Text Analytics - Assignment 7

Importing Libraries

```
In [1]:   from nltk import word_tokenize, pos_tag
          from nltk.corpus import stopwords
          from nltk.stem import PorterStemmer, WordNetLemmatizer
          import math
```

Text

```
In [2]:   text = ["Millions of people in India took part in an annual tree planting dri
          "More than 250 million saplings were planted in a single day across the count
          "The campaign was led by Uttar Pradesh state government officials, lawmakers,
          "Where were the trees planted?",
          "The saplings were planted by volunteers in forests, farms, schools, and alon
          "\"We are committed to increasing the forest cover of Uttar Pradesh to over 1
          "According to another government official, the forest cover of the state has
          "\"There has been an increase of 127 sqare kilometers [79 sqare miles] in the
          "\"There has also been an increase in trees and plants. The tree cover has in
          "How many saplings survive?",
          "Uttar Pradesh State Forest Minister Dara Singh said the long-term survival o
          "The rest succumb to disease or lack of water.",
          "However, he said that about 80% of the saplings planted in the last four ann
          "\"All the regions where plantation is being carried out have been geo-tagged
          "\"These saplings carry QR codes so that officials can maintain a record and
          "What is the extent of India's tree planting project?",
          "India has vowed to have a third of its total land area, or 95 million hectar
          "The government has allocated $6.2 billion (€5.2 billion) for the tree-planti
          "However, industrial development and a rapidly growing population has put fur
          ]
```

Tokenization

```
In [3]:   tokens = word_tokenize(text=text[1])
          print(tokens)
```

```
['More', 'than', '250', 'million', 'saplings', 'were', 'planted', 'in', 'a',
'single', 'day', 'across', 'the', 'country', "'s", 'most-populous', 'state',
'.']
```

POS Tagging

```
In [4]:   postag = pos_tag(tokens=tokens)
          print(postag)
```

```
[('More', 'JJR'), ('than', 'IN'), ('250', 'CD'), ('million', 'CD'), ('sapling
s', 'NNS'), ('were', 'VBD'), ('planted', 'VBN'), ('in', 'IN'), ('a', 'DT'),
('single', 'JJ'), ('day', 'NN'), ('across', 'IN'), ('the', 'DT'), ('country',
'NN'), ("'s", 'POS'), ('most-populous', 'JJ'), ('state', 'NN'), ('.', '.')]
```

Stop words removal

```
In [5]:   stopWords = stopwords.words('english')
```

```
Stop = []

for i in range(len(tokens)):
    if tokens[i].lower() not in stopWords:
        Stop.append(tokens[i])

print(Stop)
```

```
['250', 'million', 'saplings', 'planted', 'single', 'day', 'across', 'countr
y', "'s", 'most-populous', 'state', '.']
```

Stemming

In [6]:
```
Stem = []
for i in tokens:
    Stem.append(PorterStemmer().stem(i))

print(Stem)
```

```
['more', 'than', '250', 'million', 'sapl', 'were', 'plant', 'in', 'a', 'sing
l', 'day', 'across', 'the', 'countri', "'s", 'most-popul', 'state', '.']
```

Lemmatization

In [7]:
```
Lem = []
for i in tokens:
    Lem.append(WordNetLemmatizer().lemmatize(i))

print(Lem)
```

```
['More', 'than', '250', 'million', 'sapling', 'were', 'planted', 'in', 'a', 's
ingle', 'day', 'across', 'the', 'country', "'s", 'most-populous', 'state',
'.']
```

In [8]:
```
Preprocessed = []
for i in text:
    toks = word_tokenize(text=i)
    temp = []
    for j in toks:
        if j.lower() not in stopWords:
            WordNetLemmatizer().lemmatize(j)
            temp.append(j)
    Preprocessed.append(temp)
print(Preprocessed)
```

```
[['Millions', 'people', 'India', 'took', 'part', 'annual', 'tree', 'planting',
'drive', 'Sunday', '.'], ['250', 'million', 'saplings', 'planted', 'single',
'day', 'across', 'country', "'s", 'most-populous', 'state', '.'], ['campaign',
'led', 'Uttar', 'Pradesh', 'state', 'government', 'officials', ',', 'lawmaker
s', ',', 'activists', ',', 'bid', 'reduce', 'carbon', 'emissions', 'combat',
'climate', 'change', '.'], ['trees', 'planted', '?'], ['saplings', 'planted',
'volunteers', 'forests', ',', 'farms', ',', 'schools', ',', 'along', 'riverban
ks', 'highways', '.'], ['``', 'committed', 'increasing', 'forest', 'cover', 'U
ttar', 'Pradesh', '15', '%', 'total', 'land', 'area', 'next', 'five', 'years',
',', "''", 'said', 'state', 'forest', 'official', 'Manoj', 'Singh', '.'], ['Ac
cording', 'another', 'government', 'official', ',', 'forest', 'cover', 'stat
e', 'increased', 'last', 'years', '.'], ['``', 'increase', '127', 'sqare', 'ki
lometers', '[', '79', 'sqare', 'miles', ']', 'forest', 'cover', 'Uttar', 'Prad
esh', 'compared', '2017', ',', "''", 'state', 'government', 'spokesperson', 'q
uoted', 'saying', 'Indian', 'Express', 'newspaper', '.'], ['``', 'also', 'incr
ease', 'trees', 'plants', '.', 'tree', 'cover', 'increased', '3.05', '%', ',',
'compared', 'national', 'average', '2.89', '%', ',', "''", 'official', 'said',
',', 'citing', '2019', 'Forest', 'Survey', 'India', 'report', '.'], ['many',
```

```
'saplings', 'survive', '?'], ['Uttar', 'Pradesh', 'State', 'Forest', 'Ministe
r', 'Dara', 'Singh', 'said', 'long-term', 'survival', 'saplings', 'remains',
'concern', ',', 'adding', 'usually', '60', '%', 'saplings', 'survive', '.'],
['rest', 'succumb', 'disease', 'lack', 'water', '.'], ['However', ',', 'said',
'80', '%', 'saplings', 'planted', 'last', 'four', 'annual', 'drives', 'survive
d', '.'], ['``', 'regions', 'plantation', 'carried', 'geo-tagged', 'ascertai
n', 'exactly', 'happened', ',', "'", 'Chauhan', 'told', 'Pioneer', 'newspape
r', '.'], ['``', 'saplings', 'carry', 'QR', 'codes', 'officials', 'maintain',
'record', 'verify', 'whether', 'saplings', 'survived', '.', 'Besides', ',', 't
eams', 'formed', 'monitor', 'progress', 'plantation', 'drive', ',', "'", 'sai
d', '.'], ['extent', 'India', "'s", 'tree', 'planting', 'project', '?'], ['Ind
ia', 'vowed', 'third', 'total', 'land', 'area', ',', '95', 'million', 'hectare
s', ',', 'forest', 'tree', 'cover', '2030', '.'], ['government', 'allocated',
'$', '6.2', 'billion', '(', '€5.2', 'billion', ')', 'tree-planting', 'across',
'country', '.'], ['However', ',', 'industrial', 'development', 'rapidly', 'gro
wing', 'population', 'put', 'stress', 'land', '.']]
```

In [9]:
```python
Count = {}
for i in Preprocessed:
    temp = {}
    for j in i:
        if j in temp:
            temp[j] += 1
        else:
            temp[j] = 1
    Count[len(i)] = temp
print(Count)
```

```
{11: {'However': 1, ',': 1, 'industrial': 1, 'development': 1, 'rapidly': 1,
'growing': 1, 'population': 1, 'put': 1, 'stress': 1, 'land': 1, '.': 1}, 12:
{'According': 1, 'another': 1, 'government': 1, 'official': 1, ',': 1, 'fores
t': 1, 'cover': 1, 'state': 1, 'increased': 1, 'last': 1, 'years': 1, '.': 1},
20: {'campaign': 1, 'led': 1, 'Uttar': 1, 'Pradesh': 1, 'state': 1, 'governmen
t': 1, 'officials': 1, ',': 3, 'lawmakers': 1, 'activists': 1, 'bid': 1, 'redu
ce': 1, 'carbon': 1, 'emissions': 1, 'combat': 1, 'climate': 1, 'change': 1,
'.': 1}, 3: {'trees': 1, 'planted': 1, '?': 1}, 13: {'government': 1, 'allocat
ed': 1, '$': 1, '6.2': 1, 'billion': 2, '(': 1, '€5.2': 1, ')': 1, 'tree-plant
ing': 1, 'across': 1, 'country': 1, '.': 1}, 24: {'``': 1, 'committed': 1, 'in
creasing': 1, 'forest': 2, 'cover': 1, 'Uttar': 1, 'Pradesh': 1, '15': 1, '%':
1, 'total': 1, 'land': 1, 'area': 1, 'next': 1, 'five': 1, 'years': 1, ',': 1,
"'": 1, 'said': 1, 'state': 1, 'official': 1, 'Manoj': 1, 'Singh': 1, '.':
1}, 27: {'``': 1, 'increase': 1, '127': 1, 'sqare': 2, 'kilometers': 1, '[':
1, '79': 1, 'miles': 1, ']': 1, 'forest': 1, 'cover': 1, 'Uttar': 1, 'Prades
h': 1, 'compared': 1, '2017': 1, ',': 1, "'": 1, 'state': 1, 'government': 1,
'spokesperson': 1, 'quoted': 1, 'saying': 1, 'Indian': 1, 'Express': 1, 'newsp
aper': 1, '.': 1}, 29: {'``': 1, 'also': 1, 'increase': 1, 'trees': 1, 'plant
s': 1, '.': 2, 'tree': 1, 'cover': 1, 'increased': 1, '3.05': 1, '%': 2, ',':
3, 'compared': 1, 'national': 1, 'average': 1, '2.89': 1, "'": 1, 'official':
1, 'said': 1, 'citing': 1, '2019': 1, 'Forest': 1, 'Survey': 1, 'India': 1, 'r
eport': 1}, 4: {'many': 1, 'saplings': 1, 'survive': 1, '?': 1}, 21: {'Uttar':
1, 'Pradesh': 1, 'State': 1, 'Forest': 1, 'Minister': 1, 'Dara': 1, 'Singh':
1, 'said': 1, 'long-term': 1, 'survival': 1, 'saplings': 2, 'remains': 1, 'con
cern': 1, ',': 1, 'adding': 1, 'usually': 1, '60': 1, '%': 1, 'survive': 1,
'.': 1}, 6: {'rest': 1, 'succumb': 1, 'disease': 1, 'lack': 1, 'water': 1,
'.': 1}, 15: {'``': 1, 'regions': 1, 'plantation': 1, 'carried': 1, 'geo-tagge
d': 1, 'ascertain': 1, 'exactly': 1, 'happened': 1, ',': 1, "'": 1, 'Chauha
n': 1, 'told': 1, 'Pioneer': 1, 'newspaper': 1, '.': 1}, 25: {'``': 1, 'saplin
gs': 2, 'carry': 1, 'QR': 1, 'codes': 1, 'officials': 1, 'maintain': 1, 'recor
d': 1, 'verify': 1, 'whether': 1, 'survived': 1, '.': 2, 'Besides': 1, ',': 2,
'teams': 1, 'formed': 1, 'monitor': 1, 'progress': 1, 'plantation': 1, 'driv
e': 1, "'": 1, 'said': 1}, 7: {'extent': 1, 'India': 1, "'s": 1, 'tree': 1,
'planting': 1, 'project': 1, '?': 1}, 16: {'India': 1, 'vowed': 1, 'third': 1,
'total': 1, 'land': 1, 'area': 1, ',': 2, '95': 1, 'million': 1, 'hectares':
1, 'forest': 1, 'tree': 1, 'cover': 1, '2030': 1, '.': 1}}
```

Term Frequency Calculation

In [10]:
```python
TF = {}
for total, sentences in Count.items():
    temp = {}
    for word, count in sentences.items():
        temp[word] = count/total
    TF[total] = temp
print(TF)
```

{11: {'However': 0.09090909090909091, ',': 0.09090909090909091, 'industrial': 0.09090909090909091, 'development': 0.09090909090909091, 'rapidly': 0.09090909090909091, 'growing': 0.09090909090909091, 'population': 0.09090909090909091, 'put': 0.09090909090909091, 'stress': 0.09090909090909091, 'land': 0.09090909090909091, '.': 0.09090909090909091}, 12: {'According': 0.08333333333333333, 'another': 0.08333333333333333, 'government': 0.08333333333333333, 'official': 0.08333333333333333, ',': 0.08333333333333333, 'forest': 0.08333333333333333, 'cover': 0.08333333333333333, 'state': 0.08333333333333333, 'increased': 0.08333333333333333, 'last': 0.08333333333333333, 'years': 0.08333333333333333, '.': 0.08333333333333333}, 20: {'campaign': 0.05, 'led': 0.05, 'Uttar': 0.05, 'Pradesh': 0.05, 'state': 0.05, 'government': 0.05, 'officials': 0.05, ',': 0.15, 'lawmakers': 0.05, 'activists': 0.05, 'bid': 0.05, 'reduce': 0.05, 'carbon': 0.05, 'emissions': 0.05, 'combat': 0.05, 'climate': 0.05, 'change': 0.05, '.': 0.05}, 3: {'trees': 0.3333333333333333, 'planted': 0.3333333333333333, '?': 0.3333333333333333}, 13: {'government': 0.07692307692307693, 'allocated': 0.07692307692307693, '$': 0.07692307692307693, '6.2': 0.07692307692307693, 'billion': 0.15384615384615385, '(': 0.07692307692307693, '€5.2': 0.07692307692307693, ')': 0.07692307692307693, 'tree-planting': 0.07692307692307693, 'across': 0.07692307692307693, 'country': 0.07692307692307693, '.': 0.07692307692307693}, 24: {'``': 0.041666666666666664, 'committed': 0.041666666666666664, 'increasing': 0.041666666666666664, 'forest': 0.08333333333333333, 'cover': 0.041666666666666664, 'Uttar': 0.041666666666666664, 'Pradesh': 0.041666666666666664, '15': 0.041666666666666664, '%': 0.041666666666666664, 'total': 0.041666666666666664, 'land': 0.041666666666666664, 'area': 0.041666666666666664, 'next': 0.041666666666666664, 'five': 0.041666666666666664, 'years': 0.041666666666666664, ',': 0.041666666666666664, "''": 0.041666666666666664, 'said': 0.041666666666666664, 'state': 0.041666666666666664, 'official': 0.041666666666666664, 'Manoj': 0.041666666666666664, 'Singh': 0.041666666666666664, '.': 0.041666666666666664}, 27: {'``': 0.037037037037037035, 'increase': 0.037037037037037035, '127': 0.037037037037037035, 'sqare': 0.07407407407407407, 'kilometers': 0.037037037037037035, '[': 0.037037037037037035, '79': 0.037037037037037035, 'miles': 0.037037037037037035, ']': 0.037037037037037035, 'forest': 0.037037037037037035, 'cover': 0.037037037037037035, 'Uttar': 0.037037037037037035, 'Pradesh': 0.037037037037037035, 'compared': 0.037037037037037035, '2017': 0.037037037037037035, ',': 0.037037037037037035, "''": 0.037037037037037035, 'state': 0.037037037037037035, 'government': 0.037037037037037035, 'spokesperson': 0.037037037037037035, 'quoted': 0.037037037037037035, 'saying': 0.037037037037037035, 'Indian': 0.037037037037037035, 'Express': 0.037037037037037035, 'newspaper': 0.037037037037037035, '.': 0.037037037037037035}, 29: {'``': 0.034482758620689655, 'also': 0.034482758620689655, 'increase': 0.034482758620689655, 'trees': 0.034482758620689655, 'plants': 0.034482758620689655, '.': 0.06896551724137931, 'tree': 0.034482758620689655, 'cover': 0.034482758620689655, 'increased': 0.034482758620689655, '3.05': 0.034482758620689655, '%': 0.06896551724137931, ',': 0.10344827586206896, 'compared': 0.034482758620689655, 'national': 0.034482758620689655, 'average': 0.034482758620689655, '2.89': 0.034482758620689655, "''": 0.034482758620689655, 'official': 0.034482758620689655, 'said': 0.034482758620689655, 'citing': 0.034482758620689655, '2019': 0.034482758620689655, 'Forest': 0.034482758620689655, 'Survey': 0.034482758620689655, 'India': 0.034482758620689655, 'report': 0.034482758620689655}, 4: {'many': 0.25, 'saplings': 0.25, 'survive': 0.25, '?': 0.25}, 21: {'Uttar': 0.047619047619047616, 'Pradesh': 0.047619047619047616, 'State': 0.047619047619047616, 'Forest': 0.047619047619047616, 'Minister': 0.047619047619047616, 'Dara': 0.047619047619047616, 'Singh': 0.047619047619047616, 'said': 0.047619047619047616, 'long-term': 0.047619047619047616, 'survival': 0.047619047619047616, 'saplings': 0.09523809523809523, 'remains': 0.047619047619047616, 'concern': 0.047619047619047616, ',': 0.047619047619047616, 'adding': 0.047619047619047616, 'usually': 0.047619047619047616, '60': 0.047619047619047616, '%': 0.047619047619047616, 'survive': 0.047619047619047616, '.': 0.047619047619047616}, 6: {'rest': 0.16666666666666666, 'succumb': 0.16666666666666666, 'disease': 0.16666666666666666, 'lack': 0.16666666666666666, 'water': 0.16666666666666666, '.': 0.16666666666666666}, 15: {'``': 0.06666666666666667, 'regions': 0.06666666666666667, 'plantatio

```
n': 0.06666666666666667, 'carried': 0.06666666666666667, 'geo-tagged': 0.06666
666666666667, 'ascertain': 0.06666666666666667, 'exactly': 0.0666666666666666
7, 'happened': 0.06666666666666667, ',': 0.06666666666666667, "'''": 0.06666666
666666667, 'Chauhan': 0.06666666666666667, 'told': 0.06666666666666667, 'Pione
er': 0.06666666666666667, 'newspaper': 0.06666666666666667, '.': 0.06666666666
666667}, 25: {'``': 0.04, 'saplings': 0.08, 'carry': 0.04, 'QR': 0.04, 'code
s': 0.04, 'officials': 0.04, 'maintain': 0.04, 'record': 0.04, 'verify': 0.04,
'whether': 0.04, 'survived': 0.04, '.': 0.08, 'Besides': 0.04, ',': 0.08, 'tea
ms': 0.04, 'formed': 0.04, 'monitor': 0.04, 'progress': 0.04, 'plantation': 0.
04, 'drive': 0.04, "'''": 0.04, 'said': 0.04}, 7: {'extent': 0.1428571428571428
5, 'India': 0.14285714285714285, "'s": 0.14285714285714285, 'tree': 0.14285714
285714285, 'planting': 0.14285714285714285, 'project': 0.14285714285714285,
'?': 0.14285714285714285}, 16: {'India': 0.0625, 'vowed': 0.0625, 'third': 0.0
625, 'total': 0.0625, 'land': 0.0625, 'area': 0.0625, ',': 0.125, '95': 0.062
5, 'million': 0.0625, 'hectares': 0.0625, 'forest': 0.0625, 'tree': 0.0625, 'c
over': 0.0625, '2030': 0.0625, '.': 0.0625}}
```

In [11]:
```python
docs = len(text)
```

In [12]:
```python
wdocs = {}
for total, sentences in Count.items():
    for word, count in sentences.items():
        if word in wdocs:
            wdocs[word] += 1
        else:
            wdocs[word] = 1
print(wdocs)
```

```
{'However': 1, ',': 10, 'industrial': 1, 'development': 1, 'rapidly': 1, 'grow
ing': 1, 'population': 1, 'put': 1, 'stress': 1, 'land': 3, '.': 12, 'Accordin
g': 1, 'another': 1, 'government': 4, 'official': 3, 'forest': 4, 'cover': 5,
'state': 4, 'increased': 2, 'last': 1, 'years': 2, 'campaign': 1, 'led': 1, 'U
ttar': 4, 'Pradesh': 4, 'officials': 2, 'lawmakers': 1, 'activists': 1, 'bid':
1, 'reduce': 1, 'carbon': 1, 'emissions': 1, 'combat': 1, 'climate': 1, 'chang
e': 1, 'trees': 2, 'planted': 1, '?': 3, 'allocated': 1, '$': 1, '6.2': 1, 'bi
llion': 1, '(': 1, '€5.2': 1, ')': 1, 'tree-planting': 1, 'across': 1, 'countr
y': 1, '``': 5, 'committed': 1, 'increasing': 1, '15': 1, '%': 3, 'total': 2,
'area': 2, 'next': 1, 'five': 1, "'''": 5, 'said': 4, 'Manoj': 1, 'Singh': 2,
'increase': 2, '127': 1, 'sqare': 1, 'kilometers': 1, '[': 1, '79': 1, 'mile
s': 1, ']': 1, 'compared': 2, '2017': 1, 'spokesperson': 1, 'quoted': 1, 'sayi
ng': 1, 'Indian': 1, 'Express': 1, 'newspaper': 2, 'also': 1, 'plants': 1, 'tr
ee': 3, '3.05': 1, 'national': 1, 'average': 1, '2.89': 1, 'citing': 1, '201
9': 1, 'Forest': 2, 'Survey': 1, 'India': 3, 'report': 1, 'many': 1, 'sapling
s': 3, 'survive': 2, 'State': 1, 'Minister': 1, 'Dara': 1, 'long-term': 1, 'su
rvival': 1, 'remains': 1, 'concern': 1, 'adding': 1, 'usually': 1, '60': 1, 'r
est': 1, 'succumb': 1, 'disease': 1, 'lack': 1, 'water': 1, 'regions': 1, 'pla
ntation': 2, 'carried': 1, 'geo-tagged': 1, 'ascertain': 1, 'exactly': 1, 'hap
pened': 1, 'Chauhan': 1, 'told': 1, 'Pioneer': 1, 'carry': 1, 'QR': 1, 'code
s': 1, 'maintain': 1, 'record': 1, 'verify': 1, 'whether': 1, 'survived': 1,
'Besides': 1, 'teams': 1, 'formed': 1, 'monitor': 1, 'progress': 1, 'drive':
1, 'extent': 1, "'s": 1, 'planting': 1, 'project': 1, 'vowed': 1, 'third': 1,
'95': 1, 'million': 1, 'hectares': 1, '2030': 1}
```

Inverse Document Frequency Calculation

In [13]:
```python
IDF = {}
for total, sentences in Count.items():
    for word in sentences.keys():
        IDF[word] = math.log10(docs/float(wdocs[word]))
print(IDF)
```

```
{'However': 1.2787536009528289, ',': 0.2787536009528289, 'industrial': 1.27875
36009528289, 'development': 1.2787536009528289, 'rapidly': 1.2787536009528289,
'growing': 1.2787536009528289, 'population': 1.2787536009528289, 'put': 1.2787
```

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