Importing Data and Preprocessing (Same in All notebooks)

In [1]:

```
import numpy as np
import pandas as pd
import string
```

In [2]:

```
data = pd.read_csv('/users/rohanchitte/downloads/Dataset_lyrics.csv_lyrics.csv'
```

In [3]:

```
filtered = data[data['lyrics'].notnull()]
filtered
```

Out[3]:

	index	song	year	artist	genre	lyrics
0	0	ego-remix	2009	beyonce-knowles	Pop	Oh baby, how you doing?\nYou know I'm gonna cu...
1	1	then-tell-me	2009	beyonce-knowles	Pop	playin' everything so easy,\nit's like you see...
2	2	honesty	2009	beyonce-knowles	Pop	If you search\nFor tenderness\nIt isn't hard t...
3	3	you-are-my-rock	2009	beyonce-knowles	Pop	Oh oh oh I, oh oh oh I\n[Verse 1:]\nIf I wrote...
4	4	black-culture	2009	beyonce-knowles	Pop	Party the people, the people the party it's po...
...	...	...	...	...	...	...
362232	362232	who-am-i-drinking-tonight	2012	edens-edge	Country	I gotta say\nBoy, after only just a couple of ...
362233	362233	liar	2012	edens-edge	Country	I helped you find her diamond ring\nYou made m...
362234	362234	last-supper	2012	edens-edge	Country	Look at the couple in the corner booth\nLooks ...
362235	362235	christ-alone-live-in-studio	2012	edens-edge	Country	When I fly off this mortal earth\nAnd I'm meas...
362236	362236	amen	2012	edens-edge	Country	I heard from a friend of a friend of a friend ...

266557 rows × 6 columns

In [4]:

```
import nltk
from nltk.corpus import stopwords

cleaned = filtered.copy()

# Remove punctuation
cleaned['lyrics'] = cleaned['lyrics'].str.replace("[-\?.,\/#!$%\^&\*;:{}=\_~()]'

# Remove song-related identifiers like [Chorus] or [Verse]
cleaned['lyrics'] = cleaned['lyrics'].str.replace("\[(.*?)\]", ' ')
cleaned['lyrics'] = cleaned['lyrics'].str.replace("' | '", ' ')
cleaned['lyrics'] = cleaned['lyrics'].str.replace('x[0-9]+', ' ')

# Remove all songs without lyrics (e.g. instrumental pieces)
cleaned = cleaned[cleaned['lyrics'].str.strip().str.lower() != 'instrumental']

# Remove any songs with corrupted/non-ASCII characters, unavailable lyrics
cleaned = cleaned[~cleaned['lyrics'].str.contains(r'[^\x00-\x7F]+')]
cleaned = cleaned[cleaned['lyrics'].str.strip() != '']
cleaned = cleaned[cleaned['genre'].str.lower() != 'not available']

#Selecting Pop, Rock, Country, Jazz
cleaned = cleaned.loc[(cleaned['genre'] == 'Pop') |
            (cleaned['genre'] == 'Country') |
            (cleaned['genre'] == 'Rock') |
            (cleaned['genre'] == 'Hip-Hop') |
            (cleaned['genre'] == 'Jazz') ]
cleaned.reset_index(inplace = True)

cleaned
print(len(cleaned))

from nltk.corpus import stopwords
stop = stopwords.words('english')
#removing stop words from lyrics

cleaned['lyrics'] = cleaned['lyrics'].apply(lambda x: ' '.join([word for word in

#lemmatizing lyrics
import nltk

w_tokenizer = nltk.tokenize.WhitespaceTokenizer()
lemmatizer = nltk.stem.WordNetLemmatizer()

def lemmatize_text(text, flg_lemm=True):
    #Convert string to list (tokenize)
    lst_text = text.split()

    ## Lemmatisation (convert the word into root word)
    if flg_lemm == True:
        lem = nltk.stem.wordnet.WordNetLemmatizer()
        lst_text = [lem.lemmatize(word) for word in lst_text]

    ## back to string from list
    text = " ".join(lst_text)
    return text

#cleaned["lyrics"] = cleaned["lyrics"].apply(lemmatize_text)

```

```
cleaned["lyrics"]  = cleaned["lyrics"].apply(lambda x:  lemmatize_text(x))

df = cleaned.drop(labels=["level_0", "index","song","year","artist"], axis=1)
```

```
185493
```

# Splitting Data into training and test set (Same as LSTM-GLOVE notebook)

In [5]:

```
from sklearn.model_selection import train_test_split
```

In [6]:

```
df_train, df_test = train_test_split(df, test_size=0.33, random_state=42)
```

In [7]:

```
df_train.reset_index()
df_test.reset_index()
```

Out[7]:

	index	genre	lyrics
0	35835	Jazz	I dance ask I dance ask I dance madame My hear...
1	2538	Hip-Hop	Sonic boom head dread cause he's tread Upon Fl...
2	63159	Rock	If I could turn page In time I'd rearrange Jus...
3	6483	Rock	record stop stop skipping equipped stor ear fu...
4	15496	Hip-Hop	Hey yeah ya know I like playersNo Diggity No d...
...	...	...	...
61208	10254	Hip-Hop	We're never done found place belong Don't stan...
61209	31630	Country	It's fake hoax nowhere road one go anywhere an...
61210	107267	Rock	I've spent much time throwing rock window That...
61211	67806	Rock	You're lookin fine long time I still remember ...
61212	23935	Pop	I I get creepin feelin' That might start belie...

61213 rows × 3 columns

In [8]:

```
#train_test split
x_tr, y_tr = df_train['lyrics'].values, df_train['genre'].values
x_val, y_val = df_test['lyrics'].values, df_test['genre'].values
```

# Function to calculcate max length of the sequence in the corpus (Same as LSTM-GLOVE notebook)

In [9]:

```
def get_max_length(df_train):
    """
    get max token counts from train data,
    so we use this number as fixed length input to LSTM cell
    """
    max_length = 0
    for row in df_train['lyrics']:
        if len(row.split(" ")) > max_length:
            max_length = len(row.split(" "))
    return max_length

```

In [10]:

```
maximumlen = get_max_length(df_train)
maximumlen
```

Out[10]:

```
3666
```

```
# One hot encoding genres (Same as LSTM-GLOVE notebook)
```

In [11]:

```
def genre_encode(genre):
    """
    return one hot encoding for Y value
    """
    if genre == 'Pop':
        return [1,0,0,0,0]
    elif genre == 'Rock':
        return [0,1,0,0,0]
    elif genre == 'Country':
        return [0,0,1,0,0]
    elif genre == 'Hip-Hop':
        return [0,0,0,1,0]
    else:
        return [0,0,0,0,1]
```

In [12]:

```
genres = df_train['genre'].tolist()
y_tr = [genre_encode(genre) for genre in genres]
```

In [13]:

```
genres = df_test['genre'].tolist()
y_val = [genre_encode(genre) for genre in genres]
```

```
# Tokenization and Padding of the sequences to make their length same (Same as LSTM-GLOVE notebook)
```

In [14]:

```
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences

#Tokenize the sentences
tokenizer = Tokenizer()

#preparing vocabulary
tokenizer.fit_on_texts(list(x_tr))

#converting text into integer sequences
x_tr_seq  = tokenizer.texts_to_sequences(x_tr)
x_val_seq = tokenizer.texts_to_sequences(x_val)

#padding to prepare sequences of same length
x_tr_seq  = pad_sequences(x_tr_seq, maxlen=maximumlen)
x_val_seq = pad_sequences(x_val_seq, maxlen=maximumlen)
```

# Loading Pretrained Glove Word Embedding (Same as LSTM-GLOVE notebook)

In [15]:

```
# load the whole embedding into memory
embeddings_index = dict()
f = open('/users/rohanchitte/glove.6B.300d.txt')

for line in f:
    values = line.split()
    word = values[0]
    coefs = np.asarray(values[1:], dtype='float32')
    embeddings_index[word] = coefs

f.close()
print('Loaded %s word vectors.' % len(embeddings_index))
```

```
Loaded 400000 word vectors.
```

In [16]:

```
size_of_vocabulary=len(tokenizer.word_index) + 1 #+1 for padding
print(size_of_vocabulary)
```

```
220815
```

# Creating a weight matrix for words in training docs (Same as LSTM-GLOVE notebook)

In [17]:

```

embedding_matrix = np.zeros((size_of_vocabulary, 300))

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

# LSTM Model (Same as LSTM-GLOVE notebook)

In [18]:

```
#deep learning library
from keras.models import *
from keras.layers import *
from keras.callbacks import *
```

In [19]:

```
model=Sequential()

#embedding layer
model.add(Embedding(size_of_vocabulary,300,weights=[embedding_matrix],input_leng

#lstm layer
model.add(LSTM(128,return_sequences=True,dropout=0.2))

#Global Maxpooling
model.add(GlobalMaxPooling1D())

#Dense Layer
model.add(Dense(64,activation='relu'))
model.add(Dense(5,activation='softmax'))

#Add loss function, metrics, optimizer
model.compile(optimizer='adam', loss='categorical_crossentropy',metrics=["accura

#Adding callbacks
#es = EarlyStopping(monitor='val_loss', mode='min', verbose=1,patience=3)

#mc=ModelCheckpoint('best_model.h5', monitor='val_acc', mode='max', save_best_o

#Print summary of model
print(model.summary())
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
embedding (Embedding)        (None, 3666, 300)         66244500  
_________________________________________________________________
lstm (LSTM)                  (None, 3666, 128)         219648    
_________________________________________________________________
global_max_pooling1d (Global (None, 128)               0         
_________________________________________________________________
dense (Dense)                (None, 64)                8256      
_________________________________________________________________
dense_1 (Dense)              (None, 5)                 325       
=================================================================
Total params: 66,472,729
Trainable params: 228,229
Non-trainable params: 66,244,500
_________________________________________________________________
None
```

# Loading LSTM MODEL and Confusion Matrix

In [21]:

```
model.load_weights("lyrics-5-categories-model-glove.h5")
```

In [22]:

```
predict = model.predict(np.array(x_val_seq))
```

In [23]:

```
from numpy import argmax
predictions = [argmax(values) for values in predict]
```

In [24]:

```
target_names = ["Pop", "Rock", "Country", "Hip-Hop", "Jazz"]
```

In [25]:

```
import numpy as np


def plot_confusion_matrix(cm,
                          target_names,
                          title='Confusion matrix',
                          cmap=None,
                          normalize=True):
    """
    given a sklearn confusion matrix (cm), make a nice plot

    Arguments
    ---------
    cm:           confusion matrix from sklearn.metrics.confusion_matrix

    target_names: given classification classes such as [0, 1, 2]
                  the class names, for example: ['high', 'medium', 'low']

    title:        the text to display at the top of the matrix

    cmap:         the gradient of the values displayed from matplotlib.pyplot.c
                  see http://matplotlib.org/examples/color/colormaps_reference.
                  plt.get_cmap('jet') or plt.cm.Blues

    normalize:    If False, plot the raw numbers
                  If True, plot the proportions

    Usage
    -----
    plot_confusion_matrix(cm           = cm,                  # confusion matri
                                                              # sklearn.metrics.
                          normalize    = True,                # show proportion
                          target_names = y_labels_vals,       # list of names o
                          title        = best_estimator_name) # title of graph

    Citiation
    ---------
    http://scikit-learn.org/stable/auto_examples/model_selection/plot_confusion_

    """
    import matplotlib.pyplot as plt
    import numpy as np
    import itertools

    accuracy = np.trace(cm) / np.sum(cm).astype('float')
    misclass = 1 - accuracy

    if cmap is None:
        cmap = plt.get_cmap('Blues')

    plt.figure(figsize=(8, 6))
    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()

    if target_names is not None:
        tick_marks = np.arange(len(target_names))
        plt.xticks(tick_marks, target_names, rotation=45)
        plt.yticks(tick_marks, target_names)

    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]


    thresh = cm.max() / 1.5 if normalize else cm.max() / 2
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        if normalize:
            plt.text(j, i, "{:0.4f}".format(cm[i, j]),
                     horizontalalignment="center",
                     color="white" if cm[i, j] > thresh else "black")
        else:
            plt.text(j, i, "{:,}".format(cm[i, j]),
                     horizontalalignment="center",
                     color="white" if cm[i, j] > thresh else "black")


    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label\naccuracy={:0.4f}; misclass={:0.4f}'.format(accu
    plt.show()
```

In [26]:

```
def genre_encode(genre):
    """
    return one hot encoding for Y value
    """
    if genre == 'Pop':
        return 0
    elif genre == 'Rock':
        return 1
    elif genre == 'Country':
        return 2
    elif genre == 'Hip-Hop':
        return 3
    else:
        return 4

genres = df_test['genre'].tolist()
y_val = [genre_encode(genre) for genre in genres]
```

In [27]:

```
from sklearn.metrics import confusion_matrix
```

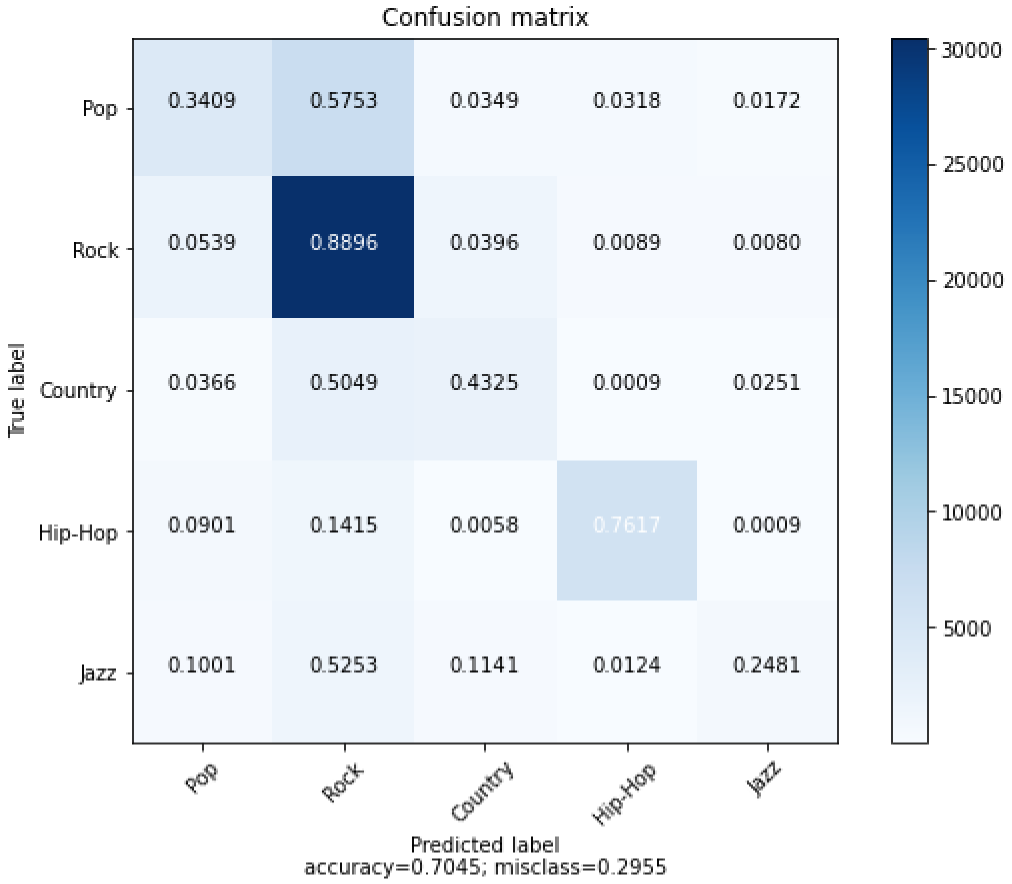
In [28]:

```
confmat = confusion_matrix(y_val, predictions)
```

In [29]:

```
print("LSTM GLOVE MODEL CONFUSION MATRIX")
plot_confusion_matrix(confmat,
                          target_names,
                          title='Confusion matrix',
                          cmap=None,
                          normalize=True)
```

```
LSTM GLOVE MODEL CONFUSION MATRIX
```



	Pop	Rock	Country	Hip-Hop	Jazz
Pop	0.3409	0.5753	0.0349	0.0318	0.0172
Rock	0.0539	0.8896	0.0396	0.0089	0.0080
Country	0.0366	0.5049	0.4325	0.0009	0.0251
Hip-Hop	0.0901	0.1415	0.0058	0.7617	0.0009
Jazz	0.1001	0.5253	0.1141	0.0124	0.2481