Dataset

WiLI-2018, the Wikipedia language identification benchmark dataset, contains 235000 paragraphs of 235 languages. Each language in this dataset contains 1000 rows/paragraphs. The following is the subset of dataset used:

• English • Arabic • French • Hindi • Urdu • Portuguese • Persian • Pushto • Spanish • Korean • Tamil • Turkish • Estonian • Russian • Romanian • Chinese • Swedish • Latin • Indonesian • Dutch • Japanese • Thai

https://www.kaggle.com/zarajamshaid/language-identification-datasst

Importing the libraries

```
import pandas as pd # Pandas
import numpy as np # Numpy
import re # Regular Expressions
import seaborn as sns # Seaborn
import matplotlib.pyplot as plt # Matplotlib
```

+ Code + Text

Loading the dataset from drive location

```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Mounted at /content/gdrive
```

```
cd /content/gdrive/MyDrive/NLP/Language Identification
```

```
/content/gdrive/MyDrive/NLP/Language Identification
```

Dataset Inspection

```
data = pd.read_csv("dataset.csv")
data.head(10)
```

	Text	language
0	klement gottwaldi surnukeha palsameeriti ning ...	Estonian
1	sebes joseph pereira thomas på eng the jesuit...	Swedish
2	ถนนเจริญกรุง อักษรโรมัน thanon charoen krung เ...	Thai
3	விசாகப்பட்டினம் தமிழ்ச்சங்கத்தை இந்துப் பத்திர...	Tamil
4	de spons behoort tot het geslacht haliclona en...	Dutch
5	エノが行きがかりでバスに乗ってしまい、気分が悪くなった際に助けるが、今すぐバスを降りたいと運...	Japanese
6	tsutinalar İngilizce tsuutina kanadada albert...	Turkish
7	müller mox figura centralis circulorum doctoru...	Latin
8	برقی بار electric charge تمام زیرجوہری ذرات کی...	Urdu
9	シャーリー・フィールドは、サン・ベルナルド・アベニュー沿い市民センターとrtマーティン高校に...	Japanese

Checking different unique languages in the dataset

```
lang = np.array(pd.unique(data['language']))
print("Total number of langauges:", len(lang))
print("Languages in the dataset:", lang)
```

```
Total number of langauges: 22
Languages in the dataset: ['Estonian' 'Swedish' 'Thai' 'Tamil' 'Dutch' 'Japanese' 'Turkish' 'Latin'
 'Urdu' 'Indonesian' 'Portugese' 'French' 'Chinese' 'Korean' 'Hindi'
 'Spanish' 'Pushto' 'Persian' 'Romanian' 'Russian' 'English' 'Arabic']
```

Checking the count of each language in the dataset

```
data['language'].value_counts()
```

```
Turkish       1000
Urdu          1000
Swedish       1000
Pushto        1000
Chinese       1000
Romanian      1000
Latin         1000
Estonian      1000
Arabic        1000
```

```
Portugese     1000
Dutch         1000
Hindi         1000
Korean        1000
Japanese      1000
French        1000
Thai          1000
Tamil         1000
Russian       1000
English       1000
Spanish       1000
Persian       1000
Indonesian    1000
Name: language, dtype: int64
```

Preprocessing the dataset

```
def data_preprocess(text):
  # Removing numbers and symbols
  text = re.sub(r'[!@#$()-_,n"%^*?:;~`0-9]', ' ', text)
  text = re.sub(r'[[]]', ' ', text)
  # Lowercasing the text
  text = text.lower()
  return text
```

```
i = 0
# Looping over all the
for text in data['Text']:
  # Updating with the preprocessed dataset
  data['Text'][i] = data_preprocess(text)
  i += 1
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:4: FutureWarning: Possible nested set at position 1
  after removing the cwd from sys.path.
```

Splitting the dataset into train, validation and test sets

```
import math # math library

# Fraction of training examples
train_split = 0.6
# Fraction of testing examples
validation_split = 0.2

# Length of the dataset
length = len(data)

# Splitting the dataset
range1 = math.floor(0.6*length)
range2 = math.floor(0.6*length) + math.floor(0.2*length)
training_data = data[:range1]
validation_data =  data[range1: range2]
testing_data = data[range2:]

# Size of train, validation and test dataset
print("Training data length: ", len(training_data))
print("Validation data length: ", len(validation_data))
print("Testing data length: ",len(testing_data))
```

```
Training data length:  13200
Validation data length:  4400
Testing data length:  4400
```

Getting the n-grams from the dataset

The lower and upper boundary of the range of n-values for different word n-grams or char n-grams to be extracted. All values of n such such that min_n <= n <= max_n will be used. For example an ngram_range of (1, 1) means only unigrams, (1, 2) means unigrams and bigrams, and (2, 2) means only bigrams. n-feat represents number of most important n-gram features to be extracted from corpus.

```
# Import CountVectorizer object
from sklearn.feature_extraction.text import CountVectorizer

# Function to extract n-grams
def get_n_grams(corpus, n_feat, min_n, max_n):
    #fit the n-gram model
    vectorizer = CountVectorizer(analyzer = 'char',
                                 ngram_range = (min_n, max_n),
                                 max_features = n_feat)
    # Train vectorizer on given corpus
    X = vectorizer.fit_transform(corpus)
    # Get model feature names
    feature_names = vectorizer.get_feature_names()
    return feature_names
```

Building the vocabulary

The following are changeable hyperparameters:

1. n_feat = 200 # No of n-grams to be extracted from single language
2. min_n = 3 # min n-gram
3. max_n = 3 # max n-gram

```
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#obtain n-grams from each language
features_set = set()
lang = pd.unique(training_data['language'])
for l in lang:
    # get corpus filtered by language
    corpus = data[data.language==l]['Text']
    # get n_feat most frequent trigrams
    trigrams = get_n_grams(corpus, n_feat, min_n, max_n)
    # add to set
    features_set.update(trigrams)

#create vocabulary list using feature set
vocab = dict()
for i,f in enumerate(features_set):
    vocab[f]=i
```

Length of vocabulary

```
vocab_length = len(vocab)
print(vocab_length)
```

```
2845
```

Creating feature matrix for training, validation and text data

```
#train count vectoriser using vocabulary
vectorizer = CountVectorizer(analyzer='char',
                             ngram_range=(3, 3),
                             vocabulary=vocab)

#create feature matrix for training set
corpus = training_data['Text']
X = vectorizer.fit_transform(corpus)
feature_names = vectorizer.get_feature_names()
training_feat = pd.DataFrame(data=X.toarray(),columns=feature_names)

#Scale feature matrix
train_min = training_feat.min()
train_max = training_feat.max()
training_feat = (training_feat - train_min)/(train_max-train_min)

#Add target variable
training_feat['language'] = list(training_data['language'])

#create feature matrix for validation set
corpus = validation_data['Text']
X = vectorizer.fit_transform(corpus)

validation_feat = pd.DataFrame(data=X.toarray(),columns=feature_names)
validation_feat = (validation_feat - train_min)/(train_max-train_min)
validation_feat['language'] = list(validation_data['language'])

#create feature matrix for test set
corpus = testing_data['Text']
X = vectorizer.fit_transform(corpus)

testing_feat = pd.DataFrame(data=X.toarray(),columns=feature_names)
testing_feat = (testing_feat - train_min)/(train_max-train_min)
testing_feat['language'] = list(testing_data['language'])
```

```
training_feat.shape
```

```
(13200, 2846)
```

```
validation_feat.shape
```

```
(4400, 2846)
```

```
testing_feat.shape
```

```
(4400, 2846)
```

Encode the target vector

```
from sklearn.preprocessing import LabelEncoder
from keras.utils import np_utils

#Fit encoder
encoder = LabelEncoder()
encoder.fit(lang)

def encode(y):
    y_encoded = encoder.transform(y)
    y_dummy = np_utils.to_categorical(y_encoded)
    return y_dummy
```

Building and training the DNN

```
# Importing keras
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Dropout

#Get training data
x = training_feat.drop('language',axis=1)
y = encode(training_feat['language'])
x_val = validation_feat.drop('language',axis=1)
y_val = encode(validation_feat['language'])

#Define model
model = Sequential()
#input dimension is the length of vocabulary
model.add(Dense(512, input_dim=vocab_length, activation='relu'))
model.add(Dense(256, activation='relu'))
model.add(Dense(256, activation='relu'))
# Output dimension is the length of total number of target languages
model.add(Dense(len(lang), activation='softmax'))
model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

Training the model

Hyperparameters:

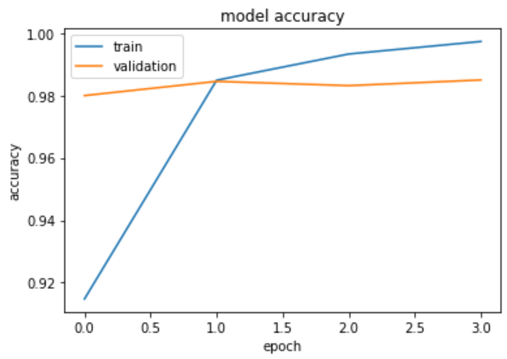
1. epochs : No of times dataset is passed forward and backward through the neural network.
2. batch_size : The number of examples in a batch.

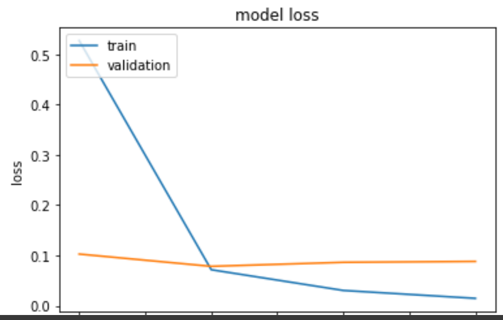
```
epochs = 4 # No of times dataset is passed forward and backward through the neural network
batch_size = 100 # The number of examples in a batch

history = model.fit(x, y, epochs=epochs, batch_size=batch_size, validation_data=(x_val, y_val))
```

```
Epoch 1/4
132/132 [==============================] - 4s 28ms/step - loss: 0.5276 - accuracy: 0.9148 - val_loss: 0.1027 - val_accuracy: 0.9800
Epoch 2/4
132/132 [==============================] - 3s 25ms/step - loss: 0.0715 - accuracy: 0.9849 - val_loss: 0.0783 - val_accuracy: 0.9845
Epoch 3/4
132/132 [==============================] - 3s 25ms/step - loss: 0.0303 - accuracy: 0.9933 - val_loss: 0.0863 - val_accuracy: 0.9832
Epoch 4/4
132/132 [==============================] - 3s 25ms/step - loss: 0.0146 - accuracy: 0.9973 - val_loss: 0.0881 - val_accuracy: 0.9850
```

Plotting the results

```
# summarize history for accuracy
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('model accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
# summarize history for loss
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'validation'], loc='upper left')
plt.show()
```





Evaluating on the test set

```
x_test = testing_feat.drop('language',axis=1)
y_test = encode(testing_feat['language'])
history = model.evaluate(x_test, y_test)
```

```
138/138 [==============================] - 1s 5ms/step - loss: 0.1034 - accuracy: 0.9786
```

Saving the model in current location

```
model.save('model.h5')
```

Saving the parameters in current location

```
import pickle
filename = 'parameters.sav'
list_of_dumps = [train_max, train_min, vectorizer, feature_names, encoder]
pickle.dump(list_of_dumps, open(filename, 'wb'))
```

Making sample predictions

Detecting the language

```
# Preprocessing each text line
def data_preprocess(text):
  # Removing numbers and symbols
  text = re.sub(r'[!@#$()-_,n"%^*?:;~`0-9]', ' ', text)
  text = re.sub(r'[[]]', ' ', text)
  # Lowercasing the text
  text = text.lower()
  return text

# Function to detect language
def detect_language(text):
  text = data_preprocess(text)
  X = vectorizer.fit_transform([text])
  X_feat = pd.DataFrame(data=X.toarray(),columns=feature_names)
  X_feat = (X_feat - train_min)/(train_max-train_min)
  predicted_my_val = model.predict(X_feat)
  val = np.where(predicted_my_val[0] == np.amax(predicted_my_val[0]))[0]
  print("Detected Language :", encoder.classes_[val[0]])
```

```
my_text = input("Enter the text : ")
my_val = detect_language(my_text)
```

```
Enter the text : De taal is in grammaticaal opzicht verregaand gelijk aan het Hindi dat in Bollywood-films wordt gesproken. De taal die i
Detected Language : Dutch
```