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
499999999999998, -1.0, -0.95, -0.8999999999999999, -0.8499999999999999,
-0.7999999999999998, -0.75, -0.7, -0.6499999999999999, -0.5999999999999
999, -0.5499999999999998, -0.5, -0.44999999999999996, -0.3999999999999
99, -0.34999999999999987, -0.2999999999999998, -0.25, -0.19999999999999
996, -0.1499999999999999, -0.09999999999999987, -0.04999999999999982,
0.0, 0.050000000000000266, 0.10000000000000009, 0.1499999999999999, 0.2
0000000000000018, 0.25, 0.30000000000000027, 0.3500000000000001, 0.4000
0000000000036, 0.4500000000000002, 0.5, 0.5500000000000003, 0.600000000
0000001, 0.6500000000000004, 0.7000000000000002, 0.75, 0.80000000000000
03, 0.8500000000000001, 0.9000000000000004, 0.9500000000000002, 1.0, 1.
0500000000000003, 1.1, 1.1500000000000004, 1.2000000000000002, 1.25, 1.
3000000000000003, 1.35, 1.4000000000000004, 1.4500000000000002, 1.5, 1.
5500000000000003, 1.6, 1.6500000000000004, 1.7000000000000002, 1.75, 1.
8000000000000003, 1.85, 1.9000000000000004, 1.9500000000000002, 2.0, 2.
05, 2.1000000000000005, 2.1500000000000004, 2.2, 2.25, 2.3, 2.350000000
0000005, 2.4000000000000004, 2.45, 2.5, 2.55, 2.6000000000000005, 2.650
0000000000004, 2.7, 2.75, 2.8000000000000007, 2.8500000000000005, 2.900
0000000000004, 2.95]
```

```
/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:25: Settin
gWithCopyWarning:
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-d
ocs/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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
 [0.8600000000000001]
 [0.7550000000000001]
 [0.9050000000000002]
 [-0.35500000000000004]
 [0.125]
 [0.95]
 [-0.26499999999999996]
 [0.2900000000000001]
 [-0.34]
 [0.17000000000000004]
 [0.935]
 [0.11000000000000007]
 [0.56]
 [0.5150000000000001]
 [0.39500000000000013]
 [0.7850000000000001]
 [-0.039999999999999925]
 [0.44000000000000006]
 [0.635]
 [0.5450000000000002]
 [0.8300000000000001]
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [0.6200000000000001]
 [0.30500000000000005]]
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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
```

```
 [0.935]
 [0.11000000000000007]
 [0.56]
 [0.5150000000000001]
 [0.39500000000000013]
 [0.7850000000000001]
 [-0.039999999999999925]
 [0.44000000000000006]
 [0.635]
 [0.5450000000000002]
 [0.8300000000000001]
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
```

```
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [0.6200000000000001]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
```

```
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
```

```
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.27999999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.18999999999999995]
[0.455]
[0.9800000000000002]
[-0.05499999999999994]
[0.8450000000000002]
[0.605]
[-0.024999999999999967]
```

```
 [0.6200000000000001]
 [0.30500000000000005]]
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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
 [0.8600000000000001]
 [0.7550000000000001]
 [0.9050000000000002]
 [-0.35500000000000004]
 [0.125]
 [0.95]
 [-0.26499999999999996]
 [0.2900000000000001]
 [-0.34]
 [0.17000000000000004]
 [0.935]
 [0.11000000000000007]
 [0.56]
 [0.5150000000000001]
 [0.39500000000000013]
 [0.7850000000000001]
 [-0.039999999999999925]
 [0.44000000000000006]
 [0.635]
 [0.5450000000000002]
 [0.8300000000000001]
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [0.6200000000000001]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
```

```
 [-0.34]
 [0.17000000000000004]
 [0.935]
 [0.11000000000000007]
 [0.56]
 [0.5150000000000001]
 [0.39500000000000013]
 [0.7850000000000001]
 [-0.039999999999999925]
 [0.44000000000000006]
 [0.635]
 [0.5450000000000002]
 [0.8300000000000001]
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
```

```
 [0.5450000000000002]
 [0.8300000000000001]
 [0.5]
 [-0.11499999999999994]
 [-0.31]
 [0.425]
 [0.7250000000000001]
 [-0.39999999999999997]
 [0.26000000000000006]
 [-0.29499999999999993]
 [0.3200000000000001]
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [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]
[0.3650000000000001]
[0.05000000000000002]
```

```
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.3200000000000001]
```

```
 [1.07]
 [0.18500000000000005]
 [-0.27999999999999997]
 [0.23000000000000004]
 [0.6799999999999999]
 [1.01]
 [-0.18999999999999995]
 [0.455]
 [0.9800000000000002]
 [-0.05499999999999994]
 [0.8450000000000002]
 [0.605]
 [-0.024999999999999967]
 [0.6200000000000001]
 [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]
[0.3650000000000001]
[0.05000000000000002]
[0.71]
[1.0400000000000003]
[0.575]
[0.41000000000000003]
[0.005000000000000032]
[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]
[0.8600000000000001]
[0.7550000000000001]
[0.9050000000000002]
[-0.35500000000000004]
[0.125]
[0.95]
[-0.26499999999999996]
[0.2900000000000001]
[-0.34]
[0.17000000000000004]
[0.935]
[0.11000000000000007]
[0.56]
[0.5150000000000001]
[0.39500000000000013]
[0.7850000000000001]
[-0.039999999999999925]
[0.44000000000000006]
[0.635]
[0.5450000000000002]
[0.8300000000000001]
[0.5]
[-0.11499999999999994]
[-0.31]
[0.425]
[0.7250000000000001]
[-0.39999999999999997]
[0.26000000000000006]
[-0.29499999999999993]
[0.3200000000000001]
[1.07]
[0.18500000000000005]
[-0.27999999999999997]
[0.23000000000000004]
[0.6799999999999999]
[1.01]
[-0.18999999999999995]
[0.455]
[0.9800000000000002]
[-0.05499999999999994]
[0.8450000000000002]
```

```
[0.605]
[-0.024999999999999967]
[0.6200000000000001]
[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 ru
n
        global_step = tf.Variable(0, dtype=tf.int32, name="global_step")

        # Increments the above `global_step` Variable, should be run whe
never 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="previo
us_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_pla
ceholder_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")  # Cre
ates 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 su
mmaries
    """
    feed_dict = {a: input_tensor}
    output, summary, step = sess.run([update_prev, merged_summaries, inc
rement_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 co
mmand:
# $ 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                                                            types_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.py
```

```
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,

/anaconda3/lib/python3.7/site-packages/tensorflow/python/client/sessio
n.py in __init__(self, fetches, contraction_fn)
```

```
    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 inval
id type <class 'function'>, must be a string or Tensor. (Can not conver
t a function into a Tensor or Operation.)
```