

Assignment 3 - Firat Ciftci

November 21, 2019

1 Assignment 3: Prediction/Modeling

Due: Friday, Nov 22, 2019 in class

Submission: Complete this notebook and print out the output or electronically submit it.

Everything you need to complete is marked with a TODO. For textual questions create a new cell under the question to respond to it.

1.1 Dataset

Game of Thrones is one of the most watched TV series of all times. With hundreds of characters and more than 22K sentences, this dataset aims to help you test your text mining skills. The content is pretty simple: the dataset contains each and every sentence said in the serie together with who has said it, the episode and the season. For the time being the dataset includes episodes from Season 1 to Season 7. You can download the dataset here: <https://github.com/sjyk/cmsc21800/blob/master/got.csv>

1.1.1 Loading the Dataset

The first task is to load the dataset into a pandas dataframe and filter relevant rows for this assignment. We only care about the rows for characters that are present in all 7 of the seasons and speak a sufficient amount. Filter the rows to include only those with the speaker name “Cersei”, “Daenerys”, “Tyrion”, and “Arya”—make sure you handle upper-case and lower case properly!

```
[293]: import pandas as pd

def load_dataset(filename):
    """
    Given a filename return a dataframe
    containing the rows.

    Only return those rows with a name:
    * "cersei"
    * "daenerys"
    * "tyrion"
    * "arya"
```

```

    ...
df = pd.read_csv(filename, delimiter=";")

return df[df['Name'].isin(['cersei', 'daenerys', 'tyrion', 'arya'])]

```

```
[294]: df = load_dataset('got.csv')

df[-10:]
```

| | Column1 | Season | Episode | \ |
|-------|---------|----------|-------------------------|---|
| 22455 | 22456 | Season 7 | the dragon and the wolf | |
| 22457 | 22458 | Season 7 | the dragon and the wolf | |
| 22459 | 22460 | Season 7 | the dragon and the wolf | |
| 22461 | 22462 | Season 7 | the dragon and the wolf | |
| 22492 | 22493 | Season 7 | the dragon and the wolf | |
| 22494 | 22495 | Season 7 | the dragon and the wolf | |
| 22496 | 22497 | Season 7 | the dragon and the wolf | |
| 22498 | 22499 | Season 7 | the dragon and the wolf | |
| 22500 | 22501 | Season 7 | the dragon and the wolf | |
| 22502 | 22503 | Season 7 | the dragon and the wolf | |

| | Sentence | Name | N_serie | \ |
|-------|---|--------|---------|---|
| 22455 | And that will be treason | cersei | 67 | |
| 22457 | Disobeying your queen | cersei | 67 | |
| 22459 | I told you no one walks away from me | cersei | 67 | |
| 22461 | Theres one more yet to come | cersei | 67 | |
| 22492 | Are you all right? | arya | 67 | |
| 22494 | You did the right thing | arya | 67 | |
| 22496 | Im just the executioner You passed the sentenc... | arya | 67 | |
| 22498 | I was never going to be as good a lady as you ... | arya | 67 | |
| 22500 | I believe thats the nicest thing youve ever sa... | arya | 67 | |
| 22502 | In winter, we must protect ourselves Look afte... | arya | 67 | |

| | N_Season | Emision Date |
|-------|----------|--------------|
| 22455 | 7 | 27/08/2017 |
| 22457 | 7 | 27/08/2017 |
| 22459 | 7 | 27/08/2017 |
| 22461 | 7 | 27/08/2017 |
| 22492 | 7 | 27/08/2017 |
| 22494 | 7 | 27/08/2017 |
| 22496 | 7 | 27/08/2017 |
| 22498 | 7 | 27/08/2017 |
| 22500 | 7 | 27/08/2017 |
| 22502 | 7 | 27/08/2017 |

1.1.2 Basic Cluster Analysis

Next, we will mine this dataset to understand what types of structure exist. In the next task, we will write a featurizer that takes the dataset and converts it into a set of feature vectors. We will use a tf-idf featurizer to do this:

https://scikit-learn.org/stable/modules/generated/sklearn.feature_extraction.text.TfidfVectorizer.html

```
[295]: from sklearn.feature_extraction.text import TfidfVectorizer

def featurize(quotes):
    """
    Takes a set of quotes as input and returns two things: an array of feature_
    →vectors
        and the featurizer.

    * Use the TfidfVectorizer from sklearn and remove english stopwords and_
    →restrict the features to
        words that appear in *at most* 20 quotes.

    Return values (returns a tuple!!):
        X - a dense numpy array of feature vectors representing the text data.
        vectorizer - a TfidfVectorizer object.
    """
    vectorizer = TfidfVectorizer(stop_words='english', max_df=20)
    vector = vectorizer.fit_transform(quotes)

    return vector.todense(), vectorizer

df = load_dataset('got.csv')
X, vectorizer = featurize(df['Sentence'])
```

Now, let's compute the principal components of this featurized dataset:

```
[296]: from sklearn.decomposition import PCA
import numpy as np

def compute_pca(features, components=2):
    """
    Calculate the first two principal components of the
    features that you have. Return the components,
    the explained variance, and N-D representation of the
    feature vectors.

    Return Values (returns a 4-tuple):
        * axes (the principal components from .components_)
        * Y (the dimensionality reduced data)
        * c = explained variance on a range from [0, 1]
```

```

    ...
pca = PCA(n_components=components)
pca.fit(features)

    return pca.components_, pca.transform(features), pca.
→explained_variance_ratio_

# Compute PCA
pcs, Y, c = compute_pca(X, 3)

```

Now write code to interpret the PCA components. Write a function that uses the vectorizer to determine the words whose presence or absence is strongest in the PC.

```
[297]: def top_k(pc, vectorizer, k=10):
    """
    Finds the highest (most positive) weighted elements in a pc and
    then returns the words that correspond to those elements.

    Exclude all words that are less than 3 letters.

    Return Value: A set of k words
    """

    weights = [x for x in list(zip(pc, vectorizer.get_feature_names())))\ \
               if len(x[1]) >= 3]
    weights.sort()

    return weights[-k:]

# Extract each of the pcs
pc1, pc2, pc3 = pcs

print("PC 1: Most Positive: ", top_k(pc1, vectorizer))
print("\nPC 2: Most Positive: ", top_k(pc2, vectorizer))
print("\nPC 3: Most Positive: ", top_k(pc3, vectorizer))
print("\nExplained Variance: ", c)
```

PC 1: Most Positive: [(0.04217712279957113, 'swear'), (0.042549794141531205, 'loved'), (0.04519834594387526, 'taken'), (0.0528466079583697, 'matter'), (0.0597150037400482, 'try'), (0.08119808479588238, 'belong'), (0.08238751952102706, 'swore'), (0.09601781471628285, 'liar'), (0.11093947939592254, 'fuck'), (0.9596955096692612, 'care')]

PC 2: Most Positive: [(0.034843461405484936, 'pick'), (0.042168033162568404, 'slaves'), (0.043217243122619875, 'mycah'), (0.05341996654600781, 'lies'), (0.06505915486791708, 'expect'), (0.07845933208057161, 'traitor'), (0.07907041923630982, 'coward'), (0.09772809651538666, 'alive'), (0.13206552413225245, 'truth'), (0.95648690824929, 'liar')]

```
PC 3: Most Positive: [(0.04097726062931132, 'desire'), (0.041290885464794494, 'interrupt'), (0.04551883302118401, 'continue'), (0.04939394703887829, 'husband'), (0.04948127694699012, 'catelyn'), (0.04994668863930759, 'loyalty'), (0.0779784998747717, 'rules'), (0.09792828051353855, 'joke'), (0.11700070540297113, 'doesn'), (0.9234743033906512, 'mean')]
```

```
Explained Variance: [0.00303668 0.00280099 0.00250545]
```

For those of you who know the story, you can see the story arcs in the principal components.

1.2 Predicting The Speaker

Now, we will have you predict the speaker from the patterns in the text. The first step is to define a training and a test set. Write the following function that splits the loaded dataset into a training set (80% of the data) and a test set (20% of the data). The partition should be random.

```
[298]: from sklearn.model_selection import train_test_split as split

def train_test_split(dataframe):
    """
    Write a function that splits the dataset into a
    training set and a testing set

    Return values (returns a tuple!):
        - A training set 80% of the data,
        - A test set 20% of the data.
    """

    # The assignment does not put a limit on importing any tools
    # in terms of splitting the data, and I think this is the
    # best/most efficient way to handle this issue, so I hope
    # that me using an imported function here isn't an issue
    train, test = split(dataframe, test_size=0.20)

    return train, test

train, test = train_test_split(df)
```

1.2.1 Your task is to build a classifier that will achieve at least 45% accuracy on this dataset

To achieve this you will have to manipulate the data and play around with different featurization techniques and modeling choices. First, write a function that “fits” a language model, such as TFIDF, to the training dataset. It is up to you to tune the parameters for the vectorizer you choose appropriately.

```
[299]: def language_model(training_quotes):
    """
    Write a function that instantiates a vectorizer
    (e.g., a TfIdfVectorizer), runs fit(), and
    returns the vectorizer.
    """
    vectorizer = TfIdfVectorizer(stop_words='english')

    vectorizer.fit(training_quotes)

    return vectorizer
```

Next, you will write a featurizer that takes in a set of quotes and returns an array of feature vectors using the language model above. You may add whatever additional features you find useful.

```
[300]: def prediction_featurize(quotes, vectorizer):
    """
    Takes in a set of quotes and returns
    an array of feature vectors using
    the language model above.
    """
    vector = vectorizer.transform(quotes)

    return vector.todense()
```

Finally, determine the right machine learning model to use to actually make the prediction.

```
[301]: vectorizer = language_model(train['Sentence'])
X = prediction_featurize(train['Sentence'], vectorizer)
Y = train['Name']

Xtest = prediction_featurize(test['Sentence'], vectorizer)
Ytest = test['Name']

from sklearn.linear_model import LogisticRegression

clf = LogisticRegression(random_state=0, solver='lbfgs',  

    multi_class='multinomial')
clf.fit(X, Y)
pred = clf.predict(Xtest)

# Calculate accuracy
from sklearn.metrics import classification_report
print(classification_report(Ytest, pred))
```

| | precision | recall | f1-score | support |
|------|-----------|--------|----------|---------|
| arya | 0.62 | 0.24 | 0.34 | 157 |

| | | | | |
|--------------|------|------|------|-----|
| cersei | 0.60 | 0.35 | 0.44 | 198 |
| daenerys | 0.55 | 0.39 | 0.46 | 164 |
| tyrion | 0.45 | 0.80 | 0.58 | 296 |
| accuracy | | | 0.50 | 815 |
| macro avg | 0.56 | 0.44 | 0.45 | 815 |
| weighted avg | 0.54 | 0.50 | 0.48 | 815 |