Experiment No.4
Apply Stemming on the given Text input
Date of Performance:
Date of Submission:

Aim: Apply Stemming on the given Text input.

Objective: Understand the working of stemming algorithms and apply stemming on the given input text.

Theory:

Stemming is a process of linguistic normalization, which reduces words to their word root word or chops off the derivational affixes. For example, connection, connected, connecting word reduce to a common word "conect". Stemming is the process of producing morphological variants of a root/base word. Stemming programs are commonly referred to as stemming algorithms or stemmers. A stemming algorithm reduces the words "chocolates", "chocolatey", "choco" to the root word, "chocolate" and "retrieval", "retrieved", "retrieves" and reduces to the stem "retrieve". Stemming is an important part of the pipelining process in Natural language processing. The input to the stemmer is tokenized words.

Applications of stemming :

1. Stemming is used in information retrieval systems like search engines.
2. It is used to determine domain vocabularies in domain analysis.

Porter's Stemmer Algorithm:

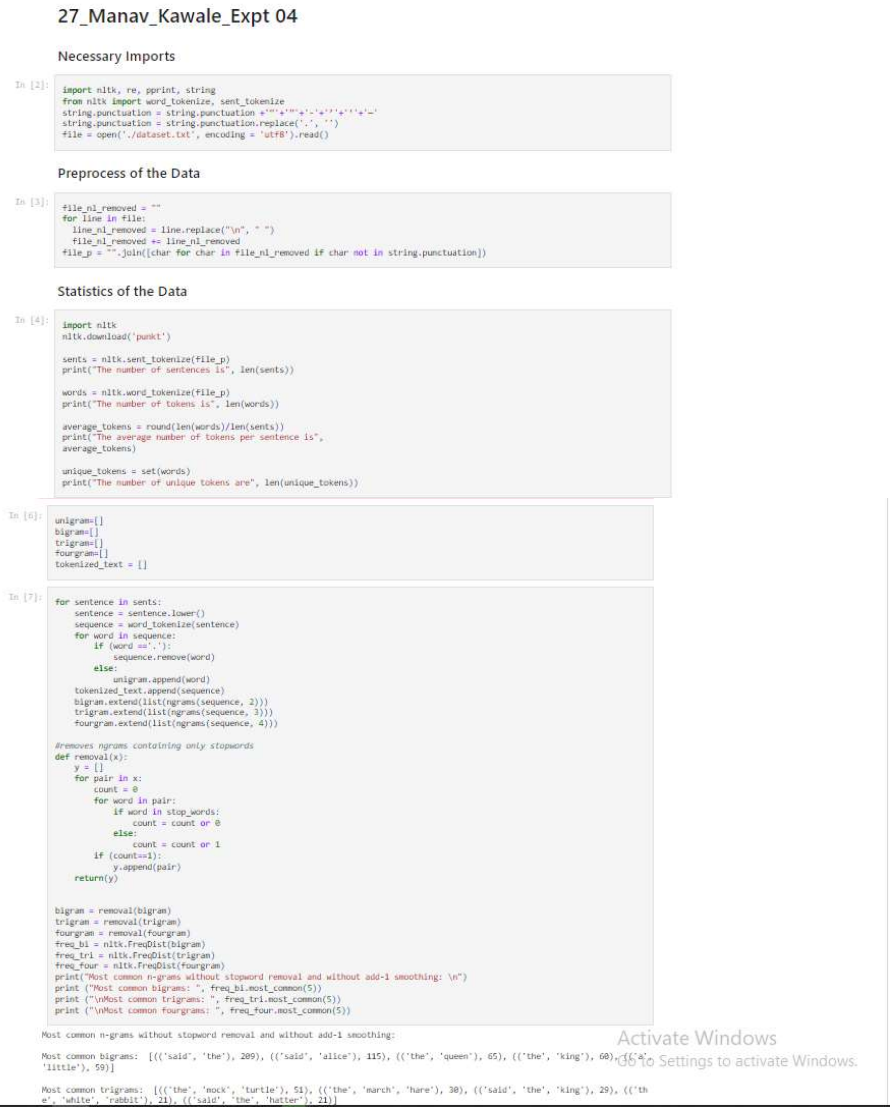
It is one of the most popular stemming methods proposed in 1980. It is based on the idea that the suffixes in the English language are made up of a combination of smaller and simpler suffixes. This stemmer is known for its speed and simplicity. The main applications of Porter Stemmer include data mining and Information retrieval. However, its applications are only limited to English words. Also, the group of stems is mapped on to the same stem and the output stem is not necessarily a meaningful word. The algorithms are fairly lengthy in nature and are known to be the oldest stemmer.

Example: EED -> EE means "if the word has at least one vowel and consonant plus EED ending, change the ending to EE" as 'agreed' becomes 'agree'.

Advantage: It produces the best output as compared to other stemmers and it has less error rate.

Limitation: Morphological variants produced are not always real words.

Output:



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Necessary Imports

In [2]:
```
import nltk, re, pprint, string
from nltk import word_tokenize, sent_tokenize
string.punctuation = string.punctuation +'"'+'"'+'-'+'''+'''+'—'
string.punctuation = string.punctuation.replace('.', '')
file = open('./dataset.txt', encoding = 'utf8').read()
```

Preprocess of the Data

In [3]:
```
file_nl_removed = ""
for line in file:
  line_nl_removed = line.replace("\n", " ")
  file_nl_removed += line_nl_removed
file_p = "".join([char for char in file_nl_removed if char not in string.punctuation])
```

Statistics of the Data

In [4]:
```
import nltk
nltk.download('punkt')

sents = nltk.sent_tokenize(file_p)
print("The number of sentences is", len(sents))

words = nltk.word_tokenize(file_p)
print("The number of tokens is", len(words))

average_tokens = round(len(words)/len(sents))
print("The average number of tokens per sentence is",
average_tokens)

unique_tokens = set(words)
print("The number of unique tokens are", len(unique_tokens))
```

In [6]:
```
unigram=[]
bigram=[]
trigram=[]
fourgram=[]
tokenized_text = []
```

In [7]:
```
for sentence in sents:
    sentence = sentence.lower()
    sequence = word_tokenize(sentence)
    for word in sequence:
        if (word =='.'):
            sequence.remove(word)
        else:
            unigram.append(word)
    tokenized_text.append(sequence)
    bigram.extend(list(ngrams(sequence, 2)))
    trigram.extend(list(ngrams(sequence, 3)))
    fourgram.extend(list(ngrams(sequence, 4)))

#removes ngrams containing only stopwords
def removal(x):
    y = []
    for pair in x:
        count = 0
        for word in pair:
            if word in stop_words:
                count = count or 0
            else:
                count = count or 1
        if (count==1):
            y.append(pair)
    return(y)


bigram = removal(bigram)
trigram = removal(trigram)
fourgram = removal(fourgram)
freq_bi = nltk.FreqDist(bigram)
freq_tri = nltk.FreqDist(trigram)
freq_four = nltk.FreqDist(fourgram)
print("Most common n-grams without stopword removal and without add-1 smoothing: \n")
print ("Most common bigrams: ", freq_bi.most_common(5))
print ("\nMost common trigrams: ", freq_tri.most_common(5))
print ("\nMost common fourgrams: ", freq_four.most_common(5))
```

```
Most common n-grams without stopword removal and without add-1 smoothing:

Most common bigrams:  [(('said', 'the'), 209), (('said', 'alice'), 115), (('the', 'queen'), 65), (('the', 'king'), 60), ((
'little'), 59)]

Most common trigrams:  [((the', 'mock', 'turtle'), 51), (('the', 'march', 'hare'), 30), (('said', 'the', 'king'), 29), ((th
e', 'white', 'rabbit'), 21), (('said', 'the', 'hatter'), 21)]
```

Script for downloading the stopwords using NLTK

```
In [8]:
from nltk.corpus import stopwords
stop_words = set(stopwords.words('english'))
```

Print 10 Unigrams and Bigrams after removing stopwords

```
In [9]:
print("Most common n-grams with stopword removal and without add-1 smoothing: \n")
unigram_sw_removed = [p for p in unigram if p not in stop_words]
fdist = nltk.FreqDist(unigram_sw_removed)
print("Most common unigrams: ", fdist.most_common(10))
bigram_sw_removed = []
bigram_sw_removed.extend(list(ngrams(unigram_sw_removed, 2)))
fdist = nltk.FreqDist(bigram_sw_removed)
print("\nMost common bigrams: ", fdist.most_common(10))
```

```
Most common n-grams with stopword removal and without add-1 smoothing:

Most common unigrams:  [('said', 462), ('alice', 385), ('little', 128), ('one', 101), ('like', 85), ('know', 85), ('would', 8
3), ('went', 83), ('could', 77), ('thought', 74)]

Most common bigrams:  [(('said', 'alice'), 122), (('mock', 'turtle'), 54), (('march', 'hare'), 31), (('said', 'king'), 29),
(('thought', 'alice'), 26), (('white', 'rabbit'), 22), (('said', 'hatter'), 22), (('said', 'mock'), 20), (('said', 'caterpilla
r'), 18), (('said', 'gryphon'), 18)]
```

Add-1 smoothing

```
In [10]:
ngrams_all = {1:[], 2:[], 3:[], 4:[]}
for i in range(4):
    for each in tokenized_text:
        for j in ngrams(each, i+1):
            ngrams_all[i+1].append(j);
ngrams_voc = {1:set([]), 2:set([]), 3:set([]), 4:set([])}
for i in range(4):
    for gram in ngrams_all[i+1]:
        if gram not in ngrams_voc[i+1]:
            ngrams_voc[i+1].add(gram)
total_ngrams = {1:-1, 2:-1, 3:-1, 4:-1}
total_voc = {1:-1, 2:-1, 3:-1, 4:-1}
for i in range(4):
    total_ngrams[i+1] = len(ngrams_all[i+1])
    total_voc[i+1] = len(ngrams_voc[i+1])

ngrams_prob = {1:[], 2:[], 3:[], 4:[]}
for i in range(4):
    for ngram in ngrams_voc[i+1]:
        tlist = [ngram]
        tlist.append(ngrams_all[i+1].count(ngram))
        ngrams_prob[i+1].append(tlist)
```


Next word Prediction

```
In [12]:
str1 = 'after that alice said the'
str2 = 'alice felt so desperate that she was'
```

```
In [13]:
token_1 = word_tokenize(str1)
token_2 = word_tokenize(str2)
ngram_1 = {1:[], 2:[], 3:[]}  #To store the n-grams formed
ngram_2 = {1:[], 2:[], 3:[]}
for i in range(3):
    ngram_1[i+1] = list(ngrams(token_1, i+1))[-1]
    ngram_2[i+1] = list(ngrams(token_2, i+1))[-1]
print("String 1: ", ngram_1,"\nString 2: ",ngram_2)
```

```
String 1:  {1: ('the',), 2: ('said', 'the'), 3: ('alice', 'said', 'the')}
String 2:  {1: ('was',), 2: ('she', 'was'), 3: ('that', 'she', 'was')}
```

```
In [14]:
for i in range(4):
    ngrams_prob[i+1] = sorted(ngrams_prob[i+1], key = lambda x:x[1], reverse = True)

pred_1 = {1:[], 2:[], 3:[]}
for i in range(3):
    count = 0
    for each in ngrams_prob[i+2]:
        if each[0][:-1] == ngram_1[i+1]:
#to find predictions based on highest probability of n-grams

            count +=1
            pred_1[i+1].append(each[0][-1])
            if count ==5:
                break
    if count<5:
        while(count!=5):
            pred_1[i+1].append("NOT FOUND")
#if no word prediction is found, replace with NOT FOUND
            count +=1
for i in range(4):
    ngrams_prob[i+1] = sorted(ngrams_prob[i+1], key = lambda x:x[1], reverse = True)

pred_2 = {1:[], 2:[], 3:[]}
for i in range(3):
    count = 0
    for each in ngrams_prob[i+2]:
        if each[0][:-1] == ngram_2[i+1]:
            count +=1
            pred_2[i+1].append(each[0][-1])
            if count ==5:
                break
    if count<5:
        while(count!=5):
            pred_2[i+1].append("\0")
```


Conclusion: Implementation of stemming for an Indian language: To implement stemming for an Indian language, you can follow these steps: Choose a stemming algorithm. There are a number of stemming algorithms available, such as the Lovins stemmer, the Porter stemmer, and the Krovetz stemmer. Build a language-specific stemmer. Implement the stemming algorithm. Once you have chosen a stemming algorithm and built a language-specific stemmer, you can implement the stemming algorithm in your code. Implementation of stemming for English: To implement stemming for English, you can use the Porter stemmer or the Krovetz stemmer. These stemmers are both widely available and easy to use.