Text Analytics and Mining

- Unstructured text data is being generated all the time
- Text analytics / Text mining involves techniques and algorithms for analyzing text
- Traditional data mining techniques may be used if text is converted to numerical vectors

Key Techniques

- NLTK: stemming, stopwords, punctuation, top words
- WordCloud: visualization
- TF-IDF Vectorizer with sklearn
- Topic Modeling with gensim
- Sentiment analysis with TextBlob

Fig. Text Mining Process

1. Text Preprocessing with NLTK (Natural Language Toolkit)

To properly use NLTK, you need to download various text corpa by running:

- import nltk
- nltk.download()

Otherwise, you may see error messages.

In [ ]:
```
!pip install --upgrade nltk
!conda install nltk
!conda list
```

In [ ]:
```
!pip install nltk
```

In [ ]:
```
import nltk
```

In [ ]:
```
nltk.download()
```

(1) Removing Punctuations & Nomalization

In [2]:
```
s = "Hello!! 2019 was great, isn't it? So is 2020!!!"
```

In [3]:
```
import string
p = string.punctuation
print(p)
```

```
!"#$%&'()*+,-./:;<=>?@[\]^_`{|}~
```

> **maketrans(< intabstring >, < outtabstring >)** returns a translation table that maps each character in the intabstring into the character at the same position in the outtab string.
>
> Then this table is passed to the translate() function.

In [4]:
```
p_out = len(p) * " "
```

In [5]:
```
p_out
```

Out[5]:
```
'                                '
```

In [6]:
```
table_p = str.maketrans(p, p_out)
table_p
```

Out[6]:
```
{33: 32,
 34: 32,
 35: 32,
 36: 32,
 37: 32,
 38: 32,
 39: 32,
 40: 32,
 41: 32,
 42: 32,
 43: 32,
 44: 32,
 45: 32,
 46: 32,
 47: 32,
 58: 32,
 59: 32,
 60: 32,
 61: 32,
 62: 32,
 63: 32,
 64: 32,
 91: 32,
 92: 32,
 93: 32,
 94: 32,
 95: 32,
 96: 32,
 123: 32,
 124: 32,
```

```
 125: 32,
 126: 32}
```

In [7]:
```
s.translate(table_p).lower()
```

Out[7]:
```
'hello   2019 was great  isn t it  so is 2020   '
```

(2) Stemming & Lemmatization

- Stemming is the process for reducing inflected (or sometimes derived) words to their stem, base or root form—generally a written word form.
- Lemmatisation (or lemmatization) in linguistics, is the process of grouping together the different inflected forms of a word so they can be analysed as a single item.
- Lemmatisation is closely related to stemming. The difference is that a stemmer operates on a single word without knowledge of the context, and therefore cannot discriminate between words which have different meanings depending on part of speech. However, stemmers are typically easier to implement and run faster, and the reduced accuracy may not matter for some applications.

In [8]:
```
from nltk.stem.lancaster import LancasterStemmer
ls = LancasterStemmer()

from nltk.stem.porter import PorterStemmer
ps = PorterStemmer()

from nltk.stem.snowball import SnowballStemmer
ss = SnowballStemmer("english")

from nltk.stem import WordNetLemmatizer
wnl = WordNetLemmatizer()
```

In [9]:
```
ps.stem('says')
```

Out[9]:
```
'say'
```

In [10]:
```
words = ['string', 'bringing', 'maximum', 'roughly', 'would',
         'multiply', 'provision', 'saying', 'saw', 'dogs', 'churches']
```

In [13]:
```
for word in words:
    print('Word: {}\tLancaster: {}\tPorter: {}\tSnowball: {}\tWordNet: {}'.format(word,
```

```
Word: string    Lancaster: string       Porter: string  Snowball: string        WordNet:
string
Word: bringing  Lancaster: bring        Porter: bring   Snowball: bring WordNet: bringin
g
Word: maximum   Lancaster: maxim        Porter: maximum Snowball: maximum       WordNet:
maximum
Word: roughly   Lancaster: rough        Porter: roughli Snowball: rough WordNet: roughly
Word: would     Lancaster: would        Porter: would   Snowball: would WordNet: would
Word: multiply  Lancaster: multiply     Porter: multipli        Snowball: multipli
```

```
WordNet: multiply
Word: provision Lancaster: provid       Porter: provis  Snowball: provis        WordNet:
provision
Word: saying    Lancaster: say  Porter: say     Snowball: say   WordNet: saying
Word: saw       Lancaster: saw  Porter: saw     Snowball: saw   WordNet: saw
Word: dogs      Lancaster: dog  Porter: dog     Snowball: dog   WordNet: dog
Word: churches  Lancaster: church       Porter: church  Snowball: church        WordNet:
church
```

(3) Removing Stopwords

In [14]:
```
# Create a List of Words
infile = open('frankenstein.txt')
words = infile.read().lower().split() # Normalization
infile.close()
```

> ***nltk.FreqDist( ):*** A frequency distribution for the outcomes of an experiment. Formally, a frequency distribution can be defined as a function mapping from each sample to the number of times that sample occurred as an outcome. For example, it will produce a frequency distribution that encodes how often each word occurs in a text.
>
> http://www.nltk.org/api/nltk.html?highlight=freqdist#nltk.probability.FreqDist

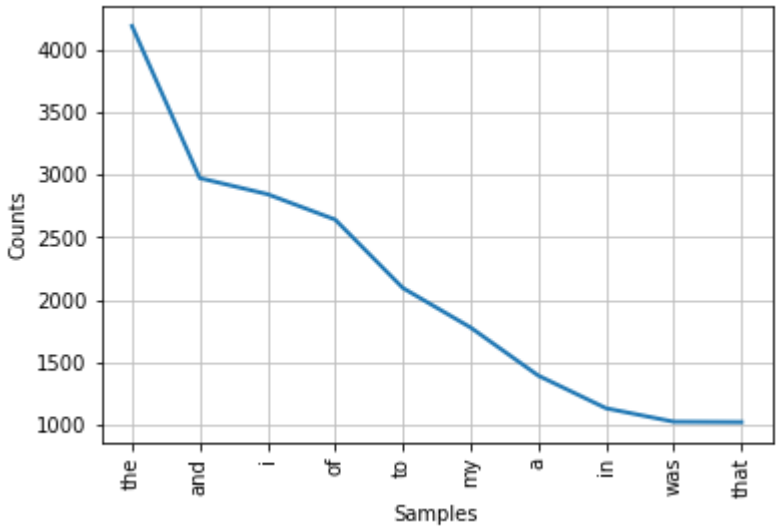
In [15]:
```
# Get Frequent Words
freq = nltk.FreqDist(words)
freq
```

Out[15]:
```
FreqDist({'the': 4196, 'and': 2976, 'i': 2847, 'of': 2643, 'to': 2094, 'my': 1777, 'a':
1391, 'in': 1129, 'was': 1021, 'that': 1018, ...})
```

In [16]:
```
freq['frankenstein']
```

Out[16]:
```
28
```

In [17]:
```
# Get a Plot of the Top 10 Most Frequent Words
%matplotlib inline
freq.plot(10)
```



Out[17]: <AxesSubplot:xlabel='Samples', ylabel='Counts'>

> ***Most of them are stopwords... We need to remove stopwords...***

In [20]:
```
stopwords = nltk.corpus.stopwords.words('english')

print(type(stopwords))
print(len(stopwords))
print(stopwords)
```

```
<class 'list'>
179
['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
"you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himse
lf', 'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 't
hem', 'their', 'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that',
"that'll", 'these', 'those', 'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'h
ave', 'has', 'had', 'having', 'do', 'does', 'did', 'doing', 'a', 'an', 'the', 'and', 'bu
t', 'if', 'or', 'because', 'as', 'until', 'while', 'of', 'at', 'by', 'for', 'with', 'abo
ut', 'against', 'between', 'into', 'through', 'during', 'before', 'after', 'above', 'bel
ow', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'fu
rther', 'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'b
oth', 'each', 'few', 'more', 'most', 'other', 'some', 'such', 'no', 'nor', 'not', 'onl
y', 'own', 'same', 'so', 'than', 'too', 'very', 's', 't', 'can', 'will', 'just', 'don',
"don't", 'should', "should've", 'now', 'd', 'll', 'm', 'o', 're', 've', 'y', 'ain', 'are
n', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn', "had
n't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't",
'mustn', "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'was
n', "wasn't", 'weren', "weren't", 'won', "won't", 'wouldn', "wouldn't"]
```

In [21]:
```
stopwords.append('would')
print(stopwords)
```

```
['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
"you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himse
lf', 'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 't
hem', 'their', 'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that',
"that'll", 'these', 'those', 'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'h
ave', 'has', 'had', 'having', 'do', 'does', 'did', 'doing', 'a', 'an', 'the', 'and', 'bu
t', 'if', 'or', 'because', 'as', 'until', 'while', 'of', 'at', 'by', 'for', 'with', 'abo
ut', 'against', 'between', 'into', 'through', 'during', 'before', 'after', 'above', 'bel
ow', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'fu
```

```
rther', 'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'b
oth', 'each', 'few', 'more', 'most', 'other', 'some', 'such', 'no', 'nor', 'not', 'onl
y', 'own', 'same', 'so', 'than', 'too', 'very', 's', 't', 'can', 'will', 'just', 'don',
"don't", 'should', "should've", 'now', 'd', 'll', 'm', 'o', 're', 've', 'y', 'ain', 'are
n', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn', "had
n't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't",
'mustn', "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'was
n', "wasn't", 'weren', "weren't", 'won', "won't", 'wouldn', "wouldn't", 'would']
```

In [22]:

```
infile = open('frankenstein.txt')
words = infile.read().lower().split() # Normalization
infile.close()

words2 = []
for w in words:
    if w not in stopwords:
        words2.append(w)

print(len(words))
print(len(words2))
```

```
75271
34507
```

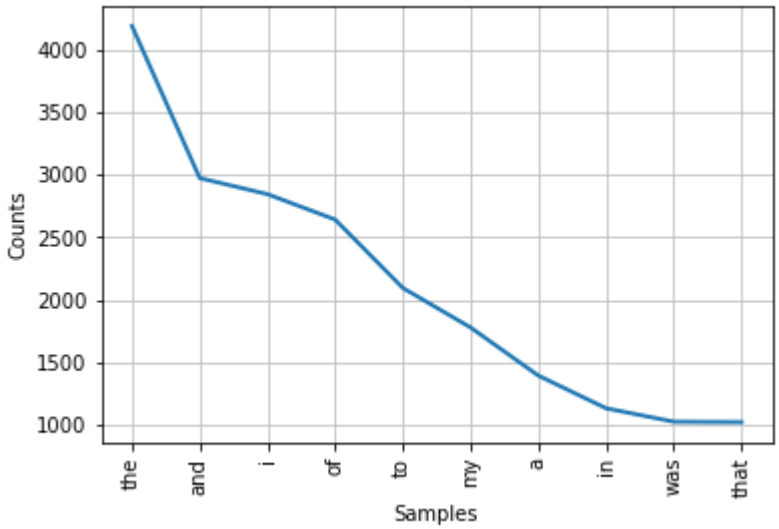
In [23]:

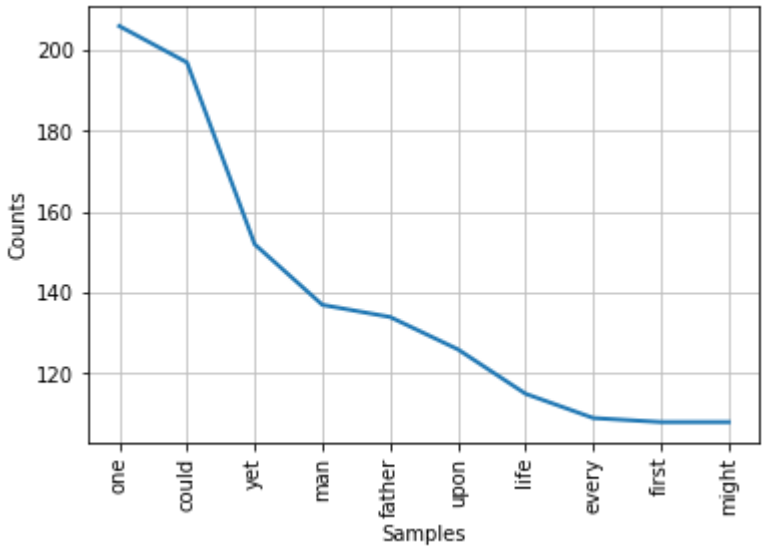
```
# Remove Stopwords From the "words" List
words2 = []
for w in words:
    if w not in stopwords and len(w) > 1:
        words2.append(w)

print(len(words))
print(len(words2))
```

```
75271
34487
```

In [24]:

```
freq = nltk.FreqDist(words)
freq2 = nltk.FreqDist(words2)
freq.plot(10)
freq2.plot(10)
```





Out[24]: <AxesSubplot:xlabel='Samples', ylabel='Counts'>

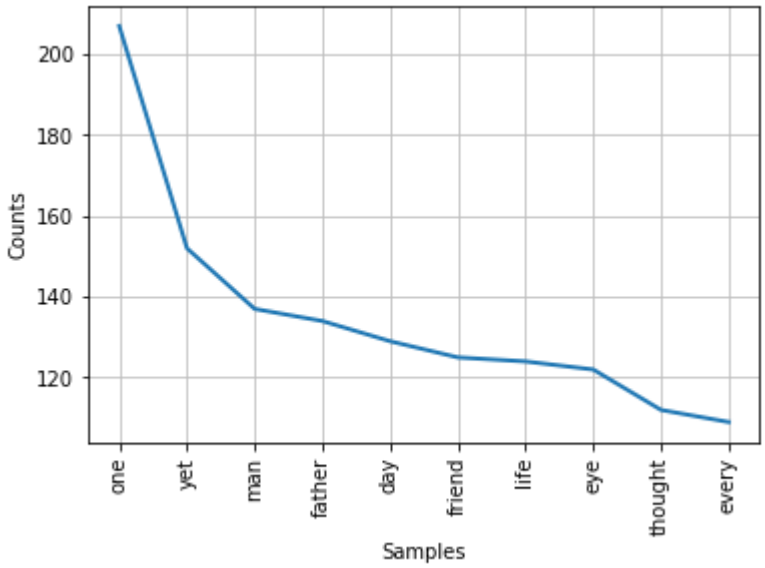
(4) Example: frankenstein.txt

Getting the Word Frequency After Pre-Processing

In [25]:

```
import nltk
import string
from nltk.stem import WordNetLemmatizer
%matplotlib inline

#(1) Load the Data
infile = open('frankenstein.txt')
content = infile.read()
infile.close()

#(2) Normalization and Removing Punctuatiion
p = string.punctuation
table_p = str.maketrans(p, len(p) * " ")

l_content = content.lower() # Normalization
n_content = l_content.translate(table_p) # Removing Punctuation

#(3) Removing Stopwords
stopwords = nltk.corpus.stopwords.words('english')
stopwords.append('could')
stopwords.append('would')
stopwords.append('upon')

words = n_content.split()

rs_words = []
for w in words:
    if w not in stopwords:
        rs_words.append(w)

#(4) Lemmatizing
wnl = WordNetLemmatizer()
```

```
le_words = []
for w in rs_words:
    le_words.append(wnl.lemmatize(w))

#(5) Getting the Word Frequency
freq = nltk.FreqDist(le_words)
freq.plot(10)
```



Out[25]: <AxesSubplot:xlabel='Samples', ylabel='Counts'>