

```
!pip install nltk spacy
print("NLTK and spaCy libraries installed.")

Requirement already satisfied: nltk in /usr/local/lib/python3.12/dist-packages (3.9.1)
Requirement already satisfied: spacy in /usr/local/lib/python3.12/dist-packages (3.8.11)
Requirement already satisfied: click in /usr/local/lib/python3.12/dist-packages (from nltk) (8.3.1)
Requirement already satisfied: joblib in /usr/local/lib/python3.12/dist-packages (from nltk) (1.5.3)
Requirement already satisfied: regex>=2021.8.3 in /usr/local/lib/python3.12/dist-packages (from nltk) (2025.11.3)
Requirement already satisfied: tqdm in /usr/local/lib/python3.12/dist-packages (from nltk) (4.67.1)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.11 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.0.
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.0.
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.0.15
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.13)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.0.12)
Requirement already satisfied: thinc<8.4.0,>=8.3.4 in /usr/local/lib/python3.12/dist-packages (from spacy) (8.3.10)
Requirement already satisfied: wasabi<1.2.0,>=0.9.1 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.1.3)
Requirement already satisfied: srsly<3.0.0,>=2.4.3 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.5.2)
Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.10)
Requirement already satisfied: weasel<0.5.0,>=0.4.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (0.4.3)
Requirement already satisfied: typer-slim<1.0.0,>=0.3.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (0.21.1)
Requirement already satisfied: numpy>=1.19.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.2)
Requirement already satisfied: requests<3.0.0,>=2.13.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.32.4)
Requirement already satisfied: pydantic!=1.8,!>1.8.1,<3.0.0,>=1.7.4 in /usr/local/lib/python3.12/dist-packages (from spa
Requirement already satisfied: jinja2 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.1.6)
Requirement already satisfied: setuptools in /usr/local/lib/python3.12/dist-packages (from spacy) (75.2.0)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (25.0)
Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,!>1
Requirement already satisfied: pydantic-core==2.41.4 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,!>1
Requirement already satisfied: typing-extensions>=4.14.1 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,
Requirement already satisfied: typing-inspection>=0.4.2 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,!>
Requirement already satisfied: charset_normalizer<4,>=2 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13.0->sp
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13
Requirement already satisfied: blis<1.4.0,>=1.3.0 in /usr/local/lib/python3.12/dist-packages (from thinc<8.4.0,>=8.3.4->
Requirement already satisfied: confection<1.0.0,>=0.0.1 in /usr/local/lib/python3.12/dist-packages (from thinc<8.4.0,>=8
Requirement already satisfied: cloudpathlib<1.0.0,>=0.7.0 in /usr/local/lib/python3.12/dist-packages (from weasel<0.5.0,
Requirement already satisfied: smart-open<8.0.0,>=5.2.1 in /usr/local/lib/python3.12/dist-packages (from weasel<0.5.0,>=
```

```
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.12/dist-packages (from jinja2->spacy) (3.0.3)
Requirement already satisfied: wrapt in /usr/local/lib/python3.12/dist-packages (from smart-open<8.0.0,>=5.2.1->weasel<0
NLTK and spaCy libraries installed.
```

```
import sys
!{sys.executable} -m pip install nltk spacy
print("NLTK and spaCy libraries installed.")
```

```
Requirement already satisfied: nltk in /usr/local/lib/python3.12/dist-packages (3.9.1)
Requirement already satisfied: spacy in /usr/local/lib/python3.12/dist-packages (3.8.11)
Requirement already satisfied: click in /usr/local/lib/python3.12/dist-packages (from nltk) (8.3.1)
Requirement already satisfied: joblib in /usr/local/lib/python3.12/dist-packages (from nltk) (1.5.3)
Requirement already satisfied: regex>=2021.8.3 in /usr/local/lib/python3.12/dist-packages (from nltk) (2025.11.3)
Requirement already satisfied: tqdm in /usr/local/lib/python3.12/dist-packages (from nltk) (4.67.1)
Requirement already satisfied: spacy-legacy<3.1.0,>=3.0.11 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.0.
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.0.
Requirement already satisfied: murmurhash<1.1.0,>=0.28.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.0.15
Requirement already satisfied: cymem<2.1.0,>=2.0.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.13)
Requirement already satisfied: preshed<3.1.0,>=3.0.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.0.12)
Requirement already satisfied: thinc<8.4.0,>=8.3.4 in /usr/local/lib/python3.12/dist-packages (from spacy) (8.3.10)
Requirement already satisfied: wasabi<1.2.0,>=0.9.1 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.1.3)
Requirement already satisfied: srsly<3.0.0,>=2.4.3 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.5.2)
Requirement already satisfied: catalogue<2.1.0,>=2.0.6 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.10)
Requirement already satisfied: weasel<0.5.0,>=0.4.2 in /usr/local/lib/python3.12/dist-packages (from spacy) (0.4.3)
Requirement already satisfied: typer-slim<1.0.0,>=0.3.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (0.21.1)
Requirement already satisfied: numpy>=1.19.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.0.2)
Requirement already satisfied: requests<3.0.0,>=2.13.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (2.32.4)
Requirement already satisfied: pydantic!=1.8,!>1.8.1,<3.0.0,>=1.7.4 in /usr/local/lib/python3.12/dist-packages (from spa
Requirement already satisfied: jinja2 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.1.6)
Requirement already satisfied: setuptools in /usr/local/lib/python3.12/dist-packages (from spacy) (75.2.0)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (25.0)
Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,!>1
Requirement already satisfied: pydantic-core==2.41.4 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,!>1.
Requirement already satisfied: typing-extensions>=4.14.1 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,
Requirement already satisfied: typing-inspection>=0.4.2 in /usr/local/lib/python3.12/dist-packages (from pydantic!=1.8,
Requirement already satisfied: charset_normalizer<4,>=2 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13.0->sp
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13
Requirement already satisfied: blis<1.4.0,>=1.3.0 in /usr/local/lib/python3.12/dist-packages (from thinc<8.4.0,>=8.3.4->
```

```
Requirement already satisfied: confection<1.0.0,>=0.0.1 in /usr/local/lib/python3.12/dist-packages (from thinc<8.4.0,>=8.3.0)
Requirement already satisfied: cloudpathlib<1.0.0,>=0.7.0 in /usr/local/lib/python3.12/dist-packages (from weasel<0.5.0,>=0.4.0)
Requirement already satisfied: smart-open<8.0.0,>=5.2.1 in /usr/local/lib/python3.12/dist-packages (from weasel<0.5.0,>=0.4.0)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.12/dist-packages (from jinja2->spacy) (3.0.3)
Requirement already satisfied: wrapt in /usr/local/lib/python3.12/dist-packages (from smart-open<8.0.0,>=5.2.1->weasel<0.5.0,>=0.4.0)
NLTK and spaCy libraries installed.
```

```
import nltk
import spacy

nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')
print("NLTK 'punkt' and 'averaged_perceptron_tagger' resources downloaded.")

try:
    spacy.cli.download('en_core_web_sm')
    print("spaCy 'en_core_web_sm' model downloaded.")
except Exception as e:
    print(f"Error downloading spaCy model: {e}. Attempting to load if already present.")

essay_text = """The rapid advancement of artificial intelligence (AI) has profound implications for various sectors, ranging from healthcare to finance. In healthcare, AI is revolutionizing diagnostics and treatment planning. For example, AI-powered systems can analyze medical imaging data to detect diseases earlier than human experts. This not only improves patient outcomes but also reduces costs for both patients and healthcare providers. However, the integration of AI in healthcare is not without its challenges. Ethical concerns regarding data privacy and security are particularly pressing. Ensuring that patient data is handled securely and used ethically is crucial for maintaining public trust. Beyond healthcare, AI is transforming the financial industry through applications like algorithmic trading, fraud detection, and risk assessment. These technologies have the potential to significantly improve the efficiency and accuracy of financial operations. Yet, the societal impact of widespread AI adoption extends to employment and economic structures. Automation, driven by AI, is replacing many jobs, especially in low-skilled sectors. This shift requires a reevaluation of our education systems and labor policies to prepare the workforce for the new job market. In conclusion, while AI presents transformative opportunities across numerous fields, its successful and ethical integration requires careful consideration of its social impacts. As AI continues to evolve, it is essential to prioritize responsible development and deployment to maximize its benefits while minimizing its risks. By doing so, we can harness the full potential of AI to build a better future for everyone.""""

print("NLTK and spaCy libraries imported and essay text loaded.")

[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]  Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]      /root/nltk_data...
[nltk_data]  Unzipping taggers/averaged_perceptron_tagger.zip.
```

```
NLTK 'punkt' and 'averaged_perceptron_tagger' resources downloaded.
```

```
✓ Download and installation successful
```

```
You can now load the package via spacy.load('en_core_web_sm')
```

```
⚠ Restart to reload dependencies
```

```
If you are in a Jupyter or Colab notebook, you may need to restart Python in  
order to load all the package's dependencies. You can do this by selecting the  
'Restart kernel' or 'Restart runtime' option.
```

```
spaCy 'en_core_web_sm' model downloaded.
```

```
NLTK and spaCy libraries imported and essay text loaded.
```

```
from nltk.tokenize import word_tokenize  
  
nltk_tokens = word_tokenize(essay_text)  
nltk_pos_tags = nltk.pos_tag(nltk_tokens)  
  
print("NLTK POS Tagging complete. First 10 tokens and their tags:")  
print(nltk_pos_tags[:10])
```

```
NLTK POS Tagging complete. First 10 tokens and their tags:
```

```
[('The', 'DT'), ('rapid', 'JJ'), ('advancement', 'NN'), ('of', 'IN'), ('artificial', 'JJ'), ('intelligence', 'NN'), ('('
```

```
from nltk.tokenize import word_tokenize  
  
nltk.download('punkt_tab')  
print("NLTK 'punkt_tab' resource downloaded.")  
  
nltk_tokens = word_tokenize(essay_text)  
nltk_pos_tags = nltk.pos_tag(nltk_tokens)  
  
print("NLTK POS Tagging complete. First 10 tokens and their tags:")  
print(nltk_pos_tags[:10])
```

```
NLTK 'punkt_tab' resource downloaded.
```

```
NLTK POS Tagging complete. First 10 tokens and their tags:
```

```
[('The', 'DT'), ('rapid', 'JJ'), ('advancement', 'NN'), ('of', 'IN'), ('artificial', 'JJ'), ('intelligence', 'NN'), ('('
```

```
[nltk_data] Downloading package punkt_tab to /root/nltk_data...  
[nltk_data] Package punkt_tab is already up-to-date!
```

```
from nltk.tokenize import word_tokenize

nltk.download('punkt_tab')
nltk.download('averaged_perceptron_tagger_eng') # Download the specific resource re-
print("NLTK 'punkt_tab' and 'averaged_perceptron_tagger_eng' resources downloaded.")

nltk_tokens = word_tokenize(essay_text)
nltk_pos_tags = nltk.pos_tag(nltk_tokens)

print("NLTK POS Tagging complete. First 10 tokens and their tags:")
print(nltk_pos_tags[:10])
```

```
[nltk_data] Downloading package punkt_tab to /root/nltk_data...
[nltk_data]   Package punkt_tab is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger_eng to
[nltk_data]   /root/nltk_data...
[nltk_data]   Unzipping taggers/averaged_perceptron_tagger_eng.zip.
NLTK 'punkt_tab' and 'averaged_perceptron_tagger_eng' resources downloaded.
NLTK POS Tagging complete. First 10 tokens and their tags:
[('The', 'DT'), ('rapid', 'JJ'), ('advancement', 'NN'), ('of', 'IN'), ('artificial', 'JJ'), ('intelligence', 'NN'), ('(')
```

```
import spacy

nlp = spacy.load('en_core_web_sm')
spacy_doc = nlp(essay_text)

spacy_pos_tags = [(token.text, token.pos_) for token in spacy_doc]

print("spaCy POS Tagging complete. First 10 tokens and their tags:")
print(spacy_pos_tags[:10])
```

```
spaCy POS Tagging complete. First 10 tokens and their tags:
[('The', 'DET'), ('rapid', 'ADJ'), ('advancement', 'NOUN'), ('of', 'ADP'), ('artificial', 'ADJ'), ('intelligence', 'NOUN')
```

```

nltk_unique_tags = set(tag for token, tag in nltk_pos_tags)
spacy_unique_tags = set(tag for token, tag in spacy_pos_tags)

print("Unique NLTK POS Tags:")
print(sorted(list(nltk_unique_tags)))

print("\nUnique spaCy POS Tags:")
print(sorted(list(spacy_unique_tags)))

Unique NLTK POS Tags:
[', ', '.', 'CC', 'DT', 'IN', 'JJ', 'JJR', 'MD', 'NN', 'NNP', 'NNS', 'POS', 'PRP', 'PRP$', 'RB', 'RBR', 'TO', '']

Unique spaCy POS Tags:
['ADJ', 'ADP', 'ADV', 'AUX', 'CCONJ', 'DET', 'NOUN', 'PART', 'PRON', 'PROPN', 'PUNCT', 'SCONJ', 'SPACE', 'VERB']

```

```

nltk_nouns = []
nltk_verbs = []
spacy_nouns = []
spacy_verbs = []

# Extract NLTK nouns and verbs
for token, tag in nltk_pos_tags:
    if tag.startswith('NN'): # NN, NNS, NNP
        nltk_nouns.append(token.lower())
    elif tag.startswith('VB'): # VB, VBG, VBN, VBP, VBZ
        nltk_verbs.append(token.lower())

# Extract spaCy nouns and verbs
for token, tag in spacy_pos_tags:
    if tag == 'NOUN' or tag == 'PROPN':
        spacy_nouns.append(token.lower())
    elif tag == 'VERB' or tag == 'AUX':
        spacy_verbs.append(token.lower())

print("NLTK Nouns (first 10):")
print(nltk_nouns[:10])

print("\nNLTK Verbs (first 10):")

```

```
print("NLTK Verbs (first 10):")
print(nltk_verbs[:10])

print("\nspaCy Nouns (first 10):")
print(spacy_nouns[:10])

print("\nspaCy Verbs (first 10):")
print(spacy_verbs[:10])

K Nouns (first 10):
dvancement', 'intelligence', 'ai', 'implications', 'sectors', 'healthcare', 'finance', 'healthcare', 'ai', 'algorithms']

K Verbs (first 10):
as', 'profound', 'ranging', 'are', 'revolutionizing', 'analyzing', 'surpassing', 'detect', 'retinopathy', 'leading']

Cy Nouns (first 10):
dvancement', 'intelligence', 'ai', 'implications', 'sectors', 'healthcare', 'finance', 'healthcare', 'ai', 'algorithms']

Cy Verbs (first 10):
as', 'ranging', 'are', 'revolutionizing', 'analyzing', 'surpassing', 'can', 'detect', 'leading', 'improves']
```

```
from collections import Counter
import matplotlib.pyplot as plt
import seaborn as sns

# 3. Calculate frequency of nouns from nltk_nouns
nltk_noun_freq = Counter(nltk_nouns)

# 4. Calculate frequency of verbs from nltk_verbs
nltk_verb_freq = Counter(nltk_verbs)

# 5. Calculate frequency of nouns from spacy_nouns
spacy_noun_freq = Counter(spacy_nouns)

# 6. Calculate frequency of verbs from spacy_verbs
spacy_verb_freq = Counter(spacy_verbs)

print("Frequencies calculated for NLTK and spaCy nouns and verbs.")
```

```
# 7. Create a function, named plot_top_words
def plot_top_words(word_frequencies, title, xlabel):
    # a. Extract the top 15 words and their counts
    top_words = word_frequencies.most_common(15)
    words = [word for word, count in top_words]
    counts = [count for word, count in top_words]

    plt.figure(figsize=(10, 7))
    # b. Use seaborn.barplot to create a horizontal bar chart
    sns.barplot(x=counts, y=words, palette='viridis')
    # c. Set the title of the plot
    plt.title(title, fontsize=16)
    # d. Set the x-axis label
    plt.xlabel(xlabel, fontsize=12)
    plt.ylabel('Word', fontsize=12)
    # e. Ensure the plot layout is tight
    plt.tight_layout()
    # f. Display the plot
    plt.show()

# 8. Call the plot_top_words function for NLTK nouns
plot_top_words(nltk_noun_freq, 'Top 15 NLTK Noun Frequencies', 'Frequency')

# 9. Call the plot_top_words function for NLTK verbs
plot_top_words(nltk_verb_freq, 'Top 15 NLTK Verb Frequencies', 'Frequency')

# 10. Call the plot_top_words function for spaCy nouns
plot_top_words(spacy_noun_freq, 'Top 15 spaCy Noun Frequencies', 'Frequency')

# 11. Call the plot_top_words function for spaCy verbs
plot_top_words(spacy_verb_freq, 'Top 15 spaCy Verb Frequencies', 'Frequency')
```


