```
# Install required libraries
!pip install nltk spacy matplotlib pandas
!python -m spacy download en_core_web_sm
```

```
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: matplotlib in /usr/local/lib/python3.12/dist-packages (3.10.0)
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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) (3.0.12)
Requirement already satisfied: spacy-loggers<2.0.0,>=1.0.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (1.0.5)
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)
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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 spacy) (2
Requirement already satisfied: jinja2 in /usr/local/lib/python3.12/dist-packages (from spacy) (3.1.6)
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Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.12/dist-packages (from spacy) (25.0)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.12/dist-packages (from matplotlib) (1.3.3)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.12/dist-packages (from matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.12/dist-packages (from matplotlib) (4.61.1)
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Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13.0->spa
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.13.0->spa
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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,>=
Collecting en-core-web-sm==3.8.0
  Downloading https://github.com/explosion/spacy-models/releases/download/en_core_web_sm-3.8.0/en_core_web_sm-3.8.0-py3-none-a
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 12.8/12.8 MB 60.1 MB/s eta 0:00:00
✓ 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
```

```
import nltk
import spacy
import pandas as pd
import matplotlib.pyplot as plt
from collections import Counter

# Download NLTK resources
nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')
nltk.download('punkt_tab')
```

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

```
[nltk_data]       date!
[nltk_data] Downloading package punkt_tab to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt_tab.zip.
True
```

```
text = """
Machine learning plays a crucial role in modern healthcare systems.
It assists doctors in diagnosing diseases, predicting patient outcomes,
and improving treatment accuracy. Advanced algorithms analyze medical data
to support decision making and enhance clinical efficiency.
"""

print("TEXT CORPUS:")
print(text)
```

```
TEXT CORPUS:

Machine learning plays a crucial role in modern healthcare systems.
It assists doctors in diagnosing diseases, predicting patient outcomes,
and improving treatment accuracy. Advanced algorithms analyze medical data
to support decision making and enhance clinical efficiency.
```

```
tokens = word_tokenize(text)
print(tokens)
```

```
['Machine', 'learning', 'plays', 'a', 'crucial', 'role', 'in', 'modern', 'healthcare', 'systems', '.', 'It', 'assists', 'doctors
```

```
nltk_pos = nltk.pos_tag(tokens)
print(nltk_pos)
```

```
[('Machine', 'NN'), ('learning', 'NN'), ('plays', 'VBZ'), ('a', 'DT'), ('crucial', 'JJ'), ('role', 'NN'), ('in', 'IN'), ('modern
```

```
nltk_nouns = [word.lower() for word, tag in nltk_pos if tag.startswith('NN')]
nltk_verbs = [word.lower() for word, tag in nltk_pos if tag.startswith('VB')]

print("NLTK NOUNS:")
print(nltk_nouns)

print("NLTK VERBS:")
print(nltk_verbs)
```

```
NLTK NOUNS:
['machine', 'learning', 'role', 'healthcare', 'systems', 'doctors', 'diseases', 'outcomes', 'treatment', 'accuracy', 'advanced',
NLTK VERBS:
['plays', 'assists', 'diagnosing', 'predicting', 'improving', 'support', 'enhance']
```

```
nltk_noun_freq = Counter(nltk_nouns)
nltk_verb_freq = Counter(nltk_verbs)

print("NLTK NOUN FREQUENCY:")
print(nltk_noun_freq)

print("NLTK VERB FREQUENCY:")
print(nltk_verb_freq)
```

```
NLTK NOUN FREQUENCY:
Counter({'machine': 1, 'learning': 1, 'role': 1, 'healthcare': 1, 'systems': 1, 'doctors': 1, 'diseases': 1, 'outcomes': 1, 'tre
NLTK VERB FREQUENCY:
Counter({'plays': 1, 'assists': 1, 'diagnosing': 1, 'predicting': 1, 'improving': 1, 'support': 1, 'enhance': 1})
```

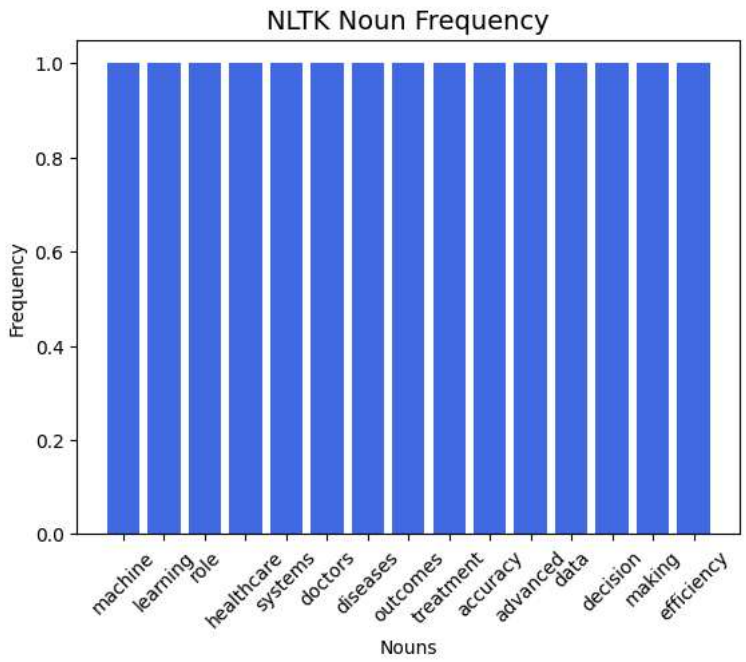
```
nlp = spacy.load("en_core_web_sm")
doc = nlp(text)

print("spaCy POS TAGS:")
for token in doc:
    print(token.text, "->", token.pos_)
```

```
spaCy POS TAGS:

 -> SPACE
Machine -> NOUN
learning -> NOUN
plays -> VERB
a -> DET
crucial -> ADJ
role -> NOUN
in -> ADP
modern -> ADJ
healthcare -> NOUN
systems -> NOUN
. -> PUNCT

 -> SPACE
It -> PRON
assists -> VERB
doctors -> NOUN
in -> ADP
diagnosing -> VERB
diseases -> NOUN
, -> PUNCT
predicting -> VERB
patient -> ADJ
outcomes -> NOUN
, -> PUNCT

 -> SPACE
and -> CCONJ
improving -> VERB
treatment -> NOUN
accuracy -> NOUN
. -> PUNCT
Advanced -> ADJ
algorithms -> NOUN
analyze -> VERB
medical -> ADJ
data -> NOUN

 -> SPACE
to -> PART
support -> VERB
decision -> NOUN
making -> NOUN
and -> CCONJ
enhance -> VERB
clinical -> ADJ
efficiency -> NOUN
. -> PUNCT

 -> SPACE
```

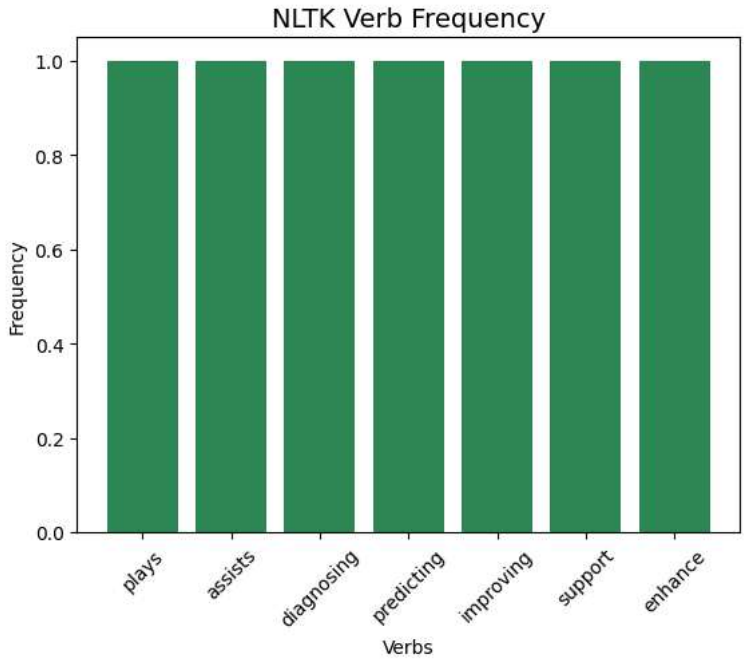
```
spacy_noun_freq = Counter(spacy_nouns)
spacy_verb_freq = Counter(spacy_verbs)

print("spaCy NOUN FREQUENCY:")
print(spacy_noun_freq)

print("spaCy VERB FREQUENCY:")
print(spacy_verb_freq)
```

```
spaCy NOUN FREQUENCY:
Counter({'machine': 1, 'learning': 1, 'role': 1, 'healthcare': 1, 'systems': 1, 'doctors': 1, 'diseases': 1, 'outcomes': 1, 'tre
spaCy VERB FREQUENCY:
Counter({'plays': 1, 'assists': 1, 'diagnosing': 1, 'predicting': 1, 'improving': 1, 'analyze': 1, 'support': 1, 'enhance': 1})
```

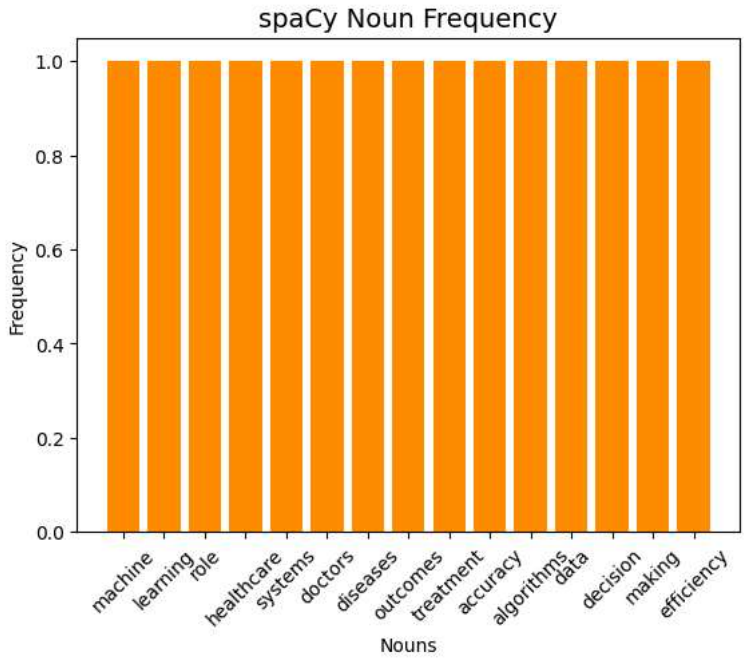
```
plt.figure()
plt.bar(nltk_noun_df["Noun"], nltk_noun_df["Frequency"], color="royalblue")
plt.title("NLTK Noun Frequency", fontsize=14)
plt.xlabel("Nouns")
plt.ylabel("Frequency")
plt.xticks(rotation=45)
plt.show()
```




```
plt.figure()
plt.bar(nltk_verb_df["Verb"], nltk_verb_df["Frequency"], color="seagreen")
plt.title("NLTK Verb Frequency", fontsize=14)
plt.xlabel("Verbs")
plt.ylabel("Frequency")
plt.xticks(rotation=45)
plt.show()
```




```
plt.figure()
plt.bar(spacy_noun_df["Noun"], spacy_noun_df["Frequency"], color="darkorange")
plt.title("spaCy Noun Frequency", fontsize=14)
plt.xlabel("Nouns")
plt.ylabel("Frequency")
plt.xticks(rotation=45)
plt.show()
```




```
plt.figure()
plt.bar(spacy_verb_df["Verb"], spacy_verb_df["Frequency"], color="purple")
plt.title("spaCy Verb Frequency", fontsize=14)
plt.xlabel("Verbs")
plt.ylabel("Frequency")
plt.xticks(rotation=45)
plt.show()
```