Natural Language Processing

Team - NLP_PROJECT_23

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PROJECT ROUND 1

[Github Code Link]

Book Referred

The Hound of the Baskervilles by Arthur Conan Doyle

Project Overview

In this project, we will be analysing the novel **The Hound of the Baskervilles**. We will pre-process the novel, tokenize and apply POS Tagging to the novel. We will use Python libraries to accomplish our tasks.

GOALS

1. Import Text in text format (call it as T)
2. Pre-processing of T
3. Tokenize the T
4. Remove Stop Words
5. Analyse the frequency distribution of tokens in T
6. Word Cloud of Tokens
7. POS tagging using Tagset (TreeBank here)
8. Get BiGram probability table for largest Chapter
9. Play Shanon game with another chapter using previous probability table

Libraries used

1. Pandas - for data manipulation and analysis
2. NLTK - for tokenization , frequency distribution, stopwords
3. Re - to use regular expressions
4. Matplotlib.pyplot - for data visualisations
5. Word cloud - Used to create WordClouds from Tokenized Data
6. Seaborn - visualisation of frequency distribution

Description Of Data in text file

```
The Hound of the
Baskervilles
By Arthur Conan Doyle

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novels at Planet eBook. Subscribe to our free eBooks blog
and email newsletter.


Chapter 1
Mr. Sherlock Holmes


Mr. Sherlock Holmes, who was usually very late in the
mornings, save upon those not infrequent occasions
when he was up all night, was seated at the breakfast table.
I stood upon the hearth-rug and picked up the stick which
our visitor had left behind him the night before. It was a
fine, thick piece of wood, bulbous-headed, of the sort which
is known as a 'Penang lawyer.' Just under the head was a
broad silver band nearly an inch across. 'To James Mortimer, M.R.C.S., from his friends of the C.C.H.,' was engraved
upon it, with the date '1884.' It was just such a stick as the
old-fashioned family practitioner used to carry—dignified,
solid, and reassuring.
'Well, Watson, what do you make of it?'
Holmes was sitting with his back to me, and I had given
him no sign of my occupation.
'How did you know what I was doing? I believe you have
eyes in the back of your head.'
'I have, at least, a well-polished, silver-plated coffee-pot
in front of me,' said he. 'But, tell me, Watson, what do you
make of our visitor's stick? Since we have been so unfortu-
```

Observations

Pre-processing requirements : We remove the title name, punctuations, chapter name, page numbers, running sections, empty spaces

Convert the text to lower case for a more flowing data to work with.

TASKS

1. Import the book as file T.txt

We also remove the sentence that only occurs once in the starting of the downloaded book. We remove the title, white spaces, and page numbers.

```
#To open the file
file = open(r"T.txt",encoding='utf-8')
listofwords = file.read().splitlines()
page_number_pattern = re.compile(r'\d+')
listofwords = [i for i in listofwords if i!='' and i!='The Hound of the Baskervilles' and i!='\x18'
               and not page_number_pattern.match(i) and i!='Download free eBooks of classic literature, books and'
               and i!='novels at Planet eBook. Subscribe to our free eBooks blog' and i!='and email newsletter.']
text = " ".join(listofwords)
```

2. Text Preprocessing

Removing the punctuation marks, chapter number, running section (footer) and converting to lowercase.

```
#string which contains the punctuations which we want removed
punctuations = '''!()-[]{};:'"\,<>./''?""@#$%^&*_~'''
processed_text = ""
for i in text:
    if i not in punctuations:
        processed_text = processed_text + i

#Making the result lowercase
processed_text = processed_text.lower()
substring_to_remove_1 = "free ebooks at planet ebookcom"
processed_text= processed_text.replace(substring_to_remove_1, "")
pattern = r'chapter \d+'
processed_text = re.sub(pattern, '', processed_text)
print(processed_text[:100])#print for 100 characters
```

```
the hound of the baskervilles by arthur conan doyle  mr sherlock holmes mr sherlock holmes who was u
```

3. Tokenizing T

Certainly, here are the sentences with numbering:

1. Next, we tokenize the processed text using the 'word_tokenize' function from the nltk.tokenize library.

```
tokenisedtext = word_tokenize(processed_text)
print(tokenisedtext[:10])
```

```
['the', 'hound', 'of', 'the', 'baskervilles', 'by', 'arthur', 'conan', 'doyle', 'mr']
```

2. Tokenizers break down strings into lists of substrings.

3. The 'word_tokenize' tokenizer requires the installation of the Punkt sentence tokenization model.

4. Remove Stopwords from T

Stopwords are common, non-significant words like "the," "and," "in" that are often removed from text data during NLP tasks to reduce noise and improve efficiency.

```
# Stop words need to be removed.
stop_words = set(stopwords.words('english'))
final_tokens = [i for i in tokenisedtext if not i in stop_words]
finaltext = "  "
finaltext = finaltext.join(final_tokens)
print(finaltext[:100]) #after removing stopwords
```

```
hound  baskervilles  arthur  conan  doyle  mr  sherlock  holmes  mr  sherlock  holmes  usually  late
```

5. Analyse the frequency distribution of tokens in T

We use the nltk.FreqDist() function from the **nltk** library to calculate the .frequency of tokens

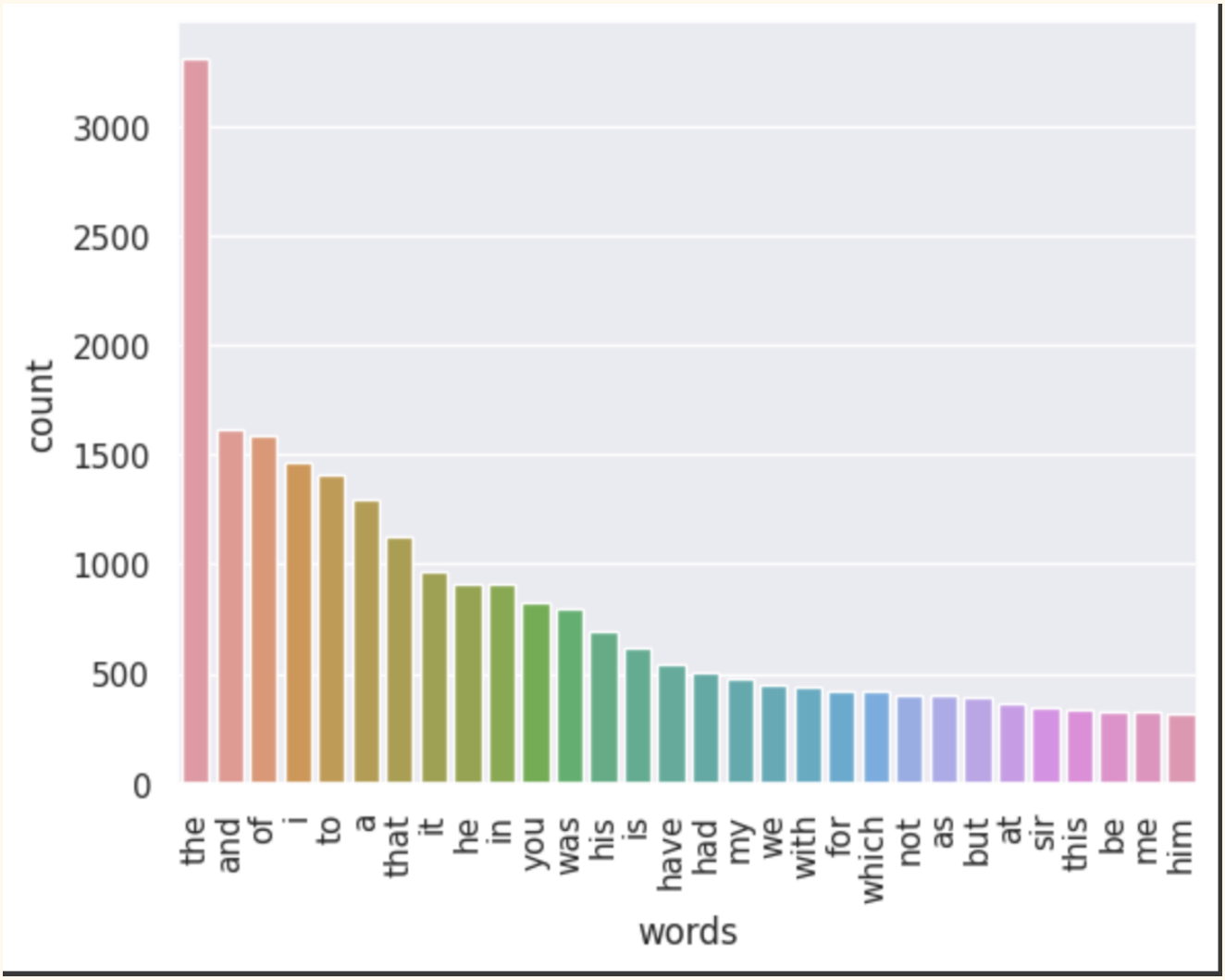
```
#Frequency Distrubution
freq_dist=nltk.FreqDist(finaltext)
print(freq_dist.most_common(15))
freq_dist=list(freq_dist)
```

```
[(' ', 53174), ('e', 19612), ('r', 11212), ('a', 11147), ('n', 11044), ('s', 10998), ('o', 10779),
```

6. Visualise the frequency distribution of 30 most occurring tokens in T

```
import seaborn as sb
sb.set(style='darkgrid')
dataf=pd.DataFrame(tokenisedtext)
```

```
sb.countplot(x=dataf[0],order=dataf[0].value_counts().iloc[:30].index)
plt.xticks(rotation=90)
plt.xlabel('words')
plt.show()
#Plotting the counts of the most frequent words ordered in descending order of their frequencies.
```



7. Create a word cloud

A word cloud is a visual representation of text data where words are displayed in varying sizes, with the most frequently occurring words appearing larger and less frequent words appearing smaller.

```
# Word cloud
wc = WordCloud(width = 800, height = 600,
                background_color ='white',
                min_font_size = 10,stopwords = {},colormap='winter').generate(finaltext)

plt.figure(figsize = (12,8), facecolor = None)
plt.imshow(wc)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
```

World Cloud

8. POS Tagging using the treebank tagset

```
nltk.download("treebank")
pos_tags = nltk.pos_tag(final_tokens)
print(pos_tags[:20])
```

```
[nltk_data] Downloading package treebank to /root/nltk_data...
[nltk_data]   Unzipping corpora/treebank.zip.
[('hound', 'NN'), ('baskervilles', 'NNS'), ('arthur', 'VBP'), ('conan', 'JJ'), ('doyle', 'JJ'), ('download', 'NN'), ('fre
```

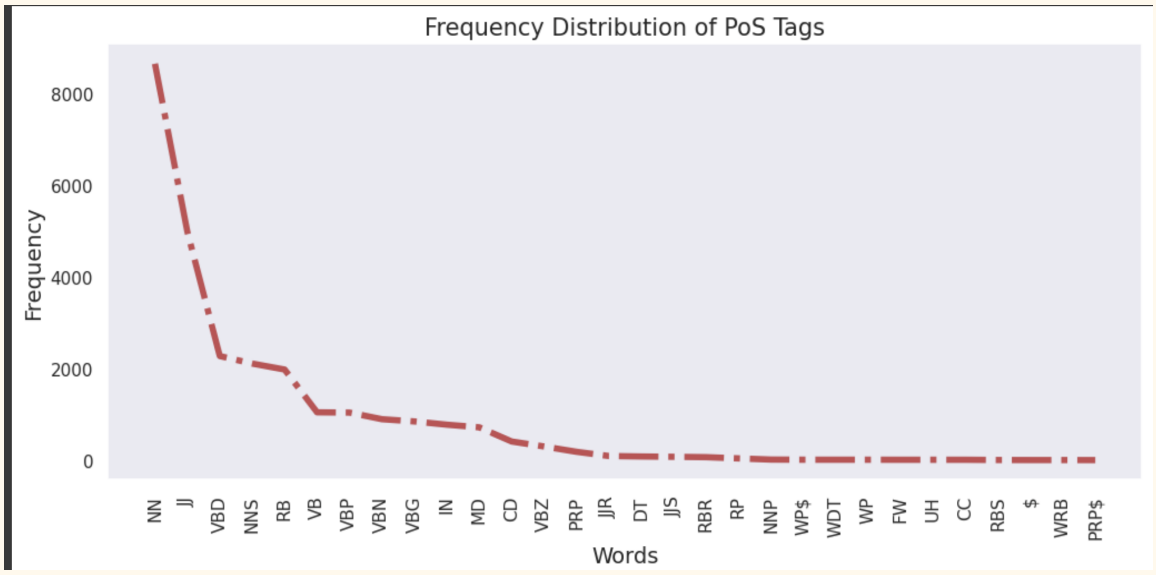
```
[ ] from collections import Counter
    counts = Counter( tag for word,  tag in pos_tags)
    print(counts)
```

```
Counter({'NN': 8645, 'JJ': 4981, 'VBD': 2270, 'NNS': 2106, 'RB': 1976, 'VB': 1043, 'VBP': 1037, 'VBN': 893, 'VBG': 844, '
```

9. Frequency Distribution of Various Tags

```
#Frequency Distribution of varios PoS Tags

pos_tags_freq = nltk.FreqDist(counts)
pos_tags_freq = {k: v for k, v in sorted(pos_tags_freq.items(), key=lambda item: item[1],reverse=True)}
x = list(pos_tags_freq.keys())[:40]
y = list(pos_tags_freq.values())[:40]
plt.figure(figsize=(12,5))
plt.plot(x,y,c='r',lw=4,ls='-.')
plt.grid()
plt.xticks(rotation=90)
plt.title('Frequency Distribution of PoS Tags',size=15)
plt.xlabel('Words',size=14)
plt.ylabel('Frequency',size=14)
plt.show()
```



10. Bi-Gram Probability Table for largest chapter C

We first create bigram tuples from the chapter C, then created a bigram probability table and displayed a 5*5 matrix for illustration and verification of the table creation.

```
# Generate bigrams
bigram_tuples = list(bigrams(tokens))

# Count bigram frequencies
bigram_freq = FreqDist(bigram_tuples)

# Create a bigram probability table
bigram_probabilities = {}

for bigram in bigram_freq:
    preceding_word, following_word = bigram
    if preceding_word not in bigram_probabilities:
        bigram_probabilities[preceding_word] = {}

    probability = bigram_freq[bigram] / tokens.count(preceding_word)
    bigram_probabilities[preceding_word][following_word] = probability
```

```
# Create a counter for preceding words
preceding_word_count = 0
#bigram probability table displayed for 5x5
for preceding_word in bigram_probabilities:
    if preceding_word_count < 5:

        following_word_count = 0
        for following_word, probability in bigram_probabilities[preceding_word].items():
            if following_word_count < 5:
                print(f"{preceding_word}, {following_word}, Probability : {probability:.4f}")
                following_word_count += 1
        preceding_word_count += 1
```

```
of, the, Probability : 0.2708
of, his, Probability : 0.0579
of, a, Probability : 0.0535
of, it, Probability : 0.0315
of, my, Probability : 0.0252
in, the, Probability : 0.2750
in, a, Probability : 0.0759
in, his, Probability : 0.0649
in, my, Probability : 0.0385
in, this, Probability : 0.0330
it, was, Probability : 0.1746
it, is, Probability : 0.1601
it, i, Probability : 0.0269
it, and, Probability : 0.0258
it, would, Probability : 0.0217
i, have, Probability : 0.0997
i, had, Probability : 0.0689
i, am, Probability : 0.0546
i, was, Probability : 0.0539
i, could, Probability : 0.0505
the, moor, Probability : 0.0420
the, man, Probability : 0.0145
the, same, Probability : 0.0112
the, baronet, Probability : 0.0112
the, matter, Probability : 0.0106
```

11. Playing the Shannon Game

In this step , we took some sentences from a random chapter in the book different from C . We removed the last word of the sentences . Then we used the bigram probability table obtained in the previous step to predict the last word . We found that accuracy in predicting the exact same word was 40%.

```
correct_predictions = 0

for sentence, expected_next_word in sentences:
    words = sentence.lower().split()  # Tokenize the given sentence

    current_word = words[-1]  # Take the last word as the current word

    if current_word in bigram_probabilities:
        next_word = random.choices(
            list(bigram_probabilities[current_word].keys()),
            weights=list(bigram_probabilities[current_word].values())
        )[0]
    else:
        # If the current word doesn't have associated bi-grams, choose a random word
        next_word = random.choice(list(bigram_probabilities.keys()))

    if next_word == expected_next_word:
        correct_predictions += 1

    generated_sentence = ' '.join(words + [next_word])
    print(f"Generated: {next_word}\nExpected: {expected_next_word}\n")

accuracy = (correct_predictions / len(sentences)) * 100
print(f"Accuracy: {accuracy:.2f}%")
```

```
Generated: hours
Expected: hours

Generated: first
Expected: purpose

Generated: the
Expected: he

Generated: public
Expected: Barrymore’s

Generated: could
Expected: have

Generated: position
Expected: position

Generated: would
Expected: would

Generated: of
Expected: of

Generated: bogie
Expected: butterfly-net

Generated: man
Expected: interruption

Accuracy: 40.00%
```

Inference

Applied POS tagging for all the tokens present in the book

Analysed the frequency distribution of the tokens

The most frequent Part of speech in the book was NOUN (NN) with 8645 count

Applied the Bigram probability table to predict the last word of a sentence from the Test set and found its accuracy as 40% correct.

Conclusion

In this round of the project , we learnt how to preprocess the data, word tokenization , concept of stop words , concept of word cloud and its generation , POS tagging of the tokens , obtained the bigram distribution and played the Shannon game.