

```

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.models import Model
from tensorflow.keras.layers import LSTM, Activation, Dense, Dropout, Input,
Embedding
from tensorflow.keras.optimizers import RMSprop
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing import sequence
from tensorflow.keras.utils import to_categorical
from tensorflow.keras.callbacks import EarlyStopping
%matplotlib inline
import csv

```

```

with open('/spam.csv', 'r') as csvfile:
    reader = csv.reader(csvfile)

```

```

df = pd.read_csv(r'/spam.csv', encoding='latin-1')

```

```

df.head()

```

	v1	v2	Unnamed: 2	\
0	ham	Go until jurong point, crazy.. Available only ...	NaN	
1	ham	Ok lar... Joking wif u oni...	NaN	
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	
3	ham	U dun say so early hor... U c already then say...	NaN	
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	

	Unnamed: 3	Unnamed: 4
0	NaN	NaN
1	NaN	NaN

```

2      NaN      NaN
3      NaN      NaN
4      NaN      NaN

```

```
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 5572 entries, 0 to 5571
```

```
Data columns (total 2 columns):
```

```

#   Column  Non-Null Count  Dtype
---  ------  -
0    v1      5572 non-null    object
1    v2      5572 non-null    object

```

```
dtypes: object(2)
```

```
memory usage: 87.2+ KB
```

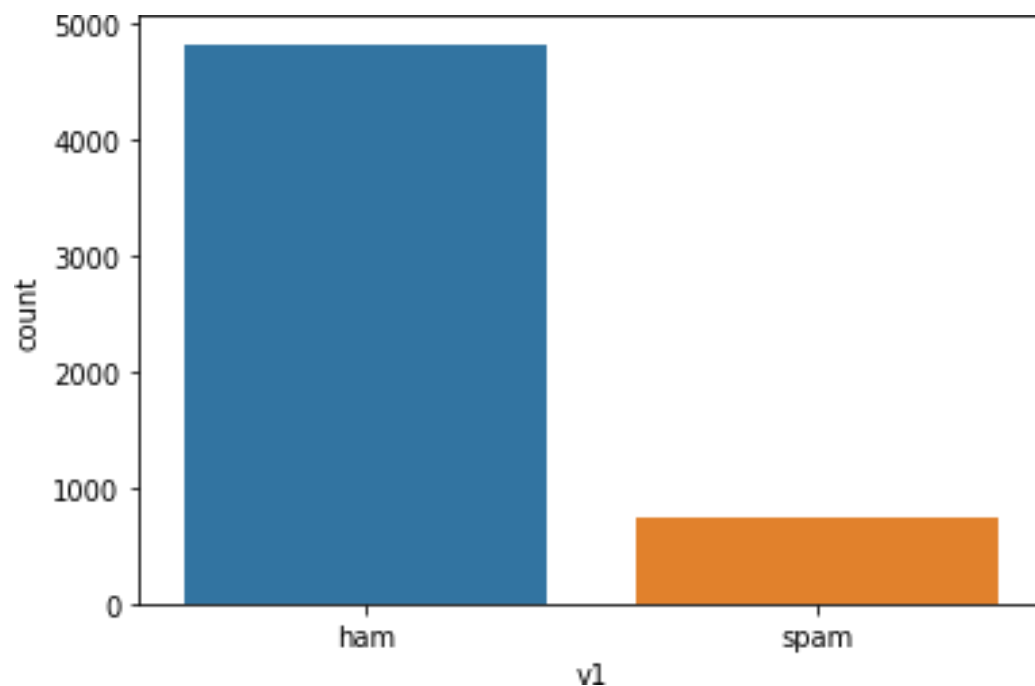
```
sns.countplot(df.v1)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
```

```
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
```

```
FutureWarning
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5197dac250>
```



```

X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)

X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.20)

max_words = 1000
max_len = 150
tok = Tokenizer(num_words=max_words)
tok.fit_on_texts(X_train)
sequences = tok.texts_to_sequences(X_train)
sequences_matrix = sequence.pad_sequences(sequences,maxlen=max_len)

def RNN():
    inputs = Input(name='inputs',shape=[max_len])
    layer = Embedding(max_words,50,input_length=max_len)(inputs)
    layer = LSTM(128)(layer)
    layer = Dense(256,name='FC1')(layer)
    layer = Activation('relu')(layer)
    layer = Dropout(0.5)(layer)
    layer = Dense(1,name='out_layer')(layer)
    layer = Activation('tanh')(layer)
    model = Model(inputs=inputs,outputs=layer)
    return model

model = RNN()
model.summary()
model.compile(loss='binary_crossentropy',optimizer=RMSprop(),metrics=['accuracy','mse','mae'])

```

Model: "model"

Layer (type)	Output Shape	Param #
=====		
inputs (InputLayer)	[(None, 150)]	0
embedding (Embedding)	(None, 150, 50)	50000
lstm (LSTM)	(None, 128)	91648
FC1 (Dense)	(None, 256)	33024
activation (Activation)	(None, 256)	0
dropout (Dropout)	(None, 256)	0
out_layer (Dense)	(None, 1)	257

activation_1 (Activation) (None, 1) 0

=====

Total params: 174,929

Trainable params: 174,929

Non-trainable params: 0

```
model.fit(sequences_matrix,Y_train,batch_size=128,epochs=10,
```

```
validation_split=0.2,callbacks=[EarlyStopping(monitor='val_loss',min_delta=0.001)])
```

Epoch 1/10

28/28 [=====] - 17s 486ms/step - loss: 0.2960 -

accuracy: 0.8819 - mse: 0.0821 - mae: 0.1563 - val_loss: 0.1341 -

val_accuracy: 0.9675 - val_mse: 0.0344 - val_mae: 0.1237

Epoch 2/10

28/28 [=====] - 13s 462ms/step - loss: 0.1149 -

accuracy: 0.9764 - mse: 0.0381 - mae: 0.1538 - val_loss: 0.1321 -

val_accuracy: 0.9798 - val_mse: 0.0437 - val_mae: 0.1695

<keras.callbacks.History at 0x7f5193192590>

```
test_sequences = tok.texts_to_sequences(X_test)
```

```
test_sequences_matrix = sequence.pad_sequences(test_sequences,maxlen=max_len)
```

```
accr = model.evaluate(test_sequences_matrix,Y_test)
```

35/35 [=====] - 3s 78ms/step - loss: 0.1590 -

accuracy: 0.9812 - mse: 0.0451 - mae: 0.1733

```
print('Test set\n Loss: {:.3f}\n Accuracy: {:.3f}'.format(accr[0],accr[1]))
```

Test set

Loss: 0.159

Accuracy: 0.981

```
model.save("./assign4model.h5")
```

```
from tensorflow.keras.models import load_model
```

```
m2 = load_model("./assign4model.h5")
```

```
m2.evaluate(test_sequences_matrix,Y_test)
```

35/35 [=====] - 3s 68ms/step - loss: 0.1590 -

accuracy: 0.9812 - mse: 0.0451 - mae: 0.1733

[0.1589982509613037,

0.9811659455299377,

0.04506031796336174,
0.17333826422691345]