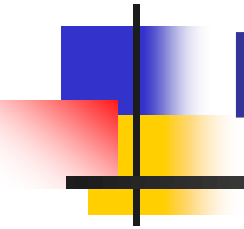
Deep Learning Using TensorFlow



Dr. Ash Pahwa

1.3: Tools for Deep Learning

Tools for Deep Learning

- Backend
  - TensorFlow (Google)
  - Scikit-Learn (Google)
  - Theano (Univ of Montreal)
  - CNTK (Microsoft)
  - Torch + PyTorch (Facebook)
  - Caffe (UC Berkeley)
  - H2O

- Frontend
  - R
  - Keras/R
  - Python
  - Keras/Python
  - Apache MXNet (Amazon)

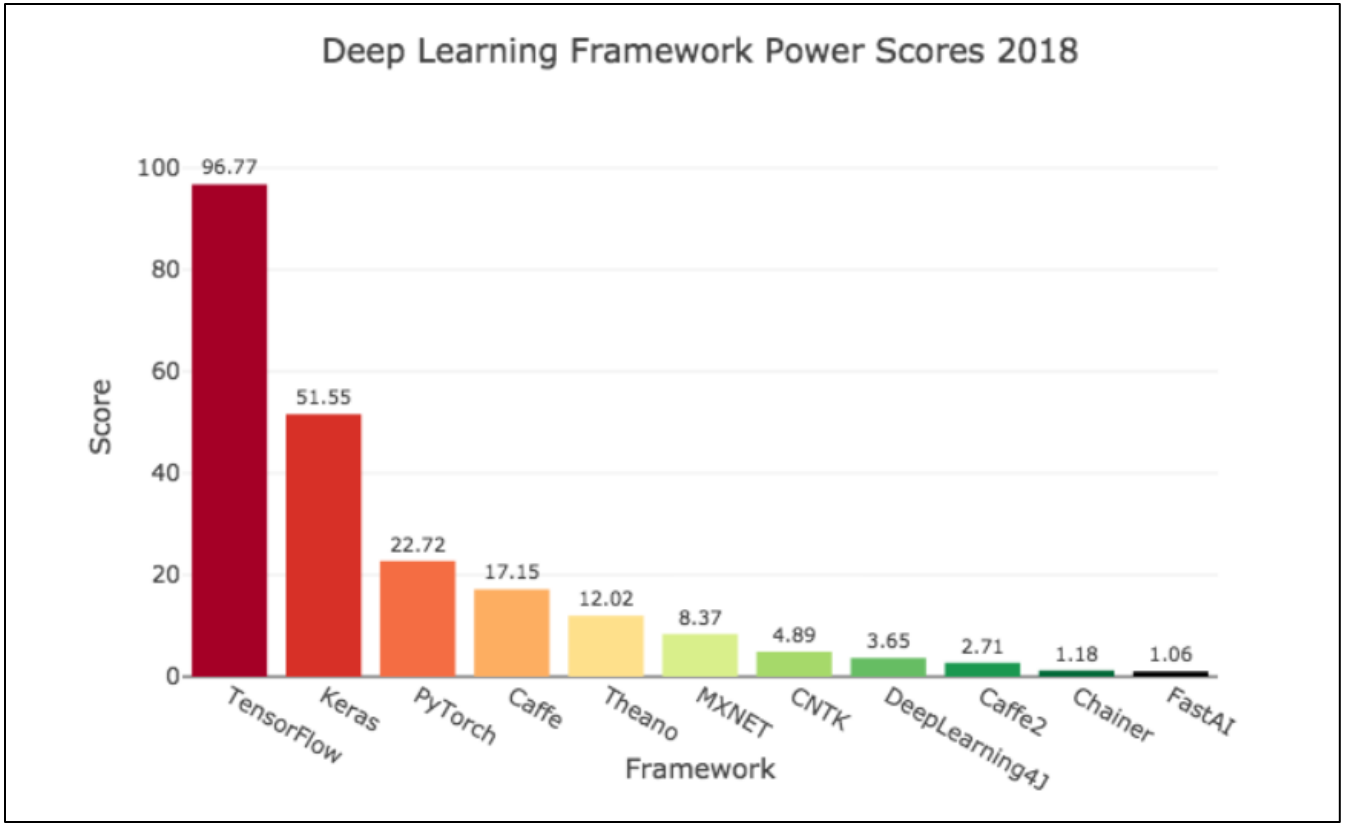
Deep Learning

Deep Learning Framework Power Scores 2018

Who's on top in usage, interest, and popularity?

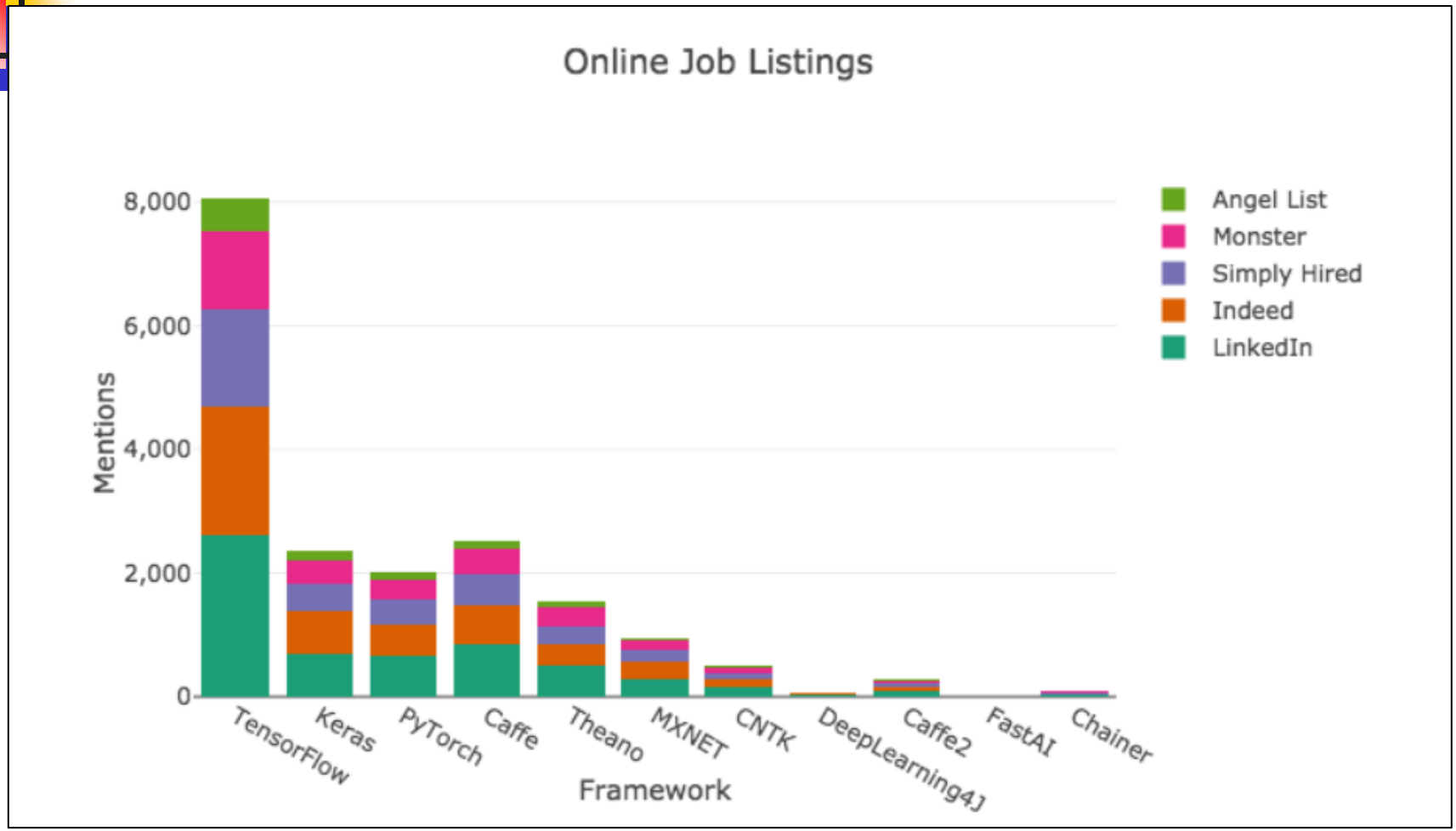
Jeff Hale Follow

Sep 19, 2018 · 10 min read



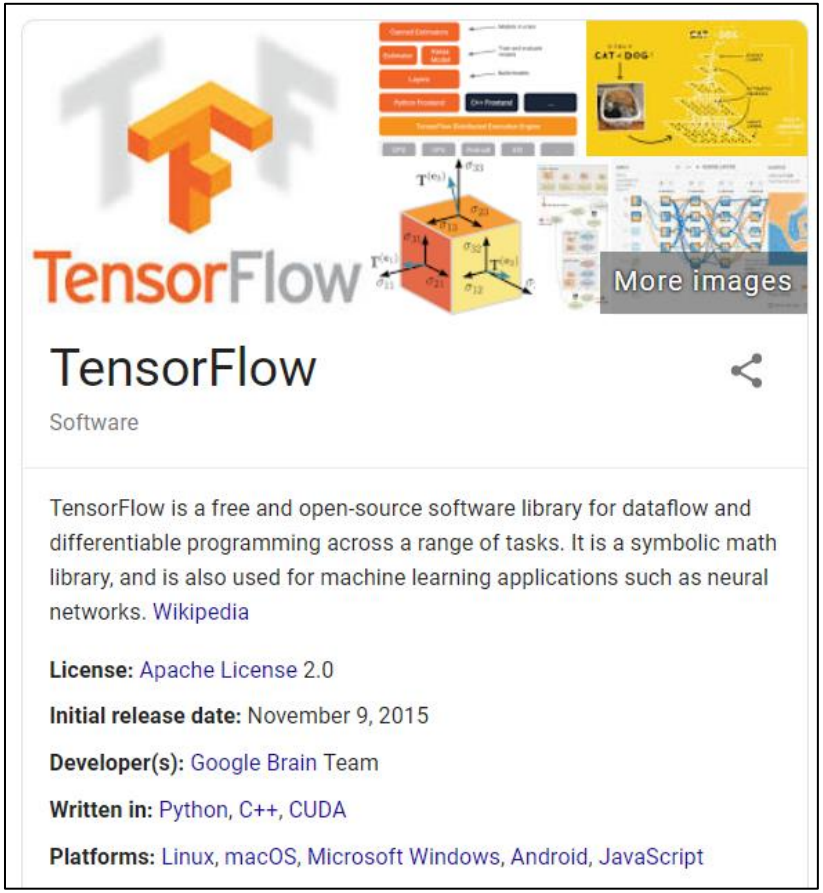
1. TensorFlow
2. Keras
3. PyTorch
4. Caffe
5. theano
6. mxnet
7. CNTK
8. DL4J
9. Caffe2
10. Chainer
11. fast.ai

Job Listings

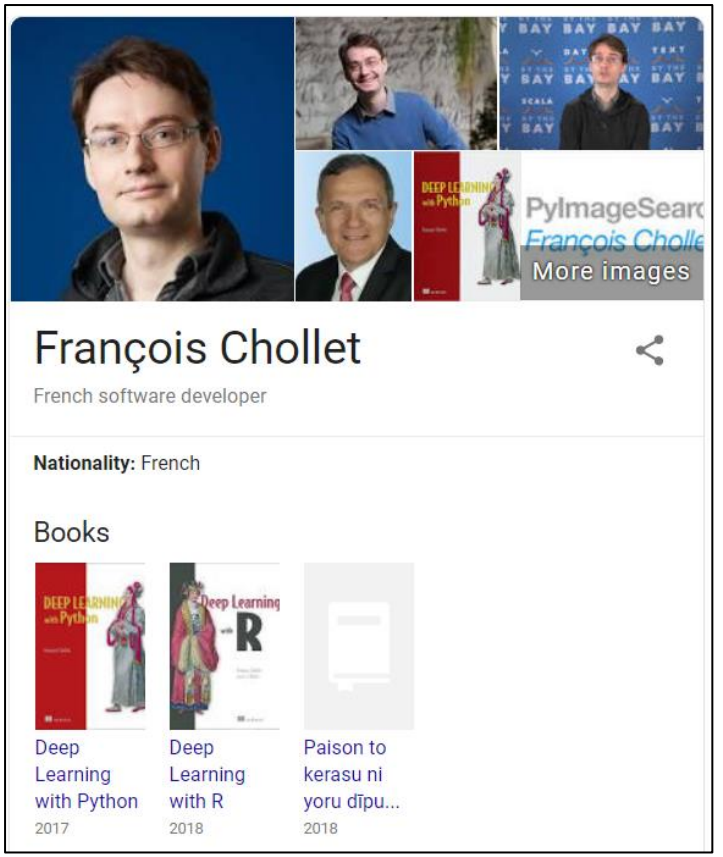


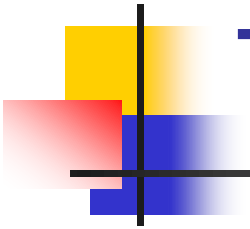
TensorFlow: Google

- **TensorFlow** is an open source software library released in 2015 by Google to make it easier for developers to design, build, and train deep learning models
- At a high level, **TensorFlow** is a Python library that allows users to express arbitrary computation as a graph of data flows



Keras: Google





TensorFlow Software History

- November 2015: TensorFlow Beta
- February 2017: Version 1.0.0
- November 2019: Version 2.0 Beta
- January 2020: Version 2.1.0

Difference between TensorFlow 1.0 & 2.0

- Eager execution is enabled by default (2.0)
  - No placeholders
  - Session.run() gone
  - Tf.global_variable_initializer() gone
- Keras API is now the standard (2.0)
- User Interface is simplified (2.0)
  - Tf.contrib is gone
  - To create your own layers and models subclass use the keras layer/model
  - Sessions are gone
  - Tf.function for efficiency of compiled graphs

TensorFlow
Step 1: Creates a DAG (Directed Acyclic Graph)
Step 2: Executes DAG

```
import tensorflow as tf

a1 = tf.constant([5,3,8])

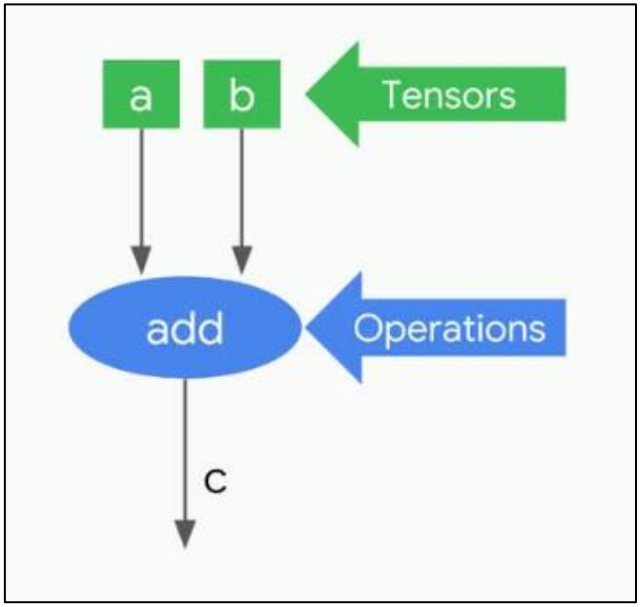
b1 = tf.constant([3,-1,2])

c1 = tf.add(a1,b1)

print (c1)
Tensor("Add_1:0", shape=(3,), dtype=int32)

with tf.Session() as sess:
    result = sess.run(c1)
    print (result)


[ 8  2 10]
```



Numpy and TensorFlow

```
import numpy as np

a = np.array([5,3,8])

b = np.array([3, -1, 2])

c = np.add(a,b)

print(c)
[ 8  2 10]
```

```
import tensorflow as tf

a1 = tf.constant([5,3,8])

b1 = tf.constant([3,-1,2])

c1 = tf.add(a1,b1)

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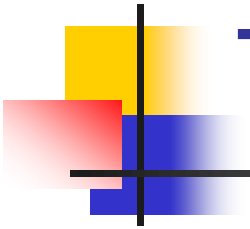
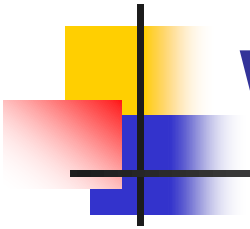


TensorFlow 2.0

- TensorFlow 2.0 supports both eager and lazy (graph) computation
  - Eager mode is default
- TF2.0 is Backward compatible with TF 1.0

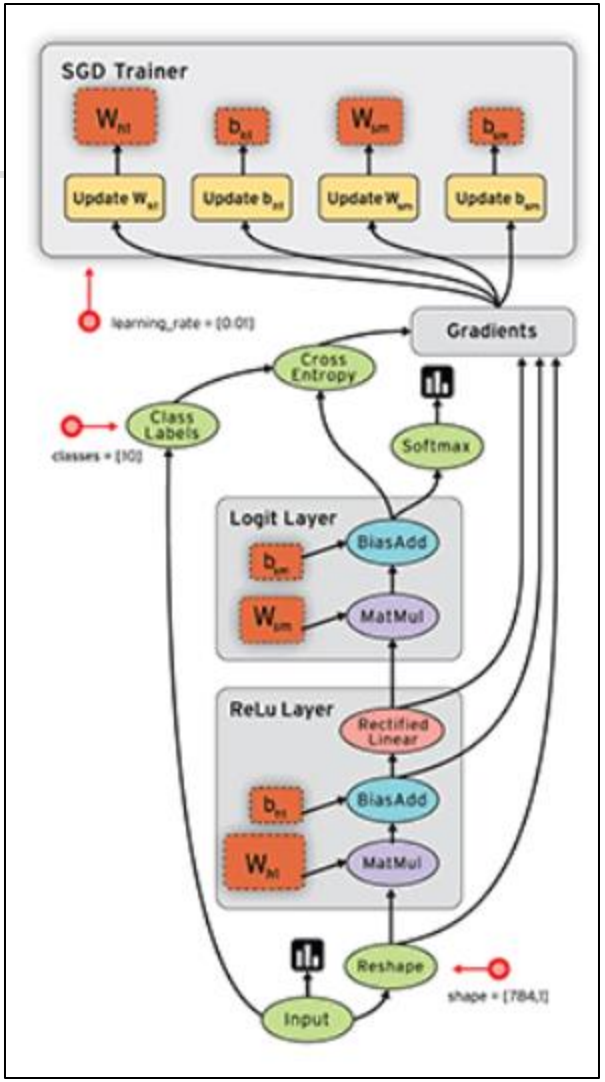
What 'Tensor Flow' Has to do with Tensors?

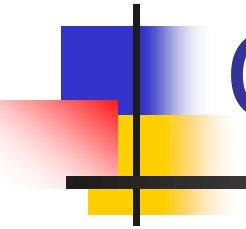


- **TensorFlow** programs use a **tensor** data structure to represent all data
- Only **tensors** are passed between operations in the computation graph
- **TensorFlow tensor** as an n-dimensional array or list.
  - For example,
    - a scaler is a **tensor**
    - a vector is a **tensor**
    - a matrix is a **tensor**

TensorFlow

- Creates Directed Acyclic Graph (DAG)
  - DAG represents mathematical operations
    - + - * /
    - Vector arithmetic
    - Matrix multiplication
- DAG
  - Edges
    - Input/output of math operation
    - Represents – array of data





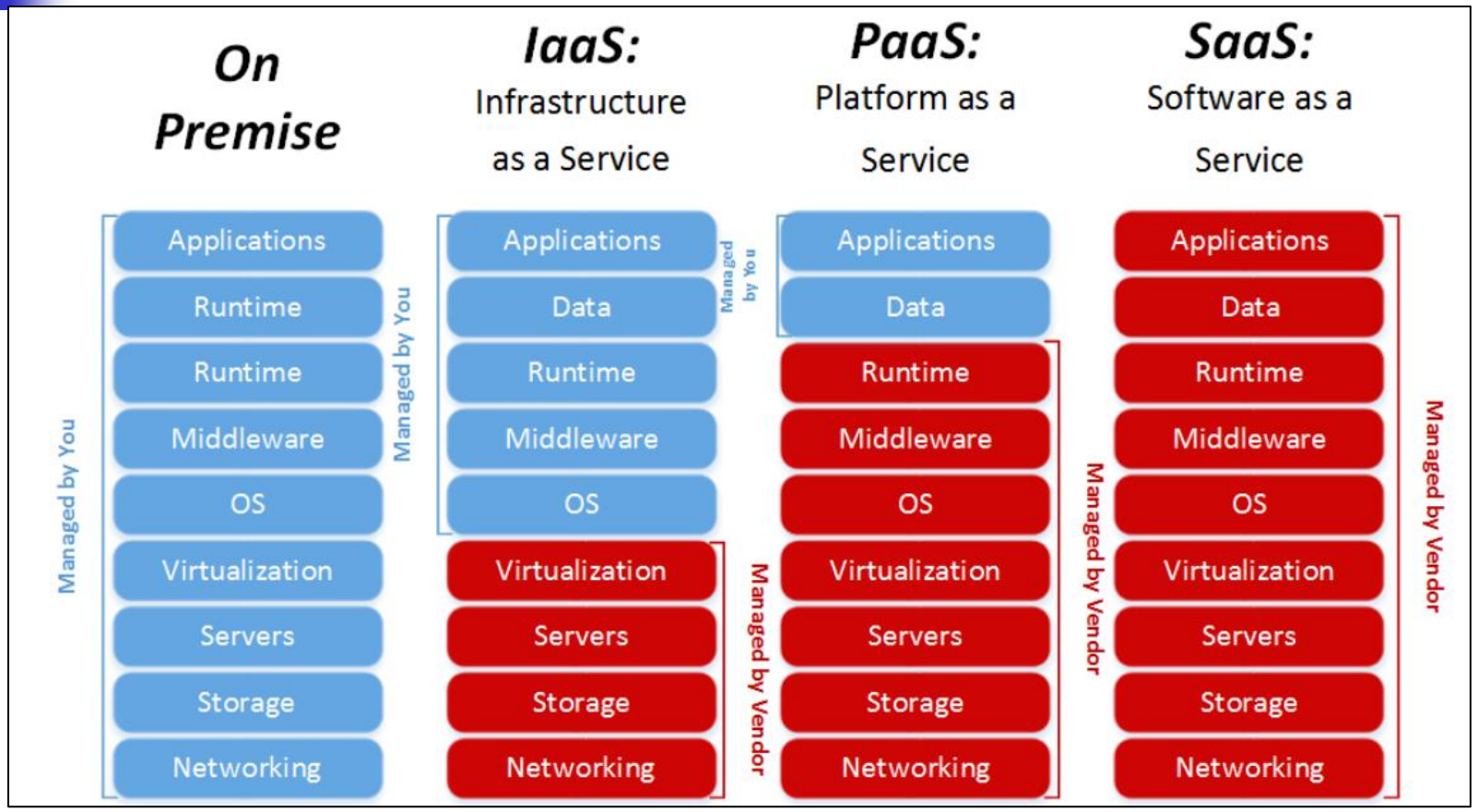
Cloud Computing

For Building Deep Learning Convolutional Neural Networks
If GPU and TPU are Needed for Data Ingestion

What is Cloud Computing?

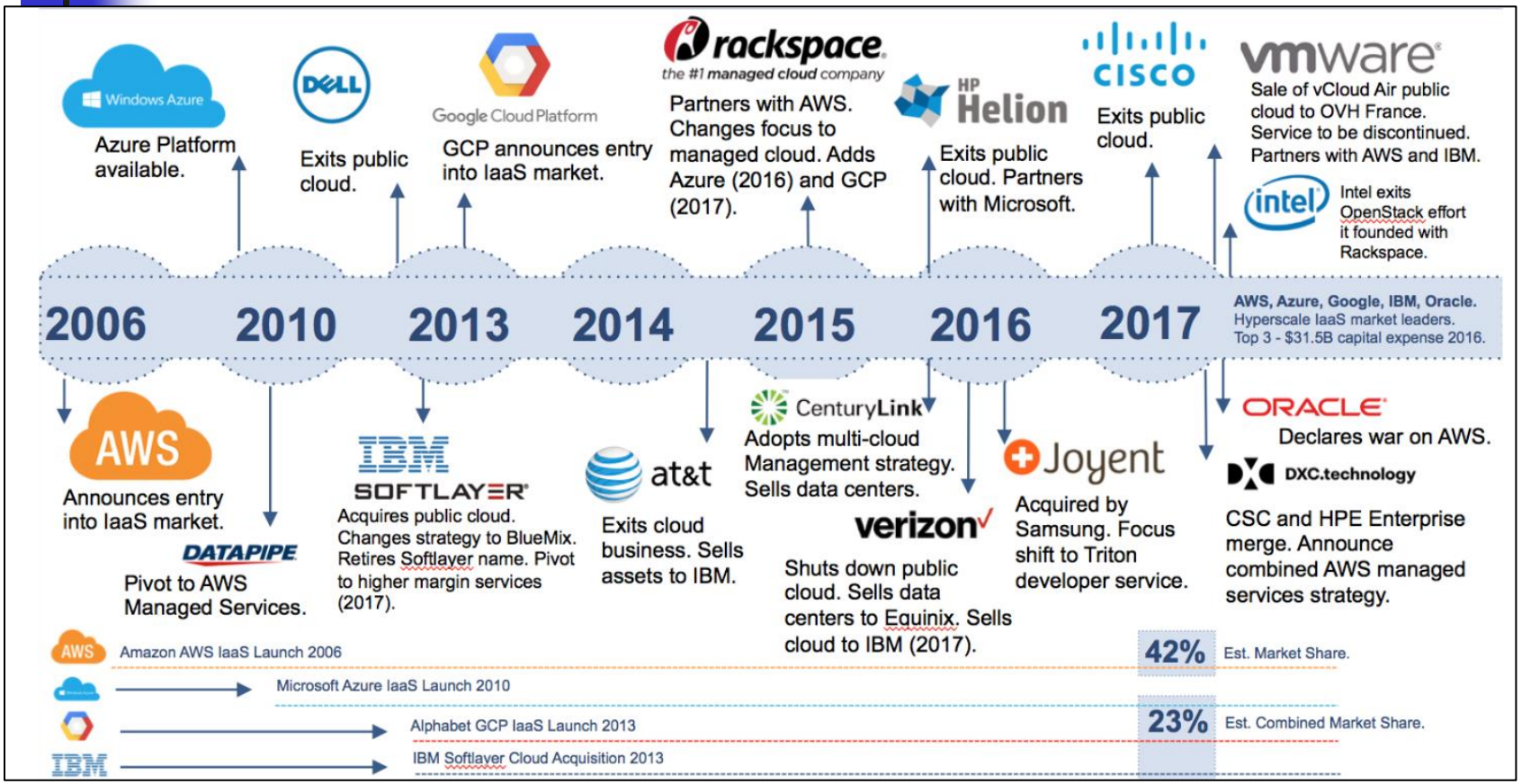
- Cloud computing is the delivery of computing services
  - Servers
  - Storage
  - Databases
  - Networking
  - Software
  - Analytics
  - Offer faster innovation, flexible resources
  - Economics of scale
- Cloud computing is using someone else's computer over the internet for your personal needs

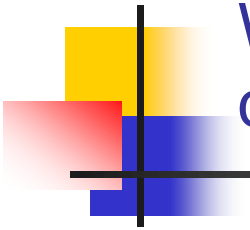
Types of Cloud Computing Service Models



Cloud Providers
Major Players

Cloud Providers Time Line





Why Choose Google Cloud Platform (GCP) over AWS and Azure?

- We plan to use TensorFlow software
  - Which is a Google's product
- We plan to use Keras software
  - Which is a Google's product
- We plan to use GPUs and TPUs
  - TPUs are only available with GCP
- Google's Cloud prices are lowest

Why Choose Google Cloud Platform (GCP) over AWS and Azure?

- If you plan to use Convolutional Neural Network (CNN) for object identification in an image
  - You must use GPUs
  - You cannot build this Model on your own personal computer because you don't have the right GPU
  - Build a computer on Google Cloud Platform which has the correct GPU
    - Build the CNN on GCP with the correct GPU

GPU and TPU Speed

	GPU	TPU
Speed	**Moderate** with 16GB memory and 100 TFLOPS on the best GPU Tesla V100	**High**, with 64GB memory and 180 TFLOPS of performance
Cost	**Expensive** at $3454 per training preemption on a GPU 8	**Cost-efficient** at $724 per training preemption
Best suited for	**Mid-to-large datasets and models, Image and video processing, Applications running CUDA or OpenCL**	**Matrix Computations, Dense vector processing, massive datasets and huge models**