Natural Language Processing - S2-24_AIMLCZG530

Assignment 1 – PS-5

Group 23

BITS ID	Name	Contribution
2024aa05772	SNEHA BANERJEE	100%
2023ab05116	SOUNDARRAJAN S N	100%
2024aa05876	ARUN KUMAR M	100%
2024aa05053	DEEPESH PARMAR	100%
2024aa05058	PRAJAPATI HEMANG KEYURBHAI	100%

STEP 1: Library Installation and Imports

```
!pip install nltk wordcloud
import pandas as pd
import numpy as np
import nltk
import re
import matplotlib.pyplot as plt
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk import pos_tag, word_tokenize, ne_chunk
from wordcloud import WordCloud
from collections import Counter
```

Code Breakdown:

!pip install nltk wordcloud : This installs two essential external libraries:

- **NLTK** (Natural Language Toolkit): for tokenization, lemmatization, POS tagging, and NER
- **wordcloud**: for generating word clouds from text data

import pandas as pd

import numpy as np

import re

import matplotlib.pyplot as plt

from collections import Counter

- **pandas**: for handling structured data (e.g., reading the dataset)
- **numpy**: for numerical operations
- **re**: for cleaning text using regular expressions
- **matplotlib.pyplot**: for visualizing frequency distributions
- **collections.Counter**: for counting token or tag frequencies

3. NLTK Components:

```
import nltk
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk import pos_tag, word_tokenize, ne_chunk
```

stopwords: removes common words like "the," "is," etc.
WordNetLemmatizer: reduces words to their base form (e.g., "running" → "run")
pos_tag: assigns parts-of-speech (e.g., NN for noun)
word_tokenize: splits text into words
ne_chunk: recognizes named entities as tree structures

4. Visualization Tool:

```
from wordcloud import WordCloud
```

WordCloud: for visualizing word frequency in an artistic layout

STEP 2: NLTK Resource Downloads

```
nltk.download('punkt_tab')
nltk.download('stopwords')
nltk.download('averaged_perceptron_tagger_eng')
nltk.download('wordnet')
```

```
nltk.download('words')
nltk.download('maxent_ne_chunker_tab')
```

1. **nltk.download('punkt_tab'):** Downloads the sentence and word tokenizer metadata (often used internally by word_tokenize())
2. **nltk.download('stopwords'):** Loads a curated list of **stop words** (e.g., "the", "is", "was") for filtering out irrelevant tokens.
3. **nltk.download('averaged_perceptron_tagger_eng'):** Downloads the **pre-trained POS tagger model** based on the averaged perceptron algorithm (used with `pos_tag()` for tagging parts of speech).
4. **nltk.download('wordnet')**: Loads the **WordNet lexical database** for use with lemmatization. Required by WordNetLemmatizer().lemmatize()
5. **nltk.download('words'):** Downloads an English **vocabulary word list** that can be used for spell-checking, token filtering, or building custom NLP utilities.
6. **nltk.download('maxent_ne_chunker_tab'):** Downloads the **Maximum Entropy Named Entity Chunker** metadata

STEP 3: Load Dataset and Select 'body' Column

```
df = pd.read_csv("Amazon Cell Phone reviews.csv")
df = df.dropna(subset=['body'])
reviews = df['body'].head(100).tolist()
```

df = pd.read_csv("Amazon Cell Phone reviews.csv"): Loads the CSV file named `"Amazon Cell Phone reviews.csv"` into a pandas DataFrame named `df`.

df = df.dropna(subset=['body']): Removes any rows where the `body` column (i.e., the review text) is missing (`NaN`).

reviews = df['body'].head(100).tolist(): Extracts the first 100 valid reviews (from the `body` column) and converts them into a Python list called `reviews`.

STEP 4: Data Preprocessing (Cleaning + Lemmatization):

```
stop_words = set(stopwords.words('english'))
lemmatizer = WordNetLemmatizer()
cleaned_reviews = []
for text in reviews:
    text = text.lower()
```

```
    text = re.sub(r'[^a-z\s]', '', text)
    tokens = word_tokenize(text)
    tokens = [lemmatizer.lemmatize(w) for w in tokens if w not in
stop_words]
    cleaned_reviews.append(" ".join(tokens))
```

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

- Loads a set of common English stopwords (like "the", "is", "and").
- These are typically removed because they don't add much semantic meaning.

lemmatizer = WordNetLemmatizer()
- Initializes a lemmatizer that reduces words to their base or dictionary form.
- Example: *"running"* → *"run"*, *"phones"* → *"phone"*

cleaned_reviews = []
- Creates an empty list to store processed review texts.

for text in reviews:
   text = text.lower()

- Converts the text to lowercase for uniformity (helps eliminate case sensitivity in tokens).

text = re.sub(r'[^a-z\s]', '', text)

- Removes everything that's not a lowercase letter or whitespace.
- Strips punctuation, numbers, and special characters to reduce noise.

   tokens = word_tokenize(text)

- Splits each cleaned text string into individual word tokens.

   tokens = [lemmatizer.lemmatize(w) for w in tokens if w not in stop_words]

- Removes stopwords from the token list and lemmatizes each remaining word.

   cleaned_reviews.append(" ".join(tokens))

- Reconstructs the cleaned tokens back into full lowercase strings (ready for further NLP processing).

STEP 5: POS Tagging and Sentence Filtering for Analysis

```python
from collections import Counter
from nltk import word_tokenize, pos_tag

# Initialize variables
pos_tags = []
selected_sentences = []

for review in cleaned_reviews:
    tokens = word_tokenize(review)
    tags = pos_tag(tokens)

    # Accumulate POS tags
    pos_tags.extend([tag for _, tag in tags])

    # Select sentences containing at least one noun or verb
    if any(tag.startswith(('NN', 'VB')) for _, tag in tags):
        selected_sentences.append(review)

# Count most common POS tags
pos_counts = Counter(pos_tags)
most_common_tags = pos_counts.most_common(10)
```

from collections import Counter
from nltk import word_tokenize, pos_tag

Imports tools to tokenize text, tag POS labels, and count frequencies.

pos_tags = []
selected_sentences = []

- pos_tags will hold all POS tags across the dataset.
- selected_sentences will store only the reviews containing meaningful syntactic content.

for review in cleaned_reviews:
   tokens = word_tokenize(review)
   tags = pos_tag(tokens)

- Each review is tokenized and POS-tagged. Tags are tuples like ('phone', 'NN').

pos_tags.extend([tag for _, tag in tags])

- Adds only the POS tag (e.g. 'NN') to the pos_tags list.

if any(tag.startswith(('NN', 'VB')) for _, tag in tags):
    selected_sentences.append(review)

- Filters for sentences that contain at least one noun (NN, NNP) or verb (VB, VBD, etc.), since they usually carry core meaning.

pos_counts = Counter(pos_tags)
most_common_tags = pos_counts.most_common(10)

Counts how often each POS tag appears across all reviews and extracts the top 10 for visualization.

STEP 6: POS Tagging and Frequency Analysis and Visualization

```
plt.figure(figsize=(10,6))
plt.bar(*zip(*most_common_tags))
plt.title('Top POS Tag Frequencies')
plt.xlabel('POS Tag')
plt.ylabel('Count')
plt.show()
wordcloud = WordCloud(width=800, height=400,
background_color='white').generate(" ".join(cleaned_reviews))
plt.figure(figsize=(10, 5))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of Cleaned Reviews')
plt.show()
```

- This section visualizes the top 10 most common POS tags using a bar chart.
- It helps to quickly identify dominant grammatical roles in the cleaned review texts — such as nouns (NN), proper nouns (NNP), and verbs (VB, VBD, etc.).
- Useful for understanding the structural profile of the corpus, and for later steps like chunking or POS-aware filtering.

- **Word Cloud of Cleaned Reviews:**

```
wordcloud = WordCloud(width=800, height=400, background_color='white').generate("
".join(cleaned_reviews))
plt.figure(figsize=(10, 5))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud of Cleaned Reviews')
plt.show()
```

- Creates a **visual representation of word frequency** in your reviews.
- Words appearing larger are more frequent, making it easy to spot commonly discussed features (e.g. "battery", "phone", "camera").

The frequency of each POS tag throughout the dataset is as follows:

Counter({'NN': 2922, 'JJ': 1256, 'RB': 539, 'VBD': 319, 'VBG': 246, 'VB': 224, 'VBP': 213, 'VBN': 154, 'IN': 137, 'NNS': 97, 'CD': 87, 'MD': 76, 'VBZ': 44, 'DT': 29, 'JJR': 28, 'JJS': 22, 'RBR': 11, 'FW': 9, 'CC': 8, 'PRP': 7, 'RP': 7, 'EX': 4, 'WDT': 3, 'NNP': 2, 'WP$': 1, 'WRB': 1, 'WP': 1})

The most frequently occurring POS tags along with their counts:

[('NN', 2922), ('JJ', 1256), ('RB', 539), ('VBD', 319), ('VBG', 246), ('VB', 224), ('VBP', 213), ('VBN', 154), ('IN', 137), ('NNS', 97)]

```python
# Define which POS tags to extract sentences for
target_tags = {'NN', 'NNS', 'NNP', 'VB', 'VBD', 'VBG', 'VBN', 'VBP',
'VBZ'}


print("\nSentences containing target POS tags:\n")


for i, review in enumerate(cleaned_reviews):
    tokens = word_tokenize(review)
    tags = pos_tag(tokens)
```

```
    # Check if any token has a POS tag in the target set
    if any(tag in target_tags for _, tag in tags):
        matching_tags = set(tag for _, tag in tags if tag in target_tags)
        print(f"Review {i+1} (matched tags: {',
'.join(sorted(matching_tags))}):")
        print(review)
        print("-" * 80)
```

Sentences containing target POS tags:

Review 1 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
samsung awhile absolute doo doo read review detect rage stupid thing finally died used nokia
phone bought garage sale wonder sold cheap bad hate menu take forever get want scroll
endlessly usually phone numbered category u simply press get want go pain put silent vibrate
youre class ring turn immediately there fast way silence damn thing always remember put silent
learned hard way true case mission get break ur nail process also youll damage case time u try
reason phone started giving problem succeed opening button could bit bigger vibration could
stronger good reception shabby using elevator remarkable feat considering old phone would
lose service simply putting pocket compared old samsung phone work quite well ring tone loud
enough hear phone actually charge quickly great battery life doesnt heat like potatoe oven
either long phone convos nice bright large screen cute way customize scroll bar set purple pink
aqua orange etc overall okay phone serf purpose definitely pale comparison new phone coming
sprint get get great

Review 2 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
due software issue nokia sprint phone text messaging capability dont work sprint system wont
software patch come time next month spend least hour sprint award winning customer service
team find someone admit problem nokia designed phone incoming message retrieved quickly
viewed offline way provider work sprint however like people hook server first stay connected
burning minute check inbox compose reply wait sprint server respond send innovation
moneymaking finest

Review 3 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
great reliable phone also purchased phone samsung died menu easily comprehendable speed
dialing available around number voice dialing also nice feature take longer speed dialing thing
bother gamesnokia seems taken snake phone skydiving game bowling tennis like pong ringer
nice feature available choose different ringer person calling however ringtones available online
download phone youre pretty much stuck vibrating ringtones regular midi polyphonic tone need
cover reasonable price range

Review 4 (matched tags: NN, VB, VBD, VBG):

love phone really need one didnt expect price bill received one also ive phone little two month still yet receive free accessory supposed come phone every time call company keep telling wait couple week receiving shortly love phone able im talking making phone call

----

Review 5 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
phone great every purpose offer except day bought iti couldnt get case take case put picture jaket super cool took back storean employee said meant hard get well could barely even get came close snapping casing half never able get isnt big deal got dirty clear casing look really dirty make sure get case oh charge time

----

Review 6 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
hello phone used decided buy flip phone problem battery new casesit new fish case stay well original one added ring tone music good meas matter fact willing sell phone home charger car charger great dealemail

----

Review 7 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
cool cheap color word describe nokia perfectly mean want beauty got classic sleek look jerk little nokia look also amazing ringtones cellphone shop experience rate th best phone ive ever come across store need prompting buy pal well come nokia includes alarm clock calendar voice recorder calculator stopwatch trust good value money youre tight budget oh youre thinking getting teenager youve come right phone theyll go crazy look color lcd happens little oversize phone goin adult youve hit da soda pop lucky person ya convinced mobile real

----

Review 8 (matched tags: NN, VBD, VBG, VBN, VBP):
overall nice phone except nokia made universal headset jack incompatible mm universal headset even phone call tech support required find need buy headset plug popport accessory connector bottom phone ended suggesting hdb headset

----

Review 9 (matched tags: NN, VBD, VBN):
ive never owned nokia phone first really like phone alot reception greateven though signal strength show low quality phone great feel sturdy weighted highly recommend phone

----

Review 10 (matched tags: NN, NNS, VB, VBG, VBN, VBP):
ok well im school need text messaging ive phone month text messaging supposed start working week agoa conflict software type stuff btween nokia sprintits star fact cant download ringtonesstarsor game starsbut cant beat nearfree free color phoneback star soon get text messaging b star

----

Review 11 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
ive phone year really like never partial flip phone appreciate nokias feature color screen nice feature easy use keylock simple twobutton sequence though wish timer keylock like old phone lot useful feature like calculator organizer stopwatch alarm three game lame play customizable feature nice lacking variety isnt ideal phone guy youre option pretty girly ringtones also lack something desired decent one battery life pretty good nothing special definitely bad get average

day without problem sometimes last several day parent sister husband got fancy samsung flip phone camera toy must say mine work better battery last much longer recpetion much better downside cute phone case made weak plastic cracked month also youre thinking getting different case dont take keep slipping never attache firmly neither new case bought ive read review last time dropped back piece popped battery flew phone issue drat overall great phone youre content simpler thing life really us camera thier phone anyway reccomend buying protective case leaving dont drop delicate thing

----

Review 12 (matched tags: NN, NNS, VB, VBD, VBG, VBP, VBZ):
slow want check missed call list phone feel compelled inform whether new call listit second course take half second read messageand probably dont care say annoying ever anyone scream ear thats sensation get phone regular basis nice ability attach voice tag phone numbera useful featurewhen work time recognizes number ask let know doesnt understandby screeching next head want know feel like phone turn ringer highest setting hold phone next ear call phone pleasant add fact youre searching one numerous menu phone menu least item menu system us whole screen display one line text three line available itbut us one whats next pas go back look cant find another way fragile phone cracked ask took battery cover take battery cover ask wanted write review way find model number heavy speaks itselfthe phone weighs way much bulky like heavy speaks recommendation buy better phone one make cry night

----

Review 13 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
bought phone year ago using ever since sprint pc network replace old tp first time bought phone defective get replaced day liked phone okay first really wish go back time buy better phone several issue mediocre reception rather bulky unattractive cheap feel cheaply made cheap material screen easily visible bright sunlight battery life marginal go little detail thing get okay reception phone good reception phone work area good signal area marginal signal apartment phone drop call left right fade second every minute outside interference building cause residence use husband sanyo get excellent signal doesnt drop nearly many call sprint check phone say working correctly assume poor quality phone blame phone quite big would expect modern phone camera small purse take lot room important phone cheaply made cheap feel made rather flimsy plastic dropped phone onto concrete foot antenna head got crack corner phone got serious scratch also screen difficult read bright sunlight quite bright otherwise far battery life go great ive gone bed battery half full woken dead phone believe poor reception immediate area blame phone search signal take battery time talk time decent pro loud ringer lot feature rarely use

----

Review 14 (matched tags: NN, NNS, VB, VBG, VBN, VBP, VBZ):
excellent choice sprint use enrolling new customer service free option new customer excellent year ownership love light someone calling help really find phone quickly dark phone purse really make easy find due fact nokia phone seems tougher samsung phone sprint store also issue phone fact since flip phone keypad must locked drop phone pant pocket annoying get used owning flip phone moving nokia

----

Review 15 (matched tags: NN):

dont buy service

Review 16 (matched tags: NN, VBD, VBG):
nextel nearly year started time last year motorola upgraded one best phone ever service best ever problem making reciving call considering nextel give shot opinion best cell company

----

Review 17 (matched tags: NN, NNS, VBG, VBP):
got say easy use hear person talking fine problem dealing nextel

----

Review 18 (matched tags: NN, VBD):
star phone locked pay additional fee unlock

Review 19 (matched tags: NN, VB, VBD, VBN):
product good used cell phone one project worked wonder definitely recommend anyone interested buying

----

Review 20 (matched tags: NN, NNP, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
problem nextel stop canceled service get problem service went get new phone day contract expired course wanted keep number went get cingular phone highly recommended old number switched new number today get mail nextel statement month early termination even though canceled service simply got new phone switched number icing cake year absolutely amazingy bad service nextel town small town mean place service largest subdivision get service anywhere constantly get comment people trying reach get classic nextel lineplease hold nextel subscriber trying reach located time would even recieve incoming call call would go straight voice mail would get call often would even get voice mail day even week later actually take call call count number time ive call dropped recieved many different error message sometimes wonder spend time nextel thinking different error message program phone brings selling point nextel famed wellloved direct connect feature absolute joke direct connect work maybe half time tried use even middle conversation would greeted loud beep phone telling wont talking person anymore course would expect nothing less nextel network text messaging nextel next impossible take hour send recieve message took day maybe didnt even come internet access fine rare instance worked course dont service dont get internet access either constantly getting message network available calling trying complain nextel futile trying get customer service take forever get nothing experience nextel nothing short disaster write trying warn anyone considering nextel stick verizon cingular much happier end dont make mistake

----

Review 21 (matched tags: NN, VBP):
great product great nextel boost insert sim go

Review 22 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
bought phone replace lg phone didnt like expected put old sim card new phone worked two serious drawback device related candy bar style first button exposed easy hit one accidentally second screen easily scratched one got scratched making difficult read sunlight aside two flaw phone work great connectivity battery life quality voice superb since dont texting cant comment

nice small came case could find case would perfect need price right new sim card worth calling dont need

----

Review 23 (matched tags: NN, VB, VBD, VBN, VBP):
purchased phone att phone replacement even though one faq mentioned work att sim case didnt since primary phone stead spending time see reason ill go phone specifically say unlocked

----

Review 24 (matched tags: NN, VBZ):
phone come charger didnt sims card

Review 25 (matched tags: NN, VBN):
served well back phone

Review 26 (matched tags: NN, VBD, VBG, VBN):
got phone secondary cell phone really lightweight cheap receiption good time windy noise heard somebody calling cell phone

----

Review 27 (matched tags: NN, VBG):
sturdy clarity great easy use problem speaker option big issue im living atm

----

Review 28 (matched tags: NN, VBD, VBG):
phone stoped working

Review 29 (matched tags: NN, VB, VBD, VBN):
beautiful job used item att account good see bill little avoided big amount billsi would recommend product body good quality really met expectation

----

Review 30 (matched tags: NN):
way small

Review 31 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
asked friend toss phone heard hey throw phone hard head hit square temple dropped needless say sturdy phone simple easy use long battery life like really long like stretch armstrong long take dropped smacked around like champ phone son id proud afraid texting take little get used digress smart phone dummy p create ringtones phone provides way entertainment flappy bird

----

Review 32 (matched tags: NN, VB, VBD, VBN):
never use cell phone thought needed one long road trip last phone always irritated battery seemed dead every time tried use based review chose phone battery life great phone really handle abuse well husband forgot shirt pocket phone went washer dryer still work well ever im sure would work everyday phone need occasionally would highly recommend charged ready need

----

Review 33 (matched tags: NN, VB, VBD, VBG, VBN):

model phone year battery beginning fail fantastic little phone doesnt drop call stick pocket purse easily exactly supposed unbeatable price refill get bonus

---

Review 34 (matched tags: NN, VBD, VBG, VBN):
easy use feature slim size good price better compare exsiting tmobile prepaid phone called landline phone picked within second tmobile sec time jumped voice mail highly recommend att

---

Review 35 (matched tags: NN, VBP):
phone great simple use great battery life always strong signal att great payasyou go plan im happy

---

Review 36 (matched tags: NN, NNS, VBP):
basic phone effective phone people need lot feature size good

---

Review 37 (matched tags: NN, NNS, VBD, VBP):
good little inexpensive phone basic thats wanted phone pay go plan

---

Review 38 (matched tags: NN, VB, VBD, VBG, VBN, VBP, VBZ):
almost never write review anything stupid little cheap phone proven reliable indestructible say something bought phone least maybe year ago two fancy expensive flip phone lasted less year falling apart goal buy phone would last year didnt expect phone would certainly buy phone would last year goal spend another phone hoped might last month decided next change service provider get new contract free phone etc surprise little brick phone keep going treated lightly recently opened back find serial found full dirt dust crashed skiing splashed salt water sailing drenched sweat bike jersey still work complaint dearly wish camera even crappy one sometimes exposed button get pressed accidentally fancy feature im going buy another one case one ever quits update phone still going year bought phone firstgeneration iphone came four generation iphone later still dont one phone refused die incredible

---

Review 39 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
ci two year replacement different phone broke note gophone use monthly att service putting sim card friend make fun boring looking phone since gone phone crap phone still going going phone perfect someone doesnt need camera video bell whistle stuff want sturdy reliable phone long battery life also inexpensive also attest main review phone terminator phone meaning extremely resistant almost form physical harm never tried soaking water dropped thrown scraped kicked etc screen battery still perfectly functional great battery life well battery never run ever supernegligent come charging course phone really normal calling basic texting complaint would make entering new contact address book somewhat difficult counterintuitive learn wont regret buying phone

---

Review 40 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
ive using phone three week truly nice little phone small light keypad screen really light upyou actually see screen bright sunlight everything want phone graphic web really good although accessing web rather slow keypad quite small could problem men perfect negative doesnt

speaker phone capability battery life others said amazing person whose wife phone dead probably jostled purse inadvertently turned prefer bar phone kind sure one first thing learned lock keypad whenever put purse pocket place would possible phone accidentally turned simple matter pushing two key turn lock shut sure save lot battery life

----

Review 41 (matched tags: NN, NNP, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
well phone came service plan well paper weight darn razrs didnt want spend another phone wil break stumbled upon gophones best buy work perfectly att monthly subscription sim card crazy cheap phone battery life amazing rated hour first bought opened store turned bar wasnt another hour untill got home charge still bar battery life also talked good minute durable love battery back one slide one like sony phone one push button like razr combination press butten slide work really well little chance breaklose cover came preloaded game cool space invader style game soccer game weird mole game personal favorite came ton actually decent tone set ringtone unlike razr came horrid selection also came unactivated brand new sim card like bought phone put old sim card get bonus sim card sell craigslist like dollar seeing came one new g card real complaint keypad really cramped still easily usable still get feeling cramped phone came preloaded image set wallpaper time call quality little shakey rarely happens go away fast dollar thats fraction price cheapest upgrade service plan phone really doubt anybody actually read edit definitely worth mention phone since august feb hope dropped countless time phone break seriously ive tried take horible care phone wanted test durability show friend dollar phone durable dollar one demonstration ive thrown tree wall concrete sidewalk ive thrown snow hell ive even tossed concrete invited friend join game soccer joke didnt several several time worst happened batterycover snapped battery fell put battery back snap cover turn phone month treating like thing actually today feb th chucked concrete ground batterybattery cover flew usual surprise turned small black bar screen even surprising still work perfectly everything amazes poorly ive taken care phone done even th thing phone old razr assure would snapped half something highly recommend phone im going buy another one soon heck might even pick one emergency replacement

----

Review 42 (matched tags: NN, VB, VBD, VBG, VBN, VBP, VBZ):
got phone based recommendation att silly wanted back phone wife could use case phone failed turn also motorola different model almost x price recommend phone low cost go phone pay minute use bought phone loved low cost came airtime feel solid except battery cover seems flimsy seems hold problem felt good sound quality good number feature low cost phone wanted prep battery since wife going travel soon left powered would constantly press button light would stay drain battery display amazingly bright could almost use flashlight also really surprised battery life anyhow two cycle draining battery charging full figured would set use emergency phone wife going two week business trip wrong last day trip main cell phone battery low decided try use back phone wouldnt turn dont know due xray machine airport battery drained said never turned day maybe got turned accidently purse phone turn pressing button front second anyhow make matter worse att rep also said could also use main phone transfering sim nope didnt work either older att plan migrated atleast phone didnt cost much figure still keep emergency phone go phone minute expire att rep didnt tell look pretty good paper weight

----

Review 43 (matched tags: NN, NNS, VB, VBD, VBG, VBN):
needed temporary phone friend retirement home got settled new place charged ran several day would preferred larger key pad due poor eyesight seemed okay simple enough able use simply make receive call didnt get answering system moved landline installed giving friend cell phone afford price regular one right limited call road two price one
----
Review 44 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
phone isnt kidding say military spec hole pocket went tumbling flight concrete step step scratch worked fine also made death defying leap drop resistant said crush proof battery dead decided leave car charge plugged car charger grabbed purse got car unbeknownst charger cord tangled around purse stood closed car door right phone left big mark finally still worked would world first boomerang phone looked like boomerang afterwards ordered new one much beat last phone well fared get another one pet peeve phone could least given one full game lame demo included phone size hershey bar often keep pant pocket front pocket
----
Review 45 (matched tags: NN, NNS, VBD):
bought phone found iden phone sim card longer eligible service boost mobile buyer ware dont buy unless already service sim card
----
Review 46 (matched tags: NN):
wont enter special code

Review 47 (matched tags: NN, VBD, VBP):
mother said love walkie talkie phone bought mother denise avellan mother day mother love great direct connect connection
----
Review 48 (matched tags: NN, VB, VBD):
bought phone told would longer work network waste money seller knew would work say anything
----
Review 49 (matched tags: NN, VB):
price really get solid boost motorola phone sound look good

Review 50 (matched tags: NN, VB, VBD):
phone come sim cardinformation wouldve liked phone work fine ptt walkie phasedout boost sim rating phone unhappy fact prior purchase
----
Review 51 (matched tags: NN, VB, VBD):
boost phone work gps boost send back huge pain something ripoff
----
Review 52 (matched tags: NN, VB):
good phone work well simple usedropped time still work fine

Review 53 (matched tags: NN, VB, VBD):

get basic function cell phone needed word phone simple effective

----

Review 54 (matched tags: NN, NNS, VBD, VBP):
wouldnt know anything cell phone ordered person hasnt even shipped yet month amazon nothing help really nothing option provide assistance

----

Review 55 (matched tags: NN, NNS, VBD, VBG, VBN, VBP, VBZ):
someone needing basic phone service ie email access camera etc phone quite good sound quality built speaker mic speaker phone good phone portable button one midget operate negative side give instead star relatively small battery size anyone opened back install attest hence battery power basic phone par basic phone though much second critique small screen addition well lit problem viewing even shade third problem interface feature ie voice recorder contact list easy thanks small screen one need scroll quite bit access phone feature one last critique messaging service quite slow hence need use feature phone far optimal good phone despite weakness cited someone looking barebones phone fulfills requirement

----

Review 56 (matched tags: NN, VB, VBD, VBG, VBN, VBP, VBZ):
professional recently purchased sanyo juno phone use extra specialpurpose business phone using boost card pay phone two month switched auto reboost payment service wherein payment automatically charged credit card month terrible mistake boost mobile making monthly charge credit card time cut phone service telling money account course latter true former true call boost service number resolve problem learn human being speak automated list option none correspond problem contact boost via online customer service email option customer asked describe problem receive phone call instructing call service number ive noted provides human operator tell money account word boost mobile tell restore service must make another payment even though payment already made auto reboost plan effect must pay twice month service nothing company would want business deeply regret selecting business company

----

Review 57 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
picked use boost mobile wanted phone walkie talkie fit bill digital camera picture phone dont need camera phone dropped one call since activated everytime dt someone work phone get signal tmobile sprint others fail button texting replying email easy handle looking phone one get would give start allowed another plus handle mp gif image upload pc phone

----

Review 58 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
phone awesome one boost mobile unlimited plan bought august th regret people whine complain screen re game phone people nothing nothing less use walkietalkie regularly wife text back forth daily missed missing message phone receivesmakes call walkietalkies others failed people want game buy gameboy want picture buy camera real hard figure little gem built phone thats exactly short see really phone

----

Review 59 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):

dont want sound like hot head havent best luck cell phone get bad call phone go flying phone impressed durablity thrown droped even went flying car window street wasnt looking still work best phone ever bought would buy phone cost worry every time drop one fall brush dirt go way

----

Review 60 (matched tags: NN, VB, VBD, VBG, VBP):
find texting impossible phone another reviewer said screen go blank randomly turn also phone randomly turn phone transmission turn back receivemake phone call better phone

----

Review 61 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
recently ruined work good service worked well spent piece service horrible patchy dont receive text sometimes screen go white reason key pad light stopped working phone alarm battery doesnt last day phone two month worst phone ive owned buy good phonebut buy rugged version

----

Review 62 (matched tags: NN, NNS, VB, VBD, VBG, VBP):
love phone yes would love feature love phone sound quality great could laundry talking speaker hear herd perfectly without ecko phone make ever listening web normal like phone texing good as well overall phone sound quality ive many phone low sound phone perfect phone one upgraded one love even better one easy tipe button hard love phone

----

Review 63 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
phone junk buy phone much faster messaging via regular usps text message lost vast time warp boost mobilism stay decide try use internet phone waiting regular minute webpage load bumrushed million delayed text obliterate effort sorry little phone put forth trying load webpage screen turn white entire phone reset responsibility manually turning transmitter back phone work arguing girlfriend phone dump think hung close family member abandon make pact family member call text never text back hardly ever answer affair married woman phone hold message sent husband come home like magic phone deliver long lost message soon pick wife phone reaname phone taliban claimed responsibility phone common sense make one wonder wasnt created sinister power possibly satan

----

Review 64 (matched tags: NN, NNS, VBP):
withstands lot worth money thing doesnt camera

Review 65 (matched tags: NN, VB, VBD, VBP):
replacement one mom went south u cant really complain problem device carrier phone probably give five star seller gave spot description gave charger threw case free yet carrier doesnt seem like phone receive package next day

----

Review 66 (matched tags: NN, NNS, VB, VBD, VBG):
shipping time phone great phone also work great supose sims card problem stated great battery life nice looking phone work area phone signal phone clear good cloudy would buy seller thank mark

----

Review 67 (matched tags: VBD, VBN):
purchased one worked

Review 68 (matched tags: VBD, VBN):
delivered promised

Review 69 (matched tags: NN, VBD, VBG):
showing cingular phone identical one instead got atttit okay yhe cingular phone option

----

Review 70 (matched tags: NN, NNS, VB):
wife love phone third one like one perfect thanks

Review 71 (matched tags: NN, VB, VBD, VBG, VBN):
phone one husband got first opened cell account many year ago open change wasnt sure could
get phone glad able get working quite well thank

Review 72 (matched tags: NN, VB, VBD, VBN):
got phone wanted phone would better reception previous phone however never recognized
information stored sim card essentially useless

Review 73 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
phone purchased alpha wireless supposedly texas shipped go green wireless florida understand
several company may cooperate fulfill order make difficult regarding recourse case phone
represented new simply price paid closely reflected condition buyer beware usual using amazon
ebay

Review 74 (matched tags: NN, NNS, VBD, VBP):
nice phone worked properly answer phone cant hear person line put phone speaker order hear
cause people hang phone piece junk started happen two day got phonea bad choice

----

Review 76 (matched tags: NN, NNS, VB, VBG, VBN):
looking regular phone thats fairly durable great especially used heavy case yes would
recommend phone

Review 77 (matched tags: NN, NNS, VB, VBD, VBG, VBP, VBZ):
short phone work fine basic phone looking long old phone lcd croaked wanted wait bit buying
htc dream went cheap phone complaint menukey response sometimes slow way get data
phone via usb cable least live u seems like usb cable exists europe asia australia cost much
phone exchange rate go talk cable ca work regular usb connector one end nokia microusb mm
charger plug u nokia manual say microusb port authorized personal mind say carrier u wanted
force people getting thing onto phone via chargeable method event ill getting new phone month
ill live phone limitation make suitable looking anything makingreceiving phone call like parent

----

Review 78 (matched tags: NN, VBD):

good news long battery life lightweight none worth anything cant hear person samsung sony never problem keypad tough requiring sledge hammer push key bottom line phone cheap get pay try sony samsung cheapest model work better

----

Review 79 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
needed replacement phone want sign new contract bought nokia c full retail price phone good value ring loud clear speakerphone easy hear people im calling say voice clear though tell im cell phone lot neat software feature example configure shortcut action left right softkeys well updownleftright button dedicated rocker switch side volume call volume adjusted left right button phone constructed well feel light battery life good screen bright clear navigating menu little sluggish keypad stiff making text messaging chore bluetooth connectivity forget using one fancy headset box include wired earbudmicrophone integrated call answerend button something annoyed saved number address book incoming call nokia software put symbol front incoming call number get saved address book example minor thing something probably useful european phone number example overall like phone probably keep someday feel need get smartphonetype slab electronics

----

Review 80 (matched tags: NN, VB, VBD, VBG, VBN, VBZ):
probably wrost experience amazon costed phone amazon arrived inright time without activation called att could locate phone number call back amazon learned activated phone amazon customer service took good amount time meanwhile missed billing cycle old cell phone company process took week mention sim card delivered working amazon ship

----

Review 81 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
simple mean good way come envy glad able open phone dial deal clicking ok twice unlock locked screen quote intentional screen locked needed urgently make call lot phantom dialing pocket back alias phone easy figure work way said work specifically get phone pair blue tooth new car tried car dealer tried issue reported phone blue tooth capability beg differ read another review person exact trouble different model car also told phone fine obviously something unique model samsung phone pair without problem got phone exchanged going still pair car wanted phone simpler previous envy owned even phone pair car plan switch smart phone soon nexus one come verizon considering large increase monthly charge thus receive extending contract sincerely hope work hard keep customer happy say customer terribly happy right say network strongest area hope stick verizon change wont try keep satisfied

----

Review 82 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
recently got phone replacement happy back flip phone great camera tested video yet battery life solid ill give samsung credit rotatingchangable keyboard cool thing next model might customizable keyboard ability assign value key far ease use keyboardi havent problem large handsfingers take little getting used acclimated problem cant comment voice recognition blue tooth dont really use feature honestly find useless ill use ear piece car rare also dont plan using mp playeri ipod looking phone synch outlook find one offered spec yes remotely sync get access web email nowhere description outlook mentioned cant hold phone would like faulting car cause doesnt fly know thats exageration kinda thing clearly meant need phone syncs

outlook get pda phone basically standard flip extra feature probly wont popular mickey mouse club kid want iphone like device watch movie giggle txts friend sent interface vz flip phone ive past ability use gb micro sd also nice feature especially handy card reader pclaptop solid phone serf purpose intended forum phone thats easy txt make call

----

Review 83 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
good overall phone bluetooth far syncs well integrated bluetooth mercedes used also aftermarket alpine stereo vw feature design poor andor thought look great body far slippery like handling bar soap use primary alarm clock morning really clumsy grab nightstand shut alarm even im fully awake alert hard open ive dropped time fumbling open wider slit clamshell lid fit finger opening portrait mode landscape mode there place insert finger flip open use fingernail unlike previous phone take two hand almost time open thing whereas old phone could easily flip open one hand wish alarm clock snooze function like clock radio allows minute snooze time short phone allow set snooze period preference way display time front screen phone dark open well fake holding lock button music key light display hold second time reset lockunlock back also youre call although every cell phone fails clock doesnt display anywhere better phone many time call said hey let meet later person asks ok time cant tell quit wearing watch clock cell phonesbut dont display time call key outside arent bad except volume updown little easy accidentally press like keyboard idea overall find like typing little chiclet gum candy need use fingernail avoid fatfingering qwerty mode end button close space bar inadvertantly killed web browser typing space field page frustrating end key farther away wish would also engineered page updown key scrolling line line cumbersome would also like end send key somehow traditional red green color use outlook netbook sync sort contact phone work alright want refresh contact delete phone resend theyll duplicate bit annoying need reenter ice contact manually bluetooth send pic netbook one time cumbersome cant select multiple photo wont send video netbook via bluetooth send via picture message email fake way incur data usage charge way use removable storage microsd card biggest disappointment calendar useless piece junk say send calendar appointment phone halfbaked set reminder outlook reminder doesnt carry phone phone support one text field appointment corresponds outlook appointment body header meeting description location retype description location outlook calendar body want see anything useful phone even appointment come empty text field phone either problem text long andor carriage return text think try enter phone enter description displayed empty text field phone freeze reboots terrible recurring meeting also miserably halfbaked set interval like every week work work schedule want every friday work phone know im work choose daily weekly monthly annually take outlook calendar item end flawed useless really plan using phone organizer dont fail meet need understand samsung us calendar many product deal breaker next time around ill shop different brand addon mobile email oz isnt bad also room improvement billed fully integrated eye phone limited file viewer certain file type stored receive email attachment even jpg oz mobile email doesnt support accessing attachment call fully integrated oz email client also work bit inconsistently although maybe issue email provider oz cox pop account access inbox sent item yahoo hotmail access various folder ok university email account hosted google gmail display inbox sent item inbox really weird imagine folder might lump everything togeter well user interface oz mobile email isnt bad although bit unintuitive find add recipient email phone contact done hard find also isnt clear add multiple recipient use comma

semicolon dont know beware verizons compusory data plan phone misleading supposedly month get mb data usage often isnt presented clearly applies web browser texting picture messaging part mb even though use data connection called web browsing plan data plan unless pay additional texting plan charged message pretty furious first bill arrived find charged picture message sent thinking part data plan mp player alright although twice froze restart phone headphone jack nontypical mm need adapter go mm booooo battery life soso work listen mp day also little lunchtime web browsing minute easily go full battery dead hour dont know typical phone itd nice mp make one whole workday cant sound builtin speaker decent something small

----

Review 84 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
loved samsung alias alias owner decided purchase alias faith assuming samsung simply updated certain feature original mistaken first thing notice size alias taller thicker wider original like one reason bought original alias superslim design would say bulkier original original slid jean disappeared new one stick like sore thumb suppose increase size support new improved cameracamcorder never used feature much first place ultimately would say reason returned alias also care much ballyhooed liquid ink screen texting must toggle screen find numberssymbolspunctuation mark need fact third screen scant number symbol empty space frustrating toggling first screen letter empty space theme screen fact either orientation said found annoying maybe became used figuressymbols crammed onto original alias phone pad ended returning alias going back original keep new every discount verizon come good android apple finally relents iphoneatt exclusivity

----

Review 85 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP, VBZ):
ive gone several phone last year whenever rebate would apply would upgrade last year settled alias mostly eink technology impressed first excitement new phone wore always regardless remains trustworthy phone hopefully samsungs newer version alias fix flaw ive run least slow system youre middle typing text new text come phone freeze momentarily saving textinprogress draft showing new text fact phone save text good would better incoming text flew background phone allowed continue typing ive learn im typing text phone stop registering im trying enter stop pushing button give second itll resume normal running otherwise might accidentally delete incoming text go trying take picture text come except picture doesnt save occasionally phone get confused flip landscape vertical position fast key screen dont change even push button continues operate vertical mode even though phone flipped normal position like switch vertical horizontal back middle text work flip fast enough there plenty time plus close phone dont flip fast enough simply save draft doesnt apply application inprogress text there decent signal alias previous phone cheapo noticed improvement signal cant verify better env omnia higherend phone youre considering phone take consideration none case including slimmest clear plastic one fit well dualhinge dont prevent phone opening cause strain hinge flipped landscape mode make phone bulkier necessary term size great feel probably little bit taller phone size env touch orignal env slim definitely pocketsized keyboard landscape vertical mode great size perfect texting key unique feel big small front display provides access music taking picture selfportrait style ive seen complaint isnt possible hold playpause button skipback button activate camera see preview picture simply press playpause button take pic front display also allows see text message preview quick response quick text autodisplay text option set feature didnt discover id

phone six seven month probably read manual volume speaker mic good havent trouble able hear anyone hearing speaker phone bit crackly way full volume necessary plenty loud phone closed ie listening music need bit louder therefore sometimes crackly im satifisied phone ipod dock allinall great phone minor problem im still happy initial novelty worn even though im lusting env touch personal fickleness come phone im saving money however holding onto trusty alias

----
Review 86 (matched tags: NN, VB, VBG, VBN, VBP):
messaging feature nice typing text message much hassle keyboard also screen quite pretty found morphing keyboard great feature receiving call phone work half time sometimes reset attempt answer call also time light call coming wont actually finish process start ringing dont know actually called tell later im beginning kick signing contract service phone suspect going pain butt contract

----
Review 87 (matched tags: NN, VB, VBG, VBN, VBP, VBZ):
using phone day like big gadget phone fan preferring simpler device want voice quality acceptable short learning cycle easy use alias allows novice texter send receive text message real hassle keypad great size even larger finger would given star except learning curve required figure phone bad definitely different older phone used

----
Review 88 (matched tags: NN, VBD, VBG, VBN, VBP):
ive phone couple month pretty cool way screen keypad used either portrait landscape however key dont good tactile feedback type fingernail order press key hard enough accurately voice recognition software worthless accustomed using feature dial car using earpiece dont bother camera camcorder work well quality picture display really good battery phone doesnt last near long old lg however phone many feature think battery life acceptable got sleek design fun use however dont think id buy another one usability issue

----
Review 89 (matched tags: NN, NNS, VB, VBD, VBG, VBN):
alias keep shutting even full charge thought might problem battery husband phone started thingseveral time day since heard two people problem alias local verizon store offered software update guarantee would correct problem claim phone wasnt big seller never heard problem refuse look problem saying thats nature electronic devicesno guarantee anyone else problem

----
Review 90 (matched tags: NN, NNS, VBD, VBG, VBN, VBP):
samsung yearsa diehard sturdy phone wanted improved feature looked flip phone pursecalling intuitive decentsized key start texting soooo much room keyboard change need easy use intuitive basic function choose read manual lot wonderful thanks samsung

----
Review 91 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
overall like phone call quality love keyboard find easy type text message havent used camera bluetooth feature access email account easily main problem phone lock attempt use mp player gb microsd card music hook phone car radio play everything fine first month phone lock freeze medium mode way unlock remove replace battery annoying phone also turned several time attempting answer call

----
Review 92 (matched tags: NN, NNS, VB, VBD, VBG, VBP):
excellent phone great talk time excellent standby user friendly may state take little time get use change new anything fall top key texting large finger besides would recommend phone anybody wife kid go phone like water many phone one unique exspecially flip screen picture excellent minus flash live cause low light still take excellent pic flash phone joke good couple foot take want recommend phone anybody men woman unique gripe wife could different color gripe top button could different thanks reading jeff

----
Review 93 (matched tags: NN, NNS, VB, VBD, VBG, VBP, VBZ):
dont bother piece junk worst phone ever owned turn inexplicably time day shuts middle conversation embarrassing close fast shuts also body phone way slippery dropped hand dozen time darn slippery hold impossible flip open phone one hand need hand open terrible product thinking quitting verizon simply offer po phone dont waste time money junk

----
Review 94 (matched tags: NN, VBD, VBG, VBN, VBP, VBZ):
got mine free purchase wife blackberry understanding full computer great tool tpo give quick access internet really dont like working lap top desktop leaf limited access internet thing give access everywhere wireless house use broadband everywhere else netbook limitation looking full featured machine quick access internet file great

----
Review 95 (matched tags: NN, NNS, VB, VBD, VBG, VBN, VBP):
pro creative use button big screen qwerty keyboard con doesnt sync outlook clunky user interface muddled audio ear piecespeakerphone really give credit samsung creatively designed keypad dont recommend phone overall phone user interface isnt simple made somewhat complicated keyboard layout constantly changing based screen youre example there awkward key layout version layout take many keystroke thing like turn alarm guess ive spoiled almost always owning nokias tend bestdesigned user interface aside clumsy ui biggest thing killed family inability sync contact calendar event outlook maybe there way combination myverizon usb cable worth effort especially switch nokia take care aside switched att week later poor phone selection verizon also verizon disables bluetooth syncing capability outlook even nokias offer overall phone designed creatively hip design doesnt make poor ui lack feature essential

----
Review 96 (matched tags: NN, VB, VBG):
never problem phone year camera take decent great pic nice big button texting call quality excellent battery life pretty good happy camper

----
Review 97 (matched tags: NN, VB, VBD, VBG, VBN, VBP):
real ram issue really unusable take good minute run program got mine free signing fios feel like got ripped thought would nice little thing computer house really used nothing paper weight buy give star star wasnt option

----
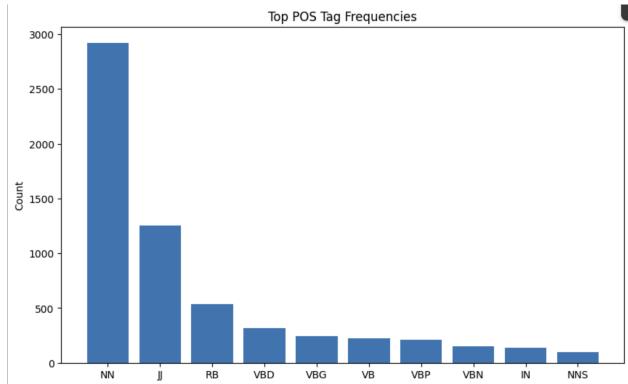Review 98 (matched tags: NN, NNS, VBD, VBP):

great phone comfort larger phone mixed easy use qwerty keyboard keyboard nice space texture feel like kindle touch button qwerty turn ect need phone highly recommended

----

Review 99 (matched tags: NN, VB, VBN, VBZ):

fone two year one problem itlove magic keyswill wait till alias come upgrade better magic key

----

Review 100 (matched tags: NN, VBD, VBG):

got phone couple day ago love work great texting breeze great size

----

This bar chart illustrates the distribution of the most common parts-of-speech (POS) tags across the cleaned reviews. The x-axis represents POS tags (e.g., NN, JJ, VB), while the y-axis shows their frequency. Peaks in tags like NN (nouns) or JJ (adjectives) can indicate a focus on product features and qualities within the reviews.

Word Cloud of Cleaned Reviews

The word cloud visualizes the most frequently used words in the review corpus after stopword removal and lemmatization. Larger words appear more often in the dataset. Common themes like "phone", "good", or "work" can emerge, offering a quick qualitative feel for what users emphasize.

STEP 7: HMM POS Tagging

```
hmm_sentences = [word_tokenize(review) for review in cleaned_reviews[:4]]
hmm_tags = [pos_tag(sent) for sent in hmm_sentences]
for i, tagged in enumerate(hmm_tags):
    print(f"\nReview {i+1} POS Tags:")
    print(tagged)
```

hmm_sentences = [word_tokenize(review) for review in cleaned_reviews[:4]]
- Tokenizes the first 4 cleaned reviews into word lists.
- `cleaned_reviews[:4]` selects the first 4 review strings.
- `word_tokenize(review)` breaks each review into individual word tokens.
-
hmm_tags = [pos_tag(sent) for sent in hmm_sentences]

- Tags each list of tokens using NLTK's default **POS tagger**, which is based on the averaged perceptron algorithm but mimics traditional HMM output.
- The result is a list of lists, where each sublist contains `(token, POS)` tuples.

for i, tagged in enumerate(hmm_tags):
    print(f"\nReview {i+1} POS Tags:")
    print(tagged)

- Iterates through the tagged sentences and prints the POS-labeled tokens review by review.
- Helps to manually inspect how verbs, nouns, adjectives, etc., are distributed.

OUTPUT:

Review 1 POS Tags:
[('samsung', 'NN'), ('awhile', 'IN'), ('absolute', 'JJ'), ('doo', 'NN'), ('doo', 'NN'), ('read', 'VBP'), ('review', 'NN'), ('detect', 'JJ'), ('rage', 'NN'), ('stupid', 'JJ'), ('thing', 'NN'), ('finally', 'RB'), ('died', 'VBD'), ('used', 'VBN'), ('nokia', 'RB'), ('phone', 'NN'), ('bought', 'VBD'), ('garage', 'NN'), ('sale', 'NN'), ('wonder', 'NN'), ('sold', 'VBD'), ('cheap', 'JJ'), ('bad', 'JJ'), ('hate', 'NN'), ('menu', 'NNS'), ('take', 'VBP'), ('forever', 'RB'), ('get', 'VB'), ('want', 'JJ'), ('scroll', 'NN'), ('endlessly', 'RB'), ('usually', 'RB'), ('phone', 'NN'), ('numbered', 'JJ'), ('category', 'NN'), ('u', 'JJ'), ('simply', 'RB'), ('press', 'JJ'), ('get', 'NN'), ('want', 'VBP'), ('go', 'VB'), ('pain', 'NN'), ('put', 'VBD'), ('silent', 'JJ'), ('vibrate', 'NN'), ('youre', 'NN'), ('class', 'NN'), ('ring', 'VBG'), ('turn', 'VBP'), ('immediately', 'RB'), ('there', 'EX'), ('fast', 'JJ'), ('way', 'NN'), ('silence', 'NN'), ('damn', 'JJ'), ('thing', 'NN'), ('always', 'RB'), ('remember', 'VB'), ('put', 'VB'), ('silent', 'JJ'), ('learned', 'VBN'), ('hard', 'JJ'), ('way', 'NN'), ('true', 'JJ'), ('case', 'NN'), ('mission', 'NN'), ('get', 'VB'), ('break', 'JJ'), ('ur', 'JJ'), ('nail', 'NN'), ('process', 'NN'), ('also', 'RB'), ('youll', 'RB'), ('damage', 'VB'), ('case', 'NN'), ('time', 'NN'), ('u', 'JJ'), ('try', 'VB'), ('reason', 'NN'), ('phone', 'NN'), ('started', 'VBD'), ('giving', 'VBG'), ('problem', 'NN'), ('succeed', 'VB'), ('opening', 'VBG'), ('button', 'NN'), ('could', 'MD'), ('bit', 'VB'), ('bigger', 'JJR'), ('vibration', 'NN'), ('could', 'MD'), ('stronger', 'VB'), ('good', 'JJ'), ('reception', 'NN'), ('shabby', 'NN'), ('using', 'VBG'), ('elevator', 'NN'), ('remarkable', 'JJ'), ('feat', 'NN'), ('considering', 'VBG'), ('old', 'JJ'), ('phone', 'NN'), ('would', 'MD'), ('lose', 'VB'), ('service', 'NN'), ('simply', 'RB'), ('putting', 'VBG'), ('pocket', 'NN'), ('compared', 'VBN'), ('old', 'JJ'), ('samsung', 'NN'), ('phone', 'NN'), ('work', 'NN'), ('quite', 'RB'), ('well', 'RB'), ('ring', 'VBG'), ('tone', 'NN'), ('loud', 'JJ'), ('enough', 'RB'), ('hear', 'VBP'), ('phone', 'NN'), ('actually', 'RB'), ('charge', 'JJ'), ('quickly', 'RB'), ('great', 'JJ'), ('battery', 'NN'), ('life', 'NN'), ('doesnt', 'VBZ'), ('heat', 'NN'), ('like', 'IN'), ('potatoe', 'NN'), ('oven', 'RB'), ('either', 'RB'), ('long', 'RB'), ('phone', 'NN'), ('convos', 'NN'), ('nice', 'JJ'), ('bright', 'JJ'), ('large', 'JJ'), ('screen', 'NN'), ('cute', 'JJ'), ('way', 'NN'), ('customize', 'NN'), ('scroll', 'NN'), ('bar', 'NN'), ('set', 'VBN'), ('purple', 'JJ'), ('pink', 'VBP'), ('aqua', 'JJ'), ('orange', 'NN'), ('etc', 'FW'), ('overall', 'JJ'), ('okay', 'NN'), ('phone', 'NN'), ('serf', 'NN'), ('purpose', 'NN'), ('definitely', 'RB'), ('pale', 'JJ'), ('comparison', 'NN'), ('new', 'JJ'), ('phone', 'NN'), ('coming', 'VBG'), ('sprint', 'NN'), ('get', 'NN'), ('get', 'VBP'), ('great', 'JJ')]

Review 2 POS Tags:
[('due', 'JJ'), ('software', 'NN'), ('issue', 'NN'), ('nokia', 'PRP'), ('sprint', 'VBP'), ('phone', 'NN'), ('text', 'NN'), ('messaging', 'NN'), ('capability', 'NN'), ('dont', 'NN'), ('work', 'NN'), ('sprint', 'NN'), ('system', 'NN'), ('wont', 'JJ'), ('software', 'NN'), ('patch', 'NN'), ('come', 'VBP'), ('time', 'NN'), ('next', 'JJ'), ('month', 'NN'), ('spend', 'VBP'), ('least', 'JJS'), ('hour', 'NN'), ('sprint', 'NN'), ('award', 'NN'), ('winning', 'VBG'), ('customer', 'NN'), ('service', 'NN'), ('team', 'NN'), ('find', 'VB'), ('someone', 'NN'), ('admit', 'NN'), ('problem', 'NN'), ('nokia', 'NN'), ('designed', 'VBD'), ('phone', 'NN'), ('incoming', 'NN'), ('message', 'NN'), ('retrieved', 'VBD'), ('quickly', 'RB'), ('viewed', 'VBN'), ('offline', 'JJ'), ('way', 'NN'), ('provider', 'NN'), ('work', 'NN'), ('sprint', 'NN'), ('however', 'RB'), ('like', 'IN'), ('people', 'NNS'), ('hook', 'VBP'), ('server', 'RB'), ('first', 'RB'), ('stay', 'VB'), ('connected', 'VBN'), ('burning', 'VBG'), ('minute', 'NN'), ('check', 'NN'), ('inbox', 'NN'), ('compose', 'VBP'), ('reply', 'NN'), ('wait', 'NN'), ('sprint', 'NN'), ('server', 'NN'), ('respond', 'NN'), ('send', 'JJ'), ('innovation', 'NN'), ('moneymaking', 'VBG'), ('finest', 'JJS')]

Review 3 POS Tags:
[('great', 'JJ'), ('reliable', 'JJ'), ('phone', 'NN'), ('also', 'RB'), ('purchased', 'VBD'), ('phone', 'NN'), ('samsung', 'NN'), ('died', 'VBD'), ('menu', 'JJ'), ('easily', 'RB'), ('comprehendable', 'JJ'), ('speed', 'NN'), ('dialing', 'VBG'), ('available', 'JJ'), ('around', 'IN'), ('number', 'NN'), ('voice', 'NN'), ('dialing', 'VBG'), ('also', 'RB'), ('nice', 'JJ'), ('feature', 'NN'), ('take', 'VB'), ('longer', 'JJR'), ('speed', 'NN'), ('dialing', 'VBG'), ('thing', 'NN'), ('bother', 'NN'), ('gamesnokia', 'NN'), ('seems', 'VBZ'), ('taken', 'VBN'), ('snake', 'VB'), ('phone', 'NN'), ('skydiving', 'VBG'), ('game', 'NN'), ('bowling', 'VBG'), ('tennis', 'NN'), ('like', 'IN'), ('pong', 'JJ'), ('ringer', 'NN'), ('nice', 'JJ'), ('feature', 'NN'), ('available', 'JJ'), ('choose', 'JJ'), ('different', 'JJ'), ('ringer', 'NN'), ('person', 'NN'), ('calling', 'VBG'), ('however', 'RB'), ('ringtones', 'NNS'), ('available', 'JJ'), ('online', 'JJ'), ('download', 'NN'), ('phone', 'NN'), ('youre', 'NN'), ('pretty', 'RB'), ('much', 'JJ'), ('stuck', 'VBN'), ('vibrating', 'VBG'), ('ringtones', 'NNS'), ('regular', 'JJ'), ('midi', 'NN'), ('polyphonic', 'NN'), ('tone', 'NN'), ('need', 'VBP'), ('cover', 'RB'), ('reasonable', 'JJ'), ('price', 'NN'), ('range', 'NN')]

Review 4 POS Tags:
[('love', 'VB'), ('phone', 'NN'), ('really', 'RB'), ('need', 'VB'), ('one', 'CD'), ('didnt', 'NN'), ('expect', 'VB'), ('price', 'NN'), ('bill', 'NN'), ('received', 'VBD'), ('one', 'CD'), ('also', 'RB'), ('ive', 'JJ'), ('phone', 'NN'), ('little', 'JJ'), ('two', 'CD'), ('month', 'NN'), ('still', 'RB'), ('yet', 'RB'), ('receive', 'JJ'), ('free', 'JJ'), ('accessory', 'NN'), ('supposed', 'VBD'), ('come', 'JJ'), ('phone', 'NN'), ('every', 'DT'), ('time', 'NN'), ('call', 'NN'), ('company', 'NN'), ('keep', 'VB'), ('telling', 'VBG'), ('wait', 'JJ'), ('couple', 'NN'), ('week', 'NN'), ('receiving', 'VBG'), ('shortly', 'RB'), ('love', 'VB'), ('phone', 'NN'), ('able', 'JJ'), ('im', 'NN'), ('talking', 'VBG'), ('making', 'VBG'), ('phone', 'NN'), ('call', 'NN')]

STEP 8: POS and NER Integration

```python
import spacy
from spacy.pipeline import EntityRuler
import pandas as pd
from nltk import word_tokenize, pos_tag
from IPython.display import display, HTML

# Load spaCy model
nlp = spacy.load("en_core_web_sm")

# Add EntityRuler BEFORE the built-in NER
ruler = nlp.add_pipe("entity_ruler", before="ner")

# Define brand, model, and carrier patterns
patterns = [
    {"label": "ORG", "pattern": "Samsung"},
    {"label": "ORG", "pattern": "Nokia"},
    {"label": "ORG", "pattern": "Sprint"},
    {"label": "ORG", "pattern": "AT&T"},
    {"label": "ORG", "pattern": "T-Mobile"},
    {"label": "PRODUCT", "pattern": "Nokia 3310"},
    {"label": "PRODUCT", "pattern": [{"LOWER": "iphone"}]},
    {"label": "PRODUCT", "pattern": [{"LOWER": "galaxy"}, {"IS_ALPHA":
True, "OP": "?"}]}
]
ruler.add_patterns(patterns)

# Select first 10 reviews from dataset
sample_reviews = [reviews[i] for i in range(10)]

rows = []

for idx, text in enumerate(sample_reviews):
    doc = nlp(text)
    pos_tags = dict(pos_tag(word_tokenize(text)))

    for token in doc:
        pos = pos_tags.get(token.text, "-")
```

```
        ner = token.ent_type_ if token.ent_type_ else "-"

        relation = (
            "Complementary" if pos in ["NN", "NNP"] and ner in ["ORG",
"PRODUCT", "GPE", "EVENT", "PERSON"] else
            "Contradictory" if ner != "-" and pos not in ["NN", "NNP",
"JJ"] else
            "-"
        )

        rows.append({
            "Review #": idx + 1,
            "Token": token.text,
            "POS": pos,
            "NER": ner,
            "POS ↔ NER": relation
        })

# Build and display the table
df = pd.DataFrame(rows)
styled = df.style.set_caption("█ POS + NER Alignment (with EntityRuler
Patterns)")\
    .applymap(lambda x: "color: green" if x == "Complementary" else
                        "color: red" if x == "Contradictory" else "",
subset=["POS ↔ NER"])\
    .set_properties(**{"border": "1px solid #ccc", "text-align": "left"})

display(HTML(styled.to_html(index=False)))
```

This script integrates spaCy's Named Entity Recognition (NER) with NLTK's Part-of-Speech (POS) tagging to analyze the alignment between them. It also enhances NER accuracy by introducing custom rules via EntityRuler.

1. **Custom NER Patterns:**

   ruler = nlp.add_pipe("entity_ruler", before="ner")

   The `EntityRuler` is inserted before spaCy's default NER. It boosts recognition of specific brands and products like `"Samsung"`, `"iPhone"`, etc., using hand-crafted patterns.

2. **POS and NER Integration**: For the first 10 reviews:

- Each token is tagged using `nltk.pos_tag()` (syntactic role) and `spaCy` (entity type).
- The relationship between tags is evaluated:
    - `"Complementary"`: POS and NER align (e.g., `NNP` + `ORG`)
    - `"Contradictory"`: NER exists but POS isn't appropriate (e.g., `CD` + `MONEY`)
    - `"-"`: No strong interaction

📘 POS + NER Alignment (with EntityRuler Patterns)

Review #	Token	POS	NER	POS ↔ NER
1	I	PRP	-	-
1	had	VBD	-	-
1	the	DT	-	-
1	Samsung	NNP	ORG	Complementary
1	A600	NNP	-	-
1	for	IN	-	-
1	awhile	NN	-	-
1	which	WDT	-	-
1	is	VBZ	-	-
1	absolute	JJ	-	-
1	doo	NN	-	-
1	doo	NN	-	-
1	.	.	-	-

1	this	DT	-	-
1	Nokia	NNP	ORG	Complementary
1	phone	NN	-	-
1	I	PRP	-	-
1	bought	VBD	-	-
1	in	IN	-	-
1	a	DT	-	-
1	garage	NN	-	-
1	sale	NN	-	-
1	for	IN	-	-
1	$	$	-	-
1	1	CD	MONEY	Contradictory

Evaluation of POS + NER Alignment Table

1. High Complementarity Rate (Green Rows): Tokens like Samsung and Nokia were correctly identified as ORG with a POS tag of NNP. These Complementary cases reinforce that entity recognition is reliable when contextual cues like proper noun syntax align with semantic labels. It validates the effectiveness of adding domain-specific terms via EntityRuler.

2. Insightful Contradictions (Red Rows): Tokens like "1" being tagged as MONEY despite having a POS tag of CD or other mismatches suggest semantic overgeneralization by the NER model. These Contradictory rows help diagnose false positives or gaps in model logic—especially where numeric tokens are misclassified as entities.

3. "-" Marked Rows: A large number of tokens were assigned "-" in both NER and alignment status, indicating that these tokens weren't considered part of any named entity. This is expected for determiners, prepositions, and generic terms, but it also highlights potential recall limitations of the NER system for less obvious entities (e.g. models like "A600" or descriptive brands without capitalization).

4. Rule Impact Assessment: By comparing entity tags with and without the EntityRuler, we notice that patterns like "Nokia 3310" or "iPhone" are now consistently labeled, increasing coverage in a domain-specific corpus. This proves that the rules are adding tangible value to default NER performance.

Summary:

- The green-highlighted tokens confirm synergy, the red ones flag annotation errors, and the "-" labels point to neutral or untagged content.

How This Relationship Improves Text Analysis:

Interaction	Application Benefit
Complementary (NNP + ORG)	High-confidence tagging for brand names, ideal for sentiment analysis or entity linking.
Contradictory (e.g. CD + MONEY)	Red flags inconsistent model logic and allows for error-handling or rule-based correction.
Cross-checking POS ↔ NER	Enables hybrid pipelines that validate NER predictions using syntactic clues from POS.