Tensorflow 2.0 Variables

This notebook will teach you about variables and how to build a basic computation graph.

We will perform gradient descent manually to optimize a simple function.

If you're familiar with Tensorflow 1.x, you will find this useful as an example to demonstrate how we can do the same operations, but without sessions, initializers, etc.

In [ ]:
```
# Install TensorFlow
# !pip install -q tensorflow-gpu==2.0.0-beta1

try:
  %tensorflow_version 2.x  # Colab only.
except Exception:
  pass

import tensorflow as tf
print(tf.__version__)
```

```
`%tensorflow_version` only switches the major version: `1.x` or `2.x`.
You set: `2.x  # Colab only.`. This will be interpreted as: `2.x`.


TensorFlow 2.x selected.
2.0.0-beta1
```

In [ ]:
```
# First, what is the difference between mutable and immutable?

# A tuple is immutable
# This should result in an error
a = (1,2,3)
a[0] = 5
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-2-0e96911569be> in <module>()
      1 a = (1,2,3)
----> 2 a[0] = 5

TypeError: 'tuple' object does not support item assignment
```

In [ ]:
```
# A list is mutable
a = [1,2,3]
a[0] = 5
print(a)
```

```
[5, 2, 3]
```

In [ ]:
```
# Now Tensorflow variables
a = tf.Variable(5.)
b = tf.Variable(3.)
print(a * b)
```

```
# Eager execution! No need for session.run() or variable initializer
```

```
tf.Tensor(15.0, shape=(), dtype=float32)
```

In [ ]:

```
# Because it's a variable, it can be updated
a = a + 1
print(a)
```

```
tf.Tensor(6.0, shape=(), dtype=float32)
```

In [ ]:

```
# Variables and constants
c = tf.constant(4.)
print(a * b + c)
```

```
tf.Tensor(22.0, shape=(), dtype=float32)
```

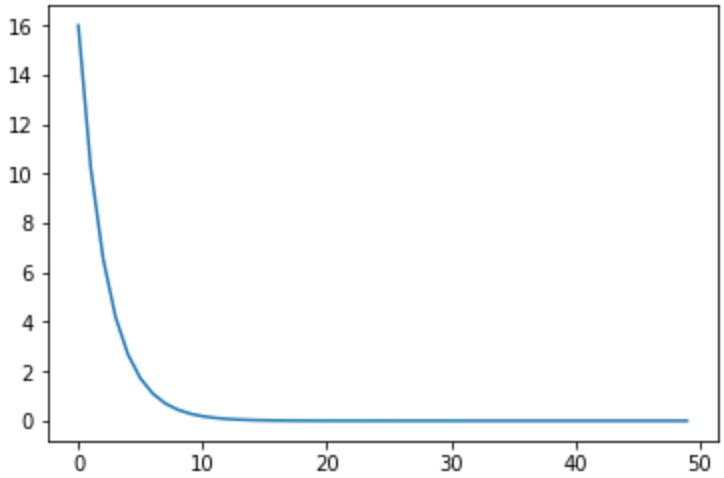
In [ ]:

```
# Let's demonstrate a simple optimization problem
# L(w) = w**2

w = tf.Variable(5.)

# Now, let us define a loss function
def get_loss(w):
  return w ** 2

# Use "gradient tape" to record the gradients
def get_grad(w):
  with tf.GradientTape() as tape:
    L = get_loss(w)

  # Get the gradient
  g = tape.gradient(L, w)
  return g


# Define an optimizer
optimizer = tf.keras.optimizers.SGD(learning_rate=0.1)


# Store the losses
losses = []

# Perform gradient descent
for i in range(50):
  g = get_grad(w)
  optimizer.apply_gradients(zip([g], [w]))
  losses.append(get_loss(w))
```

```
WARNING: Logging before flag parsing goes to stderr.
W0812 20:20:03.417810 140436135712640 deprecation.py:323] From /tensorflow-2.0.0b1/pytho
n3.6/tensorflow/python/ops/math_grad.py:1205: add_dispatch_support.<locals>.wrapper (fro
m tensorflow.python.ops.array_ops) is deprecated and will be removed in a future versio
n.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
```

In [ ]:
```
import matplotlib.pyplot as plt
plt.plot(losses)
print(f"Final loss: {get_loss(w)}")
```

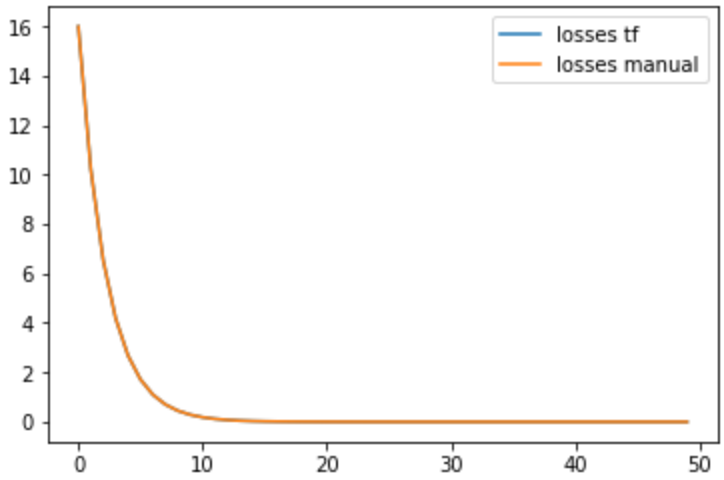
```
Final loss: 5.0925916816879635e-09
```



In [ ]:
```
# Let's do the same thing again, but manually

w = tf.Variable(5.)

# Store the losses
losses2 = []

# Perform gradient descent
for i in range(50):
  # This is doing: w = w - 0.1 * 2 * w
  # But we don't want to create a new Tensor
  w.assign(w - 0.1 * 2 * w)
  losses2.append(w ** 2)
```

In [ ]:
```
plt.plot(losses, label="losses tf")
plt.plot(losses2, label="losses manual")
plt.legend()
```

Out[ ]:
```
<matplotlib.legend.Legend at 0x7fb994fd99e8>
```


losses tf
losses manual
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50