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colab.research.google.com/drive/15SVUFWYaRA2AEvm88vMNQUVRldKOZXpD#scrollTo=qE6HwNkgOu7U

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```
import pandas as pd
import re
from bs4 import BeautifulSoup
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, precision_score, accuracy_score
from sklearn.naive_bayes import GaussianNB
from sklearn.preprocessing import StandardScaler
from sentence_transformers import SentenceTransformer, util
from transformers import pipeline, DistilBertTokenizerFast, DistilBertForSequenceClassification
import torch
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[ ]

```
# 1. Load your dataset
df = pd.read_csv("headlines.csv")
```

[ ]

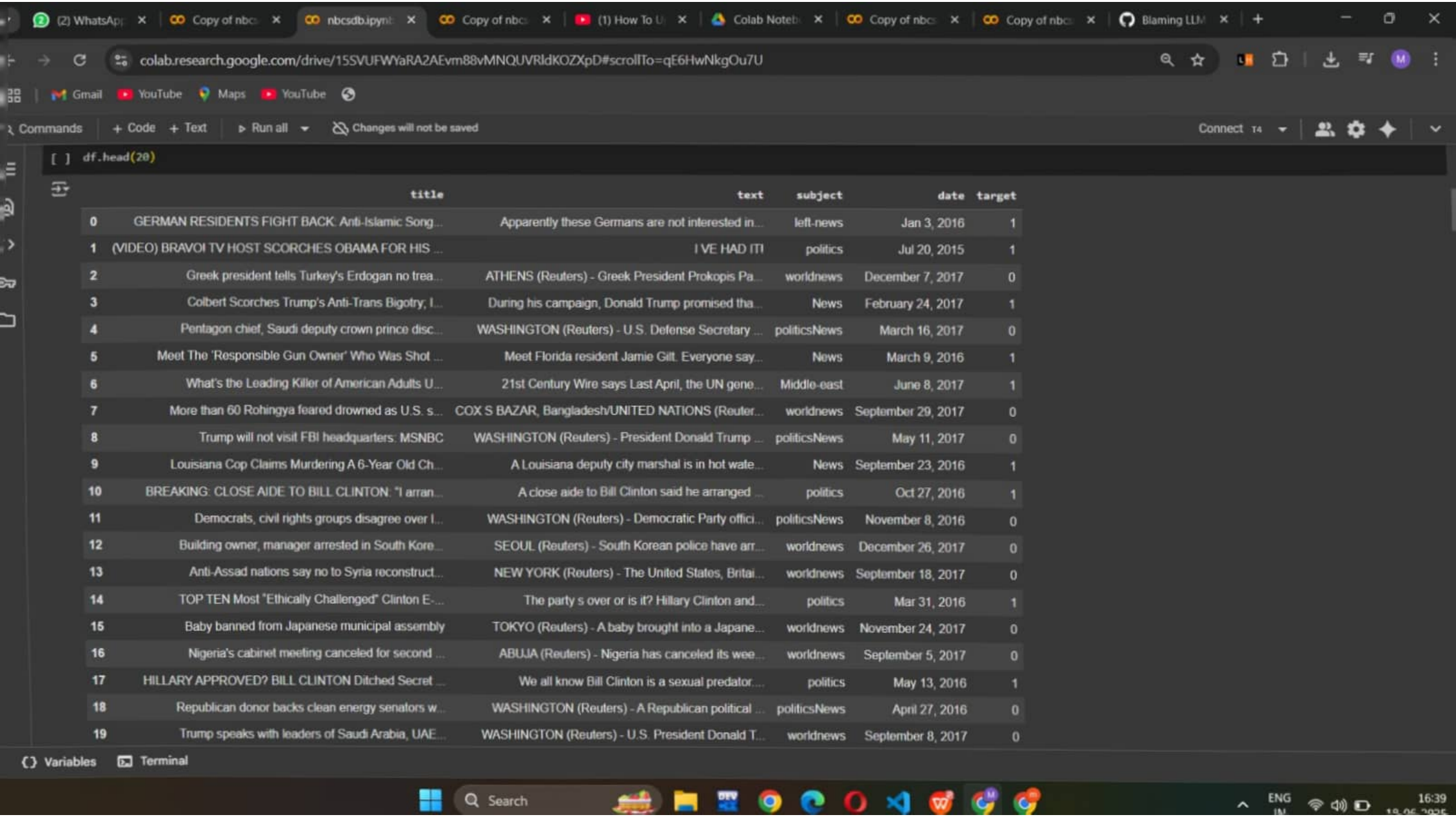
```
# 2. Clean and preprocess text
def clean_text(text):
    text = str(text)
    text = re.sub(r"http\S+|www\S+|https\S+", "", text, flags=re.MULTILINE)
    text = BeautifulSoup(text, "html.parser").get_text()
    text = re.sub(r'\[[^\]]*\]', '', text)
    text = re.sub(r'\s+', ' ', text)
    return text.strip()
```

[ ]

```
df['text'] = df['text'].apply(clean_text)
df['title'] = df['title'].apply(clean_text)
```

Variables Terminal

Search ENG 16:39



	title	text	subject	date	target
0	GERMAN RESIDENTS FIGHT BACK: Anti-Islamic Song...	Apparently these Germans are not interested in...	left-news	Jan 3, 2016	1
1	(VIDEO) BRAVO! TV HOST SCORCHES OBAMA FOR HIS ...	I'VE HAD IT!	politics	Jul 20, 2015	1
2	Greek president tells Turkey's Erdogan no trea...	ATHENS (Reuters) - Greek President Prokopis Pa...	worldnews	December 7, 2017	0
3	Colbert Scorches Trump's Anti-Trans Bigotry; I...	During his campaign, Donald Trump promised tha...	News	February 24, 2017	1
4	Pentagon chief, Saudi deputy crown prince disc...	WASHINGTON (Reuters) - U.S. Defense Secretary ...	politicsNews	March 16, 2017	0
5	Meet The 'Responsible Gun Owner' Who Was Shot ...	Meet Florida resident Jamie Gilt. Everyone say...	News	March 9, 2016	1
6	What's the Leading Killer of American Adults U...	21st Century Wire says Last April, the UN gene...	Middle-east	June 8, 2017	1
7	More than 60 Rohingya feared drowned as U.S. s...	COX'S BAZAR, Bangladesh/UNITED NATIONS (Reuter...	worldnews	September 29, 2017	0
8	Trump will not visit FBI headquarters: MSNBC	WASHINGTON (Reuters) - President Donald Trump ...	politicsNews	May 11, 2017	0
9	Louisiana Cop Claims Murdering A 6-Year Old Ch...	A Louisiana deputy city marshal is in hot wate...	News	September 23, 2016	1
10	BREAKING: CLOSE AIDE TO BILL CLINTON: "I arran...	A close aide to Bill Clinton said he arranged ...	politics	Oct 27, 2016	1
11	Democrats, civil rights groups disagree over l...	WASHINGTON (Reuters) - Democratic Party offici...	politicsNews	November 8, 2016	0
12	Building owner, manager arrested in South Kore...	SEOUL (Reuters) - South Korean police have arr...	worldnews	December 26, 2017	0
13	Anti-Assad nations say no to Syria reconstruct...	NEW YORK (Reuters) - The United States, Britai...	worldnews	September 18, 2017	0
14	TOP TEN Most "Ethically Challenged" Clinton E-...	The party's over or is it? Hillary Clinton and...	politics	Mar 31, 2016	1
15	Baby banned from Japanese municipal assembly	TOKYO (Reuters) - A baby brought into a Japane...	worldnews	November 24, 2017	0
16	Nigeria's cabinet meeting canceled for second ...	ABUJA (Reuters) - Nigeria has canceled its wee...	worldnews	September 5, 2017	0
17	HILLARY APPROVED? BILL CLINTON Ditched Secret ...	We all know Bill Clinton is a sexual predator....	politics	May 13, 2016	1
18	Republican donor backs clean energy senators w...	WASHINGTON (Reuters) - A Republican political ...	politicsNews	April 27, 2016	0
19	Trump speaks with leaders of Saudi Arabia, UAE...	WASHINGTON (Reuters) - U.S. President Donald T...	worldnews	September 8, 2017	0

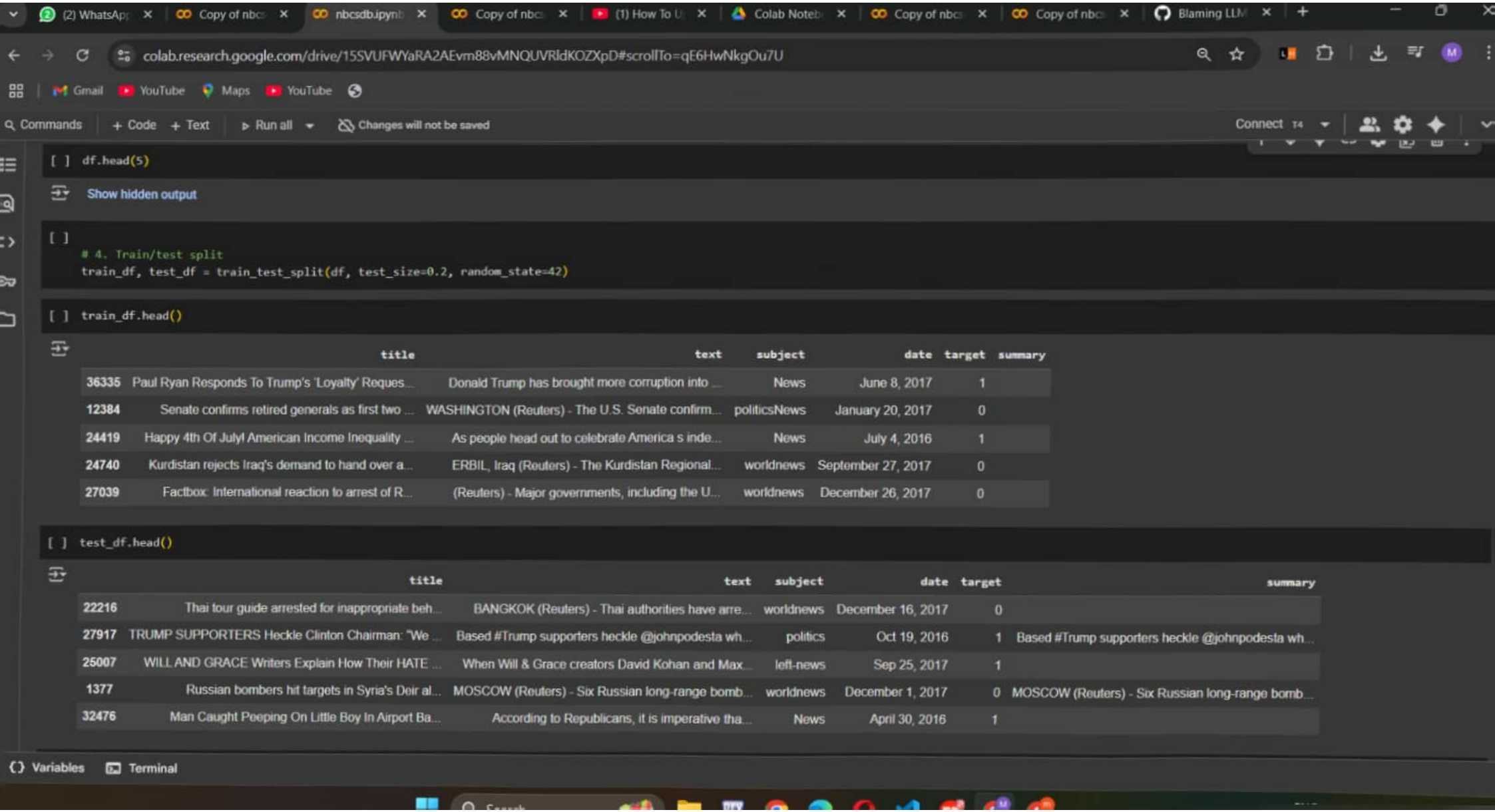
```
[ ] df = df.sample(frac=1, random_state=42).reset_index(drop=True)
```

```
import torch

# 3. Summarize articles using BART
summarizer = pipeline("summarization", model="sshleifer/distilbart-cnn-12-6", device=-1 if not torch.cuda.is_available() else 0) # Force CPU if GPU is not available
# Define summarize function
def summarize(text):
    # Adjust max_length to avoid exceeding model's input limit
    max_tokens = 512  # Adjust as per model's limitations, default is 1024
    text_tokens = text.split()
    if len(text_tokens) < 130:
        return text
    truncated_text = " ".join(text_tokens[:max_tokens]) # Truncate long texts
    # Handle potential errors using try-except
    try:
        return summarizer(truncated_text, max_length=130, min_length=30 , do_sample=False)[0]['summary_text']
    except RuntimeError as e:
        # print(f"Error summarizing: {e}, Text: {text[:50]}")
        return "" # or some default value
```

```
Device set to use cuda:0
```

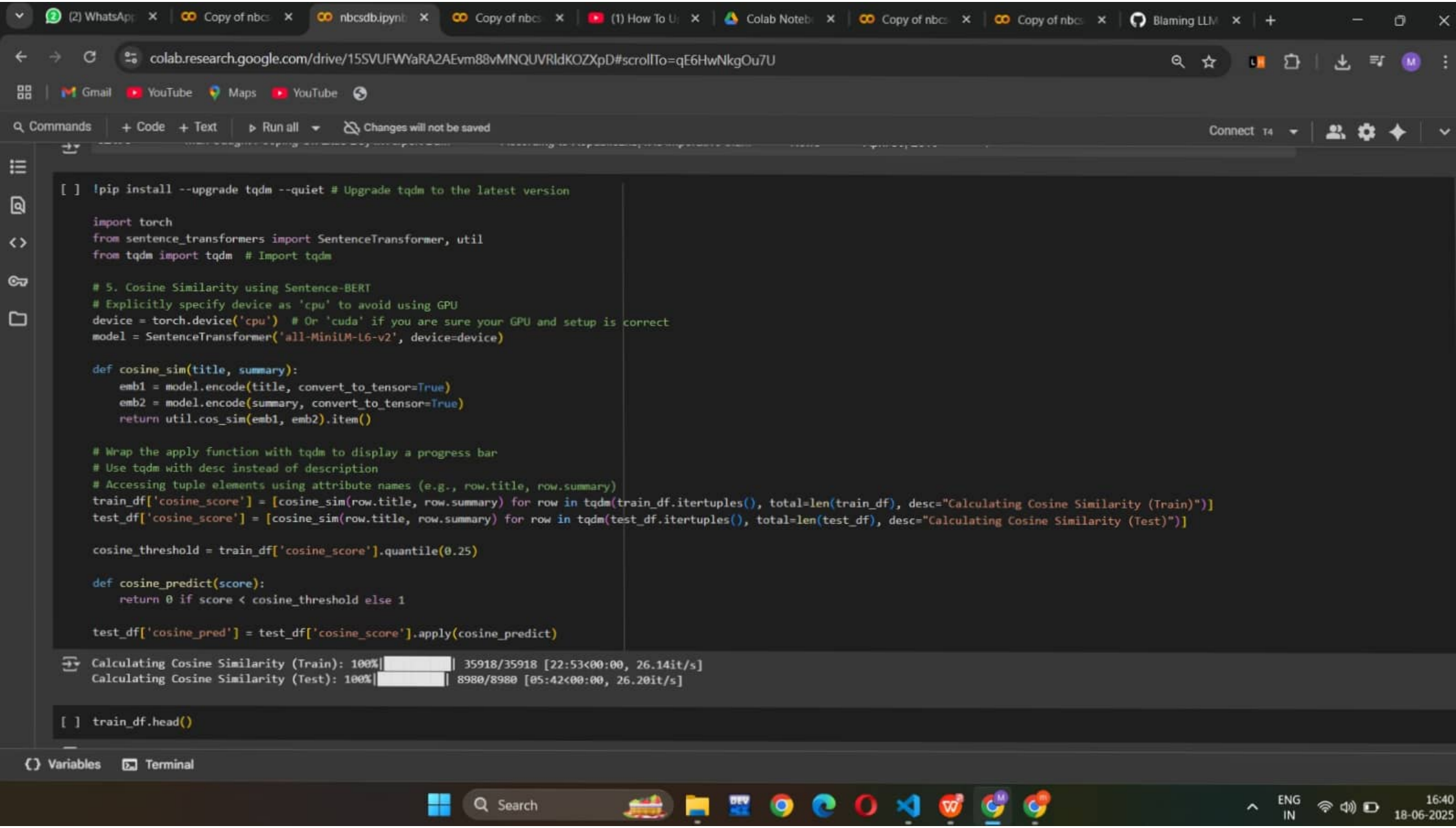
```
from tqdm.notebook import tqdm
import pandas as pd # Import pandas if not already imported
# Apply tqdm to pandas to allow for progress bar in df.apply
tqdm.pandas()

df['summary'] = df['text'].progress_apply(summarize)
```

```
100% 44898/44898 [10:25<00:00, 520.43it/s]
Token indices sequence length is longer than the specified maximum sequence length for this model (1048 > 1024). Running this sequence through the model will result in indexing errors
```



	title	text	subject	date	target	summary
36335	Paul Ryan Responds To Trump's 'Loyalty' Reques...	Donald Trump has brought more corruption into ...	News	June 8, 2017	1	
12384	Senate confirms retired generals as first two ...	WASHINGTON (Reuters) - The U.S. Senate confirm...	politicsNews	January 20, 2017	0	
24419	Happy 4th Of July! American Income Inequality ...	As people head out to celebrate America s inde...	News	July 4, 2016	1	
24740	Kurdistan rejects Iraq's demand to hand over a...	ERBIL, Iraq (Reuters) - The Kurdistan Regional...	worldnews	September 27, 2017	0	
27039	Factbox: International reaction to arrest of R...	(Reuters) - Major governments, including the U...	worldnews	December 26, 2017	0	

	title	text	subject	date	target	summary
22216	Thai tour guide arrested for inappropriate beh...	BANGKOK (Reuters) - Thai authorities have arre...	worldnews	December 16, 2017	0	
27917	TRUMP SUPPORTERS Heckle Clinton Chairman: "We ...	Based #Trump supporters heckle @johnpodesta wh...	politics	Oct 19, 2016	1	Based #Trump supporters heckle @johnpodesta wh...
25007	WILL AND GRACE Writers Explain How Their HATE ...	When Will & Grace creators David Kohan and Max...	left-news	Sep 25, 2017	1	
1377	Russian bombers hit targets in Syria's Deir al...	MOSCOW (Reuters) - Six Russian long-range bomb...	worldnews	December 1, 2017	0	MOSCOW (Reuters) - Six Russian long-range bomb...
32476	Man Caught Peeping On Little Boy In Airport Ba...	According to Republicans, it is imperative tha...	News	April 30, 2016	1	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Maps
YouTube
Commands
+ Code
+ Text
Run all
Changes will not be saved
Connect T4
[ ] !pip install --upgrade tqdm --quiet # Upgrade tqdm to the latest version
import torch
from sentence_transformers import SentenceTransformer, util
from tqdm import tqdm # Import tqdm
# 5. Cosine Similarity using Sentence-BERT
# Explicitly specify device as 'cpu' to avoid using GPU
device = torch.device('cpu') # Or 'cuda' if you are sure your GPU and setup is correct
model = SentenceTransformer('all-MiniLM-L6-v2', device=device)
def cosine_sim(title, summary):
emb1 = model.encode(title, convert_to_tensor=True)
emb2 = model.encode(summary, convert_to_tensor=True)
return util.cos_sim(emb1, emb2).item()
Wrap the apply function with tqdm to display a progress bar
Use tqdm with desc instead of description
Accessing tuple elements using attribute names (e.g., row.title, row.summary)
train_df['cosine_score'] = [cosine_sim(row.title, row.summary) for row in tqdm(train_df.itertuples(), total=len(train_df), desc="Calculating Cosine Similarity (Train)")]
test_df['cosine_score'] = [cosine_sim(row.title, row.summary) for row in tqdm(test_df.itertuples(), total=len(test_df), desc="Calculating Cosine Similarity (Test)")]
cosine_threshold = train_df['cosine_score'].quantile(0.25)
def cosine_predict(score):
return 0 if score < cosine_threshold else 1
test_df['cosine_pred'] = test_df['cosine_score'].apply(cosine_predict)
Calculating Cosine Similarity (Train): 100%| | 35918/35918 [22:53<00:00, 26.14it/s]
Calculating Cosine Similarity (Test): 100%| | 8980/8980 [05:42<00:00, 26.20it/s]
[ ] train_df.head()
Variables
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```
[ ] train_df.head()
```

	title	text	subject	date	target	summary	cosine_score
36335	Paul Ryan Responds To Trump's 'Loyalty' Reques...	Donald Trump has brought more corruption into ...	News	June 8, 2017	1		0.140484
12384	Senate confirms retired generals as first two ...	WASHINGTON (Reuters) - The U.S. Senate confirm...	politicsNews	January 20, 2017	0		-0.017588
24419	Happy 4th Of July! American Income Inequality ...	As people head out to celebrate America s inde...	News	July 4, 2016	1		0.068606
24740	Kurdistan rejects Iraq's demand to hand over a...	ERBIL, Iraq (Reuters) - The Kurdistan Regional...	worldnews	September 27, 2017	0		0.026520
27039	Factbox: International reaction to arrest of R...	(Reuters) - Major governments, including the U...	worldnews	December 26, 2017	0		0.063258

```
[ ] test_df.head()
```

	title	text	subject	date	target	summary	cosine_score	cosine_pred
22216	Thai tour guide arrested for inappropriate beh...	BANGKOK (Reuters) - Thai authorities have arre...	worldnews	December 16, 2017	0		0.026702	0
27917	TRUMP SUPPORTERS Heckle Clinton Chairman: "We ...	Based #Trump supporters heckle @johnpodesta wh...	politics	Oct 19, 2016	1	Based #Trump supporters heckle @johnpodesta wh...	0.744555	1
25007	WILL AND GRACE Writers Explain How Their HATE ...	When Will & Grace creators David Kohan and Max...	left-news	Sep 25, 2017	1		0.084517	1
1377	Russian bombers hit targets in Syria's Deir al...	MOSCOW (Reuters) - Six Russian long-range bomb...	worldnews	December 1, 2017	0	MOSCOW (Reuters) - Six Russian long-range bomb...	0.815389	1
32476	Man Caught Peeping On Little Boy In Airport Ba...	According to Republicans, it is imperative tha...	News	April 30, 2016	1		0.067392	1

```
[ ] print(cosine_threshold)
```

```
0.05056632962077856
```

Variables Terminal

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```
# 6. Naive Bayes similarity using embedding diff
train_diff = train_df.apply(lambda row: model.encode(row['title']) - model.encode(row['summary']), axis=1)
test_diff = test_df.apply(lambda row: model.encode(row['title']) - model.encode(row['summary']), axis=1)

X_train_nb = np.vstack(train_diff.values)
X_test_nb = np.vstack(test_diff.values)
y_train_nb = train_df['target'].astype(int)
y_test_nb = test_df['target'].astype(int)

scaler = StandardScaler()
X_train_nb_scaled = scaler.fit_transform(X_train_nb)
X_test_nb_scaled = scaler.transform(X_test_nb)

nb_model = GaussianNB()
nb_model.fit(X_train_nb_scaled, y_train_nb)
nb_pred = nb_model.predict(X_test_nb_scaled)
```

[ ]

```
# 7. DistilBERT for sequence classification
checkpoint = "distilbert-base-uncased-finetuned-sst-2-english"
tokenizer = DistilBertTokenizerFast.from_pretrained(checkpoint)
bert_model = DistilBertForSequenceClassification.from_pretrained(checkpoint)

def predict_distilbert(title, summary):
    inputs = tokenizer(title, summary, return_tensors="pt", truncation=True, padding=True)
    with torch.no_grad():
        outputs = bert_model(**inputs)
    logits = outputs.logits
    return torch.argmax(logits, dim=1).item()

test_df['distilbert_pred'] = test_df.apply(lambda row: predict_distilbert(row['title'], row['summary']), axis=1)
```

Variables Terminal

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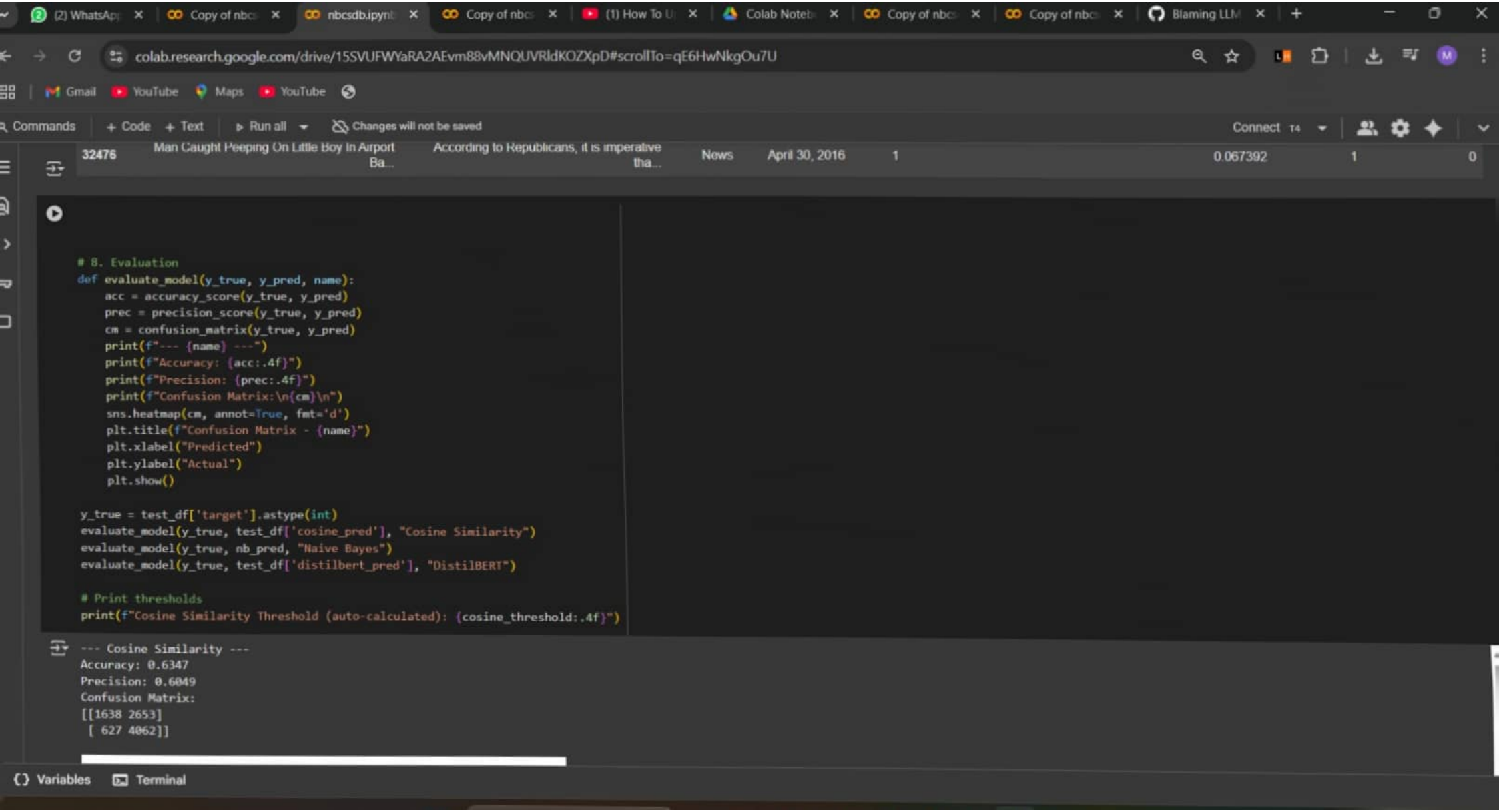
colab.research.google.com/drive/15SVUFWYaRA2AEvm88vMNQUVRldKOZXpD#scrollTo=qE6HwNkgOu7U
Commands
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Run all
Changes will not be saved
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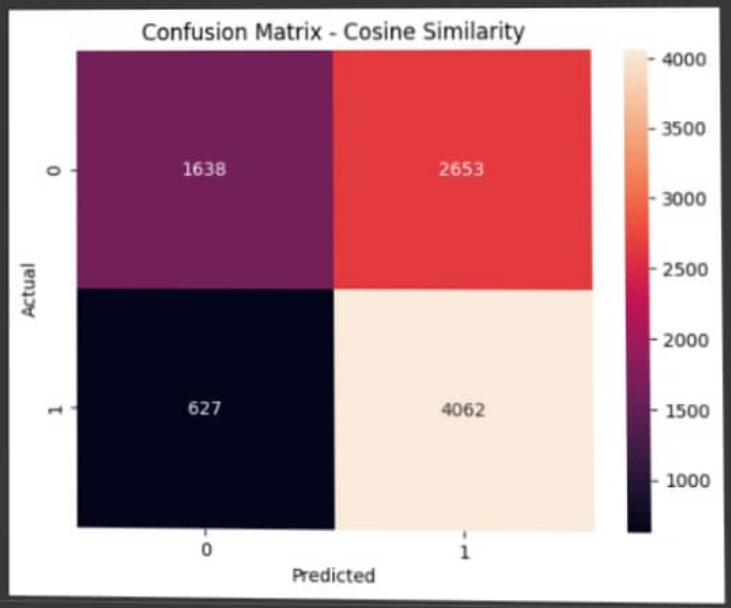
32476 Man Caught Peeping On Little Boy In Airport Ba... According to Republicans, it is imperative tha... News April 30, 2016 1 0.067392 1 0
# 8. Evaluation
def evaluate_model(y_true, y_pred, name):
acc = accuracy_score(y_true, y_pred)
prec = precision_score(y_true, y_pred)
cm = confusion_matrix(y_true, y_pred)
print(f"--- {name} ---")
print(f"Accuracy: {acc:.4f}")
print(f"Precision: {prec:.4f}")
print(f"Confusion Matrix:\n{cm}\n")
sns.heatmap(cm, annot=True, fmt='d')
plt.title(f"Confusion Matrix - {name}")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.show()
y_true = test_df['target'].astype(int)
evaluate_model(y_true, test_df['cosine_pred'], "Cosine Similarity")
evaluate_model(y_true, nb_pred, "Naive Bayes")
evaluate_model(y_true, test_df['distilbert_pred'], "DistilBERT")
# Print thresholds
print(f"Cosine Similarity Threshold (auto-calculated): {cosine_threshold:.4f}")
--- Cosine Similarity ---
Accuracy: 0.6347
Precision: 0.6049
Confusion Matrix:
[[1638 2653]
[627 4062]]
Variables
Terminal

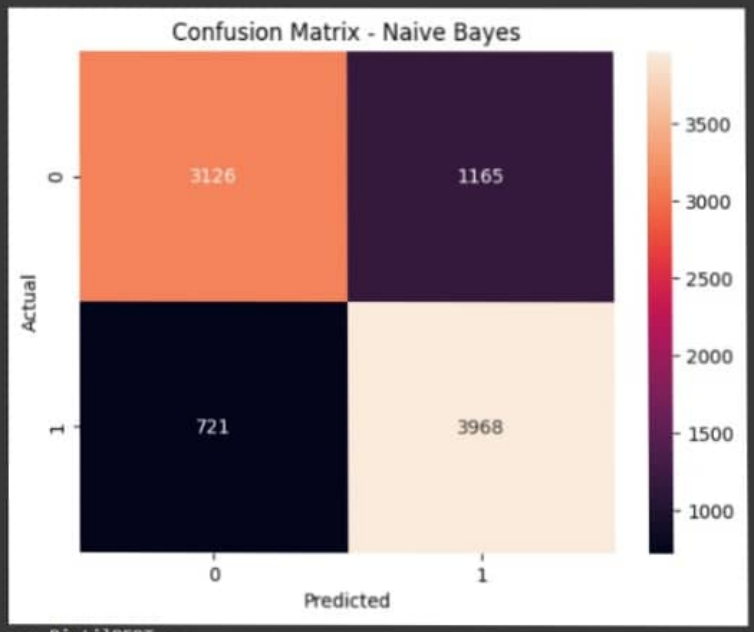
```
evaluate_model(y_true, nb_pred, "Naive Bayes")
evaluate_model(y_true, test_df['distilbert_pred'], "DistilBERT")

# Print thresholds
print(f"Cosine Similarity Threshold (auto-calculated): {cosine_threshold:.4f}")
```

```
--- Cosine Similarity ---
Accuracy: 0.6347
Precision: 0.6049
Confusion Matrix:
[[1638 2653]
 [ 627 4062]]
```

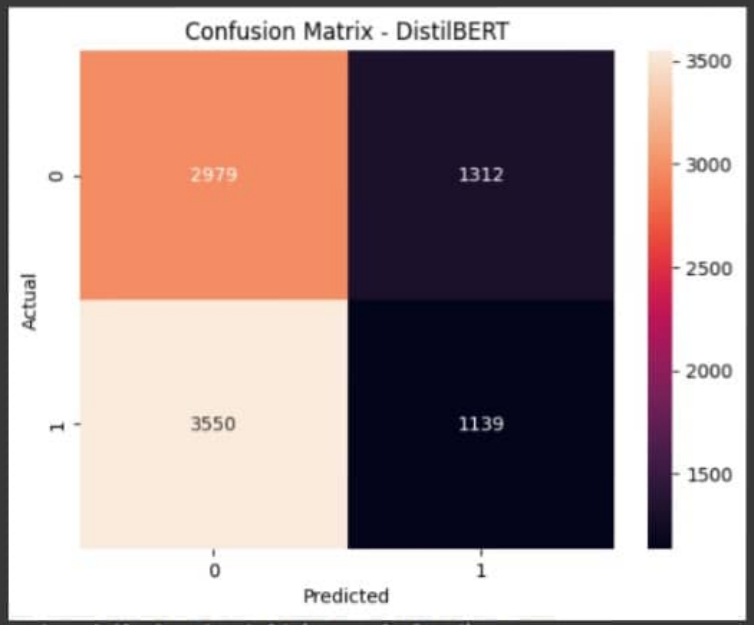


```
--- Naive Bayes ---
Accuracy: 0.7900
Precision: 0.7730
Confusion Matrix:
[[3126 1165]
 [ 721 3968]]
```



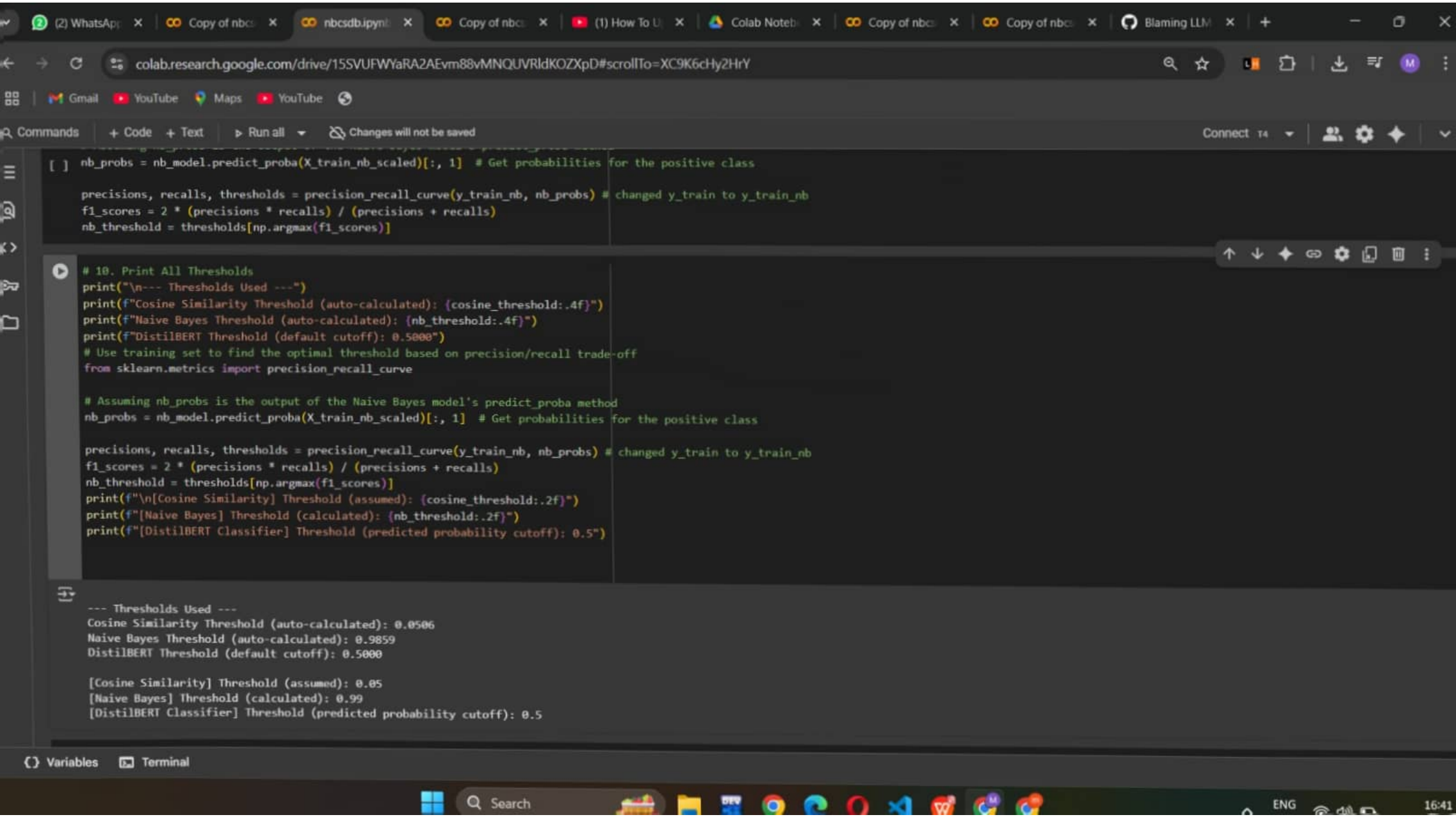

```
--- DistilBERT ---
Accuracy: 0.4586
Precision: 0.4647
Confusion Matrix:
[[2979 1312]
```


```
--- DistilBERT ---
Accuracy: 0.4586
Precision: 0.4647
Confusion Matrix:
[[2979 1312]
 [3550 1139]]
```




```
Cosine Similarity Threshold (auto-calculated): 0.0506
```

```
# Use training set to find the optimal threshold based on precision/recall trade-off
from sklearn.metrics import precision_recall_curve
```


colab.research.google.com/drive/15SVUFWYaRA2AEvm88vMNQUVRldKOZXpD#scrollTo=XC9K6cHy2HrY
Commands
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nb_probs = nb_model.predict_proba(X_train_nb_scaled)[:, 1] # Get probabilities for the positive class
precisions, recalls, thresholds = precision_recall_curve(y_train_nb, nb_probs) # changed y_train to y_train_nb
f1_scores = 2 * (precisions * recalls) / (precisions + recalls)
nb_threshold = thresholds[np.argmax(f1_scores)]
# 10. Print All Thresholds
print("\n--- Thresholds Used ---")
print(f"Cosine Similarity Threshold (auto-calculated): {cosine_threshold:.4f}")
print(f"Naive Bayes Threshold (auto-calculated): {nb_threshold:.4f}")
print(f"DistilBERT Threshold (default cutoff): 0.5000")
# Use training set to find the optimal threshold based on precision/recall trade-off
from sklearn.metrics import precision_recall_curve
# Assuming nb_probs is the output of the Naive Bayes model's predict_proba method
nb_probs = nb_model.predict_proba(X_train_nb_scaled)[:, 1] # Get probabilities for the positive class
precisions, recalls, thresholds = precision_recall_curve(y_train_nb, nb_probs) # changed y_train to y_train_nb
f1_scores = 2 * (precisions * recalls) / (precisions + recalls)
nb_threshold = thresholds[np.argmax(f1_scores)]
print(f"\n[Cosine Similarity] Threshold (assumed): {cosine_threshold:.2f}")
print(f"[Naive Bayes] Threshold (calculated): {nb_threshold:.2f}")
print(f"[DistilBERT Classifier] Threshold (predicted probability cutoff): 0.5")
--- Thresholds Used ---
Cosine Similarity Threshold (auto-calculated): 0.0506
Naive Bayes Threshold (auto-calculated): 0.9859
DistilBERT Threshold (default cutoff): 0.5000
[Cosine Similarity] Threshold (assumed): 0.05
[Naive Bayes] Threshold (calculated): 0.99
[DistilBERT Classifier] Threshold (predicted probability cutoff): 0.5
Variables
Terminal
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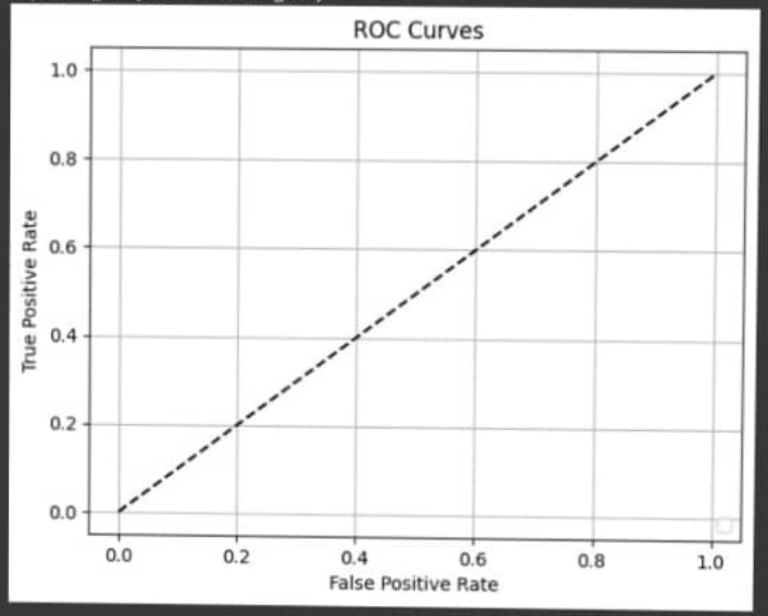
16:41

```
[ ] # Plot ROC Curves
    plt.plot([0, 1], [0, 1], 'k--')
    plt.xlabel("False Positive Rate")
    plt.ylabel("True Positive Rate")
    plt.title("ROC Curves")
    plt.legend(loc="lower right")
    plt.grid(True)
    plt.show()
```

```
<ipython-input-73-e3a4aac273ae>:6: UserWarning: No artists with labels found to put in legend.  Note that artists whose label start with an underscore are ignored when legend() is called with no argument.
  plt.legend(loc="lower right")
```



```
# Plot bar chart
metric_df.set_index("Model").plot(kind="bar", figsize=(10, 6), colormap="Set2")
plt.title("Model Comparison")
plt.ylabel("Score")
plt.ylim(0, 1)
plt.xticks(rotation=0)
plt.grid(True)
plt.show()
```