HousingRegression

December 14, 2021

[1]:
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#Implementing the housing regression from Chapter 3.6 in Deep Learning with␣
↪Python

#Importing the necessary libraries
from keras.datasets import boston_housing
import numpy as np
from keras import models
from keras import layers
import matplotlib.pyplot as plt
```

[2]:
```
#Importing and splitting the data into training and testing data
(train_data, train_targets), (test_data, test_targets) = boston_housing.
↪load_data()

#Viewing the shape of the data
print(train_data.shape)
print(test_data.shape)
```

```
(404, 13)
(102, 13)
```

[3]:
```
#Normalizing the data by subtracting the mean from each point and dividing by␣
↪the standard deviation
#This ensures that the data range stays small
mean = train_data.mean(axis=0)
train_data -= mean
std = train_data.std(axis=0)
train_data /= std
test_data -= mean
test_data /= std
```

[4]:
```
#Building the model within a function so that it can be called multiple times
def build_model():
    #Defining the layers
    model = models.Sequential()
    model.add(layers.Dense(64, activation = 'relu', input_shape=(train_data.
↪shape[1],)))
```

```
    model.add(layers.Dense(64, activation = 'relu'))
    model.add(layers.Dense(1))

    #Compiling the model and passing the optimizer, loss function, and required␣
 ↪metrics into it
    #The metric used for regression will be MAE (mean average error)
    model.compile(optimizer = 'rmsprop', loss = 'mse', metrics = ['mae'])
    return model
```

[5]:
```
#Conducting a k-fold validation since the sample size is very small

k = 4
num_val_samples = len(train_data) // k
num_epochs = 100
all_scores = []
for i in range(k):
    print('processing fold #', i+1)
    val_data = train_data[i * num_val_samples: (i + 1) * num_val_samples]
    val_targets = train_targets[i * num_val_samples: (i + 1) * num_val_samples]
    partial_train_data = np.concatenate([train_data[:i * num_val_samples],
                                         train_data[(i + 1) * num_val_samples:
 ↪]],
                                         axis = 0)
    partial_train_targets = np.concatenate([train_targets[:i * num_val_samples],
                                            train_targets[(i + 1) *␣
 ↪num_val_samples:]],
                                           axis=0)
    model = build_model()

    model.fit(partial_train_data, partial_train_targets,
              epochs = num_epochs, batch_size=1, verbose=0)

    val_mse, val_mae = model.evaluate(val_data, val_targets, verbose = 0)

    all_scores.append(val_mae)
```

```
processing fold # 1
processing fold # 2
processing fold # 3
processing fold # 4
```

[6]:
```
#Viewing the scores for each step and the average score
print(all_scores)
print(np.mean(all_scores))
```

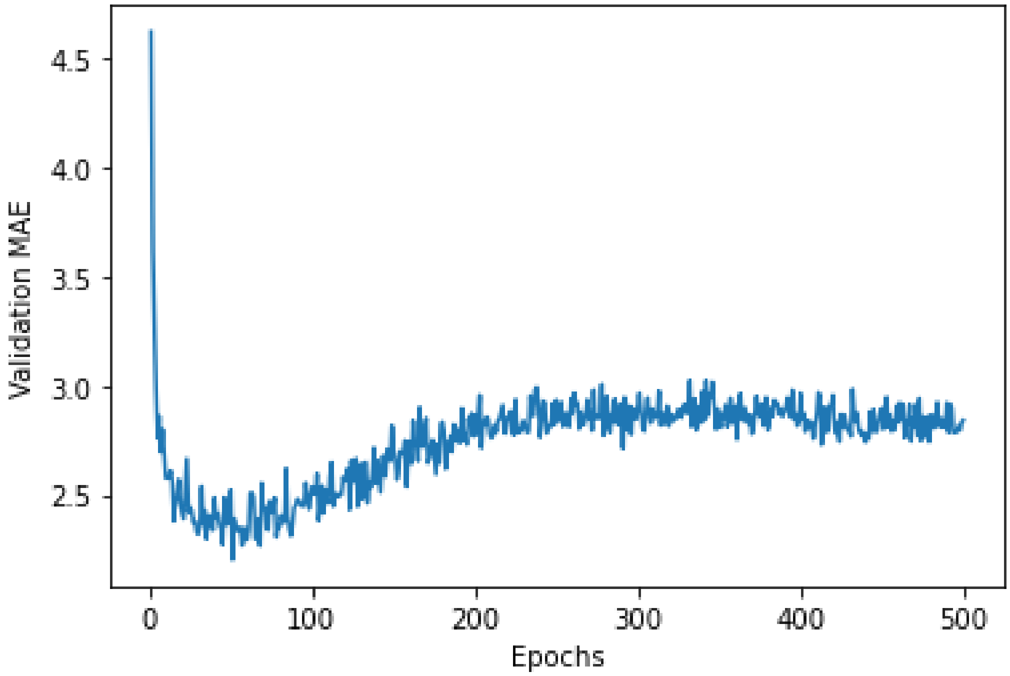
```
[1.9101117849349976, 2.869312047958374, 2.713383674621582, 2.905144453048706]
2.599487990140915
```

[7]:
```python
#Rerunning the k-fold validation with 500 epochs and a validation score log␣
↪saved for each epoch
num_epochs = 500
all_mae_histories = []
for i in range(k):
    print('processing fold #', i+1)
    val_data = train_data[i * num_val_samples: (i + 1) * num_val_samples]
    val_targets = train_targets[i * num_val_samples: (i + 1) * num_val_samples]
    partial_train_data = np.concatenate([train_data[:i * num_val_samples],
                                         train_data[(i + 1) * num_val_samples:
↪]],
                                        axis=0)
    partial_train_targets = np.concatenate([train_targets[:i * num_val_samples],
                                            train_targets[(i + 1) *␣
↪num_val_samples:]],
                                           axis=0)
    model = build_model()

    history = model.fit(partial_train_data, partial_train_targets,
                        validation_data = (val_data, val_targets),
                        epochs = num_epochs, batch_size = 1, verbose = 0)
    mae_history = history.history['val_mae']
    all_mae_histories.append(mae_history)
```

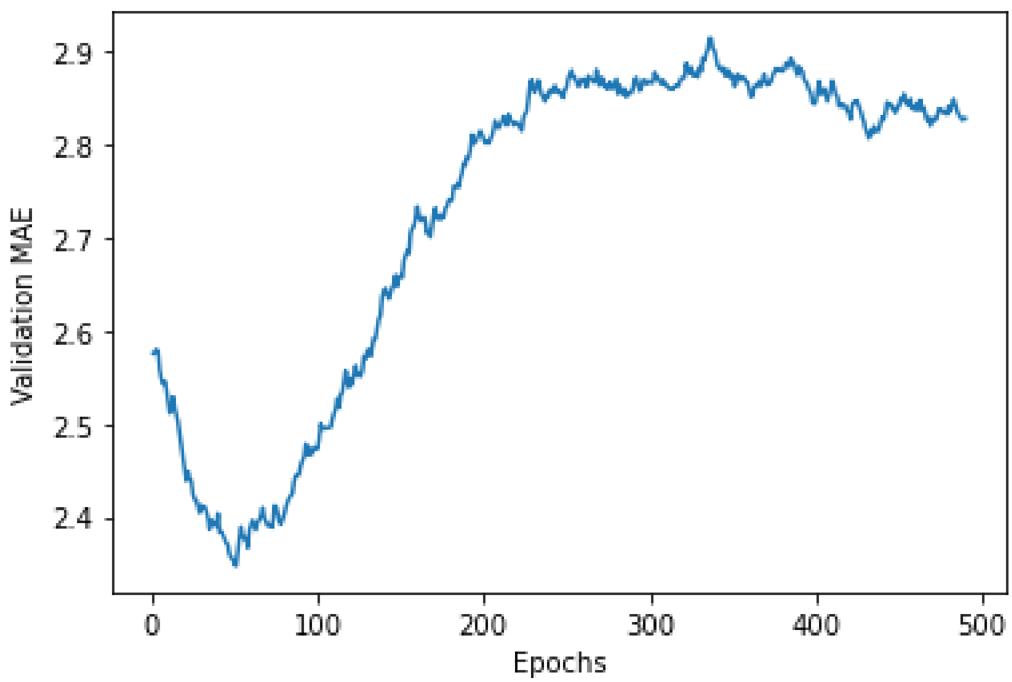
```
processing fold # 1
processing fold # 2
processing fold # 3
processing fold # 4
```

[8]:
```python
#Finding the average of the k-fold validation MAE scores for each epoch
average_mae_history = [np.mean([x[i] for x in all_mae_histories]) for i in␣
↪range(num_epochs)]
```

[9]:
```python
#Plotting the k-fold validation MAE for each epoch

plt.plot(range(1, len(average_mae_history) + 1), average_mae_history)
plt.xlabel('Epochs')
plt.ylabel('Validation MAE')
plt.show()
```



[10]:
```
#Plotting the k-fold validation MAE for each epoch excluding the first 10 epochs
#This time, the points will be smoothed with a moving average

#Defining the smoothing function
def smooth_curve(points, factor = 0.9):
    smoothed_points = []
    for point in points:
        if smoothed_points:
            previous = smoothed_points[-1]
            smoothed_points.append(previous * factor + point * (1 -
factor))
        else:
            smoothed_points.append(point)
    return smoothed_points

#Applying the smoothing function to the points excluding the first 10
smooth_mae_history = smooth_curve(average_mae_history[10:])

#Plotting the smoothed validation MAE over the epochs excluding the first 10
plt.plot(range(1, len(smooth_mae_history) + 1), smooth_mae_history)
plt.xlabel('Epochs')
plt.ylabel('Validation MAE')
plt.show()
#It looks like MAE stops decreasing around 75-80 epochs
```



[11]:
```
#Training the final model on the data using 80 epochs (epoch number with the
 ↪lowest MAE)

model = build_model()
model.fit(train_data, train_targets, epochs = 80, batch_size = 16, verbose=0)
test_mse_score, test_mae_score = model.evaluate(test_data, test_targets)
```

```
4/4 [==============================] - 0s 1ms/step - loss: 17.5505 - mae: 2.5882
```

[12]:
```
#Displaying the final MAE score
test_mae_score
```

[12]: 2.5882184505462646