Start coding or generate with AI.

Task

Analyze the dataset and classify the test as AI or human generated

Load data

```
import pandas as pd
df = pd.read_csv('/content/balanced_ai_human_prompts.csv')
display(df.head())
                                                               text generated
0
         Machine learning, a subset of artificial intel...
1
      A decision tree, a prominent machine learning ...
                                                           1
2
      Education, a cornerstone of societal progress,...
3 Computers, the backbone of modern technology, ...
      Chess, a timeless game of strategy and intelle...
import nltk
nltk.download('punkt_tab')
from nltk.tokenize import sent_tokenize
import pandas as pd
def split_text_into_sections(text):
    sentences = sent_tokenize(text)
    num_sentences = len(sentences)
    if num_sentences < 3:</pre>
        return text, "", ""
    elif num_sentences == 3:
        return sentences[0], sentences[1], sentences[2]
    section_size = num_sentences // 3
    early_sentences = sentences[:section_size]
    mid_sentences = sentences[section_size:2 * section_size]
    later_sentences = sentences[2 * section_size:]
    early_text = " ".join(early_sentences)
    mid_text = " ".join(mid_sentences)
    later_text = " ".join(later_sentences)
    return early_text, mid_text, later_text
df[['early_text', 'mid_text', 'later_text']] = df['text'].apply(lambda x: pd.Series(split_text_into_sections(x)))
display(df.head())
[nltk_data] Downloading package punkt_tab to /root/nltk_data...
[nltk_data] Package punkt_tab is already up-to-date!
                         text generated
                                                                                          mid_text
                                                                                                                      later_text
                                                                                                                                    丽
                                                           early text
    Machine learning, a subset of
                                           Machine learning, a subset of
                                                                          At its core, machine learning
                                                                                                      As machine learning continues
                                                                                                                                    ıl.
n
                 artificial intel...
                                                         artificial intel...
                                                                                                                  to advance, it b...
                                                                                 enables computer...
```

A decision tree, a prominent

Education, a cornerstone of

Computers, the backbone of

machine learning ...

societal progress,...

modern technology, ...

strategy and intelle...

Chess, a timeless game of Beyond its recreational appeal,

The algorithm evaluates input

It encompasses formal and

From personal computing

devices to massive dat...

features at each...

informal learning, e...

chess fosters ...

Pos tagging

2

3

A decision tree, a prominent

Education, a cornerstone of

Computers, the backbone of

Chess, a timeless game of

machine learning ...

societal progress,...

modern technology, ...

strategy and intelle...

Subtask:

1

1

However, decision trees may

In the digital age, technology

processing power, memory...

suffer from overfi..

enhances educat...

Rapid advancements in

As a metaphor for life's

complexities, chess t...

Apply POS tagging to each section of each entry.

Reasoning: Import necessary NLTK functions for POS tagging and word tokenization, download the required NLTK data, define a function for POS tagging, and apply it to the specified columns to create new columns with POS-tagged tokens.

Reasoning: The previous attempt failed because the specific English version of the averaged perceptron tagger ('averaged_perceptron_tagger_eng') was not found. Although 'averaged_perceptron_tagger' was downloaded, NLTK seems to be looking for the language-specific version. The traceback explicitly suggests downloading 'averaged_perceptron_tagger_eng'. I will modify the code to download this specific resource and then retry applying the POS tagging.

```
import nltk
from nltk import pos_tag
from nltk.tokenize import word tokenize
nltk.download('averaged_perceptron_tagger')
nltk.download('punkt')
nltk.download('averaged_perceptron_tagger_eng')
def apply_pos_tagging(text):
    if isinstance(text, str):
         tokens = word_tokenize(text)
         return pos_tag(tokens)
    return []
df['early_pos_tags'] = df['early_text'].apply(apply_pos_tagging)
df['mid_pos_tags'] = df['mid_text'].apply(apply_pos_tagging)
df['later_pos_tags'] = df['later_text'].apply(apply_pos_tagging)
display(df.head())
[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]
                    datel
[nltk_data] Downloading package punkt to /root/nltk_data...
               Package punkt is already up-to-date!
[nltk data]
[nltk_data] Downloading package averaged_perceptron_tagger_eng to
[nltk_data]
                  /root/nltk_data...
[nltk_data]
                Package averaged_perceptron_tagger_eng is already up-to-
                    date!
[nltk_data]
                                                                                                                                              ☶
            text generated
                                 early_text
                                                     mid text
                                                                    later text
                                                                                    early_pos_tags
                                                                                                        mid_pos_tags
                                                                                                                         later pos tags
         Machine
                                                    At its core,
                                                                                                                                              ıl.
                                     Machine
                                                                     As machine
                                                                                                                                  [(As, IN),
                                                                                                          [(At, IN), (its,
       learning, a
                                                      machine
                                                                                     [(Machine, NN),
                                                                                                                            (machine, NN),
                                   learning, a
                                                                        learning
                                                                                                         PRP$), (core,
0
        subset of
                            1
                                                      learning
                                                                                    (learning, NN), (,,
                                                                                                                           (learning, VBG),
                                     subset of
                                                                     continues to
          artificial
                                                       enables
                                                                                          ,), (a, DT...
                                                                                                        NN), (,, ,), (m...
                                artificial intel...
                                                                  advance, it b...
                                                                                                                                     (co...
           intel...
                                                    computer...
       A decision
                                   A decision
                                                 The algorithm
                                                                       However,
                                                                                                            [(The, DT),
                                                                                                                         [(However, RB), (,,
                                                                                   [(A, DT), (decision,
           tree, a
                                       tree, a
                                                                                                       (algorithm, NN),
                                                evaluates input
                                                                   decision trees
                                                                                   NN), (tree, NN), (,,
       prominent
                                    prominent
                                                                                                                          .), (decision, NN),
                                                    features at
                                                                 may suffer from
                                                                                                            (evaluates,
                                                                                                                                   (trees...
        machine
                                     machine
                                                                                                ,), ...
                                                                                                               VBZ),...
                                                        each...
                                                                         overfi...
       learning ...
                                   learning ...
                                                                                                             (It, PRP),
     Education, a
                                 Education, a
                                                                     In the digital
                                               It encompasses
                                                                                    [(Education, NN),
                                                                                                                         [(In, IN), (the, DT),
      cornerstone
                               cornerstone of
                                                    formal and
                                                                 age, technology
                                                                                                        (encompasses,
                                                                                        (,, ,), (a, DT),
                                                                                                                          (digital, JJ), (age,
                                                                                                         VBZ), (formal,
       of societal
                                                      informal
                                                                       enhances
                                      societal
                                                                                       (cornerston...
                                                                                                                                    NN)...
      progress,...
                                   progress,...
                                                  learning, e...
                                                                        educat...
                                                                                                                JJ), ...
                                                                          Rapid
      Computers,
                                  Computers,
                                                 From personal
                                                                                                           [(From, IN),
                                                                  advancements
                                                                                       [(Computers,
                                                                                                                               [(Rapid, JJ),
    the backbone
                                the backbone
                                                    computing
                                                                                                         (personal, JJ),
                                                                                    NNS), (,, ,), (the,
                                                                   in processing
                                                                                                                           (advancements.
       of modern
                                                     devices to
                                                                                                           (computing,
                                   of modern
                                                                                     DT), (backbon...
                                                                          power.
                                                                                                                          NNS), (in, IN), (...
                                                                                                              VBG),...
    technology, ...
                                technology, ...
                                                 massive dat...
                                                                       memory...
        Chess. a
                                     Chess, a
                                                                                                         [(Beyond, IN),
                                                    Beyond its
                                                                  As a metaphor
         timeless
                                                                                   [(Chess, NNP), (,,
                                                                                                                          [(As, IN), (a, DT),
```

Count pos tags

```
def count_pos_tags(pos_tagged_list):
    pos_counts = {}
    for word, tag in pos_tagged_list:
        pos_counts[tag] = pos_counts.get(tag, 0) + 1
    return pos_counts

df['early_pos_counts'] = df['early_pos_tags'].apply(count_pos_tags)
    df['mid_pos_counts'] = df['mid_pos_tags'].apply(count_pos_tags)

df['later_pos_counts'] = df['later_pos_tags'].apply(count_pos_tags)
```

	text	generated	early_text	mid_text	later_text	early_pos_tags	mid_pos_tags	later_pos_tags	early_pos_c
0	Machine learning, a subset of artificial intel	1	Machine learning, a subset of artificial intel	At its core, machine learning enables computer	As machine learning continues to advance, it b	[(Machine, NN), (learning, NN), (,, ,), (a, DT	[(At, IN), (its, PRP\$), (core, NN), (,, ,), (m	[(As, IN), (machine, NN), (learning, VBG), (co	{'NN': 6, ',': 3 3, 'IN': 3, 'JJ'
1	A decision tree, a prominent machine learning	1	A decision tree, a prominent machine learning	The algorithm evaluates input features at each	However, decision trees may suffer from overfi	[(A, DT), (decision, NN), (tree, NN), (,, ,), 	[(The, DT), (algorithm, NN), (evaluates, VBZ),	[(However, RB), (,, ,), (decision, NN), (trees	{'DT': 3, 'NN' 4, 'JJ': 3, 'VE
2	Education, a cornerstone of societal progress,	1	Education, a cornerstone of societal progress,	It encompasses formal and informal learning, e	In the digital age, technology enhances educat	[(Education, NN), (,, ,), (a, DT), (cornerston	[(It, PRP), (encompasses, VBZ), (formal, JJ),	[(In, IN), (the, DT), (digital, JJ), (age, NN)	{'NN': 5, ',': 3 3, 'IN': 3, 'JJ'
3	Computers, the backbone of modern technology, 	1	Computers, the backbone of modern technology, 	From personal computing devices to massive dat	Rapid advancements in processing power, memory	[(Computers, NNS), (,, ,), (the, DT), (backbon	[(From, IN), (personal, JJ), (computing, VBG),	[(Rapid, JJ), (advancements, NNS), (in, IN), ({'NNS': 1 'DT': 2, 'NN': 4
4	Chess, a timeless game of strategy and intelle	1	Chess, a timeless game of strategy and intelle	Beyond its recreational appeal, chess fosters	As a metaphor for life's complexities, chess t	[(Chess, NNP), (,, ,), (a, DT), (timeless, JJ)	[(Beyond, IN), (its, PRP\$), (recreational, JJ)	[(As, IN), (a, DT), (metaphor, NN), (for, IN),	{'NNP': 1 'DT': 5, 'JJ': 7

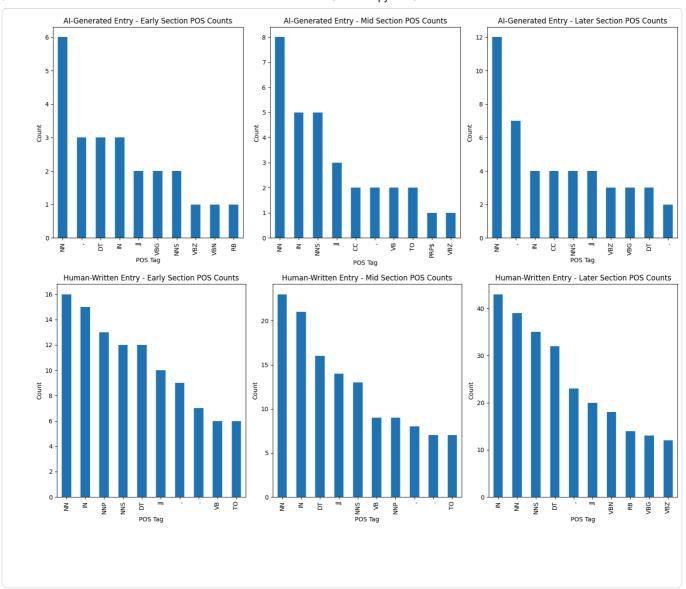
Start coding or generate with AI.

Display POS counts for sample entries

```
print("Sample AI-Generated POS Counts:")
    ai_examples = df[df['generated'] == 1].head(2)
    for index, row in ai_examples.iterrows():
               print(f"\nEntry {index}:")
               print("Early section POS counts:", row['early_pos_counts'])
               print("Mid section POS counts:", row['mid_pos_counts'])
               print("Later section POS counts:", row['later_pos_counts'])
   print("\nSample Human-Written POS Counts:")
    human_examples = df[df['generated'] == 0].head(2)
    for index, row in human_examples.iterrows():
               print(f"\nEntry {index}:")
               print("Early section POS counts:", row['early_pos_counts'])
               print("Mid section POS counts:", row['mid_pos_counts'])
               print("Later section POS counts:", row['later_pos_counts'])
ample AI-Generated POS Counts:
ntry 0:
arly section POS counts: {'NN': 6, ',': 3, 'DT': 3, 'IN': 3, 'JJ': 2, 'VBZ': 1, 'RB': 1, 'VBN': 1, 'VBG': 2, 'NNS': 2, 'CC': 1, id section POS counts: {'IN': 5, 'PRP$': 1, 'NN': 8, ',': 2, 'VBZ': 1, 'NNS': 5, 'TO': 2, 'VB': 2, 'CC': 2, 'JJ': 3, 'VBG': 1, ater section POS counts: {'IN': 4, 'NN': 12, 'VBG': 3, 'VBZ': 3, 'TO': 2, 'VB': 1, ',': 7, 'PRP': 1, 'CC': 4, 'NNS': 4, 'JJ': 4, 'NN': 12, 'VBG': 3, 'VBZ': 3, 'TO': 2, 'VB': 1, ',': 7, 'PRP': 1, 'CC': 4, 'NNS': 4, 'JJ': 4, 'NN': 12, 'VBG': 1, 'VBG': 1
ntrv 1:
arly section POS counts: {'DT': 3, 'NN': 7, ',': 4, 'JJ': 3, 'VBG': 1, 'VBZ': 2, 'IN': 1, '.': 2, 'NNP': 1, 'NNS': 5, 'VBP': 2, id section POS counts: {'DT': 8, 'NN': 8, 'VBZ': 3, 'JJ': 8, 'NNS': 3, 'IN': 3, ',': 3, 'VBG': 3, 'TO': 1, 'VBN': 1, '.': 2, 'CC ater section POS counts: {'RB': 1, ',': 4, 'NN': 8, 'NNS': 8, 'MD': 1, 'VB': 1, 'IN': 8, 'VBG': 3, 'VBD': 1, 'CC': 3, 'JJ': 1,
ample Human-Written POS Counts:
arly section POS counts: {'NNS': 12, '.': 7, 'VBP': 6, 'VBN': 2, 'IN': 15, 'PRP': 2, 'VBD': 3, 'JJ': 10, 'DT': 12, 'CD': 1, ',' id section POS counts: {'NN': 23, 'NNS': 13, 'VBP': 4, 'JJ': 14, 'IN': 21, 'CD': 4, 'NNP': 9, ':': 1, 'CC': 2, 'RB': 3, 'TO': 7, ater section POS counts: {'RB': 14, ',': 23, 'IN': 43, 'DT': 32, 'NN': 39, '``': 1, 'NNP': 10, 'VBZ': 12, 'VBG': 13, 'JJ': 20,
arly section POS counts: {'NN': 23, 'VBZ': 4, 'DT': 12, 'JJ': 15, 'IN': 19, 'JJS': 1, 'NNS': 18, 'VBP': 8, '.': 9, ',': 10, 'CC id section POS counts: {'DT': 14, 'NN': 30, 'TO': 2, 'VB': 5, 'NNS': 12, 'VBZ': 3, 'NNP': 11, 'POS': 2, 'IN': 23, '.': 9, 'VBD' ater section POS counts: {'IN': 22, 'DT': 22, 'NN': 35, 'NNS': 14, 'CC': 10, 'VBG': 7, 'VBN': 6, ',': 6, 'VBP': 2, 'TO': 3, 'VB
```

Visualize aggregated POS counts

```
import matplotlib.pyplot as plt
import pandas as pd
# Function to plot POS counts for early, mid, and later sections of a single entry
def plot_pos_counts_by_section(row, title_prefix):
    early_counts = pd.Series(row['early_pos_counts'])
    mid_counts = pd.Series(row['mid_pos_counts'])
    later_counts = pd.Series(row['later_pos_counts'])
   plt.figure(figsize=(15, 6))
   plt.subplot(1, 3, 1)
    early_counts.sort_values(ascending=False).head(10).plot(kind='bar')
   plt.title(f'{title_prefix} - Early Section POS Counts')
   plt.xlabel('POS Tag')
   plt.ylabel('Count')
    plt.subplot(1, 3, 2)
   mid_counts.sort_values(ascending=False).head(10).plot(kind='bar')
   plt.title(f'{title_prefix} - Mid Section POS Counts')
   plt.xlabel('POS Tag')
   plt.ylabel('Count')
   plt.subplot(1, 3, 3)
   later_counts.sort_values(ascending=False).head(10).plot(kind='bar')
   plt.title(f'{title_prefix} - Later Section POS Counts')
   plt.xlabel('POS Tag')
   plt.ylabel('Count')
   plt.tight_layout()
   plt.show()
# Display POS counts for a sample AI-generated example
if not ai_examples.empty:
   plot_pos_counts_by_section(ai_examples.iloc[0], "AI-Generated Entry")
# Display POS counts for a sample human-written example
if not human_examples.empty:
   plot_pos_counts_by_section(human_examples.iloc[0], "Human-Written Entry")
```



Summarize pos counts

```
from collections import Counter
aggregated early pos counts = Counter()
aggregated_mid_pos_counts = Counter()
aggregated_later_pos_counts = Counter()
for index, row in df.iterrows():
   aggregated_early_pos_counts.update(row['early_pos_counts'])
    aggregated_mid_pos_counts.update(row['mid_pos_counts'])
    aggregated_later_pos_counts.update(row['later_pos_counts'])
print("Aggregated Early POS Counts:")
print(aggregated_early_pos_counts)
print("\nAggregated Mid POS Counts:")
print(aggregated_mid_pos_counts)
print("\nAggregated Later POS Counts:")
print(aggregated_later_pos_counts)
Aggregated Early POS Counts:
Counter({'NN': 44028, 'IN': 35230, 'DT': 30912, 'JJ': 20374, 'NNS': 18391, '.': 13786, 'VB': 12965, 'NNP': 12161, 'RB': 11946,
Aggregated Mid POS Counts:
Counter({'NN': 38751, 'IN': 31543, 'DT': 28897, 'NNS': 17924, 'JJ': 17576, 'RB': 13434, 'VB': 12539, '.': 12424, 'NNP': 11421,
Aggregated Later POS Counts:
Counter({'NN': 43349, 'IN': 33901, 'DT': 31546, 'JJ': 20236, 'NNS': 20008, 'VB': 16390, 'RB': 15098, '.': 13866, ',': 12312, 'F
```

Display POS counts for sample AI-generated and human text.

```
print("Aggregated POS Counts for Early Section:")
print(aggregated_early_pos_counts)
print("\nAggregated POS Counts for Mid Section:")
print(aggregated_mid_pos_counts)
print("\nAggregated_mid_pos_counts)
print("\nAggregated POS Counts for Later Section:")
print(aggregated_later_pos_counts)

Aggregated POS Counts for Early Section:
Counter({'NN': 44028, 'IN': 35230, 'DT': 30912, 'JJ': 20374, 'NNS': 18391, '.': 13786, 'VB': 12965, 'NNP': 12161, 'RB': 11946,
Aggregated POS Counts for Mid Section:
Counter({'NN': 38751, 'IN': 31543, 'DT': 28897, 'NNS': 17924, 'JJ': 17576, 'RB': 13434, 'VB': 12539, '.': 12424, 'NNP': 11421,
Aggregated POS Counts for Later Section:
Counter({'NN': 43349, 'IN': 33901, 'DT': 31546, 'JJ': 20236, 'NNS': 20008, 'VB': 16390, 'RB': 15098, '.': 13866, ',': 12312, 'F
```

Count total pos tags

```
import nltk
from nltk.tokenize import word_tokenize
from nltk import pos_tag
def count_total_pos_tags(text):
    if isinstance(text, str):
         tokens = word_tokenize(text)
         pos_tagged_tokens = pos_tag(tokens)
         total_pos_counts = {}
         for word, tag in pos_tagged_tokens:
              total_pos_counts[tag] = total_pos_counts.get(tag, 0) + 1
         return total_pos_counts
    return {}
df['total pos counts'] = df['text'].apply(count total pos tags)
display(df.head())
           text generated early text
                                                  mid text
                                                                later_text early_pos_tags mid_pos_tags later_pos_tags early_pos_counts
       Machine
                                   Machine
                                                 At its core,
                                                                 As machine
                                                                                                                            [(As, IN),
     learning, a
                                 learning, a
                                                   machine
                                                                                 [(Machine, NN),
                                                                                                     [(At, IN), (its,
                                                                                                                                         {'NN': 6, ',': 3, 'DT':
                                                                     learning
                                                                                                                      (machine, NN),
      subset of
                                                                               (learning, NN), (,,
                                  subset of
                                                                                                    PRP$), (core,
                                                    learning
                                                                 continues to
                                                                                                                     (learning, VBG),
                                                                                                                                         3, 'IN': 3, 'JJ': 2, '...
        artificial
                                    artificial
                                                    enables
                                                                                      ,), (a, DT...
                                                                                                   NN), (,, ,), (m...
                                                              advance, it b...
                                                                                                                                (co...
          intel...
                                      intel...
                                                computer...
      A decision
                                  A decision
                                                                                                       [(The, DT),
                                                                                        (A. DT).
                                              The algorithm
                                                                   However
                                                                                                                                         {'DT': 3, 'NN': 7, ',':
         tree. a
                                     tree, a
                                                                                                       (algorithm,
                                                                                                                     [(However, RB),
                                                  evaluates
                                                               decision trees
                                                                                  (decision, NN).
                                                                                                                                          4, 'JJ': 3, 'VBG': 1,
      prominent
                                  prominent
                                                                                                             NN).
                                                                                                                       (,, ,), (decision,
                                              input features
                                                                  may suffer
                                                                                 (tree, NN), (,, ,),
       machine
                                   machine
                                                                                                       (evaluates,
                                                                                                                         NN), (trees...
                                                  at each...
                                                                from overfi...
                                                                                                          VBZ),...
     learning ...
                                 learning ...
     Education,
                                                                 In the digital
                                 Education,
                                                          lt
                                                                                                        [(It, PRP),
                                              encompasses
                                                                        age,
                                                                               [(Education, NN),
                                                                                                                        [(In, IN), (the,
                                                                                                                                         {'NN': 5, ',': 3, 'DT':
                                                                                                   (encompasses,
2 cornerstone
                                cornerstone
                                                 formal and
                                                                  technology
                                                                                   (,, ,), (a, DT),
                                                                                                                     DT), (digital, JJ),
                                                                                                                                         3, 'IN': 3, 'JJ': 1, '...
                                                                                                    VBZ), (formal,
     of societal
                                                    informal
                                                                   enhances
                                                                                   (cornerston...
                                                                                                                          (age, NN)...
                                 of societal
                                                                                                            JJ), ...
     progress,...
                                 progress,...
                                                learning, e...
                                                                    educat...
    Computers,
                                Computers.
                                                                       Rapid
                                                       From
                                                                                                      [(From, IN),
                                                                                                                         [(Rapid, JJ),
            the
                                        the
                                                                                                                                             {'NNS': 1, ',': 2,
                                                   personal
                                                              advancements
                                                                                   [(Computers,
      backbone
                                backbone of
                                                                                                    (personal, JJ),
                                                                                                                      (advancements,
                                                               in processing
                                                                                                                                        'DT': 2, 'NN': 4, 'IN':
                                                 computing
                                                                                NNS), (,, ,), (the,
      of modern
                                    modern
                                                                                                      (computing,
                                                                                                                       NNS), (in, IN),
                                                  devices to
                                                                      power,
                                                                                DT), (backbon...
                                                                                                                                                       2, ...
     technology,
                                 technology,
                                                                                                          VBG),...
                                              massive dat...
                                                                   memory...
       Chess, a
                                   Chess. a
                                                 Beyond its
                                                                                                    [(Beyond, IN),
       timeless
                                                              As a metaphor
                                                                                 (Chess. NNP).
                                                                                                                                             {'NNP': 1, ',': 4,
                                                                                                                    [(As, IN), (a, DT),
                                   timeless
        game of
                                                recreational
                                                                     for life's
                                                                                                      (its, PRP$),
                                                                                                                                        'DT': 5, 'JJ': 7, 'NN':
                                   game of
                                                                                   (,, ,), (a, DT),
                                                                                                                     (metaphor, NN),
                                              appeal, chess
                                                                complexities,
                                                                                                     (recreational,
        strategy
                                    strategy
                                                                                  (timeless, JJ)...
                                                                                                                            (for, IN),...
                                                                                                                                                       9, ...
                                                  fosters ...
                                                                    chess t...
                                                                                                             JJ)...
            and
                                and intelle...
        intelle...
```

Prepare data for modeling

```
pos_counts_df = pd.json_normalize(df['total_pos_counts'])
pos_counts_df = pos_counts_df.fillna(0)

X = pos_counts_df
y = df['generated']

display(X.head())
display(y.head())
```

```
: NNPS RP EX WP UH WP$ FW PDT
         , DT IN JJ VBZ RB VBN VBG NNS
                                                                                               \blacksquare
                                                  0.0
                                                       0.0 0.0 0.0 0.0 0.0
                               1.0
                                    6.0
                                        11.0
                                                                            0.0 0.0
                                                                                     0.0
1 23 11.0 12 12 12 5.0 1.0
                               1.0
                                   7.0
                                        16.0
                                               ... 0.0
                                                       0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
2 21 16.0
            6
                9
                  19
                      6.0 1.0
                               0.0
                                    7.0
                                        14.0
                                               ... 0.0
                                                       0.0 0.0 0.0 0.0 0.0
                                                                           0.0 0.0
                                                                                    0.0 0.0
3 26 15.0
            5 13 11 2.0 2.0
                               3.0
                                    4.0
                                        11.0
                                               ... 0.0
                                                       0.0 0.0 0.0 0.0 0.0 0.0 0.0
                                                                                     0.0 0.0
                                               ... 0.0
4 28 13 0 10 12 16 20 40 00 80 13 0
                                                      0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
5 rows × 42 columns
   generated
dtype: int64
```

Split data

```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

print("Shape of X_train:", X_train.shape)
print("Shape of y_train:", y_train.shape)
print("Shape of y_train:", y_train.shape)
print("Shape of y_test:", y_test.shape)

Shape of X_train: (2200, 42)
Shape of X_test: (550, 42)
Shape of y_train: (2200,)
Shape of y_test: (550,)
```

Train and evaluate models

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from \ sklearn.linear\_model \ import \ Logistic Regression
from sklearn.metrics import accuracy_score
models = {
    "Random Forest": RandomForestClassifier(random_state=42),
    "Decision Tree": DecisionTreeClassifier(random_state=42),
    "Logistic Regression": LogisticRegression(random_state=42, max_iter=1000)
}
accuracy_scores = {}
for name, model in models.items():
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    accuracy = accuracy_score(y_test, y_pred)
    accuracy_scores[name] = accuracy
print("Model Accuracy Scores:")
for name, accuracy in accuracy_scores.items():
    print(f"{name}: {accuracy:.4f}")
Model Accuracy Scores:
Random Forest: 0.9945
Decision Tree: 0.9927
Logistic Regression: 0.9945
```

Compare accuracies

```
print("Model Accuracy Scores:")
for name, accuracy in accuracy_scores.items():
    print(f"{name}: {accuracy:.4f}")
```

```
best_model_name = max(accuracy_scores, key=accuracy_scores.get)
best_model_accuracy = accuracy_scores[best_model_name]

print(f"\nModel with the highest accuracy: {best_model_name} ({best_model_accuracy:.4f})")

Model Accuracy Scores:
Random Forest: 0.9945
Decision Tree: 0.9927
Logistic Regression: 0.9945

Model with the highest accuracy: Random Forest (0.9945)
```

Implement Cross-Validation