1. Project Overview

Climate Change Belief Analysis

1.1. Problem Statement:

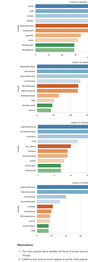
The goal is to create a machine learning model based on new tweet data and classify whether or not a person believes in climate change

2. Imports

```
!pip install -U spacy[cuda-cuda113]
```

2.1 Import python libraries

```
!pip install -U spacy[cuda-cuda113]
!python -m spacy download en_core_web_sm
import numpy as np
import pandas as pd
import re
import nltk
import spacy
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go
import plotly.offline as pyo
import wordcloud
from wordcloud import WordCloud, STOPWORDS, ImageColor
from collections import Counter
from nltk.corpus import stopwords
from nltk import word_tokenize, sent_tokenize
from nltk.stem.porter import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.pipeline import Pipeline
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score, f1_score, recall_score, precision_score
from sklearn.naive_bayes import MultinomialNB
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, AdaBoostClassifier, GradientBoostingClassifier
from xgboost import XGBClassifier
from lightgbm import LGBMClassifier
from catboost import CatBoostClassifier
from sklearn.model_selection import cross_val_score
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import OrdinalEncoder
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import LabelBinarizer
from sklearn.preprocessing import MultiLabelBinarizer
from sklearn.preprocessing import TfidfVectorizer, CountVectorizer
from sklearn.decomposition import PCA
from sklearn.manifold import TSNE
from sklearn.feature_selection import SelectKBest, chi2, mutual_info_regression, mutual_info_classif, f_regression, f_classif
from sklearn.model_selection import GridSearchCV, RandomSearchCV
from sklearn.metrics import confusion_matrix, classification_report, roc_curve, roc_auc_score, auc, precision_recall_curve, average_precision_score
from sklearn.tree import plot_tree
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.ensemble import VotingClassifier
from sklearn.ensemble import StackingClassifier
from sklearn.ensemble import BaggingClassifier
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import HistGradientBoostingClassifier
from sklearn.ensemble import RandomTreesEmbedding
from sklearn.ensemble import IsolationForest
from sklearn.ensemble import StackingClassifier
from sklearn.ensemble import VotingClassifier
from sklearn.ensemble import BaggingClassifier
from sklearn.ensemble import ExtraTrees
```


Top 20 Hashtags for Anti-sentiment
#maga
#tcot
#pjnet
#ccot
#p2
#tlot
#ctrl
#ccot2
#tlot2
#ccot3
#tlot3
#ccot4
#tlot4
#ccot5
#tlot5
#ccot6
#tlot6
#ccot7
#tlot7
#ccot8
#tlot8
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
21000
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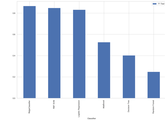
26000
27000
28000
29000
30000
31000
32000
33000
34000
35000
36000
37000
38000
39000




```
In [24]: Text[Text.Class_Topic==1].Text.sample(5).values
```

```
Out[24]: array([' Rising sea levels and increasing coastal flooding are a direct consequence of climate change, affecting millions of people in low-lying coastal areas. The Intergovernmental Panel on Climate Change (IPCC) reports that global sea levels have risen by approximately 20 cm since the late 19th century, with projections indicating further increases of up to 1 meter by the end of the 21st century if current trends continue. This phenomenon poses significant threats to coastal infrastructure, ecosystems, and communities, necessitating adaptation strategies such as coastal defenses, managed retreat, and ecosystem restoration.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.'],
      dtype=object)
```

```
In [25]: Text[Text.Class_Topic==2].Text.sample(5).values
```

```
Out[25]: array([' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.'],
      dtype=object)
```

```
In [26]: Text[Text.Class_Topic==3].Text.sample(5).values
```

```
Out[26]: array([' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.'],
      dtype=object)
```

```
In [27]: Text[Text.Class_Topic==4].Text.sample(5).values
```

```
Out[27]: array([' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.',
       ' The Paris Agreement, adopted in 2015, is a landmark international treaty aimed at combating climate change by reducing greenhouse gas emissions and promoting adaptation and resilience. The agreement sets a goal to limit global warming to well below 2°C above pre-industrial levels, with efforts to limit the increase to 1.5°C. The treaty requires all signatory countries to submit nationally determined contributions (NDCs) outlining their emission reduction targets and strategies, and to regularly report on their progress.',
       ' Climate change is a global phenomenon that has been accelerated by human activities, primarily the burning of fossil fuels and deforestation. The Intergovernmental Panel on Climate Change (IPCC) has reported that human activities have caused global temperatures to rise by approximately 1.1°C since the pre-industrial era. The consequences of this warming include more frequent and severe weather events, such as hurricanes, droughts, and heatwaves, which have significant impacts on ecosystems, agriculture, and human health.'],
      dtype=object)
```

Visualizing the performance of the RidgeClassifier model

Tuning the DVC model

```
In [28]: %%capture
         %%time
         %%bash
         ./tune.sh -m DVC -d data/Text.csv -c 1
```

New submission class 2

The most commonly used keyword in the New submission class when discussing climate change is Emissions, followed by Retrenchment. Climate change is a topic of great discussion in the Paris era, with topics such as the impact of climate change on the Great Barrier Reef and the Paris Agreement being discussed. The Paris Agreement is a landmark international treaty that aims to limit global temperature rise. The training IPCC(cv=1) training, as in Tutorial 1 does an climate changeness.

Preparing submission for kaggle

```
In [29]: df = pd.read_csv("data/submission_dvc_tune.csv")
         df.shape, df.Class_Topic.nunique()
```

```
Out[29]: ((1000, 2), 5)
```

```
In [30]: df.sample(5).sort_values(by=['id'])
```

```
Out[30]:
```

	id	Class_Topic
0	0	1
1	1	1
2	2	1
3	3	1
4	4	1

```
In [31]: df.sample(5).sort_values(by=['id'])
```

```
Out[31]:
```

	id	Class_Topic
0	0	1
1	1	1
2	2	1
3	3	1
4	4	1

```
In [32]: df.sample(5).sort_values(by=['id'])
```

```
Out[32]:
```

	id	Class_Topic
0	0	1
1	1	1
2	2	1
3	3	1
4	4	1

Packaging the output as csv file

```
In [33]: df.to_csv("dvc.csv")
```

Pickling the model

```
In [34]: %%capture
         %%time
         %%bash
         ./pickle.sh -m DVC -d data/Text.csv -c 1
         ./pickle.sh -m DVC -d data/Text.csv -c 2
         ./pickle.sh -m DVC -d data/Text.csv -c 3
         ./pickle.sh -m DVC -d data/Text.csv -c 4
         ./pickle.sh -m DVC -d data/Text.csv -c 5
```

```
In [35]: %%bash
         ls -lrtsh *.pkl
         ./predict.sh -h
         ./predict.sh -m DVC -c 1
         head -5 submission.csv
         wc -l submission.csv
         head -5 submission.dvc.csv
         wc -l submission.dvc.csv
```

References

1. Climate Reliongeneration (2020) Ten Times of North American Field Co-Friendly Events, Study Finds, Rarest's. Available at: https://www.prnewswire.com/news-releases/10-times-of-north-american-field-co-friendly-events-study-finds-1-170861-107-rarest.html, (Accessed: 15 June 2022)
2. The New York Times (2021) Climate Change: Top Questions About Causes and Effects, Answered . The New York Times. Available at: https://www.nytimes.com/guides/year-in-science/climate-change-causes-effects.html (Accessed: 15 June 2022).

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1. AJW Academy (2021) Regular Expression HAKEY – Python 3.10.0 documentation. Available at: https://www.ajwacademy.com/blog/2021/09/regular-expression-hakey-python-3.html
2. Kaggle Bitcoin (2021) sentiment Bitcoin by Kaggle Kernel. Kaggle Bitcoin sentiment Bitcoin by Kaggle Kernel. Available at: https://gitlab.com/sentiment/bitcoin-by-kaggle-kernel, (Accessed: 14 June 2021).
3. Climate Reliongeneration (2020) Ten Times of North American Field Co-Friendly Events, Study Finds, Rarest's. Available at: https://www.prnewswire.com/news-releases/10-times-of-north-american-field-co-friendly-events-study-finds-1-170861-107-rarest.html, (Accessed: 15 June 2022)
4. The New York Times (2021) Climate Change: Top Questions About Causes and Effects, Answered . The New York Times. Available at: https://www.nytimes.com/guides/year-in-science/climate-change-causes-effects.html (Accessed: 15 June 2022).