Mercari-II

May 22, 2020

[0]:
```python
import warnings
warnings.filterwarnings('ignore')
import numpy as np
import pandas as pd
import os
import pickle
import time
from datetime import datetime
from contextlib import contextmanager
import math
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import KFold
from nltk.corpus import stopwords
from tqdm import tqdm
import re

import tensorflow as tf
from tensorflow.keras.layers import Dense,␣
↪Input,Conv1D,concatenate,LSTM,BatchNormalization
from tensorflow.keras.models import Model
from tensorflow.keras.utils import plot_model
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.layers import Embedding,Flatten,Dropout
from tensorflow.keras.callbacks import␣
↪ModelCheckpoint,TensorBoard,ReduceLROnPlateau, EarlyStopping
from tensorflow.keras import backend as K
from tensorflow.keras import optimizers
```

[0]:
```python
from google.colab import drive
drive.mount('/content/drive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id
=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.apps.googleusercontent.com&redire
ct_uri=urn%3aietf%3awg%3aoauth%3a2.0%3aoob&response_type=code&scope=email%20http
s%3a%2f%2fwww.googleapis.com%2fauth%2fdocs.test%20https%3a%2f%2fwww.googleapis.c
om%2fauth%2fdrive%20https%3a%2f%2fwww.googleapis.com%2fauth%2fdrive.photos.reado
nly%20https%3a%2f%2fwww.googleapis.com%2fauth%2fpeopleapi.readonly
```

```
Enter your authorization code:
··········
Mounted at /content/drive
```

[0]:
```
os.chdir('/content/drive/My Drive/Case Study I')
```

[0]:
```
file = open('X_train_tfidf','rb')
X_train_tfidf = pickle.load(file)
file.close()

file = open('X_test_tfidf','rb')
X_test_tfidf = pickle.load(file)
file.close()

file = open('y_train_tfidf','rb')
y_train_tfidf = pickle.load(file)
file.close()

file = open('y_test_tfidf','rb')
y_test_tfidf = pickle.load(file)
file.close()
```

[0]:
```
print("X_train TFIDF Shape : ",X_train_tfidf.shape)
print("y_train TFIDF Shape : ",y_train_tfidf.shape)
print("X_test TFIDF Shape : ",X_test_tfidf.shape)
print("y_test TFIDF Shape : ",y_test_tfidf.shape)
```

```
X_train TFIDF Shape :  (1111245, 135949)
y_train TFIDF Shape :  (1111245,)
X_test TFIDF Shape :  (370634, 135949)
y_test TFIDF Shape :  (370634,)
```

[0]:
```
# Reference : https://www.kaggle.com/c/ashrae-energy-prediction/discussion/
↪113064

def rmsle_score(y, y_pred):
    assert len(y) == len(y_pred)
    to_sum = [(math.log(y_pred[i] + 1) - math.log(y[i] + 1)) ** 2.0 for i,pred␣
↪in enumerate(y_pred)]
    return (sum(to_sum) * (1.0/len(y))) ** 0.5
```

1 Defining Models

[0]:
```
# Reference : https://www.kaggle.com/lopuhin/
↪mercari-golf-0-3875-cv-in-75-loc-1900-s
@contextmanager
def timer(name):
    t0 = time.time()
    yield
    print(f'[{name}] done in {time.time() - t0:.0f} s')
```

[0]:
```
# Reference : https://www.kaggle.com/lopuhin/
↪mercari-golf-0-3875-cv-in-75-loc-1900-s
# The Model architecture is inspired from the above link

# Defining Input Layer

import keras.backend as K
K.clear_session()

input_layer = Input(shape=(X_train_tfidf.shape[1],), dtype='float32',␣
↪sparse=True)

layer1 = Dense(256,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(input_layer)

layer2 = Dense(64,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer1)

layer3 = Dense(64,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer2)

layer4 = Dense(32,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer3)

output_layer = Dense(1,kernel_initializer=tf.keras.initializers.he_uniform(seed␣
↪= 42))(layer4)

model = Model(inputs = input_layer, outputs = output_layer)

model.summary()
```

```
Model: "model"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         [(None, 135949)]          0

_________________________________________________________________
dense (Dense)                (None, 256)               34803200

_________________________________________________________________
dense_1 (Dense)              (None, 64)                16448

_________________________________________________________________
dense_2 (Dense)              (None, 64)                4160

_________________________________________________________________
dense_3 (Dense)              (None, 32)                2080

_________________________________________________________________
dense_4 (Dense)              (None, 1)                 33
=================================================================
Total params: 34,825,921
Trainable params: 34,825,921
Non-trainable params: 0

_________________________________________________________________
```

[0]:

```python
optimizer = tf.keras.optimizers.Adam(learning_rate=0.003)

model.compile(optimizer=optimizer,loss = "mean_squared_error")

for i in range(4):
  with timer(f'epoch {i + 1}'):
    model.fit(X_train_tfidf,y_train_tfidf,batch_size=2**(8 +␣
↪i),epochs=1,verbose=1,
            validation_data = (X_test_tfidf,y_test_tfidf))

    y_pred = np.expm1(model.predict(X_test_tfidf)[:,0])
    print("Test RMSLE for Batch Size : ", 2**(8 + i), " is : ", rmsle_score(np.
↪expm1(y_test_tfidf),y_pred))
```

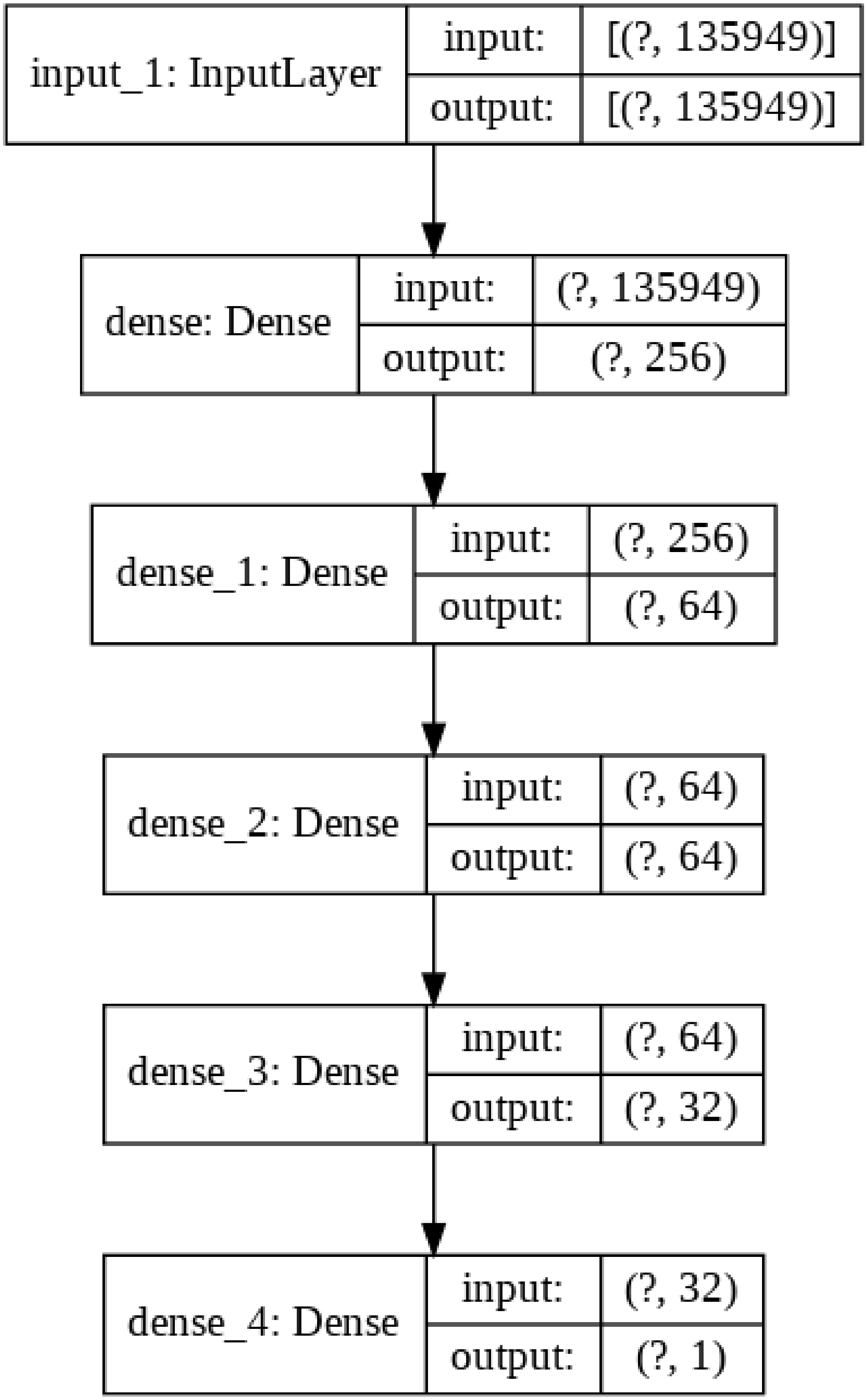
```
4341/4341 [==============================] - 461s 106ms/step - loss: 0.2331 -
val_loss: 0.1991
Test RMSLE for Batch Size :  256  is :  0.44619058856614896
[epoch 1] done in 479 s
2171/2171 [==============================] - 268s 123ms/step - loss: 0.1490 -
val_loss: 0.1898
Test RMSLE for Batch Size :  512  is :  0.4356243235988205
[epoch 2] done in 282 s
1086/1086 [==============================] - 148s 137ms/step - loss: 0.0923 -
val_loss: 0.1979
Test RMSLE for Batch Size :  1024  is :  0.444803922800796
[epoch 3] done in 164 s
543/543 [==============================] - 85s 156ms/step - loss: 0.0518 -
```

```
val_loss: 0.2017
Test RMSLE for Batch Size :  2048  is :  0.4490769100063322
[epoch 4] done in 99 s
```

Model Performs Better when Batch Size is equal to 512 with Test RMSLE Score of 0.4356

[0]:
```
tf.keras.utils.plot_model(model,to_file='model_mlp1.
 ↪png',show_shapes=True,show_layer_names=True)
```

[0]:


input_1: InputLayer
input:
[(?, 135949)]
output:
[(?, 135949)]
dense: Dense
input:
(?, 135949)
output:
(?, 256)
dense_1: Dense
input:
(?, 256)
output:
(?, 64)
dense_2: Dense
input:
(?, 64)
output:
(?, 64)
dense_3: Dense
input:
(?, 64)
output:
(?, 32)
dense_4: Dense
input:
(?, 32)
output:
(?, 1)

1.0.1 Standardizing the Price Column

[0]:
```
# Standardizing the Log Price Value before feeding it to MLP
standardscaler = StandardScaler()
y_train = standardscaler.fit_transform(y_train_tfidf.reshape(-1,1))
y_test = standardscaler.fit_transform(y_test_tfidf.reshape(-1,1))
```

[0]:
```
tf.keras.backend.clear_session()

input_layer = Input(shape=(X_train_tfidf.shape[1],), dtype='float32',␣
↪sparse=True)

layer1 = Dense(256,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(input_layer)

layer2 = Dense(64,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer1)

layer3 = Dense(64,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer2)

layer4 = Dense(32,activation = "relu",
               kernel_initializer=tf.keras.initializers.he_uniform(seed =␣
↪42))(layer3)

output_layer = Dense(1,kernel_initializer=tf.keras.initializers.he_uniform(seed␣
↪= 42))(layer4)

model1 = Model(inputs = input_layer, outputs = output_layer)

model1.summary()
```

```
Model: "model"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         [(None, 135949)]          0
_________________________________________________________________
dense (Dense)                (None, 256)               34803200
_________________________________________________________________
dense_1 (Dense)              (None, 64)                16448
```

```
_________________________________________________________________
dense_2 (Dense)              (None, 64)                4160
_________________________________________________________________
dense_3 (Dense)              (None, 32)                2080
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 33
=================================================================
Total params: 34,825,921
Trainable params: 34,825,921
Non-trainable params: 0
_________________________________________________________________
```

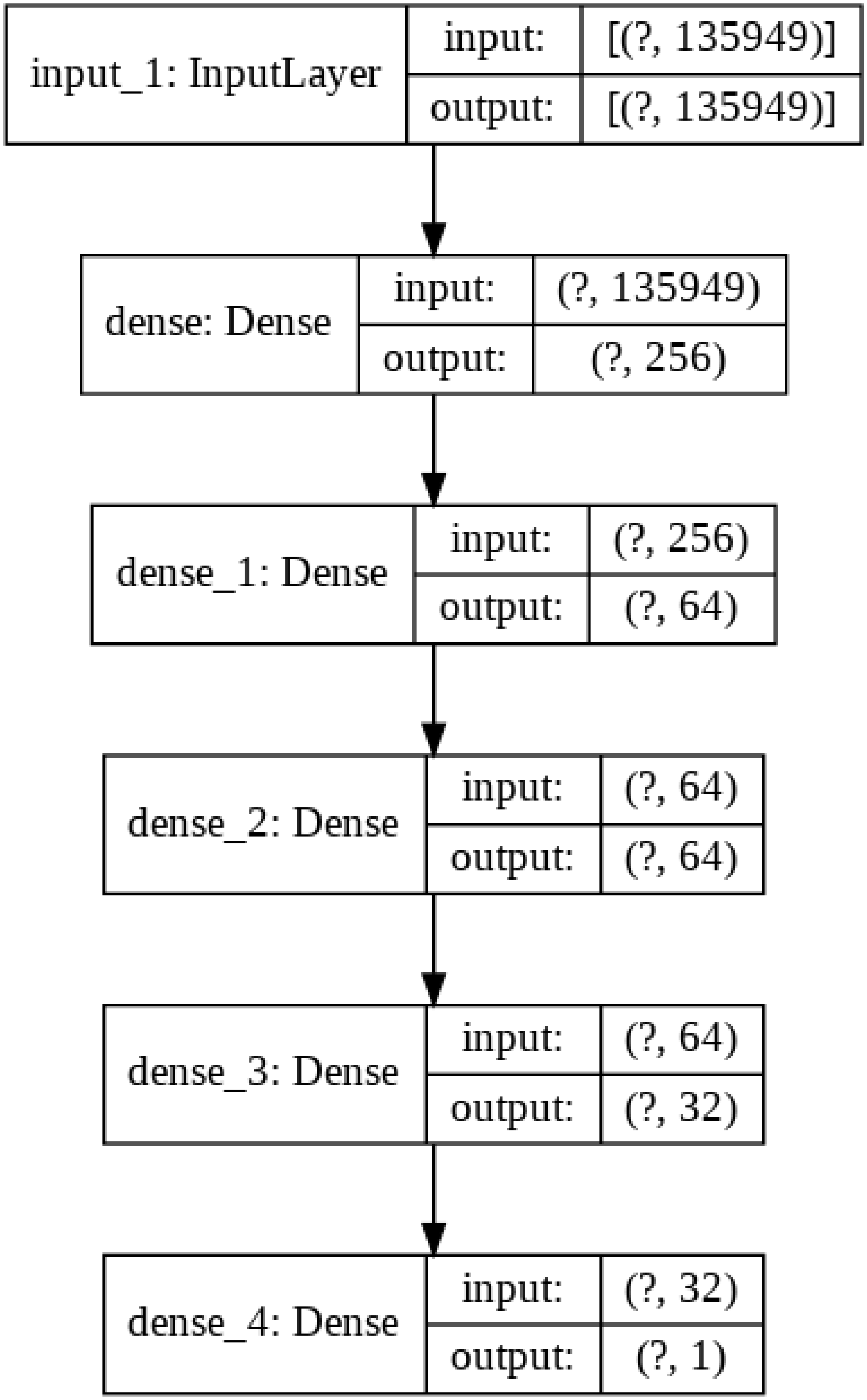
[0]:
```
optimizer = tf.keras.optimizers.Adam(learning_rate=0.003)

model1.compile(optimizer=optimizer,loss = "mean_squared_error")

for i in range(4):
  with timer(f'epoch {i + 1}'):
    model1.fit(X_train_tfidf,y_train,batch_size=2**(8 + i),epochs=1,verbose=1,
            validation_data = (X_test_tfidf,y_test))

    y_pred = model1.predict(X_test_tfidf)[:,0]
    y_pred = np.expm1(standardscaler.inverse_transform(y_pred.reshape(-1, 1))[:
↪, 0])
    y_test_temp = np.expm1(standardscaler.inverse_transform(y_test.reshape(-1,␣
↪1)))
    print("Test RMSLE for Batch Size : ", 2**(8 + i), " is : ",␣
↪rmsle_score(y_test_temp,y_pred))
```

```
4341/4341 [==============================] - 464s 107ms/step - loss: 0.3754 -
val_loss: 0.3439
Test RMSLE for Batch Size :  256  is :  0.4384528226019937
[epoch 1] done in 480 s
2171/2171 [==============================] - 245s 113ms/step - loss: 0.2350 -
val_loss: 0.3313
Test RMSLE for Batch Size :  512  is :  0.4303875866157003
[epoch 2] done in 260 s
1086/1086 [==============================] - 133s 123ms/step - loss: 0.1343 -
val_loss: 0.3390
Test RMSLE for Batch Size :  1024  is :  0.4353120187608513
[epoch 3] done in 149 s
543/543 [==============================] - 77s 141ms/step - loss: 0.0735 -
val_loss: 0.3444
Test RMSLE for Batch Size :  2048  is :  0.43877668203280695
[epoch 4] done in 91 s
```

We can see that with standardization, Model Performs Better when Batch Size is 512 with Test RMSLE = 0.4303

[0]:
```
tf.keras.utils.plot_model(model1,to_file='model_mlp1.
↪png',show_shapes=True,show_layer_names=True)
```

[0]:


input_1: InputLayer
input:
[(?, 135949)]
output:
[(?, 135949)]
dense: Dense
input:
(?, 135949)
output:
(?, 256)
dense_1: Dense
input:
(?, 256)
output:
(?, 64)
dense_2: Dense
input:
(?, 64)
output:
(?, 64)
dense_3: Dense
input:
(?, 64)
output:
(?, 32)
dense_4: Dense
input:
(?, 32)
output:
(?, 1)

[0]:

```

```

2 LSTM Model

[0]:

```
# Reference : https://www.kaggle.com/valkling/
 ↪mercari-rnn-2ridge-models-with-notes-0-42755
data = pd.read_csv('train.tsv',sep='\t')
data = data[(data.price >= 3) & (data.price <= 2000)].reset_index(drop=True)

cv = KFold(n_splits=20, shuffle=True, random_state=42)
train_ids, test_ids = next(cv.split(data))
# The above two line of code does K Fold Train Test Splitting where the Entire␣
 ↪data
# is divided into 20 folds each of size = len(data) // fold_size.
# Here data is roughly 1.4M and fold is 20 so each fold would be approx 74K

train, test = data.iloc[train_ids], data.iloc[test_ids]
# The Id's are saved to train and test respectively

# As we have seen that taking log values of the Price Column and
# standardizing them gives good result we will do the same

scaler = StandardScaler()
train_price = train['price'].values.reshape(-1,1)
test_price = test['price'].values.reshape(-1,1)

y_train = scaler.fit_transform(np.log1p(train_price))
y_test = scaler.transform(np.log1p(test_price))

print("X_Train Data Shape : ",train.shape)
print("y_train Shape : ",y_train.shape)
print("X_Test Data Shape : ",test.shape)
print("y_test Shape : ",y_test.shape)
```

```
X_Train Data Shape :  (1407575, 8)
y_train Shape :  (1407575, 1)
X_Test Data Shape :  (74083, 8)
y_test Shape :  (74083, 1)
```

[0]:

```
# Reference : Applied AI Course
def decontracted(phrase):
  # specific
  phrase = re.sub(r"won't", "will not", phrase)
  phrase = re.sub(r"can\'t", "can not", phrase)
```

```
  # general
  phrase = re.sub(r"n\'t", " not", phrase)
  phrase = re.sub(r"\'re", " are", phrase)
  phrase = re.sub(r"\'s", " is", phrase)
  phrase = re.sub(r"\'d", " would", phrase)
  phrase = re.sub(r"\'ll", " will", phrase)
  phrase = re.sub(r"\'t", " not", phrase)
  phrase = re.sub(r"\'ve", " have", phrase)
  phrase = re.sub(r"\'m", " am", phrase)

  return phrase
```

[0]:
```
import nltk
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data…
[nltk_data]   Unzipping corpora/stopwords.zip.
```

[0]: True

[0]:
```
stop_words = stopwords.words('english')
def preprocessing_text(text):
  preprocessed_text = []
  for sentence in tqdm(text.values):
    sentence = decontracted(sentence)
    sent = sentence.replace('\\r', ' ')
    sent = sent.replace('\\"', ' ')
    sent = sent.replace('\\n', ' ')
    sent = re.sub('[^A-Za-z0-9]+', ' ', sent)
    sent = ' '.join(e for e in sent.split() if e not in stop_words)
    preprocessed_text.append(sent.lower().strip())
  return preprocessed_text
```

[0]:
```
# Reference : https://www.kaggle.com/lopuhin/
 ↪mercari-golf-0-3875-cv-in-75-loc-1900-s
# The above reference suggests to combine name and brand_name, description,name␣
 ↪and category name
# so as to have only 4 columns apart from the proce column

def new_preprocess(df):
  df['name'] = df['preprocess_name'].fillna('') + ' ' + df['brand_name'].
 ↪fillna('')
  df['text'] = (df['preprocess_desc'].fillna('') + ' ' + df['preprocess_name']␣
 ↪+ ' ' + df['category_name'].fillna(''))

  return df[['name', 'text', 'shipping', 'item_condition_id']]
```

[0]:
```
train['name'] = train['name'].replace([np.nan], '')
test['name'] = test['name'].replace([np.nan], '')

train['item_description'] = train['item_description'].replace([np.nan], '')
test['item_description'] = test['item_description'].replace([np.nan], '')
```

[0]:
```
train['preprocess_name'] = preprocessing_text(train['name'])
test['preprocess_name'] = preprocessing_text(test['name'])

train['preprocess_desc'] = preprocessing_text(train['item_description'])
test['preprocess_desc'] = preprocessing_text(test['item_description'])
```

```
100%|      | 1407575/1407575 [00:27<00:00, 51296.76it/s]
100%|      | 74083/74083 [00:01<00:00, 51916.12it/s]
100%|      | 1407575/1407575 [01:28<00:00, 15872.65it/s]
100%|      | 74083/74083 [00:04<00:00, 16040.58it/s]
```

[0]:
```
X_train = new_preprocess(train)
X_test = new_preprocess(test)
print(X_train.shape)
print(X_test.shape)
```

```
(1407575, 4)
(74083, 4)
```

[0]:
```
X_train.columns
```

[0]:
```
Index(['name', 'text', 'shipping', 'item_condition_id'], dtype='object')
```

2.1 Tokenizing Name and Text Columns

[0]:
```
tokenizer_obj = Tokenizer(oov_token="UNK")
tokenizer_obj.fit_on_texts(X_train["name"])
print("Vocab Size : ", len(tokenizer_obj.word_index) + 1)
```

```
Vocab Size :  102351
```

[0]:
```
s = X_train.name.values
name_length = []
for i in range(len(s)):
  name_length.append(len(s[i]))

print(len(name_length))
```

```
1407575
```

[0]:
```
name_length.sort() # Sorting the name length in ascending order
numpy_array = np.asarray(name_length)
```

[0]:
```
for i in range(1,11):
  percentile_value = int(np.percentile(numpy_array,i*10))
  print(i*10,"th Percentile Value : ", percentile_value)
```

```
10 th Percentile Value :  17
20 th Percentile Value :  21
30 th Percentile Value :  25
40 th Percentile Value :  28
50 th Percentile Value :  31
60 th Percentile Value :  34
70 th Percentile Value :  37
80 th Percentile Value :  40
90 th Percentile Value :  45
100 th Percentile Value :  79
```

[0]:
```
for i in range(1,10):
  percentile_value = int(np.percentile(numpy_array,90 + i))
  print(90 + i,"th Percentile Value : ", percentile_value)
```

```
91 th Percentile Value :  46
92 th Percentile Value :  46
93 th Percentile Value :  47
94 th Percentile Value :  48
95 th Percentile Value :  49
96 th Percentile Value :  50
97 th Percentile Value :  51
98 th Percentile Value :  53
99 th Percentile Value :  55
```

Since 99 percentile of the Name are of length 55 we will have name to of length 55

[0]:
```
max_name_length = 55
X_train_name = tokenizer_obj.texts_to_sequences(X_train["name"])
X_test_name = tokenizer_obj.texts_to_sequences(X_test["name"])
```

[0]:
```
X_train_name_pad = np.asarray(pad_sequences(X_train_name,maxlen =␣
↪max_name_length,padding = 'post'),
                          dtype = np.float)
X_test_name_pad = np.asarray(pad_sequences(X_test_name,maxlen =␣
↪max_name_length,padding = 'post'),
                          dtype = np.float)

print(X_train_name_pad.shape)
print(X_test_name_pad.shape)
```

```
(1407575, 55)
(74083, 55)
```

[0]:
```
from numpy import asarray

embeddings_index = dict()
f = open('glove.6B.100d.txt')
for line in f:
  values = line.split()
  word = values[0]
  coefs = asarray(values[1:], dtype='float32')
  embeddings_index[word] = coefs
f.close()
print('Loaded %s word vectors.' % len(embeddings_index))

print(len(embeddings_index["the"]))
```

```
Loaded 400000 word vectors.
100
```

[0]:
```
vocab_size = len(tokenizer_obj.word_index) + 1

name_embedding_matrix = np.zeros((vocab_size, 100))

for word, i in tokenizer_obj.word_index.items():
  embedding_vector = embeddings_index.get(word)
  if embedding_vector is not None:
    name_embedding_matrix[i] = embedding_vector
```

[0]:
```
print("Name Embedding Matrix Size : ", name_embedding_matrix.shape)
```

```
Name Embedding Matrix Size :  (102351, 100)
```

[0]:
```
name_embedding_layer = Embedding(vocab_size,100, weights =␣
↪[name_embedding_matrix],
                                 input_length = max_name_length, trainable =␣
↪False)
```

[0]:
```

```

[0]:
```

```

[0]:
```
tokenizer_obj = Tokenizer(oov_token="UNK")
tokenizer_obj.fit_on_texts(X_train["text"])
print("Vocab Size : ", len(tokenizer_obj.word_index) + 1)
```

```
Vocab Size :  196636
```

[0]:
```
s = X_train.text.values
text_length = []
for i in range(len(s)):
  text_length.append(len(s[i]))

print(len(text_length))
```

```
1407575
```

[0]:
```
text_length.sort() # Sorting the text length in ascending order
numpy_array = np.asarray(text_length)
```

[0]:
```
for i in range(1,11):
  percentile_value = int(np.percentile(numpy_array,i*10))
  print(i*10,"th Percentile Value : ", percentile_value)
```

```
10 th Percentile Value :  68
20 th Percentile Value :  82
30 th Percentile Value :  95
40 th Percentile Value :  110
50 th Percentile Value :  127
60 th Percentile Value :  148
70 th Percentile Value :  176
80 th Percentile Value :  223
90 th Percentile Value :  330
100 th Percentile Value :  1050
```

[0]:
```
for i in range(1,10):
  percentile_value = int(np.percentile(numpy_array,90 + i))
  print(90 + i,"th Percentile Value : ", percentile_value)
```

```
91 th Percentile Value :  350
92 th Percentile Value :  372
93 th Percentile Value :  399
94 th Percentile Value :  431
95 th Percentile Value :  469
96 th Percentile Value :  517
97 th Percentile Value :  584
98 th Percentile Value :  673
99 th Percentile Value :  775
```

[0]:
```
for i in range(1,10):
  percentile_value = int(np.percentile(numpy_array,99 + i*0.1))
  print(99 + i*0.1,"th Percentile Value : ", percentile_value)
```

```
99.1 th Percentile Value :  787
99.2 th Percentile Value :  799
99.3 th Percentile Value :  810
```

```
99.4 th Percentile Value :  823
99.5 th Percentile Value :  837
99.6 th Percentile Value :  852
99.7 th Percentile Value :  868
99.8 th Percentile Value :  890
99.9 th Percentile Value :  920
```

Since 90 percentile of text is of length less than or equal to 330 our text would be of 330 length

[0]:
```
max_text_length = 330
X_train_text = tokenizer_obj.texts_to_sequences(X_train["text"])
X_test_text = tokenizer_obj.texts_to_sequences(X_test["text"])
```

[0]:
```
X_train_text_pad = np.asarray(pad_sequences(X_train_text,maxlen =␣
 ↪max_text_length,padding = 'post'),
                             dtype = np.float)
X_test_text_pad = np.asarray(pad_sequences(X_test_text,maxlen =␣
 ↪max_text_length,padding = 'post'),
                             dtype = np.float)

print(X_train_text_pad.shape)
print(X_test_text_pad.shape)
```

```
(1407575, 330)
(74083, 330)
```

[0]:
```
vocab_size = len(tokenizer_obj.word_index) + 1

text_embedding_matrix = np.zeros((vocab_size, 100))

for word, i in tokenizer_obj.word_index.items():
  embedding_vector = embeddings_index.get(word)
  if embedding_vector is not None:
    text_embedding_matrix[i] = embedding_vector
```

[0]:
```
print("Text Embedding Matrix Size : ", text_embedding_matrix.shape)
```

```
Text Embedding Matrix Size :  (196636, 100)
```

[0]:
```
text_embedding_layer = Embedding(vocab_size,100, weights =␣
 ↪[text_embedding_matrix],
                                 input_length = max_text_length, trainable =␣
 ↪False)
```

[0]:
```
tf.keras.backend.clear_session()
```

```
Input_layer_name = Input(shape = (max_name_length,), name =␣
↪"Input_Layer_for_Name")
Input_layer_text = Input(shape = (max_text_length,), name =␣
↪"Input_Layer_for_text")
Input_layer_item_cond = Input(shape = (1,), name = "Input_for_Item_Cond")
Input_layer_ship = Input(shape=(1,), name = "Input_for_Shipping")

Embedding_layer_name = name_embedding_layer(Input_layer_name)

Embedding_layer_text = text_embedding_layer(Input_layer_text)

lstm_layer_name = LSTM(32, return_sequences=True, recurrent_dropout=0.
↪3)(Embedding_layer_name)

lstm_layer_text = LSTM(32, return_sequences=True, recurrent_dropout=0.
↪3)(Embedding_layer_text)

flatten_1 = Flatten()(lstm_layer_name)

flatten_2 = Flatten()(lstm_layer_text)

concate_layer =␣
↪concatenate([flatten_1,flatten_2,Input_layer_item_cond,Input_layer_ship],name␣
↪= "concat")

print("After Concatenation : ", concate_layer.shape)

layer1 = Dense(64,activation="relu")(concate_layer)

layer2 = Dense(32,activation="relu")(layer1)

batch_norm = BatchNormalization()(layer2)

layer3 = Dense(16,activation="relu")(batch_norm)

output_layer = Dense(1)(layer3)

optimizer = tf.keras.optimizers.Adam(learning_rate=0.003)

model = Model(inputs = [Input_layer_name,Input_layer_text,
                        Input_layer_item_cond,Input_layer_ship],
              outputs = output_layer)

model.compile(optimizer = optimizer, loss = "mean_squared_error")

model.summary()
```

```
WARNING:tensorflow:Layer lstm will not use cuDNN kernel since it doesn't meet
the cuDNN kernel criteria. It will use generic GPU kernel as fallback when
running on GPU
WARNING:tensorflow:Layer lstm_1 will not use cuDNN kernel since it doesn't meet
the cuDNN kernel criteria. It will use generic GPU kernel as fallback when
running on GPU
After Concatenation :  (None, 12322)
Model: "model"
________________________________________________________________________________
__________________
Layer (type)                    Output Shape         Param #     Connected to
================================================================================
==================
Input_Layer_for_Name (InputLaye [(None, 55)]         0
________________________________________________________________________________
__________________
Input_Layer_for_text (InputLaye [(None, 330)]        0
________________________________________________________________________________
__________________
embedding (Embedding)           (None, 55, 100)      10235100
Input_Layer_for_Name[0][0]
________________________________________________________________________________
__________________
embedding_1 (Embedding)         (None, 330, 100)     19663600
Input_Layer_for_text[0][0]
________________________________________________________________________________
__________________
lstm (LSTM)                     (None, 55, 32)       17024       embedding[0][0]
________________________________________________________________________________
__________________
lstm_1 (LSTM)                   (None, 330, 32)      17024
embedding_1[0][0]
________________________________________________________________________________
__________________
flatten (Flatten)               (None, 1760)         0           lstm[0][0]
________________________________________________________________________________
__________________
flatten_1 (Flatten)             (None, 10560)        0           lstm_1[0][0]
________________________________________________________________________________
__________________
Input_for_Item_Cond (InputLayer [(None, 1)]          0
________________________________________________________________________________
__________________
Input_for_Shipping (InputLayer) [(None, 1)]          0
________________________________________________________________________________
__________________
concat (Concatenate)            (None, 12322)        0           flatten[0][0]
                                                                 flatten_1[0][0]
```

```
Input_for_Item_Cond[0][0]
Input_for_Shipping[0][0]
________________________________________________________________________________
__________________
dense (Dense)                   (None, 64)           788672      concat[0][0]
________________________________________________________________________________
__________________
dense_1 (Dense)                 (None, 32)           2080        dense[0][0]
________________________________________________________________________________
__________________
batch_normalization (BatchNorma (None, 32)           128         dense_1[0][0]
________________________________________________________________________________
__________________
dense_2 (Dense)                 (None, 16)           528
batch_normalization[0][0]
________________________________________________________________________________
__________________
dense_3 (Dense)                 (None, 1)            17          dense_2[0][0]
================================================================================
==================
Total params: 30,724,173
Trainable params: 825,409
Non-trainable params: 29,898,764
________________________________________________________________________________
__________________
```

[0]:
```
inputs = [X_train_name_pad,X_train_text_pad,X_train['item_condition_id'].values,
          X_train['shipping'].values]

test_data = [X_test_name_pad,X_test_text_pad,X_test['item_condition_id'].values,
          X_test['shipping'].values]

for i in range(1):
  with timer(f'epoch {i + 1}'):
    model.fit(inputs,y_train,batch_size=2**(9 + i),epochs=1,verbose=1,
            validation_data = (test_data,y_test))
    y_pred = model.predict(test_data)[:,0]
    y_pred = np.expm1(scaler.inverse_transform(y_pred.reshape(-1, 1))[:, 0])
    print("Test RMSLE for Batch Size : ", 2**(9 + i), " is : ",␣
 ↪rmsle_score(test_price,y_pred))
```

```
2750/2750 [==============================] - 2852s 1s/step - loss: 0.4809 -
val_loss: 0.4211
Test RMSLE for Batch Size :  512  is :  0.4839663736319845
[epoch 1] done in 3096 s
```

Since Training LSTM takes Time(> 1 hrs) and it also shoots over the RAM usage, I have trained it only for 1 epochs resulting in Test RMSLE 0.484

[1]:

```python
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model", "Test RMSLE"]

x.add_row(["Sparse MLP without Standardization ",0.4356])

x.add_row(["Sparse MLP with Standardization ",0.4303])

x.add_row(["LSTM ",0.484])

print(x)
```

```
+-------------------------------------+------------+
|                Model                | Test RMSLE |
+-------------------------------------+------------+
| Sparse MLP without Standardization  |   0.4356   |
|   Sparse MLP with Standardization   |   0.4303   |
|                LSTM                 |   0.484    |
+-------------------------------------+------------+
```

From the above Table ``Sparse MLP with Target Column Standardized'' performs better than other Models

[0]:

```python

```