

TensorFlow Basics

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What is TensorFlow?

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

Deep-Learning Package Zoo

- Torch
- Caffe
- Theano (Keras, Lasagne)
- CuDNN
- Tensorflow
- Mxnet
- Etc.



What is TensorFlow?

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

A multidimensional array.



TensorFlow

A graph of operations.

What is TensorFlow?

- Tensor

An n-dimensional array

0-d tensor: scalar (number)

1-d tensor: vector

2-d tensor: matrix

and so on

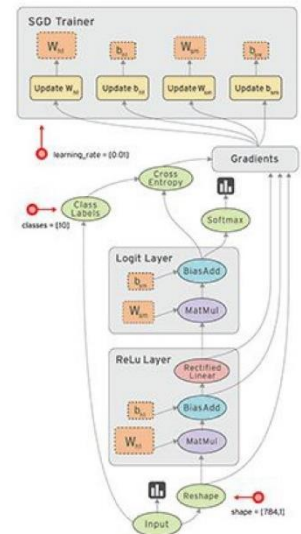
```
>>> scalar=1000
>>> type(scalar)
<type 'int'>
>>> Vector=[1,2,3,4,5,6,7,8,9,10]
>>> type(Vector)
<type 'list'>
```

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

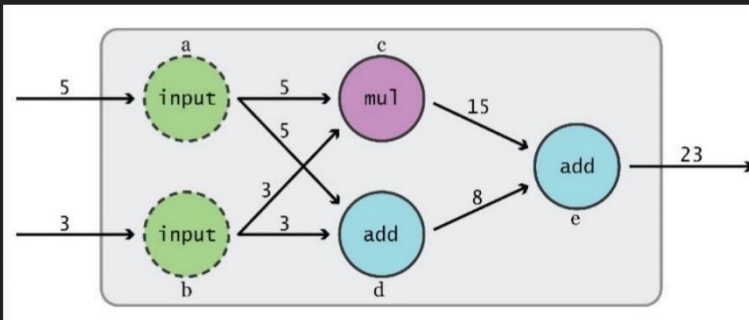


What is TensorFlow?

- Data Flow Graphs

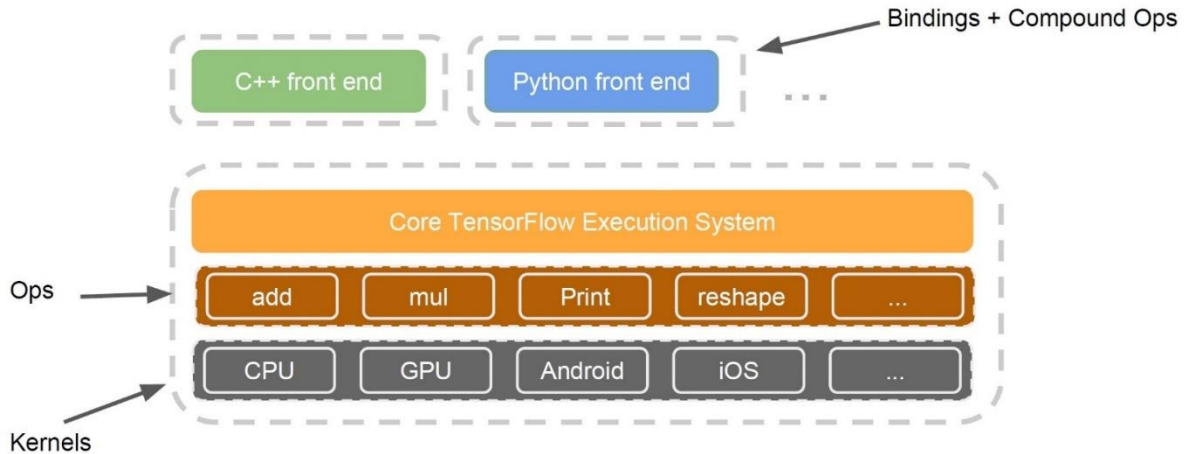
Phase 1: assemble a graph

Phase 2: use a session to execute operations in the graph.



Graph by TFFMI

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.py3-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

```
(tensorflow) # pip install --upgrade tensorflow
Collecting tensorflow
  Downloading tensorflow-1.6.0-cp27-cp27mu-manylinux1_x86_64.whl (45.9MB)
    100% |#####| 45.9MB 15KB/s
Collecting tensorboard<1.7.0,>=1.6.0 (from tensorflow)
  Downloading tensorboard-1.6.0-py2-none-any.whl (3.0MB)
    100% |#####| 3.1MB 107KB/s
Collecting numpy>=1.13.3 (from tensorflow)
  Downloading numpy-1.14.2-cp27-cp27mu-manylinux1_x86_64.whl (12.1MB)
    100% |#####| 12.1MB 139KB/s
Requirement already up-to-date: mock>=2.0.0 in /usr/local/lib/python2.7/dist-packages (from tensorflow)
Requirement already up-to-date: wheel in ./tensorflow/lib/python2.7/site-packages (from tensorflow)
Collecting astor>=0.6.0 (from tensorflow)
  Downloading astor-0.6.2-py2.py3-none-any.whl
Collecting backports.weakref>=1.0rc1 (from tensorflow)
  Downloading backports.weakref-1.0.post1-py2.py3-none-any.whl
Requirement already up-to-date: termcolor>=1.1.0 in /usr/lib/python2.7/dist-packages (from tensorflow)
Collecting gast>=0.2.0 (from tensorflow)
  Downloading gast-0.2.0.tar.gz
Collecting grpcio>=1.8.6 (from tensorflow)
  Downloading grpcio-1.10.0-cp27-cp27mu-manylinux1_x86_64.whl (7.4MB)
    100% |#####| 7.4MB 224KB/s
Requirement already up-to-date: six>=1.10.0 in /usr/lib/python2.7/dist-packages (from tensorflow)
Requirement already up-to-date: enum34>=1.1.6 in /usr/lib/python2.7/dist-packages (from tensorflow)
Collecting absl-py>=0.1.6 (from tensorflow)
  Downloading absl-py-0.1.11.tar.gz (80kB)
    100% |#####| 81kB 3.7MB/s
Collecting protobuf>=3.4.0 (from tensorflow)
  Downloading protobuf-3.5.2-cp27-cp27mu-manylinux1_x86_64.whl (6.4MB)
    100% |#####| 6.4MB 273KB/s
Requirement already up-to-date: futures>=3.1.1; python_version < "3" in /usr/lib/python2.7/dist-packages (from tensorflow)
Collecting html5lib==0.9999999 (from tensorboard<1.7.0,>=1.6.0->tensorflow)
  Downloading html5lib-0.9999999.tar.gz (889kB)
    100% |#####| 890kB 1.9MB/s
```

Installing TensorFlow

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

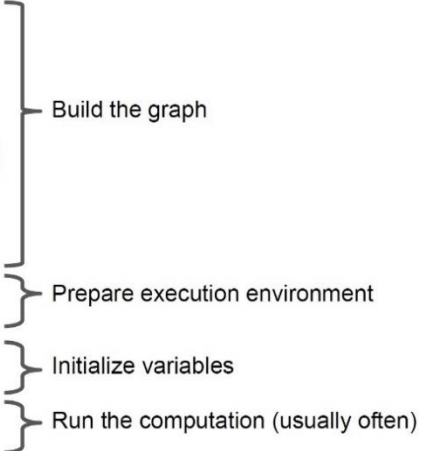
```
(tensorflow) # python
Python 2.7.14+ (default, Feb  6 2018, 19:12:18)
[GCC 7.3.0] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> import tensorflow as tf
>>> hello = tf.constant('Hello, TensorFlow')
>>> session = tf.Session()

>>> 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})
```



The code is annotated with four brackets on the right side, each pointing to a specific group of lines:

- Build the graph:** This bracket encompasses the first four lines of code, which define the placeholder for input `x`, and the variables for weights `W` and bias `b`.
- Prepare execution environment:** This bracket encompasses the `with tf.Session() as sess:` line, which sets up the TensorFlow session.
- Initialize variables:** This bracket encompasses the `sess.run(tf.initialize_all_variables())` line, which initializes the variables.
- Run the computation (usually often):** This bracket encompasses the `print sess.run(y, feed_dict={x: x_in})` line, which runs the computation and prints the result.

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>