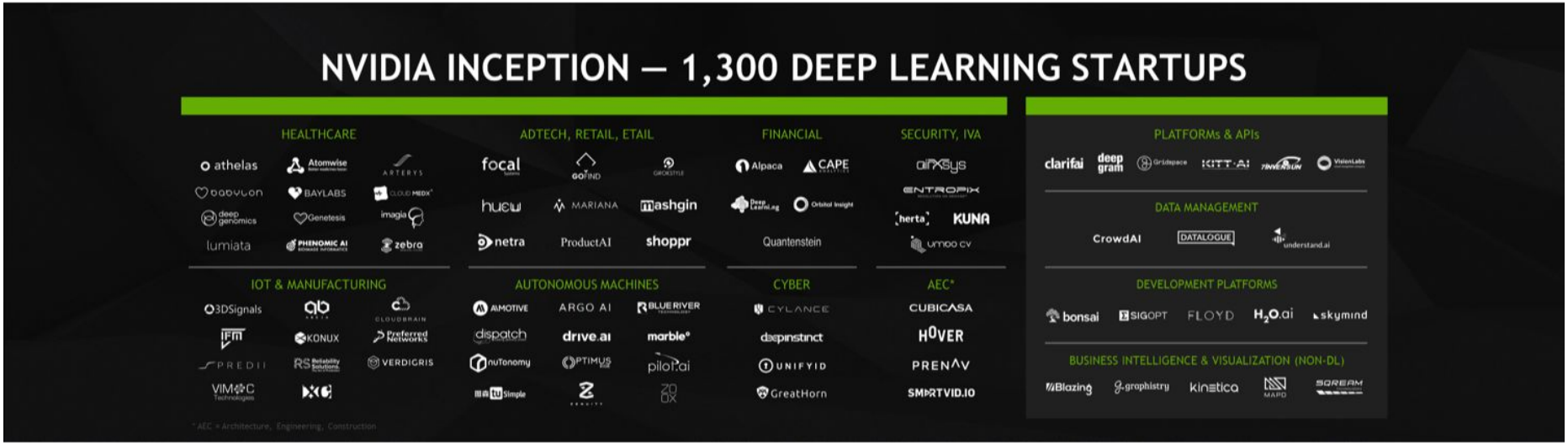
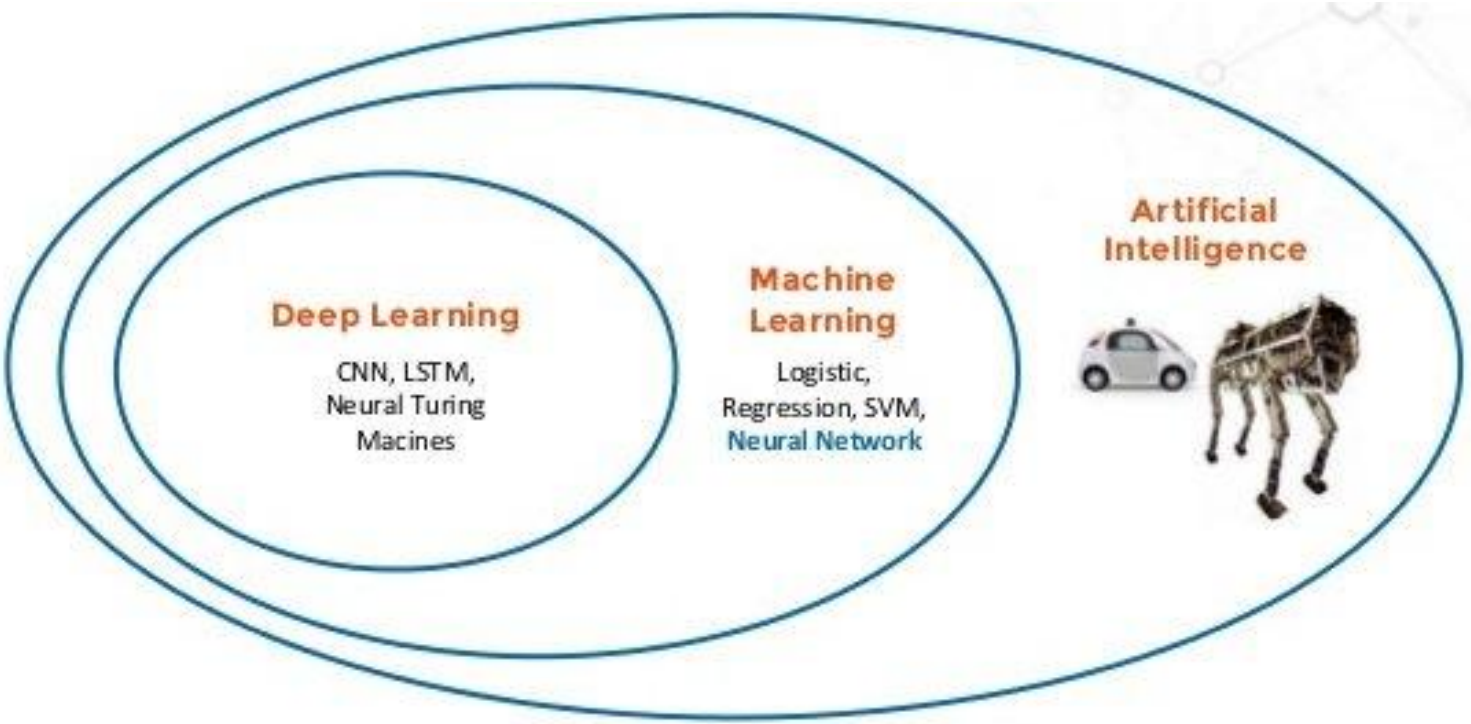
Review: From History to Practical Tips

Chuck

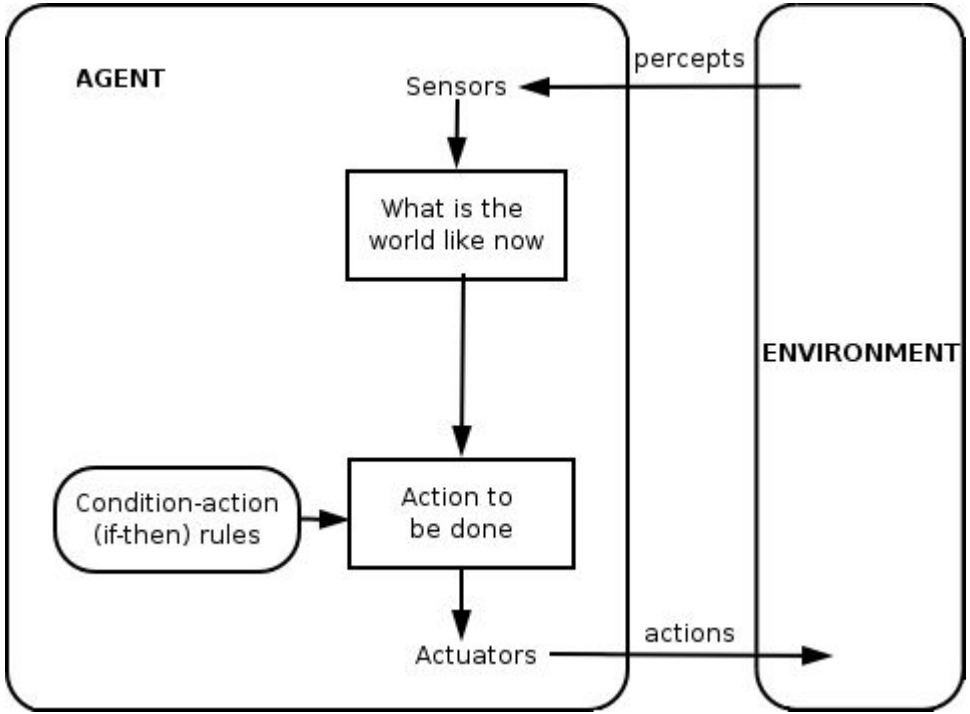
The business



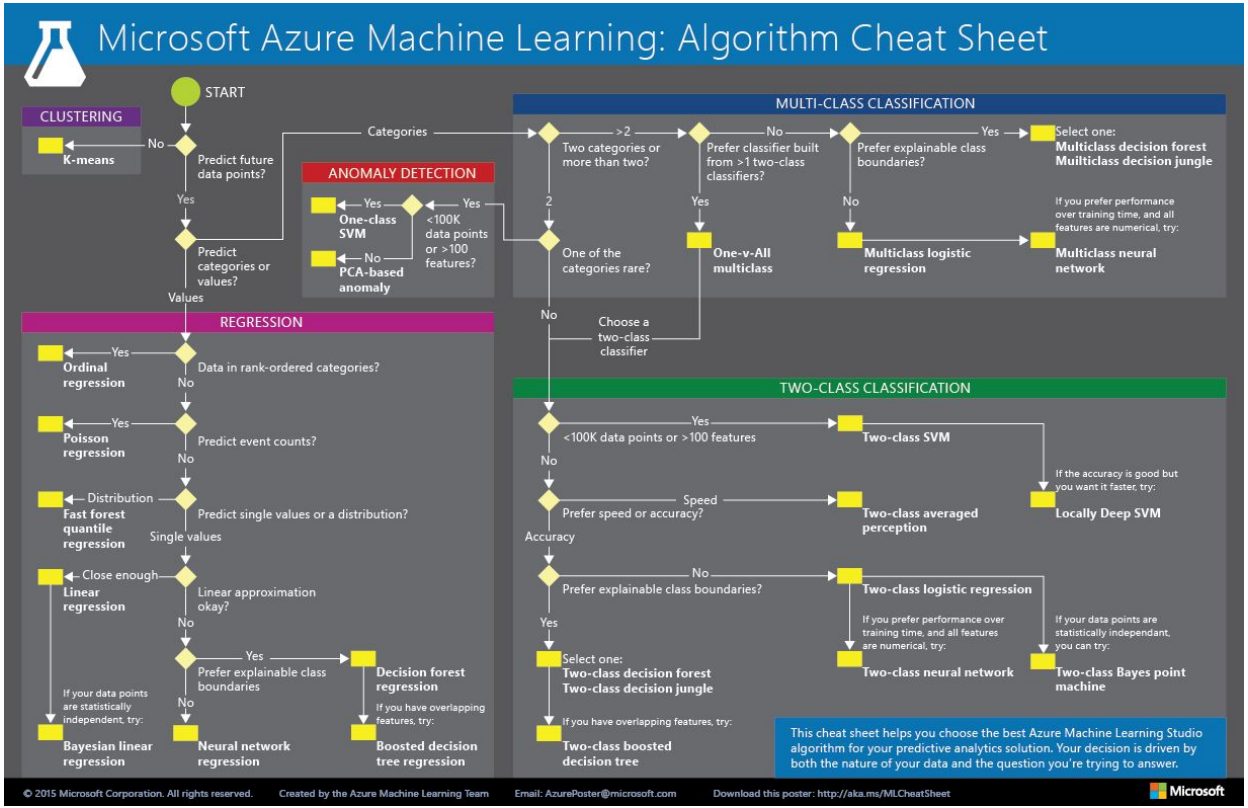
Artificial Intelligence



What is “Intelligence”



ML in one Page



The History

1958 Perceptron

1969
Perceptron criticized

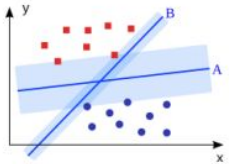
1974 Backpropagation

awkward silence (AI Winter)

Convolution Neural Networks for Handwritten Recognition
1998

Google Brain Project on 16k Cores
2012

1995
SVM reigns



2006
Restricted Boltzmann Machine

2012
AlexNet wins ImageNet

IMAGENET

Basic DL Questions in 5 seconds

- Wh
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Type	Name	Flops	Cost
Mobile	Raspberry Pi 1st Gen, 700 Mhz	0,04 Gflops	$35
Mobile	Apple A8	1,4 Gflops	$700 (in iPhone 6)
CPU	Intel Core i7-4930K (Ivy Bridge), 3.7 GHz	140 Gflops	$700
CPU	Intel Core i7-5960X (Haswell), 3.0 GHz	350 Gflops	$1300
GPU	NVidia GTX 980	4612 Gflops (single precision), 144 Gflops (double precision)	$600 + cost of PC (~$1000)
GPU	NVidia Tesla K80	8740 Gflops (single precision), 2910 Gflops (double precision)	$4500 + cost of PC (~1500)

ms that human encounter

What is the minimum Linear Algebra you must know

1. Scalar, Vector, Matrices(2D), Ndarray (tensor)
2. Matrices Operation: Transpose, Addition & Subtraction (broadcasting), Multiplication

That is all you need!!

But it is good to handle:

3. Partial Derivative, Chain Rules, Jacobian, Determinant

Question: What is gradient vanishing? What cause gradient vanishing?

Questions: Supervised Learning(1)

1. What is Linear Regression, Logistic Regression?
2. What is the formula of Gradient Descent (write it in 10s)?
3. How to solve Linear Regression and Logistic Regression by using GD and by closed form? (derive the formula)

Even More

4. SVM, why it can max-margin. How come it did overshadow Neural Network for 20 years.

5. Decision Tree, KD Tree, Bayesian, Graph, Boltzman Machine, SNN, and many others

Questions: Supervised Learning(2)

1.Hypothesis: Linear vs Non-linear

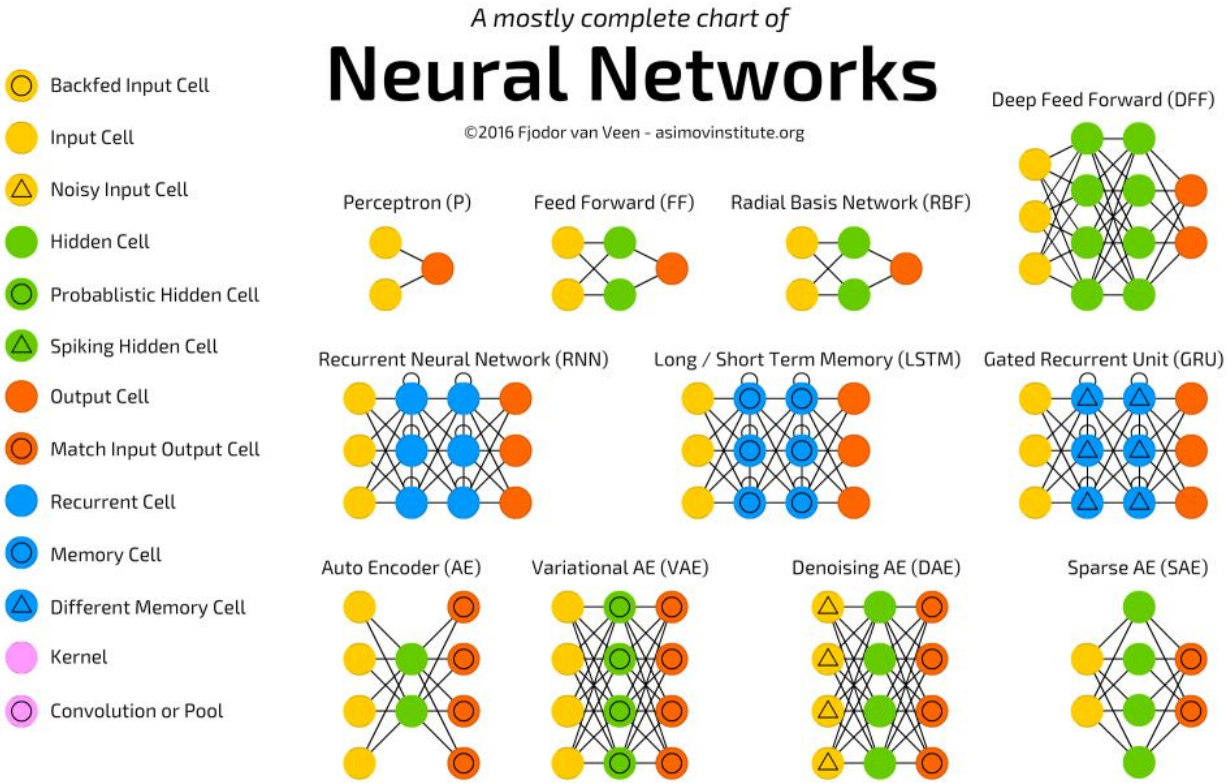
2.Cost Function design

3.Overfitting(Variance) & Underfitting(Bias), the methods to solve them

4.Precision & Recall

5. Local Minima

Neural Network



Deep Learning != Brain Learning

- The artificial neuron fires totally different than the brain
- A human brain has 100 billion neurons and 100 trillion connections (synapses) and operates on 20 watts(enough to run a dim light bulb) - in comparison the biggest neural network have 10 million neurons and 1 billion connections on 16,000 CPUs (about 3 million watts)
- The brain is limited to 5 types of input data from the 5 senses.
- Children do not learn what a cow is by reviewing 100,000 pictures labelled “cow” and “not cow”, but this is how machine learning works.
- Probably we don't learn by calculating the partial derivative of each neuron related to our initial concept. (By the way we don't know how we learn)

Basic Questions: Deep Learning

1. Derive backpropagation (convolution, activation, cost function)
2. How to do vectorize and parallel
3. Gradient Checking
4. Weight Initialization
5. Training Steps
6. Training/Testing/Validation Data

Other knowledge points:

Layer types (list all the layer type for CNN architecture), Avoid Overfitting in DL (Dropout, Drop connection, Regularization, Data Augmentation),

Optimization

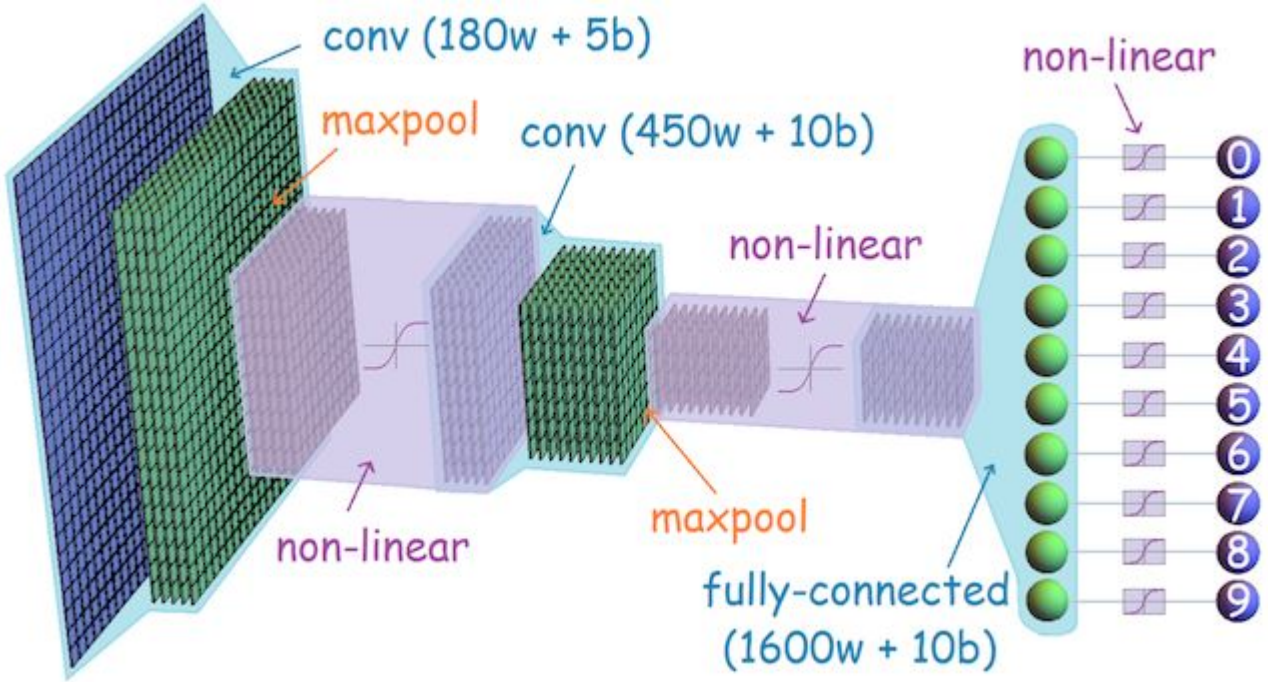
All about the SGD:

- Stochastic Gradient Descent (SGD)
- Stochastic Gradient Descent with momentum (Very popular)
- Nestorov's accelerated gradient (NAG)
- Adaptive gradient (AdaGrad)
- Adam (Very good because you need to take less care about learning rate)
- RMSprop

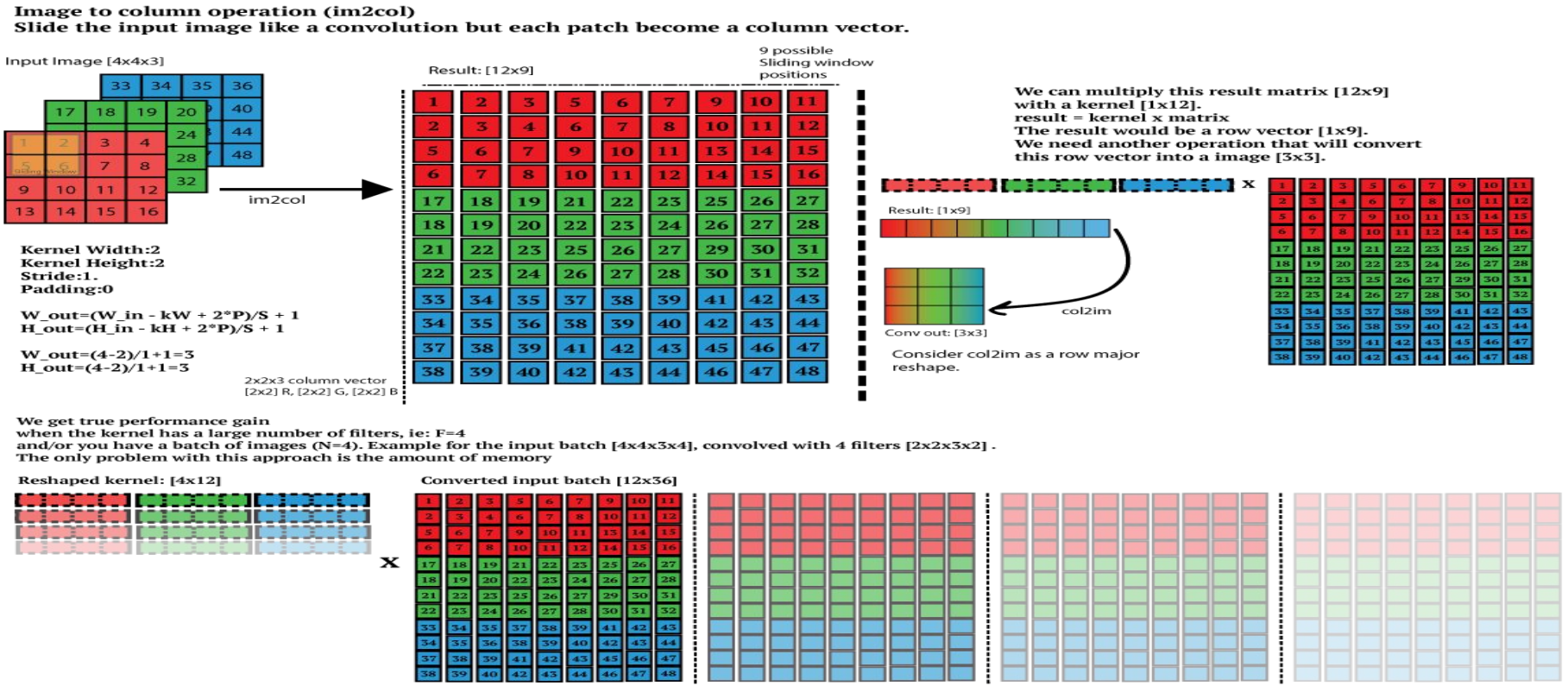
One interesting Argument:

An important thing to note is that learning rate scale proportionally with batch size so if we increase our batch size by 2x we can double our learning rate.

Just can’t not share with you the graph (where is BN)



Convolution: Make it fast! (im2col, col2im)



MXNET v.s. Tensorflow

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Data Format

Data Format: .rec v.s. .tfrecord

.rec:
https://github.com/BitTiger-MP/DS502-AI-Engineer/blob/master/DS502-1702/MXNET_course/mxnet-week4n5-final-project/data_ulti.py

.tfrecord:
http://www.machinelearninguru.com/deep_learning/tensorflow/basics/tfrecord/tfrecord.html

Symbol Build

MXNET: https://github.com/BitTiger-MP/DS502-AI-Engineer/blob/master/DS502-1702/MXNET_course/mxnet-week3/cifar10/symbols/resnet.py

Tensorflow: https://github.com/tensorflow/models/blob/master/tutorials/image/cifar10/cifar10.py#L188-#L295

Logging System

MXNET: https://github.com/dmlc/tensorboard

Tensorflow: https://www.tensorflow.org/get_started/summaries_and_tensorboard

Training Strategy

MXNET:
https://github.com/BitTiger-MP/DS502-AI-Engineer/blob/master/DS502-1702/MXNET_course/mxnet-week4n5-final-project/run_train.py#L68-L95

Tensorflow:
https://github.com/tensorflow/models/blob/master/tutorials/image/cifar10/cifar10.py#L325-L378

Trigger the Training

MXNET:
https://github.com/BitTiger-MP/DS502-AI-Engineer/blob/master/DS502-1702/MXNET_course/mxnet-week4n5-final-project/run_train.py#L68-L95

Tensorflow:

https://github.com/tensorflow/models/blob/master/tutorials/image/cifar10/cifar10_train.py

Multi-GPU Training

MXNET:
https://github.com/BitTiger-MP/DS502-AI-Engineer/blob/master/DS502-1702/MXNET_course/mxnet-week4n5-final-project/run_train.py#L26

Tensorflow:

https://github.com/tensorflow/models/blob/master/tutorials/image/cifar10/cifar10_multi_gpu_train.py

Distributed Training

MXNET:
https://github.com/apache/incubator-mxnet/blob/master/docs/how_to/cloud.md

Tensorflow:

https://www.tensorflow.org/deploy/distributed

https://aws.amazon.com/it/blogs/compute/distributed-deep-learning-made-easy/

Summary

MXNET

1. Focuses on DL only.
2. Faster, Lighter, and is maintained and optimized by AWS officially.
3. Multi-language supporting
4. Very friendly to research and engineering

Tensorflow

1. Not only for DL, but for all ML (aggressive)
2. Heavy, and only one session one GPU
3. Only Python and C++
4. Big Community, not friendly(?) to engineering

Let’s deliver a DL product!

https://blogs.dropbox.com/tech/2017/04/creating-a-modern-ocr-pipeline-using-computer-vision-and-deep-learning/

Team:

PM/Hire M, SDE, Machine Learning Engineer, DevOps (5~15 people)

Time: 6~12 month

Data: Cost of Data collection, Legal (for big company), annotation

Hardware Support: AWS or Data Center

Let’s read a chapter in DL book

http://www.deeplearningbook.org/contents/guidelines.html

Thank You for your commitment

Lifelong Learning is lifelong joy. Enjoy it!