

# C1\_W2\_Lab\_2\_huber-object-loss

December 6, 2020

## 1 Ungraded Lab: Huber Loss hyperparameter and class

In this lab, we'll extend our previous Huber loss function and show how you can include hyperparameters in defining loss functions. We'll also look at how to implement a custom loss as an object by inheriting the [Loss](#) class.

### 1.1 Imports

```
[1]: try:
      # %tensorflow_version only exists in Colab.
      %tensorflow_version 2.x
    except Exception:
        pass

    import tensorflow as tf
    import numpy as np
    from tensorflow import keras
```

### 1.2 Dataset

As before, this model will be trained on the **xs** and **ys** below where the relationship is  $y = 2x - 1$ . Thus, later, when we test for  $x=10$ , whichever version of the model gets the closest answer to 19 will be deemed more accurate.

```
[2]: # inputs
xs = np.array([-1.0, 0.0, 1.0, 2.0, 3.0, 4.0], dtype=float)

# labels
ys = np.array([-3.0, -1.0, 1.0, 3.0, 5.0, 7.0], dtype=float)
```

### 1.3 Custom loss with hyperparameter

The `loss` argument in `model.compile()` only accepts functions that accepts two parameters: the ground truth (**y\_true**) and the model predictions (**y\_pred**). If we want to include a hyperparameter that we can tune, then we can define a wrapper function that accepts this hyperparameter.

```
[3]: # wrapper function that accepts the hyperparameter
def my_huber_loss_with_threshold(threshold):

    # function that accepts the ground truth and predictions
    def my_huber_loss(y_true, y_pred):
        error = y_true - y_pred
        is_small_error = tf.abs(error) <= threshold
        small_error_loss = tf.square(error) / 2
        big_error_loss = threshold * (tf.abs(error) - (0.5 * threshold))

        return tf.where(is_small_error, small_error_loss, big_error_loss)

    # return the inner function tuned by the hyperparameter
    return my_huber_loss
```

We can now specify the loss as the wrapper function above. Notice that we can now set the threshold value. Try varying this value and see the results you get.

```
[4]: model = tf.keras.Sequential([keras.layers.Dense(units=1, input_shape=[1])])
model.compile(optimizer='sgd', loss=my_huber_loss_with_threshold(threshold=1.2))
model.fit(xs, ys, epochs=500, verbose=0)
print(model.predict([10.0]))
```

```
[[18.791162]]
```

## 1.4 Implement Custom Loss as a Class

We can also implement our custom loss as a class. It inherits from the Keras Loss class and the syntax and required methods are shown below.

```
[5]: from tensorflow.keras.losses import Loss

class MyHuberLoss(Loss):

    # class attribute
    threshold = 1

    # initialize instance attributes
    def __init__(self, threshold):
        super().__init__()
        self.threshold = threshold

    # compute loss
    def call(self, y_true, y_pred):
        error = y_true - y_pred
        is_small_error = tf.abs(error) <= self.threshold
        small_error_loss = tf.square(error) / 2
```

```
        big_error_loss = self.threshold * (tf.abs(error) - (0.5 * self.  
→threshold))  
        return tf.where(is_small_error, small_error_loss, big_error_loss)
```

You can specify the loss by instantiating an object from your custom loss class.

```
[7]: model = tf.keras.Sequential([keras.layers.Dense(units=1, input_shape=[1])])  
model.compile(optimizer='sgd', loss=MyHuberLoss(threshold=1.2))  
model.fit(xs, ys, epochs=500, verbose=0)  
print(model.predict([10.0]))
```

```
[[18.794558]]
```