

Homework 4 (Sequential Models)

1. Choose a book or other text to train your model on (I suggest [Project Gutenberg](#) to find .txt files but you can find them elsewhere). Make sure your file is a .txt file. Clean your data (You may use [this file](#) we talked about in class as a baseline). Build a sequential model (LSTM, GRU, SimpleRNN, or Transformer) that generates new lines based on the training data (NO TRANSFER LEARNING).

Print out or write 10 generated sequences from your model (Similar to Classwork 17 where we generated new Pride and Prejudice lines, but now with words instead of characters. Feel free to use [this](#) as a reference). Assess in detail how good they are, what they're good at, what they struggle to do well.

1. Make a new model with ONE substantial adjustment (e.g. use a custom embedding layer if you didn't already, use a pre-trained embedding layer if you didn't already, use a DEEP LSTM/GRU with multiple recurrent layers, use a pre-trained model to do transfer learning and fine-tune it...etc.).

Print out or write 10 generated sequences from your model (Similar to Classwork 17 where we generated new Pride and Prejudice lines, but now with words instead of characters. Feel free to use [this](#) as a reference). Assess in detail how good they are, what they're good at, what they struggle to do well. Did the performance of your model change?

1. Then create a **technical report** discussing your model building process, the results, and your reflection on it. The report should follow the format in the example including an Introduction, Analysis, Methods, Results, and Reflection section.

Introduction

An introduction should introduce the problem you're working on, give some background and relevant detail for the reader, and explain why it is important.

Analysis

Any exploratory analysis of your data, and general summarization of the data (e.g. summary statistics, correlation heatmaps, graphs, information about the data...). This can also include any cleaning and joining you did.

Methods

Explain the structure of your model and your approach to building it. This can also include changes you made to your model in the process of building it. Someone should be able to read your methods section and *generally* be able to tell exactly what architecture you used.

Results

Detailed discussion of how your model performed, and your discussion of how your model performed.

Reflection

Reflections on what you learned/discovered in the process of doing the assignment. Things you would do differently in the future, ways you'll approach similar problems in the future, etc.

```
import numpy as np

import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Embedding, Dense, LSTM
from tensorflow.keras.utils import to_categorical
from tensorflow.keras import Input
from tensorflow.keras import Model
from tensorflow.keras.preprocessing.text import Tokenizer

import string

from random import randint
from pickle import load
from keras.models import load_model
from tensorflow.keras.preprocessing.sequence import pad_sequences

!pip install tensorflow
# modified from: https://machinelearningmastery.com/how-to-develop-a-word-level-neural-language-model-in-keras/

# changeable params
my_file = "simple.txt"
seq_len = 100

# load doc into memory
def load_doc(filename):
    # open the file as read only
    file = open(filename, 'r')
    # read all text
    text = file.read()
    # close the file
    file.close()
    return text

# turn a doc into clean tokens
def clean_doc(doc):
```

```

# replace '--' with a space ' '
doc = doc.replace('--', ' ')
# split into tokens by white space
tokens = doc.split()
# remove punctuation from each token
table = str.maketrans('', '', string.punctuation)
tokens = [w.translate(table) for w in tokens]
# remove remaining tokens that are not alphabetic
tokens = [word for word in tokens if word.isalpha()]
# make lower case
tokens = [word.lower() for word in tokens]
return tokens

# save tokens to file, one dialog per line
def save_doc(lines, filename):
    data = '\n'.join(lines)
    file = open(filename, 'w')
    file.write(data)
    file.close()

# load document
doc = load_doc(my_file)
print(doc[:200])

# clean document
tokens = clean_doc(doc)
print(tokens[:200])
print('Total Tokens: %d' % len(tokens))
print('Unique Tokens: %d' % len(set(tokens)))

# organize into sequences of tokens
length = seq_len + 1
sequences = list()
for i in range(length, len(tokens)):
    # select sequence of tokens
    seq = tokens[i-length:i]
    # convert into a line
    line = ' '.join(seq)
    # store
    sequences.append(line)
print('Total Sequences: %d' % len(sequences))

# save sequences to file
out_filename = my_file[:-4] + '_seq.txt'
save_doc(sequences, out_filename)

```

Looking in indexes: <https://pypi.org/simple>, <https://us-python.pkg.dev/colab-wheels/public/simple/>
Requirement already satisfied: tensorflow in
/usr/local/lib/python3.10/dist-packages (2.12.0)

Requirement already satisfied: numpy<1.24,>=1.22 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.22.4)
Requirement already satisfied: six>=1.12.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: tensorflow-estimator<2.13,>=2.12.0
in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.0)
Requirement already satisfied: google-pasta>=0.1.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
Requirement already satisfied: packaging in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (23.1)
Requirement already satisfied: astunparse>=1.6.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=2.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (23.3.3)
Requirement already satisfied: keras<2.13,>=2.12.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.0)
Requirement already satisfied: typing-extensions>=3.6.6 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (4.5.0)
Requirement already satisfied: absl-py>=1.0.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: protobuf!=4.21.0,! =4.21.1,! =4.21.2,! =4.21.3,! =4.21.4,! =4.21.5,<5.0.0dev,>=3.20.3 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.20.3)
Requirement already satisfied: libclang>=13.0.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (16.0.0)
Requirement already satisfied: h5py>=2.9.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.8.0)
Requirement already satisfied: tensorboard<2.13,>=2.12 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.2)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.0)
Requirement already satisfied: setuptools in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: opt-einsum>=2.3.2 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: termcolor>=1.1.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (2.3.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (1.54.0)
Requirement already satisfied: jax>=0.3.15 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.8)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
/usr/local/lib/python3.10/dist-packages (from tensorflow) (0.32.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in
/usr/local/lib/python3.10/dist-packages (from astunparse>=1.6.0->tensorflow) (0.40.0)
Requirement already satisfied: ml-dtypes>=0.0.3 in
/usr/local/lib/python3.10/dist-packages (from jax>=0.3.15->tensorflow)

(0.1.0)

Requirement already satisfied: scipy>=1.7 in
/usr/local/lib/python3.10/dist-packages (from jax>=0.3.15->tensorflow)
(1.10.1)

Requirement already satisfied: werkzeug>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.3.0)

Requirement already satisfied: markdown>=2.6.8 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (3.4.3)

Requirement already satisfied: requests<3,>=2.21.0 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.27.1)

Requirement already satisfied: google-auth<3,>=1.6.3 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (2.17.3)

Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0
in /usr/local/lib/python3.10/dist-packages (from
tensorboard<2.13,>=2.12->tensorflow) (0.7.0)

Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (1.8.1)

Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in
/usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorflow) (1.0.0)

Requirement already satisfied: cachetools<6.0,>=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (5.3.0)

Requirement already satisfied: rsa<5,>=3.1.4 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (4.9)

Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.3.0)

Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.13,>=2.12->tensorflow) (1.3.1)

Requirement already satisfied: charset-normalizer~=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (2.0.12)

Requirement already satisfied: urllib3<1.27,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (1.26.15)

Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (2022.12.7)

Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.13,>=2.12->tensorflow) (3.4)

Requirement already satisfied: MarkupSafe>=2.1.1 in

```

/usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1-
>tensorboard<2.13,>=2.12->tensorflow) (2.1.2)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in
/usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1-
>google-auth<3,>=1.6.3->tensorboard<2.13,>=2.12->tensorflow) (0.5.0)
Requirement already satisfied: oauthlib>=3.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests-
oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5-
>tensorboard<2.13,>=2.12->tensorflow) (3.2.2)
The Project Gutenberg eBook of The Enchanted April, by Elizabeth Von
Arnim

```

This eBook is for the use of anyone anywhere in the United States and most other parts of the world at no cost and with almo

```

['the', 'project', 'gutenberg', 'ebook', 'of', 'the', 'enchanted',
'april', 'by', 'elizabeth', 'von', 'arnim', 'this', 'ebook', 'is',
'for', 'the', 'use', 'of', 'anyone', 'anywhere', 'in', 'the',
'united', 'states', 'and', 'most', 'other', 'parts', 'of', 'the',
'world', 'at', 'no', 'cost', 'and', 'with', 'almost', 'no',
'restrictions', 'whatsoever', 'you', 'may', 'copy', 'it', 'give',
'it', 'away', 'or', 'reuse', 'it', 'under', 'the', 'terms', 'of',
'the', 'project', 'gutenberg', 'license', 'included', 'with', 'this',
'ebook', 'or', 'online', 'at', 'www.gutenberg.org', 'if', 'you', 'are',
'not', 'located', 'in', 'the', 'united', 'states', 'you', 'will',
'have', 'to', 'check', 'the', 'laws', 'of', 'the', 'country', 'where',
'you', 'are', 'located', 'before', 'using', 'this', 'ebook', 'title',
'the', 'enchanted', 'april', 'author', 'elizabeth', 'von', 'arnim',
'release', 'date', 'july', 'ebook', 'most', 'recently', 'updated',
'april', 'language', 'english', 'produced', 'by', 'manette',
'rothermel', 'start', 'of', 'the', 'project', 'gutenberg', 'ebook',
'the', 'enchanted', 'april', 'illustration', 'the', 'enchanted',
'april', 'by', 'elizabeth', 'von', 'arnim', 'contents', 'chapter',
'chapter', 'chapter', 'chapter', 'chapter', 'chapter', 'chapter',
'chapter', 'chapter', 'chapter', 'chapter', 'chapter', 'chapter',
'chapter', 'chapter', 'chapter', 'chapter', 'chapter', 'chapter',
'chapter', 'chapter', 'chapter', 'chapter', 'it', 'began', 'in', 'a',
'club', 'in', 'london', 'on', 'a', 'february', 'uncomfortable',
'club', 'and', 'a', 'miserable', 'mrs', 'wilkins', 'who', 'had',
'come', 'down', 'from', 'hampstead', 'to', 'shop', 'and', 'had',
'lunched', 'at', 'her', 'club', 'took', 'up', 'the', 'times', 'from',
'the', 'table', 'in', 'the', 'smokingroom', 'and', 'running']

```

Total Tokens: 77117

Unique Tokens: 6333

Total Sequences: 77016

```

# load doc into memory
def load_doc(filename):
    # open the file as read only
    file = open(filename, 'r')
    # read all text

```

```

text = file.read()
# close the file
file.close()
return text

# load
in_filename = 'simple.txt'
doc = load_doc(out_filename)
lines = doc.split('\n')

# integer encode sequences of words
tokenizer = Tokenizer()
tokenizer.fit_on_texts(lines)
sequences = tokenizer.texts_to_sequences(lines)

# vocabulary size
vocab_size = len(tokenizer.word_index) + 1

# separate into input and output
sequences = np.array(sequences)
sequences.shape
X, y = sequences[:, :-1], sequences[:, -1]
y = to_categorical(y, num_classes=vocab_size)
seq_length = X.shape[1]

p_train = 0.8

n_train = int(X.shape[0]//(1/p_train))
X_train = X[0:n_train]
y_train = y[0:n_train]
X_test = X[n_train:]
y_test = y[n_train:]

vocab_size
6334

X_train.shape
(61612, 100)

X_test.shape
(15404, 100)

y_train.shape
(61612, 6334)

y_test.shape

```

(15404, 6334)

```
model = Sequential()
model.add(Embedding(vocab_size, 50, input_length=seq_length))
model.add(LSTM(100, return_sequences=True))
model.add(LSTM(100))
model.add(Dense(100, activation='relu'))
model.add(Dense(vocab_size, activation='softmax'))
print(model.summary())
```

Model: "sequential"

Layer (type)	Output Shape	Param #
embedding (Embedding)	(None, 100, 50)	316700
lstm (LSTM)	(None, 100, 100)	60400
lstm_1 (LSTM)	(None, 100)	80400
dense (Dense)	(None, 100)	10100
dense_1 (Dense)	(None, 6334)	639734

```
=====
Total params: 1,107,334
Trainable params: 1,107,334
Non-trainable params: 0
```

None

```
model.compile(loss='categorical_crossentropy', optimizer='adam',
metrics=['accuracy'])
# fit model
model.fit(X_train, y_train, batch_size=128, epochs=100)
```

Epoch 1/100

482/482 [=====] - 107s 213ms/step - loss: 6.4629 - accuracy: 0.0412

Epoch 2/100

482/482 [=====] - 105s 217ms/step - loss: 6.0931 - accuracy: 0.0507

Epoch 3/100

482/482 [=====] - 107s 222ms/step - loss: 5.8981 - accuracy: 0.0689

Epoch 4/100

482/482 [=====] - 108s 223ms/step - loss: 5.7454 - accuracy: 0.0814

Epoch 5/100

482/482 [=====] - 108s 225ms/step - loss: 5.6332 - accuracy: 0.0984

Epoch 6/100
482/482 [=====] - 108s 224ms/step - loss:
5.5094 - accuracy: 0.1149
Epoch 7/100
482/482 [=====] - 110s 228ms/step - loss:
5.4085 - accuracy: 0.1254
Epoch 8/100
482/482 [=====] - 111s 230ms/step - loss:
5.3123 - accuracy: 0.1299
Epoch 9/100
482/482 [=====] - 110s 228ms/step - loss:
5.2288 - accuracy: 0.1361
Epoch 10/100
482/482 [=====] - 107s 223ms/step - loss:
5.1522 - accuracy: 0.1382
Epoch 11/100
482/482 [=====] - 108s 225ms/step - loss:
5.0878 - accuracy: 0.1408
Epoch 12/100
482/482 [=====] - 109s 226ms/step - loss:
5.0203 - accuracy: 0.1435
Epoch 13/100
482/482 [=====] - 108s 224ms/step - loss:
4.9699 - accuracy: 0.1458
Epoch 14/100
482/482 [=====] - 110s 229ms/step - loss:
4.9167 - accuracy: 0.1485
Epoch 15/100
482/482 [=====] - 109s 226ms/step - loss:
4.8598 - accuracy: 0.1501
Epoch 16/100
482/482 [=====] - 109s 226ms/step - loss:
4.8432 - accuracy: 0.1514
Epoch 17/100
482/482 [=====] - 108s 224ms/step - loss:
4.7913 - accuracy: 0.1538
Epoch 18/100
482/482 [=====] - 108s 224ms/step - loss:
4.7778 - accuracy: 0.1553
Epoch 19/100
482/482 [=====] - 109s 227ms/step - loss:
4.7277 - accuracy: 0.1573
Epoch 20/100
482/482 [=====] - 107s 222ms/step - loss:
4.7161 - accuracy: 0.1568
Epoch 21/100
482/482 [=====] - 107s 221ms/step - loss:
4.6089 - accuracy: 0.1613
Epoch 22/100
482/482 [=====] - 107s 221ms/step - loss:

4.5510 - accuracy: 0.1628
Epoch 23/100
482/482 [=====] - 109s 225ms/step - loss:
4.5103 - accuracy: 0.1632
Epoch 24/100
482/482 [=====] - 107s 223ms/step - loss:
4.4462 - accuracy: 0.1674
Epoch 25/100
482/482 [=====] - 107s 223ms/step - loss:
4.3933 - accuracy: 0.1696
Epoch 26/100
482/482 [=====] - 108s 223ms/step - loss:
4.3408 - accuracy: 0.1743
Epoch 27/100
482/482 [=====] - 108s 224ms/step - loss:
4.2872 - accuracy: 0.1752
Epoch 28/100
482/482 [=====] - 108s 225ms/step - loss:
4.2382 - accuracy: 0.1799
Epoch 29/100
482/482 [=====] - 109s 225ms/step - loss:
4.1914 - accuracy: 0.1829
Epoch 30/100
482/482 [=====] - 108s 224ms/step - loss:
4.1380 - accuracy: 0.1873
Epoch 31/100
482/482 [=====] - 107s 222ms/step - loss:
4.1004 - accuracy: 0.1907
Epoch 32/100
482/482 [=====] - 107s 221ms/step - loss:
4.0747 - accuracy: 0.1943
Epoch 33/100
482/482 [=====] - 107s 222ms/step - loss:
4.0742 - accuracy: 0.1974
Epoch 34/100
482/482 [=====] - 107s 222ms/step - loss:
4.1192 - accuracy: 0.1943
Epoch 35/100
482/482 [=====] - 107s 222ms/step - loss:
4.0351 - accuracy: 0.2006
Epoch 36/100
482/482 [=====] - 107s 222ms/step - loss:
3.9512 - accuracy: 0.2073
Epoch 37/100
482/482 [=====] - 107s 223ms/step - loss:
3.8939 - accuracy: 0.2141
Epoch 38/100
482/482 [=====] - 108s 223ms/step - loss:
3.8313 - accuracy: 0.2176
Epoch 39/100

482/482 [=====] - 108s 225ms/step - loss:
3.7895 - accuracy: 0.2220
Epoch 40/100
482/482 [=====] - 110s 228ms/step - loss:
3.7954 - accuracy: 0.2242
Epoch 41/100
482/482 [=====] - 109s 226ms/step - loss:
3.7499 - accuracy: 0.2295
Epoch 42/100
482/482 [=====] - 109s 226ms/step - loss:
3.7191 - accuracy: 0.2344
Epoch 43/100
482/482 [=====] - 109s 226ms/step - loss:
3.7391 - accuracy: 0.2346
Epoch 44/100
482/482 [=====] - 108s 223ms/step - loss:
3.7518 - accuracy: 0.2344
Epoch 45/100
482/482 [=====] - 107s 223ms/step - loss:
3.8962 - accuracy: 0.2248
Epoch 46/100
482/482 [=====] - 109s 227ms/step - loss:
3.8664 - accuracy: 0.2260
Epoch 47/100
482/482 [=====] - 108s 225ms/step - loss:
3.8125 - accuracy: 0.2306
Epoch 48/100
482/482 [=====] - 109s 225ms/step - loss:
3.7595 - accuracy: 0.2334
Epoch 49/100
482/482 [=====] - 107s 221ms/step - loss:
3.7185 - accuracy: 0.2401
Epoch 50/100
482/482 [=====] - 102s 212ms/step - loss:
3.6837 - accuracy: 0.2444
Epoch 51/100
482/482 [=====] - 107s 221ms/step - loss:
3.7158 - accuracy: 0.2417
Epoch 52/100
482/482 [=====] - 116s 240ms/step - loss:
3.6916 - accuracy: 0.2451
Epoch 53/100
482/482 [=====] - 111s 230ms/step - loss:
3.7281 - accuracy: 0.2418
Epoch 54/100
482/482 [=====] - 109s 226ms/step - loss:
3.6765 - accuracy: 0.2466
Epoch 55/100
482/482 [=====] - 110s 228ms/step - loss:
3.6398 - accuracy: 0.2514

Epoch 56/100
482/482 [=====] - 108s 225ms/step - loss:
3.6196 - accuracy: 0.2537
Epoch 57/100
482/482 [=====] - 109s 227ms/step - loss:
3.5441 - accuracy: 0.2608
Epoch 58/100
482/482 [=====] - 109s 227ms/step - loss:
3.5028 - accuracy: 0.2650
Epoch 59/100
482/482 [=====] - 108s 224ms/step - loss:
3.4729 - accuracy: 0.2725
Epoch 60/100
482/482 [=====] - 109s 226ms/step - loss:
3.4373 - accuracy: 0.2772
Epoch 61/100
482/482 [=====] - 109s 225ms/step - loss:
3.3878 - accuracy: 0.2819
Epoch 62/100
482/482 [=====] - 108s 223ms/step - loss:
3.3578 - accuracy: 0.2869
Epoch 63/100
482/482 [=====] - 108s 225ms/step - loss:
3.3175 - accuracy: 0.2917
Epoch 64/100
482/482 [=====] - 111s 230ms/step - loss:
3.3692 - accuracy: 0.2899
Epoch 65/100
482/482 [=====] - 113s 235ms/step - loss:
3.3244 - accuracy: 0.2953
Epoch 66/100
482/482 [=====] - 112s 233ms/step - loss:
3.3015 - accuracy: 0.3000
Epoch 67/100
482/482 [=====] - 111s 230ms/step - loss:
3.2425 - accuracy: 0.3075
Epoch 68/100
482/482 [=====] - 111s 231ms/step - loss:
3.1924 - accuracy: 0.3129
Epoch 69/100
482/482 [=====] - 111s 230ms/step - loss:
3.1609 - accuracy: 0.3173
Epoch 70/100
482/482 [=====] - 111s 230ms/step - loss:
3.1034 - accuracy: 0.3239
Epoch 71/100
482/482 [=====] - 113s 233ms/step - loss:
3.0741 - accuracy: 0.3306
Epoch 72/100
482/482 [=====] - 111s 231ms/step - loss:

3.0518 - accuracy: 0.3338
Epoch 73/100
482/482 [=====] - 111s 229ms/step - loss:
3.0454 - accuracy: 0.3372
Epoch 74/100
482/482 [=====] - 112s 232ms/step - loss:
3.0577 - accuracy: 0.3379
Epoch 75/100
482/482 [=====] - 110s 229ms/step - loss:
2.9968 - accuracy: 0.3442
Epoch 76/100
482/482 [=====] - 111s 231ms/step - loss:
3.0702 - accuracy: 0.3398
Epoch 77/100
482/482 [=====] - 111s 230ms/step - loss:
3.1014 - accuracy: 0.3368
Epoch 78/100
482/482 [=====] - 112s 231ms/step - loss:
3.0541 - accuracy: 0.3438
Epoch 79/100
482/482 [=====] - 110s 229ms/step - loss:
3.0622 - accuracy: 0.3418
Epoch 80/100
482/482 [=====] - 111s 231ms/step - loss:
2.9857 - accuracy: 0.3518
Epoch 81/100
482/482 [=====] - 112s 233ms/step - loss:
2.9460 - accuracy: 0.3561
Epoch 82/100
482/482 [=====] - 112s 232ms/step - loss:
2.8913 - accuracy: 0.3646
Epoch 83/100
482/482 [=====] - 113s 233ms/step - loss:
2.8682 - accuracy: 0.3678
Epoch 84/100
482/482 [=====] - 110s 229ms/step - loss:
2.8351 - accuracy: 0.3736
Epoch 85/100
482/482 [=====] - 114s 236ms/step - loss:
2.8811 - accuracy: 0.3721
Epoch 86/100
482/482 [=====] - 111s 231ms/step - loss:
2.9035 - accuracy: 0.3719
Epoch 87/100
482/482 [=====] - 110s 228ms/step - loss:
2.9194 - accuracy: 0.3697
Epoch 88/100
482/482 [=====] - 110s 228ms/step - loss:
2.9590 - accuracy: 0.3643
Epoch 89/100

```

482/482 [=====] - 109s 227ms/step - loss:
2.8767 - accuracy: 0.3742
Epoch 90/100
482/482 [=====] - 110s 228ms/step - loss:
2.7473 - accuracy: 0.3894
Epoch 91/100
482/482 [=====] - 109s 226ms/step - loss:
2.7062 - accuracy: 0.3960
Epoch 92/100
482/482 [=====] - 109s 226ms/step - loss:
2.7414 - accuracy: 0.3957
Epoch 93/100
482/482 [=====] - 110s 227ms/step - loss:
2.7586 - accuracy: 0.3932
Epoch 94/100
482/482 [=====] - 111s 230ms/step - loss:
2.8216 - accuracy: 0.3872
Epoch 95/100
482/482 [=====] - 111s 230ms/step - loss:
3.0346 - accuracy: 0.3632
Epoch 96/100
482/482 [=====] - 112s 232ms/step - loss:
3.1073 - accuracy: 0.3488
Epoch 97/100
482/482 [=====] - 113s 234ms/step - loss:
2.9104 - accuracy: 0.3684
Epoch 98/100
482/482 [=====] - 111s 231ms/step - loss:
2.8468 - accuracy: 0.3804
Epoch 99/100
482/482 [=====] - 110s 228ms/step - loss:
2.7245 - accuracy: 0.3968
Epoch 100/100
482/482 [=====] - 109s 226ms/step - loss:
2.6993 - accuracy: 0.4010

```

```
<keras.callbacks.History at 0x7f0dae4532b0>
```

```
encoded = tokenizer.texts_to_sequences([seed_text])[0]
```

```
# predict probabilities for each word
```

```
probabilities = model.predict(X_test)
```

```
yhat = np.argmax(probabilities, axis=-1)
```

```
482/482 [=====] - 7s 11ms/step
```

```
out_word = ''
```

```
yhat_int = yhat.item(0) # Extract the first element from the yhat array
```

```
for word, index in tokenizer.word_index.items():
```

```
    if index == yhat_int:
```

```

        out_word = word
        break

# generate a sequence from a language model
def generate_seq(model, tokenizer, seq_length, seed_text, n_words):
    result = list()
    in_text = seed_text
    # generate a fixed number of words
    for _ in range(n_words):
        # encode the text as integer
        encoded = tokenizer.texts_to_sequences([in_text])[0]
        # truncate sequences to a fixed length
        encoded = pad_sequences([encoded], maxlen=seq_length,
truncating='pre')
        # predict probabilities for each word
        yhat = model.predict(encoded, verbose=0)
        yhat_int = np.argmax(yhat, axis=-1).item(0) # Extract the
first element from the yhat array
        # map predicted word index to word
        out_word = ''
        for word, index in tokenizer.word_index.items():
            if index == yhat_int:
                out_word = word
                break
        in_text += ' ' + out_word
        result.append(out_word)
    return ' '.join(result)

# Generate 10 sequences of text
for _ in range(10):
    # Select a seed text
    seed_text = lines[randint(0, len(lines))]
    print(f"Seed text: {seed_text}")

    # Generate new text
    generated_text = generate_seq(model2, tokenizer, seq_length,
seed_text, seq_length)
    print(f"Generated text: {generated_text}")
    print()

```

Seed text: circumstances which could only might or might not add heart to beat higher than ever with pride and the first steps towards what might well be the turningpoint in his career would have been taken and here he was no it was too terrible what could be more terrible only a towel on water running off his legs and that exclamation he knew at once the lady was lady minute the exclamation was out he knew it rarely did mr wilkins use that word and never never in the presence of a lady or a client while as for the had

Generated text: said a little forlorn who wondered and she had been prudent to think she had been plainly nice or costanza producing to be a little interfere with it was a little nervy her mother was a little

boring she had been a man and was a little orchard and smelling up to be able to think she had been a little to expect the same breath and lovingkindness round the garden and the other of the same goldfish she had been a little orchard and between the eyed slitwindows and seem tactless all fish it was a little dark of

Seed text: mr lotty laughed she said even if it enough love about to flood fifty mr wilkinse as you call him the great thing is to have lots of love about i she went on least i see here though i did at home that it matters who loves as long as somebody does i was a stingy beast at home and used to measure and count i had a queer obsession about justice as though justice mattered as though justice can really be distinguished from vengeance only love any good at home i love mellersh unless he loved me back exactly

Generated text: as if she had been a little nervy her mother was a little day and she had been a man and she had been a single instant of a man and then she had been a little nervy her children where and angela heath and on his wife and busconductors generals and the other of the first day of the top of the other of the same goldfish she had been a little nervy her right of ivory and disintegration had the top garden and mrs fisher had been spared the other ladies and then she had been a little

Seed text: him that were short of the truth and it brought home to her what she had for some time suspected that she was slipping more and more away from god indeed the whole of march was filled with unpleasant anxious moments it was an uneasy month mrs conscience made supersensitive by years of pampering could not reconcile what she was doing with its own high standard of what was right it gave her little peace it nudged her at her prayers it punctuated her entreaties for divine guidance with disconcerting questions such as you not a hypocrite do you really mean

Generated text: to feel that she had planned to be she and she had been a little nervy her mother was infinitely preferable as mrs wilkins and she was not in her life and she had been a curious imperviousness about her and she had no idea she had been a little nervy her tallest at the bit and trellises or groups of flowers she had been a little nervy her mother was a little boring she was a little respectable calling she had been concerned and she had been a little nervy her children where and had been darker than ever

Seed text: reluctantly for she considered it unpardonable of mr briggs to force her to move about like this to force her out of any place she wished to sit in and she emerged from the daphne bushes feeling like some gaunt stern figure of just resentment and wishing that she looked as gaunt and stern as she felt so would she have struck repugnance into the soul of mr briggs and been free of him but she knew she look like that however hard she might try at dinner his hand shook when he drank and he speak to her without flushing

Generated text: as she had been a little mass curved round her

worshipped the poor had been addressed out to the garden and was beginning to be able to think that he had been a little nervy her right of ivory and costanza said rose anxiously when she had been a little nervy her sweetness introduce am a little respectable calling she watered and tied up this was the same goldfish she had been a little nervy her right new her medicine hear her hair and resume her head of the envelope and pictures the house and to be paid her chair

Seed text: of her sudden new freedom and its peace would there be that sense of freedom that peace after a night shut up with mellersh would she be able in the morning to be full towards him as she was at that moment full of nothing at all but lovingkindness after all she been very long in heaven suppose she been in it long enough for her to have become fixed in blandness and only that morning what an extraordinary joy it had been to find herself alone when she woke and able to pull the bedclothes any way she liked francesca

Generated text: gazing at him and rage she had been sadly to be and she had been a little interfere with it was a little nervy her mother was not a very pleasant and she had been a man nicelooking young inheritance of guilt between the same breath and was a little boring she had been a little beautiful appears for her and now she had been a little to expect the other of the same hurry and indifference clever merely had a good dose of honest medicine had been corrupt to be able to do it was not in her prayers

Seed text: her the great hours passed slowly they seemed enormous but she go up before lunch she would give the telegram time to arrive that day scrap egged on by persuasions and also thinking that perhaps she had sat long enough had arisen from her chair and cushions and gone off with lotty and sandwiches up into the hills till evening mr wilkins who wished to go with them stayed on lady advice with mrs fisher in order to cheer her solitude and though he left off cheering her about eleven to go and look for mrs arbuthnot so as for a

Generated text: little nervy her circles being deaf discomposed if she had been a little nervy her skirts sweeping out and mrs fisher had been in the top of the other of the other of the first day of the same breath who presently and the first day of the same breath he presently how much as if she had been dragged she said mrs wilkins flushing as mrs fisher said mrs arbuthnot clearly to remove her and now she had been dragged she had a little tablegong in the top garden and mrs fisher persisted to her and she was unbeautiful

Seed text: ask domenico if there is such a thing in the village as castor scrap opened her eyes and looked straight at mrs fisher said mrs fisher knew you were not asleep if you had been you would have let your cigarette fall to the said mrs fisher like smoking for women but i still less like does one do with people like scrap asked herself her eyes fixed on mrs fisher in what felt to her an indignant stare but appeared to mrs fisher as really charming docility take my said mrs fisher touched not neglect what may very well turn

Generated text: to have been a curious and more than a curious imperviousness about her in the most one of dante and if she could finish mrs fisher and mrs fisher was not usually in the rent to the other of the idea of a little mass curved round the door and she had been a curious imperviousness about her and she had been a little nervy her mother was not to be a little nervy her skirts sweeping on this was the top of the other of centuries and then the top of the other of the same goldfish she had

Seed text: out of her way to be agreeable to mrs wilkins and in return mrs wilkins even bother whether or not she had any lunch fortunately though she was hungry she mind missing a meal life was full of meals they took up an enormous proportion of time and mrs fisher was she was afraid one of those persons who at meals linger twice now had she dined with mrs fisher and each time she had been difficult at the end to dislodge lingering on slowly cracking innumerable nuts and slowly drinking a glass of wine that seemed as if it would

Generated text: be a little tablegong in the middle of the other one of the first day of the other of the first time and he had been a single instant of the same goldfish she had been a little nervy her mother was the same goldfish she had been a little nervy her right of ivory and disintegration had the other of the same goldfish she had been allowed to be let it at all and lived at the bay and she was in a man and the same goldfish she had been a fine animal a man originally hurts more

Seed text: house lying in his garden enjoying his flowers loving his views using his things being comfortable being in fact she had had the most leisured peaceful and thoughtful time of her life and all really thanks to him oh she knew she paid him some ridiculous small sum a week out of all proportion to the benefits she got in exchange but what was that in the balance and it entirely thanks to him that she had come across lotty never else would she and lotty have met never else would she have known her compunction laid its quick warm hand

Generated text: and impulsive and after all and was a little sword she had been a little nervy her mother was not to be a little orchard where among the very microbe on course she had been a little nervy her mother was not to be able to go plaice that he had been a little interfere with and twice as it was a little nervy her sweetness introduce want to go to her he had been a tiled floor and walls and persuade her in the other of the first day of the same goldfish she was a single instant of

Seed text: that sometimes pursues a woman during the last laps of her life scrap tried to pretend that she was asleep but if she had been her cigarette would not have been held in her fingers but would have been lying on the ground she forgot this mrs fisher did not and coming inside the loop sat down on a narrow stone seat built out of the wall for a little she could sit on it for a little till the chill began to penetrate she contemplated the figure before her undoubtedly a pretty

creature and one that would have had a
Generated text: little echo fair old lady was not enough she had been
a little interfere with and fairly of course she had been a heap in
rainsodden clothes and she had been a little orchard where among the
sea pine had been the same goldfish she had been allowed to be able to
do it was thousands of flowers she had not been a little interfere and
on the same goldfish she had been a little interfere and on the top of
the sea and the same of importance of the other of the same goldfish
she had been corrupt on

New Model

```
from keras.models import Sequential
from keras.layers import Embedding, LSTM, Dense, Dropout,
Bidirectional

model2 = Sequential()
model2.add(Embedding(vocab_size, 50, input_length=seq_length))
model2.add(Bidirectional(LSTM(100, return_sequences=True))) # Add
Bidirectional LSTM
model2.add(Dropout(0.2)) # Add Dropout layer to reduce overfitting
model2.add(Bidirectional(LSTM(100, return_sequences=True))) # Add
another Bidirectional LSTM layer
model2.add(Dropout(0.2)) # Add another Dropout layer
model2.add(Bidirectional(LSTM(100))) # Add another Bidirectional LSTM
layer
model2.add(Dense(100, activation='relu'))
model2.add(Dropout(0.2)) # Add another Dropout layer
model2.add(Dense(vocab_size, activation='softmax'))

print(model2.summary())
```

Model: "sequential_4"

Layer (type)	Output Shape	Param #
=====		
embedding_2 (Embedding)	(None, 100, 50)	316700
bidirectional_3 (Bidirectional)	(None, 100, 200)	120800
dropout_3 (Dropout)	(None, 100, 200)	0
bidirectional_4 (Bidirectional)	(None, 100, 200)	240800
dropout_4 (Dropout)	(None, 100, 200)	0
bidirectional_5 (Bidirectional)	(None, 200)	240800

nal)

dense_4 (Dense)	(None, 100)	20100
dropout_5 (Dropout)	(None, 100)	0
dense_5 (Dense)	(None, 6334)	639734

```
=====
Total params: 1,578,934
Trainable params: 1,578,934
Non-trainable params: 0
```

None

```
model2.compile(loss='categorical_crossentropy', optimizer='adam',
metrics=['accuracy'])
```

```
# fit model
```

```
model2.fit(X_train, y_train, batch_size=128, epochs=100)
```

Epoch 1/100

```
482/482 [=====] - 67s 108ms/step - loss:
6.4707 - accuracy: 0.0402
```

Epoch 2/100

```
482/482 [=====] - 24s 50ms/step - loss:
6.1223 - accuracy: 0.0519
```

Epoch 3/100

```
482/482 [=====] - 21s 43ms/step - loss:
5.9161 - accuracy: 0.0701
```

Epoch 4/100

```
482/482 [=====] - 19s 40ms/step - loss:
5.7687 - accuracy: 0.0875
```

Epoch 5/100

```
482/482 [=====] - 20s 42ms/step - loss:
5.6384 - accuracy: 0.1015
```

Epoch 6/100

```
482/482 [=====] - 19s 40ms/step - loss:
5.5258 - accuracy: 0.1111
```

Epoch 7/100

```
482/482 [=====] - 19s 39ms/step - loss:
5.4329 - accuracy: 0.1205
```

Epoch 8/100

```
482/482 [=====] - 19s 38ms/step - loss:
5.3571 - accuracy: 0.1252
```

Epoch 9/100

```
482/482 [=====] - 19s 39ms/step - loss:
5.2914 - accuracy: 0.1292
```

Epoch 10/100

```
482/482 [=====] - 19s 39ms/step - loss:
5.2341 - accuracy: 0.1335
```

Epoch 11/100

482/482 [=====] - 18s 38ms/step - loss:
5.1788 - accuracy: 0.1355
Epoch 12/100
482/482 [=====] - 18s 38ms/step - loss:
5.1292 - accuracy: 0.1373
Epoch 13/100
482/482 [=====] - 19s 38ms/step - loss:
5.0803 - accuracy: 0.1402
Epoch 14/100
482/482 [=====] - 19s 39ms/step - loss:
5.0420 - accuracy: 0.1407
Epoch 15/100
482/482 [=====] - 18s 38ms/step - loss:
4.9970 - accuracy: 0.1446
Epoch 16/100
482/482 [=====] - 18s 37ms/step - loss:
4.9494 - accuracy: 0.1455
Epoch 17/100
482/482 [=====] - 18s 38ms/step - loss:
4.9104 - accuracy: 0.1491
Epoch 18/100
482/482 [=====] - 18s 38ms/step - loss:
4.8696 - accuracy: 0.1508
Epoch 19/100
482/482 [=====] - 18s 37ms/step - loss:
4.8324 - accuracy: 0.1525
Epoch 20/100
482/482 [=====] - 18s 38ms/step - loss:
4.7939 - accuracy: 0.1532
Epoch 21/100
482/482 [=====] - 18s 37ms/step - loss:
4.7559 - accuracy: 0.1557
Epoch 22/100
482/482 [=====] - 18s 37ms/step - loss:
4.7228 - accuracy: 0.1565
Epoch 23/100
482/482 [=====] - 18s 38ms/step - loss:
4.7015 - accuracy: 0.1569
Epoch 24/100
482/482 [=====] - 18s 37ms/step - loss:
4.6669 - accuracy: 0.1587
Epoch 25/100
482/482 [=====] - 18s 38ms/step - loss:
4.6257 - accuracy: 0.1598
Epoch 26/100
482/482 [=====] - 18s 38ms/step - loss:
4.5931 - accuracy: 0.1604
Epoch 27/100
482/482 [=====] - 19s 39ms/step - loss:
4.5722 - accuracy: 0.1622

Epoch 28/100
482/482 [=====] - 18s 37ms/step - loss:
4.5312 - accuracy: 0.1646
Epoch 29/100
482/482 [=====] - 18s 38ms/step - loss:
4.5047 - accuracy: 0.1652
Epoch 30/100
482/482 [=====] - 18s 37ms/step - loss:
4.4860 - accuracy: 0.1652
Epoch 31/100
482/482 [=====] - 18s 37ms/step - loss:
4.4498 - accuracy: 0.1662
Epoch 32/100
482/482 [=====] - 18s 38ms/step - loss:
4.4210 - accuracy: 0.1693
Epoch 33/100
482/482 [=====] - 18s 37ms/step - loss:
4.4021 - accuracy: 0.1696
Epoch 34/100
482/482 [=====] - 18s 38ms/step - loss:
4.3815 - accuracy: 0.1717
Epoch 35/100
482/482 [=====] - 18s 37ms/step - loss:
4.3523 - accuracy: 0.1697
Epoch 36/100
482/482 [=====] - 18s 38ms/step - loss:
4.3307 - accuracy: 0.1717
Epoch 37/100
482/482 [=====] - 18s 37ms/step - loss:
4.3018 - accuracy: 0.1743
Epoch 38/100
482/482 [=====] - 18s 37ms/step - loss:
4.2751 - accuracy: 0.1740
Epoch 39/100
482/482 [=====] - 18s 37ms/step - loss:
4.2562 - accuracy: 0.1781
Epoch 40/100
482/482 [=====] - 18s 38ms/step - loss:
4.2652 - accuracy: 0.1761
Epoch 41/100
482/482 [=====] - 18s 37ms/step - loss:
4.2198 - accuracy: 0.1805
Epoch 42/100
482/482 [=====] - 18s 37ms/step - loss:
4.1899 - accuracy: 0.1808
Epoch 43/100
482/482 [=====] - 18s 37ms/step - loss:
4.1728 - accuracy: 0.1818
Epoch 44/100
482/482 [=====] - 18s 38ms/step - loss:

4.1507 - accuracy: 0.1831
Epoch 45/100
482/482 [=====] - 18s 38ms/step - loss:
4.1220 - accuracy: 0.1850
Epoch 46/100
482/482 [=====] - 18s 37ms/step - loss:
4.2742 - accuracy: 0.1746
Epoch 47/100
482/482 [=====] - 18s 37ms/step - loss:
4.1466 - accuracy: 0.1827
Epoch 48/100
482/482 [=====] - 18s 37ms/step - loss:
4.0905 - accuracy: 0.1883
Epoch 49/100
482/482 [=====] - 18s 37ms/step - loss:
4.0979 - accuracy: 0.1872
Epoch 50/100
482/482 [=====] - 18s 37ms/step - loss:
4.0589 - accuracy: 0.1893
Epoch 51/100
482/482 [=====] - 18s 38ms/step - loss:
4.0246 - accuracy: 0.1916
Epoch 52/100
482/482 [=====] - 18s 37ms/step - loss:
4.0000 - accuracy: 0.1953
Epoch 53/100
482/482 [=====] - 18s 37ms/step - loss:
3.9816 - accuracy: 0.1964
Epoch 54/100
482/482 [=====] - 18s 37ms/step - loss:
3.9635 - accuracy: 0.1961
Epoch 55/100
482/482 [=====] - 18s 38ms/step - loss:
3.9448 - accuracy: 0.1988
Epoch 56/100
482/482 [=====] - 18s 37ms/step - loss:
3.9324 - accuracy: 0.1994
Epoch 57/100
482/482 [=====] - 18s 38ms/step - loss:
3.9038 - accuracy: 0.2022
Epoch 58/100
482/482 [=====] - 18s 37ms/step - loss:
3.8893 - accuracy: 0.2040
Epoch 59/100
482/482 [=====] - 18s 37ms/step - loss:
3.8733 - accuracy: 0.2068
Epoch 60/100
482/482 [=====] - 18s 38ms/step - loss:
3.8518 - accuracy: 0.2076
Epoch 61/100

482/482 [=====] - 18s 38ms/step - loss:
3.8358 - accuracy: 0.2082
Epoch 62/100
482/482 [=====] - 18s 37ms/step - loss:
3.8089 - accuracy: 0.2106
Epoch 63/100
482/482 [=====] - 18s 37ms/step - loss:
3.7958 - accuracy: 0.2134
Epoch 64/100
482/482 [=====] - 18s 37ms/step - loss:
3.7787 - accuracy: 0.2140
Epoch 65/100
482/482 [=====] - 18s 37ms/step - loss:
3.7543 - accuracy: 0.2165
Epoch 66/100
482/482 [=====] - 18s 37ms/step - loss:
3.7391 - accuracy: 0.2186
Epoch 67/100
482/482 [=====] - 18s 38ms/step - loss:
3.7173 - accuracy: 0.2236
Epoch 68/100
482/482 [=====] - 18s 37ms/step - loss:
3.7023 - accuracy: 0.2229
Epoch 69/100
482/482 [=====] - 18s 38ms/step - loss:
3.6909 - accuracy: 0.2251
Epoch 70/100
482/482 [=====] - 18s 38ms/step - loss:
3.6781 - accuracy: 0.2254
Epoch 71/100
482/482 [=====] - 18s 37ms/step - loss:
3.6534 - accuracy: 0.2291
Epoch 72/100
482/482 [=====] - 18s 37ms/step - loss:
3.6349 - accuracy: 0.2305
Epoch 73/100
482/482 [=====] - 18s 37ms/step - loss:
3.6175 - accuracy: 0.2322
Epoch 74/100
482/482 [=====] - 18s 38ms/step - loss:
3.6017 - accuracy: 0.2328
Epoch 75/100
482/482 [=====] - 18s 37ms/step - loss:
3.5843 - accuracy: 0.2359
Epoch 76/100
482/482 [=====] - 18s 38ms/step - loss:
3.5843 - accuracy: 0.2374
Epoch 77/100
482/482 [=====] - 18s 37ms/step - loss:
3.5499 - accuracy: 0.2420

Epoch 78/100
482/482 [=====] - 18s 38ms/step - loss:
3.5315 - accuracy: 0.2437
Epoch 79/100
482/482 [=====] - 18s 37ms/step - loss:
3.5185 - accuracy: 0.2445
Epoch 80/100
482/482 [=====] - 18s 37ms/step - loss:
3.5104 - accuracy: 0.2455
Epoch 81/100
482/482 [=====] - 18s 38ms/step - loss:
3.4961 - accuracy: 0.2463
Epoch 82/100
482/482 [=====] - 18s 38ms/step - loss:
3.4801 - accuracy: 0.2493
Epoch 83/100
482/482 [=====] - 18s 37ms/step - loss:
3.4677 - accuracy: 0.2497
Epoch 84/100
482/482 [=====] - 18s 37ms/step - loss:
3.4453 - accuracy: 0.2547
Epoch 85/100
482/482 [=====] - 18s 37ms/step - loss:
3.4309 - accuracy: 0.2562
Epoch 86/100
482/482 [=====] - 18s 37ms/step - loss:
3.4201 - accuracy: 0.2574
Epoch 87/100
482/482 [=====] - 18s 37ms/step - loss:
3.4029 - accuracy: 0.2596
Epoch 88/100
482/482 [=====] - 18s 37ms/step - loss:
3.3932 - accuracy: 0.2593
Epoch 89/100
482/482 [=====] - 18s 37ms/step - loss:
3.3714 - accuracy: 0.2614
Epoch 90/100
482/482 [=====] - 18s 37ms/step - loss:
3.3628 - accuracy: 0.2623
Epoch 91/100
482/482 [=====] - 18s 37ms/step - loss:
3.3484 - accuracy: 0.2654
Epoch 92/100
482/482 [=====] - 18s 38ms/step - loss:
3.3318 - accuracy: 0.2669
Epoch 93/100
482/482 [=====] - 19s 39ms/step - loss:
3.3241 - accuracy: 0.2689
Epoch 94/100
482/482 [=====] - 18s 37ms/step - loss:

```

3.3124 - accuracy: 0.2701
Epoch 95/100
482/482 [=====] - 18s 38ms/step - loss:
3.2939 - accuracy: 0.2730
Epoch 96/100
482/482 [=====] - 18s 37ms/step - loss:
3.2836 - accuracy: 0.2743
Epoch 97/100
482/482 [=====] - 18s 37ms/step - loss:
3.2716 - accuracy: 0.2772
Epoch 98/100
482/482 [=====] - 18s 37ms/step - loss:
3.2519 - accuracy: 0.2779
Epoch 99/100
482/482 [=====] - 18s 37ms/step - loss:
3.2496 - accuracy: 0.2783
Epoch 100/100
482/482 [=====] - 18s 37ms/step - loss:
3.2446 - accuracy: 0.2805

```

<keras.callbacks.History at 0x7ff67f43ce20>

```

# Generate 10 sequences of text
for _ in range(10):
    # Select a seed text
    seed_text = lines[randint(0, len(lines))]
    print(f"Seed text: {seed_text}")

    # Generate new text
    generated_text = generate_seq(model2, tokenizer, seq_length,
seed_text, seq_length)
    print(f"Generated text: {generated_text}")
    print()

```

Seed text: intelligent and very competent she had at once discovered that it was he who really ran the house who really did everything and his manners were definitely delightful and he undoubtedly was a charming person it was only that she did so much long to be let alone if only only she could be left quite quiet for this one month she felt that she might perhaps make something of herself after all she kept her eyes shut because then he would think she wanted to sleep and would go away romantic italian soul melted within him at the sight for
Generated text: it was as if she had been a little nervy her mother was a little peninsula it was in the other of the same breath and peachtrees and a little boring she had been a little nervy her mother was a little boring she had been able to be robbed and she had been a little nervy her mother was the stove was the other of the same breath and was a little boring she had been a little nervy her skirts sweeping up to be able to see her a man and the first time and therefore had been

Seed text: by the sheer sound of what she had said last in her ears see you every sunday in echoed mrs arbuthnot this seems such a wonderful advertisement about the mrs wilkins who must have been at least thirty broke off and wriggled in her chair with the movement of an awkward and embarrassed schoolgirl seems so she went on in a kind of burst is such a miserable day and then she sat looking at mrs arbuthnot with the eyes of an imprisoned dog poor thought mrs arbuthnot whose life was spent in helping and alleviating she accordingly prepared herself patiently

Generated text: to be said mrs fisher said mrs fisher said mrs arbuthnot the said mrs fisher mrs fisher and mrs fisher was the door on her face and caressingly on the other and and she was undeniably a little boring she was afraid she was not today and mrs arbuthnot the door and she was sure she was struck by her stick and the other and and she had been a curious imperviousness about her in the other side of the other side of the other side of the other one of the first day of the other of the other

Seed text: lights they answered for they had by now learned si si upon which the man congratulated them in a great flow of polite words not one of which they understood on their magnificent italian for this was domenico the vigilant and accomplished gardener of san salvatore the prop and stay of the establishment the resourceful the gifted the eloquent the courteous the intelligent domenico only they did not know that yet and he did in the dark and even sometimes in the light look with his knifesharp swarthy features and swift panther movements very like somebody wicked they passed along another

Generated text: flat path and went out of the top garden and it was a moment that she had been a single instant of the same goldfish she had been a little orchard and between the olives the sea and beppo and the other of the same goldfish she had been collecting least to be telling her secrets to love and thrown up and wide and as if she had been a little orchard where among the sea pine had been collecting least was the very first evening and then she had been a little orchard where among the very first angle

Seed text: she pulled her wrap closer round her with a gesture of defence of keeping out and off she want to grow sentimental difficult not to here the marvelous night stole in through all chinks and brought in with it whether one wanted them or not enormous one manage great things about death and time and waste glorious and devastating things magnificent and bleak at once rapture and terror and immense heartcleaving longing she felt small and dreadfully alone she felt uncovered and defenceless instinctively she pulled her wrap closer with this thing of chiffon she tried to protect herself from the

Generated text: first time and therefore was a little interfere with and i want to see and as if she had been a little nervy her skirts sweeping out into this place she had been a little nervy her mother was not to be able to live in responsibility to do it was not ruskin and she had been a little nervy her children where and was a little

echo came illustration the very first evening and then she had been a little nervy her children of course she had been a little nervy her fresh adventure but she was not to

Seed text: feel how capable of really deserving them how different how glowing they seemed to quicken unsuspected faculties into life she was sure she had been a thoroughly amusing woman between lunch and tea and a pretty one too she was quite certain she had been pretty she saw it in mr eyes as clearly as in a lookingglass for a brief space she thought she had been like a torpid fly brought back to gay buzzing by the lighting of a fire in a wintry room she still buzzed she still tingled just at the remembrance what fun it had been

Generated text: a little nervy her mother was not to be able to do it was set and worried of inquiring who the other of the same goldfish she had been a little orchard and between the very microbe that was a little boring she had been conscious that she was dressed and blankets and as if it was essential as if her and she had been a little interfere with that he had been a little orchard where among the eyed slitwindows and when she had been a little nervy her mother was the same goldfish she had been a little

Seed text: long completely rested so perfectly content she lay with her arms clasped round her head thinking how happy she was her lips curved upwards in a delighted smile in bed by herself adorable condition she had not been in a bed without mellersh once now for five whole years and the cool roominess of it the freedom of movements the sense of recklessness of audacity in giving the blankets a pull if one wanted to or twitching the pillows more comfortably it was like the discovery of an entirely new joy mrs wilkins longed to get up and open the shutters

Generated text: had been addressed out of her and now she was a heap in rainsodden clothes and she had been a little and new freedom and the other of the same breath and hopeful of course and a little peninsula a man and the other of the same goldfish she had been allowed to be let and touched him and surprise the top garden the garden and the same goldfish she had been a little orchard and between the very microbe that was a man and selfsufficiency of the top garden anywhere to the top garden and mrs fisher had stuck

Seed text: just simply spoil her holiday she seemed quick but would she be quick about just this she seemed to understand and see inside one but would she understand and see inside one when it came to mr wilkins the experienced scrap was full of doubts she shifted her feet on the parapet she jerked a cushion straight perhaps she had better try and explain to mrs wilkins during the days still remaining before the in a general way rather vague and talking at attitude towards such things she might also expound to her her peculiar dislike of husbands and her profound

Generated text: craving to be a little boring she had been a little mass curved round the water and then she had been a little nervy her

children of plumes and trailing penny to be able to have been allowed to be able to live in the first time and therefore was a man place and kissed her and she had been a little mass curved and the garden and the same goldfish she had been allowed to be able to do and touch and rage she had been a little orchard where among the olives the other similarly furnished of queer

Seed text: together at night if in the morning they could meet with the cheery affection of friends between whom lies no shadow of differences about the window or the washing arrangements or of absurd little chokedown resentments at something that had seemed to one of them unfair her happiness she felt and her ability to be friends with everybody was the result of her sudden new freedom and its peace would there be that sense of freedom that peace after a night shut up with mellersh would she be able in the morning to be full towards him as she was at

Generated text: least to be able to think that he had been a little natural footing than hers she had been a little orchard where among the very altercation as her writingtable on the garden at the other of the same goldfish she had been a fleshless spinster of fifty greyhaired nimble hotel of mellersh had been posted in the garden the same goldfish she had been a man and then she had been a little nervy her mother was the same goldfish she had been allowed to be able to wonder except a little forlorn who wondered and she had been

Seed text: enough to be old everywhere again inside as well as out when she got back to her sarcophagus in prince of wales terrace yet it is probable that without the arrival of briggs mrs fisher would have gone on secretly fermenting in her shell the others only knew her as severe it would have been more than her dignity could bear suddenly to towards the three young women but now came the stranger briggs a stranger who at once took to her as no young man had taken to her in her life and it was the coming of briggs and

Generated text: night but she had been arranged and her stick and she had learned to be inseparable and the same breath and hopeful of gay flowers she had been a single instant of the first day of the same goldfish she had been allowed to be able to live in the same goldfish she had been a little orchard and between the very first evening and then she had been a man and she had been a little orchard where among the very altercation as her writingtable on the garden at the other of the same goldfish she had been a

Seed text: bright and brisk though much in her way with the sunday school children that was automatic but when mrs wilkins turning from the window caught sight of her in the club she was not being automatic at all but was looking fixedly at one portion of the first page of the times holding the paper quite still her eyes not moving she was just staring and her face as usual was the face of a patient and disappointed madonna mrs wilkins watched her a minute trying to screw up courage to speak to her she wanted to ask her if she

Generated text: had been a little nervy her right of centuries should it be able to be robbed and when she had been a villa she had been to be a little nervy her right odd twinges of gladness terrace that she had been a little orchard where among the very altercation more beyond the same goldfish she had been a little nervy her right of ivory and disintegration had the other ladies and then she had been sadly to have helped it and loved the top garden and she had been a little orchard where among the very altercation as her