Step 1: Load the dataset ,here we are uploading News_Category_Dataset_v3.json

```
import json

data = []
with open("/content/News_Category_Dataset_v3.json", 'r') as f:
    for line in f:
        data.append(json.loads(line))
```

Let's have a look at the dataset

```
data[:2]
```

```
[{'link': 'https://www.huffpost.com/entry/covid-boosters-uptake-us_n_632d719ee4b087fae6feaac9',
  'headline': 'Over 4 Million Americans Roll Up Sleeves For Omicron-Targeted COVID Boosters',
  'category': 'U.S. NEWS',
  'short_description': 'Health experts said it is too early to predict whether demand would match up with the 171 million doses of the
new boosters the U.S. ordered for the fall.',
  'authors': 'Carla K. Johnson, AP',
  'date': '2022-09-23'},
 {'link': 'https://www.huffpost.com/entry/american-airlines-passenger-banned-flight-attendant-punch-justice-
department_n_632e25d3e4b0e247890329fe',
  'headline': 'American Airlines Flyer Charged, Banned For Life After Punching Flight Attendant On Video',
  'category': 'U.S. NEWS',
  'short_description': "He was subdued by passengers and crew when he fled to the back of the aircraft after the confrontation,
according to the U.S. attorney's office in Los Angeles.",
  'authors': 'Mary Papenfuss',
  'date': '2022-09-23'}]
```

```
print(len(data))
```

```
209527
```

```
import pandas as pd
```

```
# we only need the headlines text from the dataset
# Assuming data is a list of dictionaries where each dictionary represents a data entry
data_text = [entry["headline"] for entry in data]

# Convert data_text to a DataFrame with an "index" column
data_text_df = pd.DataFrame(data_text, columns=["headline"])
data_text_df["index"] = data_text_df.index

# Optional: Rename the DataFrame to 'documents' as in your code
documents = data_text_df
```

since our task is to classify the news_article based on news headings only so I am taking only headline

```
documents[:5]
```

	headline	index
0	Over 4 Million Americans Roll Up Sleeves For O...	0
1	American Airlines Flyer Charged, Banned For Li...	1
2	23 Of The Funniest Tweets About Cats And Dogs ...	2
3	The Funniest Tweets From Parents This Week (Se...	3
4	Woman Who Called Cops On Black Bird-Watcher Lo...	4

```
print(len(documents))
```

```
209527
```

Data Preprocessing:

- **Tokenization**:split the text into sentences and sentences into words.Lowercase the words and remove punctuation

- remove all stopwords
- words are Lemmatized -words in third person are changed to first person and past and future tense are changed to present tense
- words are stemmed-removing the prefix and suffix

```
#loading Gensim and nltk libraries
import gensim
from gensim.utils import simple_preprocess
from gensim.parsing.preprocessing import STOPWORDS
from nltk.stem import WordNetLemmatizer,SnowballStemmer
from nltk.stem.porter import *
import numpy as np
np.random.seed(400)
```

```
import nltk
nltk.download("wordnet")
```

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

Lemmatizer Example

```
#Lemmatizer
print(WordNetLemmatizer().lemmatize("went",pos="v"))
```

```
go
```

Stemmer Example

```
#stemmer
stemmer=SnowballStemmer("english")
original_words=["dies","sized","stating"]
singles=[stemmer.stem(plural) for plural in original_words]
pd.DataFrame(data={"original word":original_words,"stemmed":singles})
```

	original word	stemmed
0	dies	die
1	sized	size
2	stating	state

```
#function to perform the pre-processing steps
def lemmatize_stemming(text):
  return stemmer.stem(WordNetLemmatizer().lemmatize(text,pos="v"))
  #tokenize and lemmatize
def preprocess(text):
  result=[]
  for token in gensim.utils.simple_preprocess(text):
    if token not in gensim.parsing.preprocessing.STOPWORDS and len(token) >3:
      result.append(lemmatize_stemming(token))
  return result
```

```
# preview document after preprocessing
document_num=400
doc_sample=documents[documents["index"]==document_num].values[0][0]
doc_sample
```

```
'At Least 15 Killed In South Africa Bar Shooting'
```

```
print("Original document")
words=[]
for word in doc_sample.split(" "):
  words.append(word)
print(words)
print("\n\n Tokenized and lemmatized document")
print(preprocess(doc_sample))
```

```
Original document
['At', 'Least', '15', 'Killed', 'In', 'South', 'Africa', 'Bar', 'Shooting']


 Tokenized and lemmatized document
['kill', 'south', 'africa', 'shoot']
```

```
documents
```

	headline	index
0	Over 4 Million Americans Roll Up Sleeves For O...	0
1	American Airlines Flyer Charged, Banned For Li...	1
2	23 Of The Funniest Tweets About Cats And Dogs ...	2
3	The Funniest Tweets From Parents This Week (Se...	3
4	Woman Who Called Cops On Black Bird-Watcher Lo...	4
...	...	...
209522	RIM CEO Thorsten Heins' 'Significant' Plans Fo...	209522
209523	Maria Sharapova Stunned By Victoria Azarenka I...	209523
209524	Giants Over Patriots, Jets Over Colts Among M...	209524
209525	Aldon Smith Arrested: 49ers Linebacker Busted ...	209525
209526	Dwight Howard Rips Teammates After Magic Loss ...	209526

209527 rows × 2 columns

now preprocess the news headlines we have.to do that we are using map function from pandas to apply preprocess() to the headline column

```
preprocess_docs=documents["headline"].map(lambda x: preprocess(x))
```

```
preprocess_docs[:10]
```

```
0    [million, american, roll, sleev, omicron, targ...
1    [american, airlin, flyer, charg, ban, life, pu...
2              [funniest, tweet, cat, dog, week, sept]
3                [funniest, tweet, parent, week, sept]
4    [woman, call, cop, black, bird, watcher, lose,...
5    [cleaner, dead, belk, bathroom, day, bodi, polic]
6        [report, get, ador, surpris, boyfriend, live]
7    [puerto, rican, desper, water, hurrican, fiona...
8        [documentari, captur, complex, child, immigr]
9             [biden, russian, affront, bodi, charter]
Name: headline, dtype: object
```

Now let's create a dictionary from 'processed_docs' containing the number of times a word appears in the training set. To do that, let's pass processed_docs to gensim.corpora.Dictionary() and call it 'dictionary'.

```
#bag of words om the dataset
dictionary=gensim.corpora.Dictionary(preprocess_docs)
```

```
#check dictionary created
count=0
for k,v in dictionary.iteritems():
  print(k,v)
  count+=1
  if count > 10:
    break
```

```
0 american
1 booster
2 covid
3 million
4 omicron
5 roll
6 sleev
7 target
8 airlin
```

```
9 attend
10 ban
```

```
print(dictionary)
```

```
Dictionary<36647 unique tokens: ['american', 'booster', 'covid', 'million', 'omicron']...>
```

```
from collections import Counter
count=Counter()
for doc in preprocess_docs:
  for word in doc:
    count[word]+=1
print(count)
```

```
Counter({'trump': 14425, 'photo': 12446, 'video': 6283, 'year': 4991, 'donald': 4850, 'say': 4821, 'best': 3902, 'women': 3515, 'time':
```

```
print(count["photo"])
```

```
12446
```

```
len(count)
```

```
36647
```

```
#filter_extreme
dictionary.filter_extremes(no_below=15,no_above=0.1,keep_n=100000)
```

filter out tokens that appear in

- less than no_below documents(absolute number)
- or more than no_above documents (fraction of total corpus size,not absolute number)
- after this keep only the first keep_n most frequent tokens

```
len(dictionary)
```

```
7480
```

```
#creating bag of words model for each documents ,for each document we created a dictionary of words and how many  times those words appear ,
bow_corpus=[dictionary.doc2bow(doc) for doc in preprocess_docs]
```

```
bow_corpus[document_num]
```

```
[(433, 1), (464, 1), (476, 1), (1414, 1)]
```

TF-IDF on our document:

Term Frequency (TF): This measures how frequently a term appears in a document. It's calculated by dividing the number of times a term appears in a document by the total number of terms in that document.

Inverse Document Frequency (IDF): This measures how unique a term is across all documents. It's calculated by taking the logarithm of the total number of documents divided by the number of documents containing the term.

TF-IDF Score: The TF-IDF score is the product of TF and IDF. It reflects the importance of a term in a document relative to its importance in the entire corpus of documents.

```
# create TF-IDF model object using models.TfIDModel on 'Bow_corpus" and save it to tdidf

from gensim import corpora,models
tfidf=models.TfidfModel(bow_corpus)
```

```
corpus_tfidf=tfidf[bow_corpus]
```

```
# preview TF-IDF
from pprint import pprint
for doc in corpus_tfidf:
  pprint(doc)
  break
```

```
[(0, 0.2756574126836034),
 (1, 0.577418735823452),
 (2, 0.41253789976930527),
 (3, 0.3223998219431091),
 (4, 0.40579281807324596),
 (5, 0.38961983935341893)]
```

Running LDA using Bag of words: We're aiming to extract 10 latent topics from our document corpus using LDA, and we'll leverage all CPU cores for faster model training. Here's a breakdown of some parameters we'll be adjusting:

num_topics: This parameter specifies the number of latent topics we want to extract from the training corpus.

**id2word:* *It's a mapping from word IDs (integers) to words (strings). It helps determine the vocabulary size and aids in debugging and topic printing.

workers: This parameter determines the number of extra processes used for parallelization. By default, it utilizes all available CPU cores.

alpha and eta: These are hyperparameters affecting the sparsity of the document-topic (theta) and topic-word (lambda) distributions. For now, we'll stick with the default values (1/num_topics).

Alpha: Controls the per-document topic distribution.

High alpha: Each document has a mixture of all topics, making documents appear similar to each other.

Low alpha: Each document has a mixture of very few topics.

Eta: Governs the per-topic word distribution.

High eta: Each topic comprises a mixture of most words, resulting in topics appearing similar to each other.

Low eta: Each topic consists of a mixture of few words.

```
pip install tqdm
```

```
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (4.66.2)
```

Double-click (or enter) to edit

```
from tqdm import tqdm

# Define the number of passes
num_passes = 50

# Train the LDA model with tqdm progress bar
with tqdm(total=num_passes, desc="Training LDA Model") as pbar:
    for i in range(num_passes):
        lda_model = gensim.models.LdaMulticore(bow_corpus, num_topics=10, id2word=dictionary, passes=1, workers=2)
        pbar.update(1)  # Update the progress bar
```

```
Training LDA Model: 100%|██████████| 50/50 [34:51<00:00, 41.84s/it]
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-34-649eeceaada3> in <cell line: 13>()
     11
     12 # Disable logging after training
---> 13 logging.disable(logging.INFO)

NameError: name 'logging' is not defined
```

```
from gensim.models import CoherenceModel

# Compute coherence score
coherence_model_lda = CoherenceModel(model=lda_model, texts=preprocess_docs, dictionary=dictionary, coherence='c_v')
coherence_lda = coherence_model_lda.get_coherence()
print('\nCoherence Score: ', coherence_lda)
```

```
    Coherence Score:  0.2906932833205403
```

```
for idx, topic in lda_model.print_topics(-1):
    print("Topic: {} \nWords: {}".format(idx, topic))
    print("\n")
```

```
    Topic: 0
    Words: 0.024*"video" + 0.019*"design" + 0.013*"game" + 0.011*"mind" + 0.011*"evolut" + 0.011*"network" + 0.009*"father" + 0.007*"season"


    Topic: 1
    Words: 0.036*"photo" + 0.020*"poll" + 0.020*"america" + 0.016*"guid" + 0.011*"weekend" + 0.010*"drink" + 0.008*"roundup" + 0.008*"dinner


    Topic: 2
    Words: 0.033*"tip" + 0.018*"stress" + 0.017*"free" + 0.013*"craft" + 0.013*"children" + 0.013*"right" + 0.008*"space" + 0.008*"fight" +


    Topic: 3
    Words: 0.110*"photo" + 0.021*"love" + 0.021*"video" + 0.020*"style" + 0.013*"best" + 0.013*"babi" + 0.012*"beauti" + 0.011*"dress" + 0.0


    Topic: 4
    Words: 0.034*"way" + 0.033*"look" + 0.019*"summer" + 0.016*"recip" + 0.014*"parent" + 0.014*"learn" + 0.013*"kid" + 0.011*"video" + 0.01


    Topic: 5
    Words: 0.021*"hous" + 0.019*"sleep" + 0.016*"night" + 0.015*"friend" + 0.011*"wall" + 0.010*"room" + 0.010*"white" + 0.008*"product" + 0


    Topic: 6
    Words: 0.026*"need" + 0.026*"chang" + 0.024*"know" + 0.018*"travel" + 0.017*"world" + 0.015*"super" + 0.014*"bowl" + 0.010*"huffpost" +


    Topic: 7
    Words: 0.037*"health" + 0.021*"cancer" + 0.017*"studi" + 0.016*"care" + 0.014*"risk" + 0.012*"propos" + 0.009*"link" + 0.008*"organ" + 0


    Topic: 8
    Words: 0.041*"divorc" + 0.023*"studi" + 0.018*"week" + 0.017*"food" + 0.016*"find" + 0.014*"healthi" + 0.012*"citi" + 0.011*"home" + 0.0


    Topic: 9
    Words: 0.052*"photo" + 0.033*"video" + 0.023*"life" + 0.019*"fashion" + 0.013*"best" + 0.013*"wed" + 0.012*"week" + 0.010*"celebr" + 0.0
```

Classification of the topics Using the words in each topic and their corresponding weights, what categories were you able to infer?

- 0: social, world news
- 1: Urgent issue / catastrophe
- 2: Accidents, wars, conflicts
- 3: Economy
- 4: Politics
- 5: Diplomacy
- 6: Agriculture
- 7: Sports
- 8: Justice
- 9: Claims, disputes

```
document_num = 4310
# Our test document is document number 4310

# TODO
# Our test document is document number 4310
for index, score in sorted(lda_model[bow_corpus[document_num]], key=lambda tup: -1*tup[1]):
    print("\nScore: {}\t \nTopic: {}".format(score, lda_model.print_topic(index, 10)))
```

```

Score: 0.5640257596969604
Topic: 0.037*"health" + 0.021*"cancer" + 0.017*"studi" + 0.016*"care" + 0.014*"risk" + 0.012*"propos" + 0.009*"link" + 0.008*"organ" + 0

Score: 0.3359050452709198
Topic: 0.110*"photo" + 0.021*"love" + 0.021*"video" + 0.020*"style" + 0.013*"best" + 0.013*"babi" + 0.012*"beauti" + 0.011*"dress" + 0.0

Score: 0.012509817257523537
Topic: 0.033*"tip" + 0.018*"stress" + 0.017*"free" + 0.013*"craft" + 0.013*"children" + 0.013*"right" + 0.008*"space" + 0.008*"fight" +

Score: 0.012509310618042946
Topic: 0.021*"hous" + 0.019*"sleep" + 0.016*"night" + 0.015*"friend" + 0.011*"wall" + 0.010*"room" + 0.010*"white" + 0.008*"product" + 0

Score: 0.012508814223110676
Topic: 0.041*"divorc" + 0.023*"studi" + 0.018*"week" + 0.017*"food" + 0.016*"find" + 0.014*"healthi" + 0.012*"citi" + 0.011*"home" + 0.0

Score: 0.012508531101047993
Topic: 0.024*"video" + 0.019*"design" + 0.013*"game" + 0.011*"mind" + 0.011*"evolut" + 0.011*"network" + 0.009*"father" + 0.007*"season"

Score: 0.012508219107985497
Topic: 0.026*"need" + 0.026*"chang" + 0.024*"know" + 0.018*"travel" + 0.017*"world" + 0.015*"super" + 0.014*"bowl" + 0.010*"huffpost" +

Score: 0.012508177198469639
Topic: 0.034*"way" + 0.033*"look" + 0.019*"summer" + 0.016*"recip" + 0.014*"parent" + 0.014*"learn" + 0.013*"kid" + 0.011*"video" + 0.01

Score: 0.012508177198469639
Topic: 0.052*"photo" + 0.033*"video" + 0.023*"life" + 0.019*"fashion" + 0.013*"best" + 0.013*"wed" + 0.012*"week" + 0.010*"celebr" + 0.0

Score: 0.012508145533502102
Topic: 0.036*"photo" + 0.020*"poll" + 0.020*"america" + 0.016*"guid" + 0.011*"weekend" + 0.010*"drink" + 0.008*"roundup" + 0.008*"dinner
```

```
'''
Check which topic our test document belongs to using the LDA TF-IDF model.
'''
# Our test document is document number 4310
for index, score in sorted(lda_model[bow_corpus[document_num]], key=lambda tup: -1*tup[1]):
    print("\nScore: {}\t \nTopic: {}".format(score, lda_model.print_topic(index, 10)))
```

```

Score: 0.564028263092041
Topic: 0.037*"health" + 0.021*"cancer" + 0.017*"studi" + 0.016*"care" + 0.014*"risk" + 0.012*"propos" + 0.009*"link" + 0.008*"organ" + 0

Score: 0.33590254187583923
Topic: 0.110*"photo" + 0.021*"love" + 0.021*"video" + 0.020*"style" + 0.013*"best" + 0.013*"babi" + 0.012*"beauti" + 0.011*"dress" + 0.0

Score: 0.012509818188846111
Topic: 0.033*"tip" + 0.018*"stress" + 0.017*"free" + 0.013*"craft" + 0.013*"children" + 0.013*"right" + 0.008*"space" + 0.008*"fight" +

Score: 0.01250931154936552
Topic: 0.021*"hous" + 0.019*"sleep" + 0.016*"night" + 0.015*"friend" + 0.011*"wall" + 0.010*"room" + 0.010*"white" + 0.008*"product" + 0

Score: 0.01250881515443325
Topic: 0.041*"divorc" + 0.023*"studi" + 0.018*"week" + 0.017*"food" + 0.016*"find" + 0.014*"healthi" + 0.012*"citi" + 0.011*"home" + 0.0

Score: 0.012508532032370567
Topic: 0.024*"video" + 0.019*"design" + 0.013*"game" + 0.011*"mind" + 0.011*"evolut" + 0.011*"network" + 0.009*"father" + 0.007*"season"

Score: 0.012508220039308071
Topic: 0.026*"need" + 0.026*"chang" + 0.024*"know" + 0.018*"travel" + 0.017*"world" + 0.015*"super" + 0.014*"bowl" + 0.010*"huffpost" +

Score: 0.012508177198469639
Topic: 0.034*"way" + 0.033*"look" + 0.019*"summer" + 0.016*"recip" + 0.014*"parent" + 0.014*"learn" + 0.013*"kid" + 0.011*"video" + 0.01

Score: 0.012508177198469639
Topic: 0.052*"photo" + 0.033*"video" + 0.023*"life" + 0.019*"fashion" + 0.013*"best" + 0.013*"wed" + 0.012*"week" + 0.010*"celebr" + 0.0

Score: 0.012508145533502102
Topic: 0.036*"photo" + 0.020*"poll" + 0.020*"america" + 0.016*"guid" + 0.011*"weekend" + 0.010*"drink" + 0.008*"roundup" + 0.008*"dinner
```

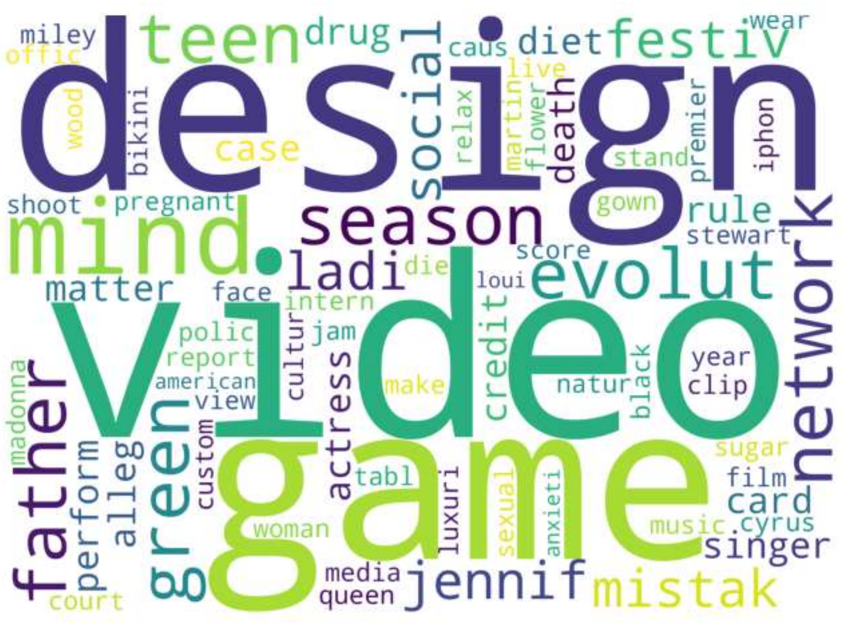
```
#testing on unseen data
unseen_document = "My favorite sports activities are running and swimming."

# Data preprocessing step for the unseen document
bow_vector = dictionary.doc2bow(preprocess(unseen_document))
threshold = 0.1
for index, score in sorted(lda_model[bow_vector], key=lambda tup: -1*tup[1]):
    if score < threshold: break
    print("Score: {}\n Topic: {}".format(score, lda_model.print_topic(index, 5)))
    print()
```

```
Score: 0.39234164357185364
 Topic: 0.110*"photo" + 0.021*"love" + 0.021*"video" + 0.020*"style" + 0.013*"best"

Score: 0.2936677038669586
 Topic: 0.052*"photo" + 0.033*"video" + 0.023*"life" + 0.019*"fashion" + 0.013*"best"

Score: 0.19729594886302948
 Topic: 0.036*"photo" + 0.020*"poll" + 0.020*"america" + 0.016*"guid" + 0.011*"weekend"
```

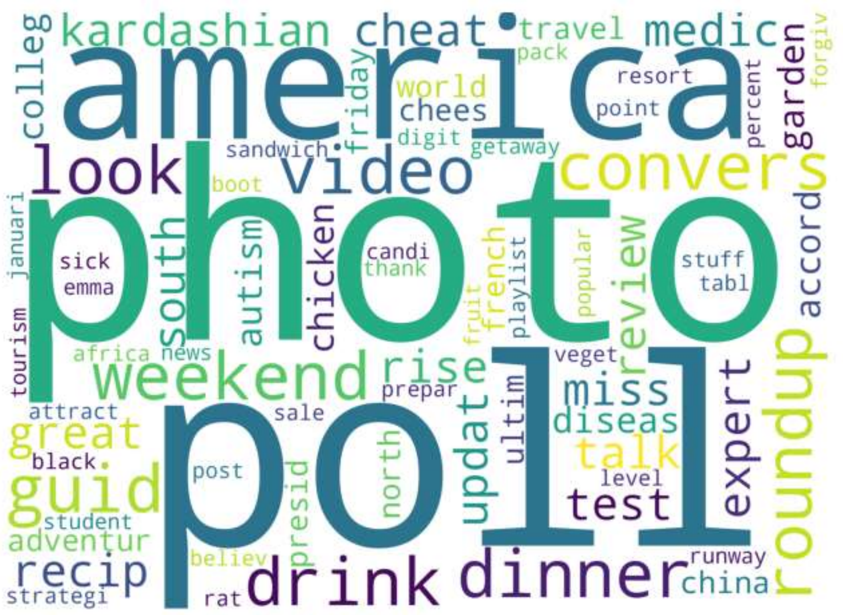
```
import matplotlib.pyplot as plt
%matplotlib inline

from wordcloud import WordCloud, STOPWORDS


def word_cloud(topic, model):
    plt.figure(figsize = (8,6))
    topic_words = [model.print_topic(topic, 75)]
    cloud = WordCloud(stopwords = STOPWORDS, background_color = 'white',
                      width=2500, height=1800).generate(" ".join(topic_words))

    print('\nWordcloud for topic:', topic, '\n')
    plt.imshow(cloud)
    plt.axis('off')
    plt.show()
```

```
for topic in range(10):
    #plt.figure(figsize=(10,15))
    word_cloud(topic, lda_model)
```

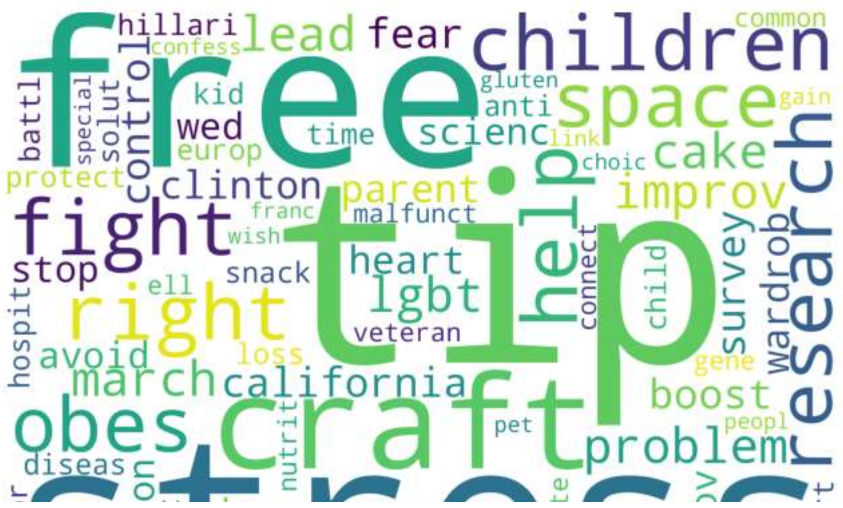
```
Wordcloud for topic: 0
```



```
Wordcloud for topic: 1
```



```
Wordcloud for topic: 2
```


free
tip
hillari
confess
lead
fear
children
common
gluten
space
gain
battl
special
solut
control
kid
wed
europ
time
anti
scienc
link
choic
cake
research
protect
clinton
parent
improv
fight
franc
malfunct
wish
stop
snack
heart
help
connect
child
survey
wardrob
right
ell
lgbt
hospit
avoid
loss
veteran
gene
march
california
boost
obes
craft
nutrit
pet
peopl
problem
diseas