```
import pandas as pd
import matplotlib.pyplot as plt
from transformers import AutoTokenizer, AutoModelForSequenceClassification
import torch
from tqdm import tqdm
```

```
df = pd.read_csv('abcnews-date-text.csv')
df.head()
```

	publish_date	headline_text
0	20030219	aba decides against community broadcasting lic...
1	20030219	act fire witnesses must be aware of defamation
2	20030219	a g calls for infrastructure protection summit
3	20030219	air nz staff in aust strike for pay rise
4	20030219	air nz strike to affect australian travellers

```
df['publish_date'] = pd.to_datetime(df['publish_date'], format='%Y%m%d')
df['year'] = df['publish_date'].dt.year
```

```
model_name = "distilbert-base-uncased-finetuned-sst-2-english"
tokenizer = AutoTokenizer.from_pretrained(model_name)
model = AutoModelForSequenceClassification.from_pretrained(model_name)

device = torch.device("cuda" if torch.cuda.is_available() else "cpu")
model.to(device)
```

```
/usr/local/lib/python3.10/dist-packages/huggingface_hub/utils/_token.py:89: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (https://huggingface.co/settings/tokens), set it as secre
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
  warnings.warn(
```

```
tokenizer_config.json: 100%  48.0/48.0 [00:00<00:00, 2.64kB/s]

config.json: 100%  629/629 [00:00<00:00, 10.6kB/s]

vocab.txt: 100%  232k/232k [00:00<00:00, 2.55MB/s]

model.safetensors: 100%  268M/268M [00:01<00:00, 201MB/s]
```

```
DistilBertForSequenceClassification(
  (distilbert): DistilBertModel(
    (embeddings): Embeddings(
      (word_embeddings): Embedding(30522, 768, padding_idx=0)
      (position_embeddings): Embedding(512, 768)
      (LayerNorm): LayerNorm((768,), eps=1e-12, elementwise_affine=True)
      (dropout): Dropout(p=0.1, inplace=False)
    )
    (transformer): Transformer(
      (layer): ModuleList(
        (0-5): 6 x TransformerBlock(
          (attention): MultiHeadSelfAttention(
            (dropout): Dropout(p=0.1, inplace=False)
            (q_lin): Linear(in_features=768, out_features=768, bias=True)
            (k_lin): Linear(in_features=768, out_features=768, bias=True)
            (v_lin): Linear(in_features=768, out_features=768, bias=True)
            (out_lin): Linear(in_features=768, out_features=768, bias=True)
          )
          (sa_layer_norm): LayerNorm((768,), eps=1e-12, elementwise_affine=True)
          (ffn): FFN(
            (dropout): Dropout(p=0.1, inplace=False)
            (lin1): Linear(in_features=768, out_features=3072, bias=True)
            (lin2): Linear(in_features=3072, out_features=768, bias=True)
            (activation): GELUActivation()
          )
          (output_layer_norm): LayerNorm((768,), eps=1e-12, elementwise_affine=True)
        )
      )
    )
  )
  (pre_classifier): Linear(in_features=768, out_features=768, bias=True)
```

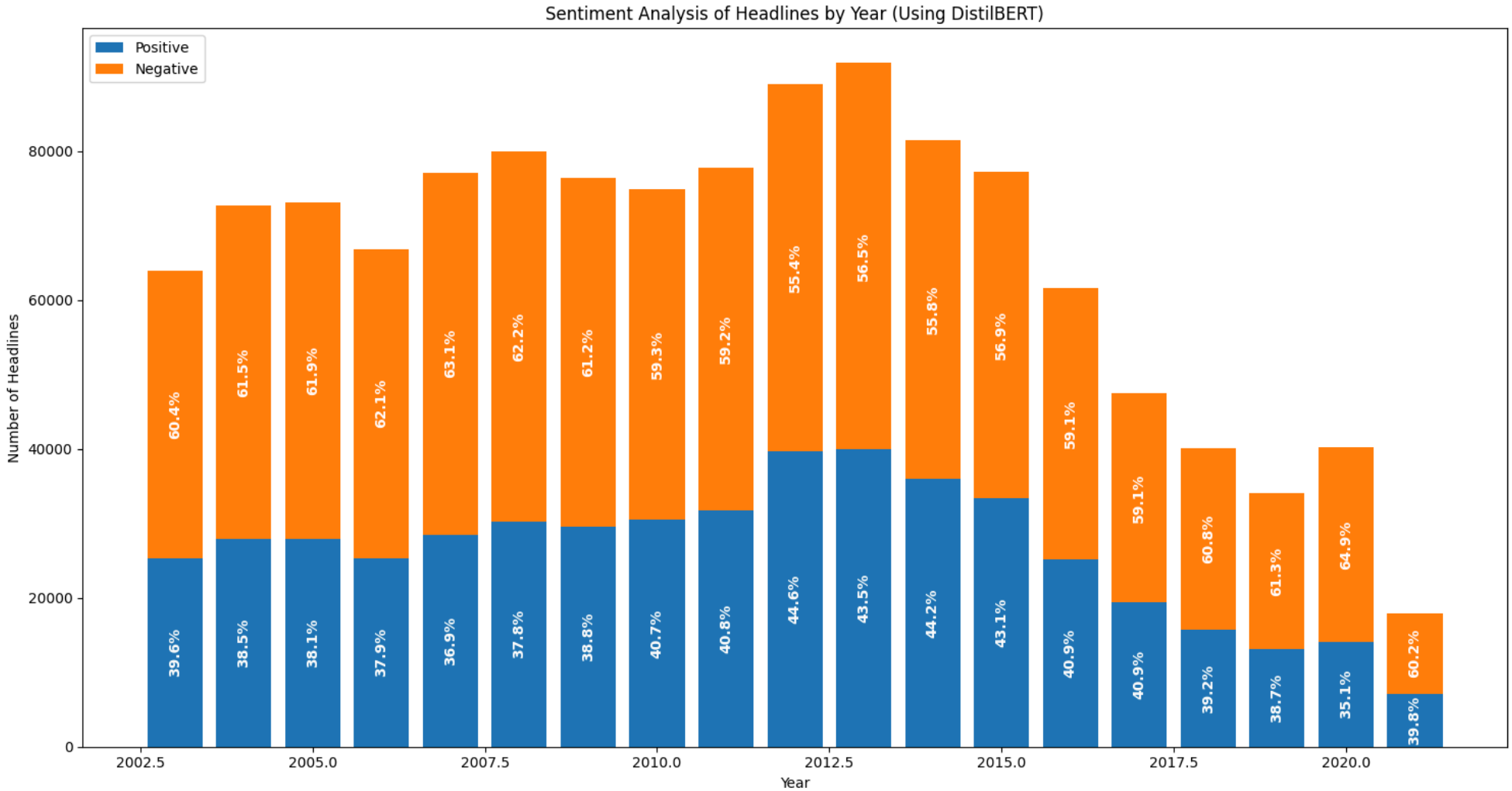
```
    (pre_classifier): Linear(in_features=768, out_features=768, bias=True)
    (classifier): Linear(in_features=768, out_features=2, bias=True)
    (dropout): Dropout(p=0.2, inplace=False)
  )
```

```
def process_batches(texts, batch_size=32):
    for i in range(0, len(texts), batch_size):
        batch = texts[i:i+batch_size]
        inputs = tokenizer(batch, padding=True, truncation=True, return_tensors="pt", max_length=128).to(device)
        with torch.no_grad():
            outputs = model(**inputs)
        yield torch.nn.functional.softmax(outputs.logits, dim=-1)


all_sentiments = []
for batch_predictions in tqdm(process_batches(df['headline_text'].tolist()), total=len(df)//32 + 1):
    all_sentiments.extend(batch_predictions[:, 1].tolist())  # Positive sentiment scores

df['sentiment'] = all_sentiments
```

```
100%|██████████| 38881/38881 [09:42<00:00, 66.80it/s]
```

```
sentiment_by_year = df.groupby('year').agg({
    'sentiment': 'sum',
    'headline_text': 'count'
}).rename(columns={'sentiment': 'positive_count', 'headline_text': 'total_count'})

sentiment_by_year['negative_count'] = sentiment_by_year['total_count'] - sentiment_by_year['positive_count']


plt.figure(figsize=(15, 8))

bars = plt.bar(sentiment_by_year.index, sentiment_by_year['positive_count'], label='Positive')
bars_neg = plt.bar(sentiment_by_year.index, sentiment_by_year['negative_count'],
                   bottom=sentiment_by_year['positive_count'], label='Negative')

plt.xlabel('Year')
plt.ylabel('Number of Headlines')
```

```
plt.title('Sentiment Analysis of Headlines by Year (Using DistilBERT)')
plt.legend(loc='upper left')

def add_percentages(bars, bars_neg):
    for i, (bar, bar_neg) in enumerate(zip(bars, bars_neg)):
        total = bar.get_height() + bar_neg.get_height()
        positive_percentage = (bar.get_height() / total) * 100
        negative_percentage = (bar_neg.get_height() / total) * 100

        plt.text(bar.get_x() + bar.get_width()/2, bar.get_height()/2,
                 f'{positive_percentage:.1f}%',
                 ha='center', va='center', rotation=90, color='white', fontweight='bold')

        plt.text(bar_neg.get_x() + bar_neg.get_width()/2, bar.get_height() + bar_neg.get_height()/2,
                 f'{negative_percentage:.1f}%',
                 ha='center', va='center', rotation=90, color='white', fontweight='bold')

add_percentages(bars, bars_neg)

plt.tight_layout()
plt.show()
```


Sentiment Analysis of Headlines by Year (Using DistilBERT)
Positive
Negative
Number of Headlines
0
20000
40000
60000
80000
Year
2002.5
2005.0
2007.5
2010.0
2012.5
2015.0
2017.5
2020.0
60.4%
61.5%
61.9%
62.1%
63.1%
62.2%
61.2%
59.3%
59.2%
55.4%
56.5%
55.8%
56.9%
59.1%
59.1%
60.8%
61.3%
64.9%
60.2%
39.6%
38.5%
38.1%
37.9%
36.9%
37.8%
38.8%
40.7%
40.8%
44.6%
43.5%
44.2%
43.1%
40.9%
40.9%
39.2%
38.7%
35.1%
39.8%