

Program 1 - Study of Python and basic commands to access text data

```
import pandas as pd
import os
import docx
import PyPDF2

dir_path='C:\\Users\\Archu\\Documents\\NLP_Lab\\Program'
files=[f for f in os.listdir(dir_path) if (f.endswith('.txt') or
f.endswith('.docx') or f.endswith('.pdf'))]
data = []

for txt_file in files:
    if(txt_file.endswith('.txt')):
        with open(os.path.join(dir_path, txt_file), 'r') as file:
            content = file.read()
            data.append({'filename': txt_file, 'content': content })

    elif(txt_file.endswith('.docx')):
        docx_path = os.path.join(dir_path, txt_file)
        doc = docx.Document(docx_path)
        content = "\n".join([paragraph.text for paragraph in
doc.paragraphs])
        data.append({'filename': txt_file, 'content': content })
    elif(txt_file.endswith('.pdf')):
        with open(os.path.join(dir_path, txt_file), 'rb') as f:
            # Create a PDF reader object
            pdf_reader = PyPDF2.PdfReader(f)
            num_pages = len(pdf_reader.pages)
            for page in range(num_pages):
                #page=(page_num)
                content=pdf_reader.pages[page].extract_text()
                data.append({'filename': txt_file, 'content': content})

df = pd.DataFrame(data)
#Display the DataFrame
print(df)
```

Program 2 - Perform Pre-Proessing

```
import pandas as pd
import re
import nltk
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
```

```
#Download necessary nltk data
nltk.download('punkt')
nltk.download('stopwords')
```

```
data = {'text': [""WASHINGTON - The Trump administration has ordered
the military to start withdrawing roughly 7,000 troops from
Afghanistan in the coming months, two defense officials said Thursday,
an abrupt shift in the 17-year-old war there and a decision that
stunned Afghan officials, who said they had not been briefed on the
plans.
```

```
President Trump made the decision to pull the troops - about half the
number the United States has in Afghanistan now - at the same time he
decided to pull American forces out of Syria, one official said.
```

```
The announcement came hours after Jim Mattis, the secretary of
defense, said that he would resign from his position at the end of
February after disagreeing with the president over his approach to
policy in the Middle East.
```

```
The whirlwind of troop withdrawals and the resignation of Mr. Mattis
leave a murky picture for what is next in the United States' longest
war, and they come as Afghanistan has been troubled by spasms of
violence afflicting the capital, Kabul, and other important areas.
```

```
The United States has also been conducting talks with representatives
of the Taliban, in what officials have described as discussions that
could lead to formal talks to end the conflict.
```

```
Senior Afghan officials and Western diplomats in Kabul woke up to the
shock of the news on Friday morning, and many of them braced for chaos
ahead.
```

```
Several Afghan officials, often in the loop on security planning and
decision-making, said they had received no indication in recent days
that the Americans would pull troops out.
```

```
The fear that Mr. Trump might take impulsive actions, however, often
loomed in the background of discussions with the United States, they
said.
```

```
They saw the abrupt decision as a further sign that voices from the
ground were lacking in the debate over the war and that with Mr.
Mattis's resignation, Afghanistan had lost one of the last influential
voices in Washington who channeled the reality of the conflict into
the White House's deliberations.
```

```
The president long campaigned on bringing troops home, but in 2017, at
the request of Mr. Mattis, he begrudgingly pledged an additional 4,000
troops to the Afghan campaign to try to hasten an end to the conflict.
Though Pentagon officials have said the influx of forces - coupled
with a more aggressive air campaign - was helping the war effort,
Afghan forces continued to take nearly unsustainable levels of
casualties and lose ground to the Taliban.
```

```
The renewed American effort in 2017 was the first step in ensuring
Afghan forces could become more independent without a set timeline for
a withdrawal.
```

```
But with plans to quickly reduce the number of American troops in the
```

country, it is unclear if the Afghans can hold their own against an increasingly aggressive Taliban. Currently, American airstrikes are at levels not seen since the height of the war, when tens of thousands of American troops were spread throughout the country. That air support, officials say, consists mostly of propping up Afghan troops while they try to hold territory from a resurgent Taliban.""]}]}

```
df = pd.DataFrame(data)
```

```
#Initialize stopwords and stemmer
```

```
stop_words = set(stopwords.words('english'))
```

```
ps = PorterStemmer()
```

```
def clean_text(text):
```

```
    #Remove special characters and digits using regex
```

```
    text = re.sub(r'^A-Za-z\s', '', text)
```

```
    #Convert to lowercase
```

```
    text = text.lower()
```

```
    #Tokenization
```

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

```
    #Remove stopwords and perform stemming
```

```
    tokens = [ps.stem(word) for word in tokens if word not in stop_words]
```

```
    #lemmatization
```

```
    lemmatized_output = ' '.join([lemmatizer.lemmatize(w) for w in tokens])
```

```
    print(lemmatized_output)
```

```
    return ' '.join(tokens)
```

```
df['cleaned_content'] = df['text'].apply(clean_text)
```

```
df['cleaned_content'] = df['text'].apply(clean_text)
```

```
print(df)
```

washington trump administr order militari start withdraw roughli troop
afghanistan come month two defens offici said thursday abrupt shift
yearold war decis stun afghan offici said brief plan presid trump made
decis pull troop half number unit state afghanistan time decid pull
american forc syria one offici said announc came hour jim matti
secretari defens said would resign posit end februaryi disagre presid
approach polici middl east whirlwind troop withdraw resign mr matti
leav murki pictur next unit state longest war come afghanistan troubl
spasm violenc afflict capit kabul import area unit state also conduct

talk repres taliban offici describ discus could lead formal talk end conflict senior afghan offici western diplomat kabul woke shock news friday morn mani brace chao ahead sever afghan offici often loop secur plan decisionmak said receiv indic recent day american would pull troop fear mr trump might take impuls action howev often loom background discus unit state said saw abrupt decis sign voic ground lack debat war mr mattiss resign afghanistan lost one last influenti voic washington channel realiti conflict white hous deliber presid long campaign bring troop home request mr matti begrudgingli pledg addit troop afghan campaign tri hasten end conflict though pentagon offici said influx forc coupl aggress air campaign help war effort afghan forc continu take nearli unsustain level casualti lose ground taliban renew american effort first step ensur afghan forc could becom independ without set timelin withdraw plan quickli reduc number american troop countri unclear afghan hold increasingli aggress taliban current american airstrik level seen sinc height war ten thousand american troop spread throughout countri air support offici say consist mostli prop afghan troop tri hold territori resurg taliban washington trump administr order militari start withdraw roughli troop afghanistan come month two defens offici said thursday abrupt shift yearold war decis stun afghan offici said brief plan presid trump made decis pull troop half number unit state afghanistan time decid pull american forc syria one offici said announc came hour jim matti secretari defens said would resign posit end februaryi disagre presid approach polici middl east whirlwind troop withdraw resign mr matti leav murki pictur next unit state longest war come afghanistan troubl spasm violenc afflict capit kabul import area unit state also conduct talk repres taliban offici describ discus could lead formal talk end conflict senior afghan offici western diplomat kabul woke shock news friday morn mani brace chao ahead sever afghan offici often loop secur plan decisionmak said receiv indic recent day american would pull troop fear mr trump might take impuls action howev often loom background discus unit state said saw abrupt decis sign voic ground lack debat war mr mattiss resign afghanistan lost one last influenti voic washington channel realiti conflict white hous deliber presid long campaign bring troop home request mr matti begrudgingli pledg addit troop afghan campaign tri hasten end conflict though pentagon offici said influx forc coupl aggress air campaign help war effort afghan forc continu take nearli unsustain level casualti lose ground taliban renew american effort first step ensur afghan forc could becom independ without set timelin withdraw plan quickli reduc number american troop countri unclear afghan hold increasingli aggress taliban current american airstrik level seen sinc height war ten thousand american troop spread throughout countri air support offici say consist mostli prop afghan troop tri hold territori resurg taliban

text \

0 WASHINGTON - The Trump administration has orde...

```
                                cleaned_content
0  washington trump administr order militari star...

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

Program 3 - Implement N-Gram Model

```
from nltk.util import ngrams

data = {'text': [""""WASHINGTON - The Trump administration has ordered
the military to start withdrawing roughly 7,000 troops from
Afghanistan in the coming months, two defense officials said Thursday,
an abrupt shift in the 17-year-old war there and a decision that
stunned Afghan officials, who said they had not been briefed on the
plans.
President Trump made the decision to pull the troops - about half the
number the United States has in Afghanistan now - at the same time he
decided to pull American forces out of Syria, one official said.
The announcement came hours after Jim Mattis, the secretary of
defense, said that he would resign from his position at the end of
February after disagreeing with the president over his approach to
policy in the Middle East.
The whirlwind of troop withdrawals and the resignation of Mr. Mattis
leave a murky picture for what is next in the United States' longest
war, and they come as Afghanistan has been troubled by spasms of
violence afflicting the capital, Kabul, and other important areas.
The United States has also been conducting talks with representatives
of the Taliban, in what officials have described as discussions that
could lead to formal talks to end the conflict.
Senior Afghan officials and Western diplomats in Kabul woke up to the
shock of the news on Friday morning, and many of them braced for chaos
ahead.
Several Afghan officials, often in the loop on security planning and
decision-making, said they had received no indication in recent days
that the Americans would pull troops out.
The fear that Mr. Trump might take impulsive actions, however, often
loomed in the background of discussions with the United States, they
said.
They saw the abrupt decision as a further sign that voices from the
ground were lacking in the debate over the war and that with Mr.
Mattis's resignation, Afghanistan had lost one of the last influential
voices in Washington who channeled the reality of the conflict into
the White House's deliberations.
The president long campaigned on bringing troops home, but in 2017, at
the request of Mr. Mattis, he begrudgingly pledged an additional 4,000
troops to the Afghan campaign to try to hasten an end to the conflict."""]}
```

Though Pentagon officials have said the influx of forces - coupled with a more aggressive air campaign - was helping the war effort, Afghan forces continued to take nearly unsustainable levels of casualties and lose ground to the Taliban. The renewed American effort in 2017 was the first step in ensuring Afghan forces could become more independent without a set timeline for a withdrawal. But with plans to quickly reduce the number of American troops in the country, it is unclear if the Afghans can hold their own against an increasingly aggressive Taliban. Currently, American airstrikes are at levels not seen since the height of the war, when tens of thousands of American troops were spread throughout the country. That air support, officials say, consists mostly of propping up Afghan troops while they try to hold territory from a resurgent Taliban.""]}

```
df = pd.DataFrame(data)
```

```
def generate_ngrams(text, n):
    tokens = text.split()
    return [' '.join(gram) for gram in ngrams(tokens, n)]

# Generate bi-grams (2-gram) for demonstration, but you can adjust 'n'
# for other n-grams
df['trigram'] = df['text'].apply(generate_ngrams, n=2)
print(df)
```

	text	trigram
0	WASHINGTON - The Trump administration has orde...	[WASHINGTON -, - The, The Trump, Trump adminis...

Program 4 - Program 4 – Implement POS Tagging

```
import nltk
nltk.download('averaged_perceptron_tagger')

data = {'text': ["She saw the car"]}
df = pd.DataFrame(data)

def pos_tagging(text):
    tokens = nltk.word_tokenize(text)
    return nltk.pos_tag(tokens)

# Apply POS tagging to the cleaned_content
df['POS_tags'] = df['text'].apply(pos_tagging)
print(df)
```

	text	POS_tags
0	She saw the car	[(She, PRP), (saw, VBD), (the, DT), (car, NN)]

```
[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!
```

Program 5 - Implement Chunking

```
import nltk
nltk.download('maxent_ne_chunker')
nltk.download('words')

# Sample DataFrame
data = {'text': ["I ditch this product!", "It's terrible.", "Neutral statement."]}
df1 = pd.DataFrame(data)

# Assuming df has a 'text' column
df1['POS_tags'] = df1['text'].apply(lambda x:
nltk.pos_tag(word_tokenize(x)))

def noun_phrase_chunking(text_with_tags):
    #Define the chunk grammar
    grammar = "NP: {<DT>?<JJ>*<NN>}"

    #Create a chunk parser with the grammar
    cp = nltk.RegexpParser(grammar)

    #Parse the sentence with tags to extract chunks
    tree = cp.parse(text_with_tags)

    #Extract only NP (noun phrase) chunks
    noun_phrases = []
    for subtree in tree.subtrees():
        if subtree.label() == 'NP':
            noun_phrases.append(' '.join(word for word, tag in
subtree.leaves()))

    return noun_phrases

# Apply chunking to extract noun phrases
df1['noun_phrases'] = df1['POS_tags'].apply(noun_phrase_chunking)
print(df1)
```

	text	POS_tags	\
0	I ditch this product!	[(I, PRP), (ditch, VBP), (this, DT), (product, ...	
1	It's terrible.	[(It, PRP), ('s, VBZ), (terrible, JJ), (., .)]	
2	Neutral statement.	[(Neutral, JJ), (statement, NN),	

```
(., .)]

      noun_phrases
0      [this product]
1      []
2      [Neutral statement]

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

Program 6 - Implement Sentence Completion

```
import random
sentence_prompts = {
    "She opened the door and saw a": ["beautiful garden", "mysterious
figure", "bright light"],
    "After a long day at work, I like to relax by": ["watching my
favorite TV show", "going for a walk", "reading a book"],
}

# Input prompt
input_prompt = "After a long day at work, I like to relax by"

# Check if the input prompt exists in the dictionary
if input_prompt in sentence_prompts:
    possible_completions = sentence_prompts[input_prompt]

# Print the possible completions
print("Possible Completions:")

for completion in possible_completions:
    print(f"- {input_prompt} {completion}")

else:
    print("Prompt not found in the dictionary.")

Possible Completions:
- After a long day at work, I like to relax by watching my favorite TV
show
- After a long day at work, I like to relax by going for a walk
- After a long day at work, I like to relax by reading a book
Prompt not found in the dictionary.
```

Program 7 - Sentiment Analysis

```
from textblob import TextBlob
```



```

# Sample text data
data = ["I love this product!", "It's terrible.", "Neutral statement."]

# Perform sentiment analysis using TextBlob
sentiments = [TextBlob(text).sentiment.polarity for text in data]

# Map sentiment scores to labels
labels = ['positive' if score > 0 else 'negative' if score < 0 else 'neutral' for score in sentiments]

# Create a DataFrame for easy display
result_df = pd.DataFrame({'text': data, 'sentiment_score': sentiments, 'label': labels})

# Display the results
print(result_df)

```

	text	sentiment_score	label
0	I love this product!	0.625	positive
1	It's terrible.	-1.000	negative
2	Neutral statement.	0.000	neutral

Program 8 - Text Summarisation (Abstractive and Extractive)

```

import re
import nltk
import numpy as np
from nltk.corpus import stopwords
from summarizer import Summarizer
from nltk.cluster.util import cosine_distance
from nltk.tokenize import sent_tokenize, word_tokenize
from transformers import T5ForConditionalGeneration, T5Tokenizer

```

```

nltk.download("punkt")
nltk.download("stopwords")

```

#Abstractive Text Summarisation

article_text="Pop!_OS is a free and open-source Linux distribution, based on Ubuntu, and featuring a customized GNOME desktop environment known as COSMIC. The distribution is developed by American Linux computer manufacturer System76. Pop!_OS is primarily built to be bundled with the computers built by System76, but can also be downloaded and installed on most computers.[4] Pop!_OS provides full out-of-the-box support for both AMD and Nvidia GPUs. A 2020 review in Foss BYTES described it as an easy distribution to set up for gaming, mainly due to its built-in GPU support. Pop!_OS provides default disk

encryption, streamlined window and workspace management, keyboard shortcuts for navigation as well as built-in power management profiles. The latest releases also have packages that allow for easy setup for TensorFlow and CUDA.[5][6] Pop!_OS is maintained primarily by System76, with the release version source code hosted in a GitHub repository. Unlike many other Linux distributions, it is not community-driven, although outside programmers can contribute, view and modify the source code. They can also build custom ISO images and redistribute them under another name."

```
def generate_abstractive_summary(text, max_length=150):
    model_name = "t5-base"
    tokenizer = T5Tokenizer.from_pretrained(model_name)
    model = T5ForConditionalGeneration.from_pretrained(model_name)

    input_ids = tokenizer.encode("summarize: " + text,
    return_tensors="pt", max_length=1024, truncation=True)
    summary_ids = model.generate(input_ids, max_length=max_length,
    length_penalty=2.0, num_beams=4, early_stopping=True)

    summary = tokenizer.decode(summary_ids[0],
    skip_special_tokens=True)
    return summary
```

```
abstractive_summary = generate_abstractive_summary(article_text)
print("Abstractive Summary:\n", abstractive_summary)
```

#Extractive Text Summarisation

article=""WASHINGTON - The Trump administration has ordered the military to start withdrawing roughly 7,000 troops from Afghanistan in the coming months, two defense officials said Thursday, an abrupt shift in the 17-year-old war there and a decision that stunned Afghan officials, who said they had not been briefed on the plans. President Trump made the decision to pull the troops - about half the number the United States has in Afghanistan now - at the same time he decided to pull American forces out of Syria, one official said. The announcement came hours after Jim Mattis, the secretary of defense, said that he would resign from his position at the end of February after disagreeing with the president over his approach to policy in the Middle East. The whirlwind of troop withdrawals and the resignation of Mr. Mattis leave a murky picture for what is next in the United States' longest war, and they come as Afghanistan has been troubled by spasms of violence afflicting the capital, Kabul, and other important areas. The United States has also been conducting talks with representatives of the Taliban, in what officials have described as discussions that could lead to formal talks to end the conflict. Senior Afghan officials and Western diplomats in Kabul woke up to the shock of the news on Friday morning, and many of them braced for chaos

ahead.

Several Afghan officials, often in the loop on security planning and decision-making, said they had received no indication in recent days that the Americans would pull troops out.

The fear that Mr. Trump might take impulsive actions, however, often loomed in the background of discussions with the United States, they said.

They saw the abrupt decision as a further sign that voices from the ground were lacking in the debate over the war and that with Mr. Mattis's resignation, Afghanistan had lost one of the last influential voices in Washington who channeled the reality of the conflict into the White House's deliberations.

The president long campaigned on bringing troops home, but in 2017, at the request of Mr. Mattis, he begrudgingly pledged an additional 4,000 troops to the Afghan campaign to try to hasten an end to the conflict. Though Pentagon officials have said the influx of forces - coupled with a more aggressive air campaign - was helping the war effort, Afghan forces continued to take nearly unsustainable levels of casualties and lose ground to the Taliban.

The renewed American effort in 2017 was the first step in ensuring Afghan forces could become more independent without a set timeline for a withdrawal.

But with plans to quickly reduce the number of American troops in the country, it is unclear if the Afghans can hold their own against an increasingly aggressive Taliban.

Currently, American airstrikes are at levels not seen since the height of the war, when tens of thousands of American troops were spread throughout the country.

That air support, officials say, consists mostly of propping up Afghan troops while they try to hold territory from a resurgent Taliban."""

```
# Create a Summarizer object
```

```
summarizer = Summarizer()
```

```
# Perform extractive summarization
```

```
summary = summarizer(article)
```

```
# Display the summary
```

```
print("Extractive Summary:\n", summary)
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
```

```
[nltk_data] Package punkt is already up-to-date!
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
```

```
[nltk_data] Package stopwords is already up-to-date!
```

```
/usr/local/lib/python3.10/dist-packages/transformers/models/t5/tokenization_t5.py:240: FutureWarning: This tokenizer was incorrectly instantiated with a model max length of 512 which will be corrected in Transformers v5.
```

```
For now, this behavior is kept to avoid breaking backwards
```

compatibility when padding/encoding with `truncation is True`.

- Be aware that you SHOULD NOT rely on t5-base automatically truncating your input to 512 when padding/encoding.
- If you want to encode/pad to sequences longer than 512 you can either instantiate this tokenizer with `model_max_length` or pass `max_length` when encoding/padding.
- To avoid this warning, please instantiate this tokenizer with `model_max_length` set to your preferred value.

```
warnings.warn(
```

Special tokens have been added in the vocabulary, make sure the associated word embeddings are fine-tuned or trained.

Abstractive Summary:

pop!_OS is a free and open-source Linux distribution, based on Ubuntu. the distribution is developed by american Linux computer manufacturer System76. pop!_OS provides full out-of-the-box support for both AMD and Nvidia GPUs.

```
{"model_id":"4fdec63814ef4c6dabab28eefcd014da","version_major":2,"version_minor":0}
```

```
{"model_id":"48865fad578b418fbb2887f8ee5c5385","version_major":2,"version_minor":0}
```

```
{"model_id":"0be6d5ff66cf4229883ca2090fbf2875","version_major":2,"version_minor":0}
```

```
{"model_id":"fd9e38e8469e482bbba56d95abe6c8ee","version_major":2,"version_minor":0}
```

```
{"model_id":"dca201245b214da3a27b58ed8a615377","version_major":2,"version_minor":0}
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `n_init` explicitly to suppress the warning
  warnings.warn(
```

Extractive Summary:

WASHINGTON - The Trump administration has ordered the military to start withdrawing roughly 7,000 troops from Afghanistan in the coming months, two defense officials said Thursday, an abrupt shift in the 17-year-old war there and a decision that stunned Afghan officials, who said they had not been briefed on the plans. Though Pentagon officials have said the influx of forces - coupled with a more aggressive air campaign - was helping the war effort, Afghan forces continued to take nearly unsustainable levels of casualties and lose ground to the Taliban. Currently, American airstrikes are at levels not seen since the height of the war, when tens of thousands of American troops were spread throughout the country.

Program 9 -Perform Named Entity Recognition (NER)

```
import nltk
from nltk import pos_tag
from nltk.tokenize import word_tokenize
from nltk.chunk import ne_chunk

# Download NLTK resources (if not already downloaded)
nltk.download('punkt')
nltk.download('maxent_ne_chunker')
nltk.download('averaged_perceptron_tagger')
nltk.download('words')

# Example text for NER
text = "Barack Obama was born in Hawaii and served as the 44th President of the United States."

# Tokenize the text into words
words = word_tokenize(text)

# Perform part-of-speech tagging
pos_tags = pos_tag(words)

# Perform named entity chunking
named_entities = ne_chunk(pos_tags)

# Display the results
print(named_entities)

[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data] Package punkt is already up-to-date!
[nltk_data] Downloading package maxent_ne_chunker to
[nltk_data] /root/nltk_data...
[nltk_data] Unzipping chunkers/maxent_ne_chunker.zip.
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data] /root/nltk_data...
[nltk_data] Unzipping taggers/averaged_perceptron_tagger.zip.
[nltk_data] Downloading package words to /root/nltk_data...
[nltk_data] Unzipping corpora/words.zip.

(S
  (PERSON Barack/NNP)
  (PERSON Obama/NNP)
  was/VBD
  born/VBN
  in/IN
  (GPE Hawaii/NNP)
  and/CC
  served/VBD
  as/IN
  the/DT
```

```
44th/CD
President/NNP
of/IN
the/DT
(GPE United/NNP States/NNPS)
./.)
```

Program 10 - Perform Morphological Analysis

```
import nltk
from nltk.tokenize import word_tokenize
from nltk.stem import PorterStemmer, WordNetLemmatizer
from nltk.corpus import wordnet
nltk.download('punkt')
nltk.download('wordnet')

#Stemming and Lemmatization

#Example text for morphological analysis
text = "The quick brown foxes are jumping over the lazy dogs."

#Tokenize the text into words
words = word_tokenize(text)

#Perform stemming
porter_stemmer = PorterStemmer()
stemmed_words = [porter_stemmer.stem(word) for word in words]

#Perform lemmatization
lemmatizer = WordNetLemmatizer()
lemmatized_words = [lemmatizer.lemmatize(word, pos=wordnet.VERB) for
word in words]

#Display the results
print("Original words:", words)
print("Stemmed words:", stemmed_words)
print("Lemmatized words:", lemmatized_words)
print("\n")

#Morphemes

# Sample word
word = "misunderstanding"

# Define morphemes
prefixes = ["mis"]
root = "understand"
suffixes = ["ing"]

# Extract morphemes from the word
```

```

morphemes = []

# Check for prefixes
for prefix in prefixes:
    if word.startswith(prefix):
        morphemes.append(prefix)
        word = word[len(prefix):]

# Check for suffixes
for suffix in suffixes:
    if word.endswith(suffix):
        morphemes.append(suffix)
        word = word[:-len(suffix)]

# The remaining part is the root
morphemes.append(word)

print("Word:", word)
print("Morphemes:", morphemes)

```

```

Original words: ['The', 'quick', 'brown', 'foxes', 'are', 'jumping',
'over', 'the', 'lazy', 'dogs', '.']
Stemmed words: ['the', 'quick', 'brown', 'fox', 'are', 'jump', 'over',
'the', 'lazi', 'dog', '.']
Lemmatized words: ['The', 'quick', 'brown', 'fox', 'be', 'jump',
'over', 'the', 'lazy', 'dog', '.']

```

```

Word: understand
Morphemes: ['mis', 'ing', 'understand']

```

```

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

```