

```
In [1]: import tensorflow as tf
```

```
/anaconda3/lib/python3.7/importlib/_bootstrap.py:219: RuntimeWarning: c
ompiletime version 3.6 of module 'tensorflow.python.framework.fast_tens
or_util' does not match runtime version 3.7
  return f(*args, **kwds)
```

```
In [3]: tf.reset_default_graph
x = tf.Variable(3, name="x")
y = tf.Variable(4, name="y")

f = x*x*y + y + 2
f
```

```
Out[3]: <tf.Tensor 'add_1:0' shape=() dtype=int32>
```

```
In [4]: sess = tf.Session()
sess.run(x.initializer)
sess.run(y.initializer)
result = sess.run(f)
print(result)

sess.close()
```

```
42
```

```
In [5]: import tensorflow as tf
with tf.Graph().as_default() as g:
    x = tf.Variable(1.0, name="x")
    add_op = tf.add(x, tf.constant(1.5))
    assign_op = tf.assign(x, add_op)
    init = tf.global_variables_initializer()
    sess = tf.Session()
    file_writer = tf.summary.FileWriter("output", sess.graph)
    sess.run(init)
    sess.run(assign_op)
    print(sess.run(x))
```

```
2.5
```

```
In [28]: y = [1,2,3]
y[0]
```

```
Out[28]: 1
```

Problem 1

```

In [32]: x_place = [1,2,3,4,5,6,7,8,9]
# getting "y"
y = [0]*9
import tensorflow as tf
with tf.Graph().as_default() as g:
    for i in range(0,9):

        # A fake 'x' b/c using 'replace_dict' later
        x = tf.constant(0, name="x")
        # Operations
        b = tf.multiply(x,x, name="b")
        c = tf.multiply(b,2, name="c")
        d = tf.add(c,5, name="d")
        sess = tf.Session()
        # Replace dict
        replace_dict = {x:x_place[i]}
        out = sess.run(d, feed_dict = replace_dict)
        # Save to y
        y[i] = out
        sess.close()
print(y)

```

```
[7, 13, 23, 37, 55, 77, 103, 133, 167]
```

```

In [38]: z = [0]*9
y1 = [7, 13, 23, 37, 55, 77, 103, 133, 167]
# Getting 'z'
with tf.Graph().as_default() as g:
    for i in range(0,8):

        # A fake 'x' b/c using 'replace_dict' later
        x = tf.constant(0, name="x")
        y = tf.constant(y1[i+1], name="y")
        # Operations
        t = tf.multiply(3,y, name="t")
        u = tf.subtract(t,4, name="u")
        o = tf.divide(u,x, name="o")
        sess = tf.Session()
        # Replace dict
        replace_dict = {x:x_place[i]}
        out = sess.run(o, feed_dict = replace_dict)
        # Save to y
        z[i] = out
        sess.close()
print(z)

```

```
[35.0, 32.5, 35.666666666666664, 40.25, 45.4, 50.833333333333336, 56.42
857142857143, 62.125, 0]
```

Problem 2

```
In [41]: from sklearn.model_selection import train_test_split
import pandas as pd
import numpy as np

# Starting by creating the 100 unique points along the x-axis
# Setting total distance, then dividing it into 100 equal segments
dist = 3 - (-2)
leng_per_point = 5/100

# Creating 100 distinct points along the line Y=X between X=[-2,3]
# Each element in 'point_table' is a X value
point_table = [0 for x in range(100)]
for i in range(0,100):
    point_table[i] = -2 + leng_per_point*i

print(point_table)
len(point_table)

# Creating Input and Output into one Pandas dataframe, and doing train/t
est splits
df = pd.DataFrame(columns = ['input', 'output'])
df['input'] = point_table

# Creating 'Y' values ('output')
for k in range(len(point_table)):
    df['output'][k] = 0.3*df['input'][k] + 0.2

# Train/test split
X_train, X_test, y_train, y_test = train_test_split(df['input'], df['out
put'], train_size=0.75, test_size=0.25, random_state=7)

## Re-shaping my train/test splits into arrays, something happened where
they were an improper shape
x_train = np.array([X_train])
x_train.shape = [75,1]
y_train = np.array([y_train])
y_train.shape = [75,1]

x_test = np.array([X_test])
x_test.shape = [25,1]
y_test = np.array([y_test])
y_test.shape = [25,1]
```

```
[-2.0, -1.95, -1.9, -1.85, -1.8, -1.75, -1.7, -1.65, -1.6, -1.55, -1.5,
-1.45, -1.4, -1.35, -1.2999999999999998, -1.25, -1.2, -1.15, -1.1, -1.0
4999999999999998, -1.0, -0.95, -0.8999999999999999, -0.8499999999999999,
-0.7999999999999998, -0.75, -0.7, -0.6499999999999999, -0.599999999999999
999, -0.5499999999999998, -0.5, -0.4499999999999996, -0.399999999999999
99, -0.34999999999999987, -0.2999999999999998, -0.25, -0.199999999999999
996, -0.1499999999999999, -0.09999999999999987, -0.04999999999999982,
0.0, 0.0500000000000000266, 0.10000000000000009, 0.1499999999999999, 0.2
00000000000000018, 0.25, 0.300000000000000027, 0.35000000000000001, 0.4000
00000000000036, 0.45000000000000002, 0.5, 0.55000000000000003, 0.600000000
0000001, 0.65000000000000004, 0.70000000000000002, 0.75, 0.800000000000000
03, 0.85000000000000001, 0.90000000000000004, 0.95000000000000002, 1.0, 1.
05000000000000003, 1.1, 1.15000000000000004, 1.20000000000000002, 1.25, 1.
30000000000000003, 1.35, 1.40000000000000004, 1.45000000000000002, 1.5, 1.
55000000000000003, 1.6, 1.65000000000000004, 1.70000000000000002, 1.75, 1.
80000000000000003, 1.85, 1.90000000000000004, 1.95000000000000002, 2.0, 2.
05, 2.10000000000000005, 2.15000000000000004, 2.2, 2.25, 2.3, 2.3500000000
0000005, 2.40000000000000004, 2.45, 2.5, 2.55, 2.60000000000000005, 2.650
0000000000004, 2.7, 2.75, 2.80000000000000007, 2.85000000000000005, 2.900
0000000000004, 2.95]
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:25: Setting
WithCopyWarning:
```

A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: <http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy>

```

In [49]: tf.reset_default_graph
X = tf.placeholder(tf.float32, shape = (None,1), name = "x")
Y = tf.placeholder(tf.float32, shape=(None,1), name = "y")

w = tf.Variable(tf.random_uniform(shape=(1,1)),name = "w")
b = tf.Variable(tf.random_uniform(shape=(1,)), name = "b")

Y_pred = tf.matmul(X,tf.transpose(w)) + b
error = Y_pred - Y
mse = 0.5 * tf.reduce_mean(tf.square(error), name = "mse")

learning_rate = 0.01
grad_w = tf.matmul(tf.transpose(X) , error)
grad_b = tf.reduce_sum(error)
train_w = tf.assign(w,w - learning_rate * grad_w)
train_b = tf.assign(b, b - learning_rate * grad_b)

feedDict = {X:x_train, Y:y_train}

reportStep = 500
init = tf.global_variables_initializer()
with tf.Session() as sess:
    sess.run(init)
    for epoch in range(5000):
        w_c, b_c,_,_, y_result, mse_result = \
            sess.run([w,b,train_w, train_b, Y_pred, mse],feed_dict=feedDict)
        # note the training steps for w and b!
        #w_c, b_c, y_result, mse_result = \
        #sess.run([w,b, Y_pred, mse],feed_dict=feedDict) # note the training
        steps for w and b!
        if (epoch ) % reportStep == 0:
            print('Epoch: ', epoch+1)
            print('\terror: ',mse_result)
            print('\tcurrent w: ', w_c)
            print('\tcurrent b', b_c)
            print('\nFinal values:')
            print('\tepochs: ',epoch+1)
            print('\terror: ',mse_result)
            print('\tw: ', w_c)
            print('\tb: ', b_c)
            print('\tPredicted y: ', y_result)
            print('\tActual y: ', y_train)

```

```
Epoch: 1
error: 0.050250966
current w: [[0.39438453]]
current b [0.33673286]
```

```
Final values:
epochs: 1
error: 0.050250966
w: [[0.39438453]]
b: [0.33673286]
Predicted y: [[0.5820518 ]
```

```
[0.40578884]
[0.32532096]
[0.49392033]
[0.57822 ]
[0.4594341 ]
[0.41728425]
[0.31382555]
[0.43261147]
[0.33681637]
[0.3751344 ]
[0.34831178]
[0.29083472]
[0.33298457]
[0.4785931 ]
[0.44793868]
[0.5897154 ]
[0.49008852]
[0.43644327]
[0.3674708 ]
[0.24868488]
[0.50158393]
[0.5743882 ]
[0.31765735]
[0.51691115]
[0.32148916]
[0.32915276]
[0.2716757 ]
[0.52074295]
[0.21419865]
[0.53223836]
[0.50541574]
[0.5437338 ]
[0.22186226]
[0.34447998]
[0.5552292 ]
[0.24485308]
[0.38662982]
[0.22569406]
[0.3559754 ]
[0.5513974 ]
[0.34064817]
[0.4556023 ]
[0.44410688]
[0.41345245]
[0.51307935]
[0.30233014]
```

```
[0.42494786]
[0.4747613 ]
[0.45177048]
[0.52457476]
[0.44027507]
[0.28317112]
[0.23335767]
[0.42111605]
[0.49775213]
[0.21036685]
[0.3789662 ]
[0.23718947]
[0.39429343]
[0.5858836 ]
[0.3598072 ]
[0.24102128]
[0.3713026 ]
[0.48625672]
[0.5705564 ]
[0.2640121 ]
[0.42877966]
[0.5628928 ]
[0.29849833]
[0.52840656]
[0.4670977 ]
[0.30616194]
[0.4709295 ]
[0.39046162]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.69500000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.15999999999999998]
[0.815]
```

```
[ -0.3849999999999995 ]
[ 0.8600000000000001 ]
[ 0.7550000000000001 ]
[ 0.9050000000000002 ]
[ -0.3550000000000004 ]
[ 0.125 ]
[ 0.95 ]
[ -0.2649999999999996 ]
[ 0.2900000000000001 ]
[ -0.34 ]
[ 0.1700000000000004 ]
[ 0.935 ]
[ 0.1100000000000007 ]
[ 0.56 ]
[ 0.5150000000000001 ]
[ 0.3950000000000013 ]
[ 0.7850000000000001 ]
[ -0.03999999999999925 ]
[ 0.4400000000000006 ]
[ 0.635 ]
[ 0.5450000000000002 ]
[ 0.8300000000000001 ]
[ 0.5 ]
[ -0.1149999999999994 ]
[ -0.31 ]
[ 0.425 ]
[ 0.7250000000000001 ]
[ -0.3999999999999997 ]
[ 0.2600000000000006 ]
[ -0.2949999999999993 ]
[ 0.3200000000000001 ]
[ 1.07 ]
[ 0.1850000000000005 ]
[ -0.2799999999999997 ]
[ 0.2300000000000004 ]
[ 0.6799999999999999 ]
[ 1.01 ]
[ -0.1899999999999995 ]
[ 0.455 ]
[ 0.9800000000000002 ]
[ -0.0549999999999994 ]
[ 0.8450000000000002 ]
[ 0.605 ]
[ -0.02499999999999967 ]
[ 0.6200000000000001 ]
[ 0.3050000000000005 ]
Epoch: 501
        error: 3.1288688e-15
        current w: [[0.30000004]]
        current b [0.20000002]

Final values:
        epochs: 501
        error: 3.1288688e-15
        w: [[0.30000004]]
        b: [0.20000002]
        Predicted y: [[ 1.0549998 ]]
```



```
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125     ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11      ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26      ]
```

```
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.69500000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.15999999999999998]
[0.815]
[-0.38499999999999995]
[0.86000000000000001]
[0.75500000000000001]
[0.90500000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.29000000000000001]
[-0.34]
[0.17000000000000004]
```

```

[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.26000000000000006]
[-0.2949999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.2799999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.1899999999999995]
[0.455]
[0.9800000000000002]
[-0.0549999999999994]
[0.8450000000000002]
[0.605]
[-0.02499999999999967]
[0.6200000000000001]
[0.30500000000000005]]
Epoch: 1001
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 1001
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]

```

```
[ -0.08499995 ]
[  0.08000001 ]
[  0.6499999  ]
[  0.53       ]
[  1.0849998  ]
[  0.69499993 ]
[  0.48499992 ]
[  0.21499999 ]
[ -0.24999994 ]
[  0.7399999  ]
[  1.0249999  ]
[  0.02000001 ]
[  0.7999999  ]
[  0.03500001 ]
[  0.06500001 ]
[ -0.15999997 ]
[  0.8149999  ]
[ -0.38499993 ]
[  0.8599999  ]
[  0.75499994 ]
[  0.90499985 ]
[ -0.35499996 ]
[  0.125       ]
[  0.94999987 ]
[ -0.26499993 ]
[  0.28999996 ]
[ -0.3399999  ]
[  0.16999999 ]
[  0.9349999  ]
[  0.11       ]
[  0.55999994 ]
[  0.5149999  ]
[  0.39499995 ]
[  0.7849999  ]
[ -0.03999998 ]
[  0.43999994 ]
[  0.63499993 ]
[  0.54499996 ]
[  0.82999986 ]
[  0.49999994 ]
[ -0.11499995 ]
[ -0.30999994 ]
[  0.42499995 ]
[  0.7249999  ]
[ -0.39999992 ]
[  0.26       ]
[ -0.29499993 ]
[  0.31999996 ]
[  1.0699999  ]
[  0.18499999 ]
[ -0.27999994 ]
[  0.22999999 ]
[  0.67999995 ]
[  1.0099999  ]
[ -0.18999994 ]
[  0.45499995 ]
[  0.97999984 ]
```

```
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.69500000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.15999999999999998]
[0.815]
[-0.38499999999999995]
[0.86000000000000001]
[0.75500000000000001]
[0.90500000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.29000000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.51500000000000001]
[0.39500000000000013]
[0.78500000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.54500000000000002]
[0.83000000000000001]
```

```

[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.72500000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.32000000000000001]
[1.07]
[0.18500000000000005]
[-0.27999999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.18999999999999995]
[0.455]
[0.98000000000000002]
[-0.05499999999999994]
[0.84500000000000002]
[0.605]
[-0.024999999999999967]
[0.62000000000000001]
[0.30500000000000005]]
Epoch: 1501
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 1501
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]

```

```
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11       ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26       ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
```

```
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.4700000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.0849999999999996]
[0.08000000000000004]
[0.649999999999999]
[0.53]
[1.085]
[0.6950000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.2499999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.1599999999999998]
[0.815]
[-0.3849999999999995]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.2649999999999996]
[0.29000000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.26000000000000006]
[-0.2949999999999993]
[0.32000000000000001]
[1.07]
[0.18500000000000005]
```



```
[ -0.2799999999999997]
[ 0.23000000000000004]
[ 0.6799999999999999]
[ 1.01]
[ -0.1899999999999995]
[ 0.455]
[ 0.9800000000000002]
[ -0.0549999999999994]
[ 0.8450000000000002]
[ 0.605]
[ -0.02499999999999967]
[ 0.6200000000000001]
[ 0.30500000000000005]]
Epoch: 2001
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 2001
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]
[ -0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[ -0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[ -0.15999997]
[ 0.8149999 ]
[ -0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[ -0.35499996]
```

```
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11       ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26       ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
    Actual y:  [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
```

```
[1.085]
[0.6950000000000001]
[0.4850000000000004]
[0.2150000000000008]
[-0.2499999999999994]
[0.74]
[1.025]
[0.02000000000000046]
[0.8]
[0.0350000000000006]
[0.0650000000000003]
[-0.1599999999999998]
[0.815]
[-0.3849999999999995]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.3550000000000004]
[0.125]
[0.95]
[-0.2649999999999996]
[0.2900000000000001]
[-0.34]
[0.1700000000000004]
[0.935]
[0.1100000000000007]
[0.56]
[0.5150000000000001]
[0.3950000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.4400000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.2600000000000006]
[-0.2949999999999993]
[0.3200000000000001]
[1.07]
[0.1850000000000005]
[-0.2799999999999997]
[0.2300000000000004]
[0.6799999999999999]
[1.01]
[-0.1899999999999995]
[0.455]
[0.9800000000000002]
[-0.0549999999999994]
[0.8450000000000002]
[0.605]
[-0.02499999999999967]
```

```
[0.6200000000000001]
[0.3050000000000005]]
Epoch: 2501
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 2501
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14       ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53       ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125       ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11       ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
```

```
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26       ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.4100000000000003]
[0.00500000000000032]
[0.4700000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.6950000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
```

```
[-0.15999999999999998]
[0.815]
[-0.38499999999999995]
[0.86000000000000001]
[0.75500000000000001]
[0.90500000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.29000000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.51500000000000001]
[0.395000000000000013]
[0.78500000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.54500000000000002]
[0.83000000000000001]
[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.72500000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.32000000000000001]
[1.07]
[0.18500000000000005]
[-0.27999999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.18999999999999995]
[0.455]
[0.98000000000000002]
[-0.05499999999999994]
[0.84500000000000002]
[0.605]
[-0.024999999999999967]
[0.62000000000000001]
[0.30500000000000005]]
Epoch: 3001
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]
```

```
Final values:
      epochs: 3001
      error: 3.1288688e-15
      w: [[0.30000004]]
```

```
b: [0.20000002]
Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14       ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53       ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11       ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
```

```
[ -0.39999992 ]
[  0.26       ]
[ -0.29499993 ]
[  0.31999996 ]
[  1.0699999  ]
[  0.18499999 ]
[ -0.27999994 ]
[  0.22999999 ]
[  0.67999995 ]
[  1.0099999  ]
[ -0.18999994 ]
[  0.45499995 ]
[  0.97999984 ]
[ -0.05499998 ]
[  0.8449999  ]
[  0.6049999  ]
[ -0.02499998 ]
[  0.6199999  ]
[  0.30499998 ]
      Actual y:  [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[ -0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.69500000000000001]
[0.48500000000000004]
[0.21500000000000008]
[ -0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[ -0.15999999999999998]
[0.815]
[ -0.38499999999999995]
[0.86000000000000001]
[0.75500000000000001]
[0.90500000000000002]
[ -0.35500000000000004]
[0.125]
[0.95]
[ -0.26499999999999996]
[0.29000000000000001]
```



```

[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.26000000000000006]
[-0.2949999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.2799999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.1899999999999995]
[0.455]
[0.9800000000000002]
[-0.0549999999999994]
[0.8450000000000002]
[0.605]
[-0.02499999999999967]
[0.6200000000000001]
[0.30500000000000005]]
Epoch: 3501
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 3501
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]

```

```
[ 0.24499997]
[ 0.14      ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11      ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26      ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
```

```
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
[0.6499999999999999]
[0.53]
[1.085]
[0.69500000000000001]
[0.48500000000000004]
[0.21500000000000008]
[-0.24999999999999994]
[0.74]
[1.025]
[0.020000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.15999999999999998]
[0.815]
[-0.38499999999999995]
[0.86000000000000001]
[0.75500000000000001]
[0.90500000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.29000000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.51500000000000001]
[0.39500000000000013]
[0.78500000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
```

```

[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.26000000000000006]
[-0.2949999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.2799999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.1899999999999995]
[0.455]
[0.9800000000000002]
[-0.0549999999999994]
[0.8450000000000002]
[0.605]
[-0.02499999999999967]
[0.6200000000000001]
[0.30500000000000005]]
Epoch: 4001
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 4001
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
```

```
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
[ 0.90499985]
[-0.35499996]
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11      ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26      ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
      Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.05000000000000002]
```

```
[0.71]
[1.0400000000000003]
[0.575]
[0.4100000000000003]
[0.00500000000000032]
[0.4700000000000001]
[0.0950000000000006]
[0.245]
[0.14]
[-0.0849999999999996]
[0.0800000000000004]
[0.649999999999999]
[0.53]
[1.085]
[0.6950000000000001]
[0.4850000000000004]
[0.2150000000000008]
[-0.2499999999999994]
[0.74]
[1.025]
[0.02000000000000046]
[0.8]
[0.0350000000000006]
[0.0650000000000003]
[-0.1599999999999998]
[0.815]
[-0.3849999999999995]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.3550000000000004]
[0.125]
[0.95]
[-0.2649999999999996]
[0.2900000000000001]
[-0.34]
[0.1700000000000004]
[0.935]
[0.1100000000000007]
[0.56]
[0.5150000000000001]
[0.3950000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.4400000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.2600000000000006]
[-0.2949999999999993]
[0.3200000000000001]
```

```
[1.07]
[0.18500000000000005]
[-0.27999999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.18999999999999995]
[0.455]
[0.98000000000000002]
[-0.05499999999999994]
[0.84500000000000002]
[0.605]
[-0.024999999999999967]
[0.62000000000000001]
[0.30500000000000005]]
Epoch: 4501
      error: 3.1288688e-15
      current w: [[0.30000004]]
      current b [0.20000002]

Final values:
      epochs: 4501
      error: 3.1288688e-15
      w: [[0.30000004]]
      b: [0.20000002]
      Predicted y: [[ 1.0549998 ]
[ 0.36499995]
[ 0.05000001]
[ 0.7099999 ]
[ 1.0399998 ]
[ 0.5749999 ]
[ 0.40999997]
[ 0.00500003]
[ 0.46999994]
[ 0.09500001]
[ 0.24499997]
[ 0.14      ]
[-0.08499995]
[ 0.08000001]
[ 0.6499999 ]
[ 0.53      ]
[ 1.0849998 ]
[ 0.69499993]
[ 0.48499992]
[ 0.21499999]
[-0.24999994]
[ 0.7399999 ]
[ 1.0249999 ]
[ 0.02000001]
[ 0.7999999 ]
[ 0.03500001]
[ 0.06500001]
[-0.15999997]
[ 0.8149999 ]
[-0.38499993]
[ 0.8599999 ]
[ 0.75499994]
```

```
[ 0.90499985]
[-0.35499996]
[ 0.125      ]
[ 0.94999987]
[-0.26499993]
[ 0.28999996]
[-0.3399999 ]
[ 0.16999999]
[ 0.9349999 ]
[ 0.11       ]
[ 0.55999994]
[ 0.5149999 ]
[ 0.39499995]
[ 0.7849999 ]
[-0.03999998]
[ 0.43999994]
[ 0.63499993]
[ 0.54499996]
[ 0.82999986]
[ 0.49999994]
[-0.11499995]
[-0.30999994]
[ 0.42499995]
[ 0.7249999 ]
[-0.39999992]
[ 0.26       ]
[-0.29499993]
[ 0.31999996]
[ 1.0699999 ]
[ 0.18499999]
[-0.27999994]
[ 0.22999999]
[ 0.67999995]
[ 1.0099999 ]
[-0.18999994]
[ 0.45499995]
[ 0.97999984]
[-0.05499998]
[ 0.8449999 ]
[ 0.6049999 ]
[-0.02499998]
[ 0.6199999 ]
[ 0.30499998]]
    Actual y: [[1.0550000000000002]
[0.36500000000000001]
[0.050000000000000002]
[0.71]
[1.04000000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[0.47000000000000001]
[0.09500000000000006]
[0.245]
[0.14]
[-0.08499999999999996]
[0.08000000000000004]
```



```
[0.6499999999999999]
[0.53]
[1.085]
[0.6950000000000001]
[0.4850000000000004]
[0.2150000000000008]
[-0.2499999999999994]
[0.74]
[1.025]
[0.02000000000000046]
[0.8]
[0.03500000000000006]
[0.06500000000000003]
[-0.1599999999999998]
[0.815]
[-0.3849999999999995]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.3550000000000004]
[0.125]
[0.95]
[-0.2649999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.03999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.1149999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.3999999999999997]
[0.26000000000000006]
[-0.2949999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.2799999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.1899999999999995]
[0.455]
[0.9800000000000002]
[-0.0549999999999994]
[0.8450000000000002]
```

```
[ 0.605 ]  
[ -0.024999999999999967 ]  
[ 0.62000000000000001 ]  
[ 0.30500000000000005 ]]
```

```

In [59]: import tensorflow as tf
import numpy as np

# Explicitly create a Graph object
graph = tf.Graph()

with graph.as_default():

    with tf.name_scope("variables"):
        # Variable to keep track of how many times the graph has been run
        global_step = tf.Variable(0, dtype=tf.int32, name="global_step")

        # Increments the above `global_step` Variable, should be run whenever the graph is run
        increment_step = global_step.assign_add(1)

        # Variable that keeps track of previous output value:
        previous_value = tf.Variable(0.0, dtype=tf.float32, name="previous_value")

    # Primary transformation Operations
    with tf.name_scope("exercise_transformation"):

        # Separate input layer
        with tf.name_scope("input"):
            # Create input placeholder- takes in a Vector
            a = tf.placeholder(tf.float32, shape=[None], name="input_placeholder_a")

        # Separate middle layer
        with tf.name_scope("intermediate_layer"):
            b = tf.reduce_prod(a, name="product_b")
            c = tf.reduce_sum(a, name="sum_c")

        # Separate output layer
        with tf.name_scope("output"):
            d = tf.add(b, c, name="add_d")
            output = tf.subtract(d, previous_value, name="output")
            update_prev = previous_value.assign(output)

    # Summary Operations
    with tf.name_scope("summaries"):
        tf.summary.scalar(tensor = output, name="output_summary") # Creates summary for output node
        tf.summary.scalar(tensor = b, name="prod_summary")
        tf.summary.scalar(tensor = c, name="sum_summary")

    # Global Variables and Operations
    with tf.name_scope("global_ops"):
        # Initialization Op
        init = tf.initialize_all_variables()
        # Collect all summary Ops in graph
        merged_summaries = tf.summary.merge_all

# Start a Session, using the explicitly created Graph

```

```

sess = tf.Session(graph=graph)

# Open a SummaryWriter to save summaries
writer = tf.summary.FileWriter('./improved_graph', graph)

# Initialize Variables
sess.run(init)

def run_graph(input_tensor):
    """
    Helper function; runs the graph with given input tensor and saves summaries
    """
    feed_dict = {a: input_tensor}
    output, summary, step = sess.run([update_prev, merged_summaries, increment_step], feed_dict=feed_dict)
    writer.add_summary(summary, global_step=step)

# Run the graph with various inputs
run_graph([2,8])
run_graph([3,1,3,3])
run_graph([8])
run_graph([1,2,3])
run_graph([11,4])
run_graph([4,1])
run_graph([7,3,1])
run_graph([6,3])
run_graph([0,2])
run_graph([4,5,6])

# Writes the summaries to disk
writer.flush()

# Flushes the summaries to disk and closes the SummaryWriter
writer.close()

# Close the session
sess.close()

# To start TensorBoard after running this file, execute the following command:
# $ tensorboard --logdir='./improved_graph'

```

```

-----
TypeError                                Traceback (most recent call last)
/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/session.py in __init__(self, fetches, contraction_fn)
    281         self._unique_fetches.append(ops.get_default_graph().as_graph_element(
--> 282             fetch, allow_tensor=True, allow_operation=True))
    283         except TypeError as e:

/anaconda3/lib/python3.7/site-packages/tensorflow/python/framework/ops.py in as_graph_element(self, obj, allow_tensor, allow_operation)
    3589         with self._lock:
-> 3590             return self._as_graph_element_locked(obj, allow_tensor, allow_operation)
    3591

/anaconda3/lib/python3.7/site-packages/tensorflow/python/framework/ops.py in _as_graph_element_locked(self, obj, allow_tensor, allow_operation)
    3678         raise TypeError("Can not convert a %s into a %s." % (type(obj).__name__,
-> 3679                                                                type_s_str))
    3680

```

TypeError: Can not convert a function into a Tensor or Operation.

During handling of the above exception, another exception occurred:

```

TypeError                                Traceback (most recent call last)
<ipython-input-59-defa2f4646dc> in <module>()
    68
    69 # Run the graph with various inputs
--> 70 run_graph([2,8])
    71 run_graph([3,1,3,3])
    72 run_graph([8])

<ipython-input-59-defa2f4646dc> in run_graph(input_tensor)
    63     """
    64     feed_dict = {a: input_tensor}
--> 65     output, summary, step = sess.run([update_prev, merged_summaries, increment_step], feed_dict=feed_dict)
    66     writer.add_summary(summary, global_step=step)
    67

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/session.py in run(self, fetches, feed_dict, options, run_metadata)
    898     try:
    899         result = self._run(None, fetches, feed_dict, options_ptr,
--> 900                             run_metadata_ptr)
    901         if run_metadata:
    902             proto_data = tf_session.TF_GetBuffer(run_metadata_ptr)

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/session

```

```

n.py in _run(self, handle, fetches, feed_dict, options, run_metadata)
    1118     # Create a fetch handler to take care of the structure of f
    etches.
    1119     fetch_handler = _FetchHandler(
-> 1120         self._graph, fetches, feed_dict_tensor, feed_handles=fe
    ed_handles)
    1121
    1122     # Run request and get response.

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in __init__(self, graph, fetches, feeds, feed_handles)
    425     """
    426     with graph.as_default():
-> 427         self._fetch_mapper = _FetchMapper.for_fetch(fetches)
    428         self._fetches = []
    429         self._targets = []

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in for_fetch(fetch)
    243     elif isinstance(fetch, (list, tuple)):
    244         # NOTE(touts): This is also the code path for namedtuple
    s.
-> 245         return _ListFetchMapper(fetch)
    246     elif isinstance(fetch, dict):
    247         return _DictFetchMapper(fetch)

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in __init__(self, fetches)
    350     """
    351     self._fetch_type = type(fetches)
-> 352     self._mappers = [_FetchMapper.for_fetch(fetch) for fetch in
    fetches]
    353     self._unique_fetches, self._value_indices = _uniquify_fetch
    es(self._mappers)
    354

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in <listcomp>(.0)
    350     """
    351     self._fetch_type = type(fetches)
-> 352     self._mappers = [_FetchMapper.for_fetch(fetch) for fetch in
    fetches]
    353     self._unique_fetches, self._value_indices = _uniquify_fetch
    es(self._mappers)
    354

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in for_fetch(fetch)
    251     if isinstance(fetch, tensor_type):
    252         fetches, contraction_fn = fetch_fn(fetch)
-> 253     return _ElementFetchMapper(fetches, contraction_fn)
    254     # Did not find anything.
    255     raise TypeError('Fetch argument %r has invalid type %r' %
    (fetch,

```

```
284         raise TypeError('Fetch argument %r has invalid type %r,
,
285                               'must be a string or Tensor. (%s)' %
--> 286                               (fetch, type(fetch), str(e)))
287     except ValueError as e:
288         raise ValueError('Fetch argument %r cannot be interpret
ed as a '
```

TypeError: Fetch argument <function merge_all at 0x125cdac80> has invalid type <class 'function'>, must be a string or Tensor. (Can not convert a function into a Tensor or Operation.)