

## Lets create our first graph

```
In [1]: import tensorflow as tf
A = tf.random_uniform([5, 5])
B = tf.random_uniform([5, 5])
C = tf.matmul(A, B)
```

Nothing happens yet!! You need to execute within a session

```
In [2]: init = tf.global_variables_initializer()
session = tf.Session()
session.run(init)
print(session.run(C))

[[0.92342293  0.97581744  1.0739827   0.95377946  1.4225585 ]
 [1.4423686   0.7632344   1.34619     0.37725523  1.3136735 ]
 [2.0695152   1.3710645   1.8551669   1.3018324   2.321424   ]
 [0.5328803   0.3415317   0.37220478  0.3285788   0.67516005]
 [1.5628947   0.8033425   1.2338192   0.625152    1.5510216 ]]
```

## Lets look at the execution graph

```
In [3]: writer = tf.summary.FileWriter("./tmp/1", session.graph)
```

Look at Tensorboard.

Reset your graphs, variables and tensors. Just losing the scope of your Python variable would not make them disappear from TF.

```
In [4]: session.close()
writer.close()
```

```
In [5]: tf.reset_default_graph()
```

**Alternately, wrap definition and execution in a 'with' statement**

```
In [18]: tf.reset_default_graph()

A = tf.random_uniform([5, 5])
B = tf.random_uniform([5, 5])
C = tf.matmul(A, B)

with tf.Session() as session:
    writer = tf.summary.FileWriter("./tmp/2", session.graph)
    session.run(tf.global_variables_initializer())
    print(session.run(C))
```

```
[[0.58270246 0.12107206 0.6014858 0.5765956 0.4590448 ]
 [2.1913083 0.42713028 2.215557 2.0758169 1.6073785 ]
 [1.2803727 0.45601678 1.361676 1.678514 0.93928903]
 [0.7882417 0.21050674 0.6483246 0.8291022 0.79267156]
 [1.716768 0.31448406 1.6254915 1.538184 1.2250867 ]]
```

## Placeholders

```
In [19]: # Lets say we have data from some source
import numpy as np
a = np.random.rand(5, 5)
b = np.random.rand(5, 5)
print("a:")
print(a)
print("b:")
print(b)

tf.reset_default_graph()

# Let's create a graph with placeholders of data
x = tf.placeholder(tf.float32, [None, 5])
y = tf.placeholder(tf.float32, [None, 5])
xy = tf.matmul(x, y)
```

```
a:
[[0.53176869 0.42558849 0.8641057 0.75066237 0.69844921]
 [0.9558211 0.53669498 0.21975959 0.09194225 0.12469031]
 [0.20182447 0.08360521 0.91691463 0.1248992 0.4439368 ]
 [0.166133 0.13165877 0.78759152 0.93770036 0.37055783]
 [0.24356433 0.22916981 0.88310983 0.58110336 0.86627189]]

b:
[[0.33429038 0.80749723 0.0811067 0.73530326 0.36601407]
 [0.66219357 0.97903184 0.54732042 0.20120722 0.47366138]
 [0.31884244 0.8803958 0.71287797 0.92654382 0.60774345]
 [0.55643788 0.76128433 0.17171884 0.04807842 0.54661895]
 [0.62693397 0.88245876 0.36384744 0.32861626 0.12736735]]
```

```
In [16]: with tf.Session() as session:
         session.run(xy)
```

```
-----
-----
InvalidArgumentError                                Traceback (most recent call last)
/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in _do_call(self, fn, *args)
    1349         try:
-> 1350             return fn(*args)
    1351         except errors.OpError as e:

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in _run_fn(session, feed_dict, fetch_list, target_list, options, run_metadata)
    1328                                     feed_dict, fetch_list,
target_list,
-> 1329                                     status, run_metadata)
    1330

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/framework/errors_impl.py in __exit__(self, type_arg, value_arg, traceback_arg)
    472             compat.as_text(c_api.TF_Message(self.status.status)),
--> 473             c_api.TF_GetCode(self.status.status))
    474         # Delete the underlying status object from memory otherwise it stays alive

InvalidArgumentError: You must feed a value for placeholder tensor 'placeholder-b' with dtype float and shape [?,5]
      [[Node: placeholder-b = Placeholder[dtype=DT_FLOAT, shape=[?,5], _device="/job:localhost/replica:0/task:0/device:CPU:0"]()]]]

During handling of the above exception, another exception occurred:

InvalidArgumentError                                Traceback (most recent call last)
<ipython-input-16-ad4b583c82ec> in <module>()
      1 with tf.Session() as session:
----> 2     session.run(xy)

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in run(self, fetches, feed_dict, options, run_metadata)
    893         try:
    894             result = self._run(None, fetches, feed_dict, options_ptr,
--> 895                             run_metadata_ptr)
    896             if run_metadata:
    897                 proto_data = tf_session.TF_GetBuffer(run_metadata_ptr)
r)
```

```

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/ten
sorflow/python/client/session.py in _run(self, handle, fetches, feed
_dict, options, run_metadata)
    1126         if final_fetches or final_targets or (handle and
feed_dict_tensor):
    1127             results = self._do_run(handle, final_targets, final_fe
tches,
-> 1128                                     feed_dict_tensor, options, run_
metadata)
    1129         else:
    1130             results = []

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/ten
sorflow/python/client/session.py in _do_run(self, handle, target_lis
t, fetch_list, feed_dict, options, run_metadata)
    1342         if handle is None:
    1343             return self._do_call(_run_fn, self._session, feeds, fe
tches, targets,
-> 1344                                     options, run_metadata)
    1345         else:
    1346             return self._do_call(_prun_fn, self._session, handle,
feeds, fetches)

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/ten
sorflow/python/client/session.py in _do_call(self, fn, *args)
    1361         except KeyError:
    1362             pass
-> 1363         raise type(e)(node_def, op, message)
    1364
    1365     def _extend_graph(self):

```

InvalidArgumentError: You must feed a value for placeholder tensor 'placeholder-b' with dtype float and shape [?,5]

```

[[Node: placeholder-b = Placeholder[dtype=DT_FLOAT, shape=[
?,5], _device="/job:localhost/replica:0/task:0/device:CPU:0"]()]]

```

Caused by op 'placeholder-b', defined at:

```

File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/runpy.py"
, line 193, in _run_module_as_main
    "__main__", mod_spec)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/runpy.py"
, line 85, in _run_code
    exec(code, run_globals)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/__main__.py", line 3, in <module>
    app.launch_new_instance()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/traitlets/config/application.py", line 658, in launch_instance
    app.start()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelapp.py", line 474, in start
    ioloop.IOLoop.instance().start()

```

```

File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/ioloop.py", line 177, in start
    super(ZMQIOLoop, self).start()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/ioloop.py", line 887, in start
    handler_func(fd_obj, events)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/stack_context.py", line 275, in null_wrapper
    return fn(*args, **kwargs)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 440, in _handle_events
    self._handle_recv()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 472, in _handle_recv
    self._run_callback(callback, msg)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 414, in _run_callback
    callback(*args, **kwargs)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/stack_context.py", line 275, in null_wrapper
    return fn(*args, **kwargs)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 276, in dispatcher
    return self.dispatch_shell(stream, msg)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 228, in dispatch_shell
    handler(stream, idents, msg)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 390, in execute_request
    user_expressions, allow_stdin)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/ipkernel.py", line 196, in do_execute
    res = shell.run_cell(code, store_history=store_history, silent=s
ilent)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/zmqshell.py", line 501, in run_cell
    return super(ZMQInteractiveShell, self).run_cell(*args, **kwargs
)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2717, in run_cell
    interactivity=interactivity, compiler=compiler, result=result)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2821, in run_ast_nodes
    if self.run_code(code, result):
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2881, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
File "<ipython-input-15-cf99f08db3f4>", line 12, in <module>
    y = tf.placeholder(tf.float32, [None, 5], name="placeholder-b")
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/array_ops.py", line 1680, in placeholder
    return gen_array_ops._placeholder(dtype=dtype, shape=shape, name
=name)

```

```

File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/gen_array_ops.py", line 3141, in _placeho
lder
    "Placeholder", dtype=dtype, shape=shape, name=name)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/op_def_library.py", line 787, in _a
pply_op_helper
    op_def=op_def)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/ops.py", line 3160, in create_op
    op_def=op_def)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/ops.py", line 1625, in __init__
    self._traceback = self._graph._extract_stack() # pylint: disabl
e=protected-access

InvalidArgumentError (see above for traceback): You must feed a valu
e for placeholder tensor 'placeholder-b' with dtype float and shape
[?,5]

[[Node: placeholder-b = Placeholder[dtype=DT_FLOAT, shape=[
?,5], _device="/job:localhost/replica:0/task:0/device:CPU:0"]()]

```

What happened there?

Placeholders have no data to work with!!

```

In [20]: # Lets bind our data to our placeholders in the TF graph
with tf.Session() as session:
    print(session.run(xy, feed_dict={x:a, y:b}))

[[1.5906792  2.7946415  1.275097  1.542887  1.42066   ]
 [0.8743193  1.6707681  0.5890859  1.0598178  0.80375195]
 [0.76299983 1.5389124  0.8987492  1.1666756  0.79553527]
 [1.1479251  1.9973011  0.9428381  1.0452414  1.161584   ]
 [1.3811922  2.4053626  1.1897107  1.3560537  1.162378   ]]

```

## Variables

```

In [25]: W = tf.Variable(tf.random_uniform([1000,1000]))
        x = tf.Variable(tf.ones([1000,1]))

```

Let's execute this graph !!

```

In [26]: with tf.Session() as session:
        session.run(tf.matmul(W, x))

```

-----

```

-----
FailedPreconditionError                                Traceback (most recent call last)
/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in _do_call(self, fn, *args)
    1349         try:
-> 1350             return fn(*args)
    1351         except errors.OpError as e:

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in _run_fn(session, feed_dict, fetch_list, target_list, options, run_metadata)
    1328                                     feed_dict, fetch_list,
target_list,
-> 1329                                     status, run_metadata)
    1330

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/framework/errors_impl.py in __exit__(self, type_arg, value_arg, traceback_arg)
    472             compat.as_text(c_api.TF_Message(self.status.status)),
--> 473             c_api.TF_GetCode(self.status.status))
    474         # Delete the underlying status object from memory otherwise it stays alive

```

FailedPreconditionError: Attempting to use uninitialized value Variable\_3

```

[[Node: Variable_3/read = Identity[T=DT_FLOAT, _class=["loc:@Variable_3"], _device="/job:localhost/replica:0/task:0/device:CPU:0"](Variable_3)]]

```

During handling of the above exception, another exception occurred:

```

FailedPreconditionError                                Traceback (most recent call last)
<ipython-input-26-f353ce3be324> in <module>()
      1 with tf.Session() as session:
----> 2     session.run(tf.matmul(W, x))

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in run(self, fetches, feed_dict, options, run_metadata)
    893         try:
    894             result = self._run(None, fetches, feed_dict, options_ptr,
--> 895                               run_metadata_ptr)
    896         if run_metadata:
    897             proto_data = tf_session.TF_GetBuffer(run_metadata_ptr)
r)

```

```

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/tensorflow/python/client/session.py in _run(self, handle, fetches, feed

```

```

_dict, options, run_metadata)
    1126     if final_fetches or final_targets or (handle and
feed_dict_tensor):
    1127         results = self._do_run(handle, final_targets, final_fe
tches,
-> 1128                                     feed_dict_tensor, options, run_
metadata)
    1129     else:
    1130         results = []

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/ten
sorflow/python/client/session.py in _do_run(self, handle, target_lis
t, fetch_list, feed_dict, options, run_metadata)
    1342     if handle is None:
    1343         return self._do_call(_run_fn, self._session, feeds, fe
tches, targets,
-> 1344                                     options, run_metadata)
    1345     else:
    1346         return self._do_call(_prun_fn, self._session, handle,
feeds, fetches)

/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-packages/ten
sorflow/python/client/session.py in _do_call(self, fn, *args)
    1361     except KeyError:
    1362         pass
-> 1363     raise type(e)(node_def, op, message)
    1364
    1365     def _extend_graph(self):

```

FailedPreconditionError: Attempting to use uninitialized value Variable\_3

```

[[Node: Variable_3/read = Identity[T=DT_FLOAT, _class=["loc
:@Variable_3"], _device="/job:localhost/replica:0/task:0/device:CPU:
0"](Variable_3)]]

```

Caused by op 'Variable\_3/read', defined at:

```

File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/runpy.py"
, line 193, in _run_module_as_main
    "__main__", mod_spec)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/runpy.py"
, line 85, in _run_code
    exec(code, run_globals)
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/__main__.py", line 3, in <module>
    app.launch_new_instance()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/traitlets/config/application.py", line 658, in launch_instance
    app.start()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelapp.py", line 474, in start
    ioloop.IOLoop.instance().start()
File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/ioloop.py", line 177, in start

```



```

        super(ZMQIOLoop, self).start()
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/ioloop.py", line 887, in start
        handler_func(fd_obj, events)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/stack_context.py", line 275, in null_wrapper
        return fn(*args, **kwargs)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 440, in _handle_events
        self._handle_recv()
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 472, in _handle_recv
        self._run_callback(callback, msg)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/zmq/eventloop/zmqstream.py", line 414, in _run_callback
        callback(*args, **kwargs)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tornado/stack_context.py", line 275, in null_wrapper
        return fn(*args, **kwargs)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 276, in dispatcher
        return self.dispatch_shell(stream, msg)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 228, in dispatch_shell
        handler(stream, idents, msg)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/kernelbase.py", line 390, in execute_request
        user_expressions, allow_stdin)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/ipkernel.py", line 196, in do_execute
        res = shell.run_cell(code, store_history=store_history, silent=s
ilent)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/ipykernel/zmqshell.py", line 501, in run_cell
        return super(ZMQInteractiveShell, self).run_cell(*args, **kwargs
)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2717, in run_cell
        interactivity=interactivity, compiler=compiler, result=result)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2821, in run_ast_nodes
        if self.run_code(code, result):
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/IPython/core/interactiveshell.py", line 2881, in run_code
        exec(code_obj, self.user_global_ns, self.user_ns)
    File "<ipython-input-25-caalcc01cdde>", line 2, in <module>
        x = tf.Variable(tf.ones([1000,1]))
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/variables.py", line 229, in __init__
        constraint=constraint)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/variables.py", line 376, in _init_from_ar
gs

```

```

        self._snapshot = array_ops.identity(self._variable, name="read")
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/array_ops.py", line 127, in identity
        return gen_array_ops.identity(input, name=name)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/ops/gen_array_ops.py", line 2134, in identity
        "Identity", input=input, name=name)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/op_def_library.py", line 787, in _a
pply_op_helper
        op_def=op_def)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/ops.py", line 3160, in create_op
        op_def=op_def)
    File "/Users/raghurajah/anaconda/envs/dlnd/lib/python3.6/site-pack
ages/tensorflow/python/framework/ops.py", line 1625, in __init__
        self._traceback = self._graph._extract_stack() # pylint: disabl
e=protected-access

FailedPreconditionError (see above for traceback): Attempting to use
uninitialized value Variable_3
[[Node: Variable_3/read = Identity[T=DT_FLOAT, _class=["loc
:@Variable_3"], _device="/job:localhost/replica:0/task:0/device:CPU:
0"](Variable_3)]]

```

Now, what happened there?

Remember to initialize the variables !!

```

In [12]: with tf.Session() as session:
          session.run(tf.global_variables_initializer())
          session.run(tf.matmul(W, x))

```

Worked!!!!

Let's look at this in Tensorboard

```

In [21]: writer = tf.summary.FileWriter("./tmp/3", session.graph)

```

Let's try naming them

```

In [ ]:

```