With TF 1.0!

Lab 1

TensorFlow Basics

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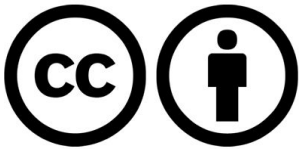
Code: https://github.com/hunkim/DeepLearningZeroToAll/



TensorFlow ™ Install Develop API r1.0 Deploy Extend Resources Versions Search GitHub

An open-source software library for Machine Intelligence

GET STARTED

TensorFlow 1.0 has arrived!

We're excited to announce the release of TensorFlow 1.0! Check out the migration guide to upgrade your code with ease.

UPGRADE NOW

Dynamic graphs in TensorFlow

We've open-sourced TensorFlow Fold to make it easier than ever to work with input data with varying shapes and sizes.

LEARN MORE

The 2017 TensorFlow Dev Summit

Thousands of people from the TensorFlow community participated in the first flagship event. Watch the keynote and talks.

WATCH VIDEOS

https://www.tensorflow.org

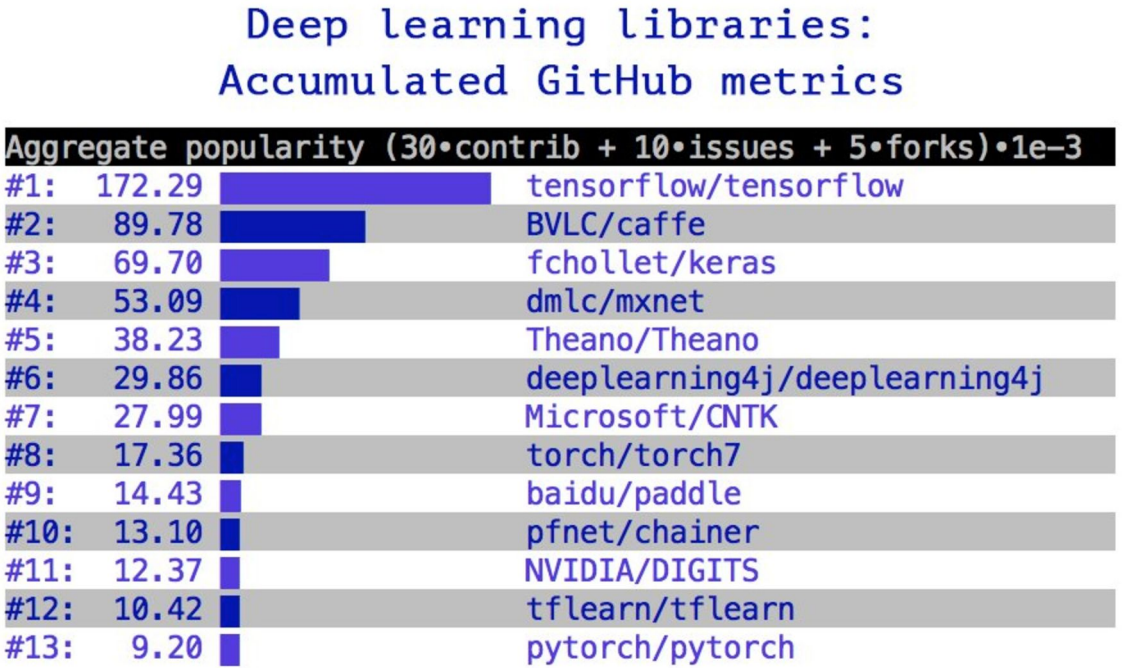
Call for comments

Please feel free to add comments directly on these slides

Other slides: https://goo.gl/jPtWNt

Picture from http://www.tssablog.org/archives/3280

TensorFlow



https://twitter.com/fchollet/status/830499993450450944/

Deep learning libraries: growth over past three months

new contributors from 2016-10-09 to 2017-02-10		
#1:	192	tensorflow/tensorflow
#2:	89	dmlc/mxnet
#3:	78	fchollet/keras
#4:	42	baidu/paddle
#5:	29	Microsoft/CNTK
#6:	23	pfnet/chainer
#7:	21	Theano/Theano
#8:	20	deeplearning4j/deeplearning4j
#9:	20	tflearn/tflearn
#10:	19	BVLC/caffe
#11:	9	torch/torch7
#12:	3	NVIDIA/DIGITS

new forks from 2016-10-09 to 2017-02-10		
#1:	6525	tensorflow/tensorflow
#2:	1822	BVLC/caffe
#3:	1316	fchollet/keras
#4:	999	dmlc/mxnet
#5:	909	deeplearning4j/deeplearning4j
#6:	887	Microsoft/CNTK
#7:	324	tflearn/tflearn
#8:	321	baidu/paddle
#9:	287	Theano/Theano
#10:	257	torch/torch7
#11:	175	NVIDIA/DIGITS
#12:	142	pfnet/chainer

new issues from 2016-10-09 to 2017-02-10		
#1:	1563	tensorflow/tensorflow
#2:	979	fchollet/keras
#3:	871	dmlc/mxnet
#4:	646	baidu/paddle
#5:	486	Microsoft/CNTK
#6:	361	deeplearning4j/deeplearning4j
#7:	318	BVLC/caffe
#8:	217	NVIDIA/DIGITS
#9:	214	Theano/Theano
#10:	167	tflearn/tflearn
#11:	150	pfnet/chainer
#12:	90	torch/torch7

aggregate metrics growth from 2016-10-09 to 2017-02-10		
#1:	54.01	tensorflow/tensorflow
#2:	18.71	fchollet/keras
#3:	16.38	dmlc/mxnet
#4:	12.86	BVLC/caffe
#5:	10.17	Microsoft/CNTK
#6:	9.32	baidu/paddle
#7:	8.75	deeplearning4j/deeplearning4j
#8:	4.21	Theano/Theano
#9:	3.89	tflearn/tflearn
#10:	3.14	NVIDIA/DIGITS
#11:	2.90	pfnet/chainer
#12:	2.46	torch/torch7

François Chollet @fchollet · Feb 11

Time for an update: what does the deep learning library landscape look like, seen from GitHub? pic.twitter.com/QDZyvLrYBd

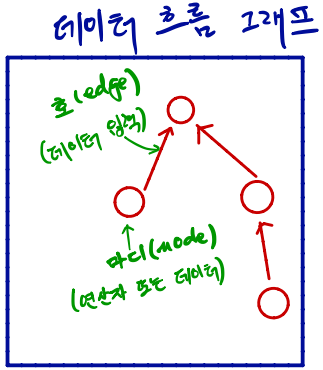
https://twitter.com/fchollet/status/830499993450450944/

TensorFlow

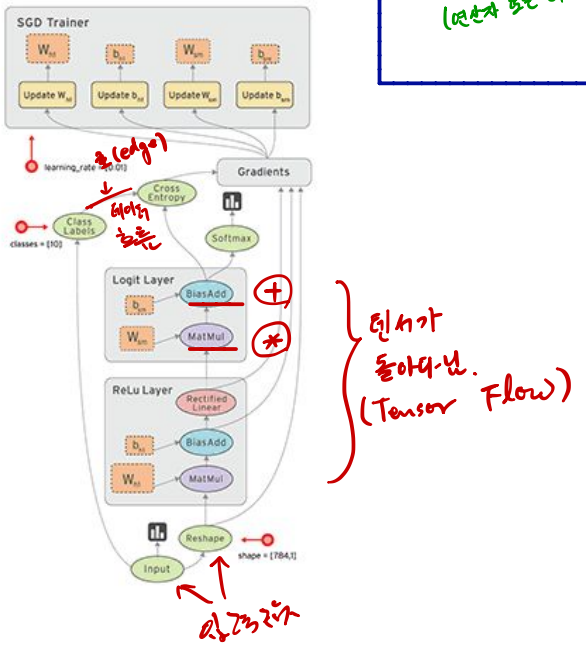
- TensorFlow™ is an open source software library for numerical computation using data flow graphs.
- Python!

https://www.tensorflow.org/

What is a Data Flow Graph?



- Nodes in the graph represent mathematical operations
- Edges represent the multidimensional data arrays (tensors) communicated between them.



https://www.tensorflow.org/

Installing TensorFlow

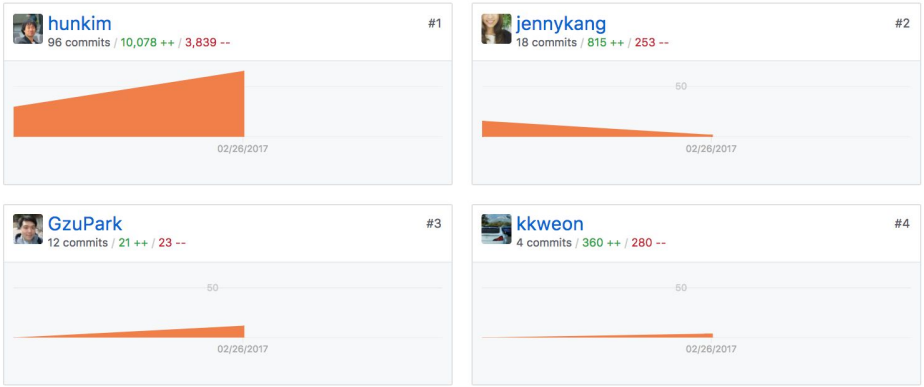
- Linux, Max OSX, Windows
  - (sudo -H) pip install --upgrade tensorflow
  - (sudo -H) pip install --upgrade tensorflow-gpu
- From source
  - bazel ...
  - https://www.tensorflow.org/install/install_sources
- Google search/Community help
  - https://www.facebook.com/groups/TensorFlowKR/

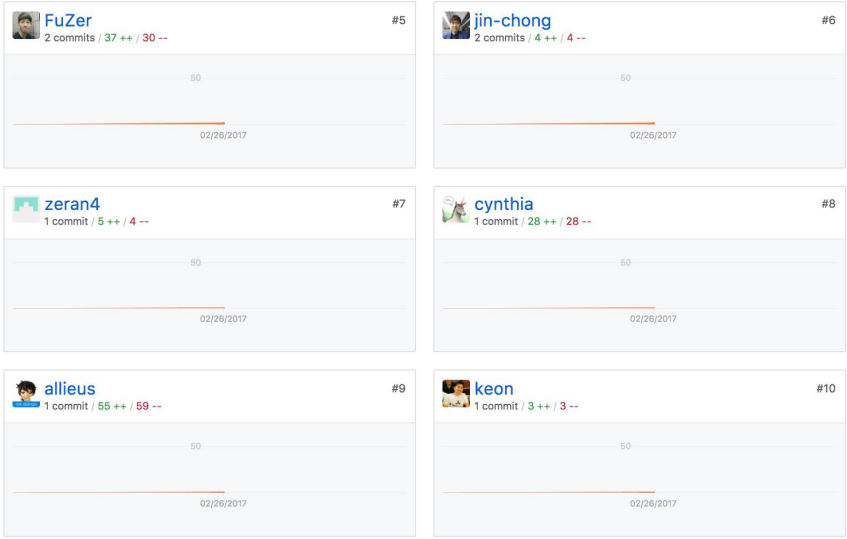
https://www.tensorflow.org/install/

Check installation and version

```
Sungs-MacBook-Pro:hunkim$ python3
Python 3.6.0 (v3.6.0:41df79263a11, Dec 22 2016, 17:23:13)
[GCC 4.2.1 (Apple Inc. build 5666) (dot 3)] on darwin
Type "help", "copyright", "credits" or "license" for more
information.
>>> import tensorflow as tf
>>> tf.__version__
'1.0.0'
>>>
```

https://github.com/hunkim/DeepLearningZeroToAll/





TensorFlow Hello World!

Hello TensorFlow!

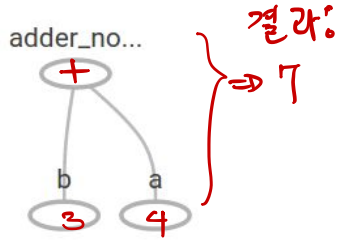
In [2]:
```
# Create a constant op
# This op is added as a node to the default graph
hello = tf.constant("Hello, TensorFlow!")

# seart a TF session
sess = tf.Session()

# run the op and get result
print(sess.run(hello))
```

```
b'Hello, TensorFlow!'
```

b'String' '**b**' indicates *Bytes literals*. http://stackoverflow.com/questions/6269765/

https://github.com/hunkim/DeepLearningZeroToAll/blob/master/lab-01-basics.ipynb

Computational Graph



In [4]:
```
node1 = tf.constant(3.0, tf.float32)
node2 = tf.constant(4.0) # also tf.float32 implicitly
node3 = tf.add(node1, node2)
```

In [5]:
```
print("node1:", node1, "node2:", node2)
print("node3: ", node3)
```

```
node1: Tensor("Const_1:0", shape=(), dtype=float32) node2: Tensor("Const_2:0", shape=(), dtyp
e=float32)
node3:  Tensor("Add:0", shape=(), dtype=float32)
```

In [6]:
```
sess = tf.Session()
print("sess.run(node1, node2): ", sess.run([node1, node2]))
print("sess.run(node3): ", sess.run(node3))
```

리스트 사용: 즉, "run"은 하나의 연산값과 사용?

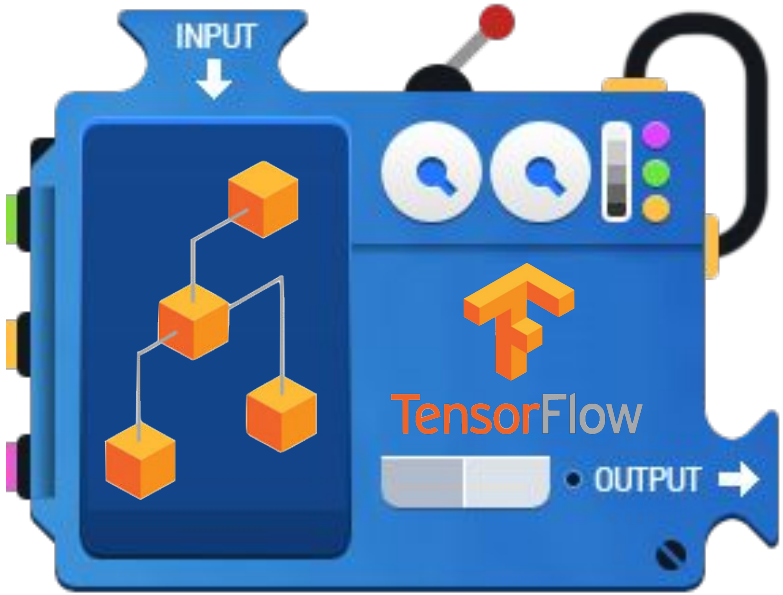
```
sess.run(node1, node2):  [3.0, 4.0]
sess.run(node3):  7.0
```

https://github.com/hunkim/DeepLearningZeroToAll/blob/master/lab-01-basics.ipynb

TensorFlow Mechanics

2 feed data and run graph (operation)
sess.run (op)

1 Build graph using
TensorFlow operations



3 update variables
in the graph
(and return values)

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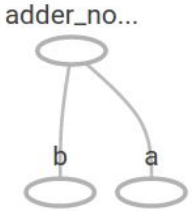
Computational Graph



(1) Build graph (tensors) using TensorFlow operations

In [4]:
```
node1 = tf.constant(3.0, tf.float32)
node2 = tf.constant(4.0) # also tf.float32 implicitly
node3 = tf.add(node1, node2)
```

(2) feed data and run graph (operation)
sess.run (op)

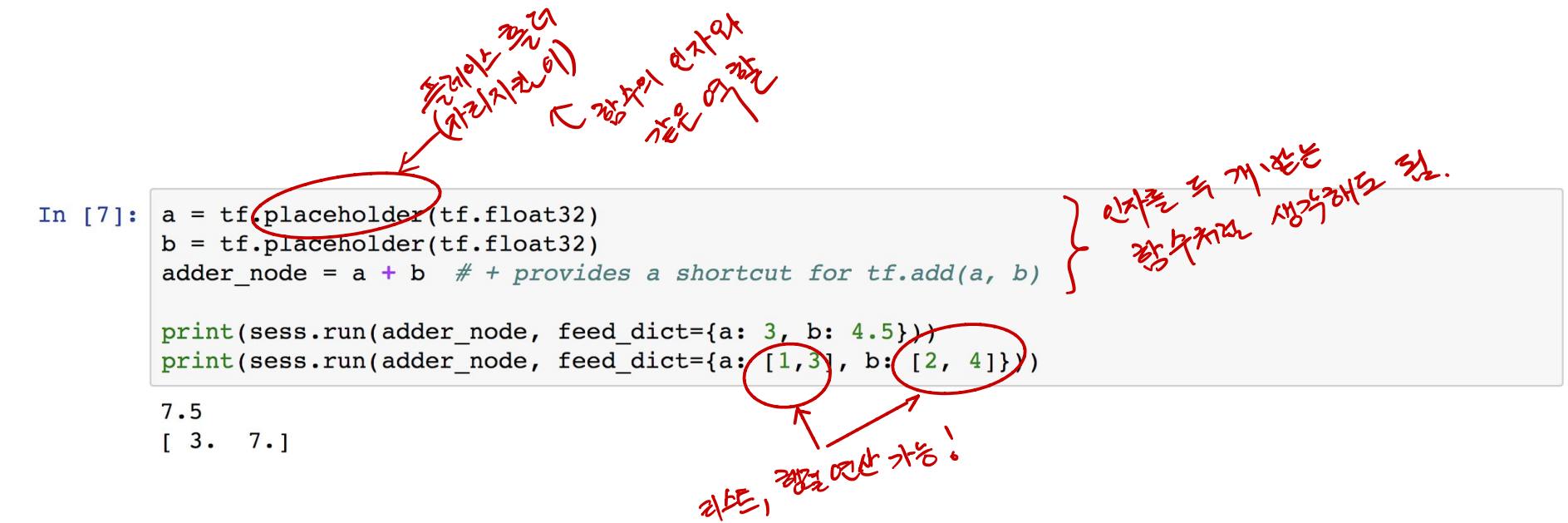
(3) update variables in the graph
(and return values)

In [6]:
```
sess = tf.Session()
print("sess.run(node1, node2): ", sess.run([node1, node2]))
print("sess.run(node3): ", sess.run(node3))
```

```
sess.run(node1, node2):  [3.0, 4.0]
sess.run(node3):  7.0
```

https://github.com/hunkim/DeepLearningZeroToAll/blob/master/lab-01-basics.ipynb

Placeholder



In [7]:
```
a = tf.placeholder(tf.float32)
b = tf.placeholder(tf.float32)
adder_node = a + b  # + provides a shortcut for tf.add(a, b)

print(sess.run(adder_node, feed_dict={a: 3, b: 4.5}))
print(sess.run(adder_node, feed_dict={a: [1,3], b: [2, 4]}))
```

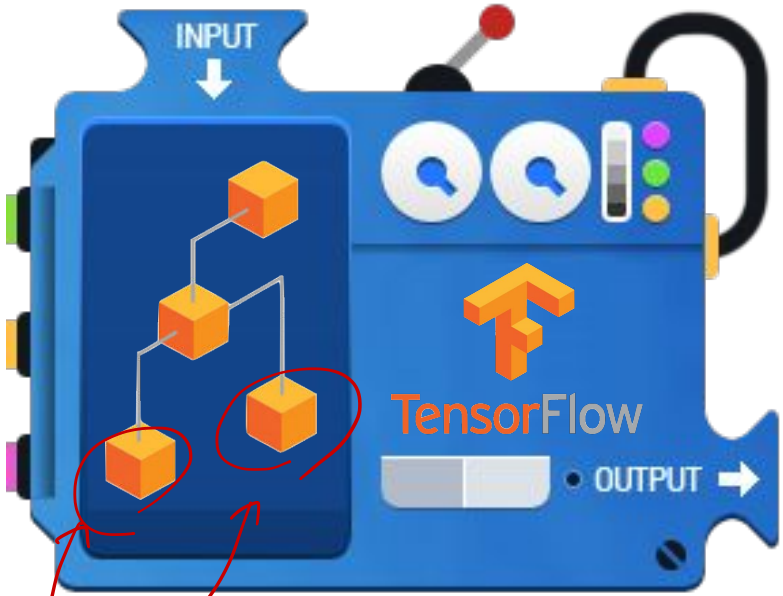
```
7.5
[ 3.  7.]
```


https://github.com/hunkim/DeepLearningZeroToAll/blob/master/lab-01-basics.ipynb

TensorFlow Mechanics

2 feed data and run graph (operation)
sess.run (op, feed_dict={x: x_data})

1 Build graph using
TensorFlow operations



3 update variables
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Everything is Tensor

Tensors

In [3]:
```
3 # a rank 0 tensor; this is a scalar with shape []
[1. ,2., 3.] # a rank 1 tensor; this is a vector with shape [3]
[[1., 2., 3.], [4., 5., 6.]] # a rank 2 tensor; a matrix with shape [2, 3]
[[[1., 2., 3.]], [[7., 8., 9.]]] # a rank 3 tensor with shape [2, 1, 3]
```

Out[3]:
```
[[[1.0, 2.0, 3.0]], [[7.0, 8.0, 9.0]]]
```

```
t = tf.Constant([1., 2., 3.])
```

Tensor Ranks, Shapes, and Types

```
t = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
```

Rank	Math entity	Python example
0	Scalar (magnitude only)	`s = 483`
1	Vector (magnitude and direction)	`v = [1.1, 2.2, 3.3]`
2	Matrix (table of numbers)	`m = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]`
3	3-Tensor (cube of numbers)	`t = [[[2], [4], [6]], [[8], [10], [12]], [[14], [16], [18]]]`
n	n-Tensor (you get the idea)	`....`

https://www.tensorflow.org/programmers_guide/dims_types

Tensor Ranks, Shapes, and Types

```
t = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
```

[3, 3]

Rank	Shape	Dimension number	Example
0	[]	0-D	A 0-D tensor. A scalar.
1	[D0]	1-D	A 1-D tensor with shape [5].
2	[D0, D1]	2-D	A 2-D tensor with shape [3, 4].
3	[D0, D1, D2]	3-D	A 3-D tensor with shape [1, 4, 3].
n	[D0, D1, ... Dn-1]	n-D	A tensor with shape [D0, D1, ... Dn-1].

https://www.tensorflow.org/programmers_guide/dims_types

Tensor Ranks, Shapes, and Types

```
t = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
```

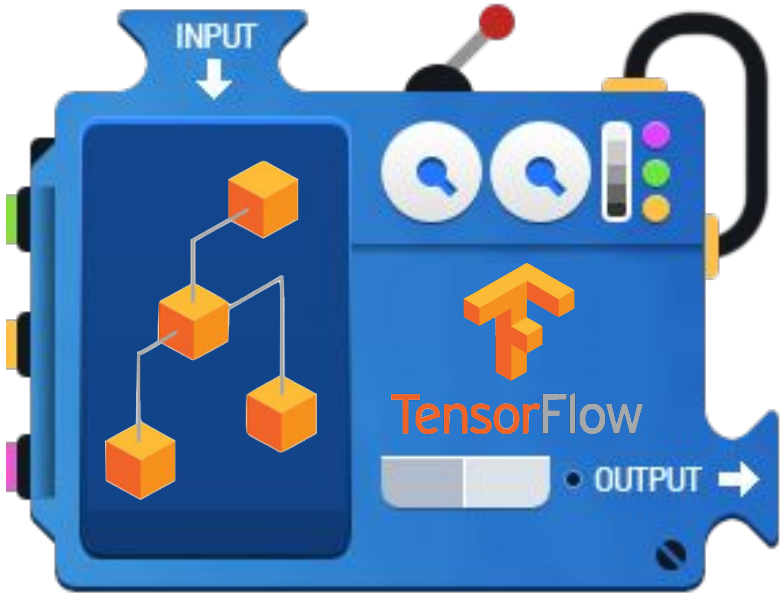
Data type	Python type	Description
DT_FLOAT	tf.float32	32 bits floating point.
DT_DOUBLE	tf.float64	64 bits floating point.
DT_INT8	tf.int8	8 bits signed integer.
DT_INT16	tf.int16	16 bits signed integer.
DT_INT32	tf.int32	32 bits signed integer.
DT_INT64	tf.int64	64 bits signed integer.

...

https://www.quora.com/When-should-I-use-tf-float32-vs-tf-float64-in-TensorFlow

TensorFlow Mechanics

2 feed data and run graph (operation)
sess.run (op, feed_dict={x: x_data})



1 Build graph using
TensorFlow operations

3 update variables
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