Python for Data Science and AI Presentation II

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Introduction

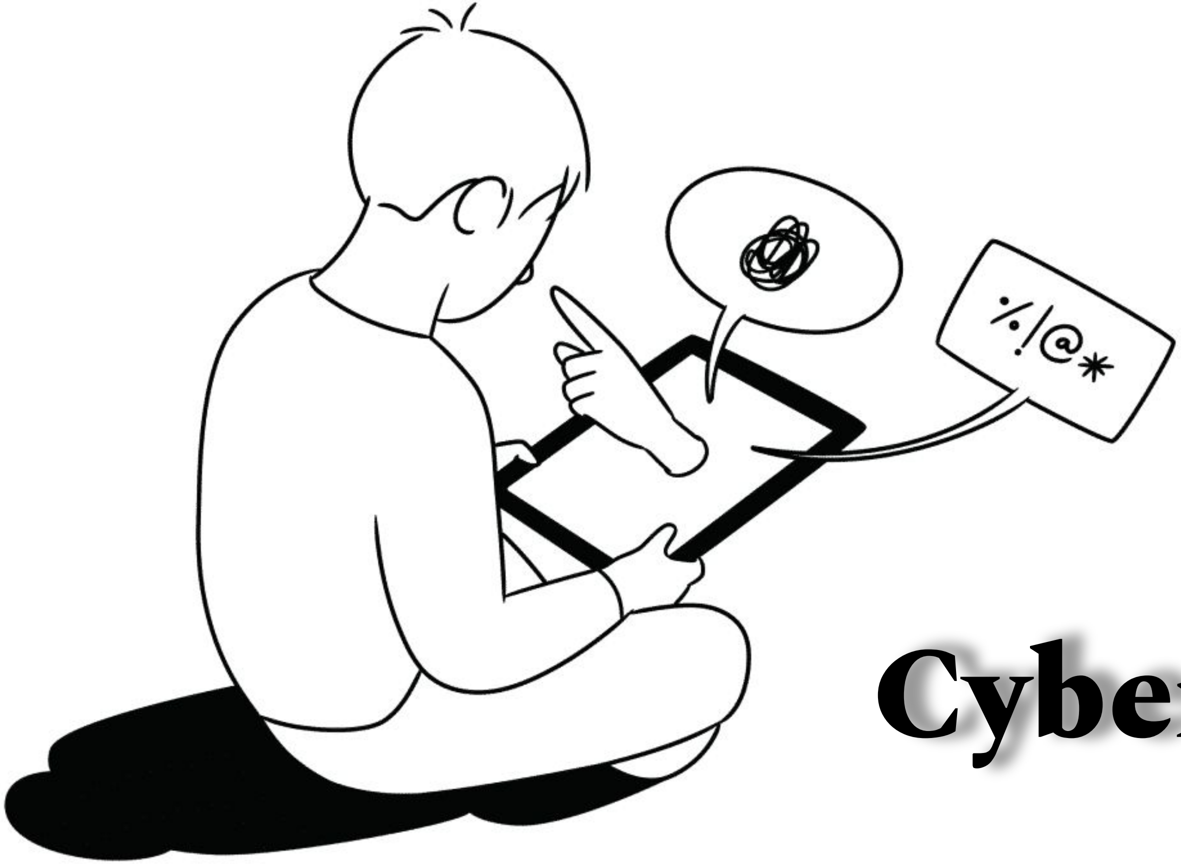
Hugging Face 🤗

- A free platform where the machine learning community collaborates on models, datasets, and applications.
  - Natural Language Processing
  - Computer Vision
  - Audio
  - Multimodal tasks
- Providing an accessible platform for everyone will reduce the education gaps between professionals and beginners

The Role of Pre-trained Models in DS & AI research field

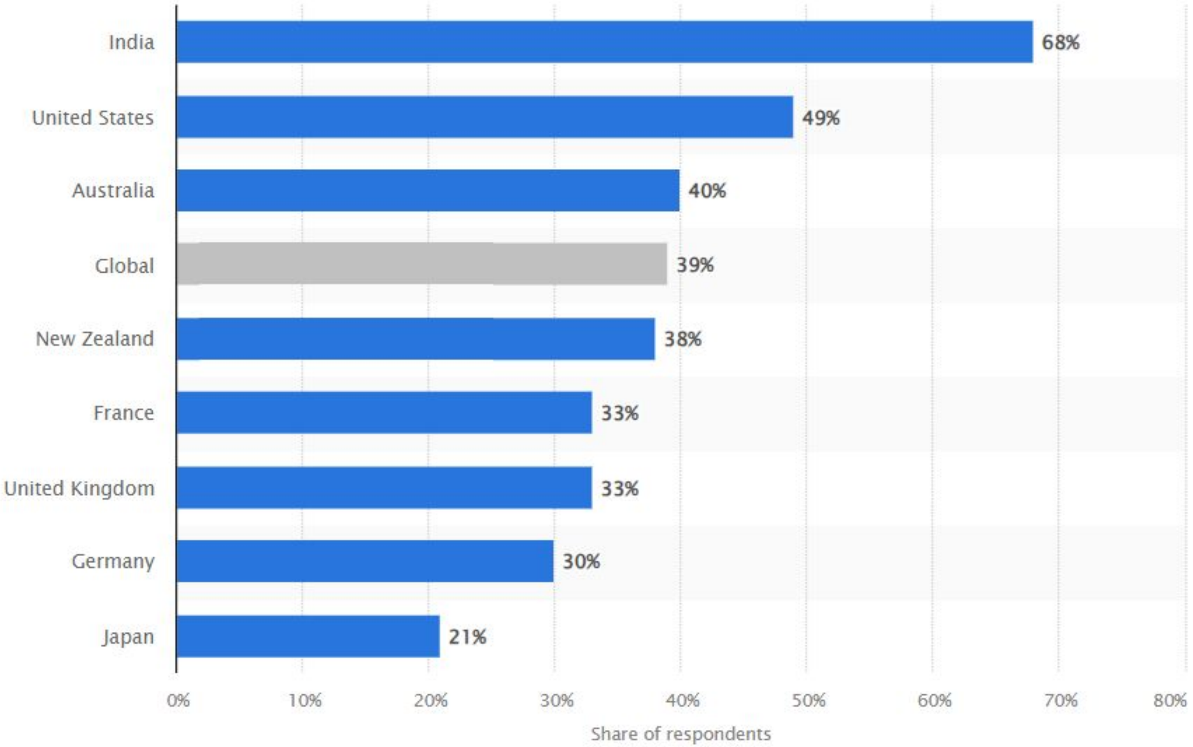
- Pretrained models could undeniably accelerate data science and AI research.
- Building a model takes a lot of time, being able to access pretrained models created by other people would significantly reduce the time of conducting a research.
- Time could be spent on other areas as the researchers are not required to build their own model from the scratch.

Problem and Motivation



Cyberbullying

Percentage of internet users in selected countries who have ever experienced any cybercrime in 2022 (Petrosyan, 2023)



However...

“Laws against bullying, particularly on cyberbullying, are relatively new and still do not exist everywhere.”

UNICEF (2023)

The Problem : Cyberbullying

Therefore, we would like to try using AI and machine learning to determine whether a person's comment/post/message is resulting in cyberbullying.

This will be performed by the help of a pretrained model called 'toxic comment model'.

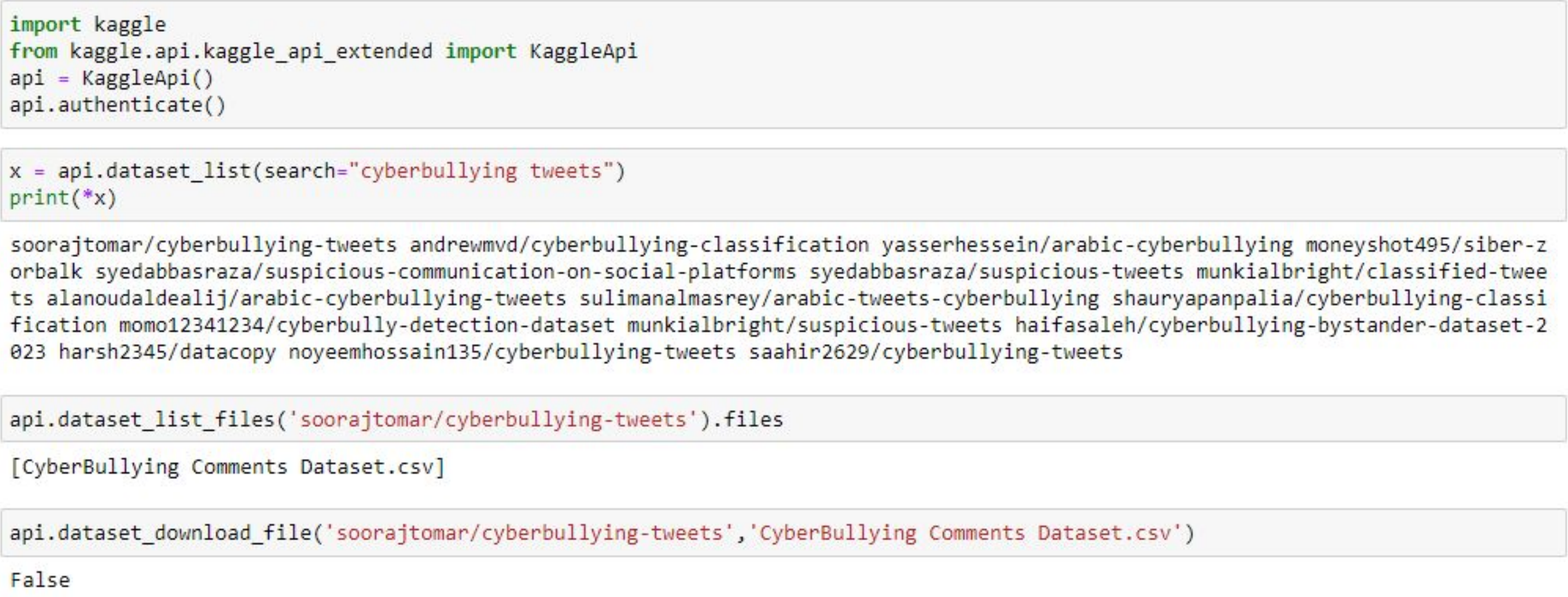
The Importance

- Implementation of classification techniques in order to address cyberbullying issue by differentiating toxic/harmful text from the normal ones.
- As cyberbullying is a real-world issue and we could retrieve data to assist in building a classification model.
- The ideal model after testing and training would not only be able to address cyberbullying but other issues such as hate speech identification and other forms of text classification.

Data and Preprocessing

Our Dataset

We used a dataset from kaggle comprising of tweets which which were considered cyberbullying



```
import kaggle
from kaggle.api.kaggle_api_extended import KaggleApi
api = KaggleApi()
api.authenticate()
```

```
x = api.dataset_list(search="cyberbullying tweets")
print(*x)
```

```
soorajtomar/cyberbullying-tweets andrewmvd/cyberbullying-classification yasserhessein/arabic-cyberbullying moneyshot495/siber-z
orbalk syedabbasraza/suspicious-communication-on-social-platforms syedabbasraza/suspicious-tweets munkialbright/classified-twee
ts alanoudaldealij/arabic-cyberbullying-tweets sulimanalmasrey/arabic-tweets-cyberbullying shauryapanpalia/cyberbullying-classi
fication momo12341234/cyberbully-detection-dataset munkialbright/suspicious-tweets haifasaleh/cyberbullying-bystander-dataset-2
023 harsh2345/datacopy noyeemhossain135/cyberbullying-tweets saahir2629/cyberbullying-tweets
```

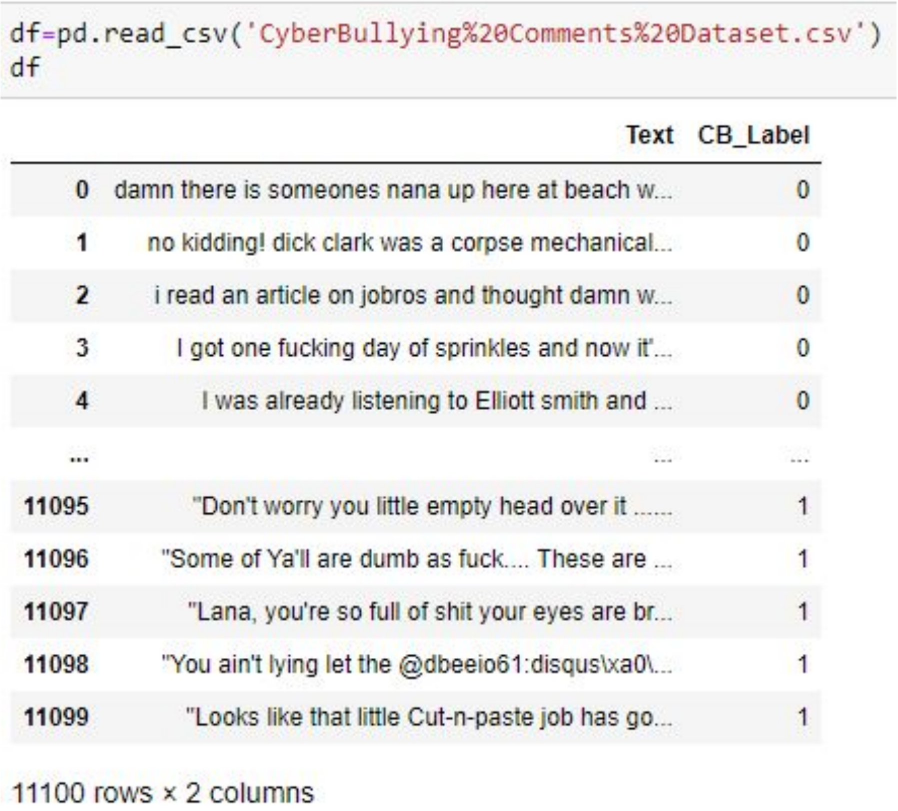
```
api.dataset_list_files('soorajtomar/cyberbullying-tweets').files
```

```
[CyberBullying Comments Dataset.csv]
```

```
api.dataset_download_file('soorajtomar/cyberbullying-tweets','CyberBullying Comments Dataset.csv')
```

```
False
```

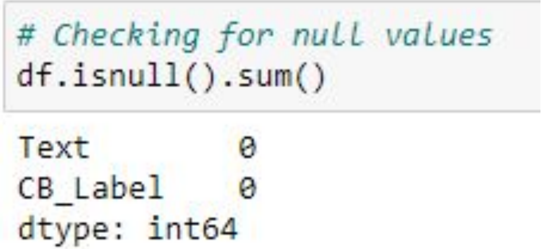
Loading our dataframe



```
df=pd.read_csv('CyberBullying%20Comments%20Dataset.csv')
df
```

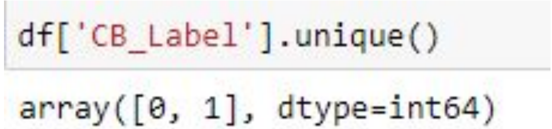
	Text	CB_Label
0	damn there is someones nana up here at beach w...	0
1	no kidding! dick clark was a corpse mechanical...	0
2	i read an article on jobros and thought damn w...	0
3	I got one fucking day of sprinkles and now it'...	0
4	I was already listening to Elliott smith and ...	0
...	...	...
11095	"Don't worry you little empty head over it	1
11096	"Some of Ya'll are dumb as fuck.... These are ...	1
11097	"Lana, you're so full of shit your eyes are br...	1
11098	"You ain't lying let the @dbeeio61:disqus\xa0\...	1
11099	"Looks like that little Cut-n-paste job has go...	1

11100 rows × 2 columns



```
# Checking for null values
df.isnull().sum()
```

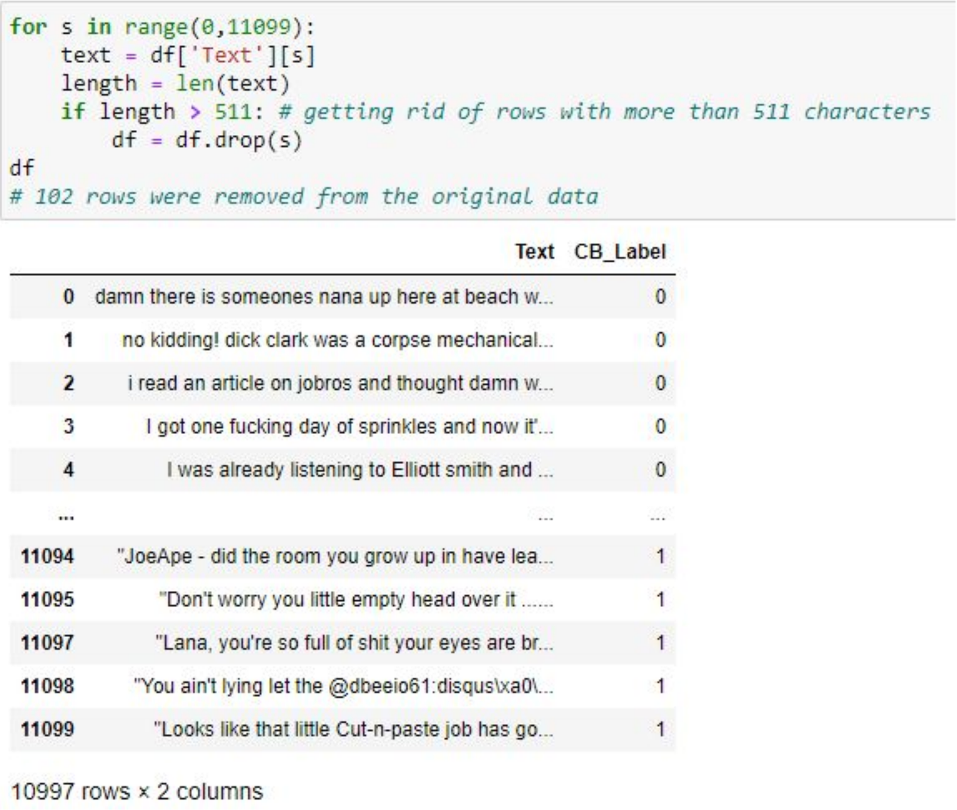
```
Text        0
CB_Label    0
dtype: int64
```



```
df['CB_Label'].unique()
```

```
array([0, 1], dtype=int64)
```

Preparing our dataframe



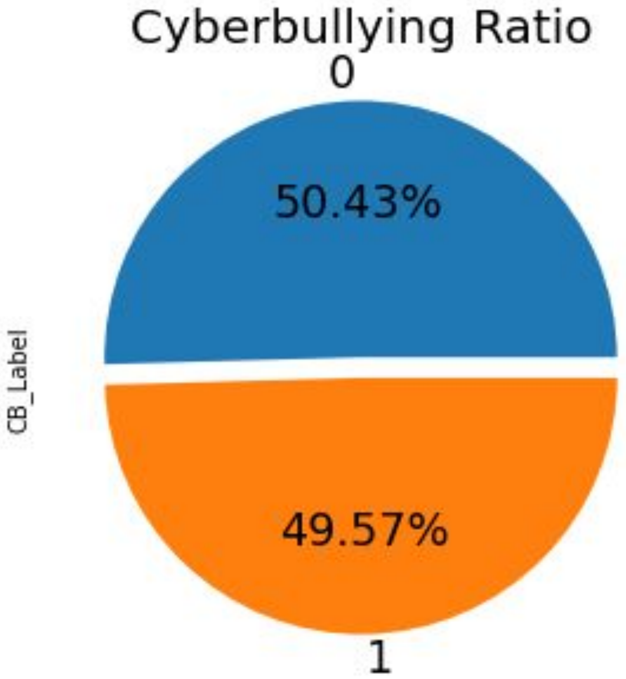
```
for s in range(0,11099):
    text = df['Text'][s]
    length = len(text)
    if length > 511: # getting rid of rows with more than 511 characters
        df = df.drop(s)
df
# 102 rows were removed from the original data
```

	Text	CB_Label
0	damn there is someones nana up here at beach w...	0
1	no kidding! dick clark was a corpse mechanical...	0
2	i read an article on jobros and thought damn w...	0
3	I got one fucking day of sprinkles and now it'...	0
4	I was already listening to Elliott smith and ...	0
...	...	...
11094	"JoeApe - did the room you grow up in have lea...	1
11095	"Don't worry you little empty head over it	1
11097	"Lana, you're so full of shit your eyes are br...	1
11098	"You ain't lying let the @dbeeio61:disqus\xa0\...	1
11099	"Looks like that little Cut-n-paste job has go...	1

10997 rows × 2 columns

We removed tweets which has more than 512 characters as there as is maximum number of characters which the Hugging Face model can tokenize.

Final Dataframe



Our final dataframe shows that the amount of tweets that are classified as cyberbullying and non-cyberbullying are approximately half each, which will lessen the risk of producing biased result.

Model Selection and Training

Model Selection

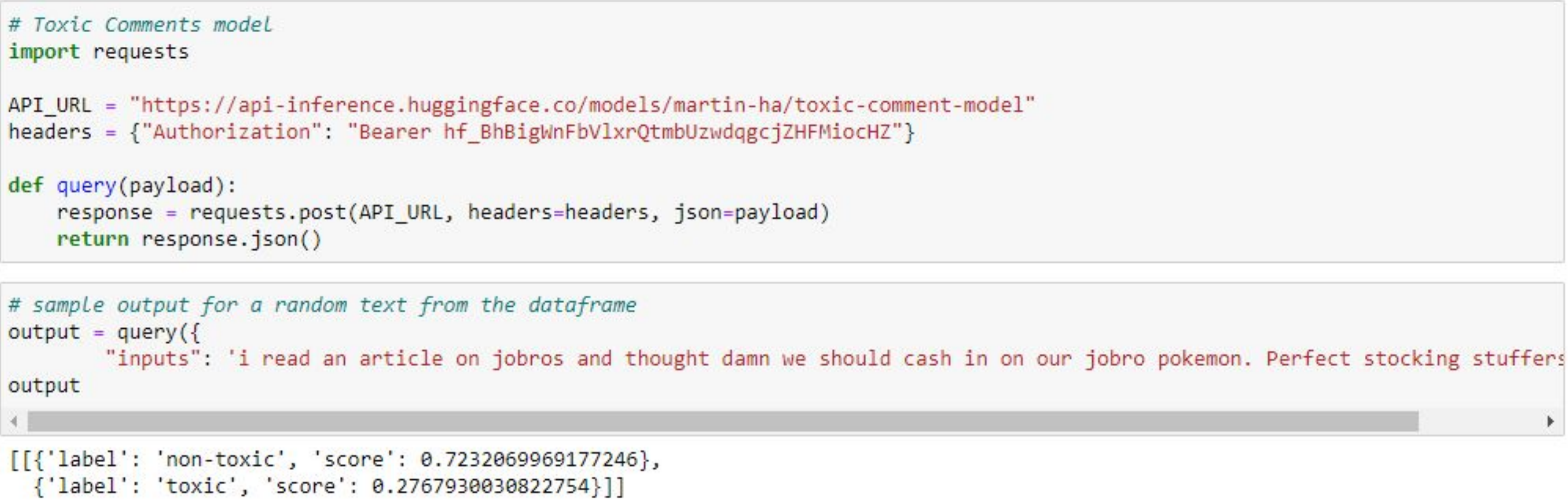
The specific pretrained model ('**toxic comment model**')

- Fine-tuned
- Accuracy of 94%
- Documentations unavailable on their GitHub repository
- Downloaded at least 1 million times in the past month
- Benefit of doubt on their credibility and reliability.

The model classifies text with a toxicity index, meaning that texts will be classified as either toxic or non-toxic based on the score predicted by the model.

Training the model

Calling the model through Hugging Face API and the sample output for a random tweet from the dataframe.



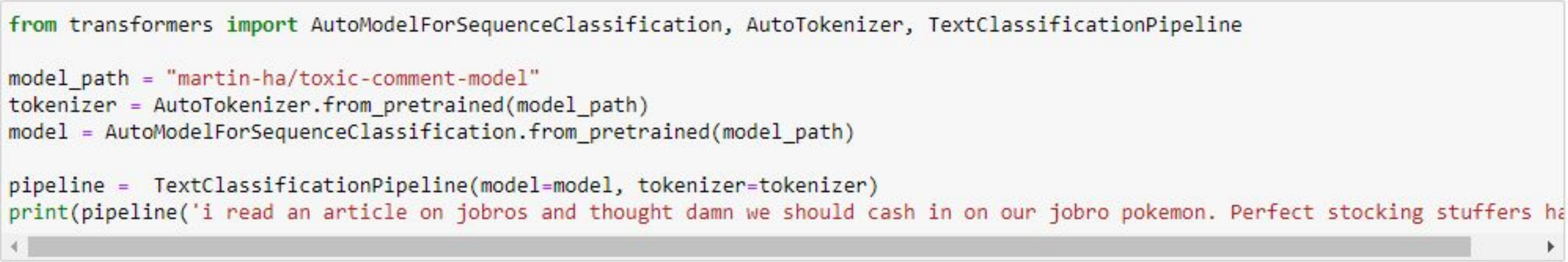
```
# Toxic Comments model
import requests

API_URL = "https://api-inference.huggingface.co/models/martin-ha/toxic-comment-model"
headers = {"Authorization": "Bearer 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"}

def query(payload):
    response = requests.post(API_URL, headers=headers, json=payload)
    return response.json()
```

```
# sample output for a random text from the dataframe
output = query({
        "inputs": 'i read an article on jobros and thought damn we should cash in on our jobro pokemon. Perfect stocking stuffers
output
```

```
[[{'label': 'non-toxic', 'score': 0.7232069969177246},
  {'label': 'toxic', 'score': 0.2767930030822754}]]
```

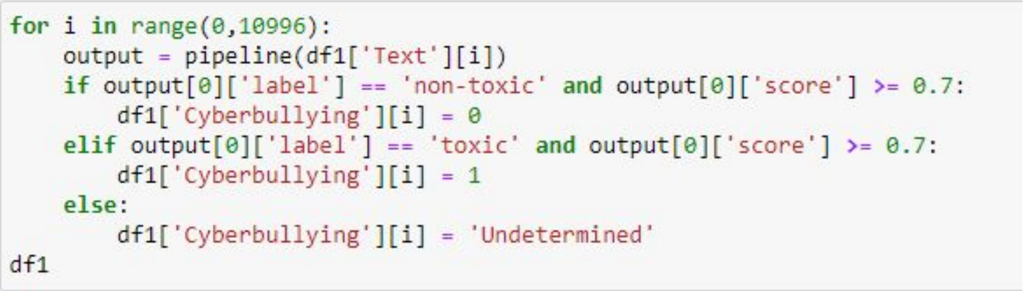
Training the model

However, due to the large dataframe and the limits placed by Hugging Face on its API usage, we imported the model for use directly.

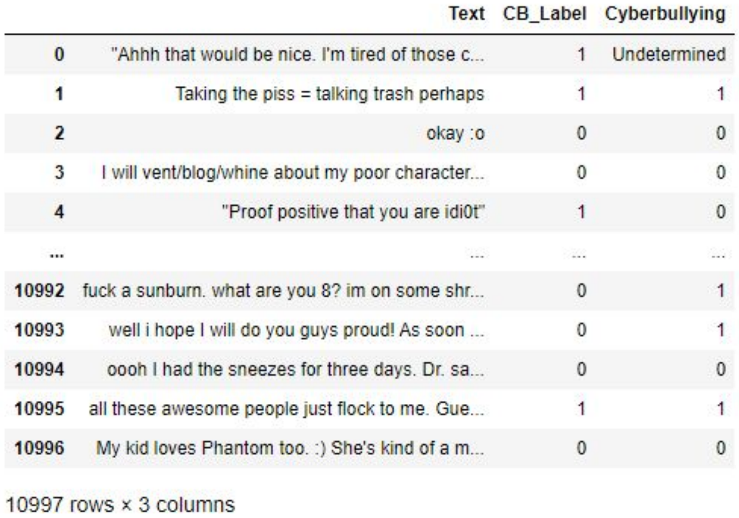


```
from transformers import AutoModelForSequenceClassification, AutoTokenizer, TextClassificationPipeline

model_path = "martin-ha/toxic-comment-model"
tokenizer = AutoTokenizer.from_pretrained(model_path)
model = AutoModelForSequenceClassification.from_pretrained(model_path)

pipeline =  TextClassificationPipeline(model=model, tokenizer=tokenizer)
print(pipeline('i read an article on jobros and thought damn we should cash in on our jobro pokemon. Perfect stocking stuffers ha
```

Training the model



```
for i in range(0,10996):
    output = pipeline(df1['Text'][i])
    if output[0]['label'] == 'non-toxic' and output[0]['score'] >= 0.7:
        df1['Cyberbullying'][i] = 0
    elif output[0]['label'] == 'toxic' and output[0]['score'] >= 0.7:
        df1['Cyberbullying'][i] = 1
    else:
        df1['Cyberbullying'][i] = 'Undetermined'
df1
```



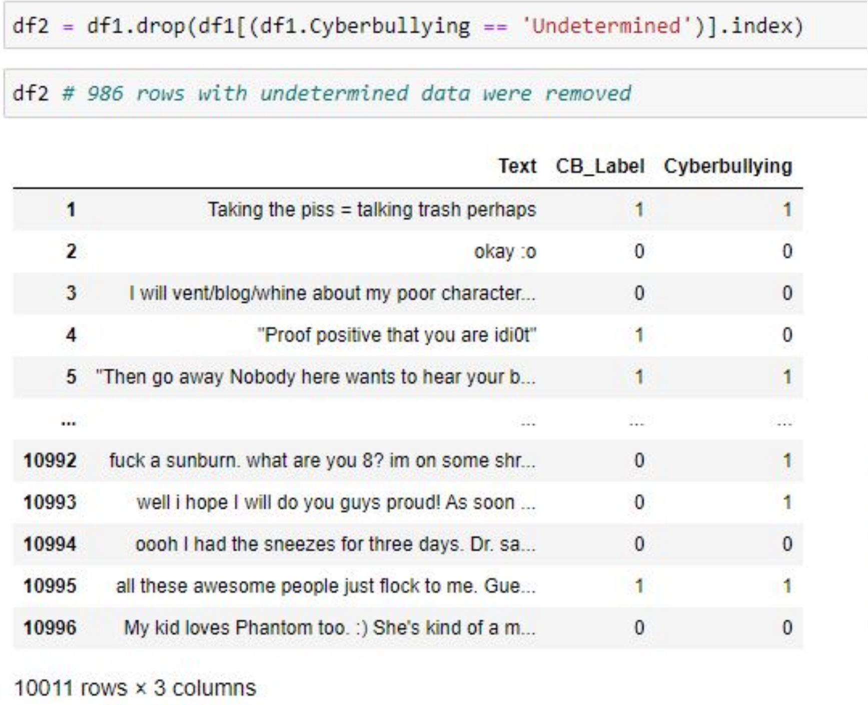
	Text	CB_Label	Cyberbullying
0	"Ahhh that would be nice. I'm tired of those c...	1	Undetermined
1	Taking the piss = talking trash perhaps	1	1
2	okay :o	0	0
3	I will vent/blog/whine about my poor character...	0	0
4	"Proof positive that you are idi0t"	1	0
...	...	...	...
10992	fuck a sunburn. what are you 8? im on some shr...	0	1
10993	well i hope I will do you guys proud! As soon ...	0	1
10994	oooh I had the sneezes for three days. Dr. sa...	0	0
10995	all these awesome people just flock to me. Gue...	1	1
10996	My kid loves Phantom too. :) She's kind of a m...	0	0

10997 rows × 3 columns

We applied the model for all tweets in the data frame to obtain the predicted outcome.

We also placed a score limit of 0.7, meaning that we only accept tweets with a 'non-toxic' or 'toxic' score of 0.7 and above to prevent ambiguous tweets from affecting our predictions. Tweets that do not meet the limit will be classified as 'Undetermined'.

Training the model

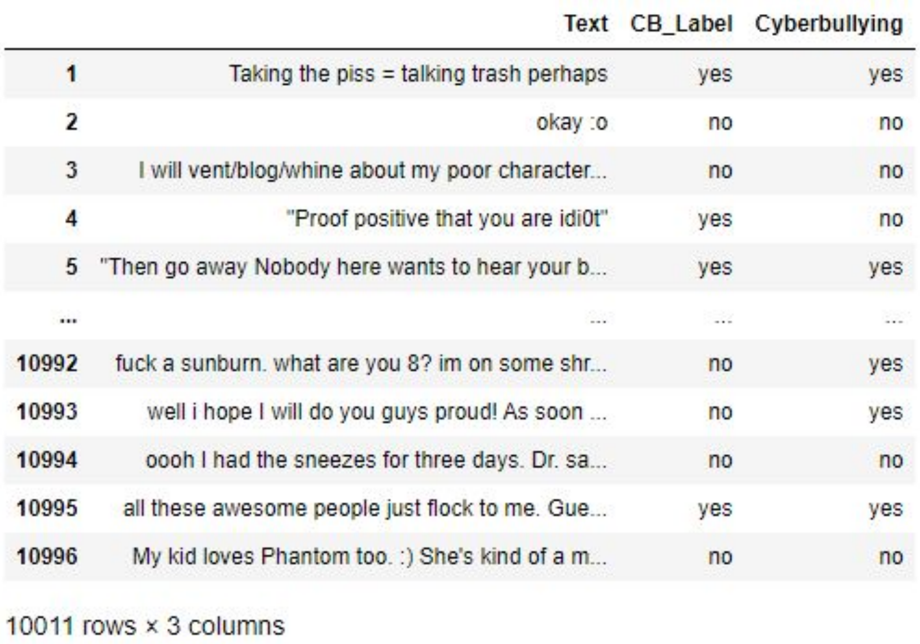


```
df2 = df1.drop(df1[(df1.Cyberbullying == 'Undetermined')].index)
```

```
df2 # 986 rows with undetermined data were removed
```

	Text	CB_Label	Cyberbullying
1	Taking the piss = talking trash perhaps	1	1
2	okay :o	0	0
3	I will vent/blog/whine about my poor character...	0	0
4	"Proof positive that you are idi0t"	1	0
5	"Then go away Nobody here wants to hear your b...	1	1
...	...	...	...
10992	fuck a sunburn. what are you 8? im on some shr...	0	1
10993	well i hope I will do you guys proud! As soon ...	0	1
10994	oooh I had the sneezes for three days. Dr. sa...	0	0
10995	all these awesome people just flock to me. Gue...	1	1
10996	My kid loves Phantom too. :) She's kind of a m...	0	0

10011 rows × 3 columns

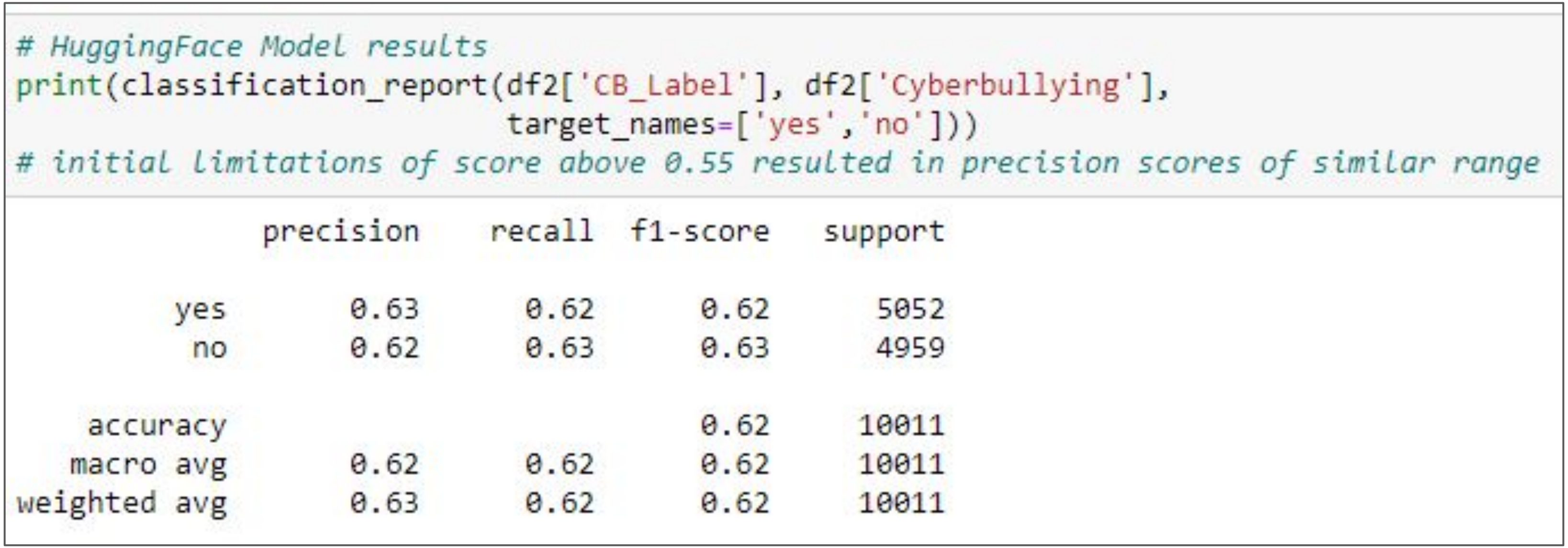


	Text	CB_Label	Cyberbullying
1	Taking the piss = talking trash perhaps	yes	yes
2	okay :o	no	no
3	I will vent/blog/whine about my poor character...	no	no
4	"Proof positive that you are idi0t"	yes	no
5	"Then go away Nobody here wants to hear your b...	yes	yes
...	...	...	...
10992	fuck a sunburn. what are you 8? im on some shr...	no	yes
10993	well i hope I will do you guys proud! As soon ...	no	yes
10994	oooh I had the sneezes for three days. Dr. sa...	no	no
10995	all these awesome people just flock to me. Gue...	yes	yes
10996	My kid loves Phantom too. :) She's kind of a m...	no	no

10011 rows × 3 columns

CB_Label : True data
Cyberbullying : Model predictions

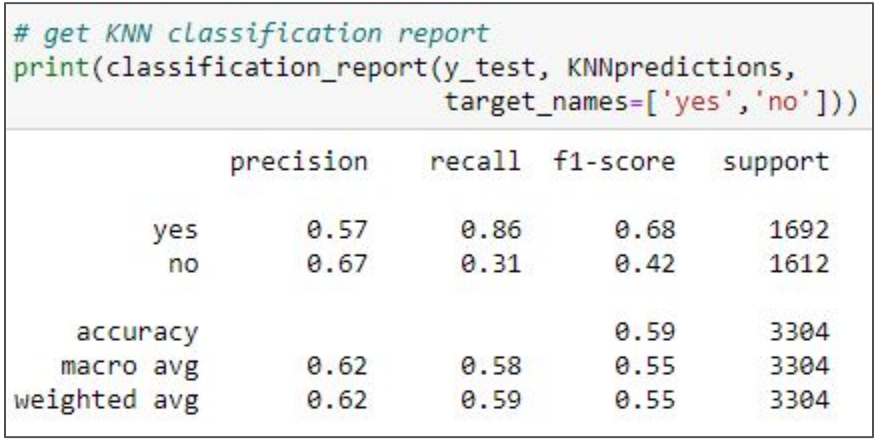
Model Evaluation



```
# HuggingFace Model results
print(classification_report(df2['CB_Label'], df2['Cyberbullying'],
                            target_names=['yes','no']))
# initial limitations of score above 0.55 resulted in precision scores of similar range
```

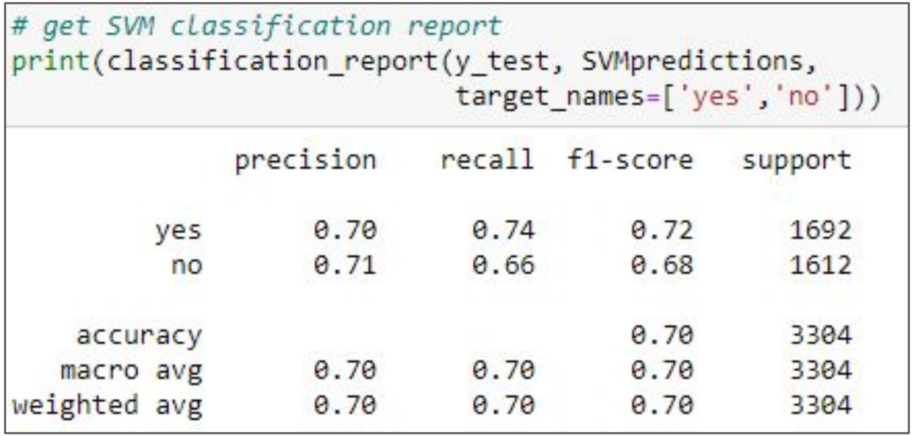
```
              precision    recall  f1-score   support

         yes       0.63      0.62      0.62      5052
          no       0.62      0.63      0.63      4959

    accuracy                           0.62     10011
   macro avg       0.62      0.62      0.62     10011
weighted avg       0.63      0.62      0.62     10011
```

Utilizing other model predictions



```
# get KNN classification report
print(classification_report(y_test, KNNpredictions,
                            target_names=['yes','no']))
```

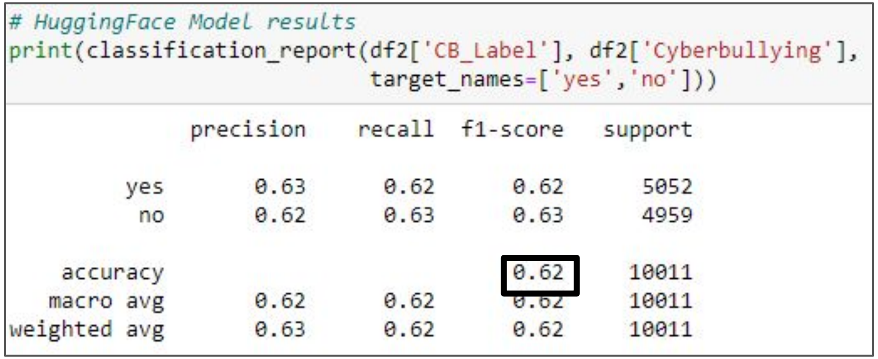
```
              precision    recall  f1-score   support

         yes       0.57      0.86      0.68      1692
          no       0.67      0.31      0.42      1612

    accuracy                           0.59      3304
   macro avg       0.62      0.58      0.55      3304
weighted avg       0.62      0.59      0.55      3304
```



```
# get SVM classification report
print(classification_report(y_test, SVMpredictions,
                            target_names=['yes','no']))
```

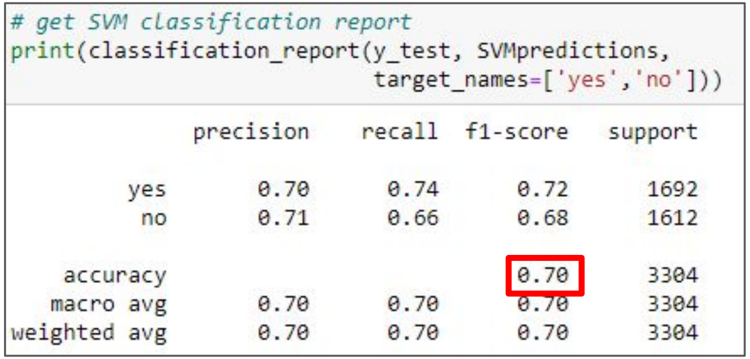
```
              precision    recall  f1-score   support

         yes       0.70      0.74      0.72      1692
          no       0.71      0.66      0.68      1612

    accuracy                           0.70      3304
   macro avg       0.70      0.70      0.70      3304
weighted avg       0.70      0.70      0.70      3304
```

Result Comparison



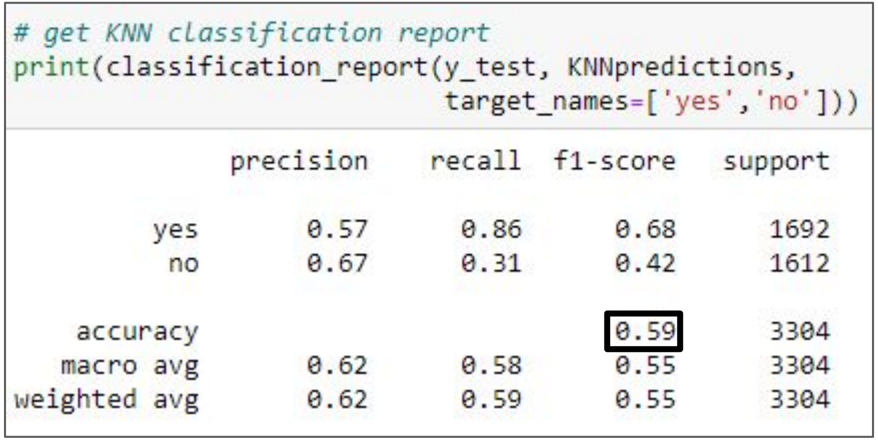
```
# HuggingFace Model results
print(classification_report(df2['CB_Label'], df2['Cyberbullying'],
                            target_names=['yes','no']))
```

```
              precision    recall  f1-score   support

         yes       0.63      0.62      0.62      5052
          no       0.62      0.63      0.63      4959

    accuracy                           0.62     10011
   macro avg       0.62      0.62      0.62     10011
weighted avg       0.63      0.62      0.62     10011
```



```
# get SVM classification report
print(classification_report(y_test, SVMpredictions,
                            target_names=['yes','no']))
```

```
              precision    recall  f1-score   support

         yes       0.70      0.74      0.72      1692
          no       0.71      0.66      0.68      1612

    accuracy                           0.70      3304
   macro avg       0.70      0.70      0.70      3304
weighted avg       0.70      0.70      0.70      3304
```

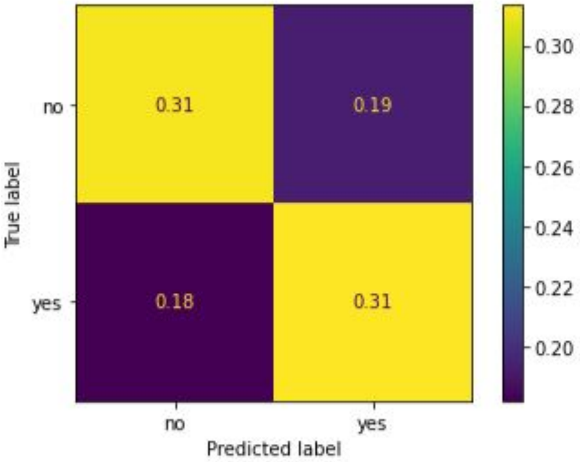


```
# get KNN classification report
print(classification_report(y_test, KNNpredictions,
                            target_names=['yes','no']))
```

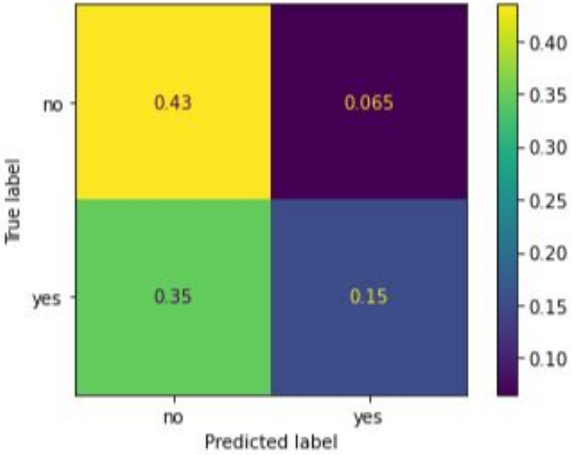
```
              precision    recall  f1-score   support

         yes       0.57      0.86      0.68      1692
          no       0.67      0.31      0.42      1612

    accuracy                           0.59      3304
   macro avg       0.62      0.58      0.55      3304
weighted avg       0.62      0.59      0.55      3304
```

We can see from the results that SVM has an overall higher accuracy score as compared to the KNN and the Hugging Face model.

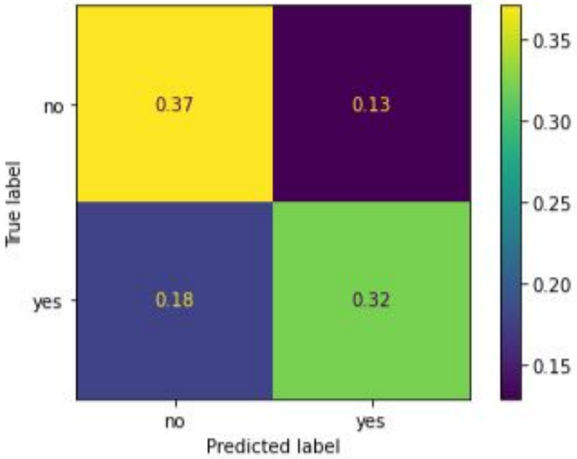
Result Comparison



Hugging Face



KNN



SVM

Based on the confusion matrix, SVM has an overall higher precision as compared to the KNN and the Hugging Face model.

Results and Discussion

Results & Discussion

Model	**Accuracy**
Hugging Face	0.63
KNN	0.59
SVM	**0.69**

SVM seems to be a better model for prediction compared to the Hugging Face model.

One of the limitations of the model that is mentioned by the author is that it performs poorly for some comments that mention a specific identity subgroup, such as Muslim.

Another reason for the poor performance might be due to evolution of linguistics as well as the usage of internet slang on social media platforms. The current Hugging Face model might not have enough pre-trained data as well as dictionaries on the use of internet slang to be able to accurately predict whether the tweet is considered to be cyberbullying or not.

Implications

Propose to be used for user management on social media platforms

- Model helps to distinguish cyberbullies on platform
- Analyze whether majority of posts from the person is toxic
- Restrict usage of the person

Constantly reviewing and updating the prediction model through the online community, allows us to create a more accurate model which we can even use it to demonstrate to legislation the usefulness of AI as a tool in the law making process.

Enacting relevant laws on cyberbullying will help in maintaining social order as internet users would be more self-conscious while posting, commenting, or messaging using online platforms. However, in order to implement this, it is important to abolish network anonymity so that the identity of cyberbullies are not hidden.

With this, netizens are accountable for their actions online and practise caution while using the internet.

Conclusion and Future Work

Main Takeaways

- Current Natural Language Processing models might not work well with social media platforms
- Understand the pre-trained model and their limitations
- Investigate which data the pre-trained model had used for training

In our case, we hypothesized that the Hugging Face did not have training data which consists of internet slang.

Hence the pre-trained model is unable to accurately predict whether the comment is considered to be cyberbullying or not.

Potential Future Directions

In other to strengthen Natural Language Processing models,

- Develop a dictionary for internet slang
- Constantly update the dictionary

so that more models can be utilize the dictionary for more accurate results and predictions.

Additionally, we should not blindly trust pre-trained models available on Hugging Face to be entirely accurate. It is important to be able to ascertain the strengths and weaknesses of the models.

When working with pre-trained models, we should cross check our own models with the pre-trained models from Hugging Face and compare their predictions and accuracies. The ultimate goal is to figure out the optimal model which best fits a specific dataset.

References

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