SMOKE TEST

Tensorflow 1.13

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Document Information

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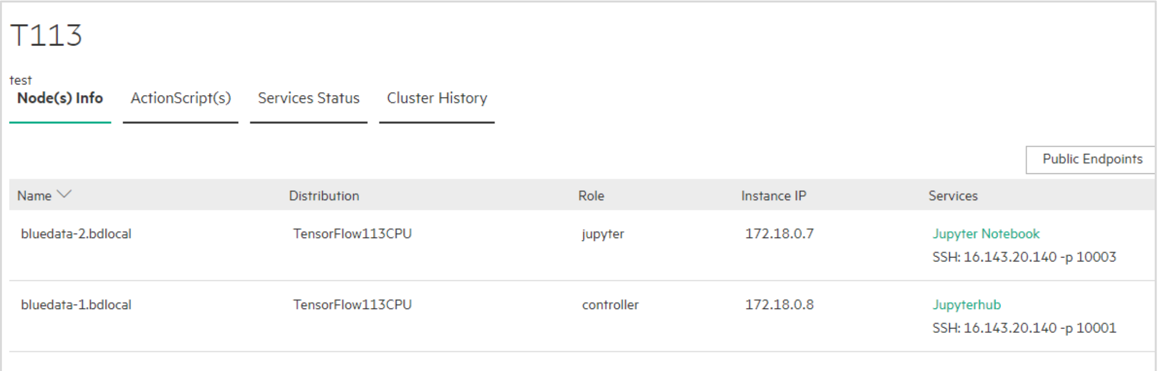
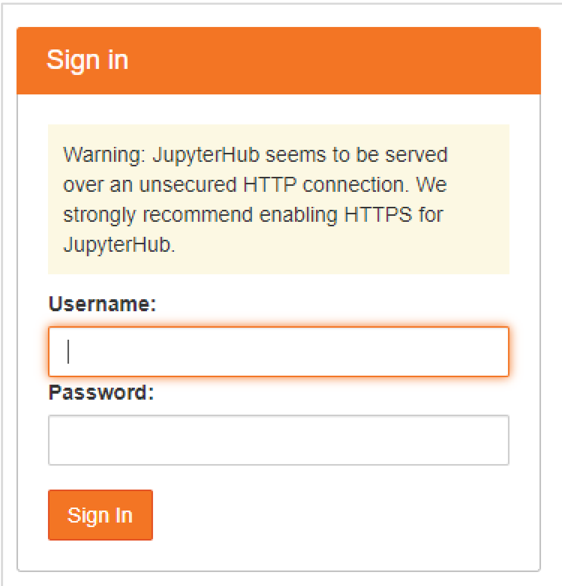
1 LOGIN TO JUPYTERHUB WEB UI

Login to the JupyterHub Web UI, using the following steps:

1. From the Cluster page under Services, click on **Jupterhub**



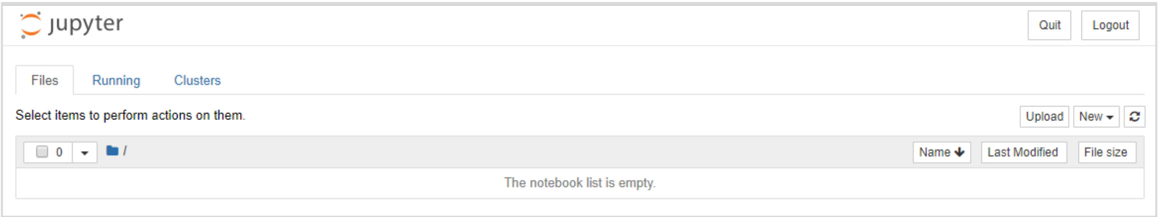
2. It will open-up a new tab with JupyterHub login page, login using your credentials



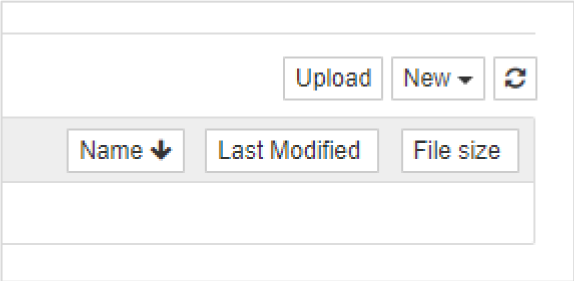
2 CREATE NOTEBOOK

To create a new notebook, in JupyterHub use the following steps:

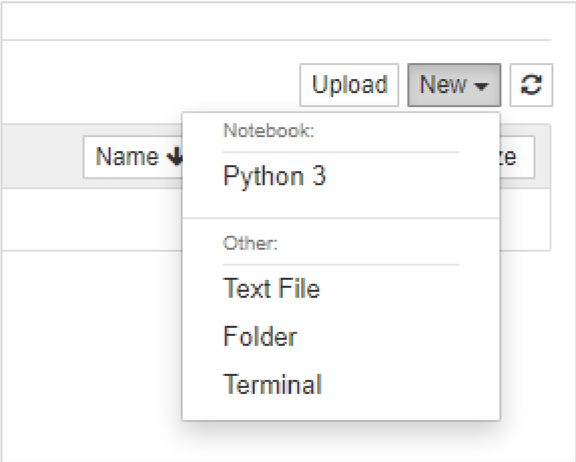
1. Once you log into JupyterHub, you will get the dashboard like below:



2. Click on **New** drop-down button, to create a new notebook



3. Select **Python3**, for upcoming tasks



3 LINEAR REGRESSION

In this section, we are testing a Linear Regression example:

1. In Python3 notebook, add the following code in the code cell:

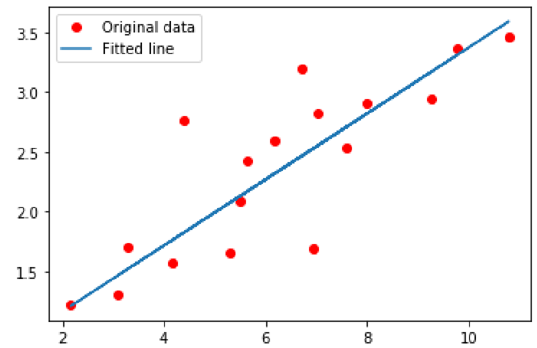
```
import tensorflow as tf
import numpy
import matplotlib.pyplot as plt
rng = numpy.random

# Parameters
learning_rate = 0.01
training_epochs = 1000
display_step = 50
train_X =
numpy.asarray([3.3,4.4,5.5,6.71,6.93,4.168,9.779,6.182,7.59,2.167,7.042,10.791,5.313
,7.997,5.654,9.27,3.1])
train_Y =
numpy.asarray([1.7,2.76,2.09,3.19,1.694,1.573,3.366,2.596,2.53,1.221,2.827,3.465,1.6
5,2.904,2.42,2.94,1.3])
n_samples = train_X.shape[0]
X = tf.placeholder("float")
Y = tf.placeholder("float")
W = tf.Variable(rng.randn(), name="weight")
b = tf.Variable(rng.randn(), name="bias")

# Construct a linear model
pred = tf.add(tf.multiply(X, W), b)
# Mean squared error
cost = tf.reduce_sum(tf.pow(pred-Y, 2))/(2*n_samples)
# Gradient descent
optimizer = tf.train.GradientDescentOptimizer(learning_rate).minimize(cost)

# Initialize the variables (i.e. assign their default value)
init = tf.global_variables_initializer()

# Start training
with tf.Session() as sess:
    sess.run(init)
    # Fit all training data
    for epoch in range(training_epochs):
        for (x, y) in zip(train_X, train_Y):
            sess.run(optimizer, feed_dict={X: x, Y: y})
        #Display logs per epoch step
        if (epoch+1) % display_step == 0:
            c = sess.run(cost, feed_dict={X: train_X, Y:train_Y})
            print ("Epoch:", '%04d' % (epoch+1), "cost=", "{:.9f}".format(c), "W=",
sess.run(W), "b=", sess.run(b))
    print ("Optimization Finished!")
    training_cost = sess.run(cost, feed_dict={X: train_X, Y: train_Y})
    print ("Training cost=", training_cost, "W=", sess.run(W), "b=", sess.run(b),
'\n')

    #Graphic display
    plt.plot(train_X, train_Y, 'ro', label='Original data')
    plt.plot(train_X, sess.run(W) * train_X + sess.run(b), label='Fitted line')
    plt.legend()
    plt.show()
```

```
In [ ]: import tensorflow as tf
        import numpy
        import matplotlib.pyplot as plt
        rng = numpy.random

        # Parameters
        learning_rate = 0.01
        training_epochs = 1000
        display_step = 50

        # Training Data
        train_X = numpy.asarray([3.3,4.4,5.5,6.71,6.93,4.168,9.779,6.182,7.59,2.167,7.042,10.791,5.313,7.997,5.654,9.27,3.1])
        train_Y = numpy.asarray([1.7,2.76,2.09,3.19,1.694,1.573,3.366,2.596,2.53,1.221,2.827,3.465,1.65,2.904,2.42,2.94,1.3])
        n_samples = train_X.shape[0]

        # tf Graph Input
        X = tf.placeholder("float")
        Y = tf.placeholder("float")

        # Set model weights
        W = tf.Variable(rng.randn(), name="weight")
        b = tf.Variable(rng.randn(), name="bias")

        # Construct a linear model
        pred = tf.add(tf.multiply(X, W), b)

        # Mean squared error
        cost = tf.reduce_sum(tf.pow(pred-Y, 2))/(2*n_samples)
        # Gradient descent
        optimizer = tf.train.GradientDescentOptimizer(learning_rate).minimize(cost)

        # Initialize the variables (i.e. assign their default value)
        init = tf.global_variables_initializer()

        # Start training
        with tf.Session() as sess:
            sess.run(init)

            # Fit all training data
            for epoch in range(training_epochs):
                for (x, y) in zip(train_X, train_Y):
                    sess.run(optimizer, feed_dict={X: x, Y: y})

                #Display logs per epoch step
                if (epoch+1) % display_step == 0:
```

```
                #Display logs per epoch step
                if (epoch+1) % display_step == 0:
                    c = sess.run(cost, feed_dict={X: train_X, Y:train_Y})
                    print ("Epoch:", '%04d' % (epoch+1), "cost=", "{:.9f}".format(c), "W=", sess.run(W), "b=", sess.run(b))
            print ("Optimization Finished!")
            training_cost = sess.run(cost, feed_dict={X: train_X, Y: train_Y})
            print ("Training cost=", training_cost, "W=", sess.run(W), "b=", sess.run(b), '\n')

            #Graphic display
            plt.plot(train_X, train_Y, 'ro', label='Original data')
            plt.plot(train_X, sess.run(W) * train_X + sess.run(b), label='Fitted line')
            plt.legend()
            plt.show()
```

2. Click on **Run**, to view the output

```
Epoch: 0050 cost= 0.100056902 W= 0.33464253 b= 0.1896305
Epoch: 0100 cost= 0.097387671 W= 0.32958433 b= 0.22601922
Epoch: 0150 cost= 0.095026977 W= 0.3248268 b= 0.26024374
Epoch: 0200 cost= 0.092939079 W= 0.3203523 b= 0.29243314
Epoch: 0250 cost= 0.091092519 W= 0.31614393 b= 0.32270795
Epoch: 0300 cost= 0.089459457 W= 0.312186 b= 0.35118157
Epoch: 0350 cost= 0.088015184 W= 0.30846328 b= 0.37796235
Epoch: 0400 cost= 0.086737908 W= 0.30496192 b= 0.40315053
Epoch: 0450 cost= 0.085608326 W= 0.30166888 b= 0.42684048
Epoch: 0500 cost= 0.084609419 W= 0.29857177 b= 0.44912106
Epoch: 0550 cost= 0.083726034 W= 0.29565877 b= 0.47007725
Epoch: 0600 cost= 0.082944840 W= 0.29291892 b= 0.48978683
Epoch: 0650 cost= 0.082254037 W= 0.2903422 b= 0.5083237
Epoch: 0700 cost= 0.081643179 W= 0.2879186 b= 0.52575904
Epoch: 0750 cost= 0.081103034 W= 0.28563923 b= 0.54215676
Epoch: 0800 cost= 0.080625392 W= 0.28349537 b= 0.5575797
Epoch: 0850 cost= 0.080203041 W= 0.28147882 b= 0.5720862
Epoch: 0900 cost= 0.079829641 W= 0.27958238 b= 0.5857292
Epoch: 0950 cost= 0.079499461 W= 0.27779865 b= 0.5985611
Epoch: 1000 cost= 0.079207547 W= 0.27612087 b= 0.6106305
Optimization Finished!
Training cost= 0.07920755 W= 0.27612087 b= 0.6106305
```



Note: Try adding **%matplotlib inline** at the top of the code if you get, <Figure size 640x480 with 1 Axes> instead of graph.

4 NEURAL NETWORK

In this section, we will test some neural network example:

1. In a Python3 notebook, add the below code in the code cell:

```
import numpy as np

class NeuralNetwork():
    def __init__(self):
        np.random.seed(1)
        self.synaptic_weights = 2 * np.random.random((3, 1)) - 1

    def sigmoid(self, x):
        return 1 / (1 + np.exp(-x))

    def sigmoid_derivative(self, x):
        return x * (1 - x)

    def train(self, training_inputs, training_outputs, training_iterations):
        for iteration in range(training_iterations):
            output = self.think(training_inputs)
            error = training_outputs - output
            adjustments = np.dot(training_inputs.T, error *
self.sigmoid_derivative(output))
            self.synaptic_weights += adjustments

    def think(self, inputs):
        inputs = inputs.astype(float)
        output = self.sigmoid(np.dot(inputs, self.synaptic_weights))
        return output


if __name__ == "__main__":
    neural_network = NeuralNetwork()
    print("Beginning Randomly Generated Weights: ")
    print(neural_network.synaptic_weights)
    training_inputs = np.array([[0,0,1],
                                [1,1,1],
                                [1,0,1],
                                [0,1,1]])

    training_outputs = np.array([[0,1,1,0]]).T
    neural_network.train(training_inputs, training_outputs, 15000)
    print("Ending Weights After Training: ")
    print(neural_network.synaptic_weights)
    user_input_one = str(input("User Input One: "))
    user_input_two = str(input("User Input Two: "))
    user_input_three = str(input("User Input Three: "))
    print("Considering New Situation: ", user_input_one, user_input_two,
user_input_three)
    print("New Output data: ")
    print(neural_network.think(np.array([user_input_one, user_input_two,
user_input_three])))
    print("Wow, we did it!")
```

2. Click on **Run**, to view the output

```
Beginning Randomly Generated Weights:
[[-0.16595599]
 [ 0.44064899]
 [-0.99977125]]
Ending Weights After Training:
[[10.08740896]
 [-0.20695366]
 [-4.83757835]]
User Input One:  1
User Input Two:  0
User Input Three:  0
Considering New Situation:  1 0 0
New Output data:
[0.9999584]
Wow, we did it!
```

4.1 Single Neuron Neural Network

1. Add the below code in the code cell:

```
from numpy import exp, array, random, dot, tanh

class NeuralNetwork():

    def __init__(self):
        random.seed(1)
        self.weight_matrix = 2 * random.random((3, 1)) - 1

    def tanh(self, x):
        return tanh(x)

    def tanh_derivative(self, x):
        return 1.0 - tanh(x) ** 2

    def forward_propagation(self, inputs):
        return self.tanh(dot(inputs, self.weight_matrix))

    def train(self, train_inputs, train_outputs,
                            num_train_iterations):
        for iteration in range(num_train_iterations):
            output = self.forward_propagation(train_inputs)
            error = train_outputs - output
            adjustment = dot(train_inputs.T, error *
                             self.tanh_derivative(output))
            self.weight_matrix += adjustment

if __name__ == "__main__":
    neural_network = NeuralNetwork()
    print ('Random weights at the start of training')
    print (neural_network.weight_matrix)
    train_inputs = array([[0, 0, 1], [1, 1, 1], [1, 0, 1], [0, 1, 1]])
    train_outputs = array([[0, 1, 1, 0]]).T
    neural_network.train(train_inputs, train_outputs, 10000)
    print ('New weights after training')
    print (neural_network.weight_matrix)
    print ("Testing network on new examples ->")
    print (neural_network.forward_propagation(array([1, 0, 0])))
```

2. Click on **Run**, to view the output

```
Random weights at the start of training
[[-0.16595599]
 [ 0.44064899]
 [-0.99977125]]
New weights after training
[[5.39428067]
 [0.19482422]
 [0.34317086]]
Testing network on new examples ->
[0.99995873]
```

4.2 One Dimensional Vector

1. Add the below code in the code cell:

```
import numpy as np
input_vector = np.array([2, 4, 11])
print(input_vector)
```

2. Click on **Run**, to view the output

```
[14]: import numpy as np
      input_vector = np.array([2, 4, 11])
      print(input_vector)

      [ 2  4 11]
```

4.3 Two Dimensional Array with one column

1. Add the below code in the code cell:

```
import numpy as np
input_vector = np.array([2, 4, 11])
input_vector = np.array(input_vector, ndmin=2).T
print(input_vector, input_vector.shape)
```

2. Click on **Run**, to view the output

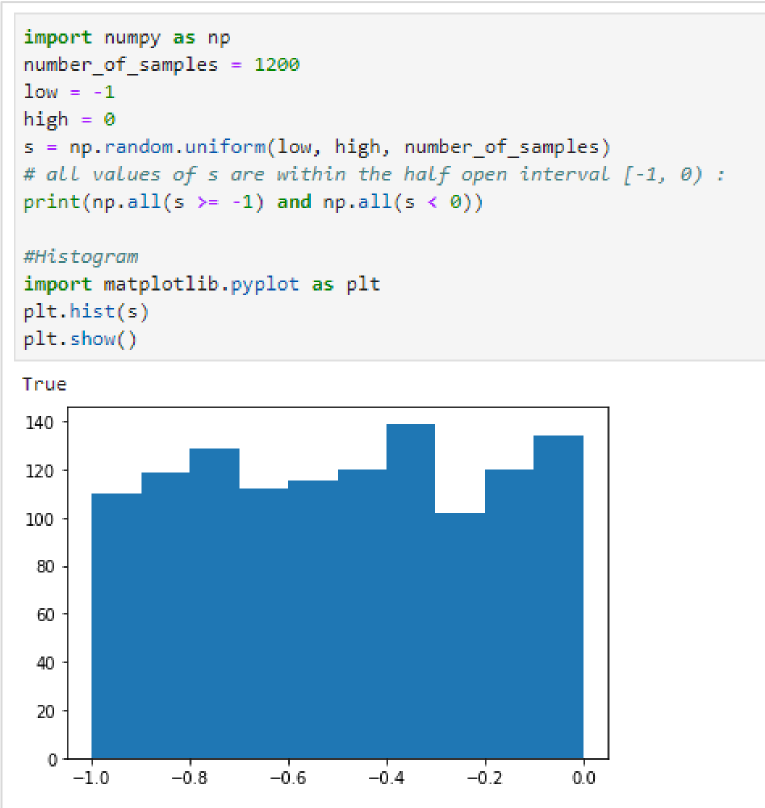
```
import numpy as np
input_vector = np.array([2, 4, 11])
input_vector = np.array(input_vector, ndmin=2).T
print(input_vector, input_vector.shape)

[[ 2]
 [ 4]
 [11]] (3, 1)
```

4.4 Weight Matrices

1. Add the below code in the code cell:

```
import numpy as np
number_of_samples = 1200
low = -1
high = 0
s = np.random.uniform(low, high, number_of_samples)
# all values of s are within the half open interval [-1, 0) :
print(np.all(s >= -1) and np.all(s < 0))

#Histogram
import matplotlib.pyplot as plt
plt.hist(s)
plt.show()
```

2. To execute the code, click on **Run**



Note: Try adding **%matplotlib inline** at the top of the code if you don't get the graph.

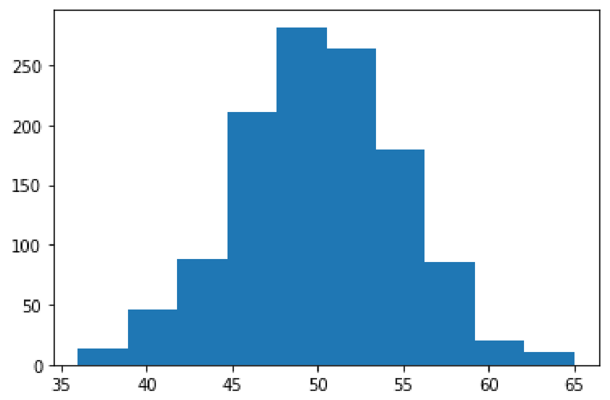
4.5 Binomial Function

1. Add the below code in the code cell:

```
s = np.random.binomial(100, 0.5, 1200)
plt.hist(s)
plt.show()
```

2. To execute click on **Run**

```
s = np.random.binomial(100, 0.5, 1200)
plt.hist(s)
plt.show()
```



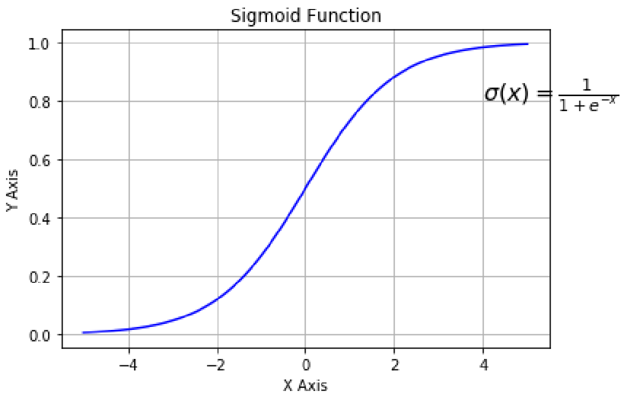
4.6 Sigmoid Function

1. Add the below code in the code cell:

```
import numpy as np
import matplotlib.pyplot as plt
def sigma(x):
    return 1 / (1 + np.exp(-x))
X = np.linspace(-5, 5, 100)
plt.plot(X, sigma(X),'b')
plt.xlabel('X Axis')
plt.ylabel('Y Axis')
plt.title('Sigmoid Function')
plt.grid()
plt.text(4, 0.8, r'$\sigma(x)=\frac{1}{1+e^{-x}}$', fontsize=16)
plt.show()
```

2. To execute click on **Run**

```python
import numpy as np
import matplotlib.pyplot as plt
def sigma(x):
    return 1 / (1 + np.exp(-x))
X = np.linspace(-5, 5, 100)
plt.plot(X, sigma(X),'b')
plt.xlabel('X Axis')
plt.ylabel('Y Axis')
plt.title('Sigmoid Function')
plt.grid()
plt.text(4, 0.8, r'$\sigma(x)=\frac{1}{1+e^{-x}}$', fontsize=16)
plt.show()
```



5 CPU CONSUMPTION

1. In a Python3 notebook, add the below code in the code cell:

```
from __future__ import print_function
import matplotlib
import matplotlib.pyplot as plt
import tensorflow as tf
import time

with tf.Session(config=tf.ConfigProto(log_device_placement=True)) as
session:
    start_time = time.time()
    time_taken = time.time() - start_time
    #print(result)

def get_times(maximum_time):

    device_times = {
        "/cpu:0":[]
    }
    matrix_sizes = range(500,50000,50)

    for size in matrix_sizes:
        for device_name in device_times.keys():

            print("####### Calculating on the " + device_name + " #######")

            shape = (size,size)
            data_type = tf.float16
            with tf.device(device_name):
                r1 = tf.random_uniform(shape=shape, minval=0, maxval=1,
dtype=data_type)
                r2 = tf.random_uniform(shape=shape, minval=0, maxval=1,
dtype=data_type)
                dot_operation = tf.matmul(r2, r1)


            with
tf.Session(config=tf.ConfigProto(log_device_placement=True)) as session:
                    start_time = time.time()
                    result = session.run(dot_operation)
                    time_taken = time.time() - start_time
                    print(result)
                    device_times[device_name].append(time_taken)

            print(device_times)

            if time_taken > maximum_time:
                return device_times, matrix_sizes

device_times, matrix_sizes = get_times(1.5)
cpu_times = device_times["/cpu:0"]

plt.plot(matrix_sizes[:len(cpu_times)], cpu_times, 'o-')
plt.ylabel('Time')
plt.xlabel('Matrix size')
plt.show()
```

2. To execute the code, click on **Run**

```
####### Calculating on the /cpu:0 #######
[[122.   126.5  122.4  ... 128.4  122.75 125.56]
 [125.25 124.75 125.9  ... 130.6  125.   127.75]
 [125.2  124.   123.   ... 130.2  122.9  125.7 ]
 ...
 [128.2  128.   126.6  ... 133.8  127.75 129.8 ]
 [117.5  120.9  116.9  ... 125.94 118.2  120.6 ]
 [128.5  128.4  127.94 ... 134.   126.   131.8 ]]
{'/cpu:0': [0.898186445236206]}
####### Calculating on the /cpu:0 #######
[[133.8 136.2 135.8 ... 139.6 142.8 135. ]
 [135.8 135.9 135.2 ... 138.6 143.6 135.1]
 [131.1 132.2 130.8 ... 135.2 139.5 128.4]
 ...
 [136.4 136.5 131.8 ... 136.6 143.9 133.2]
 [137.6 138.8 136.  ... 138.6 146.6 133. ]
 [135.5 132.9 134.6 ... 138.6 138.8 131. ]]
{'/cpu:0': [0.898186445236206, 1.0762956142425537]}
####### Calculating on the /cpu:0 #######
[[151.1 149.8 142.5 ... 154.  149.8 141.5]
 [159.  154.5 145.9 ... 152.  151.1 145.2]
 [153.2 151.5 145.4 ... 153.  150.1 146. ]
 ...
 [147.6 145.2 135.5 ... 149.  145.8 136.8]
 [146.2 151.  140.5 ... 149.9 146.  141.6]
 [147.2 141.5 135.6 ... 145.5 148.1 138.4]]
{'/cpu:0': [0.898186445236206, 1.0762956142425537, 1.306037187576294]}
####### Calculating on the /cpu:0 #######
[[155.9 156.5 161.2 ... 157.1 161.  161.2]
 [164.8 156.5 159.1 ... 158.1 156.8 165.9]
 [159.  156.6 163.1 ... 161.  160.6 164.8]
 ...
 [160.5 160.6 164.9 ... 160.  163.2 162.8]
 [154.5 157.5 156.5 ... 156.1 157.  161.1]
 [159.9 159.6 159.6 ... 156.4 159.9 159.8]]
{'/cpu:0': [0.898186445236206, 1.0762956142425537, 1.306037187576294, 1.6062920093536377]}
```