model_batting

April 29, 2020

[1]:
```
import tensorflow as tf
import pandas as pd
import numpy as np
```

[2]:
```
df = pd.read_csv('../core/output/batters.csv')
indexer = df.reset_index()[['index', 'retroID']].to_dict()['retroID']
y = df['Batting'].values
to_drop = ['debutYear', 'finalYear', 'G', '1B', 'AB', 'RBI', 'wOBA']
df.drop(columns=to_drop, inplace=True)
```

[3]:
```
df
```

[3]:

	retroID	weight	height	pos_1B	pos_2B	pos_3B	pos_C	pos_OF	\
0	aardd001	0.569672	0.60	0	0	0	0	0	
1	aaroh101	0.426230	0.45	0	0	0	0	1	
2	aarot101	0.467213	0.60	1	0	0	0	0	
3	aased001	0.467213	0.60	0	0	0	0	0	
4	abada001	0.442623	0.50	1	0	0	0	0	
...	...	...	...	...	...	...	...	...	
15288	zupcb001	0.590164	0.65	0	0	0	0	1	
15289	zupof101	0.434426	0.40	0	0	0	1	0	
15290	zuveg101	0.487705	0.65	0	0	0	0	0	
15291	zuvep001	0.397541	0.45	0	0	0	0	0	
15292	zycht001	0.467213	0.60	0	0	0	0	0	

	pos_P	pos_SS	...	SO	IBB	HBP	SH	SF	GIDP	NL	wRC+	WAR	\
0	1	0	...	2	0	0	1	0	0	1	-100	-0.1	
1	0	0	...	1383	293	32	21	121	328	1	153	136.3	
2	0	0	...	145	3	0	9	6	36	1	76	-1.7	
3	1	0	...	3	0	0	0	0	0	1	-100	-0.1	
4	0	0	...	5	0	0	0	0	1	1	0	-0.4	
...	...	...	...	...	...	...	..	...	...	..	...	...	
15288	0	0	...	137	3	6	20	8	15	0	74	-0.9	
15289	0	0	...	6	0	0	0	0	0	0	37	-0.2	
15290	1	0	...	39	0	0	16	0	3	1	0	-0.3	
15291	0	1	...	50	1	2	18	0	8	1	52	-2.2	
15292	1	0	...	0	0	0	0	0	0	0	0	0.0	

```
        Batting
0      0.000358
1      0.350195
2      0.157131
3      0.000358
4      0.090001
...         ...
15288  0.156062
15289  0.123425
15290  0.090088
15291  0.135118
15292  0.090195

[15293 rows x 31 columns]
```

Building the Model

[4]:
```
from sklearn.model_selection import train_test_split
```

[5]:
```
X = df.drop(columns=['Batting']).values
y = df[['retroID', 'Batting']].values
```

When we do our train-test split, since it's random in how it splits up the data, we need to keep track of the appropriate keys (retro IDs) for each data point.

[6]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=101)
X_train_keys = np.asarray([x[0] for x in X_train])
X_train = np.asarray([x[1:] for x in X_train])
X_test_keys = np.asarray([x[0] for x in X_test])
X_test = np.asarray([x[1:] for x in X_test])
y_train_keys = np.asarray([y[0] for y in y_train])
y_train = np.asarray([y[1] for y in y_train])
y_test_keys = np.asarray([y[0] for y in y_test])
y_test = np.asarray([y[1] for y in y_test])
```

[7]:
```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras import regularizers
```

[8]:
```
X_train.shape
```

[8]:
```
(12234, 29)
```

[9]:
```
from sklearn.preprocessing import MinMaxScaler
```

[10]:
```
scaler = MinMaxScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

[11]:
```
def to_tensor_input(player):
    return scaler.transform(player.values.reshape(-1,29))[0]
```

[12]:
```
tensor = df.drop(columns=['retroID', 'Batting'])
player_tensor_inputs = tensor.apply(lambda player: to_tensor_input(player),␣
 ↪axis=1)
```

[13]:
```
player_tensor_inputs
```

[13]:
```
0         [0.5696720000000001, 0.6, 0.0, 0.0, 0.0, 0.0, ...
1         [0.42623, 0.45, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0, ...
2         [0.467213, 0.6, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, ...
3         [0.467213, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, ...
4         [0.44262299999999993, 0.5, 1.0, 0.0, 0.0, 0.0,...
                                ...
15288     [0.590164, 0.65, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0,...
15289     [0.43442600000000003, 0.4, 0.0, 0.0, 0.0, 1.0,...
15290     [0.487705, 0.65, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0,...
15291     [0.397541, 0.45, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,...
15292     [0.467213, 0.6, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, ...
Length: 15293, dtype: object
```

[14]:
```
tensor = pd.DataFrame(player_tensor_inputs.values.tolist())
```

[15]:
```
tensor.to_csv('../core/tensors/t_batting.csv', index=False, float_format='%g')
```

[27]:
```
epochs = 400
batch_size = 64
loss_param = 'mse'
optimizer_param = 'adam'
stop_monitor = 'val_loss'
stop_patience = 20
```

[28]:
```
model = Sequential()

model.add(Dense(116, activation='relu', kernel_regularizer=regularizers.l2(0.
 ↪0001)))
model.add(Dropout(0.5))

model.add(Dense(232, activation='relu', kernel_regularizer=regularizers.l2(0.
 ↪0001)))
model.add(Dropout(0.5))
```

```
model.add(Dense(116, activation='relu', kernel_regularizer=regularizers.l2(0.
↪0001)))
model.add(Dropout(0.5))

model.add(Dense(units=1, activation='sigmoid'))

model.compile(loss=loss_param, optimizer=optimizer_param)
```

[19]:
```
from tensorflow.keras.callbacks import EarlyStopping
```

[20]:
```
early_stop = EarlyStopping(monitor=stop_monitor, patience=stop_patience)
```

[29]:
```
results = model.fit(x=X_train, y=y_train,
                        epochs=epochs,
                        batch_size=batch_size,
                        validation_data=(X_test, y_test),
                        callbacks=[early_stop]
                    )
```

```
Train on 12234 samples, validate on 3059 samples
Epoch 1/400
12234/12234 [==============================] - 1s 88us/sample - loss: 0.0339 -
val_loss: 0.0177
Epoch 2/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0144 -
val_loss: 0.0089
Epoch 3/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0082 -
val_loss: 0.0050
Epoch 4/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0053 -
val_loss: 0.0033
Epoch 5/400
12234/12234 [==============================] - 0s 39us/sample - loss: 0.0039 -
val_loss: 0.0026
Epoch 6/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0032 -
val_loss: 0.0020
Epoch 7/400
12234/12234 [==============================] - 0s 39us/sample - loss: 0.0029 -
val_loss: 0.0018
Epoch 8/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0026 -
val_loss: 0.0016
Epoch 9/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0025 -
val_loss: 0.0017
```

```
Epoch 10/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0024 -
val_loss: 0.0015
Epoch 11/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0023 -
val_loss: 0.0015
Epoch 12/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0022 -
val_loss: 0.0014
Epoch 13/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0022 -
val_loss: 0.0014
Epoch 14/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0022 -
val_loss: 0.0013
Epoch 15/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0022 -
val_loss: 0.0013
Epoch 16/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0021 -
val_loss: 0.0015
Epoch 17/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0021 -
val_loss: 0.0014
Epoch 18/400
12234/12234 [==============================] - 1s 51us/sample - loss: 0.0020 -
val_loss: 0.0013
Epoch 19/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0020 -
val_loss: 0.0013
Epoch 20/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0019 -
val_loss: 0.0013
Epoch 21/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0019 -
val_loss: 0.0013
Epoch 22/400
12234/12234 [==============================] - 1s 47us/sample - loss: 0.0019 -
val_loss: 0.0012
Epoch 23/400
12234/12234 [==============================] - 1s 47us/sample - loss: 0.0019 -
val_loss: 0.0013
Epoch 24/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0019 -
val_loss: 0.0012
Epoch 25/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0018 -
val_loss: 0.0012
```

```
Epoch 26/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0018 -
val_loss: 0.0012
Epoch 27/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0018 -
val_loss: 0.0013
Epoch 28/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0018 -
val_loss: 0.0013
Epoch 29/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0018 -
val_loss: 0.0012
Epoch 30/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0018 -
val_loss: 0.0012
Epoch 31/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0017 -
val_loss: 0.0012
Epoch 32/400
12234/12234 [==============================] - 0s 39us/sample - loss: 0.0017 -
val_loss: 0.0011
Epoch 33/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0017 -
val_loss: 0.0012
Epoch 34/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0017 -
val_loss: 0.0012
Epoch 35/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0017 -
val_loss: 0.0012
Epoch 36/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0017 -
val_loss: 0.0012
Epoch 37/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0016 -
val_loss: 0.0013
Epoch 38/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 39/400
12234/12234 [==============================] - 1s 56us/sample - loss: 0.0017 -
val_loss: 0.0013
Epoch 40/400
12234/12234 [==============================] - 1s 56us/sample - loss: 0.0017 -
val_loss: 0.0011
Epoch 41/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0016 -
val_loss: 0.0012
```

```
Epoch 42/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0017 -
val_loss: 0.0018
Epoch 43/400
12234/12234 [==============================] - 1s 52us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 44/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 45/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 46/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 47/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 48/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0017 -
val_loss: 0.0011
Epoch 49/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 50/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 51/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0016 -
val_loss: 0.0013
Epoch 52/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0016 -
val_loss: 0.0014
Epoch 53/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 54/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 55/400
12234/12234 [==============================] - 1s 53us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 56/400
12234/12234 [==============================] - 1s 51us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 57/400
12234/12234 [==============================] - 1s 53us/sample - loss: 0.0016 -
val_loss: 0.0011
```

```
Epoch 58/400
12234/12234 [==============================] - 1s 52us/sample - loss: 0.0015 -
val_loss: 0.0013
Epoch 59/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0016 -
val_loss: 0.0012
Epoch 60/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 61/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 62/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 63/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 64/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 0.0013
Epoch 65/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 66/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 67/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 0.0012
Epoch 68/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0016 -
val_loss: 0.0014
Epoch 69/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0016 -
val_loss: 0.0010
Epoch 70/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 71/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 0.0014
Epoch 72/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0016 -
val_loss: 0.0010
Epoch 73/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0015 -
val_loss: 9.8471e-04
```

```
Epoch 74/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 75/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0015 -
val_loss: 9.6721e-04
Epoch 76/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 77/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0015 -
val_loss: 9.9823e-04
Epoch 78/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 79/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0016 -
val_loss: 0.0011
Epoch 80/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 9.9099e-04
Epoch 81/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 82/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 83/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 9.9834e-04
Epoch 84/400
12234/12234 [==============================] - 1s 64us/sample - loss: 0.0015 -
val_loss: 9.6191e-04
Epoch 85/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 86/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 87/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 9.7191e-04
Epoch 88/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 9.7572e-04
Epoch 89/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0015 -
val_loss: 0.0012
```

```
Epoch 90/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 0.0012
Epoch 91/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0015 -
val_loss: 9.5506e-04
Epoch 92/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0015 -
val_loss: 9.4303e-04
Epoch 93/400
12234/12234 [==============================] - 1s 56us/sample - loss: 0.0015 -
val_loss: 9.8456e-04
Epoch 94/400
12234/12234 [==============================] - 1s 56us/sample - loss: 0.0015 -
val_loss: 9.5695e-04
Epoch 95/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 96/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 9.7383e-04
Epoch 97/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 98/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 9.4741e-04
Epoch 99/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 9.6006e-04
Epoch 100/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 101/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 9.5989e-04
Epoch 102/400
12234/12234 [==============================] - 1s 50us/sample - loss: 0.0015 -
val_loss: 9.6959e-04
Epoch 103/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 9.6324e-04
Epoch 104/400
12234/12234 [==============================] - 0s 40us/sample - loss: 0.0016 -
val_loss: 9.4944e-04
Epoch 105/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0014 -
val_loss: 9.5811e-04
```

```
Epoch 106/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 0.0010
Epoch 107/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 9.1667e-04
Epoch 108/400
12234/12234 [==============================] - 1s 47us/sample - loss: 0.0014 -
val_loss: 0.0011
Epoch 109/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0015 -
val_loss: 9.7293e-04
Epoch 110/400
12234/12234 [==============================] - 1s 51us/sample - loss: 0.0014 -
val_loss: 9.5498e-04
Epoch 111/400
12234/12234 [==============================] - 1s 52us/sample - loss: 0.0014 -
val_loss: 9.5635e-04
Epoch 112/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0015 -
val_loss: 9.4925e-04
Epoch 113/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0015 -
val_loss: 0.0011
Epoch 114/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0014 -
val_loss: 9.3379e-04
Epoch 115/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0015 -
val_loss: 0.0014
Epoch 116/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 9.9035e-04
Epoch 117/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0014 -
val_loss: 0.0010
Epoch 118/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 9.4646e-04
Epoch 119/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0015 -
val_loss: 9.7571e-04
Epoch 120/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 9.1578e-04
Epoch 121/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 0.0012
```

```
Epoch 122/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0014 -
val_loss: 9.1460e-04
Epoch 123/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 124/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0015 -
val_loss: 9.5794e-04
Epoch 125/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 0.0010
Epoch 126/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 9.2401e-04
Epoch 127/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0014 -
val_loss: 9.5520e-04
Epoch 128/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0014 -
val_loss: 9.2518e-04
Epoch 129/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0014 -
val_loss: 9.1161e-04
Epoch 130/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0014 -
val_loss: 9.1013e-04
Epoch 131/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0015 -
val_loss: 9.9162e-04
Epoch 132/400
12234/12234 [==============================] - 1s 50us/sample - loss: 0.0015 -
val_loss: 9.1913e-04
Epoch 133/400
12234/12234 [==============================] - 1s 50us/sample - loss: 0.0015 -
val_loss: 9.8137e-04
Epoch 134/400
12234/12234 [==============================] - 1s 41us/sample - loss: 0.0014 -
val_loss: 9.1023e-04
Epoch 135/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0015 -
val_loss: 9.3859e-04
Epoch 136/400
12234/12234 [==============================] - 0s 41us/sample - loss: 0.0014 -
val_loss: 8.9324e-04
Epoch 137/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 9.4240e-04
```

```
Epoch 138/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0014 -
val_loss: 9.0494e-04
Epoch 139/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 0.0011
Epoch 140/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0014 -
val_loss: 8.8544e-04
Epoch 141/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 0.0011
Epoch 142/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0014 -
val_loss: 8.8677e-04
Epoch 143/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 0.0015
Epoch 144/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0015 -
val_loss: 8.8369e-04
Epoch 145/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0014 -
val_loss: 0.0015
Epoch 146/400
12234/12234 [==============================] - 1s 59us/sample - loss: 0.0015 -
val_loss: 9.7839e-04
Epoch 147/400
12234/12234 [==============================] - 1s 59us/sample - loss: 0.0015 -
val_loss: 0.0010
Epoch 148/400
12234/12234 [==============================] - 1s 64us/sample - loss: 0.0014 -
val_loss: 8.8733e-04
Epoch 149/400
12234/12234 [==============================] - 1s 62us/sample - loss: 0.0014 -
val_loss: 0.0010
Epoch 150/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0014 -
val_loss: 9.7863e-04
Epoch 151/400
12234/12234 [==============================] - 1s 51us/sample - loss: 0.0014 -
val_loss: 9.1807e-04
Epoch 152/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 8.7598e-04
Epoch 153/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 9.9196e-04
```

```
Epoch 154/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 0.0016
Epoch 155/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0015 -
val_loss: 9.1860e-04
Epoch 156/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 0.0011
Epoch 157/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0014 -
val_loss: 9.0657e-04
Epoch 158/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 9.2692e-04
Epoch 159/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0014 -
val_loss: 9.2203e-04
Epoch 160/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 9.2283e-04
Epoch 161/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0014 -
val_loss: 9.1643e-04
Epoch 162/400
12234/12234 [==============================] - 1s 43us/sample - loss: 0.0014 -
val_loss: 9.0883e-04
Epoch 163/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0014 -
val_loss: 0.0012
Epoch 164/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0014 -
val_loss: 9.5491e-04
Epoch 165/400
12234/12234 [==============================] - 1s 63us/sample - loss: 0.0014 -
val_loss: 9.2393e-04
Epoch 166/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0014 -
val_loss: 9.1901e-04
Epoch 167/400
12234/12234 [==============================] - 1s 59us/sample - loss: 0.0014 -
val_loss: 0.0014
Epoch 168/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0015 -
val_loss: 8.8174e-04
Epoch 169/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0014 -
val_loss: 8.5809e-04
```

```
Epoch 170/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 9.0156e-04
Epoch 171/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0014 -
val_loss: 0.0012
Epoch 172/400
12234/12234 [==============================] - 1s 45us/sample - loss: 0.0015 -
val_loss: 8.7756e-04
Epoch 173/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0014 -
val_loss: 8.7620e-04
Epoch 174/400
12234/12234 [==============================] - 1s 55us/sample - loss: 0.0014 -
val_loss: 8.6786e-04
Epoch 175/400
12234/12234 [==============================] - 1s 61us/sample - loss: 0.0014 -
val_loss: 8.6015e-04
Epoch 176/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 0.0010
Epoch 177/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0014 -
val_loss: 9.9136e-04
Epoch 178/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0015 -
val_loss: 9.1635e-04
Epoch 179/400
12234/12234 [==============================] - 1s 66us/sample - loss: 0.0014 -
val_loss: 8.6218e-04
Epoch 180/400
12234/12234 [==============================] - 1s 78us/sample - loss: 0.0014 -
val_loss: 8.4677e-04
Epoch 181/400
12234/12234 [==============================] - 1s 74us/sample - loss: 0.0014 -
val_loss: 9.0584e-04
Epoch 182/400
12234/12234 [==============================] - 1s 78us/sample - loss: 0.0014 -
val_loss: 9.9842e-04
Epoch 183/400
12234/12234 [==============================] - 1s 84us/sample - loss: 0.0014 -
val_loss: 0.0015
Epoch 184/400
12234/12234 [==============================] - 1s 68us/sample - loss: 0.0015 -
val_loss: 9.1945e-04
Epoch 185/400
12234/12234 [==============================] - 1s 58us/sample - loss: 0.0014 -
val_loss: 9.9103e-04
```

```
Epoch 186/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0014 -
val_loss: 0.0015
Epoch 187/400
12234/12234 [==============================] - 1s 54us/sample - loss: 0.0014 -
val_loss: 8.5842e-04
Epoch 188/400
12234/12234 [==============================] - 1s 46us/sample - loss: 0.0014 -
val_loss: 8.9506e-04
Epoch 189/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0014 -
val_loss: 8.5331e-04
Epoch 190/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 8.8959e-04
Epoch 191/400
12234/12234 [==============================] - 1s 42us/sample - loss: 0.0014 -
val_loss: 8.8742e-04
Epoch 192/400
12234/12234 [==============================] - 1s 44us/sample - loss: 0.0014 -
val_loss: 9.0049e-04
Epoch 193/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0014 -
val_loss: 9.6137e-04
Epoch 194/400
12234/12234 [==============================] - 1s 62us/sample - loss: 0.0014 -
val_loss: 9.6924e-04
Epoch 195/400
12234/12234 [==============================] - 1s 77us/sample - loss: 0.0014 -
val_loss: 8.5014e-04
Epoch 196/400
12234/12234 [==============================] - 1s 68us/sample - loss: 0.0014 -
val_loss: 0.0012
Epoch 197/400
12234/12234 [==============================] - 1s 61us/sample - loss: 0.0015 -
val_loss: 9.4546e-04
Epoch 198/400
12234/12234 [==============================] - 1s 57us/sample - loss: 0.0014 -
val_loss: 8.4731e-04
Epoch 199/400
12234/12234 [==============================] - 1s 49us/sample - loss: 0.0014 -
val_loss: 9.2903e-04
Epoch 200/400
12234/12234 [==============================] - 1s 48us/sample - loss: 0.0014 -
val_loss: 8.8370e-04
```

[30]:
```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_4 (Dense)              multiple                  3480
_________________________________________________________________
dropout_3 (Dropout)          multiple                  0
_________________________________________________________________
dense_5 (Dense)              multiple                  27144
_________________________________________________________________
dropout_4 (Dropout)          multiple                  0
_________________________________________________________________
dense_6 (Dense)              multiple                  27028
_________________________________________________________________
dropout_5 (Dropout)          multiple                  0
_________________________________________________________________
dense_7 (Dense)              multiple                  117
=================================================================
Total params: 57,769
Trainable params: 57,769
Non-trainable params: 0
_________________________________________________________________
```

[31]:
```
import os
```

[32]:
```
losses = model.history.history
losses['loss'] = np.asarray(losses['loss'])
losses['val_loss'] = np.asarray(losses['val_loss'])
final_number_of_epochs = len(losses['loss'])
min_loss = losses['loss'].min()
mean_loss = losses['loss'].mean()
final_loss = losses['loss'][-1]
min_val_loss = losses['val_loss'].min()
mean_val_loss = losses['val_loss'].mean()
final_val_loss = losses['val_loss'][-1]

def get_model_summary():
    output = []
    model.summary(print_fn=lambda line: output.append(line))
    return str(output).strip('[]')

summary = get_model_summary()

record = {
    'Epochs': final_number_of_epochs,
    'Batch_Size': batch_size,
    'Loss_Func': loss_param,
```

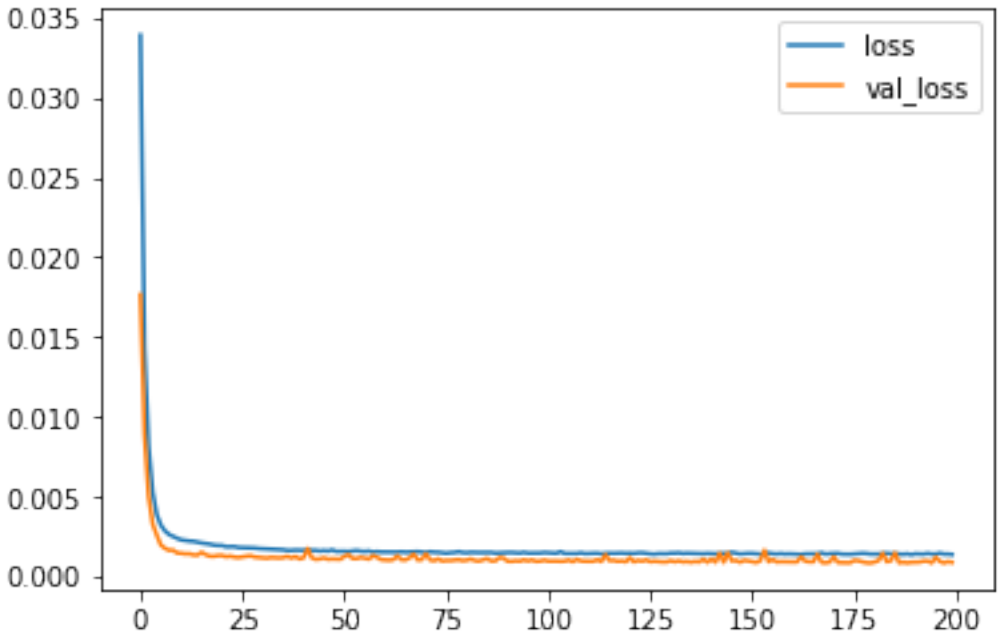
```
    'Optimizer': optimizer_param,
    'Early_Stop_Monitor': stop_monitor,
    'Early_Stop_Patience': stop_patience,
    'Min_Loss': min_loss,
    'Mean_Loss': mean_loss,
    'Final_Loss': final_loss,
    'Min_Val_Loss': min_val_loss,
    'Mean_Val_Loss': mean_val_loss,
    'Final_Val_Loss': final_val_loss,
    'Model': summary
}

new_data = pd.DataFrame(record, index=[0])

if os.path.exists('../core/records/batting_results.csv'):
    df_records = pd.read_csv('../core/records/batting_results.csv')
    df_records = df_records.append(new_data)
else:
    df_records = pd.DataFrame(new_data)

df_records.to_csv('../core/records/batting_results.csv', index=False,␣
 ↪float_format='%g')
```

Model Evaluation

[33]:
```
losses = pd.DataFrame(model.history.history)
```

[34]:
```
losses.plot()
```

[34]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x145a367d0>
```



[61]:
```
predictions = model.predict(X_test)
predictions = [pred for sublist in predictions for pred in sublist]
```

[29]:
```
test_player_ratings = dict(zip(X_test_keys, predictions))
```

[30]:
```
player_key = df['retroID']
```

[31]:
```
player_key
```

[31]:
```
0        aardd001
1        aaroh101
2        aarot101
3        aased001
4        abada001
           ...
15288    zupcb001
15289    zupof101
15290    zuveg101
15291    zuvep001
15292    zycht001
Name: retroID, Length: 15293, dtype: object
```

[32]:
```
results = model.predict(tensor.to_numpy())
```

[33]:
```
len(results)
```

[33]: 15293

[34]:
```
results.mean()
```

[34]: 0.11595928

[35]:
```
df['Batting'].shape
```

[35]: (15293,)

[36]:
```
results.shape
```

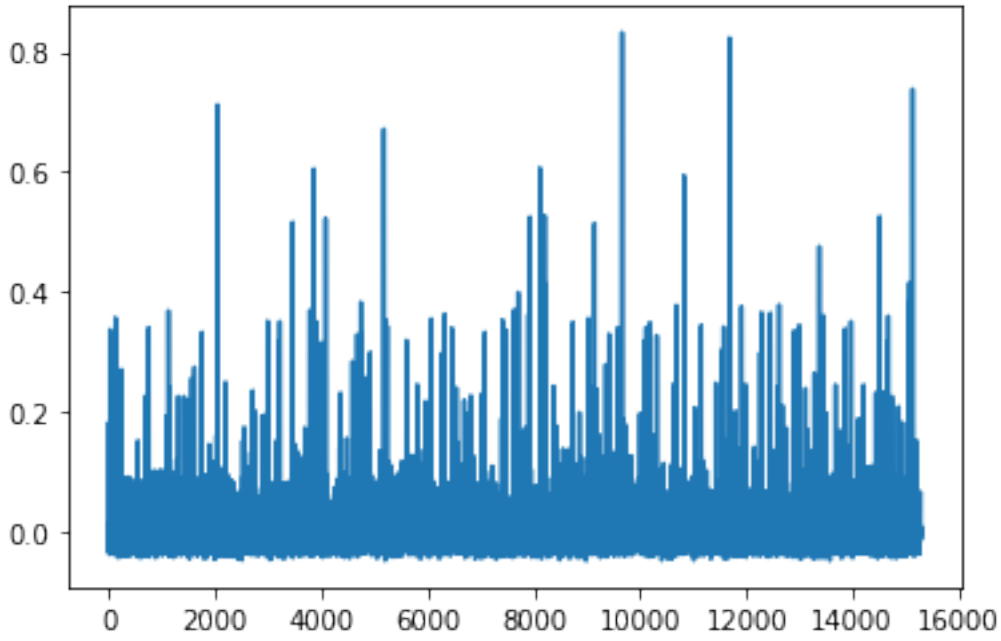
[36]: (15293, 1)

[37]:
```
results = [pred for sublist in results for pred in sublist]
```

[38]:
```
diff = df['Batting'] - results
```

[39]:
```
diff.plot()
```

[39]: <matplotlib.axes._subplots.AxesSubplot at 0x145c29890>



[40]:
```
diff.mean()
```

[40]: 0.005629653826018003

[ ]: