osntvycde

December 12, 2023

1 Question 2

```python
[1]: # Supresses NonCritical Warnings of Tensorflow
     import os
     os.environ['TF_CPP_MIN_LOG_LEVEL'] = '3'
```

```python
[2]: # This code imports the TensorFlow library and then enables memory growth for␣
     ↪GPU devices, if any are available.
     # Important for some runtime errors during model execution
     import tensorflow as tf

     # Enable memory growth
     gpus = tf.config.list_physical_devices('GPU')
     if gpus:
         try:
             # Currently, memory growth needs to be the same across GPUs
             for gpu in gpus:
                 tf.config.experimental.set_memory_growth(gpu, True)
             logical_gpus = tf.config.experimental.list_logical_devices('GPU')
             print(len(gpus), "Physical GPUs,", len(logical_gpus), "Logical GPUs")
         except RuntimeError as e:
             # Memory growth must be set before GPUs have been initialized
             print(e)
```

```python
[3]: ## !pip install evaluate
```

```python
[4]: import requests
     import pandas as pd
     import numpy as np
     from sklearn.utils import shuffle
     from sklearn.model_selection import train_test_split
     from transformers import AutoTokenizer, TFAutoModelForSequenceClassification
     from tensorflow.keras.optimizers import Adam
     import evaluate
```

1.1 Question 2.1

1.1.1 Create your own dataset for text classification. It should contain at least 1000 words in total and at least two categories with at least 100 examples per category.

Created the dataset by scraping the web.

```
[5]: headers = ({'User Agent': 'Mozilla/5.0 (Macintosh; Intel Mac OS X 10_15_7)
      ↪AppleWebKit/537.36 (KHTML, like Gecko) Chrome/119.0.0.0 Safari/537.36',
      ↪'Accept-Language':'en-US, en;q=0.5'})
```

```
[6]: url = 'https://newsapi.org/v2/top-headlines'
```

```
[7]: webpage = requests.get(url, headers=headers)
```

```
[8]: webpage # should get response [200]
```

```
[8]: <Response [401]>
```

```
[9]: # set the request parameters
     params = {
         'category': 'technology',
         'language': 'en',
         'pageSize': 100,
         'apiKey': 'e30743332dd1426eb170927023ba09d7'
     }
```

```
[10]: response = requests.get(url, params=params)
```

```
[11]: #response.content
```

```
[12]: type(response.content)
```

```
[12]: bytes
```

```
[13]: articles = response.json()['articles']
```

```
[14]: Tech_titles = [article['title'].split(' - ')[0].split(' | ')[0] for article in
      ↪articles]
```

```
[15]: for title in Tech_titles:
          print(title)
```

```
Beeper Mini's iMessage integration is on the fritz
PUBG Mobile guide to avoid dying (December 2023)
Apple's iPhone and Watch Product Design Chief to Leave in Shake-Up
Den of Wolves
Minecraft - Jurassic World DLC - Nintendo Switch
```

Round 2: We test the new Gemini-powered Bard against ChatGPT
Apple Wallet ticket sharing is becoming more like NameDrop
GTA Vice City map vs GTA 6 map: Everything known so far from leaks and trailer
A brain without a body can now be kept alive for hours, thanks to new tech
Hideo Kojima Teams With Jordan Peele for Upcoming Horror Game 'OD,' Announces His 'Death Stranding' Docu Will Stream on Disney+
Google's AI-assisted NotebookLM note-taking app is now open to users in the US
Google faces controversy over edited Gemini AI demo video
Chimney for modern homes: Here are top 10 options to consider before buying one
The Game Awards 2023: All The Biggest Announcements
Battlegrounds Mobile India (BGMI): Mid-range guide (December 2023)
This brand made an $1,100 edible gold iPhone 15 Pro Max chocolate bar
In 1990, You Could Get A Chevy 1500 With 405 Lb-Ft Of Torque From A Big Block V8: Holy Grails
Hogwarts Legacy - Live the Unwritten Trailer - Nintendo Switch
Why AI Chess Bots Are Virtually Unbeatable (ft. GothamChess)
Pasta dinner in just 1 minute? This viral hack shows how - but there's a catch
Starfield Testers Had To Unionize To Get A Copy Of The Game
The Day Before's overwhelmingly negative Steam reviews seem deserved
You Can Use Meta's New AI Image Generator for Free
For some reason Yamaha is launching a 5-disk CD changer in 2023
'Jurassic Park: Survival' trailer teases what happened to raptor in freezer
God of War Ragnarok: Valhalla Set After Main Game as Kratos Faces His Past in a Personal Story
OnePlus 12 confirmed to launch globally on January 23
Flipkart announces 'Big Year End Sale', starts from this Saturday
WhatsApp rolls out `View Once` voice message feature
Best Buy's New Weekend Sale Has Record Low Prices on MacBook Pro and MacBook Air
Drama, ghosting and tales of misery on NYC's 'cutthroat' dating scene: 'We're all out for ourselves'
Tech this week: NoiseFit Endeavour to Google's Gemini, check top tech launches
This Week In Security: LogoFail, National DNS Poison, And DNA
This Dealer Is Trying To Sell A 1995 Honda Accord For More Than The Original MSRP
Huge surge in malicious phishing emails attributed to AI tools like ChatGPT
Sony PlayStation VR2 Price In India New Headset With Horizon Call of the Mountain Bundle Launched; Know Specs, Availability
The Finals' Playercount Is Exploding After Surprise Game Awards Release
Sonos Holiday Sale Offers Perfect Holiday Gifts for the Audiophile in Your Life
Alan Wake 2: 'The Final Draft' Update Includes New Game Plus And New Ending, Out Next Week
Tears of the Kingdom Devs Leave Door Open for Playable Zelda in Potential Future Release
Best games of 2023: 'Starfield,' 'Baldur's Gate 3' and more
How to get LEGO Fortnite True Explorers Quest Pack for free
Baldur's Gate 3 Is Now Available On Xbox Series X/S
CMF Buds Pro by Nothing: Quick Review
Google REMOVES 17 apps with over 1 crore downloads for SNOOPING on users, say

reports
Vacuum cleaner for car: 10 best options to consider before purchase
iPhone SE 4 said to get a major upgrade in battery and design
The Big Vision Behind These iOS, WatchOS Updates
Best premium tablets of 2023: Samsung Galaxy Tab S9 Ultra to Google Pixel tablet, check top 5 here
Yes, Apple just made an AI announcement of its own. No, it's not a Gemini competitor
Google adding dedicated 'Weather' shortcut to app grid on Pixel
Google rolls out migration tool ahead of its Podcasts shutdown in April 2024
Xiaomi announces Redmi 13R 5G with a familiar set of specs
Meta AI is here: Know how to talk to the chatbot on WhatsApp, Instagram, and Facebook
'Baldur's Gate 3', 'Alan Wake 2' win big at ad-heavy Game Awards 2023 • FRANCE 24 English
Download OnePlus 12 wallpapers and live wallpapers here!
Infinix Smart 8HD smartphone launched at just Rs 5,669
Final Fantasy 7 Rebirth Fans Are Swooning Over Sexy Cid
5 best perks to use in Warzone
Generative AI Battle: Google's Gemini and OpenAI's GPT-4 features compared
ROG Phone 8 officially teased
1080° Snowboarding, Harvest Moon 64 and Jet Force Gemini join Nintendo Switch Online
83-year-old man gets call from bank to update KYC online, later loses life savings
Quordle 683 answer for December 8: Keep winning! Check Quordle hints, clues, solutions
6 common smartphone mistakes that you must avoid
5 'must try' note-taking apps to boost productivity
Fujifilm unveils campaign, aiming to connect India
Gmail Receives A Major Upgrade As Google Intensifies Efforts Against Spam
Upgrade your printing game with high quality printers on Amazon
Best gifts under $25: Cheap presents that people on your list actually want.
Fortnite launches Lego mode to rival Minecraft
Boat launches its first LTE smartwatch with Jio eSIM support: All the details
ChatGPT responds to complaints of being 'lazy', says 'model behavior can be unpredictable'
Best monitor for PS5 assure high-end gaming? Bring home one from top 10 options
Best JBL Home Theater Systems To Elevate Your Entertainment!
Gmail tips and tricks: 10 key hacks for better email handling
WhatsApp could bring higher quality media for your status updates
Explained: What is keyboard-based hacking on iPhones
Character.AI, the quirky chatbot that lets you talk to AI replicas of celebrities; Know how to use it
5 Smartphones To Buy Under Rs 25,000 in December 2023
Best camera phones in 2023: From Apple to Redmi, here are our top 6 across all price range
Urbn Nano Power Banks with up to 20,000 mAh capacity launched at Rs 1,699

Garena Free Fire MAX Redeem Codes Today, December 8, 2023 Full List Of Latest
Codes To Win Free Rewards Here
TECNO Mobile's SPARK Go 2024 debuts, available at retail stores and Amazon
Apple   iPhone   50   - WSJ
Flashback Friday
10 best mobiles for gaming and streaming: From iQOO Neo 7 5G to iPhone 15 Pro,
check them all out
The Drive Report: 2023 BMW M340i
Meta's Threads brings 'Tags' for organising posts by topics: Know details
Suicide Squad Will Get An Offline Story Mode, Eventually
 LibreOffice 7.6.4/7.5.9 Community   v7.5
Final Fantasy 16 DLC Echoes Of The Fallen Releases Today, Second DLC Coming Next
Year
Nothing Phone 3: News, leaks, rumored price, and release window
Marvel's 'Blade,' Matthew McConaughey, Jordan Peele, 'Jurassic Park' all make
splashy announcements at the Game Awards
Monster Hunter Wilds revealed at The Game Awards 2023, coming in 2025
7 dramatic bathroom design ideas for a chic black look
Honkai Star Rail reveals Penacony at The Game Awards 2023: Expected release date
and more
Light No Fire is the next game from No Man's Sky studio Hello Games
Stormgate
Warhammer 40,000 Space Marine 2

[16]: len(Tech_titles)

[16]: 100

[17]:
```python
# set the request parameters
params = {
    'category': 'business',
    'language': 'en',
    'pageSize': 100,
    'apiKey': 'e30743332dd1426eb170927023ba09d7'
}

# send the request and get the response
response = requests.get(url, params=params)

# get the 'articles' list from the response JSON data
articles = response.json()['articles']

# extract the titles from the articles aslo splitting the source from titles
Business_titles = [article['title'].split(' - ')[0].split(' | ')[0] for article
  in articles]

# print the titles
```

```python
for title in Business_titles:
    print(title)
```

Stock Faithful Ride $7 Trillion Rally as Market Timing Backfires
Why automakers are turning to hybrids in the middle of the industry's EV transition
SmileDirectClub Rescue Deal Falls Apart, Company to Liquidate
Warning from OpenAI leaders helped trigger Sam Altman's ouster
DHL Express strike
Starbucks Says It Wants Union Talks, Agreements in 2024
Exxon Mobil is one of most oversold names, could be primed for bounce
Paramount stock surges more than 14% as sale chatter mounts
S&P 500 is little changed, on pace to snap 5-week win streak as comeback rally pauses: Live updates
New McDonald's spinoff restaurant CosMc's officially opens in a Chicago suburb
Bulk Deals: Softbank exits Zomato, GQG Partners buys Rs 1,671.5 cr shares in GMR Airports Infra
Monitoring panel clears directors for Rel Naval board
New laws taking effect in Minnesota on Jan. 1, 2024
Elon Musk Throws Fresh Barbs at Disney's Bob Iger
Kawasaki W175 Street Launched In India At Rs. 1.35 Lakh
Paramount, RH, Carrier Global, Lululemon, First Solar, and More Market Movers
Stocks gain, Treasury yields climb after US payrolls report
Philanthropist MacKenzie Scott reveals the groups that got some of her $2.1 billion in gifts in 2023
Tesla must respect collective bargaining rights, Norway's sovereign wealth fund says
Huge global coffee supplier to liquidate in Chapter 11 bankruptcy
FDA Approves First Gene Therapies to Treat Patients with Sickle Cell Disease
Wealthy neighbors blast Jeff Bezos for 'not picking up trash on Cleanup Day': report
Companies are spending millions to get AI into the hands of workers. Payback won't be quick
For 2 Years in a Row, Man Has Won $10M at Same Store
The self-checkout reversal is growing
23andMe frantically changed its terms of service to prevent hacked customers from suing
Inflation expectations plunge in closely watched University of Michigan survey
AMD takes aim at Nvidia with new AI chips. Here's what might be next for the stock
Google selects 20 AI-first startups for the eighth batch of its India accelerator programme
MTA suspends Baltimore light rail services, what are the reasons for closure and for how long?
No Better Market Than India Right Now: ICICI Prudential AMC S Naren
Cantaloupe recall: Deaths linked to salmonella outbreak rises to 8
Wipro announces top leadership change; chief growth officer quits

Charlie Munger said there was no secret to his success: 'I avoided the standard ways of failing'
Matrixport's $45K End of Year Target for Bitcoin Looks to Be Accurate
Jeep-owner Stellantis announces mass layoffs, blames California
Kia Sonet facelift 2024: Variant details leaked
Weekly Funding Wrap: Large cheques, late-stage deals make a comeback; startups raise about $105 million
Aprilia RS 457 launched at Rs 4.10 lakh: Ninja 400 rival with 47hp twin-cylinder engine
JSW Steel Shares Hit 52-Week High as Arm Plans to Raise Long-Term Funds
A Bull Market Is Coming: 1 Magnificent Artificial Intelligence (AI) Growth Stock to Buy Hand Over Fist Before 2024 and Hold Forever
Praj Industries Shares Plummet 14% After Ban on Ethanol Production
India's largest consumer care company shows negative momentum. What gives
Microsoft's links with OpenAI to be examined by competition watchdog
[Removed]
Japan's Q3 GDP falls faster than first estimates as consumption sags
India's forex reserves touch four-month high at $604 billion: RBI
Zerodha's Kamath brothers take home Rs 72 crore each in remuneration in FY23
$19 Billion in a Week: AbbVie Makes Two Big Bets
Piramal Pharma to invest 1,000 cr for expansion: Nandini Piramal
Savings Of Up To Rs 59,000 On Maruti Arena Cars This December
Carrier Announces Agreement to Sell Global Access Solutions Business to Honeywell for $4.95 Billion
Here's what to know as the Seminole Tribe launches sports betting, table games in Tampa
                    2023 12 8 #WBS
Mullen Provides Securities Litigation Update
The biggest study of 'greedflation' yet looked at 1,300 corporations to find many of them were lying to you about inflation
Bank Nifty hits record high of 47,303, clocks biggest weekly gain since July 2022
Has Microsoft taken over control of OpenAI? Brad Smith issues clarification
Supreme Court: Supreme Court dismisses Chanda Kochhar's plea for retirement benefits from ICICI bank
SIPs hit a new high in November, exceeding 17,000 crore
Tata Punch EV launch on December 21
Woman claims Airtel imposed 1 lakh roaming charges during her trip to Bihar
MC Interview: Hindalco has ability to invest in commodity downcycle; $4.4 billion capex on track: MD
What does RBI's MPC meet outcome spell for banking and housing loan sectors?
The great awakening: HDFC Bank shows cup and handle pattern breakout after 2 years of consolidation
Washington Post strikers say 'we deserve better' as they walk off job in historic protest
2024 Skoda Kushaq & Slavia Elegance Edition
Pharma stock jumps up to 20% after merger with Dhanuka Laboratories; Check the latest targets

Gold price on December 8: Rates in main Indian cities
Indias Foreign Inflows To Grow But Not At The Cost Of China Yet, Says Samir
Arora
India's top VCs face fresh obstacles as startup investment plummets
RBI monetary policy: Governor Das says central bank working on establishing
cloud facility for financials
AMD Stock (NASDAQ:AMD): Will AI-Fueled Rally Lose Steam?
Soaring Adani Shares Push LIC To Newer Highs --Check What Experts Say
Heavy buying after FIIs increasing stake: Back-to-back upper circuits and
52-week highs in this multibagger micro-cap stock; scrip up by 30000 per cent!
Apple's strategic pivot: A quarter of world's iPhones to be made in India
Block Deal: Midcap stock jumps 14% after 76 Cr equity shares exchanged hands
EV stock jumps after it receives order worth 62.80 Cr for supply of 40
electric buses
Tata Group set to build one of the largest iPhone assembly plant in India:
Location, jobs to be created a
Sensex hits all-time high; Nifty scales 21,000 mark post RBI policy decision
Paytm Shares Rebound After Worst Fall Since Listing
IREDA soars 14% on heavy volumes; stock zooms 129% against issue price
Marinetrans India share price hits 5% lower circuit after listing at 15.4%
premium on NSE SME exchange
DOMS IPO: GMP jumps as issue opens next week. Date, price, other details of
upcoming IPO
Public sector bankers to get 17 per cent wage hike
Gautam Adani shares plan for Adani Ports, 'carbon neutral by 2025, net zero by
2040'
NDTV Profit Is Back, Business Channel Relaunches In New Avatar
OMB focused on automation, federal employee satisfaction as keys to better
public-facing services
Seattle cancer patients face blackmail threats after recent Fred Hutch data
breach
Louisville Teamsters warn of strike against UPS citing unfair labor practices
US Judge Bans Changpeng 'CZ' Zhao from Leaving the Country
Oil prices jump after U.S. jobs report By Investing.com
Cathay Pacific chooses Airbus over Boeing for freighter order
Stocks to Watch: Zomato, Maruti Suzuki, SpiceJet, IDFC First Bank
Eye on elections: PSU bank stocks may continue to race ahead as BJP prospects
instill confidence
Off-Duty Pilot, Joseph Emerson, Released
Nifty 50, Sensex today: What to expect from stock market indices in trade on
December 8
X begins rolling out Grok, its 'rebellious' chatbot, to subscribers
House Republicans have once again voted to poison you and cost you trillions
Stock Market Today: All You Need To Know Going Into Trade On Dec. 8

```
[18]: len(Business_titles)
```

```
[18]: 100
```

```
[19]: data_list = []
      for title in Tech_titles:
          data_list.append({'sentence': str(title), 'label': 0})

      for title in Business_titles:
          data_list.append({'sentence': str(title), 'label': 1})
```

```
[20]: data = pd.DataFrame(data_list)
      print(data)
```

```
                                             sentence  label
     0    Beeper Mini's iMessage integration is on the f…      0
     1      PUBG Mobile guide to avoid dying (December 2023)       0
     2    Apple's iPhone and Watch Product Design Chief …      0
     3                                    Den of Wolves      0
     4      Minecraft - Jurassic World DLC - Nintendo Switch       0
     ..                                             …    …
     195           Off-Duty Pilot, Joseph Emerson, Released       1
     196  Nifty 50, Sensex today: What to expect from st…      1
     197  X begins rolling out Grok, its 'rebellious' ch…      1
     198  House Republicans have once again voted to poi…      1
     199  Stock Market Today: All You Need To Know Going…      1

     [200 rows x 2 columns]
```

```
[21]: data = shuffle(data, random_state=987654321)
      data.head()
```

```
[21]:                                           sentence  label
     155  The biggest study of 'greedflation' yet looked…      1
     175  Apple's strategic pivot: A quarter of world's …      1
     124              The self-checkout reversal is growing       1
     11   Google faces controversy over edited Gemini AI…      0
     23   For some reason Yamaha is launching a 5-disk C…      0
```

```
[22]: X_train = data.drop('label', axis=1)
      y_train = data['label']
```

```
[23]: len(X_train)
```

```
[23]: 200
```

```
[24]: len(y_train)
```

```
[24]: 200
```

1.2 Question 2.2

1.2.1 Split the dataset into training (at least 160 examples) and test (at least 40 examples) sets.

```
[25]: X_train, X_test, y_train, y_test = train_test_split(X_train, y_train,␣
      ↪test_size=40, random_state=987654321)
```

```
[26]: print(len(X_train))
      print(len(y_train))
      print(len(X_test))
      print(len(y_test))
```

```
160
160
40
40
```

1.3 Question 2.3

1.3.1 Fine tune a pretrained language model capable of generating text (e.g., GPT) that you can take from the Hugging Face Transformers library with the dataset your created (this tutorial could be very helpful: https://huggingface.co/docs/transformers/training).

```
[27]: import tensorflow as tf
      tf.keras.backend.clear_session()
      tf.random.set_seed(987654321)
      np.random.seed(987654321)
```

```
[28]: ## !pip install --upgrade transformers
```

Using Albert-base-v2

```
[29]: # initializing a tokenizer and a pre-trained model for sequence classification␣
      ↪using the ALBERT-base-v2 architecture
      tokenizer = AutoTokenizer.from_pretrained("albert-base-v2")

      model = TFAutoModelForSequenceClassification.from_pretrained("albert-base-v2")
```

```
model.safetensors:   0%|          | 0.00/47.4M [00:00<?, ?B/s]
```

```
All PyTorch model weights were used when initializing
TFAlbertForSequenceClassification.

Some weights or buffers of the TF 2.0 model TFAlbertForSequenceClassification
were not initialized from the PyTorch model and are newly initialized:
['classifier.weight', 'classifier.bias']
```

You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.

```python
[30]: X_train = dict(tokenizer([str(i) for i in X_train['sentence']],␣
         ↪return_tensors='np', padding=True))
      X_test = dict(tokenizer([str(i) for i in X_test['sentence']],␣
         ↪return_tensors='np', padding=True))
```

```python
[31]: model.compile(optimizer=Adam(1e-5))
      model.fit(X_train, y_train,epochs=4, batch_size=80)
```

WARNING:absl:At this time, the v2.11+ optimizer `tf.keras.optimizers.Adam` runs
slowly on M1/M2 Macs, please use the legacy Keras optimizer instead, located at
`tf.keras.optimizers.legacy.Adam`.

```
Epoch 1/4
2/2 [==============================] - 13s 5s/step - loss: 0.6960
Epoch 2/4
2/2 [==============================] - 9s 5s/step - loss: 0.6202
Epoch 3/4
2/2 [==============================] - 9s 5s/step - loss: 0.5775
Epoch 4/4
2/2 [==============================] - 9s 5s/step - loss: 0.5064
```

```
[31]: <keras.src.callbacks.History at 0x17d618c50>
```

```python
[32]: preds = model.predict(X_test)["logits"]
```

```
2/2 [==============================] - 2s 172ms/step
```

```python
[33]: y_pred = np.argmax(preds, axis=1)
```

1.3.2 Report the test accuracy.

```python
[34]: metric = evaluate.load('accuracy')
      metric.compute(predictions=y_pred, references=np.array(y_test))
```

```
Downloading builder script:   0%|              | 0.00/4.20k [00:00<?, ?B/s]
```

```
[34]: {'accuracy': 0.775}
```

1.3.3 Discuss what could be done to improve accuracy.

We can see here that when we compile the model with 4 epochs, the training loss is reduced at
each step. When we calculate the accuracy, we get 77.5% accuracy. If we increase the epochs, we
can potentially obtain better accuracy, but there is also a risk of overfitting the model. Hence,
we will test the model with epoch = 20 to further evaluate its performance. However, we can add

regularization techniques like dropout to prevent overfitting. We can also experiment with different batch sizes. A smaller batch size may allow the model to generalize better.

```
[35]: tf.keras.backend.clear_session()
      tf.random.set_seed(987654321)
      np.random.seed(987654321)
```

```
[36]: model.compile(optimizer=Adam(1e-5))
      model.fit(X_train, y_train,epochs=20, batch_size=80)
```

```
WARNING:absl:At this time, the v2.11+ optimizer `tf.keras.optimizers.Adam` runs
slowly on M1/M2 Macs, please use the legacy Keras optimizer instead, located at
`tf.keras.optimizers.legacy.Adam`.

Epoch 1/20
2/2 [==============================] - 12s 5s/step - loss: 0.4674
Epoch 2/20
2/2 [==============================] - 10s 5s/step - loss: 0.4080
Epoch 3/20
2/2 [==============================] - 9s 5s/step - loss: 0.3636
Epoch 4/20
2/2 [==============================] - 9s 5s/step - loss: 0.3184
Epoch 5/20
2/2 [==============================] - 10s 5s/step - loss: 0.2799
Epoch 6/20
2/2 [==============================] - 10s 5s/step - loss: 0.2497
Epoch 7/20
2/2 [==============================] - 10s 5s/step - loss: 0.2130
Epoch 8/20
2/2 [==============================] - 9s 5s/step - loss: 0.1895
Epoch 9/20
2/2 [==============================] - 9s 5s/step - loss: 0.1616
Epoch 10/20
2/2 [==============================] - 10s 5s/step - loss: 0.1371
Epoch 11/20
2/2 [==============================] - 9s 5s/step - loss: 0.1156
Epoch 12/20
2/2 [==============================] - 10s 5s/step - loss: 0.0997
Epoch 13/20
2/2 [==============================] - 10s 5s/step - loss: 0.0854
Epoch 14/20
2/2 [==============================] - 10s 5s/step - loss: 0.0700
Epoch 15/20
2/2 [==============================] - 10s 5s/step - loss: 0.0594
Epoch 16/20
2/2 [==============================] - 10s 5s/step - loss: 0.0505
Epoch 17/20
2/2 [==============================] - 10s 5s/step - loss: 0.0435
```

```
Epoch 18/20
2/2 [==============================] - 10s 5s/step - loss: 0.0377
Epoch 19/20
2/2 [==============================] - 10s 5s/step - loss: 0.0307
Epoch 20/20
2/2 [==============================] - 10s 5s/step - loss: 0.0259
```

[36]: `<keras.src.callbacks.History at 0x28ade4610>`

[37]:
```python
preds = model.predict(X_test)["logits"]
```

```
2/2 [==============================] - 1s 181ms/step
```

[38]:
```python
y_pred = np.argmax(preds, axis=1)
```

[39]:
```python
metric = evaluate.load('accuracy')
metric.compute(predictions=y_pred, references=np.array(y_test))
```

[39]: `{'accuracy': 0.85}`

After training the model with 20 epochs, we observed a decrease in the training loss at each step. The accuracy obtained was 85%, which is higher than the accuracy obtained with 4 epochs. However, we could have achieved even higher accuracy if we had used a larger model.

1.3.4 Trying different models to gain a better understanding.

[40]:
```python
tf.keras.backend.clear_session()
tf.random.set_seed(987654321)
np.random.seed(987654321)
```

Using GPT-J > Computationally expensive since the model requires around 24.2 GB of memory space to download.

> Too big to be used on regular hardware: wouldn't fit in RAM.

[41]:
```python
tokenizer = AutoTokenizer.from_pretrained("EleutherAI/gpt-j-6B")

model = TFAutoModelForSequenceClassification.from_pretrained("EleutherAI/
 ↪gpt-j-6B")

model.compile(optimizer=Adam(1e-5))
model.fit(X_train, y_train,epochs=20, batch_size=80)

preds = model.predict(X_test)["logits"]

y_pred = np.argmax(preds, axis=1)

metric = evaluate.load('accuracy')
```

```
metric.compute(predictions=y_pred, references=np.array(y_test))
```

tokenizer_config.json: 0%| | 0.00/619 [00:00<?, ?B/s]

vocab.json: 0%| | 0.00/798k [00:00<?, ?B/s]

merges.txt: 0%| | 0.00/456k [00:00<?, ?B/s]

tokenizer.json: 0%| | 0.00/1.37M [00:00<?, ?B/s]

added_tokens.json: 0%| | 0.00/4.04k [00:00<?, ?B/s]

special_tokens_map.json: 0%| | 0.00/357 [00:00<?, ?B/s]

Special tokens have been added in the vocabulary, make sure the associated word embeddings are fine-tuned or trained.

config.json: 0%| | 0.00/930 [00:00<?, ?B/s]

tf_model.h5:   0%| | 0.00/24.2G [00:00<?, ?B/s]

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
Cell In[41], line 3
      1 tokenizer = AutoTokenizer.from_pretrained("EleutherAI/gpt-j-6B")
----> 3 model = TFAutoModelForSequenceClassification.from_pretrained("EleutherA /
  ↪gpt-j-6B")
      5 model.compile(optimizer=Adam(1e-5))
      6 model.fit(X_train, y_train,epochs=20, batch_size=80)

File ~/anaconda3/lib/python3.11/site-packages/transformers/models/auto/
  ↪auto_factory.py:566, in _BaseAutoModelClass.from_pretrained(cls,␣
  ↪pretrained_model_name_or_path, *model_args, **kwargs)
    564 elif type(config) in cls._model_mapping.keys():
    565     model_class = _get_model_class(config, cls._model_mapping)
--> 566     return model_class.from_pretrained(
    567         pretrained_model_name_or_path, *model_args, config=config,␣
  ↪**hub_kwargs, **kwargs
    568     )
    569 raise ValueError(
    570     f"Unrecognized configuration class {config.__class__} for this kind␣
  ↪of AutoModel: {cls.__name__}.\n"
    571     f"Model type should be one of {', '.join(c.__name__ for c in cls.
  ↪_model_mapping.keys())}."
    572 )

File ~/anaconda3/lib/python3.11/site-packages/transformers/modeling_tf_utils.py
  ↪2792, in TFPreTrainedModel.from_pretrained(cls, pretrained_model_name_or_path␣
  ↪config, cache_dir, ignore_mismatched_sizes, force_download, local_files_only,␣
  ↪token, revision, *model_args, **kwargs)
   2788 if resolved_archive_file is None and filename == SAFE_WEIGHTS_NAME:
   2789     # Did not find the safetensors file, let's fallback to TF.
```

```
  2790       # No support for sharded safetensors yet, so we'll raise an error if ↵
↪that's all we find.
  2791       filename = TF2_WEIGHTS_NAME
-> 2792       resolved_archive_file = cached_file(
  2793           pretrained_model_name_or_path, TF2_WEIGHTS_NAME, ↵
↪**cached_file_kwargs
  2794       )
  2795 if resolved_archive_file is None and filename == TF2_WEIGHTS_NAME:
  2796       # Maybe the checkpoint is sharded, we try to grab the index name in ↵
↪this case.
  2797       resolved_archive_file = cached_file(
  2798           pretrained_model_name_or_path, TF2_WEIGHTS_INDEX_NAME, ↵
↪**cached_file_kwargs
  2799       )

File ~/anaconda3/lib/python3.11/site-packages/transformers/utils/hub.py:430, in↵
 ↪cached_file(path_or_repo_id, filename, cache_dir, force_download, ↵
 ↪resume_download, proxies, token, revision, local_files_only, subfolder, ↵
 ↪repo_type, user_agent, _raise_exceptions_for_missing_entries, ↵
 ↪_raise_exceptions_for_connection_errors, _commit_hash, **deprecated_kwargs)
  427 user_agent = http_user_agent(user_agent)
  428 try:
  429       # Load from URL or cache if already cached
--> 430       resolved_file = hf_hub_download(
  431           path_or_repo_id,
  432           filename,
  433           subfolder=None if len(subfolder) == 0 else subfolder,
  434           repo_type=repo_type,
  435           revision=revision,
  436           cache_dir=cache_dir,
  437           user_agent=user_agent,
  438           force_download=force_download,
  439           proxies=proxies,
  440           resume_download=resume_download,
  441           token=token,
  442           local_files_only=local_files_only,
  443       )
  444 except GatedRepoError as e:
  445       raise EnvironmentError(
  446           "You are trying to access a gated repo.\nMake sure to request ↵
↪access at "
  447           f"https://huggingface.co/{path_or_repo_id} and pass a token ↵
↪having permission to this repo either "
  448           "by logging in with `huggingface-cli login` or by passing ↵
↪`token=<your_token>`."
  449       ) from e

File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/utils/_validators↵
 ↪py:118, in validate_hf_hub_args.<locals>._inner_fn(*args, **kwargs)
```

```
    115 if check_use_auth_token:
    116     kwargs = smoothly_deprecate_use_auth_token(fn_name=fn.__name__,␣
 ↪has_token=has_token, kwargs=kwargs)
--> 118 return fn(*args, **kwargs)


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
 ↪1461, in hf_hub_download(repo_id, filename, subfolder, repo_type, revision,␣
 ↪library_name, library_version, cache_dir, local_dir, local_dir_use_symlinks,␣
 ↪user_agent, force_download, force_filename, proxies, etag_timeout,␣
 ↪resume_download, token, local_files_only, legacy_cache_layout, endpoint)
   1458            if local_dir is not None:
   1459                _check_disk_space(expected_size, local_dir)
-> 1461        http_get(
   1462            url_to_download,
   1463            temp_file,
   1464            proxies=proxies,
   1465            resume_size=resume_size,
   1466            headers=headers,
   1467            expected_size=expected_size,
   1468        )
   1470 if local_dir is None:
   1471     logger.debug(f"Storing {url} in cache at {blob_path}")


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
 ↪541, in http_get(url, temp_file, proxies, resume_size, headers, expected_size␣
 ↪_nb_retries)
    539 new_resume_size = resume_size
    540 try:
--> 541     for chunk in r.iter_content(chunk_size=DOWNLOAD_CHUNK_SIZE):
    542         if chunk:  # filter out keep-alive new chunks
    543             progress.update(len(chunk))


File ~/anaconda3/lib/python3.11/site-packages/requests/models.py:816, in␣
 ↪Response.iter_content.<locals>.generate()
    814 if hasattr(self.raw, "stream"):
    815     try:
--> 816         yield from self.raw.stream(chunk_size, decode_content=True)
    817     except ProtocolError as e:
    818         raise ChunkedEncodingError(e)


File ~/anaconda3/lib/python3.11/site-packages/urllib3/response.py:628, in␣
 ↪HTTPResponse.stream(self, amt, decode_content)
    626 else:
    627     while not is_fp_closed(self._fp):
--> 628         data = self.read(amt=amt, decode_content=decode_content)
    630         if data:
    631             yield data
```

```
File ~/anaconda3/lib/python3.11/site-packages/urllib3/response.py:567, in
 ↪HTTPResponse.read(self, amt, decode_content, cache_content)
    564 fp_closed = getattr(self._fp, "closed", False)
    566 with self._error_catcher():
--> 567     data = self._fp_read(amt) if not fp_closed else b""
    568     if amt is None:
    569         flush_decoder = True


File ~/anaconda3/lib/python3.11/site-packages/urllib3/response.py:533, in
 ↪HTTPResponse._fp_read(self, amt)
    530     return buffer.getvalue()
    531 else:
    532     # StringIO doesn't like amt=None
--> 533     return self._fp.read(amt) if amt is not None else self._fp.read()


File ~/anaconda3/lib/python3.11/http/client.py:466, in HTTPResponse.read(self,
 ↪amt)
    463 if self.length is not None and amt > self.length:
    464     # clip the read to the "end of response"
    465     amt = self.length
--> 466 s = self.fp.read(amt)
    467 if not s and amt:
    468     # Ideally, we would raise IncompleteRead if the content-length
    469     # wasn't satisfied, but it might break compatibility.
    470     self._close_conn()


File ~/anaconda3/lib/python3.11/socket.py:706, in SocketIO.readinto(self, b)
    704 while True:
    705     try:
--> 706         return self._sock.recv_into(b)
    707     except timeout:
    708         self._timeout_occurred = True


File ~/anaconda3/lib/python3.11/ssl.py:1278, in SSLSocket.recv_into(self,
 ↪buffer, nbytes, flags)
    1274     if flags != 0:
    1275         raise ValueError(
    1276             "non-zero flags not allowed in calls to recv_into() on %s" %
    1277             self.__class__)
-> 1278     return self.read(nbytes, buffer)
    1279 else:
    1280     return super().recv_into(buffer, nbytes, flags)


File ~/anaconda3/lib/python3.11/ssl.py:1134, in SSLSocket.read(self, len, buffer)
    1132 try:
    1133     if buffer is not None:
-> 1134         return self._sslobj.read(len, buffer)
    1135     else:
```

```
   1136              return self._sslobj.read(len)

KeyboardInterrupt:
```

Using GPT-Sw3 > Not released publicly: requires token access.

```
[42]: tokenizer = AutoTokenizer.from_pretrained("AI-Sweden/gpt-sw3-356m")

      model = TFAutoModelForSequenceClassification.from_pretrained("AI-Sweden/
       ↪gpt-sw3-356m")

      model.compile(optimizer=Adam(1e-5))
      model.fit(X_train, y_train,epochs=20, batch_size=80)

      preds = model.predict(X_test)["logits"]

      y_pred = np.argmax(preds, axis=1)

      metric = evaluate.load('accuracy')
      metric.compute(predictions=y_pred, references=np.array(y_test))
```

```
      ---------------------------------------------------------------------------
      HTTPError                                 Traceback (most recent call last)
      File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/utils/_errors.py:
       ↪270, in hf_raise_for_status(response, endpoint_name)
          269 try:
      --> 270     response.raise_for_status()
          271 except HTTPError as e:

      File ~/anaconda3/lib/python3.11/site-packages/requests/models.py:1021, in␣
       ↪Response.raise_for_status(self)
         1020 if http_error_msg:
      -> 1021     raise HTTPError(http_error_msg, response=self)

      HTTPError: 401 Client Error: Unauthorized for url: https://huggingface.co/
       ↪AI-Sweden/gpt-sw3-356m/resolve/main/tokenizer_config.json

      The above exception was the direct cause of the following exception:

      RepositoryNotFoundError                   Traceback (most recent call last)
      File ~/anaconda3/lib/python3.11/site-packages/transformers/utils/hub.py:430, in␣
       ↪cached_file(path_or_repo_id, filename, cache_dir, force_download,␣
       ↪resume_download, proxies, token, revision, local_files_only, subfolder,␣
       ↪repo_type, user_agent, _raise_exceptions_for_missing_entries,␣
       ↪_raise_exceptions_for_connection_errors, _commit_hash, **deprecated_kwargs)
          428 try:
          429     # Load from URL or cache if already cached
      --> 430     resolved_file = hf_hub_download(
```

```
431            path_or_repo_id,
432            filename,
433            subfolder=None if len(subfolder) == 0 else subfolder,
434            repo_type=repo_type,
435            revision=revision,
436            cache_dir=cache_dir,
437            user_agent=user_agent,
438            force_download=force_download,
439            proxies=proxies,
440            resume_download=resume_download,
441            token=token,
442            local_files_only=local_files_only,
443        )
444 except GatedRepoError as e:

File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/utils/_validators
 ↪py:118, in validate_hf_hub_args.<locals>._inner_fn(*args, **kwargs)
    116      kwargs = smoothly_deprecate_use_auth_token(fn_name=fn.__name__,␣
 ↪has_token=has_token, kwargs=kwargs)
--> 118 return fn(*args, **kwargs)

File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
 ↪1374, in hf_hub_download(repo_id, filename, subfolder, repo_type, revision,␣
 ↪library_name, library_version, cache_dir, local_dir, local_dir_use_symlinks,␣
 ↪user_agent, force_download, force_filename, proxies, etag_timeout,␣
 ↪resume_download, token, local_files_only, legacy_cache_layout, endpoint)
   1372 elif isinstance(head_call_error, RepositoryNotFoundError) or␣
 ↪isinstance(head_call_error, GatedRepoError):
   1373     # Repo not found => let's raise the actual error
-> 1374     raise head_call_error
   1375 else:
   1376     # Otherwise: most likely a connection issue or Hub downtime => let'␣
 ↪warn the user

File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
 ↪1247, in hf_hub_download(repo_id, filename, subfolder, repo_type, revision,␣
 ↪library_name, library_version, cache_dir, local_dir, local_dir_use_symlinks,␣
 ↪user_agent, force_download, force_filename, proxies, etag_timeout,␣
 ↪resume_download, token, local_files_only, legacy_cache_layout, endpoint)
   1246 try:
-> 1247     metadata = get_hf_file_metadata(
   1248         url=url,
   1249         token=token,
   1250         proxies=proxies,
   1251         timeout=etag_timeout,
   1252     )
   1253 except EntryNotFoundError as http_error:
   1254     # Cache the non-existence of the file and raise
```

```
File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/utils/_validators
  ↪py:118, in validate_hf_hub_args.<locals>._inner_fn(*args, **kwargs)
    116     kwargs = smoothly_deprecate_use_auth_token(fn_name=fn.__name__,␣
  ↪has_token=has_token, kwargs=kwargs)
--> 118 return fn(*args, **kwargs)


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
  ↪1624, in get_hf_file_metadata(url, token, proxies, timeout)
    1623 # Retrieve metadata
-> 1624 r = _request_wrapper(
    1625     method="HEAD",
    1626     url=url,
    1627     headers=headers,
    1628     allow_redirects=False,
    1629     follow_relative_redirects=True,
    1630     proxies=proxies,
    1631     timeout=timeout,
    1632 )
    1633 hf_raise_for_status(r)


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
  ↪402, in _request_wrapper(method, url, follow_relative_redirects, **params)
    401 if follow_relative_redirects:
--> 402     response = _request_wrapper(
    403         method=method,
    404         url=url,
    405         follow_relative_redirects=False,
    406         **params,
    407     )
    409     # If redirection, we redirect only relative paths.
    410     # This is useful in case of a renamed repository.


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/file_download.py:
  ↪426, in _request_wrapper(method, url, follow_relative_redirects, **params)
    425 response = get_session().request(method=method, url=url, **params)
--> 426 hf_raise_for_status(response)
    427 return response


File ~/anaconda3/lib/python3.11/site-packages/huggingface_hub/utils/_errors.py:
  ↪320, in hf_raise_for_status(response, endpoint_name)
    312     message = (
    313         f"{response.status_code} Client Error."
    314         + "\n\n"
    (…)
    318         " make sure you are authenticated."
    319     )
--> 320     raise RepositoryNotFoundError(message, response) from e
    322 elif response.status_code == 400:
```

```
RepositoryNotFoundError: 401 Client Error. (Request ID:␣
 ↪Root=1-6574ff10-544f0ad83a0e11b9611ac46e;260f302e-4a40-4b20-8303-ff2163bbc870

Repository Not Found for url: https://huggingface.co/AI-Sweden/gpt-sw3-356m/
 ↪resolve/main/tokenizer_config.json.
Please make sure you specified the correct `repo_id` and `repo_type`.
If you are trying to access a private or gated repo, make sure you are␣
 ↪authenticated.
Invalid username or password.

The above exception was the direct cause of the following exception:

OSError                                   Traceback (most recent call last)
Cell In[42], line 1
----> 1 tokenizer = AutoTokenizer.from_pretrained("AI-Sweden/gpt-sw3-356m")
      3 model = TFAutoModelForSequenceClassification.from_pretrained("AI-Sweden
 ↪gpt-sw3-356m")
      5 model.compile(optimizer=Adam(1e-5))

File ~/anaconda3/lib/python3.11/site-packages/transformers/models/auto/
 ↪tokenization_auto.py:718, in AutoTokenizer.from_pretrained(cls,␣
 ↪pretrained_model_name_or_path, *inputs, **kwargs)
    715         return tokenizer_class.
 ↪from_pretrained(pretrained_model_name_or_path, *inputs, **kwargs)
    717 # Next, let's try to use the tokenizer_config file to get the tokenizer
 ↪class.
--> 718 tokenizer_config = get_tokenizer_config(pretrained_model_name_or_path,␣
 ↪**kwargs)
    719 if "_commit_hash" in tokenizer_config:
    720     kwargs["_commit_hash"] = tokenizer_config["_commit_hash"]

File ~/anaconda3/lib/python3.11/site-packages/transformers/models/auto/
 ↪tokenization_auto.py:550, in␣
 ↪get_tokenizer_config(pretrained_model_name_or_path, cache_dir, force_download␣
 ↪resume_download, proxies, token, revision, local_files_only, subfolder,␣
 ↪**kwargs)
    547     token = use_auth_token
    549 commit_hash = kwargs.get("_commit_hash", None)
--> 550 resolved_config_file = cached_file(
    551     pretrained_model_name_or_path,
    552     TOKENIZER_CONFIG_FILE,
    553     cache_dir=cache_dir,
    554     force_download=force_download,
    555     resume_download=resume_download,
    556     proxies=proxies,
    557     token=token,
    558     revision=revision,
    559     local_files_only=local_files_only,
```

```
  560      subfolder=subfolder,
  561      _raise_exceptions_for_missing_entries=False,
  562      _raise_exceptions_for_connection_errors=False,
  563      _commit_hash=commit_hash,
  564 )
  565 if resolved_config_file is None:
  566      logger.info("Could not locate the tokenizer configuration file, will␣
↪try to use the model config instead.")
```

File ~/anaconda3/lib/python3.11/site-packages/transformers/utils/hub.py:451, in␣
  ↪cached_file(path_or_repo_id, filename, cache_dir, force_download,␣
  ↪resume_download, proxies, token, revision, local_files_only, subfolder,␣
  ↪repo_type, user_agent, _raise_exceptions_for_missing_entries,␣
  ↪_raise_exceptions_for_connection_errors, _commit_hash, **deprecated_kwargs)

```
  445      raise EnvironmentError(
  446          "You are trying to access a gated repo.\nMake sure to request␣
↪access at "
  447          f"https://huggingface.co/{path_or_repo_id} and pass a token␣
↪having permission to this repo either "
  448          "by logging in with `huggingface-cli login` or by passing␣
↪`token=<your_token>`."
  449      ) from e
  450 except RepositoryNotFoundError as e:
--> 451      raise EnvironmentError(
  452          f"{path_or_repo_id} is not a local folder and is not a valid␣
↪model identifier "
  453          "listed on 'https://huggingface.co/models'\nIf this is a private␣
↪repository, make sure to pass a token "
  454          "having permission to this repo either by logging in with␣
↪`huggingface-cli login` or by passing "
  455          "`token=<your_token>`"
  456      ) from e
  457 except RevisionNotFoundError as e:
  458      raise EnvironmentError(
  459          f"{revision} is not a valid git identifier (branch name, tag␣
↪name or commit id) that exists "
  460          "for this model name. Check the model page at "
  461          f"'https://huggingface.co/{path_or_repo_id}' for available␣
↪revisions."
  462      ) from e
```

OSError: AI-Sweden/gpt-sw3-356m is not a local folder and is not a valid model␣
  ↪identifier listed on 'https://huggingface.co/models'
If this is a private repository, make sure to pass a token having permission to␣
  ↪this repo either by logging in with `huggingface-cli login` or by passing␣
  ↪`token=<your_token>`