Pure_TensorFlow

September 25, 2020

[1]:
```
import tensorflow as tf
import datetime
import numpy as np
import matplotlib.pyplot as plt

tf.__version__
tf.random.set_seed(56)
np.random.seed(56)
```

[2]:
```
class Dense(tf.Module):
    def __init__(self, input_size, output_size, name=None,␣
 ↪activation_function=tf.nn.relu):
        super().__init__(name=name)
        self.activation_function = activation_function
        self.weights = tf.Variable(tf.random.normal([input_size, output_size]),␣
 ↪name='weights')
        self.bias = tf.Variable(tf.random.normal([output_size]), name='bias')

    @tf.function
    def __call__(self, x):
        y = tf.matmul(x, self.weights) + self.bias
        return self.activation_function(y)

class NeuralNetwork(tf.Module):
    def __init__(self, input_size, layers, name=None):
        super(NeuralNetwork, self).__init__(name=name)
        self.layers = []
        l = 0
        with self.name_scope:
            for size in layers:
                if l == len(layers) - 1:
                    self.layers.append(Dense(input_size=input_size,␣
 ↪output_size=size, name=f'dense_{l}', activation_function = tf.nn.sigmoid))
                    break

                self.layers.append(Dense(input_size=input_size,␣
 ↪output_size=size, name=f'dense_{l}'))
```

```
                input_size = size
                l += 1

    @tf.Module.with_name_scope
    def __call__(self, x):
        for layer in self.layers:
            x = layer(x)
        return x
```

[3]:
```
def loss(target_y, predicted_y):
  return tf.reduce_mean(tf.square(target_y - predicted_y))
```

[4]:
```
def accuracy(target_y, predicted_y):
    a = tf.math.round(predicted_y).numpy()
    return (100.0 / len(target_y)) * sum(target_y == a[0])
```

[5]:
```
inputs = np.array([[0.0,0.0],[0.0,1.0],[1.0,0.0],[1.0,1.0]], dtype=np.float32)
expected_output = np.array([[0.0],[1.0],[1.0],[0.0]], dtype=np.float32)
```

[6]:
```
def train(model, x, y, learning_rate):
  with tf.GradientTape(persistent=True) as t:
    predicted_y = model(x)
    current_loss = loss(y, predicted_y)
    for layer in reversed(model.layers):
        dw, db = t.gradient(current_loss, [layer.weights, layer.bias])
        layer.weights.assign_sub(learning_rate * dw)
        layer.bias.assign_sub(learning_rate * db)
```

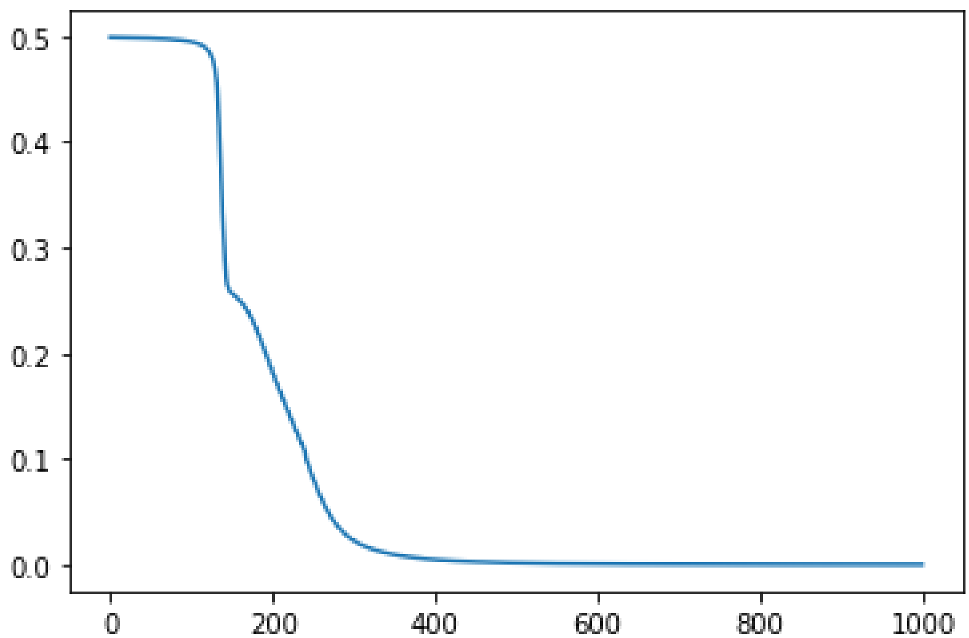
[7]:
```
model = NeuralNetwork(input_size = 2, layers = [6, 6, 6, 1],␣
 ↪name="MyNeuralNetwork")

epochs = range(1000)
losses = []
accuracies = []

def training_loop(model, x, y):
  for epoch in epochs:
    train(model, x, y, learning_rate=0.1)
    predicted_y = model(x)
    current_loss = loss(y, predicted_y)
    current_accuracy = accuracy(y, predicted_y)
    accuracies.append(current_accuracy)
    losses.append(current_loss)
    if epoch % 100 == 0:
        print(f"Epoch {epoch}: loss={current_loss},␣
 ↪accuracy={current_accuracy[0]}%")
```

[8]:
```
training_loop(model, inputs, expected_output)
```

```
WARNING:tensorflow:Calling GradientTape.gradient on a persistent tape inside its
context is significantly less efficient than calling it outside the context (it
causes the gradient ops to be recorded on the tape, leading to increased CPU and
memory usage). Only call GradientTape.gradient inside the context if you
actually want to trace the gradient in order to compute higher order
derivatives.
Epoch 0: loss=0.49881720542907715, accuracy=50.0%
Epoch 100: loss=0.49455690383911133, accuracy=50.0%
Epoch 200: loss=0.1806519329547882, accuracy=50.0%
Epoch 300: loss=0.02289137803018093, accuracy=50.0%
Epoch 400: loss=0.005002772901207209, accuracy=50.0%
Epoch 500: loss=0.0018621550407260656, accuracy=50.0%
Epoch 600: loss=0.0010209871688857675, accuracy=50.0%
Epoch 700: loss=0.000685071456246078, accuracy=50.0%
Epoch 800: loss=0.0005062589189037681, accuracy=50.0%
Epoch 900: loss=0.0003969075041823089, accuracy=50.0%
```

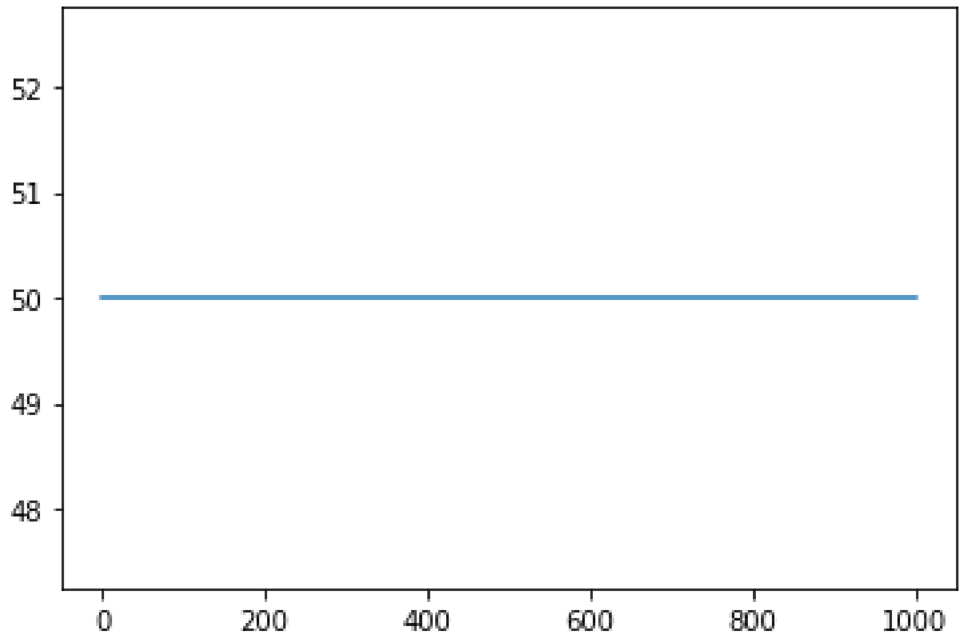
[9]:
```
plt.plot(losses)
```

[9]: [<matplotlib.lines.Line2D at 0x7f77703b2550>]



[10]:
```
plt.plot(accuracies)
```

[10]: [<matplotlib.lines.Line2D at 0x7f775c575a10>]


52
51
50
49
48
0
200
400
600
800
1000