ann

November 29, 2023

[ ]:

```python
import pandas as pd
import numpy as np
import sqlite3
import logging
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.preprocessing import StandardScaler
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow import keras
from tensorflow.keras import layers
import keras_tuner as kt
from tensorflow import keras
from tensorflow.keras import layers
import tensorflow as tf
import logging
```

[ ]:

```python
print("TensorFlow Version:", tf.__version__)

gpus = tf.config.experimental.list_physical_devices('GPU')
print("Num GPUs Available: ", len(gpus))

tf.test.gpu_device_name()

print("Available GPU devices:", tf.config.list_physical_devices('GPU'))
```

```
TensorFlow Version: 2.14.1
Num GPUs Available:  1
Available GPU devices: [PhysicalDevice(name='/physical_device:GPU:0',
device_type='GPU')]
```

```
2023-11-19 23:14:58.103117: I
tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894]
successful NUMA node read from SysFS had negative value (-1), but there must be
at least one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2023-11-19 23:14:58.103283: I
tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894]
```

```
successful NUMA node read from SysFS had negative value (-1), but there must be
at least one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2023-11-19 23:14:58.103380: I
tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894]
successful NUMA node read from SysFS had negative value (-1), but there must be
at least one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2023-11-19 23:14:58.103518: I
tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894]
successful NUMA node read from SysFS had negative value (-1), but there must be
at least one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2023-11-19 23:14:58.103615: I
tensorflow/compiler/xla/stream_executor/cuda/cuda_gpu_executor.cc:894]
successful NUMA node read from SysFS had negative value (-1), but there must be
at least one NUMA node, so returning NUMA node zero. See more at
https://github.com/torvalds/linux/blob/v6.0/Documentation/ABI/testing/sysfs-bus-
pci#L344-L355
2023-11-19 23:14:58.103681: I
tensorflow/core/common_runtime/gpu/gpu_device.cc:1886] Created device
/device:GPU:0 with 19224 MB memory:  -> device: 0, name: NVIDIA GeForce RTX
4090, pci bus id: 0000:01:00.0, compute capability: 8.9
```

[ ]:

```
logging.basicConfig(filename='logs.log', level=logging.DEBUG,
                    format='%(asctime)s:%(levelname)s:%(message)s')

conn = sqlite3.connect('../data_eng/HOUSING.db')
cursor = conn.cursor()
df = pd.read_sql("select * from Realtor_Final_Merged", conn)


cursor.close()
conn.close()

df = df.select_dtypes(include=[np.number])

df.head(2)

df['target_bins'] = pd.qcut(df['median_days_on_market'], q=10,␣
 ↪duplicates='drop')

train_set, temp_set = train_test_split(df, test_size=0.4,␣
 ↪stratify=df['target_bins'], random_state=42)
```

```
validation_set, test_set = train_test_split(temp_set, test_size=0.5,␣
 ↪random_state=42)

train_set = train_set.drop(columns=['target_bins','month_date_yyyymm','year'])
validation_set = validation_set.
 ↪drop(columns=['target_bins','month_date_yyyymm','year'])
test_set = test_set.drop(columns=['target_bins','month_date_yyyymm','year'])

logging.info(f"Created Train Validate and Test sets")

train_set_x = train_set.drop('median_days_on_market', axis=1)
train_set_y = train_set['median_days_on_market']


val_set_x = validation_set.drop('median_days_on_market', axis=1)
val_set_y = validation_set['median_days_on_market']

test_set_x = test_set.drop('median_days_on_market', axis=1)
test_set_y = test_set['median_days_on_market']
```

[ ]:

```
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(train_set_x)
X_val_scaled = scaler.transform(val_set_x)
X_test_scaled = scaler.transform(test_set_x)


model = Sequential()
model.add(Dense(64, activation='relu', input_shape=(X_train_scaled.shape[1],)))
model.add(Dense(32, activation='relu'))
model.add(Dense(1, activation='linear'))


model.compile(optimizer='adam', loss='mean_squared_error')

history = model.fit(X_train_scaled, train_set_y, validation_data=(X_val_scaled,␣
 ↪val_set_y), epochs=100, batch_size=32)


val_loss = model.evaluate(X_val_scaled, val_set_y)
test_loss = model.evaluate(X_test_scaled, test_set_y)

print("Validation Loss:", val_loss)
print("Test Loss:", test_loss)
```

```
Epoch 1/100
38034/38034 [==============================] - 56s 1ms/step - loss: 2015.1163 -
```

```
val_loss: 1960.6550
Epoch 2/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1911.2092 -
val_loss: 1925.7747
Epoch 3/100
38034/38034 [==============================] - 57s 1ms/step - loss: 1895.0607 -
val_loss: 1964.1068
Epoch 4/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1881.4310 -
val_loss: 2392.4746
Epoch 5/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1878.5850 -
val_loss: 1943.9026
Epoch 6/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1871.1521 -
val_loss: 1897.7858
Epoch 7/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1867.3713 -
val_loss: 2044.3147
Epoch 8/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1862.0863 -
val_loss: 1875.7498
Epoch 9/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1859.9968 -
val_loss: 1912.2645
Epoch 10/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1856.1456 -
val_loss: 1945.3889
Epoch 11/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1883.0562 -
val_loss: 1916.7406
Epoch 12/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1856.6780 -
val_loss: 1921.7100
Epoch 13/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1857.2750 -
val_loss: 1867.1552
Epoch 14/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1852.7833 -
val_loss: 2353.4653
Epoch 15/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1851.0333 -
val_loss: 2004.1527
Epoch 16/100
38034/38034 [==============================] - 58s 2ms/step - loss: 1852.3711 -
val_loss: 1849.3888
Epoch 17/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1846.3568 -
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val_loss: 1870.5375
Epoch 18/100
38034/38034 [==============================] - 57s 2ms/step - loss: 1865.4318 -
val_loss: 2899.4043
Epoch 19/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1848.0616 -
val_loss: 1848.1740
Epoch 20/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1844.6172 -
val_loss: 1900.6151
Epoch 21/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1857.0709 -
val_loss: 1902.7008
Epoch 22/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1842.4551 -
val_loss: 2016.0564
Epoch 23/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1842.0546 -
val_loss: 1891.7947
Epoch 24/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1843.0851 -
val_loss: 1938.4015
Epoch 25/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1841.2869 -
val_loss: 1845.3116
Epoch 26/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1839.9224 -
val_loss: 1856.3833
Epoch 27/100
38034/38034 [==============================] - 57s 1ms/step - loss: 1842.1636 -
val_loss: 1865.3818
Epoch 28/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1838.1664 -
val_loss: 1874.7417
Epoch 29/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1856.1235 -
val_loss: 1934.5237
Epoch 30/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1839.7938 -
val_loss: 1851.5210
Epoch 31/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1835.3573 -
val_loss: 2043.6393
Epoch 32/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1836.8960 -
val_loss: 1912.6125
Epoch 33/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1836.5813 -
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val_loss: 1884.9851
Epoch 34/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1846.7136 -
val_loss: 1848.9312
Epoch 35/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1838.2623 -
val_loss: 1843.3712
Epoch 36/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1834.2573 -
val_loss: 1995.2209
Epoch 37/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1834.4418 -
val_loss: 1851.3759
Epoch 38/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1832.0748 -
val_loss: 1853.4427
Epoch 39/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1832.9059 -
val_loss: 1885.2422
Epoch 40/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1833.8496 -
val_loss: 1853.2114
Epoch 41/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1830.4777 -
val_loss: 1970.3175
Epoch 42/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1831.2604 -
val_loss: 1900.7489
Epoch 43/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1830.0687 -
val_loss: 1885.5591
Epoch 44/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1830.0393 -
val_loss: 2380.1558
Epoch 45/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1844.2426 -
val_loss: 1845.0282
Epoch 46/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1835.9093 -
val_loss: 1891.7823
Epoch 47/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1832.9813 -
val_loss: 1879.5826
Epoch 48/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1834.3677 -
val_loss: 1838.6830
Epoch 49/100
38034/38034 [==============================] - 52s 1ms/step - loss: 1828.4993 -
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```
val_loss: 1978.1880
Epoch 50/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1829.9421 -
val_loss: 1846.3364
Epoch 51/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1864.1897 -
val_loss: 2385.2319
Epoch 52/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1833.3842 -
val_loss: 1836.2864
Epoch 53/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1828.2228 -
val_loss: 1865.9678
Epoch 54/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1831.5399 -
val_loss: 1852.5741
Epoch 55/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1826.6785 -
val_loss: 1850.0143
Epoch 56/100
38034/38034 [==============================] - 52s 1ms/step - loss: 1826.8556 -
val_loss: 1841.7661
Epoch 57/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1826.3422 -
val_loss: 1839.6832
Epoch 58/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1829.0709 -
val_loss: 1932.9348
Epoch 59/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1825.0992 -
val_loss: 1847.0948
Epoch 60/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1827.3922 -
val_loss: 1972.0282
Epoch 61/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1835.0896 -
val_loss: 1893.8931
Epoch 62/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1831.9292 -
val_loss: 1833.1262
Epoch 63/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1824.5802 -
val_loss: 1833.5958
Epoch 64/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1824.4424 -
val_loss: 1850.2802
Epoch 65/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1827.3198 -
```

```
val_loss: 1843.3669
Epoch 66/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1826.3142 -
val_loss: 1988.2124
Epoch 67/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1825.9553 -
val_loss: 1862.7307
Epoch 68/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1825.4520 -
val_loss: 1999.2101
Epoch 69/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1824.4916 -
val_loss: 1851.1664
Epoch 70/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1827.3146 -
val_loss: 1896.0049
Epoch 71/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1833.2308 -
val_loss: 1921.4916
Epoch 72/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1829.2764 -
val_loss: 1965.9242
Epoch 73/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1829.7903 -
val_loss: 2009.2354
Epoch 74/100
38034/38034 [==============================] - 52s 1ms/step - loss: 1824.0709 -
val_loss: 1840.8545
Epoch 75/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1823.8009 -
val_loss: 1963.8501
Epoch 76/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1836.9854 -
val_loss: 1832.1490
Epoch 77/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1822.4591 -
val_loss: 1839.2777
Epoch 78/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1824.3549 -
val_loss: 1844.8528
Epoch 79/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1829.6786 -
val_loss: 2041.3451
Epoch 80/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1828.1256 -
val_loss: 1981.4814
Epoch 81/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1827.4563 -
```

```
val_loss: 1919.6381
Epoch 82/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1823.0889 -
val_loss: 1908.8669
Epoch 83/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1821.3159 -
val_loss: 1832.3070
Epoch 84/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1821.4966 -
val_loss: 1868.4773
Epoch 85/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1830.6428 -
val_loss: 1836.5472
Epoch 86/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1826.7765 -
val_loss: 1831.9419
Epoch 87/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1821.8811 -
val_loss: 1829.9056
Epoch 88/100
38034/38034 [==============================] - 53s 1ms/step - loss: 1821.6956 -
val_loss: 1863.2264
Epoch 89/100
38034/38034 [==============================] - 57s 2ms/step - loss: 1821.5311 -
val_loss: 1838.4106
Epoch 90/100
38034/38034 [==============================] - 55s 1ms/step - loss: 1821.2086 -
val_loss: 1926.6335
Epoch 91/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1820.7463 -
val_loss: 1877.9320
Epoch 92/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1825.1661 -
val_loss: 1871.2194
Epoch 93/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1824.3604 -
val_loss: 1914.6963
Epoch 94/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1826.9877 -
val_loss: 1832.9828
Epoch 95/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1825.7501 -
val_loss: 1834.6313
Epoch 96/100
38034/38034 [==============================] - 54s 1ms/step - loss: 1861.8452 -
val_loss: 1851.9606
Epoch 97/100
38034/38034 [==============================] - 57s 1ms/step - loss: 1823.9255 -
```

```
val_loss: 1837.0347
Epoch 98/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1820.3875 -
val_loss: 1854.1230
Epoch 99/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1821.7433 -
val_loss: 2033.8589
Epoch 100/100
38034/38034 [==============================] - 56s 1ms/step - loss: 1820.4602 -
val_loss: 1840.2485
12678/12678 [==============================] - 8s 594us/step - loss: 1840.2485
12678/12678 [==============================] - 7s 579us/step - loss: 1819.3311
Validation Loss: 1840.24853515625
Test Loss: 1819.3310546875
```

[ ]:

```python
def build_model(hp):
    model = keras.Sequential()
    model.add(layers.Dense(units=hp.Int('units', min_value=32, max_value=512,␣
 ↪step=32),
                           activation='relu', input_shape=(X_train_scaled.
 ↪shape[1],)))
    model.add(layers.Dropout(rate=hp.Float('dropout', min_value=0.0,␣
 ↪max_value=0.5, step=0.1)))
    model.add(layers.Dense(1, activation='linear'))  # Output layer for␣
 ↪regression

    model.compile(optimizer=keras.optimizers.Adam(
        hp.Choice('learning_rate', values=[1e-2, 1e-3, 1e-4])),
        loss='mean_squared_error')

    return model

tuner = kt.RandomSearch(
    build_model,
    objective='val_loss',
    max_trials=10,
    executions_per_trial=1,
    directory='my_dir',
    project_name='ann_regression'
)

tuner.search(X_train_scaled, train_set_y, epochs=20,␣
 ↪validation_data=(X_val_scaled, val_set_y))

# Get the best hyperparameters
best_hps = tuner.get_best_hyperparameters(num_trials=1)[0]
```

```python
# Build the model with the best hyperparameters
best_model = build_model(best_hps)

# Fit the best model
history = best_model.fit(X_train_scaled, train_set_y, epochs=20,␣
 ↪validation_data=(X_val_scaled, val_set_y))

# Evaluate on the test set
test_loss = best_model.evaluate(X_test_scaled, test_set_y)
print("Test Loss:", test_loss)
```

```
Trial 10 Complete [00h 17m 43s]
val_loss: 1919.8477783203125

Best val_loss So Far: 1887.568359375
Total elapsed time: 02h 56m 57s
Epoch 1/20
38034/38034 [==============================] - 54s 1ms/step - loss: 2099.0203 -
val_loss: 1999.5122
Epoch 2/20
38034/38034 [==============================] - 50s 1ms/step - loss: 1970.2155 -
val_loss: 1969.7638
Epoch 3/20
38034/38034 [==============================] - 50s 1ms/step - loss: 1951.0525 -
val_loss: 1959.7430
Epoch 4/20
38034/38034 [==============================] - 50s 1ms/step - loss: 1943.7100 -
val_loss: 1934.6832
Epoch 5/20
38034/38034 [==============================] - 52s 1ms/step - loss: 1933.1969 -
val_loss: 1956.2208
Epoch 6/20
38034/38034 [==============================] - 53s 1ms/step - loss: 1929.7802 -
val_loss: 2134.4514
Epoch 7/20
38034/38034 [==============================] - 51s 1ms/step - loss: 1928.1239 -
val_loss: 1913.3273
Epoch 8/20
38034/38034 [==============================] - 51s 1ms/step - loss: 1925.3127 -
val_loss: 1948.3372
Epoch 9/20
38034/38034 [==============================] - 52s 1ms/step - loss: 1919.4805 -
val_loss: 1911.3817
Epoch 10/20
38034/38034 [==============================] - 51s 1ms/step - loss: 1922.8832 -
val_loss: 1917.0205
Epoch 11/20
```

```
38034/38034 [==============================] - 51s 1ms/step - loss: 1920.3016 -
val_loss: 1918.7432
Epoch 12/20
38034/38034 [==============================] - 50s 1ms/step - loss: 1929.3269 -
val_loss: 1894.2183
Epoch 13/20
38034/38034 [==============================] - 52s 1ms/step - loss: 1911.8256 -
val_loss: 1923.9585
Epoch 14/20
38034/38034 [==============================] - 49s 1ms/step - loss: 1914.0150 -
val_loss: 2072.9771
Epoch 15/20
38034/38034 [==============================] - 52s 1ms/step - loss: 1910.4022 -
val_loss: 2032.9346
Epoch 16/20
38034/38034 [==============================] - 51s 1ms/step - loss: 1910.7150 -
val_loss: 1950.3925
Epoch 17/20
38034/38034 [==============================] - 50s 1ms/step - loss: 1907.4413 -
val_loss: 1969.8988
Epoch 18/20
38034/38034 [==============================] - 51s 1ms/step - loss: 1917.8815 -
val_loss: 1931.2646
Epoch 19/20
38034/38034 [==============================] - 53s 1ms/step - loss: 1910.0421 -
val_loss: 2129.5347
Epoch 20/20
38034/38034 [==============================] - 54s 1ms/step - loss: 1907.1443 -
val_loss: 1918.4674
12678/12678 [==============================] - 7s 558us/step - loss: 1869.4038
Test Loss: 1869.40380859375
```

```
[ ]: best_model.save('ann_model')
```

```
INFO:tensorflow:Assets written to: ann_model/assets
```