Assignment 10
CSCI E 63 - Big Data Analytics

Problem 1:
Install newest release of TensorFlow 1.4 on the operating system of your choice. Use installation instructions on https://www.tensorflow.org site and instructions on https://github.com/tensorflow/tensorflow. If you know what you are doing install TensorFlow for GPU. Otherwise, install TensorFlow for CPU. Use attach Jupyter notebook: `0_test_install.ipynb` to demonstrate that TensorFlow is properly installed. Please document all installation steps including the version of Python you are using.

Answer:

→ Installing TensorFlow on macOS

Follow instructions from: https://www.tensorflow.org/install/install_mac

For Installing with Anaconda:
Follow the instructions on the Anaconda download site to download and install Anaconda

```
[karanbhandarkar@Karans-MacBook-Air:~$ python -V
Python 3.6.3 :: Anaconda, Inc.
```

Check version of pip3. Pip3 version 8.1+ is recommended.

```
[karanbhandarkar@Karans-MacBook-Air:~$ pip3 -V
pip 9.0.1 from /Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages (python 3.6)
```

Create a conda env by issuing the following command: `condo create -n tensorflow python=3.5.2`

```
[karanbhandarkar@Karans-MacBook-Air:~$ conda create -n tensorflow python=3.5.2
Fetching package metadata ...........
Solving package specifications: .

Package plan for installation in environment /anaconda3/envs/tensorflow:

The following NEW packages will be INSTALLED:

    ca-certificates: 2017.08.26-ha1e5d58_0
    certifi:         2017.7.27.1-py35h0fdde5e_0
    openssl:         1.0.2m-h86d3e6a_0
    pip:             9.0.1-py35h33ce766_4
    python:          3.5.2-0
    readline:        6.2-2
    setuptools:      36.5.0-py35h52cde6a_0
    sqlite:          3.13.0-0
    tk:              8.5.18-0
    wheel:           0.29.0-py35ha7aa5c4_1
    xz:              5.2.3-h0278029_2
    zlib:            1.2.11-hf3cbc9b_2

Proceed ([y]/n)? y

ca-certificate 100% |################################################################################| Time: 0:00:00   2.47 MB/s
readline-6.2-2 100% |################################################################################| Time: 0:00:00   3.62 MB/s
sqlite-3.13.0- 100% |################################################################################| Time: 0:00:00   3.58 MB/s
tk-8.5.18-0.ta 100% |################################################################################| Time: 0:00:00   3.74 MB/s
xz-5.2.3-h0278 100% |################################################################################| Time: 0:00:00   4.41 MB/s
zlib-1.2.11-hf 100% |################################################################################| Time: 0:00:00   4.16 MB/s
openssl-1.0.2m 100% |################################################################################| Time: 0:00:00   3.75 MB/s
python-3.5.2-0 100% |################################################################################| Time: 0:00:03   3.64 MB/s
certifi-2017.7 100% |################################################################################| Time: 0:00:00   3.95 MB/s
setuptools-36. 100% |################################################################################| Time: 0:00:00   3.67 MB/s
wheel-0.29.0-p 100% |################################################################################| Time: 0:00:00   5.15 MB/s
pip-9.0.1-py35 100% |################################################################################| Time: 0:00:00   3.77 MB/s
#
# To activate this environment, use:
# > source activate tensorflow
```

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Activate the condo env by issuing the following command(your prompt should change):
`source activate tensorflow`

Issue the following command to install TensorFlowin inside your conda env to install CPU-only version:
`pip install --ignore-installed --upgrade tensorflow`

```
(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$ pip install --ignore-installed --upgrade tensorflow
Collecting tensorflow
  Downloading tensorflow-1.4.0-cp35-cp35m-macosx_10_11_x86_64.whl (38.8MB)
    100% |████████████████████████████████| 38.8MB 29kB/s
Collecting tensorflow-tensorboard<0.5.0,>=0.4.0rc1 (from tensorflow)
  Using cached tensorflow_tensorboard-0.4.0rc2-py3-none-any.whl
Collecting six>=1.10.0 (from tensorflow)
  Using cached six-1.11.0-py2.py3-none-any.whl
Collecting protobuf>=3.3.0 (from tensorflow)
  Using cached protobuf-3.4.0-py2.py3-none-any.whl
Collecting enum34>=1.1.6 (from tensorflow)
  Using cached enum34-1.1.6-py3-none-any.whl
Collecting numpy>=1.12.1 (from tensorflow)
  Downloading numpy-1.13.3-cp35-cp35m-macosx_10_6_intel.macosx_10_9_intel.macosx_10_9_x86_64.macosx_10_10_intel.macosx_10_10_x86_64.whl (4.5M
B)
    100% |████████████████████████████████| 4.5MB 268kB/s
Collecting wheel>=0.26 (from tensorflow)
  Using cached wheel-0.30.0-py2.py3-none-any.whl
Collecting bleach==1.5.0 (from tensorflow-tensorboard<0.5.0,>=0.4.0rc1->tensorflow)
  Using cached bleach-1.5.0-py2.py3-none-any.whl
Collecting html5lib==0.9999999 (from tensorflow-tensorboard<0.5.0,>=0.4.0rc1->tensorflow)
  Using cached html5lib-0.9999999.tar.gz
Collecting markdown>=2.6.8 (from tensorflow-tensorboard<0.5.0,>=0.4.0rc1->tensorflow)
  Using cached Markdown-2.6.9.tar.gz
Collecting werkzeug>=0.11.10 (from tensorflow-tensorboard<0.5.0,>=0.4.0rc1->tensorflow)
  Using cached Werkzeug-0.12.2-py2.py3-none-any.whl
Collecting setuptools (from protobuf>=3.3.0->tensorflow)
  Downloading setuptools-36.7.0-py2.py3-none-any.whl (482kB)
    100% |████████████████████████████████| 491kB 1.6MB/s
Building wheels for collected packages: html5lib, markdown
  Running setup.py bdist_wheel for html5lib ... done
  Stored in directory: /Users/karanbhandarkar/Library/Caches/pip/wheels/6f/85/6c/56b8e1292c6214c4eb73b9dda50f53e8e977bf65989373c962
  Running setup.py bdist_wheel for markdown ... done
  Stored in directory: /Users/karanbhandarkar/Library/Caches/pip/wheels/bf/46/10/c93e17ae86ae3b3a919c7b39dad3b5ccf09aeb066419e5c1e5
Successfully built html5lib markdown
Installing collected packages: six, html5lib, bleach, markdown, numpy, setuptools, protobuf, wheel, werkzeug, tensorflow-tensorboard, enum34,
 tensorflow
Successfully installed bleach-1.5.0 enum34-1.1.6 html5lib-0.9999999 markdown-2.6.9 numpy-1.13.3 protobuf-3.4.0 setuptools-36.7.0 six-1.11.0 t
ensorflow-1.4.0 tensorflow-tensorboard-0.4.0rc2 werkzeug-0.12.2 wheel-0.30.0
```

Validate the installation:

Start a terminal.
Activate the created the Anaconda env.
Invoke python.
Import the tensorflow package.

```
(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$ python
Python 3.5.2 |Continuum Analytics, Inc.| (default, Jul  2 2016, 17:52:12)
[GCC 4.2.1 Compatible Apple LLVM 4.2 (clang-425.0.28)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> import tensorflow as tf
>>>
```

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→ Use attached Jupyter notebook: `0_test_install.ipynb` to demonstrate that TensorFlow is properly installed.

Install Jupyter Notebook in your Anaconda environment using command:
`conda install jupyter`

Installation ends as:

```
jupyter_client 100% |################################################################################################| Time: 0:00:00   3.91 MB/s
nbformat-4.4.0 100% |################################################################################################| Time: 0:00:00   3.67 MB/s
prompt_toolkit 100% |################################################################################################| Time: 0:00:00   3.98 MB/s
ipython-6.1.0- 100% |################################################################################################| Time: 0:00:00   3.82 MB/s
nbconvert-5.3. 100% |################################################################################################| Time: 0:00:00   3.88 MB/s
ipykernel-4.6. 100% |################################################################################################| Time: 0:00:00   4.77 MB/s
jupyter_consol 100% |################################################################################################| Time: 0:00:00   4.30 MB/s
notebook-5.2.1 100% |################################################################################################| Time: 0:00:01   3.61 MB/s
qtconsole-4.3. 100% |################################################################################################| Time: 0:00:00   3.52 MB/s
widgetsnbexten 100% |################################################################################################| Time: 0:00:00   3.65 MB/s
ipywidgets-7.0 100% |################################################################################################| Time: 0:00:00   4.58 MB/s
jupyter-1.0.0- 100% |################################################################################################| Time: 0:00:00   3.88 MB/s
    If this is your first install of dbus, automatically load on login with:
        mkdir -p ~/Library/LaunchAgents
        cp /anaconda3/envs/tensorflow/org.freedesktop.dbus-session.plist ~/Library/LaunchAgents/
        launchctl load -w ~/Library/LaunchAgents/org.freedesktop.dbus-session.plist

    If this is an upgrade and you already have the org.freedesktop.dbus-session.plist loaded:
        launchctl unload -w ~/Library/LaunchAgents/org.freedesktop.dbus-session.plist
        cp /anaconda3/envs/tensorflow/org.freedesktop.dbus-session.plist ~/Library/LaunchAgents/
        launchctl load -w ~/Library/LaunchAgents/org.freedesktop.dbus-session.plist

(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$
```

Install matplotlib using command: `pip install matplotlib`

```
(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$ pip install matplotlib
Collecting matplotlib
  Downloading matplotlib-2.1.0-cp35-cp35m-macosx_10_6_intel.macosx_10_9_intel.macosx_10_9_x86_64.macosx_10_10_intel.macosx_10_10_x86_64.whl (13.2MB
)
    100% |████████████████████████████████| 13.2MB 98kB/s
Requirement already satisfied: six>=1.10 in /anaconda3/envs/tensorflow/lib/python3.5/site-packages (from matplotlib)
Requirement already satisfied: python-dateutil>=2.0 in /anaconda3/envs/tensorflow/lib/python3.5/site-packages (from matplotlib)
Collecting pytz (from matplotlib)
  Downloading pytz-2017.3-py2.py3-none-any.whl (511kB)
    100% |████████████████████████████████| 512kB 1.4MB/s
Collecting pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 (from matplotlib)
  Downloading pyparsing-2.2.0-py2.py3-none-any.whl (56kB)
    100% |████████████████████████████████| 61kB 2.7MB/s
Requirement already satisfied: numpy>=1.7.1 in /anaconda3/envs/tensorflow/lib/python3.5/site-packages (from matplotlib)
Collecting cycler>=0.10 (from matplotlib)
  Downloading cycler-0.10.0-py2.py3-none-any.whl
Installing collected packages: pytz, pyparsing, cycler, matplotlib
Successfully installed cycler-0.10.0 matplotlib-2.1.0 pyparsing-2.2.0 pytz-2017.3
```

Start Jupyter Notebook and run `0_test_install.ipynb`

```
(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$ jupyter notebook
[I 23:31:51.627 NotebookApp] JupyterLab alpha preview extension loaded from /anaconda3/lib/python3.6/site-packages/jupyterlab
JupyterLab v0.27.0
Known labextensions:
[I 23:31:51.629 NotebookApp] Running the core application with no additional extensions or settings
[I 23:31:51.636 NotebookApp] Serving notebooks from local directory: /Users/karanbhandarkar
[I 23:31:51.636 NotebookApp] 0 active kernels
[I 23:31:51.637 NotebookApp] The Jupyter Notebook is running at: http://localhost:8888/?token=c7f3a9a6de76ecc857a327dad8b8aa4177a6eeb99e71f1e
a
[I 23:31:51.637 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
[C 23:31:51.638 NotebookApp]

    Copy/paste this URL into your browser when you connect for the first time,
    to login with a token:
        http://localhost:8888/?token=c7f3a9a6de76ecc857a327dad8b8aa4177a6eeb99e71f1ea
[I 23:31:51.816 NotebookApp] Accepting one-time-token-authenticated connection from ::1
```

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You can press shift + enter to quickly advance through each line of a notebook. Try it!

This snippet of Python creates a simple graph.

In [4]:
```
import tensorflow as tf
hello = tf.constant('It works!')
sess = tf.Session()
print(sess.run(hello))
```

```
b'It works!'
```

Check that you have a recent version of TensorFlow installed, >= 0.12.0rc0

In [5]:
```
print("You have version %s" % tf.__version__)
```

```
You have version 1.4.0
```

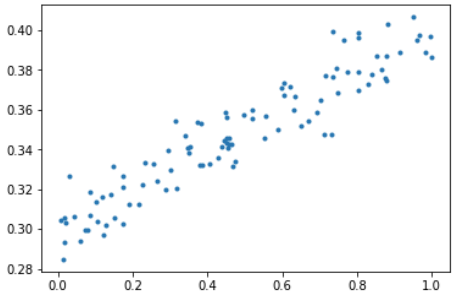
We'll also use matplotlib, so let's test if that's working.

In [6]:
```
%matplotlib inline
import pylab
import numpy as np

# create some data using numpy. y = x * 0.1 + 0.3 + noise
x_train = np.random.rand(100).astype(np.float32)
noise = np.random.normal(scale=0.01, size=len(x_train))
y_train = x_train * 0.1 + 0.3 + noise

# plot it
pylab.plot(x_train, y_train, '.')
```

Out[6]:
```
[<matplotlib.lines.Line2D at 0x11057b518>]
```



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Problem 2:
Construct a simple neural network (a network of logistic units) which will implement (X1 XOR X2) AND X3 function. Choose weights (θ_i-s) of all dendritic inputs and bias inputs. Demonstrate that your network works by presenting the truth table. Present your network by a simple graph. You can produce the graph in any way convenient including pan and paper.

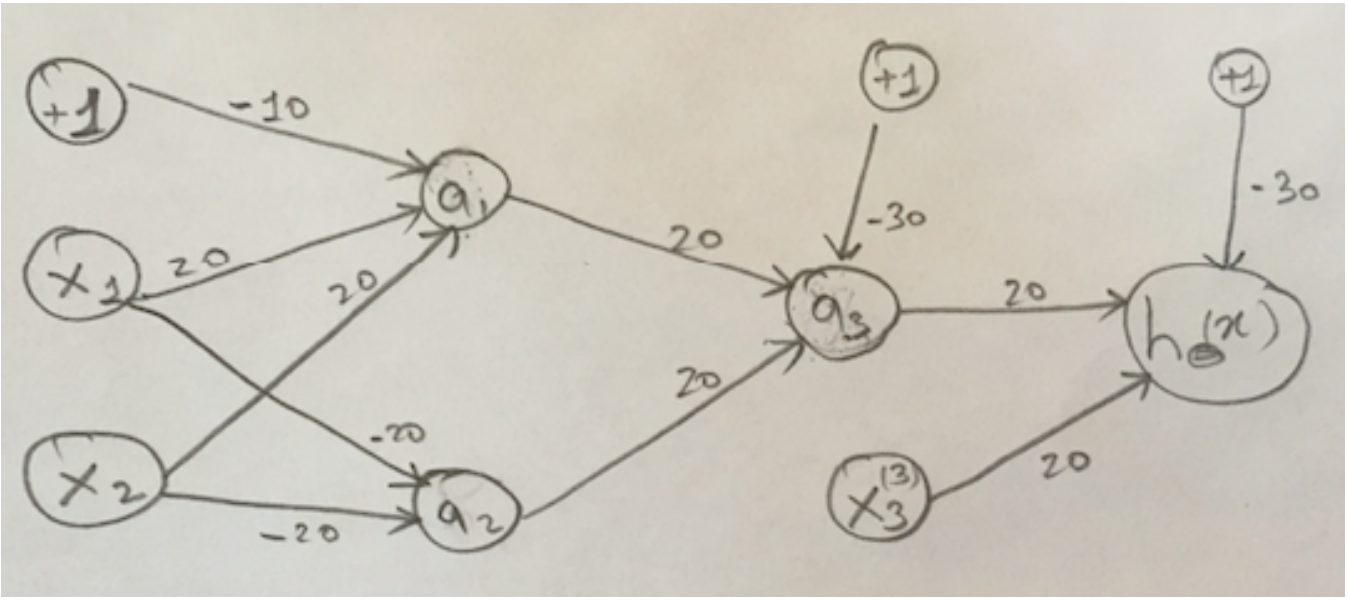
Answer:

→ Expected Truth Table

X1	X2	X1 XOR X2	X3	(X1 XOR X2) AND X3
0	0	0	0	0
0	1	1	1	1
1	0	1	0	0
1	1	0	1	0

→ Neural Network

We first construct an XOR gate with inputs X1 and X2.Then we feed the output to an AND gate with X3



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→ **Truth Table generated by network**

X1	X2	q1	q2	Y (X1 XOR X2)	X3	Z (X3 AND Y)
0	0	-10 → 0	30 → 1	-10 → 0	1	-10 → 0
0	1	10 → 1	10 → 1	10 → 1	1	10 → 1
1	0	10 → 1	10 → 1	10 → 1	0	-30 → 0
1	1	-10 → 0	30 → 1	-10 → 0	0	-30 → 0

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Problem 3:
Determine the value of number e = 2.7183… to 6 decimal places using Taylor expansion. Export the TensorBoard graph of your process. Perform similar calculation using expression for e as $\lim_{n \to \infty} (1 + \frac{1}{n})^n$. Again export the TensorBoard graph of you process. Provide working code for both approaches.

Answer:

→ Taylor Expansion

The number *e* can be represented as $e = \sum_{n=0}^{\infty} \frac{1}{n!}$

Code:

e_TaylorSeries.ipynb separately submitted

```
import tensorflow as tf
import math

with tf.Graph().as_default() as g:

    # We start with e = 1, for n = 0, and add to it
    print('Start with e = 0')
    e = tf.Variable([0.0], dtype=tf.float64, name='e_value')
    prev_e = tf.Variable([0.0], dtype=tf.float64, name='prev_e_value')
    one = tf.Variable([1], dtype=tf.float64, name = 'one_value')

    init = tf.global_variables_initializer()  # an operation, initializes all
    with tf.Session() as sess:
        sess.run(init)       # run init operation, initialize all

        for step in range(20):

            # Keep track of previous value of e
            assign_op = tf.assign(prev_e, e)
            sess.run(assign_op)

            # We need to calculate the next value from the series
            next_e = tf.divide(one,math.factorial(step))

            # And add the result back to e_value using tf.add()
            e = e+next_e

            sess.run(next_e)
            print('Iteration:',step+1,'changed e from:',sess.run(prev_e),' to:',sess.run(e))

    file_writer = tf.summary.FileWriter("e_TaylorSeries", sess.graph)
    file_writer.close()
    sess.close()
```

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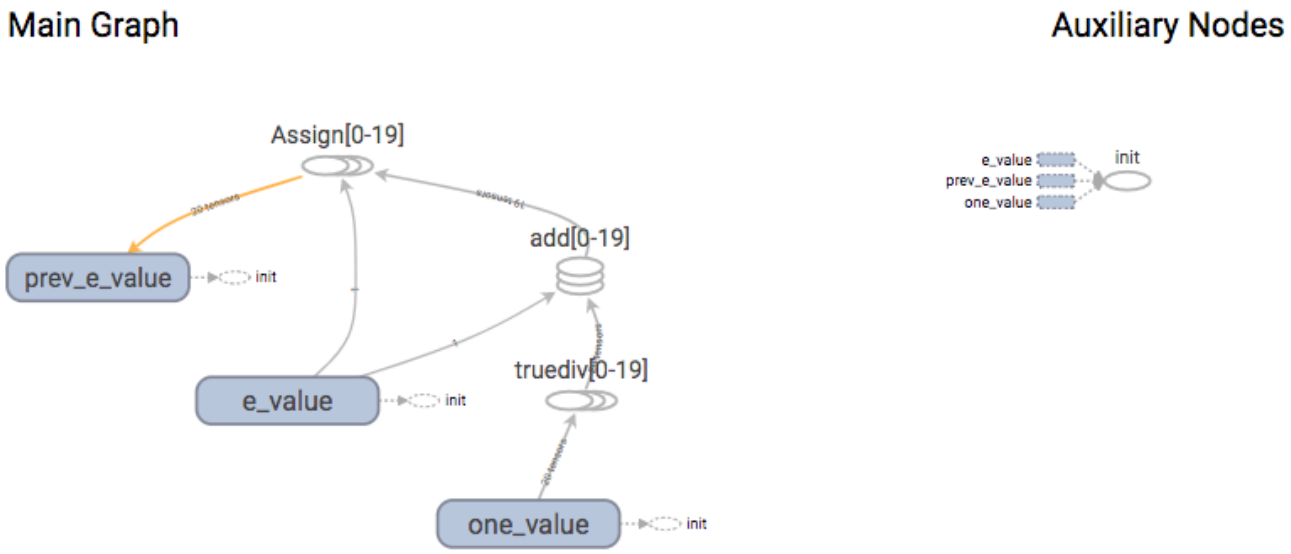
Output:

```
Start with e = 0
Iteration: 1 changed e from: [ 0.]  to: [ 1.]
Iteration: 2 changed e from: [ 1.]  to: [ 2.]
Iteration: 3 changed e from: [ 2.]  to: [ 2.5]
Iteration: 4 changed e from: [ 2.5]  to: [ 2.66666667]
Iteration: 5 changed e from: [ 2.66666667]  to: [ 2.70833333]
Iteration: 6 changed e from: [ 2.70833333]  to: [ 2.71666667]
Iteration: 7 changed e from: [ 2.71666667]  to: [ 2.71805556]
Iteration: 8 changed e from: [ 2.71805556]  to: [ 2.71825397]
Iteration: 9 changed e from: [ 2.71825397]  to: [ 2.71827877]
Iteration: 10 changed e from: [ 2.71827877]  to: [ 2.71828153]
Iteration: 11 changed e from: [ 2.71828153]  to: [ 2.7182818]
Iteration: 12 changed e from: [ 2.7182818]  to: [ 2.71828183]
Iteration: 13 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 14 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 15 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 16 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 17 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 18 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 19 changed e from: [ 2.71828183]  to: [ 2.71828183]
Iteration: 20 changed e from: [ 2.71828183]  to: [ 2.71828183]
```

The 6th decimal of e stops changing after iteration 10 at value **2.718281**

TensorBoard:

e_TaylorSeries_Graph.png separately submitted



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→ e Expression

$$e = \lim_{n \to \infty} (1 + \frac{1}{n})^n$$

Code:
e_Expression.ipynb separately submitted

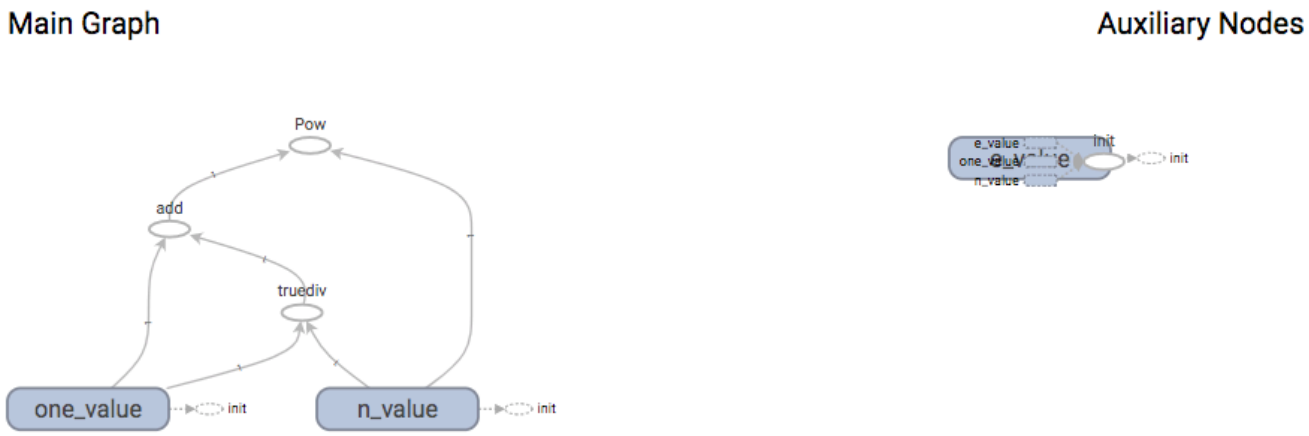
Output:

```
import tensorflow as tf
import math

with tf.Graph().as_default() as g:

    # We start with e = 1, for n = 0, and add to it
    print('Start with e = 0')
    e = tf.Variable([0.0], dtype=tf.float64, name='e_value')
    one = tf.Variable([1], dtype=tf.float64, name = 'one_value')
    n = tf.Variable([100000000], dtype=tf.float64, name = 'n_value')

    init = tf.global_variables_initializer()  # an operation, initializes all
    with tf.Session() as sess:
        sess.run(init)       # run init operation, initialize all

        # We need to calculate the next value from the series
        e = tf.pow((one + tf.divide(one,n)),n)

        sess.run(e)
        print('Derived value of e as:',sess.run(e),' for a large enough n:',sess.run(n))

    file_writer = tf.summary.FileWriter("e_TaylorSeries", sess.graph)
    file_writer.close()
    sess.close()
```

```
Start with e = 0
Derived value of e as: [ 2.7182818]  for a large enough n: [  1.00000000e+08]
```

TensorBoard:

e_Expression_Graph.png separately submitted



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Problem 4:
When I tried running code on page 63 on my notes for lecture 10, the resulting TensorBoard graph was not entirely identical with the graph on page 64. Please fix the code on page 63 in order to produce the graph identical to the graph on page 64.

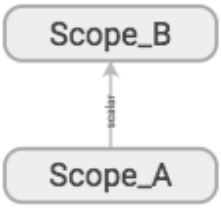
Answer:

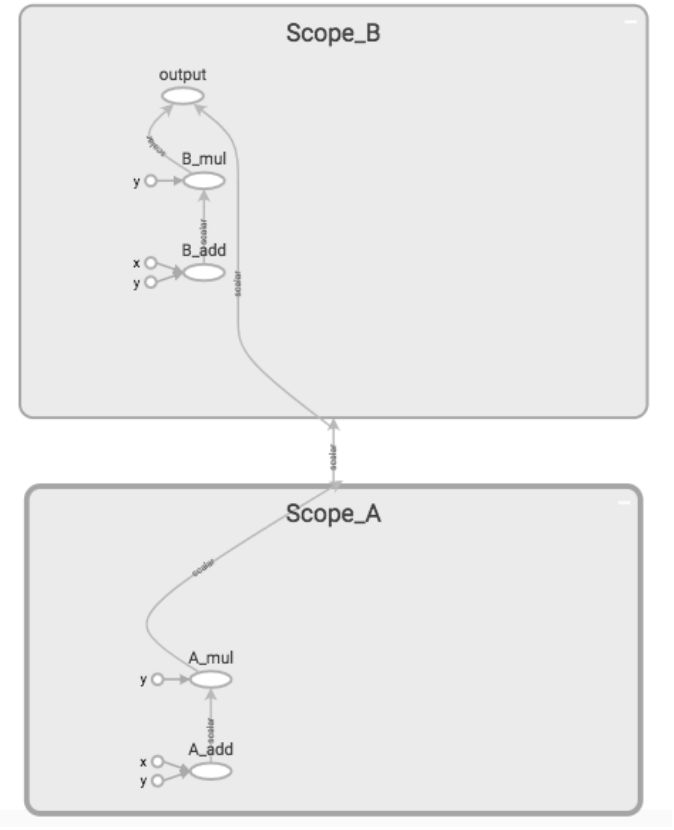
→
Provided Code:

```
>>> import tensorflow as tf
>>> with tf.name_scope("Scope_A"):
...     a = tf.add(1, 2, name="A_add")
...     b = tf.multiply(a, 3, name="A_mul")
...
>>> with tf.name_scope("Scope_B"):
...     c = tf.add(4, 5, name="B_add")
...     d = tf.multiply(c, 6, name="B_mul")
...     e = tf.add(b, d, name="output")
...
>>> writer = tf.summary.FileWriter('name_scope_1',graph=tf.get_default_graph())
>>> writer.close()
```

NOTE:
tf.mul is deprecated in favor of tf.multiply

Generated Graph:





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Corrected Code:

```
>>> import tensorflow as tf
>>> with tf.name_scope("Scope_A"):
...     a = tf.add(1, 2, name="A_add")
...     b = tf.multiply(a, 3, name="A_mul")
...
>>> with tf.name_scope("Scope_B"):
...     c = tf.add(4, 5, name="B_add")
...     d = tf.multiply(c, 6, name="B_mul")
...
>>> e = tf.add(b, d, name="output")
>>> sess = tf.Session()
2017-11-11 00:26:31.348521: I tensorflow/core/platform/cpu_feature_guard.cc:137]
Your CPU supports instructions that this TensorFlow binary was not compiled to use:
SSE4.1 SSE4.2 AVX AVX2 FMA
>>> writer = tf.summary.FileWriter('name_scope_1',graph=tf.get_default_graph())
>>> sess.run(e)
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>>> writer.close()
>>> quit()
```
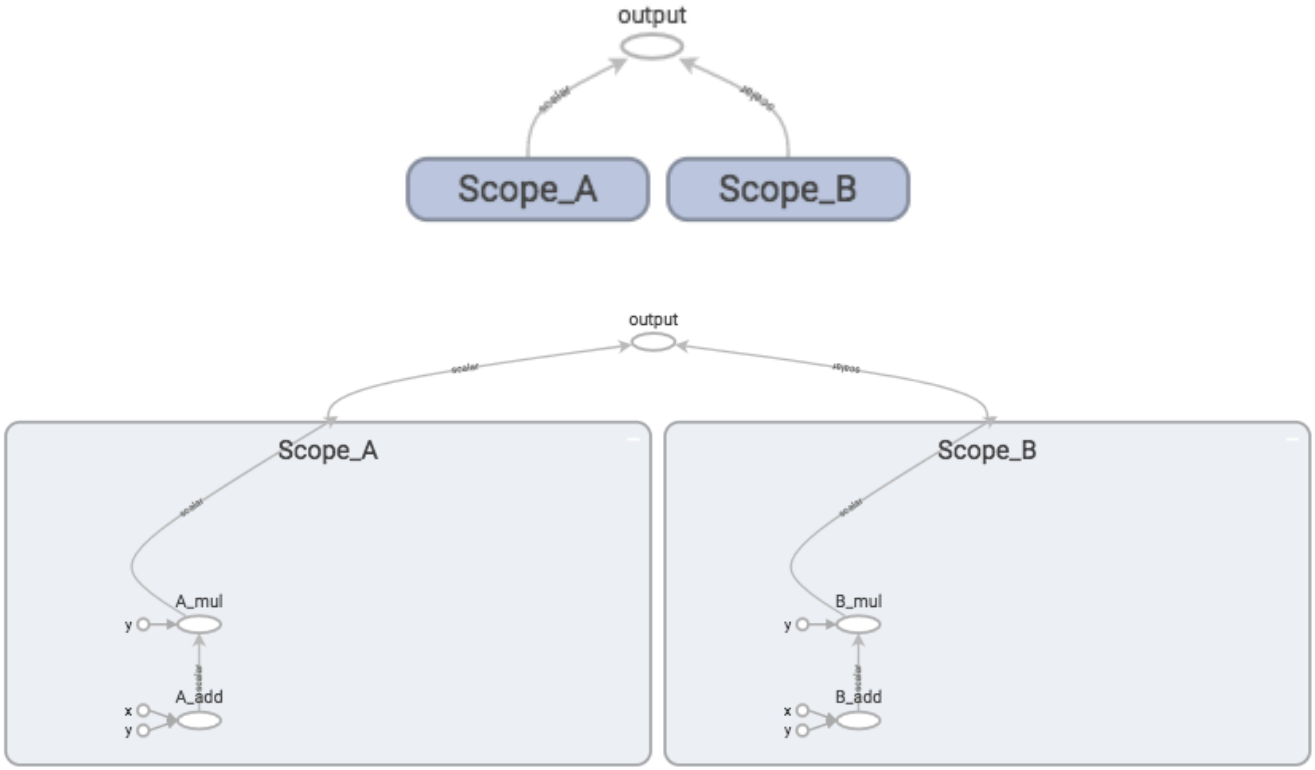

Correct Expected Graph:



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Problem 5:
Please examine attached Jupyter notebook 2_linear_regression.ipynb. As you are running its cells, the notebook will complain about non-existent API calls. This notebook was written in an earlier version of TensorFlow API and some calls changed their names. Fix all code by replacing older calls with calls in TF 1.5. Uncomment all optional (print) lines. Provide a copy of this notebook with all intermediate results and the image of TensorFlow graph as captured by the TensorBoard.

Answer:
→ Issues Faced(Successfully run copy submitted separately):
1.

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-12-e9dbfb989589> in <module>()
      1 # Write the graph so we can look at it in TensorBoard
      2 # https://www.tensorflow.org/versions/r0.12/how_tos/summaries_and_tensorboard/index.html
----> 3 sw = tf.train.SummaryWriter('summaries/', graph=tf.get_default_graph())
      4 #sw = tf.summary.FileWriter('summaries/', graph=tf.get_default_graph())

AttributeError: module 'tensorflow.python.training.training' has no attribute 'SummaryWriter'
```

→ tf.train.SummaryWriter is deprecated. Use tf.summary.FileWriter instead

2.

```
# Create an operation to initialize all the variables.
init = tf.initialize_all_variables()
print(init)
sess.run(init)
```

```
WARNING:tensorflow:From /anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/util/tf_should_use.p
y:107: initialize_all_variables (from tensorflow.python.ops.variables) is deprecated and will be removed after 2017-0
3-02.
Instructions for updating:
Use `tf.global_variables_initializer` instead.
name: "init"
op: "NoOp"
input: "^weights/Assign"
input: "^bias/Assign"
```

→ initialize_all_variables is deprecated and will be removed after 2017-03-02. Use tf.global_variables_initializer instead.

3.

```
# Track of how loss changes, so we can visualize it in TensorBoard
tf.scalar_summary('loss', loss)
summary_op = tf.merge_all_summaries()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-17-e1626494cf91> in <module>()
      1 # Track of how loss changes, so we can visualize it in TensorBoard
----> 2 tf.scalar_summary('loss', loss)
      3 summary_op = tf.merge_all_summaries()

AttributeError: module 'tensorflow' has no attribute 'scalar_summary'
```

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→ tf.scalar_summary() was moved after the 0.12 release. You can now find it as tf.summary.scalar()

4.

```
# Track of how loss changes, so we can visualize it in TensorBoard
tf.summary.scalar('loss', loss)
summary_op = tf.merge_all_summaries()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-27-e8d51d92c937> in <module>()
      1 # Track of how loss changes, so we can visualize it in TensorBoard
      2 tf.summary.scalar('loss', loss)
----> 3 summary_op = tf.merge_all_summaries()

AttributeError: module 'tensorflow' has no attribute 'merge_all_summaries'
```

→ Replace merge_all_summaries() with tf.summary.merge_all()

5.

```
# Save the model
saver = tf.train.Saver()
saver.save(sess, 'my_checkpoint.ckpt')
```

```
During handling of the above exception, another exception occurred:

ValueError                                Traceback (most recent call last)
<ipython-input-35-d6c03154b3e5> in <module>()
      1 # Save the model
      2 saver = tf.train.Saver()
----> 3 saver.save(sess, 'my_checkpoint.ckpt')

/anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/training/saver.py in save(self, sess, save_p
ath, global_step, latest_filename, meta_graph_suffix, write_meta_graph, write_state)
   1592                 "Parent directory of {} doesn't exist, can't save.".format(
   1593                     save_path))
-> 1594           raise exc
   1595
   1596       if write_meta_graph:

ValueError: Parent directory of my_checkpoint.ckpt doesn't exist, can't save.
```

→ Provide full file path as:
saver.save(sess, 'Users/karanbhandarkar/Projects/PythonProjects/CSCI E 63 Big Data Anlytics/Assignment 10/my_checkpoint.ckpt')

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6.

```
saver.restore(sess, 'my_checkpoint.ckpt')
```

```
    [spec.tensor.dtype])[0])
  File "/anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/ops/gen_io_ops.py", line 1021, in re
store_v2
    shape_and_slices=shape_and_slices, dtypes=dtypes, name=name)
  File "/anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/framework/op_def_library.py", line 7
87, in _apply_op_helper
    op_def=op_def)
  File "/anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/framework/ops.py", line 2956, in cre
ate_op
    op_def=op_def)
  File "/anaconda3/envs/tensorflow/lib/python3.5/site-packages/tensorflow/python/framework/ops.py", line 1470, in __i
nit__
    self._traceback = self._graph._extract_stack()  # pylint: disable=protected-access

NotFoundError (see above for traceback): Unsuccessful TensorSliceReader constructor: Failed to find any matching file
s for my_checkpoint.ckpt
         [[Node: save_2/RestoreV2_1 = RestoreV2[dtypes=[DT_FLOAT], _device="/job:localhost/replica:0/task:0/device:CP
U:0"](_arg_save_2/Const_0_0, save_2/RestoreV2_1/tensor_names, save_2/RestoreV2_1/shape_and_slices)]]
```

→ Provide full file path as:
saver.restore(sess, 'Users/karanbhandarkar/Projects/PythonProjects/CSCI E 63 Big Data Anlytics/Assignment 10/my_checkpoint.ckpt
')

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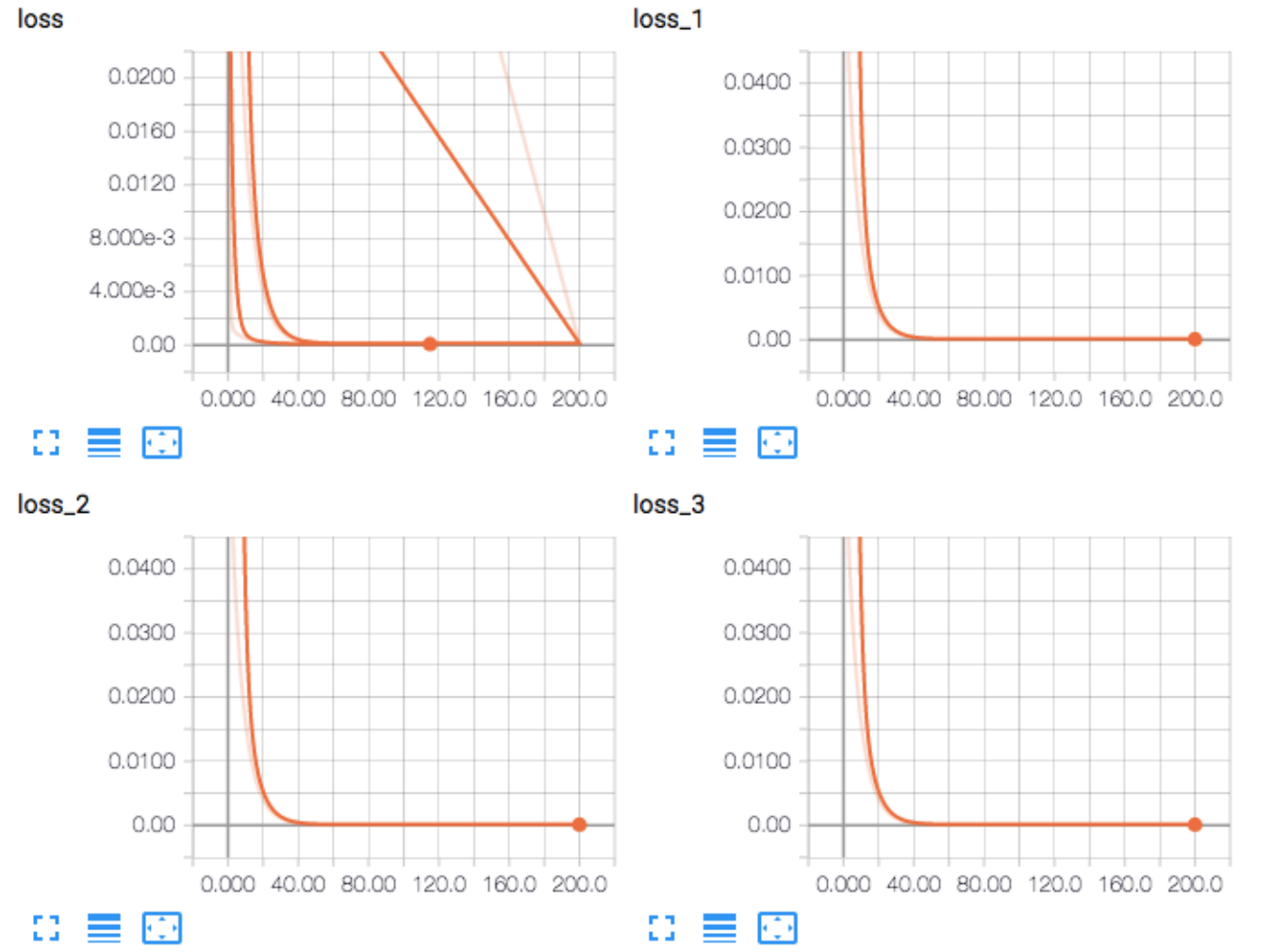
→ Image of TensorFlow graph as captured by the TensorBoard

Open up the generated graph on TensorBoard:

```
drwxr-xr-x   5 karanbhandarkar  staff   170B Nov 11 01:11 summaries/
(tensorflow) karanbhandarkar@Karans-MacBook-Air:~$ tensorboard --logdir summaries
W1111 01:20:31.625228 Reloader tf_logging.py:86] Found more than one graph event per run, or there was a metagraph containing a graph_def, as well as one or
 more graph events.  Overwriting the graph with the newest event.
W1111 01:20:31.625757 Reloader tf_logging.py:86] Found more than one metagraph event per run. Overwriting the metagraph with the newest event.
W1111 01:20:31.825725 Reloader tf_logging.py:86] Found more than one graph event per run, or there was a metagraph containing a graph_def, as well as one or
 more graph events.  Overwriting the graph with the newest event.
W1111 01:20:31.825949 Reloader tf_logging.py:86] Found more than one metagraph event per run. Overwriting the metagraph with the newest event.
TensorBoard 0.4.0rc2 at http://Karans-MacBook-Air.local:6006 (Press CTRL+C to quit)
```



Karan A. Bhandarkar