Getting started with Tensorflow

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Boise Code Camp before 2018

- 2014 – Android Development
- 2016 – Getting rich with JavaFX
- 2017 – WPF 3D programming

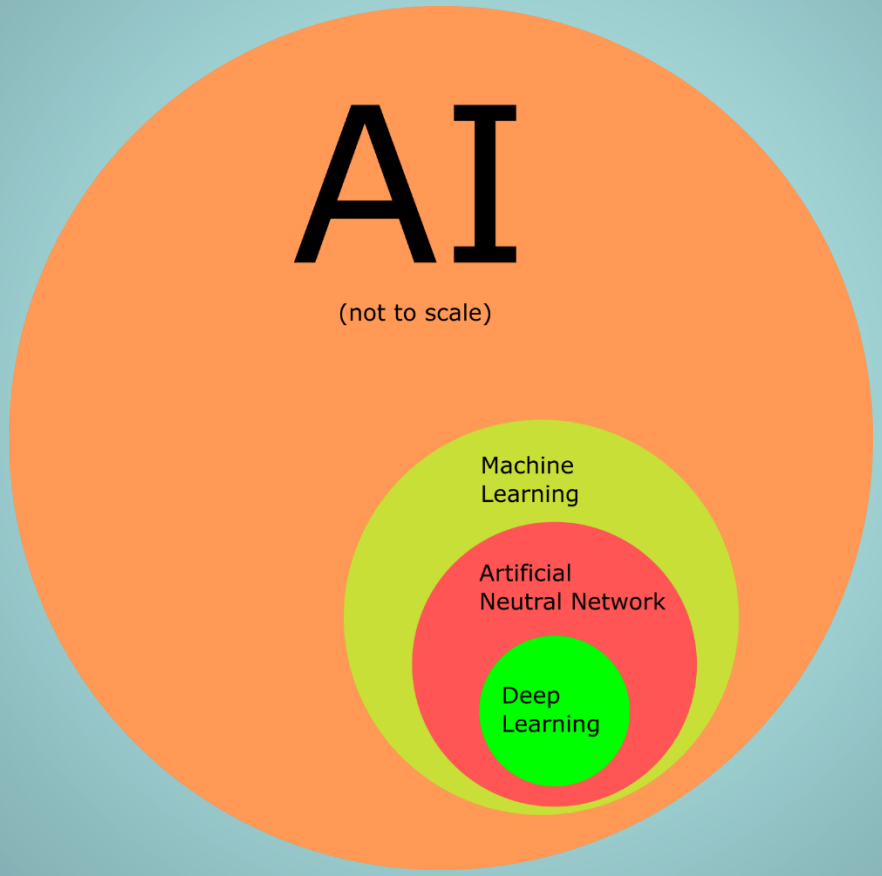
Machine Learning related presentations

- Email spam filter
- AI for facial / Image Recognition (or computer vision)

Agenda

- Introduction
- History
- Installation/Setup
- Recent news
- Core component/concept
- TensorFlow is a library with hundreds of functions, not a programming language. Code demo until we run out of time.
- Future of TensorFlow (make sure we leave time for that)

What is Machine Learning?



- A subset of AI (Artificial Intelligence)
- Has been around for several decades
- Not to scale since size of AI is unknown

Questions…

- Learn TensorFlow for?
- Learn machine learning or deep neural network for?
- What is the path to learn machine learning?
- Experience with Machine Learning using Scikit-Learn?

- Background:
  data scientists, academic researchers, current college students (computer/science/engineering/math and …), fresh CS graduates, veteran developers or others?

- Python is a must…(at least at this time)

- Programming is (relatively) light, concept is deep

Get your hands dirty

Play with code from books, online tutorial, github etc.

- Change the parameters: learning rate, epochs, batch size, optimizer, percentage of train/test/validation etc. or even another dataset
- Plot the output with matplotlib for visualization and analysis

What is TensorFlow™

- an open source software library for numerical computation using data flow graphs.
  Provide primitives for defining functions on tensors and automatically computing their derivatives.
  Building neutral network

- The most popular AI framework

- Other AI libraries/frameworks:
  PyTorch, Caffe, Theano (no further development), CNTK, …etc

- Comparison of AI Frameworks
  https://skymind.ai/wiki/comparison-frameworks-dl4j-tensorflow-pytorch

A Little History

- Google Brain team built DistBrief in 2011 as proprietary machine learning system for deep neutral network
- TensorFlow was developed by the Google Brain team for internal Google use. It was released under the Apache 2.0 open source license on November 9, 2015
- Version 1.0.0 was released on February 11, 2017
- 2017 integrated with Keras in Tensorflow core library
- Keras is an open source neural network library in Python and can run on top of framework other than TensorFlow

- Google Tensorflow 2018 summit: Interactive, Tensorflow.js (provide building blocks for neutral network programming in Javascript), tf.data.Datasets (see demo later),
- May 2017 Tensorflow Lite for running machine learning models on mobile and embedded devices

Latest News: TensorFlow 2.0 Alpha - A

- Google is rolling out the alpha version of TensorFlow 2.0, which Google says is simpler and more intuitive to use.
- The launch of TensorFlow Datasets lets developers import many common datasets.
- With TensorFlow 2.0, Google is making API components integrate better with tf.keras as the recommended high-level API for most users
- TensorFlow 2.0 will feature eager execution by default
- Keras is an open source neural network library in Python

Latest News: TensorFlow 2.0 Alpha - B

- A new add-ons, TensorFlow Federated. The open source framework allows for experimentation with machine learning and other computations on decentralized data -- where the data is generated

- TensorFlow Privacy is an open source library that makes it easier for developers to train machine learning models using techniques based on the theory of differential privacy (fairer and safer training.). It effectively offers a strong mathematical guarantee that machine learning models don't learn or remember details about specific users.
- https://venturebeat.com/2019/03/06/google-releases-tensorflow-privacy-a-library-for-training-ai-models-with-strong-privacy-guarantees/

- TensorFlow.js version 1.0 for the Javascript community.
- TensorFlow with Swift
- TensorFlow Lite for mobile. In January 2019, TensorFlow team released a developer preview of the mobile GPU inference engine with OpenGL ES 3.1 Compute Shaders on Android devices and Metal Compute Shaders on iOS devices.

- Clear complexity and duplicates (used to be seem confusing of have many ways to doing things)

- https://www.tensorflow.org/community/roadmap

- To uninstall: pip install –U –pre tensorflow

Conda / Anaconda

Conda or full Anaconda before install TensorFlow

<base> c:\...\myFolder>conda info --envs
*base * C:\Users\....\Anaconda3*
py_3_6_4_tf C:\Users\.....\Anaconda3\envs\py_3_6_4_tf

<base> c:\...\myFolder\activate py_3_6_4_tf
<py_3_6_4_tf> c:\....\myFolder>

Import tensorflow as tf
print('Tensorflow version:', tf.__version__) # python 3
→ Tensorflow version: 1.12.0 # Installation success!!!

Installaton

Mac, Ubantu, Windows 7 or later (64-bit) *(Python 3 only)* etc.

https://www.tensorflow.org/install
https://www.tensorflow.org/install/pip

CPU or GPU (Nvida) and Google TPU
pip install tensorflow (CPU only)
devices = sess.list_devices() # show CPU/GPU/TPU etc. devices

Note: I once had issue with OpenCV2

Install to take advantage of GPU needs extra work.

(demo tf_verify.py)

ML in the cloud

Microsoft Azure

Google Cloud

AWS EC2

Floydhub

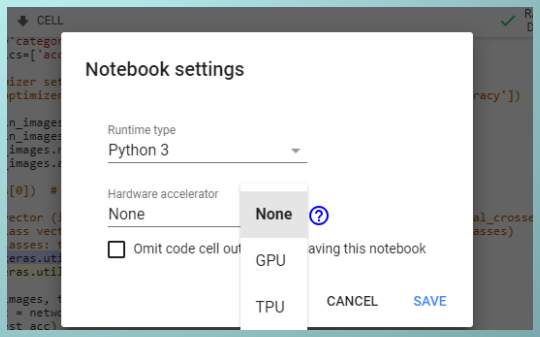
….. Etc.

Best Deals in Deep Learning Cloud Providers

https://towardsdatascience.com/maximize-your-gpu-dollars-a9133f4e546a

Google Colab

- https://colab.research.google.com
- Jupyter Notebook with TensorFlow readuy.
- Free cloud service
- Free GPU!!!
  Edit -> Notebook settings or Runtime -> Change runtime type and select GPU (or TPU) as Hardware accelerator.



- Files stored in Google Drive
  or from upload

What is tensor?

In mathematics, a tensor is a geometric object that maps in a multi-linear manner geometric vectors, scalars, and other tensors to a resulting tensor.

……. multi-dimensional array

In the Tensorflow graph, nodes are operators (ops), variables etc. Edges are tensors

- 0-D Scalar
- 1-D Vector
- 2-D Matrix
- etc.

DataTypes

- Constants
  x = tf.constant([1,2])

- Variables
  are the parameters of the algorithm and
  TensorFlow keeps track of how to change these to optimize the algorithm.

- Placeholders (demo: sigmoid.py)
  are objects that allow you to feed in data of a specific type and shape and depend on the results of the computational graph, such as the expected outcome of a computation. (feed_dict)

- Tensor

Many many functions

- https://www.tensorflow.org/api_docs/python/tf

tf.reshape, tf.add, tf.mul, tf.cross, tf.sqeeze, tf.pack, tf.random_normal, tf.print(), tf.matmul()

tf.add (tf.math.add), abs(), ceil()

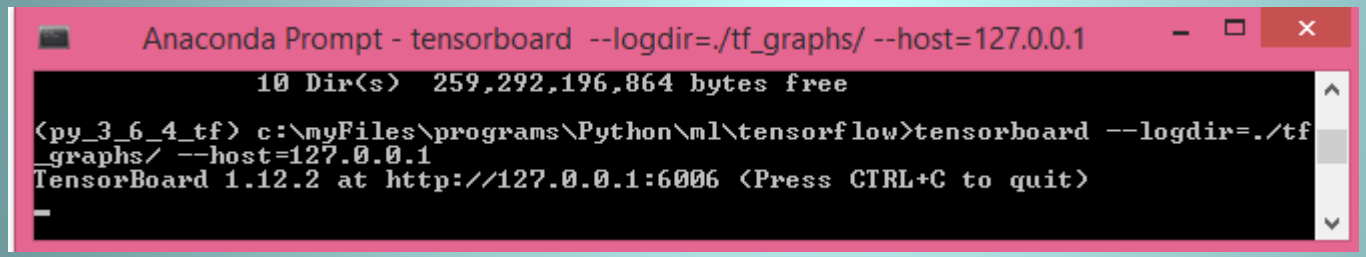
cos(), cosh(), floor(), min(), max(),power()

softmax(), sqrt() ……..many more.

Tensorboard

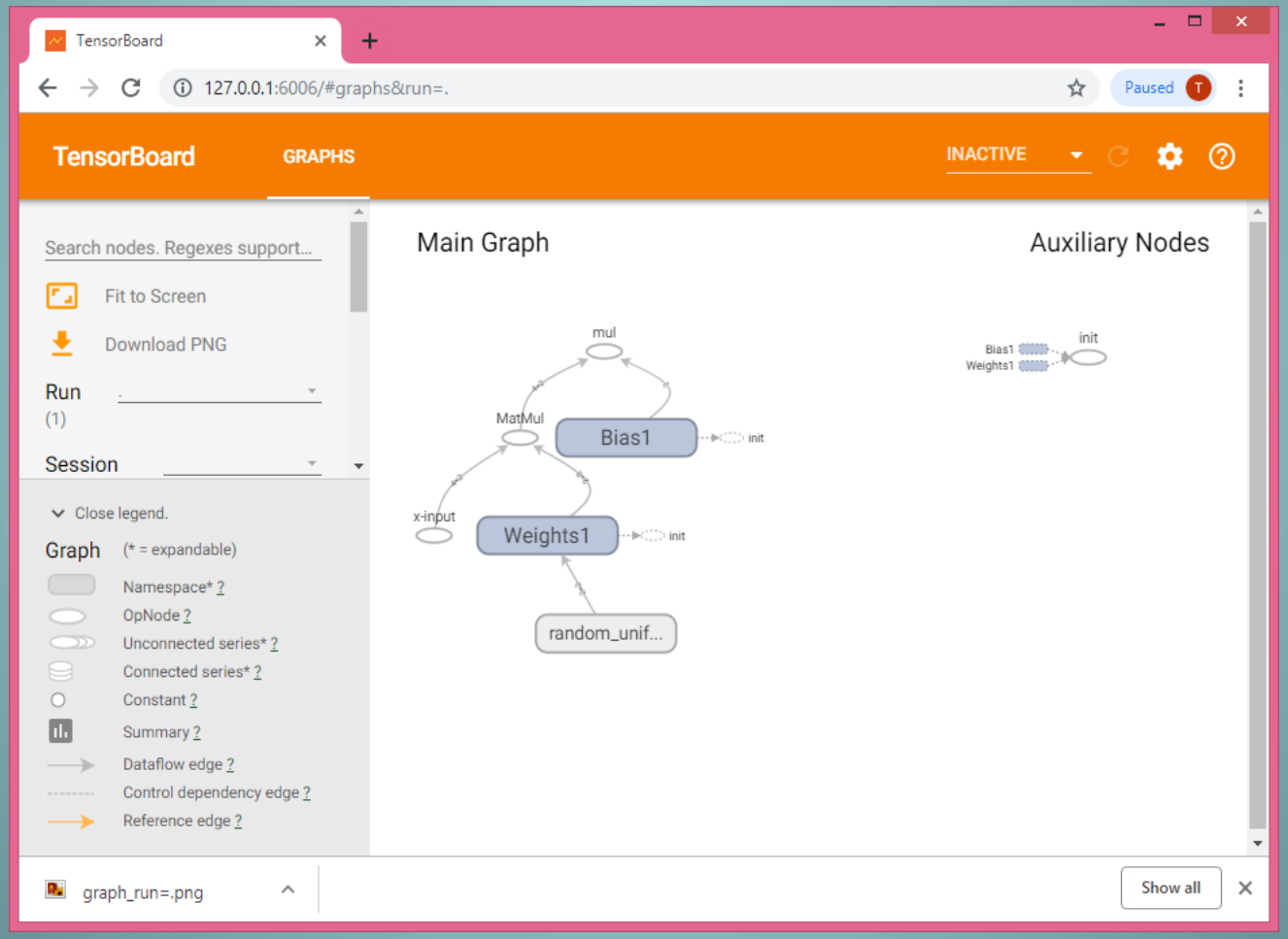
writer = tf.summary.FileWriter("./tf_graphs", sess.graph)

c:\...\tensorflow>tensorboard --logdir=.//(your subfolder) --host=127.0.0.1
→
TensorBoard 1.12.2 at http://127.0.0.1:6006 (Press CTRL+C to quit)



Note:
Use –host:127.0.0.1 resolves issue of Tensorboard error:
No dashboards are active for current data set
It does not like multiple files. Keep each output file in its subfolder

Tensorflow Graph



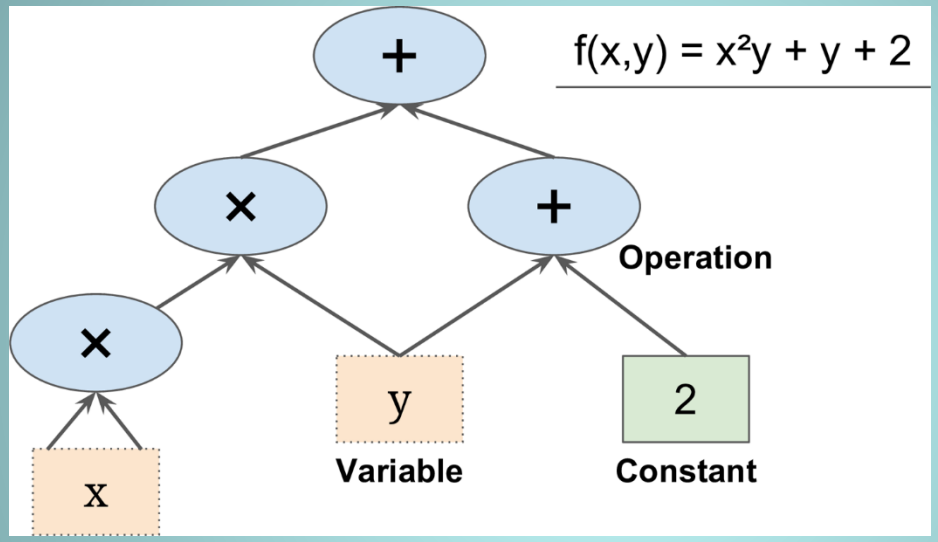
Key components

Tensors
Operations
Sessions
Computational Graph

But for tensor flow to really work you have to initiate a "**session**" and run your "**operation**“
When you say print, you only assess the shape of the variable and constant you defined

sess.run(tf.global_variables_initializer())

Computation Graph



- An animated dataflow graph sample at https://www.tensorflow.org/guide/graphs

Session

```
sess = tf.session()
sess.run(tf.global_variables_initializer())
sess.close()
```

Alternative:

```
with tf.Session() as sess:
    sess.run(tf.global_variables_initializer())
```

```
sess = tf.InteractiveSession()
```

Note: demo in pc and Colab

Variables

Syntax:
Create a variable:
x = tf.Variable(<init-value>,name=<optional-name>)

init_op = tf.global_variables_initializer()
sess.run(init_op)
or
sess.run(tf.global_variables_initializer())

Variable Name

```
v1 = tf.Variable([[1, 2], [3,4]], name='vector_1')
v2 = tf.Variable([[5, 6], [7,8]], name='vector_2')
Init = tf.initialize_all_variables()

Saver = tf.train.Saver()
sess = tf.Session()
sess.run(init)
save.path = save.save(sess, "/mymodel.ckpt")
sess.close()
```

When saving and restoring variables, only TensorFlow names are used. Variables, v1 and v2, are saved as vector_1 and vector_2 in the file.

TensorFlow with Keras

```
import tensorflow as tf
from tensorflow.keras import layers
from tensorflow.keras.utils import to_categorical

model = tf.keras.models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(28, 28, 1)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu', input_shape=(28, 28, 1)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
# print(model.summary())

model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10, activation='softmax'))
# print(model.summary())

mnist = tf.keras.datasets.mnist
(train_images, train_labels),(test_images, test_labels) = mnist.load_data()
```

TensorFlowJS 1.0 for Javacript Community

```
<script
src="https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@0.14.1/dist/tf.min.js">
</script>
```

Use Chrome
No Internet Explorer

(Simple code demo)

Future of TensorFlow

- What is the future of TensorFlow?
  https://www.quora.com/What-is-the-future-of-TensorFlow
  https://www.quora.com/profile/Liang-Huang-4

- Why does Facebook use Pytorch and not Tensorflow for deep learning?
  https://www.quora.com/Why-does-Facebook-use-Pytorch-and-not-Tensorflow-for-deep-learning

- Should I go for TensorFlow or PyTorch?
  https://www.quora.com/Should-I-go-for-TensorFlow-or-PyTorch
  quoted: Honestly, most experts that I know love Pytorch and detest TensorFlow. Karpathy and Justin from Stanford for example.

- https://www.quora.com/Which-deep-learning-framework-do-you-prefer
  quoted: I now use TensorFlow, as does everyone else at OpenAI. If I have to be honest, I feel like my code complexity has increased and I spend more time debugging than what I'm used to with Torch. This could also be temporary, while I'm still learning. (Andrej Karpathy)

- Swift for TensorFlow? https://www.tensorflow.org/swift

Thank You