWORK FROM BLOCKS?

speaker: Jakub Czakon
moderator: Piotr Migdał
webinar, 6th July 2017

Competition

Objective:

Answer questions

Rules:

Do it well, do it fast

Prizes:

Intel® Joule™ 570x Developer Kit.



Chip Shot

August 16, 2016

Share this Article



Contact Intel PR

MAKE AMAZING THINGS HAPPEN IN IOT AND ENTREPRENEURSHIP WITH INTEL JOULE

Today during the Intel Developer Forum (IDF) opening keynote, Intel CEO Brian Krzanich introduced the Intel® Joule™ compute module, a high-performance developer platform with support for Intel® RealSense™ depth-sensing cameras, targeted at Internet of Things (IoT) developers, entrepreneurs and established enterprises. The Intel Joule platform will be featured in the upcoming season of America's Greatest Makers.

Several Intel customers and partners are demonstrating potential applications of this technology this week at IDF, including Microsoft, Canonical and French company PivotHead, which has created augmented reality safety glasses for manufacturing environments.



The Intel Joule developer kit, a high-performance platform for Internet of Things developers, entrepreneurs and established enterprises. (Credit: Intel Corporation)

The Intel Joule platform enables people to rapidly prototype a concept and then take it into production in a fraction of the time and development cost. Intel Joule is a high performance system-on-module (SOM) in a tiny, low-power package thus making it ideal for computer vision, robotics, drones, industrial IoT, VR, AR, micro-servers and other applications that require high-end edge computing.



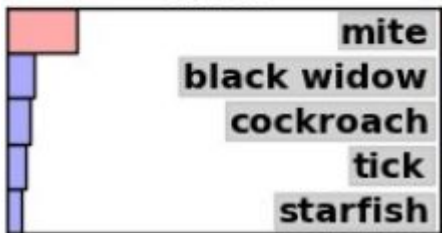
ARTIFICIAL
INTELLIGENCE



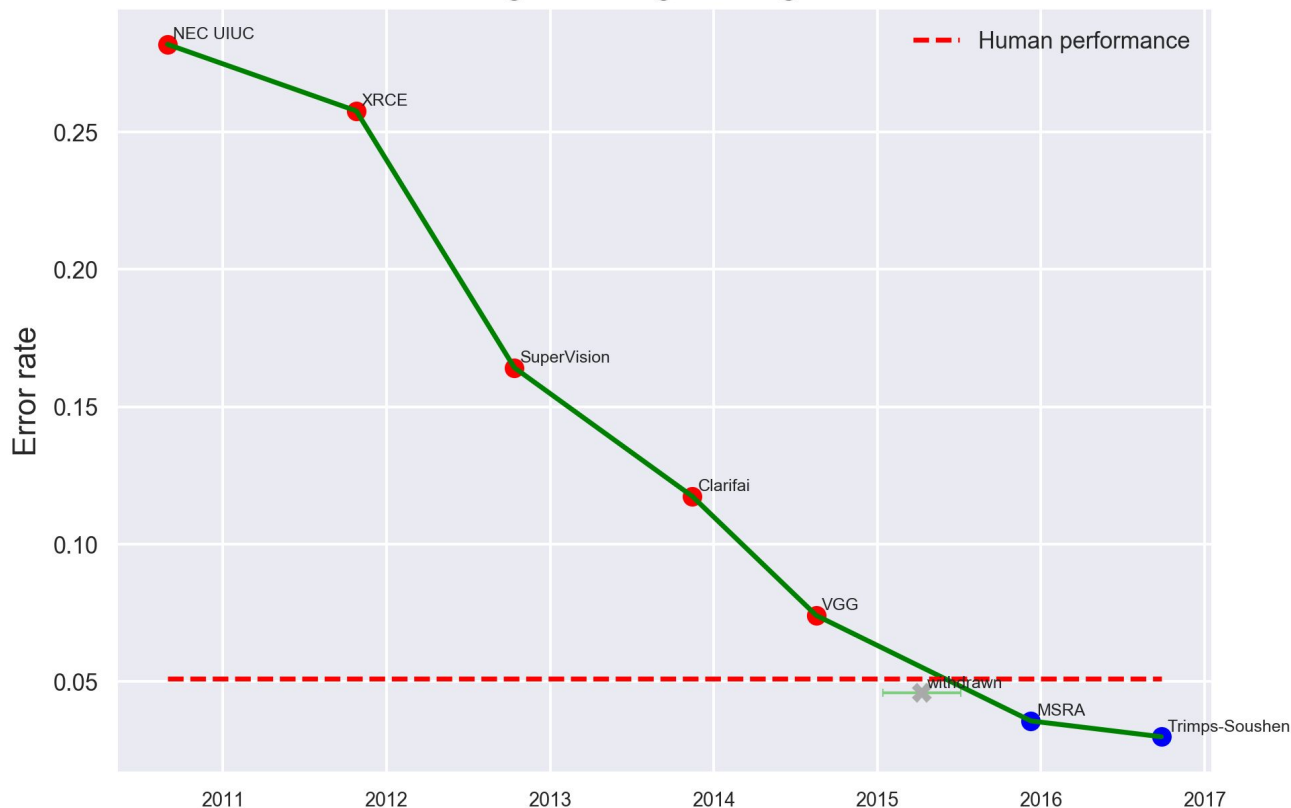
STUDENT DEVELOPER PROGRAM



mite



Imagenet Image Recognition



<https://www.eff.org/ai/metrics>



ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

THE POWER OF NEURAL NETWORKS



Andrew Ng ✓
@AndrewYNg

Following



Pretty much anything that a normal person can do in <1 sec, we can now automate with AI.

RETWEETS
554

LIKES
729



6:11 PM - 18 Oct 2016 from [Osaka-shi Fukushima, Osaka](#)

<https://twitter.com/andrewnyng/status/788548053745569792>

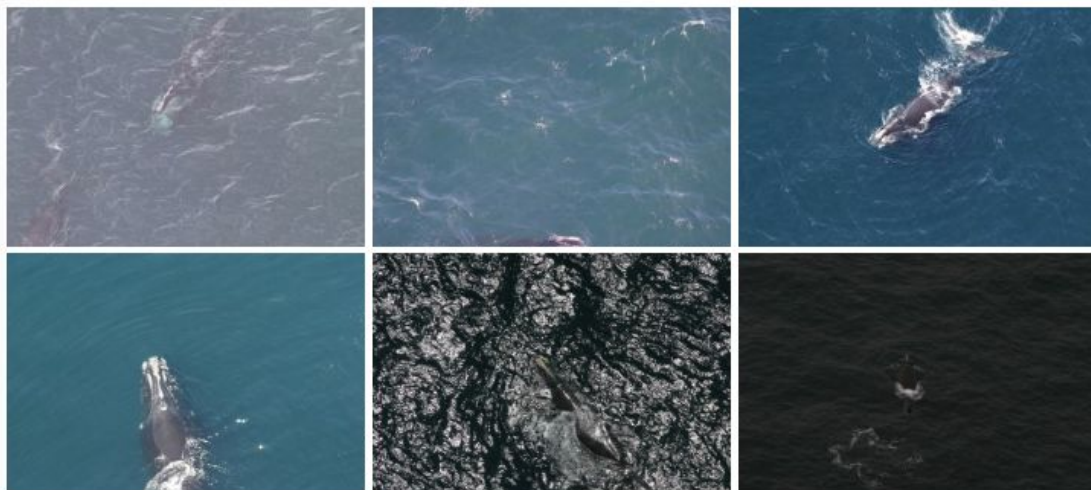


ARTIFICIAL
INTELLIGENCE

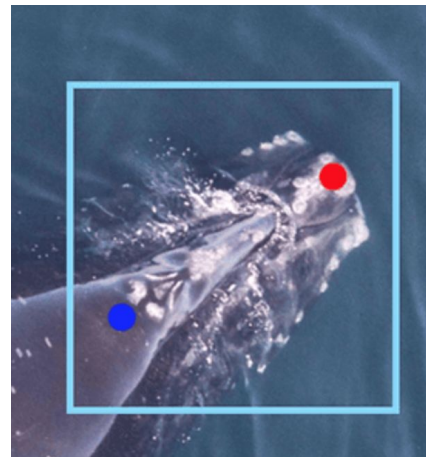


STUDENT DEVELOPER PROGRAM

WHALE RECOGNITION



- 447 individual whales
- 4.5k images
- 87% accuracy!

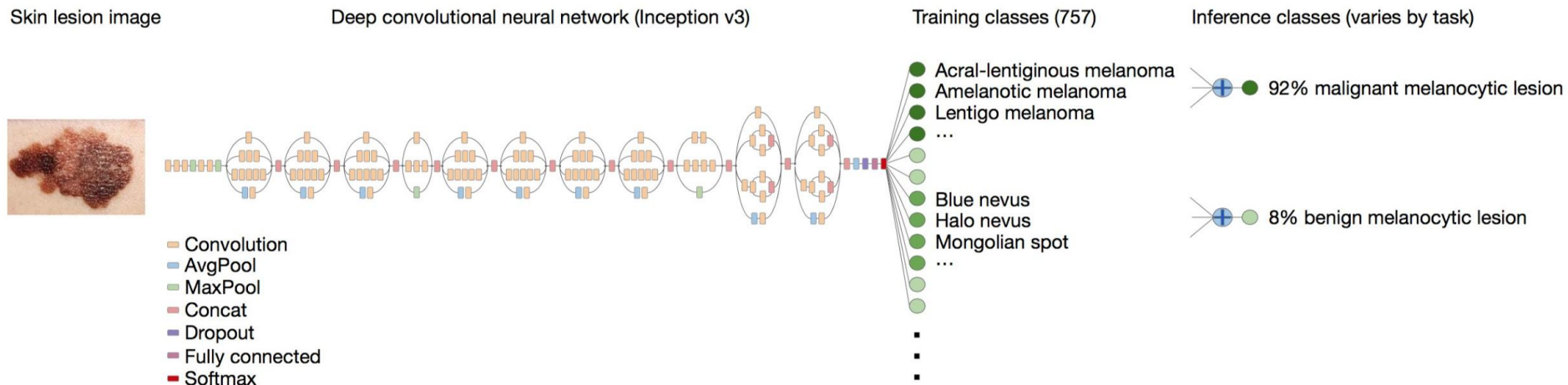


#	Δ1w	Team Name	‡ model uploaded * in the money	Score ?
1	↑27	deepsense.io	‡ *	0.61614
2	↑1	felixlaumon	‡ *	1.01971

<http://blog.kaggle.com/2016/01/29/noaa-right-whale-recognition-winners-interview-1st-place-deepsense-io/>



MEDICAL-LEVEL SKIN CANCER DETECTION



<http://cs.stanford.edu/people/esteva/nature/>



ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

ARTIFICIAL INTELLIGENCE: A CHANGING FRONTIER

*The toughest challenge facing AI workers
is to answer the question:
“What are the letters A and I?”*



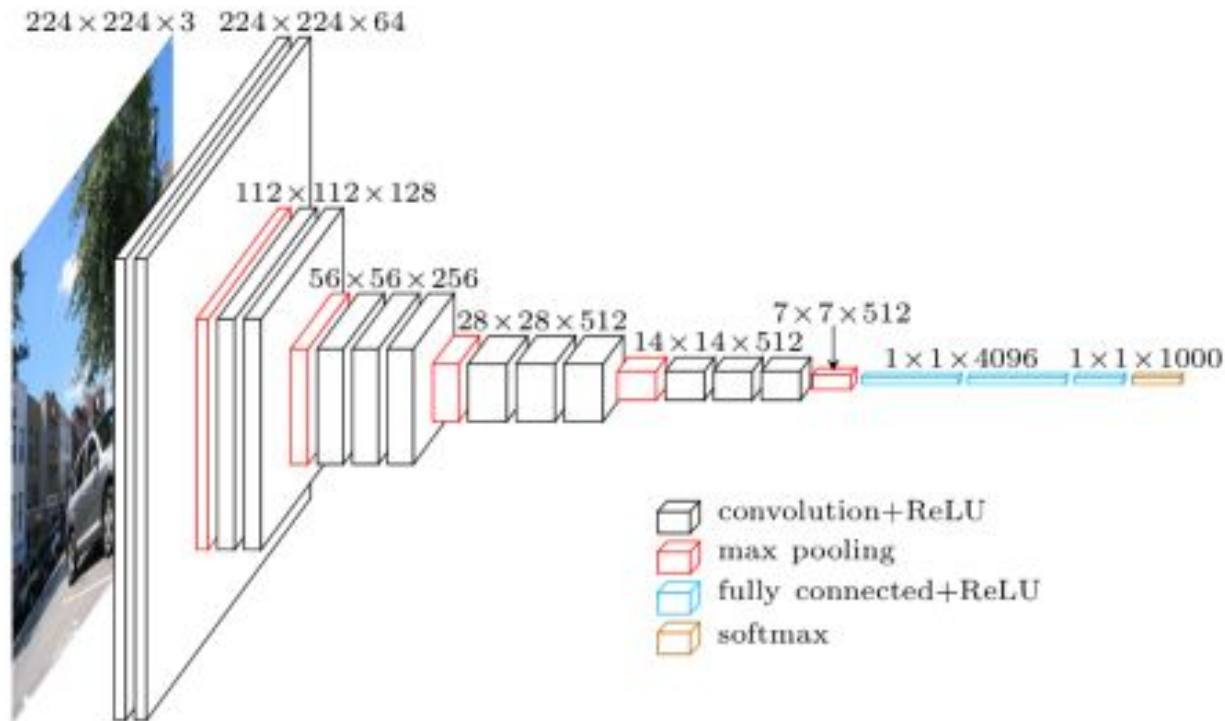
Douglas R. Hofstadter (1995)





CONVOLUTIONAL NEURAL NETWORKS

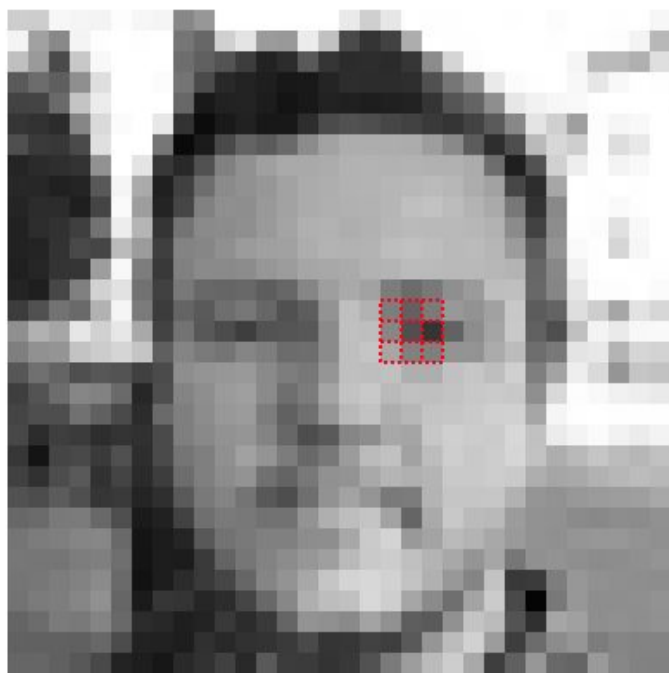
CONVNET EXAMPLE: VGG16



<https://www.cs.toronto.edu/~frossard/post/vgg16/>



CONVOLUTIONS



input image

$$\left(\begin{array}{ccc} 126 & + & 98 & + & 123 \\ \times 0 & \times -1 & \times 0 \\ + & 135 & + & 80 & + & 53 \\ \times -1 & \times 5 & \times -1 \\ + & 167 & + & 129 & + & 127 \\ \times 0 & \times -1 & \times 0 \end{array} \right) = -15$$

kernel:

sharpen



output image

<http://setosa.io/ev/image-kernels/>



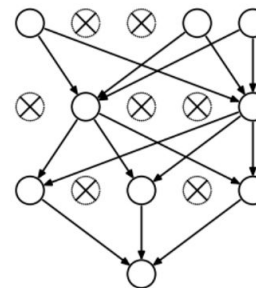
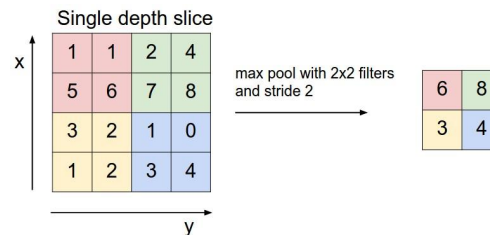
ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

TYPICAL BUILDING BLOCKS

- convolutional layers
- activation function (tanh or ReLU)
- max pooling
- batch normalization
- dense layer
- softmax
- log-loss cost function
- optimizer

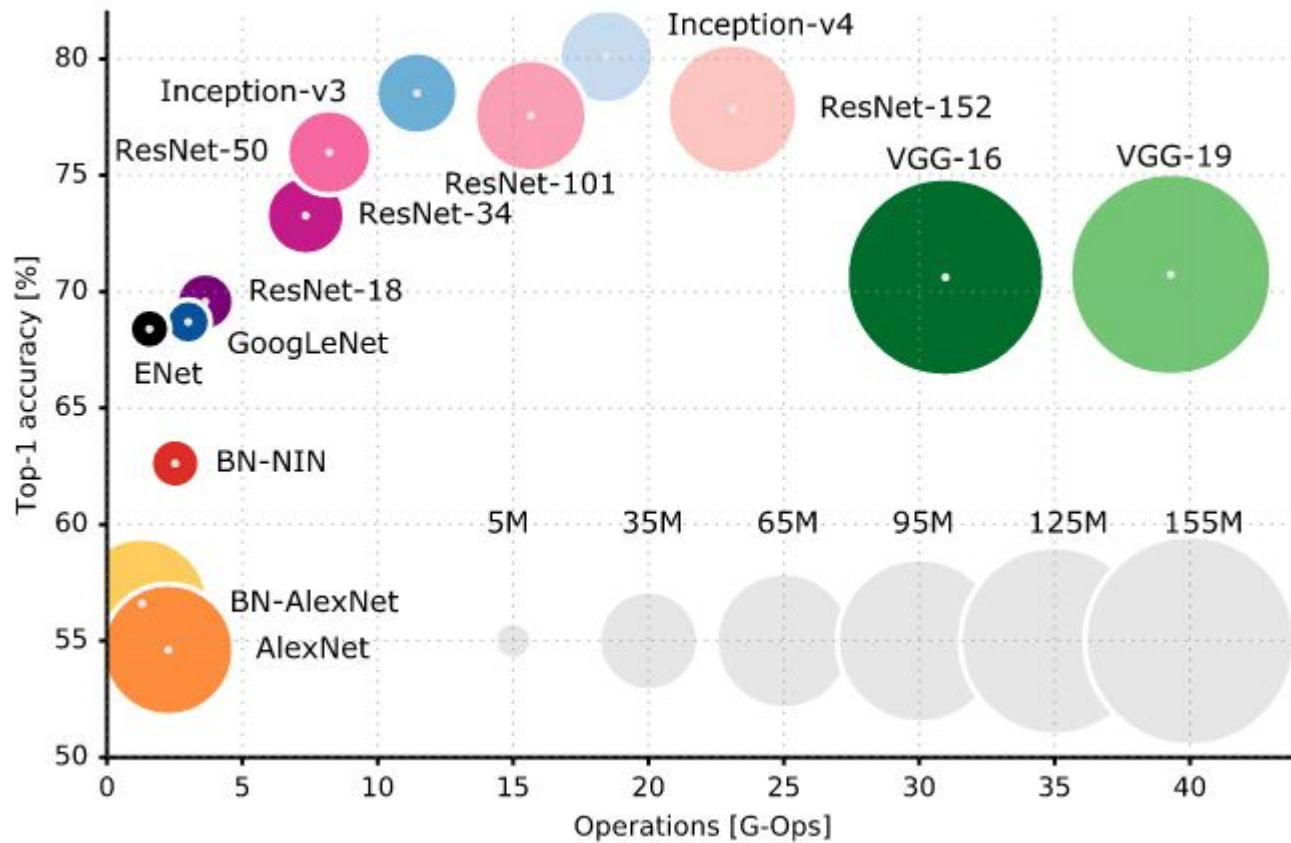


```
z = array([0.4, -0.9, 2.1])
```

```
# soft-max  
exp(z) / sum(exp(z))
```

```
array([ 0.14822546,  0.04039615,  0.81137839])
```





<https://medium.com/towards-data-science/neural-network-architectures-156e5bad51ba>



ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

TYPICAL APPROACHES

Training from scratch

- Full control over network architecture
- Requires a lot of data and time

Fine-tuning

- Using a pre-trained network (e.g. VGG16 or ResNet) and training it a bit
- Great for detecting similar objects

Feature generation

- Using a neural pre-trained network for features for other ML methods



Question 1

What is the correct order (largest to lowest) of the following neural networks in terms of the computation complexity of the forward pass?

AlexNet, VGG19, InceptionV3, ResNet152





LET'S GET PRACTICAL

Deep Learning



What society thinks I do



What my friends think I do



What other computer scientists think I do



What mathematicians think I do



What I think I do

```
In [1]:  
import keras  
Using TensorFlow backend.
```

What I actually do



SOFTWARE FOR DEEP LEARNING

Caffe



theano



PYTORCH



Question 2











What is the correct order (first commit on GitHub) the following frameworks were created in?

Keras, Theano, Caffe, MXnet, Torch



KERAS: HIGH-LEVEL FRAMEWORK

new contributors from 2017-02-11 to 2017-04-12

#1:	131		tensorflow/tensorflow
#2:	63		fchollet/keras
#3:	51		pytorch/pytorch
#4:	49		dmlc/mxnet
#5:	18		Theano/Theano
#6:	11		BVLC/caffe
#7:	11		Microsoft/CNTK
#8:	9		tflearn/tflearn
#9:	9		pfnet/chainer
#10:	8		torch/torch7



LIVE DEMONSTRATION

```
In [18]: model = Sequential()

model.add(Conv2D(16, (3, 3), activation='relu',
                 input_shape=(resolution, resolution, 1)))
model.add(MaxPool2D())

model.add(Conv2D(32, (3, 3), activation='relu'))
model.add(MaxPool2D())

model.add(Flatten())
model.add(Dense(classes, activation='softmax'))

model.compile(loss='categorical_crossentropy',
              optimizer='adam',
              metrics=['accuracy'])
```



Question 3

Who is the owner of the following avatar on GitHub?





INTEL DEEP LEARNING SDK

Machine Learning: Your Path to Deeper Insight

Driving increasing innovation and competitive advantage across industries


strategy
provides the
foundation for
success using AI

Solutions
for reference across industries



Tools/Platforms
to accelerate deployment

TAP
Trusted Analytics Platform

Intel® Deep Learning
SDK for Training &
Deployment

nervana

Optimized Frameworks
to simplify development

Spark

Caffe

theano

torch

TensorFlow

neon

Libraries/Languages
featuring optimized building blocks

Intel® Math Kernel
Library (Intel® MKL &
MKL-DNN)

Intel® Data Analytics
Acceleration Library
(Intel® DAAL)

Intel®
Distribution
for Python*

Hardware Technology
portfolio that is broad and cross-
compatible



Datacenter

Endpoint

+Network
+Memory
+Storage

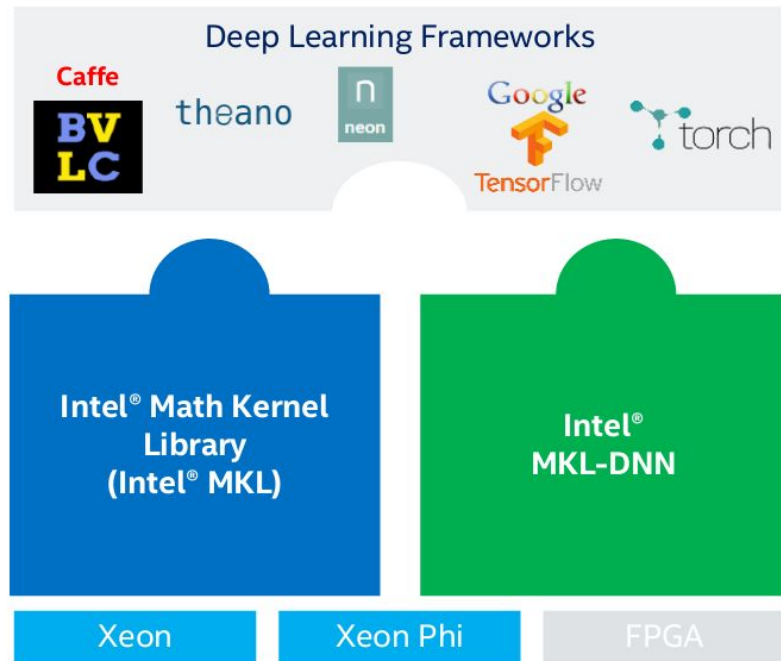


ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

Intel® Math Kernel Library and Intel® MKL-DNN for Deep Learning Framework Optimization



Intel® MKL	Intel® MKL-DNN
DNN primitives + wide variety of other math functions	DNN primitives
C DNN APIs	C/C++ DNN APIs
Binary distribution	Open source DNN code*
Free community license. Premium support available as part of Parallel Studio XE	Apache 2.0 license
Broad usage DNN primitives; not specific to individual frameworks	Multiple variants of DNN primitives as required for framework integrations
Quarterly update releases	Rapid development ahead of Intel MKL releases

* GEMM matrix multiply building blocks are binary





CLOSING REMARKS

INSPIRATION: CAN I HUG THAT?

Go for it! Hug it out. With a score of **0.695779**, we're somewhat sure.



Don't hug that. Please. With a score of **0.778686**, we're pretty sure.



https://www.reddit.com/r/MachineLearning/comments/4casci/can_i_hug_that_i_trained_a_classifier_to_tell_you/

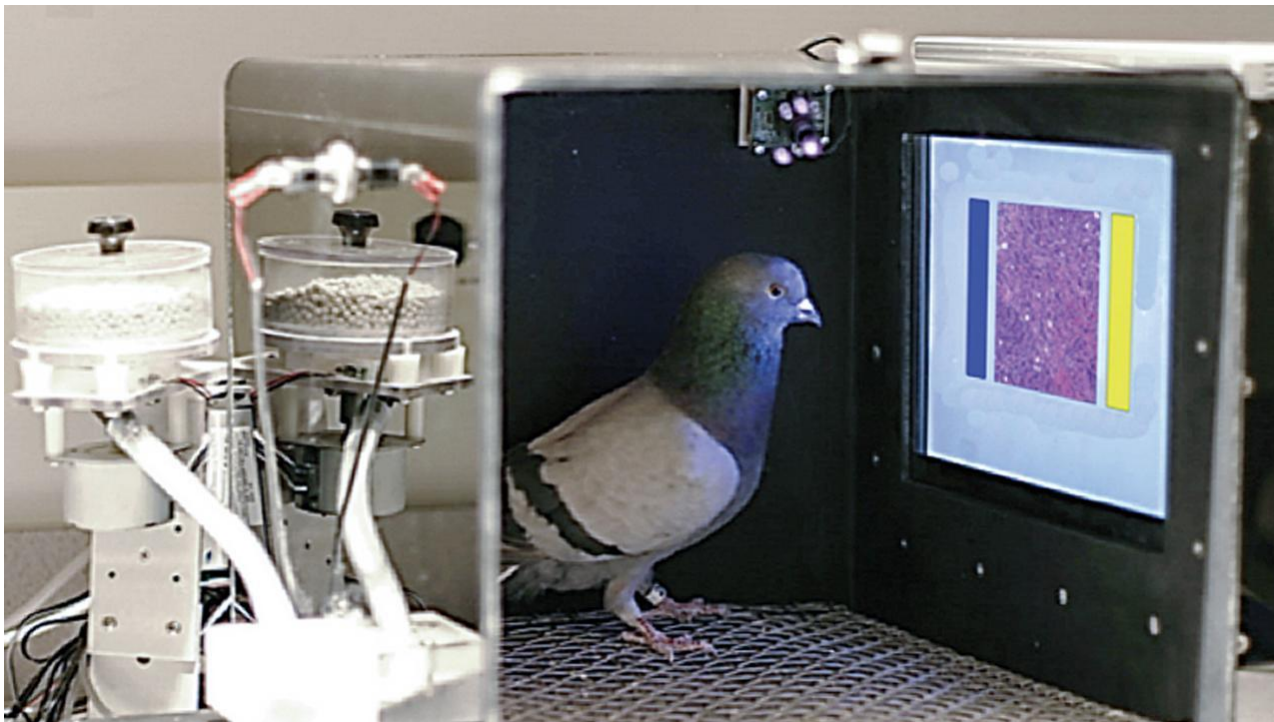


ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

PIGEONS RECOGNIZING CANCER TISSUE



<http://www.sciencemag.org/news/2015/11/pigeons-spot-cancer-well-human-experts>



ARTIFICIAL
INTELLIGENCE



STUDENT DEVELOPER PROGRAM

WHERE TO LEARN MORE?

Tutorial

- Intel Nervana AI Academy
<https://software.intel.com/en-us/ai/academy>

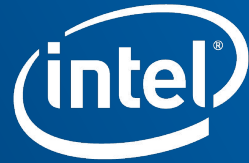
A course in image processing

- CS231n: Convolutional Neural Networks for Visual Recognition
<http://cs231n.github.io/>

An easy introductory blog post

- Learning Deep Learning with Keras
<http://p.migdal.pl/2017/04/30/teaching-deep-learning.html>





Software

STUDENT DEVELOPER PROGRAM

INTEL SUPPORT

FIND MORE KNOWLEDGE

Intel Nervana AI Academy <https://software.intel.com/en-us/ai/academy>

BUILD YOUR OWN PROJECT

Devmash - Find and follow world-class developers, share your own projects and collaborate with others <https://devmesh.intel.com/>

FIND EVEN MORE SUPPORT FOR YOUR ML IDEAS

- Interested graduate students can apply to become a student ambassadors <https://software.intel.com/en-us/experts/ambassadors/apply>
- Any & All interested students can join Intel-sponsored University Clubs <https://software.intel.com/en-us/experts/ambassadors/club-sponsorship>



That's all folks, thank you!



DEEP LEARNING (VS 'SHALLOW' ML)

PROS

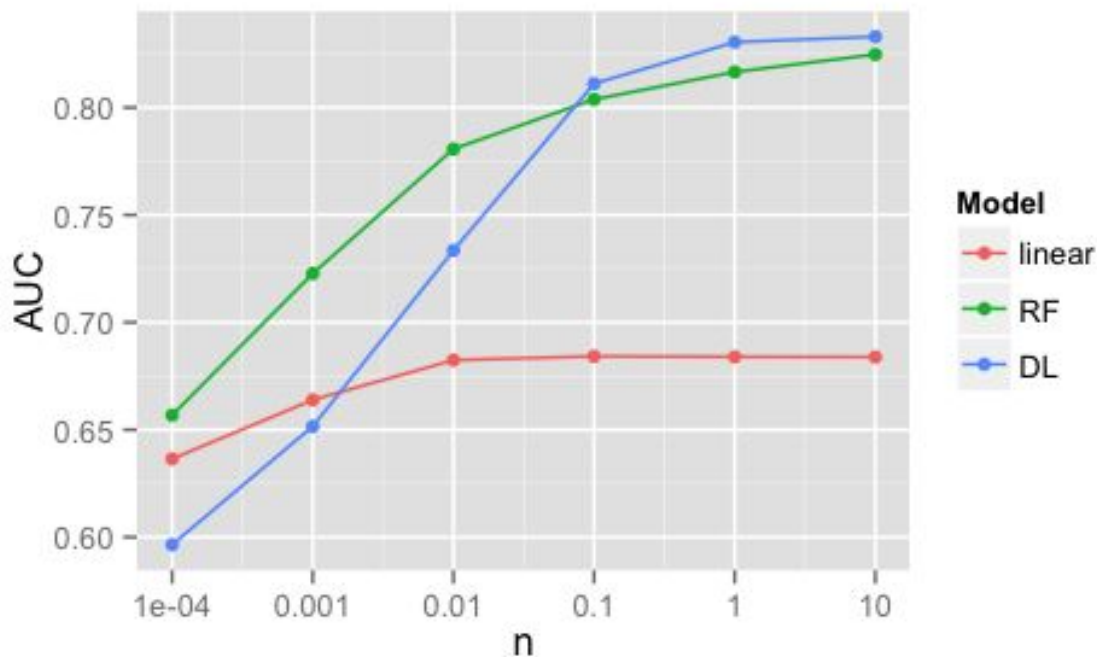
- By far the best method for image classification and segmentation
- Great progress in natural language processing
- Easy to base on a pre-trained model

CONS

- Require a lot of data
- Training takes a lot of time
- Tweaking architecture and parameters is difficult
- For many business applications tree-based techniques are better (e.g. Random Forest and XGBoost)



MORE DATA FOR MORE COMPLEX MODELS



<https://github.com/szilard/benchm-ml/tree/master/x1-data-higgs>

see also: <https://github.com/szilard/benchm-ml>



PERFORMANCE

CPU

- Suitable for small neural network models
- Check out Intel-optimized TensorFlow! (Intel Deep Learning SDK)

GPU

- Speed up networks a lot
- Expensive to buy, but convenient to rent (\$0.5-2/h) at AWS

TPU?

- Architecture optimized for neural networks

