Lab 8

Gaining Early Insights from Textual Data

In [ ]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import FunctionTransformer

# suppress warnings
import warnings
warnings.filterwarnings('ignore')
```

```
C:\Users\naumh\AppData\Local\Temp\ipykernel_25272\3073577173.py:1: DeprecationWarning:
Pyarrow will become a required dependency of pandas in the next major release of pandas (pandas 3.0),
(to allow more performant data types, such as the Arrow string type, and better interoperability with other librarie
s)
but was not found to be installed on your system.
If this would cause problems for you,
please provide us feedback at https://github.com/pandas-dev/pandas/issues/54466

  import pandas as pd
```

Introducing the Dataset

In [ ]:
```
# Load some data from UN debates
df = pd.read_csv('https://github.com/blueprints-for-text-analytics-python/blueprints-text/raw/master/data/un-general-

# take a sample of 1000 rows for faster processing
df = df.sample(1000, random_state=42)
df.head()
```

Out[ ]:

	session	year	country	country_name	speaker	position	text
4456	54	1999	ZAF	South Africa	Thabo Mbeki	President	On behalf of our Government and\nin my capacit...
5603	61	2006	BRA	Brazil	Mr. Lula Da Silva	President	When I first \naddressed the Assembly from thi...
4685	56	2001	DZA	Algeria	Abdelaziz Belkhadem	Minister for Foreign Affairs	This\nsession is taking place at a time when ...
1055	33	1978	NIC	Nicaragua	Quintana	NaN	\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n388.\tIt ...
4812	56	2001	UKR	Ukraine	Anatoliy M. Zlenko	Minister for Foreign Affairs	Allow me at the outset to\ncongratulate the P...

Calculating Summary Statistics for Columns

In [ ]:
```
# create a new column with the length of the text
df['length'] = df['text'].str.len()

# Describe gives summarry statistics (can pass in list-like of dtypes for filtering)
# use the transpose to get a better visual view
df.describe(include='all').T
```

Out[ ]:

	count	unique	top	freq	mean	std	min	25%	50%	75%	max
session	1000.0	NaN	NaN	NaN	48.95	12.888895	25.0	38.0	50.0	60.0	70.0
year	1000.0	NaN	NaN	NaN	1993.95	12.888895	1970.0	1983.0	1995.0	2005.0	2015.0
country	1000	195	GHA	14	NaN	NaN	NaN	NaN	NaN	NaN	NaN
country_name	1000	195	Ghana	14	NaN	NaN	NaN	NaN	NaN	NaN	NaN
speaker	998	946	Haile Weldensae	4	NaN	NaN	NaN	NaN	NaN	NaN	NaN
position	576	32	Minister for Foreign Affairs	226	NaN	NaN	NaN	NaN	NaN	NaN	NaN
text	1000	1000	On behalf of our Government and\nin my capacit...	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
length	1000.0	NaN	NaN	NaN	18274.424	7618.119264	3534.0	12426.5	16727.5	23001.25	54633.0

In [ ]:
```
# use describe(include='O') to describe the object (in this case string) columns
df.describe(include='O').T
```

Out[ ]:

	count	unique	top	freq
country	1000	195	GHA	14
country_name	1000	195	Ghana	14
speaker	998	946	Haile Weldensae	4
position	576	32	Minister for Foreign Affairs	226
text	1000	1000	On behalf of our Government and\nin my capacit...	1

In [ ]:
```
# use describe(include=np.number) to describe the numeric columns
df.describe(include=np.number).T
```

Out[ ]:

	count	mean	std	min	25%	50%	75%	max
session	1000.0	48.950	12.888895	25.0	38.0	50.0	60.00	70.0
year	1000.0	1993.950	12.888895	1970.0	1983.0	1995.0	2005.00	2015.0
length	1000.0	18274.424	7618.119264	3534.0	12426.5	16727.5	23001.25	54633.0

Checking for Missing Data

In [ ]:
```
# find the number of na values in each column
df.isna().sum()
```

Out[ ]:
```
session          0
year             0
country          0
country_name     0
speaker          2
position       424
text             0
length           0
dtype: int64
```

In [ ]:
```
# fill the na values in the speaker column with 'unknown'
df['speaker'].fillna('unknown', inplace=True)
```

In [ ]:
```
# find the number of speakers that contain the subword 'Bush'
df[df['speaker'].str.contains('Bush')]['speaker'].value_counts()
```

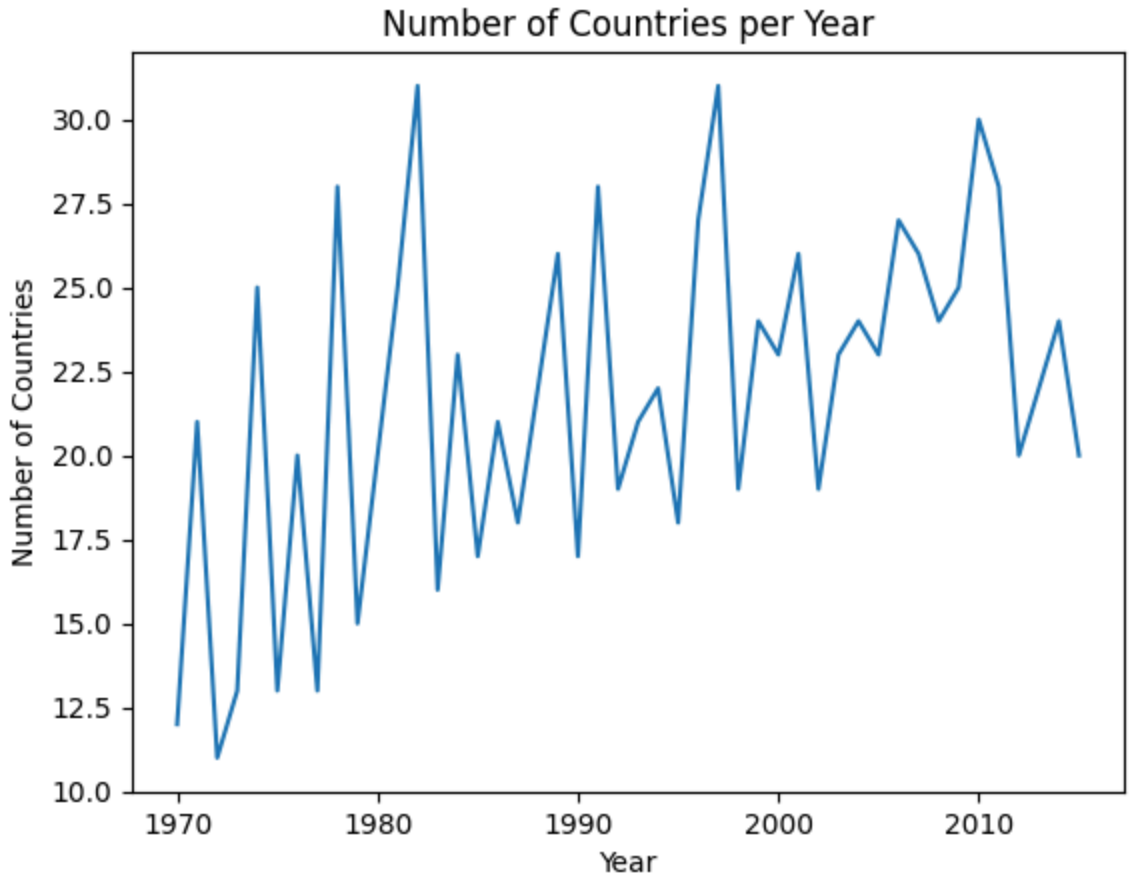
Out[ ]:
```
speaker
Mr. George W Bush    1
George Bush          1
Name: count, dtype: int64
```

Visualizing Developments over Time

In [ ]:
```
# Group by year and count the number of unique countries
countries_per_year = df.groupby('year')['country'].nunique()
```

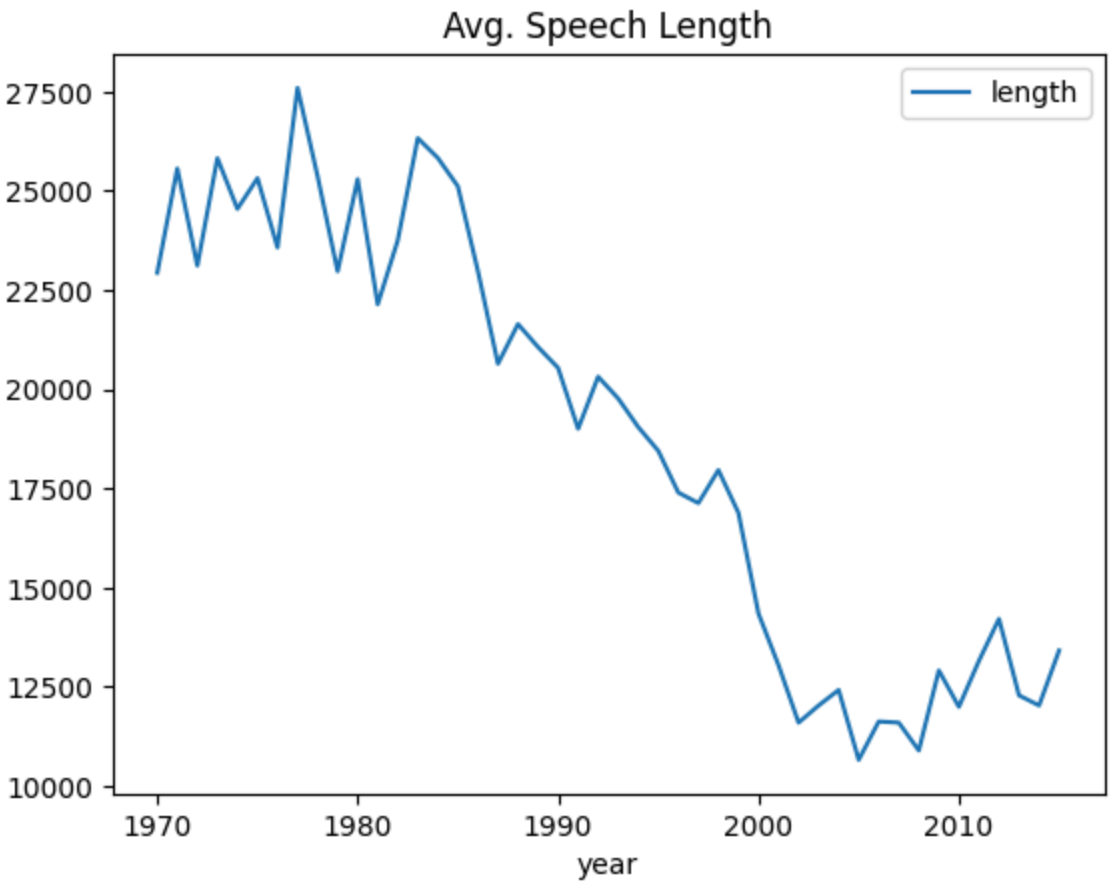
```
# Plot the number of countries per year
countries_per_year.plot(kind='line')

# Setting the titles and labels
plt.title('Number of Countries per Year')
plt.xlabel('Year')
plt.ylabel('Number of Countries')
```

Out[ ]: Text(0, 0.5, 'Number of Countries')



In [ ]:
```
# Can use groupby objects to take advantage of built in aggregation function
df.groupby('year').agg({'length': 'mean'}).plot(title="Avg. Speech Length")
```

Out[ ]: <Axes: title={'center': 'Avg. Speech Length'}, xlabel='year'>



Building a Simple Text Preprocessing Pipeline

Tokenization with Regular Expressions

In [ ]:
```
import regex as re

def tokenize(text):
    return re.findall(r'[\w-]*\p{L}[\w-]*', text)

text = "Let's defeat SARS-CoV-2 together in 2020!"
```

```
tokens = tokenize(text)
print("|".join(tokens))
```

```
Let|s|defeat|SARS-CoV-2|together|in
```

Let's break down the regular expression [\w-]*\p{L}[\w-]*:

[\w-]* : This segment is looking for zero or more (*) occurrences of a "word" character (\w) or a hyphen (-). A "word" character in regex terms includes the set of [a-zA-Z0-9_]. So it will match any alphanumeric (letters and numbers) and underscore characters, as well as hyphens, in any quantity—including none.

\p{L} : This segment stands for any kind of letter from any language. \p{} is a Unicode property escape, and L stands for letter. It will match a single character that is a letter.

[\w-]* : This is the same as the first segment. It's looking for zero or more word characters or hyphens.

So, put all together, [\w-]*\p{L}[\w-]* will match any string that has at least one letter (from any language) that can be surrounded by any number (including zero) of alphanumeric characters, underscores, or hyphens. This pattern allows the letter to appear anywhere within the string.

In [ ]:
```
def lower_text(text):
    return text.lower()
```

Removing Stop Words

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

stopwords = set(nltk.corpus.stopwords.words('english'))

include_stopwords = {'dear', 'regards', 'must', 'would', 'also'}
exclude_stopwords = {'against'}

stopwords |= include_stopwords
stopwords -= exclude_stopwords
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\naumh\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

In [ ]:
```python
def remove_stop(tokens):
    return [t for t in tokens if t.lower() not in stopwords]
```

Processing a Pipeline with one Line of Code

In [ ]:
```python
to_lower_transformer = FunctionTransformer(lower_text)
tokenizer_transformer = FunctionTransformer(tokenize)
remove_stop_transformer = FunctionTransformer(remove_stop)

# Build the pipeline
pipeline_sk = Pipeline([
    ('lower_text', to_lower_transformer),
    ('tokenizer', tokenizer_transformer),
    ('remove_stop', remove_stop_transformer)
])

# Now you can fit and transform text with the pipeline
prepared_text = pipeline_sk.fit_transform('This is a sample text')
print(prepared_text)
```

```
['sample', 'text']
```

In [ ]:
```python
# We can now tokenize the text in our dataset using a single line of code
df['tokens'] = df['text'].apply(pipeline_sk.fit_transform)
df['num_tokens'] = df['tokens'].map(len)
df.head()
```

Out[ ]:

	session	year	country	country_name	speaker	position	text	length	toke
4456	54	1999	ZAF	South Africa	Thabo Mbeki	President	On behalf of our Government and\nin my capacit...	14384	[beh governme capac chair, nc ali
5603	61	2006	BRA	Brazil	Mr. Lula Da Silva	President	When I first \naddressed the Assembly from thi...	12120	[fi address assemb rostru stresse
4685	56	2001	DZA	Algeria	Abdelaziz Belkhadem	Minister for Foreign Affairs	This\nsession is taking place at a time when ...	13995	[sessi taking, pla time, ne internati
1055	33	1978	NIC	Nicaragua	Quintana	NaN	\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n388.\tIt ...	13973	[pleasu conv beh governme behal
4812	56	2001	UKR	Ukraine	Anatoliy M. Zlenko	Minister for Foreign Affairs	Allow me at the outset to\ncongratulate the P...	11672	[allc outs congratula preside gene

Creating Word Clouds

In [ ]:
```
from wordcloud import WordCloud

# Compute TF-IDF values
vectorizer = TfidfVectorizer(stop_words='english')
tfidf_matrix = vectorizer.fit_transform(df['text'])
feature_names = vectorizer.get_feature_names_out()
```

```
# Compute total TF-IDF weights for each term in a more memory-efficient way
weights = tfidf_matrix.sum(axis=0).A1

# Build a dictionary where keys are terms and values are weights
tfidf_dict = dict(zip(feature_names, weights))

# Create and display the word cloud
wordcloud = WordCloud().generate_from_frequencies(tfidf_dict)

plt.figure()
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis("off")
plt.show()
```

Filtering our word clouds

In [ ]:
```
from wordcloud import WordCloud

# Compute TF-IDF values
vectorizer = TfidfVectorizer(stop_words='english')

# We can do some filtering here on what text we pass in
tfidf_matrix = vectorizer.fit_transform(df.loc[(df['year'] == 2000) & (df['country'] == 'USA')]['text'])
```

```
feature_names = vectorizer.get_feature_names_out()

# Compute total TF-IDF weights for each term in a more memory-efficient way
weights = tfidf_matrix.sum(axis=0).A1

# Build a dictionary where keys are terms and values are weights
tfidf_dict = dict(zip(feature_names, weights))

# We can filter out the popular terms from our dictionary like so
sorted_tfidf = sorted(tfidf_dict.items(), key=lambda x:x[1], reverse=True)

# There are more efficient ways to do this by filtering first but here our data set is small so it's fine
remove_top = 20
converted_dict = dict(sorted_tfidf[remove_top:])


# Create and display the word cloud
wordcloud = WordCloud().generate_from_frequencies(converted_dict)

plt.figure()
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis("off")
plt.show()
```

Creating Frequency Timelines

In [ ]:
```python
# The Counter function takes an iterable (like a list or a string) as an argument and returns
# a dictionary-like object where the keys are the unique elements in the iterable,
# and the values are their respective counts.
# The elements in the iterable can be any hashable Python object.
from collections import Counter

tokens = tokenize("She likes my cats and my cats like my sofa.")

counter = Counter(tokens)
print(counter)
```

```
Counter({'my': 3, 'cats': 2, 'She': 1, 'likes': 1, 'and': 1, 'like': 1, 'sofa': 1})
```

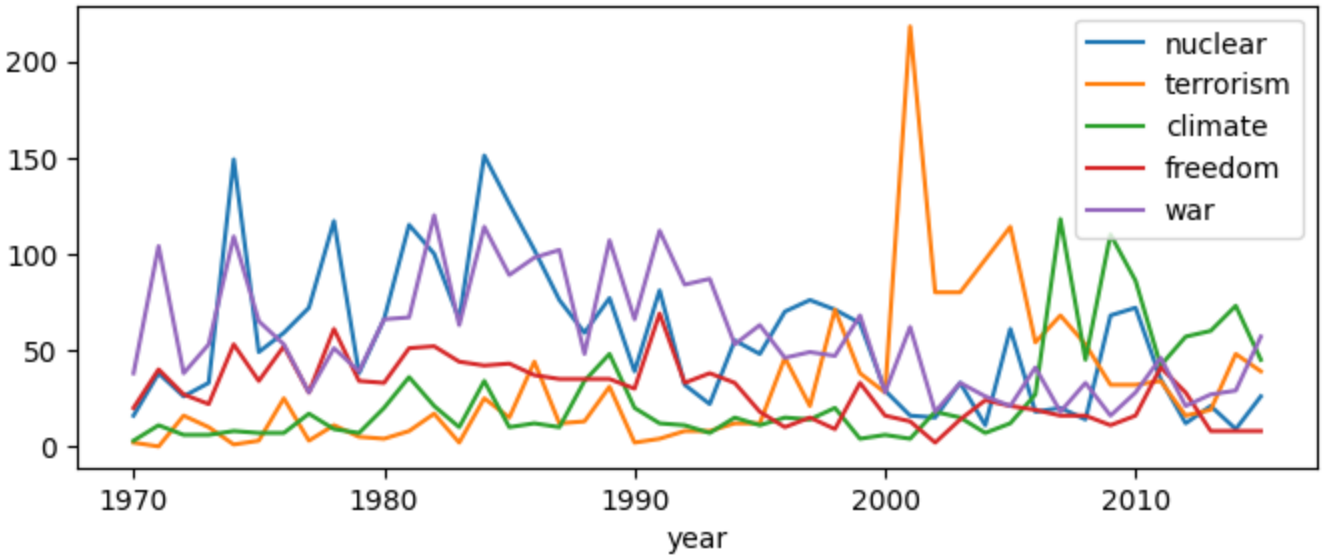
In [ ]:
```python
# We want to count the occurunces of certain keywords
def count_keywords(tokens, keywords):

    # Here we are taking advantage of list comprehensions
    tokens = [t for t in tokens if t in keywords]
    counter = Counter(tokens)
    return [counter.get(k, 0) for k in keywords]
```

In [ ]:
```python
# This is a helper function that we can use to create a df using our count_keywords function
def count_keywords_by(df, by, keywords, column='tokens'):

    df = df.reset_index(drop=True) # if the supplied dataframe has gaps in the index
    freq_matrix = df[column].apply(count_keywords, keywords=keywords)
    freq_df = pd.DataFrame.from_records(freq_matrix, columns=keywords)
    freq_df[by] = df[by] # copy the grouping column(s)

    return freq_df.groupby(by=by).sum().sort_values(by)
```

In [ ]:
```python
keywords = ['nuclear', 'terrorism', 'climate', 'freedom', 'war']

freq_df = count_keywords_by(df, by='year', keywords=keywords)
```

In [ ]:
```python
freq_df.plot(kind='line', figsize=(8, 3))
```

Out[ ]: <Axes: xlabel='year'>



Student Section

Create a filtered word cloud for Canadian (CAN) speeches from 2006 where you remove the top 10 words

In [ ]:
```
from wordcloud import WordCloud

# Compute TF-IDF values
vectorizer = TfidfVectorizer(stop_words='english')

# We can do some filtering here on what text we pass in
tfidf_matrix = vectorizer.fit_transform(df.loc[(df['year'] == 2006) & (df['country'] == 'CAN')]['text'])

feature_names = vectorizer.get_feature_names_out()

# Compute total TF-IDF weights for each term in a more memory-efficient way
weights = tfidf_matrix.sum(axis=0).A1

# Build a dictionary where keys are terms and values are weights
tfidf_dict = dict(zip(feature_names, weights))
```

```
# We can filter out the popular terms from our dictionary like so
sorted_tfidf = sorted(tfidf_dict.items(), key=lambda x:x[1], reverse=True)

# There are more efficient ways to do this by filtering first but here our data set is small so it's fine
remove_top = 20
converted_dict = dict(sorted_tfidf[remove_top:])


# Create and display the word cloud
wordcloud = WordCloud().generate_from_frequencies(converted_dict)

plt.figure()
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis("off")
plt.show()
```

Create a frequency timeline for the following keywords = ['war', 'peace', 'military', 'civilian']

In [ ]:
```
from collections import Counter

keywords = ['war','peace','military','civilian']
freq_df = count_keywords_by(df, by='year', keywords=keywords)
freq_df.plot(kind='line', figsize=(8, 3))
```

Out[ ]: <Axes: xlabel='year'>