TensorFlow Basics

Information Security Inc.

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What is TensorFlow?

- Google's publicly available Deep Learning library
- In competition with Caffe, Theano, etc

What is TensorFlow?

- Tensors are data (multidimensional array), Data Flow -> Tensor Flow

What is TensorFlow?

- Tensor

An n-dimensional array

0-d tensor: scalar (number)

1-d tensor: vector

2-d tensor: matrix

and so on

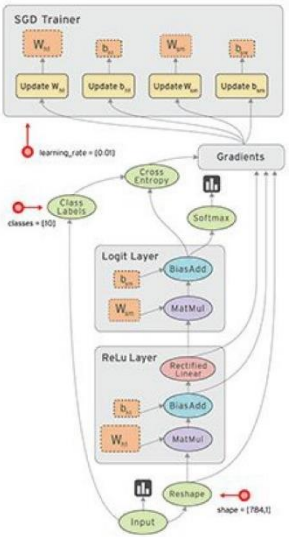
```
>>> scalar=1000
>>> type(scalar)
<type 'int'>
>>> Vector=[1,2,3,4,5,6,7,8,9,10]
>>> type(Vector)
<type 'list'>
```

What is TensorFlow?

- Flow

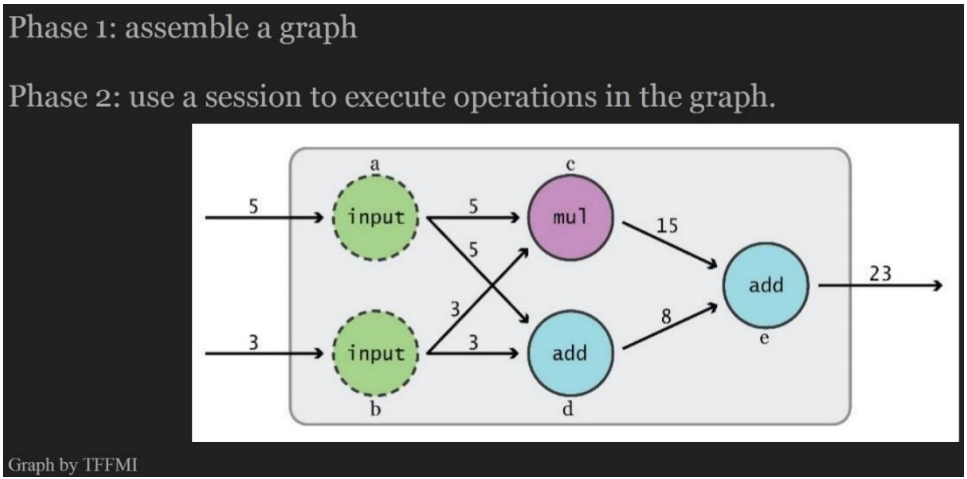
Computation is defined as a directed acyclic graph (DAG) to optimize an objective function

- Graph is defined in high-level language (Python)
- Graph is compiled and optimized
- Graph is executed (in parts or fully) on available low level devices (CPU, GPU)
- Data (tensors) flow through the graph
- TensorFlow can compute gradients automatically

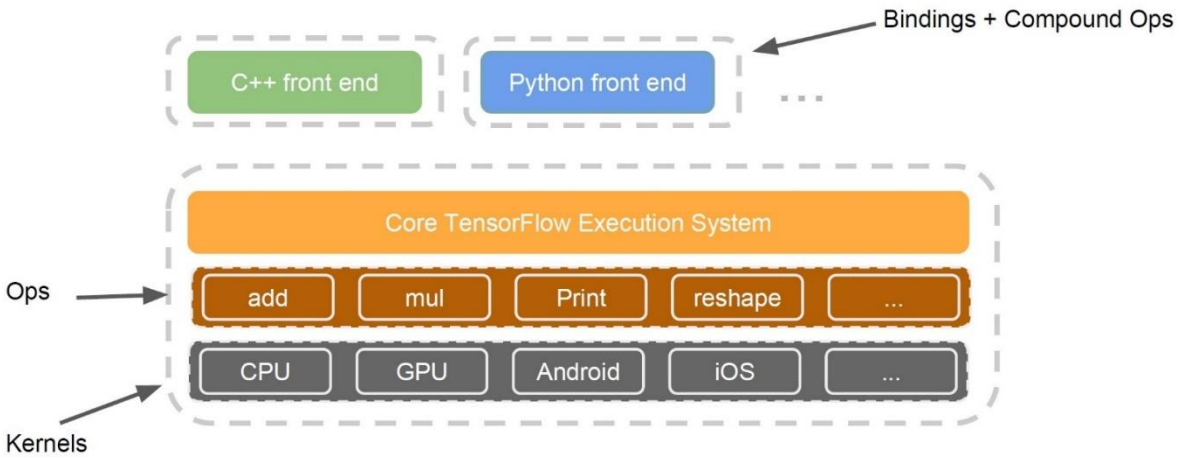


What is TensorFlow?

- Data Flow Graphs



TensorFlow Architecture



Testing Setup

- Kali Linux 2018.1

```
~# cat /etc/*rel*
DISTRIB_ID=Kali
DISTRIB_RELEASE=kali-rolling
DISTRIB_CODENAME=kali-rolling
DISTRIB_DESCRIPTION="Kali GNU/Linux Rolling"
PRETTY_NAME="Kali GNU/Linux Rolling"
NAME="Kali GNU/Linux"
ID=kali
VERSION="2018.1"
VERSION_ID="2018.1"
ID_LIKE=debian
ANSI_COLOR="1;31"
HOME_URL="http://www.kali.org/"
SUPPORT_URL="http://forums.kali.org/"
BUG_REPORT_URL="http://bugs.kali.org/"
```

Installing TensorFlow

- Installing with Virtualenv (https://www.tensorflow.org/install/install_linux)
- Python 2.7, Python 3.n

```
~# apt-get install python-pip python-dev python-virtualenv
Reading package lists... Done
Building dependency tree
Reading state information... Done
python-dev is already the newest version (2.7.14-4).
python-pip is already the newest version (9.0.1-2).
python-virtualenv is already the newest version (15.1.0+ds-1).
python-virtualenv set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
~# apt-get install python3-pip python3-dev python-virtualenv
Reading package lists... Done
Building dependency tree
Reading state information... Done
python-virtualenv is already the newest version (15.1.0+ds-1).
python3-dev is already the newest version (3.6.4-1).
python3-pip is already the newest version (9.0.1-2).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

Installing TensorFlow

- Installing with Virtualenv (https://www.tensorflow.org/install/install_linux)
- Python 2.7

```
             ~# virtualenv --system-site-packages tensorflow
Running virtualenv with interpreter /usr/bin/python2
New python executable in /root/tensorflow/bin/python2
Also creating executable in /root/tensorflow/bin/python
Installing setuptools, pkg_resources, pip, wheel...done.
```

Installing TensorFlow

- Installing with Virtualenv (https://www.tensorflow.org/install/install_linux)
- Python 2.7

```
~# source ~/tensorflow/bin/activate
(tensorflow) ~#
```

Installing TensorFlow

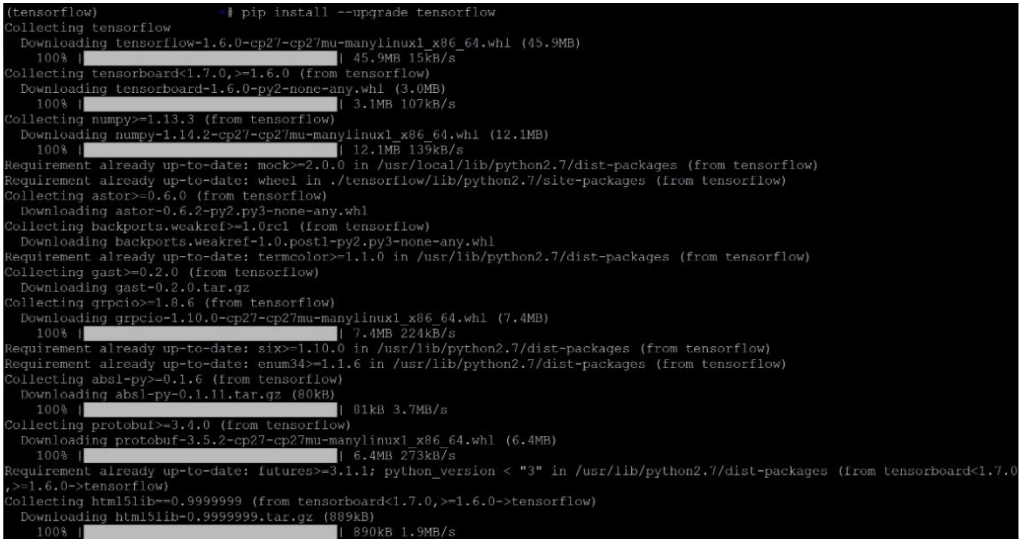
- Installing with Virtualenv (https://www.tensorflow.org/install/install_linux)
- Python 2.7

```
(tensorflow)              ~# easy_install -U pip
Searching for pip
Reading https://pypi.python.org/simple/pip/
Downloading https://pypi.python.org/packages/b6/ac/7015eb97dc749283ffdec1c3a88ddb8ae03b8fad0f0e611408f196358da3/pip-9.0.1-py2.py
3-none-any.whl#md5=297dbd16ef53bcef0447d245815f5144
Best match: pip 9.0.1
Processing pip-9.0.1-py2.py3-none-any.whl
Installing pip-9.0.1-py2.py3-none-any.whl to /root/tensorflow/lib/python2.7/site-packages
writing requirements to /root/tensorflow/lib/python2.7/site-packages/pip-9.0.1-py2.7.egg/EGG-INFO/requires.txt
Adding pip 9.0.1 to easy-install.pth file
Installing pip script to /root/tensorflow/bin
Installing pip3.5 script to /root/tensorflow/bin
Installing pip3 script to /root/tensorflow/bin

Installed /root/tensorflow/lib/python2.7/site-packages/pip-9.0.1-py2.7.egg
Processing dependencies for pip
Finished processing dependencies for pip
(tensorflow)              ~#
```

Installing TensorFlow

- Installing with Virtualenv (https://www.tensorflow.org/install/install_linux)
- Python 2.7



Installing TensorFlow

- Validate the installation (https://www.tensorflow.org/install/install_linux#ValidateYourInstallation)
- Python 2.7

```
(tensorflow)                ~# python
Python 2.7.14+ (default, Feb  6 2018, 19:12:18)
[GCC 7.3.0] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import tensorflow as tf
>>> hello = tf.constant('Hello, TensorFlow')
>>> session = tf.Session()


>>> print(session.run(hello))
Hello, TensorFlow
```

Using TensorFlow

- Linear Regression Program Code Basics

```
import tensorflow as tf
x = tf.placeholder(shape=[2,1],
                   dtype=tf.float32,
                   name="x")
W = tf.get_variable(shape=[1,2], name="W")
b = tf.get_variable(shape=[1], name="b")
y = tf.matmul(W, x) + b

with tf.Session() as sess:

  sess.run(tf.initialize_all_variables())

  print sess.run(y, feed_dict={x: x_in})
```

Build the graph

Prepare execution environment

Initialize variables

Run the computation (usually often)

Using TensorFlow

- tf.add

```
>>> import tensorflow as tf
>>> Sum = tf.add(10,5)
>>> print Sum
Tensor("Add_1:0", shape=(), dtype=int32)
>>> type(Sum)
<class 'tensorflow.python.framework.ops.Tensor'>
>>> with tf.Session() as session:
...       print session.run(Sum)
...
15
```

Using TensorFlow

- tf.pow, tf.multiply

```
>>> import tensorflow as tf
>>> x = 1
>>> y = 2
>>> add = tf.add(x,y)
>>> multiply = tf.multiply(x,y)
>>> power = tf.pow(multiply,add)
>>> with tf.Session() as session:
...      power = session.run(power)
...
>>> print power
8
>>> type(power)
<type 'numpy.int32'>
```

References

- GitHub
https://github.com/tensorflow/tensorflow

- Official website
https://www.tensorflow.org

- Tutorials
https://github.com/martinwicke/tensorflow-tutorial