German Corpora Analysis

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Used open source links :

- German Corpora Source (Category : News, Year : 2023) : https://wortschatz.uni-leipzig.de/en/download/German
- German Stop words : https://countwordsfree.com/stopwords/german
- German Words list : https://github.com/hermitdave/FrequencyWords/tree/master
- Full Download link: https://github.com/alepp07/nltk-corpora

NLTK Installation

NLTK is installed as usual as a package with `pip`.

```
# from the command line execute
pip install nltk
```

Since it consists of a lot of files, NLTK has an own download mechanism for managing them. The following command opens a graphical user interface to manage them.

```
# in Python runtime execute
>>> import nltk
>>> nltk.download()
```

Reading data file

```
FILE = './data_without_index_1M.txt'
f = open(FILE, encoding='utf-8', mode='r')
data   = f.read()
```

Data Pre-processing

```
import re

def remove_special_chars(text):
  return re.sub(r"[^\w\s]", "", text)

cleaned_text = remove_special_chars(data.strip())
```

```
from nltk import *

WORDS = word_tokenize(cleaned_text)

# Lowercase all words of list
WORDS = [word.lower() for word in WORDS]

# Remove numbers
wordfilter = filter(lambda w: not w.isnumeric(), WORDS)
WORDS = list(wordfilter)
print(WORDS[:10000])
```

```
['grad', 'mehr', 'als', 'je', 'gemessenwie', 'warm', 'können', 'unsere', 'meere', 'noch', 'werden', 'cetcest', 'veröffentlichung',
```

Number 4 : Calculate the lexical richness of the selected corpus

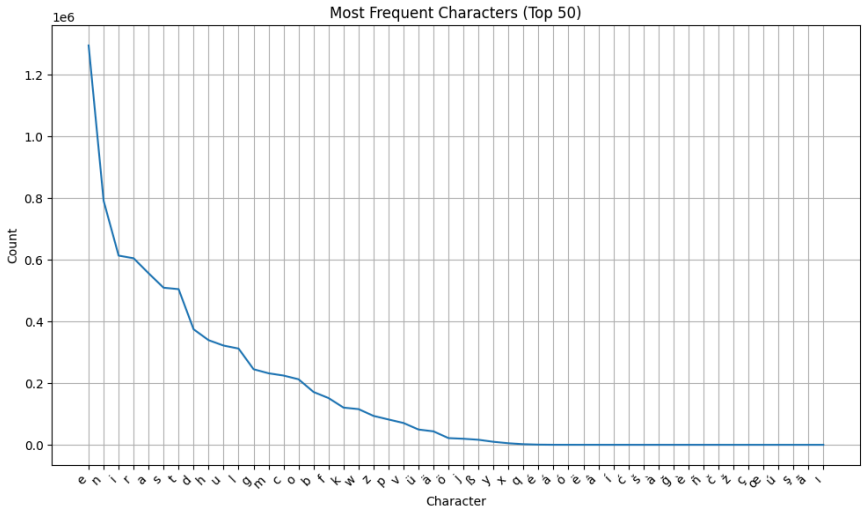
```
def lexical_diversity(text):
    return len(set(text))/len(text)

richness = lexical_diversity(cleaned_text)
print(f'Lexical Richness of the corpus : {richness}')
```

```
Lexical Richness of the corpus : 1.5516920160030475e-05
```

Number 5 : Plot the character distribution of your selected corpus.

```
import nltk
import matplotlib
import matplotlib.pyplot as plt

fdist = nltk.FreqDist(ch.lower() for ch in cleaned_text if ch.isalpha())
print(fdist.most_common(25))

most_common = fdist.most_common(50)
characters, counts = zip(*most_common)

plt.figure(figsize=(10, 6))
plt.plot(characters, counts, linestyle='-')
plt.xlabel("Character")
plt.ylabel("Count")
plt.title("Most Frequent Characters (Top 50)")

plt.xticks(rotation=45, ha="right")  # Rotate x-axis labels for better readability
plt.grid()
plt.tight_layout()
plt.show()
```

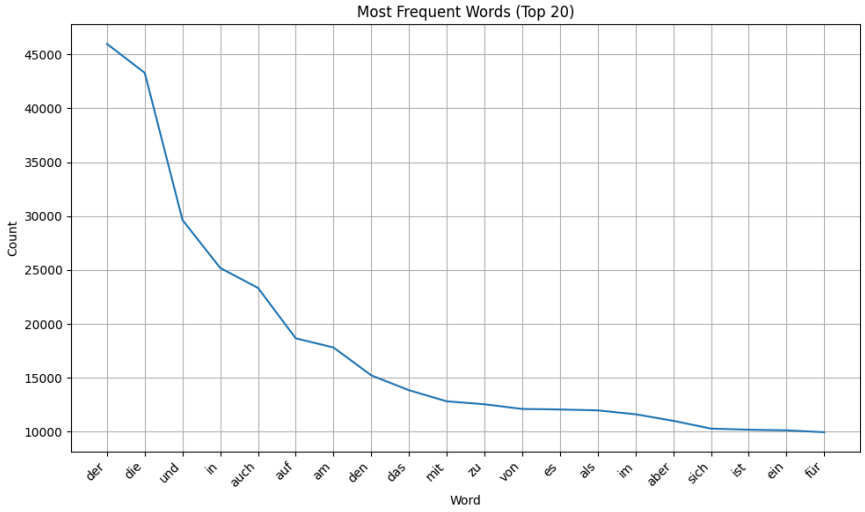
```
[('e', 1295014), ('n', 791255), ('i', 613567), ('r', 604943), ('a', 556163), ('s', 50
```



Number 6 : Plot the word distribution of the 20 most often used words of your selected corpus (with stopwords).

```
wordsfd = FreqDist(WORDS)
print(wordsfd.most_common(20))

most_common = wordsfd.most_common(20)
words, counts = zip(*most_common)

plt.figure(figsize=(10, 6))
plt.plot(words, counts, linestyle='-')
plt.xlabel("Word")
plt.ylabel("Count")
plt.title("Most Frequent Words (Top 20)")

plt.xticks(rotation=45, ha="right")  # Rotate x-axis labels for better readability
plt.grid()
plt.tight_layout()
plt.show()
```

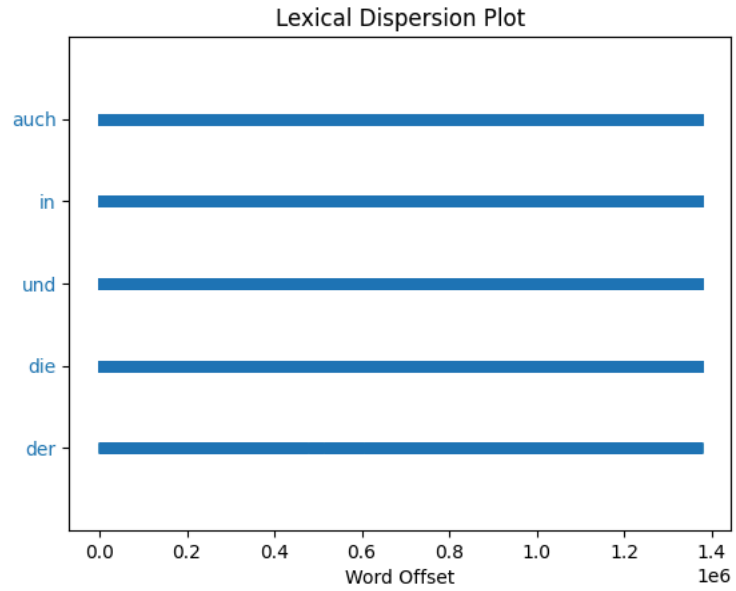
```
[('der', 45979), ('die', 43293), ('und', 29639), ('in', 25186), ('auch', 23336), ('au
```



Number 7 : Plot the dispersion plot of the 5 most often used words

```
top_words = []

common_5 = wordsfd.most_common(5)

for word, word_counts in common_5:
  top_words.append(word)

print(f'Most common 5 words : {top_words}')

text2 = Text( WORDS )
plot = text2.dispersion_plot( top_words )
```

```
Most common 5 words : ['der', 'die', 'und', 'in', 'auch']
```



Number 8 : Find the longest word in the text

Since the NLTK library does not include a built-in German word list, we used the external German word list from the Github.
https://github.com/hermitdave/FrequencyWords/tree/master

We can get the list of the built-in word list of NLTK :

```
from nltk.corpus import words

print(words.fileids()) // ['en', 'en-basic']
```

```
word_lengths = [ (len(w), w) for w in WORDS ]
word_lengths_sorted = sorted(word_lengths, key=lambda x: -len(x[1]))
most_longest = word_lengths_sorted[0]
print(f'The most longest word in text : {most_longest}')
```

```
The most longest word in text : (57, 'kreditinstituteimmobilienfinanzierungsmaßnahmenverordnung')
```

```
# Load German words from file and convert to a set of lowercase words
with open('./words_only.txt', 'r', encoding='utf-8') as file:
    german_words = set(word.lower() for word in file.read().split())

# Define the longest word
longest_word = 'KreditinstituteImmobilienfinanzierungsmaßnahmenVerordnung'

# Revised word break function using dynamic programming
def word_break(s, word_dict):
    s = s.lower()  # Convert the input string to lowercase
    dp = [None] * (len(s) + 1)
    dp[0] = []

    for i in range(1, len(s) + 1):
        for j in range(i):
            if dp[j] is not None and s[j:i] in word_dict:
                dp[i] = dp[j] + [s[j:i]]
                break

    return dp[-1]

# Split the longest word into subwords
split_subwords = word_break(longest_word, german_words)

# Print the subwords
print(f'The longest word "{longest_word}" is split into subwords: {split_subwords}')
```

```
The longest word "KreditinstituteImmobilienfinanzierungsmaßnahmenVerordnung" is split into subwords: ['kredit', 'institute', 'immobi
```

Number 9 : Find a short sentence with 5 words (plus/minus 1)

There are a lot of short sentences.

But we chose the "Ab April sind die Boxen erhältlich"

as our sample sentence for context-free grammar

```
# Finding short sentence function
def find_short_sentences(text):
    sentences = text.splitlines()
    short_sentences = []

    for sentence in sentences:
        words = sentence.split()
        word_count = len(words)

        if 4 <= word_count <= 6:  # Check if word count is within the desired range
            short_sentences.append(sentence)

    return short_sentences

short_sentence = find_short_sentences(cleaned_text)
print(f'Short sentence : {short_sentence}')
```

```
Short sentence : ['100 Prozent recycelbar  geht das überhaupt', '15 Millionen Vermögen wäre notwendig', '2019 wurde die SPD eigentli
```

```
# Number 9 : Create a context-free grammar for the sentence. The grammar shall show the syntactical structure of the sentence, so the ter

import nltk
from nltk import CFG

chosen_sentence = "Ab April sind die Boxen erhältlich"

# Define the grammar
german_grammar = CFG.fromstring("""
    S -> PP VP
    PP -> P NP
    VP -> V NP Adj | V Adj

    NP -> N | Det N

    P -> 'Ab'
    V -> 'sind'
    Det -> 'die'
    N -> 'April' | 'Boxen'
    Adj -> 'erhältlich'
""")


sentence = chosen_sentence.split()

parser = nltk.ChartParser(german_grammar)
trees = list(parser.parse(sentence))

# Display the parse tree
for tree in trees:
    tree.pretty_print()


print(trees)
```

```
                S
      __________|____
     PP             VP
  ___|____      ____|_______________
 |        NP   |        NP          |
 |        |    |     ___|____       |
 P        N    V   Det       N      Adj
 |        |    |    |        |       |
 Ab     April sind die     Boxen erhältlich

[Tree('S', [Tree('PP', [Tree('P', ['Ab']), Tree('NP', [Tree('N', ['April'])])]), Tree('VP', [Tree('V', ['sind']), Tree('NP', [Tree(
```

Number 10 : Select a suitable stemmer and stem every word in the sentence found with part 9.

```
from nltk.stem.snowball import GermanStemmer

chosen_sentence = "Ab April sind die Boxen erhältlich"
```

```
word_tokens = word_tokenize(chosen_sentence)
word_tokens = [word.lower() for word in word_tokens]

snowball = SnowballStemmer("german")

snowball_stems = [snowball.stem(word) for word in word_tokens]
print(' '.join(snowball_stems))
```

```
ab april sind die box erhalt
```

Double-click (or enter) to edit

Number 11 : Find a lemmatizer for the language and lemmatize every word in the sentence.

commands to install spacy and load model

- pip install spacy
- python -m spacy download de_core_news_sm

```
import spacy

# Load the German language model
nlp = spacy.load("de_core_news_sm")

sentence = "Ab April sind die Boxen erhältlich"

doc = nlp(sentence)
lemmas = [token.lemma_ for token in doc]

print("Lemmas:", lemmas)
```

```
Lemmas: ['ab', 'April', 'sein', 'der', 'Box', 'erhältlich']
```

Number 12 : Remove stopwords and repeat exercises 6+7 (word distribution and dispersion plot)

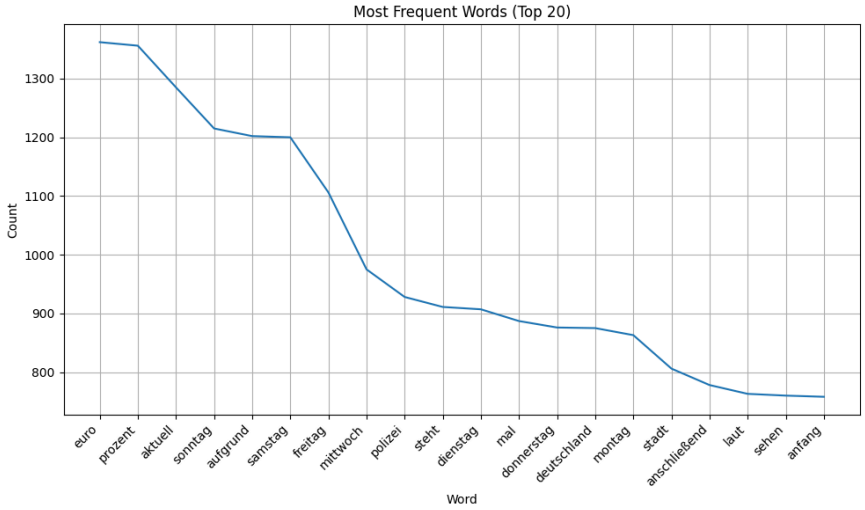
Additional stop words are from - https://countwordsfree.com/stopwords/german

```
from nltk.corpus import stopwords

# use stopwords from NLTK
default_stopwords = set(stopwords.words('german'))

stopwords_file = './stop_words_german.txt'
with open(stopwords_file, 'r', encoding='utf-8') as f:
    custom_stopwords = set(f.read().splitlines())


# bundle both sources for all_stopwords
all_stopwords = default_stopwords | custom_stopwords

print(all_stopwords)

filtered_words = [w for w in WORDS if not w in all_stopwords]
```

```
{'kommen', 'mögen', 'soll', 'gewollt', 'willst', 'müßt', 'wollte', 'mag', 'lieber', 'uhr', 'durch', 'eures', 'zweiten', 'wurde', 'ma
```

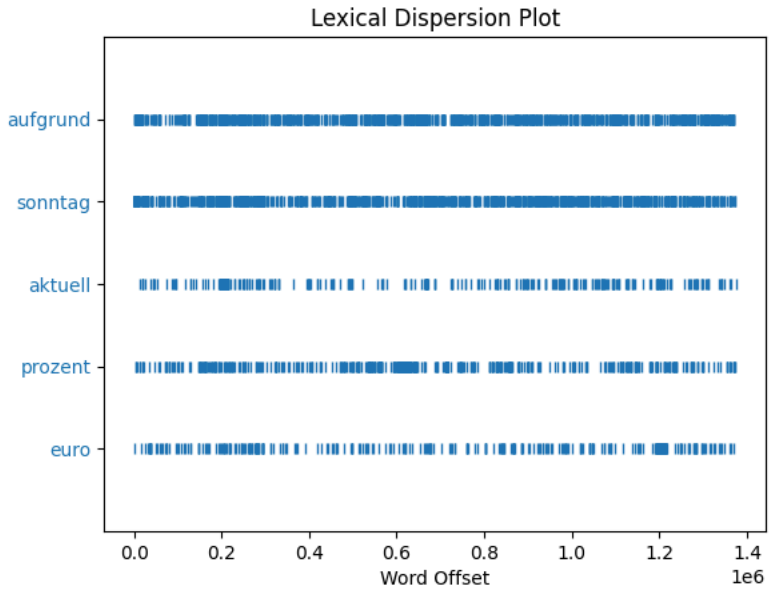
```
filtered_wordsfd = FreqDist(filtered_words)
print(filtered_wordsfd.most_common(20))

most_common = filtered_wordsfd.most_common(20)
words, counts = zip(*most_common)

plt.figure(figsize=(10, 6))
plt.plot(words, counts, linestyle='-')
plt.xlabel("Word")
plt.ylabel("Count")
plt.title("Most Frequent Words (Top 20)")
plt.xticks(rotation=45, ha="right")  # Rotate x-axis labels for better readability
plt.grid()
plt.tight_layout()
plt.show()
```

```
[('euro', 1362), ('prozent', 1356), ('aktuell', 1285), ('sonntag', 1215), ('aufgrund'
```




```
top_5_words = filtered_wordsfd.most_common(5)

top_words = []
for word, word_counts in top_5_words:
  top_words.append(word)

print(top_words)

text2 = Text( WORDS )
plot = text2.dispersion_plot( top_words )
```

```
['euro', 'prozent', 'aktuell', 'sonntag', 'aufgrund']
```



Number 13 : Print a wordcloud without your stopwords

To install the wordcloud :

- pip install wordcloud matplotlib

```
from wordcloud import WordCloud
import matplotlib.pyplot as plt
```

```
width = 6
height = 6
plt.figure(figsize=(width, height))
wordcloud = WordCloud(
    background_color="white",
    width=1800,
    height=1400,
    stopwords=all_stopwords,
    collections=False  # Disable collections for case-insensitive stopword removal
).generate(" ".join(filtered_words))

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