```
!pip install nltk
```

```
Requirement already satisfied: nltk in /usr/local/lib/python3.10/dist-packages (3.8.1)
Requirement already satisfied: click in /usr/local/lib/python3.10/dist-packages (from nltk) (8.1.7)
Requirement already satisfied: joblib in /usr/local/lib/python3.10/dist-packages (from nltk) (1.3.2)
Requirement already satisfied: regex>=2021.8.3 in /usr/local/lib/python3.10/dist-packages (from nltk) (2023.12.25)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from nltk) (4.66.2)
```

```
!pip install bertopic
```

```
Requirement already satisfied: bertopic in /usr/local/lib/python3.10/dist-packages (0.16.0)
Requirement already satisfied: numpy>=1.20.0 in /usr/local/lib/python3.10/dist-packages (from bertopic) (1.25.2)
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Requirement already satisfied: transformers<5.0.0,>=4.32.0 in /usr/local/lib/python3.10/dist-packages (from sentence-transformers>=0
Requirement already satisfied: torch>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from sentence-transformers>=0.4.1->bertopic
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Requirement already satisfied: numba>=0.51.2 in /usr/local/lib/python3.10/dist-packages (from umap-learn>=0.5.0->bertopic) (0.58.1)
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Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.11.0->sentence-transfor
```

```
!pip install bertopic[visualization]
```

```
Requirement already satisfied: bertopic[visualization] in /usr/local/lib/python3.10/dist-packages (0.16.0)
WARNING: bertopic 0.16.0 does not provide the extra 'visualization'
Requirement already satisfied: numpy>=1.20.0 in /usr/local/lib/python3.10/dist-packages (from bertopic[visualization]) (1.25.2)
Requirement already satisfied: hdbscan>=0.8.29 in /usr/local/lib/python3.10/dist-packages (from bertopic[visualization]) (0.8.33)
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Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sentence-transformers>=0.
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sentence-transformers>=0.4.
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Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0-
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Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sente
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Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sen
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Requirement already satisfied: nvidia-cusparse-cu12==12.1.0.106 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->s
Requirement already satisfied: nvidia-nccl-cu12==2.19.3 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sentence-
Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch>=1.11.0->sentenc
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Requirement already satisfied: safetensors>=0.4.1 in /usr/local/lib/python3.10/dist-packages (from transformers<5.0.0,>=4.32.0->s
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Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests->huggingface-hub>=0.1
Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.11.0->sentence-trans
```

```
from bertopic import BERTopic
import nltk
import os
import pandas as pd
from tqdm.notebook import tqdm
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.preprocessing import LabelEncoder
from nltk.stem import PorterStemmer
from nltk.stem import WordNetLemmatizer
from nltk import word_tokenize
import numpy as np
from gensim.models import Nmf
from gensim.models.ldamodel import LdaModel
from gensim.models import LsiModel
from gensim.models import HdpModel
from gensim.models import LdaMulticore
from gensim.models import EnsembleLda
from gensim.models.ldamulticore import LdaMulticore
from gensim.models.coherencemodel import CoherenceModel
import gensim
import gensim.corpora as corpora
from gensim.models import Phrases
from gensim.utils import simple_preprocess
from gensim.corpora.dictionary import Dictionary
from gensim.utils import tokenize
from nltk.corpus import stopwords
from collections import Counter
nltk.download('stopwords')
nltk.download('wordnet')
import re
import json
import string
from bs4 import BeautifulSoup
from gensim.parsing.preprocessing import (
    strip_non_alphanum,
    split_alphanum,
    strip_short,
    strip_numeric
)
from collections import Counter
from wordcloud import WordCloud, STOPWORDS
from PIL import Image
```

```
import seaborn as sns
import matplotlib.pyplot as plt
```

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

```
df=pd.read_csv("latest_ticket_data.csv")
```

```
df.head()
```

	Description	Category
0	hi since recruiter lead permission approve req...	Application
1	re expire days hi ask help update passwords co...	Application
2	verification warning hi has got attached pleas...	Application
3	please dear looks blacklisted receiving mails ...	Application
4	dear modules report report cost thank much req...	Application

```
#Assign nan in place of blanks in the body column
df[df.loc[:, 'Description'] == ''] = np.nan
```

```
# Check if blank values still exist
df[df.loc[:, 'Description'] == '']
```

	Description	Category

```
df.shape
```

```
(3000, 2)
```

```
#Remove all rows where body column is nan
df = df[~df['Description'].isnull()]
```

```
df.shape
```

```
(3000, 2)
```

```
# Convert body column to string for performing text operations
df['Description'] = df['Description'].astype(str)
```

```
stop_words = stopwords.words('english')
custom_stop_words = ['hi', 'since', 'please', 'best', 'regards', 'thank', 'thanks', 'hello', 'sent', 'great', 'dear', 'help', 'kind']
time_words = ['january', 'february', 'march', 'april', 'may', 'june', 'july', 'august', 'september', 'october', 'november', 'december',

def remove_stop_words(text):
    pattern = re.compile(r'\b(' + r'|'.join(stop_words) + r')\b\s*')
    text = pattern.sub('', text)
    return text

def remove_custom_words(text):
    pattern = re.compile(r'\b(' + r'|'.join(custom_stop_words) + r')\b\s*')
    text = pattern.sub('', text)
    return text

def remove_time_words(text):
    pattern = re.compile(r'\b(' + r'|'.join(time_words) + r')\b\s*')
    text = pattern.sub('', text)
    return text

df['Description'] = df["Description"].map(lambda x: remove_stop_words(x))
df['Description'] = df["Description"].map(lambda x: remove_custom_words(x))
df['Description'] = df["Description"].map(lambda x: remove_time_words(x))
```

```
def parse_html(text, parser="html.parser"):
    soup = BeautifulSoup(text, parser)
    soup = remove_html_tags(soup)
    text = remove_multiple_space(soup.get_text()).strip()
    return text
```

```
def parse_html_v2(text, loop=2, parser="html.parser"):
```

```
    if not text:
        text = ""
    # some contents still have html code after first parse
    # loop solved problem
    for _ in range(loop):
        soup = BeautifulSoup(text, parser)
        text = soup.get_text()
    text = remove_multiple_space(text)
    return text


def remove_links_content(text):
    text = re.sub(r"http\S+", "", text)
    return text


def remove_emails(text):
    return re.sub('\S*@\S*\s?', '', text)  # noqa


def remove_punctuation(text):
    """https://stackoverflow.com/a/37221663"""
    table = str.maketrans({key: None for key in string.punctuation})
    return text.translate(table)


def remove_special_tags(text):
    """Remove html tags from a string"""
    clean = re.compile('{.*?}')
    return re.sub(clean, '', text)


def preprocess_text(text):
    text = parse_html_v2(text)
    text = text.lower()
    text = remove_links_content(text)
    text = remove_emails(text)
    text = remove_special_tags(text)  # remove content between {}
    text = remove_punctuation(text)  # remove all puntuations
    text = split_alphanum(text)  # add space between word and numeric
    text = strip_numeric(text)  # remove digits
    text = strip_non_alphanum(text)  # remove non-alphabetic characters
    text = strip_short(text, minsize=2)  # remove word with length  <  minsize
    text = remove_multiple_space(text).strip()  # remove space and strip
    #text = tokenize(text)
    return text


def remove_multiple_space(text):
    return re.sub("\s\s+", " ", text)  # noqa


def remove_html_tags(soup,
                     tags=["script", "style"],
                     get_text=False):
    for tag in tags:
        for sample in soup.find_all(tag):
            sample.replaceWith('')

    if get_text:
        return soup.get_text()
    return soup

# Convert body column to string for performing text operations
df['Description'] = df['Description'].astype(str)
df['Description'] = df["Description"].map(lambda x: preprocess_text(x))


lemmatizer = WordNetLemmatizer()
df['Lemma_Description'] = df["Description"].map(lambda x: lemmatizer.lemmatize(x))


# create model
bert_model = BERTopic(verbose=True)
#convert to list
docs = df.Lemma_Description.to_list()


#bert_model.fit_transform(docs)
topics, probabilities = bert_model.fit_transform(docs)
```

```
2024-03-31 09:01:21,702 - BERTopic - Embedding - Transforming documents to embeddings.
modules.json: 100%                                                  349/349 [00:00<00:00, 13.7kB/s]
config_sentence_transformers.json: 100%                             116/116 [00:00<00:00, 4.32kB/s]
README.md: 100%                                                     10.7k/10.7k [00:00<00:00, 210kB/s]
sentence_bert_config.json: 100%                                     53.0/53.0 [00:00<00:00, 1.62kB/s]
config.json: 100%                                                   612/612 [00:00<00:00, 20.9kB/s]
model.safetensors: 100%                                             90.9M/90.9M [00:00<00:00, 209MB/s]
tokenizer_config.json: 100%                                         350/350 [00:00<00:00, 22.0kB/s]
vocab.txt: 100%                                                     232k/232k [00:00<00:00, 586kB/s]
tokenizer.json: 100%                                                466k/466k [00:00<00:00, 1.19MB/s]
special_tokens_map.json: 100%                                       112/112 [00:00<00:00, 1.54kB/s]
1_Pooling/config.json: 100%                                         190/190 [00:00<00:00, 4.04kB/s]
Batches: 100%                                                       94/94 [01:11<00:00,  5.59it/s]
2024-03-31 09:02:43,229 - BERTopic - Embedding - Completed ✓
2024-03-31 09:02:43,232 - BERTopic - Dimensionality - Fitting the dimensionality reduction algorithm
2024-03-31 09:03:06,568 - BERTopic - Dimensionality - Completed ✓
2024-03-31 09:03:06,570 - BERTopic - Cluster - Start clustering the reduced embeddings
2024-03-31 09:03:06,776 - BERTopic - Cluster - Completed ✓
2024-03-31 09:03:06,788 - BERTopic - Representation - Extracting topics from clusters using representation models.
2024-03-31 09:03:07,161 - BERTopic - Representation - Completed ✓
```

```
# Preprocess documents
cleaned_docs = bert_model._preprocess_text(docs)

# Extract vectorizer and tokenizer from BERTopic
vectorizer = bert_model.vectorizer_model
tokenizer = vectorizer.build_tokenizer()

# Extract features for Topic Coherence evaluation
words = vectorizer.get_feature_names_out()
tokens = [tokenizer(doc) for doc in cleaned_docs]
dictionary = corpora.Dictionary(tokens)
corpus = [dictionary.doc2bow(token) for token in tokens]
topic_words = [[words for words, _ in bert_model.get_topic(topic)]
               for topic in range(len(set(topics))-1)]


# Evaluate
coherence_model = CoherenceModel(topics=topic_words,
                                 texts=tokens,
                                 corpus=corpus,
                                 dictionary=dictionary,
                                 coherence='c_v')
coherence = coherence_model.get_coherence()
coherence
```

```
0.5108303713239383
```

```
# Evaluate
u_mass_coherence_model = CoherenceModel(topics=topic_words,
                                 texts=tokens,
                                 corpus=corpus,
                                 dictionary=dictionary,
                                 coherence='u_mass')
u_mass_coherence = u_mass_coherence_model.get_coherence()
u_mass_coherence
```

```
-6.442755937630485
```

```
# Evaluate
c_uci_coherence_model = CoherenceModel(topics=topic_words,
                                 texts=tokens,
                                 corpus=corpus,
                                 dictionary=dictionary,
                                 coherence='c_uci')
c_uci_coherence = c_uci_coherence_model.get_coherence()
c_uci_coherence
```

```
-2.620747508656331
```

```
# Evaluate
c_npmi_coherence_model = CoherenceModel(topics=topic_words,
```

```
                                texts=tokens,
                                corpus=corpus,
                                dictionary=dictionary,
                                coherence='c_npmi')
c_npmi_coherence = c_npmi_coherence_model.get_coherence()
c_npmi_coherence
```

```
0.063172328595613
```

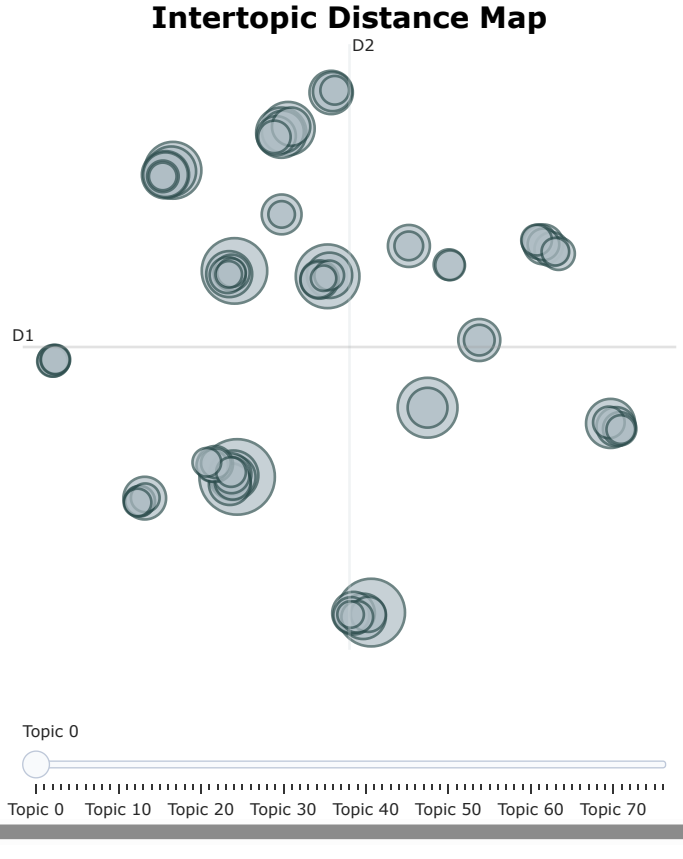
```
bert_model.get_topic_freq().head(11)
```

	Topic	Count
6	-1	963
24	0	97
25	1	78
47	2	73
23	3	69
56	4	61
14	5	55
34	6	48
4	7	43
27	8	42
0	9	42

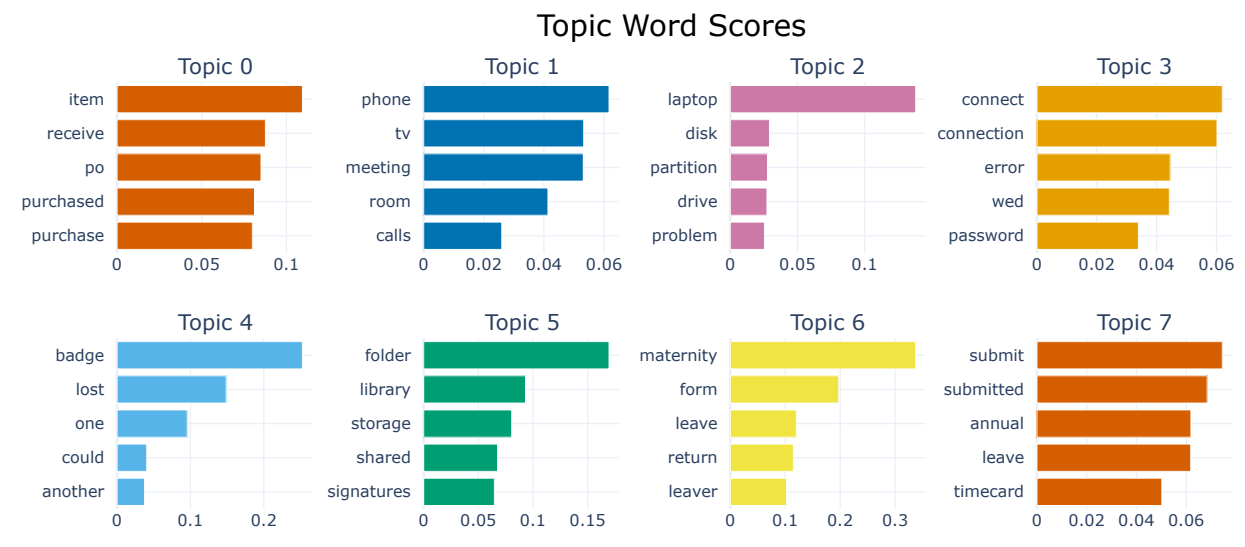
```
bert_model.get_topic(7)
```

```
[('submit', 0.0744794167125373),
 ('submitted', 0.06840681754853037),
 ('annual', 0.06187634278482901),
 ('leave', 0.061796572029398235),
 ('timecard', 0.050173290746146224),
 ('entered', 0.048411094710755935),
 ('absence', 0.042266296006762474),
 ('reports', 0.039900748999711112),
 ('action', 0.038729547333533725),
 ('accordingly', 0.038079113557479165)]
```

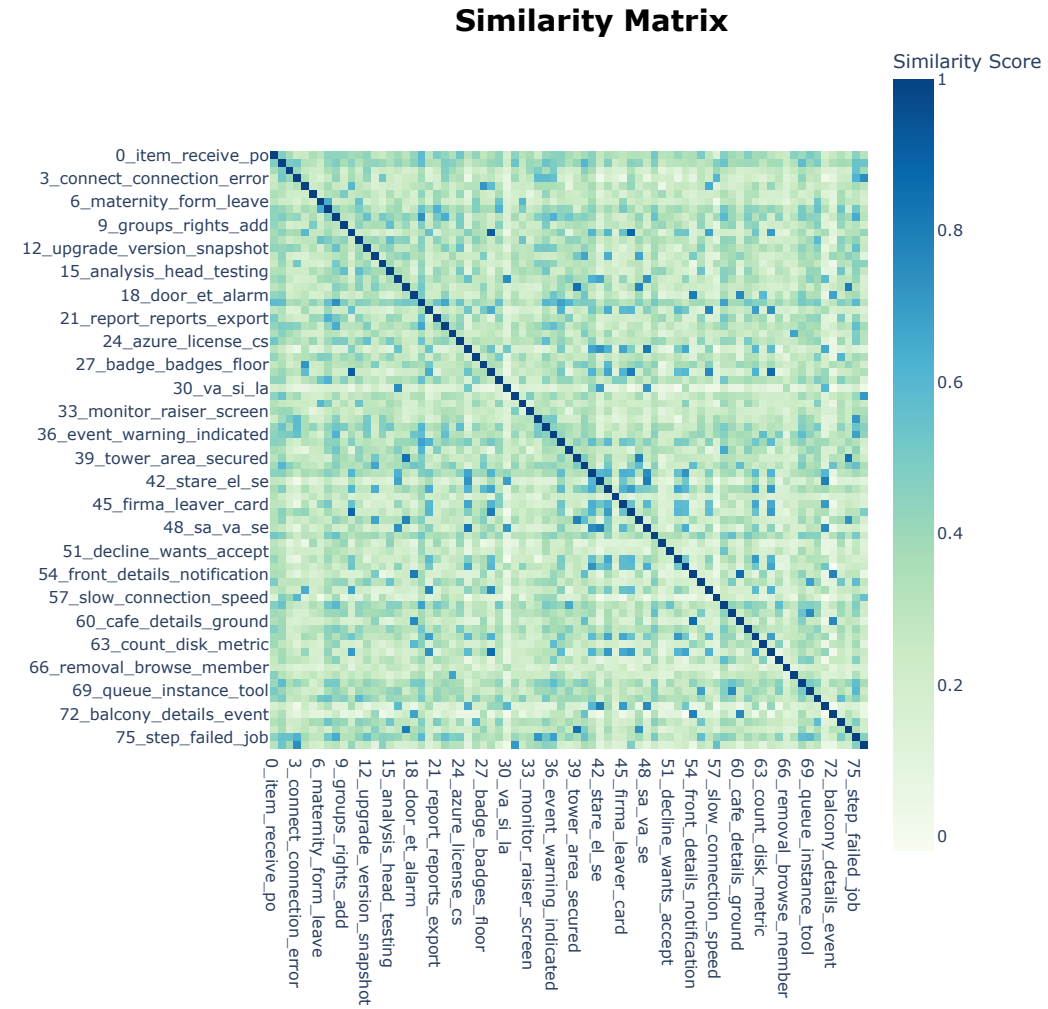
```
bert_model.visualize_topics()
```



```
bert_model.visualize_barchart()
```




```
bert_model.visualize_heatmap()
```




```
bert_model.save("latest_ticket_data_bert_model")
```

```
2024-03-31 09:03:18,219 - BERTopic - WARNING: When you use `pickle` to save/load a BERTopic model,please make sure that the environm
```

Start coding or generate with AI.