0. Install Dependencies and Bring in Data

In [1]:
```
import os
import pandas as pd
import tensorflow as tf
import numpy as np
```

```
C:\Users\kkliv\anaconda3\lib\site-packages\scipy\__init__.py:146: UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this version of SciPy (detected version 1.26.1
  warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}"
```

In [2]:
```
df = pd.read_csv(r'E://Toxic Comment Classification//Toxic-Comment-Classification//train
```

In [3]:
```
df.head()
```

Out[3]:

	id	comment_text	toxic	severe_toxic	obscene	threat	insult	identity_hate
0	0000997932d777bf	Explanation\r\nWhy the edits made under my use...	0	0	0	0	0	0
1	000103f0d9cfb60f	D'aww! He matches this background colour I'm s...	0	0	0	0	0	0
2	000113f07ec002fd	Hey man, I'm really not trying to edit war. It...	0	0	0	0	0	0
3	0001b41b1c6bb37e	"\r\nMore\r\nI can't make any real suggestions...	0	0	0	0	0	0
4	0001d958c54c6e35	You, sir, are my hero. Any chance you remember...	0	0	0	0	0	0

In [4]:
```
df.tail(20)
```

Out[4]:

	id	comment_text	toxic	severe_toxic	obscene	threat	insult	identity_hate
159551	ffbc2db4225258dd	While about half the references are from BYU-I...	0	0	0	0	0	0
159552	ffbcd64a71775e04	Prague Spring \r\n\r\nI think that Prague Spri...	0	0	0	0	0	0
159553	ffbd331a3aa269b9	I see this as having been merged; undoing one ...	0	0	0	0	0	0
159554	ffbdbb0483ed0841	and i'm going to keep posting the stuff u dele...	1	0	1	0	1	0
159555	ffc2f409658571f1	"\r\n\r\nHow come when you download that MP3 i...	0	0	0	0	0	0
159556	ffc671f2acdd80e1	I'll be on IRC, too, if you have a more specif...	0	0	0	0	0	0
159557	ffc7bbb177c3c966	It is my opinion that that happens to be off-t...	0	0	0	0	0	0
159558	ffca1e81aefc48ac	Please stop removing content from Wikipedia; i...	0	0	0	0	0	0

159559	ffca8d71d71a3fae	Image:Barack-obama-mother.jpg listed for delet...	0	0	0	0	0	0
159560	ffcdcb71854f6d8a	"Editing of article without Consensus & Remova...	0	0	0	0	0	0
159561	ffd2e85b07b3c7e4	"\r\nNo he did not, read it again (I would hav...	0	0	0	0	0	0
159562	ffd72e9766c09c97	"\r\n Auto guides and the motoring press are n...	0	0	0	0	0	0
159563	ffe029a7c79dc7fe	"\r\nplease identify what part of BLP applies ...	0	0	0	0	0	0
159564	ffe897e7f7182c90	Catalan independentism is the social movement ...	0	0	0	0	0	0
159565	ffe8b9316245be30	The numbers in parentheses are the additional ...	0	0	0	0	0	0
159566	ffe987279560d7ff	":::::And for the second time of asking, when ...	0	0	0	0	0	0
159567	ffea4adeee384e90	You should be ashamed of yourself \r\n\r\nThat...	0	0	0	0	0	0
159568	ffee36eab5c267c9	Spitzer \r\n\r\nUmm, theres no actual article ...	0	0	0	0	0	0
159569	fff125370e4aaaf3	And it looks like it was actually you who put ...	0	0	0	0	0	0
159570	fff46fc426af1f9a	"\r\nAnd ... I really don't think you understa...	0	0	0	0	0	0

In [5]:
```
df.iloc[9]['comment_text']
```

Out[5]:
```
'alignment on this subject and which are contrary to those of DuLithgow'
```

In [6]:
```
df.iloc[159554]['comment_text']
```

Out[6]:
```
"and i'm going to keep posting the stuff u deleted until this fucking site closes down h
ave fun u stupid ass bitch don't ever delete anything fuckin hore like i said before go
to hell"
```

In [7]:
```
df.columns
```

Out[7]:
```
Index(['id', 'comment_text', 'toxic', 'severe_toxic', 'obscene', 'threat',
       'insult', 'identity_hate'],
      dtype='object')
```

In [8]:
```
df[df.columns[2:]]
```

Out[8]:

	toxic	severe_toxic	obscene	threat	insult	identity_hate
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0

...	...	...	...	...	...	...
159566	0	0	0	0	0	0
159567	0	0	0	0	0	0
159568	0	0	0	0	0	0
159569	0	0	0	0	0	0
159570	0	0	0	0	0	0

159571 rows × 6 columns

In [9]:
```
df[df.columns[2:]].iloc[159554]
```

Out[9]:
```
toxic            1
severe_toxic     0
obscene          1
threat           0
insult           1
identity_hate    0
Name: 159554, dtype: int64
```

In [10]:
```
df[df['identity_hate']==1].head()
```

Out[10]:

	id	comment_text	toxic	severe_toxic	obscene	threat	insult	identity_hate
42	001810bf8c45bf5f	You are gay or antisemmitian? \r\n\r\nArchange...	1	0	1	0	1	1
105	00472b8e2d38d1ea	A pair of jew-hating weiner nazi schmucks.	1	0	1	0	1	1
176	006b94add72ed61c	I think that your a Fagget get a oife and burn...	1	0	1	1	1	1
218	008e0818dde894fb	Kill all niggers. \r\n\r\nI have hard, that ot...	1	0	1	0	1	1
238	0097dd5c29bf7a15	u r a tw@ fuck off u gay boy.U r smelly.Fuck u...	1	0	1	0	1	1

1. Preprocess

In [11]:
```
from tensorflow.keras.layers import TextVectorization
```

In [12]:
```
X = df['comment_text']
X
```

Out[12]:
```
0         Explanation\r\nWhy the edits made under my use...
1         D'aww! He matches this background colour I'm s...
2         Hey man, I'm really not trying to edit war. It...
3         "\r\nMore\r\nI can't make any real suggestions...
4         You, sir, are my hero. Any chance you remember...
                              ...
159566    ":::::And for the second time of asking, when ...
159567    You should be ashamed of yourself \r\n\r\nThat...
159568    Spitzer \r\n\r\nUmm, theres no actual article ...
159569    And it looks like it was actually you who put ...
159570    "\r\nAnd ... I really don't think you understa...
Name: comment_text, Length: 159571, dtype: object
```

In [13]:
```
y = df[df.columns[2:]]
y
```

Out[13]:

	toxic	severe_toxic	obscene	threat	insult	identity_hate
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
...	...	...	...	...	...	...
159566	0	0	0	0	0	0
159567	0	0	0	0	0	0
159568	0	0	0	0	0	0
159569	0	0	0	0	0	0
159570	0	0	0	0	0	0

159571 rows × 6 columns

In [14]:
```
y = df[df.columns[2:]].values
y
```

Out[14]:
```
array([[0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       ...,
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0]], dtype=int64)
```

In [15]:
```
MAX_FEATURES = 200000 # number of words in the dictionary --> more words = effective mod
```

In [16]:
```
vectorizer = TextVectorization(max_tokens=MAX_FEATURES,
                               output_sequence_length=1800,
                               output_mode='int')
```

In [17]:
```
vectorizer.adapt(X.values)
```

In [18]:
```
type(X)
```

Out[18]:
```
pandas.core.series.Series
```

In [19]:
```
type(X.values)
```

Out[19]:
```
numpy.ndarray
```

In [20]:
```
vectorizer.get_vocabulary()
```

Out[20]:
```
['',
 '[UNK]',
 'the',
 'to',
 'of',
 'and',
 'a',
```

```
'you',
'i',
'is',
'that',
'in',
'it',
'for',
'this',
'not',
'on',
'be',
'as',
'have',
'are',
'your',
'with',
'if',
'article',
'was',
'or',
'but',
'page',
'my',
'an',
'from',
'by',
'do',
'at',
'about',
'me',
'so',
'wikipedia',
'can',
'what',
'there',
'all',
'has',
'will',
'talk',
'please',
'would',
'its',
'no',
'one',
'just',
'like',
'they',
'he',
'dont',
'which',
'any',
'been',
'should',
'more',
'we',
'some',
'other',
'who',
'see',
'here',
'also',
'his',
'think',
'im',
'because',
'know',
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'how',
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'why',
'edit',
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'when',
'were',
'use',
'then',
'may',
'time',
'did',
'them',
'now',
'being',
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'information',
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'want',
'such',
'sources',
'way',
'name',
'these',
'deletion',
'pages',
'first',
'help',
'new',
'editing',
'source',
'go',
'need',
'say',
'section',
'edits',
'again',
'thank',
'where',
'user',
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'much',
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'discussion',
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'into',
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'point',
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'read',
'image',
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'still',
'over',
'someone',
'him',
'two',
'back',
'too',
'fact',
'link',
'said',
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'something',
'going',
'youre',
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'stop',
'without',
'content',
'hi',
'under',
'editors',
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'block',
'thats',
'us',
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'history',
'another',
'doesnt',
'removed',
'might',
'note',
'however',
'sure',
'place',
'never',
'done',
'welcome',
'her',
'case',
'put',
'personal',
'seems',
'reason',
'better',
'using',
'yourself',
'cant',
'actually',
'ask',
'comment',
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'believe',
'person',
'links',
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'war',
'notable',
'contributions',
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'material',
'book',
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'lot',
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'box',
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'june',
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'abuse',
'arguments',
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'shall',
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'tutorial',
'january',
'friends',
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'house',
'finally',
'absolutely',
'putting',
'scientific',
'respond',
'mistake',
'decision',
'de',
'lost',
'entirely',
'100',
'towards',
'merely',
'home',
'neither',
'dear',
'independent',
'international',
'song',
'balls',
'wants',
'possibly',
'unsigned',
'million',
'irrelevant',
'standards',
'april',
'12',
'press',
'figure',
'organization',
'looked',
'inappropriate',
'chance',
'posting',
'population',
'advice',
'posts',
'north',
'events',
```

```
 'unfortunately',
 'named',
 'album',
 ...]
```

In [21]:
```
vectorizer("Hello, good to be here")[:7]
```

Out[21]:
```
<tf.Tensor: shape=(7,), dtype=int64, numpy=array([288,  98,   3,  17,  66,   0,   0], dt
ype=int64)>
```

In [22]:
```
vectorized_text = vectorizer(X.values)
```

In [23]:
```
vectorized_text  #numeric representation of all the sentences
```

Out[23]:
```
<tf.Tensor: shape=(159571, 1800), dtype=int64, numpy=
array([[  645,    76,     2, ...,     0,     0,     0],
       [    1,    54,  2489, ...,     0,     0,     0],
       [  425,   441,    70, ...,     0,     0,     0],
       ...,
       [32445,  7392,   383, ...,     0,     0,     0],
       [    5,    12,   534, ...,     0,     0,     0],
       [    5,     8,   130, ...,     0,     0,     0]], dtype=int64)>
```

In [24]:
```
dataset = tf.data.Dataset.from_tensor_slices((vectorized_text, y))
dataset = dataset.cache()
dataset = dataset.shuffle(160000)
dataset = dataset.batch(16)
dataset = dataset.prefetch(8)
```

In [25]:
```
batch_X, batch_y=dataset.as_numpy_iterator().next()
```

In [26]:
```
batch_X
```

Out[26]:
```
array([[   7,  120,   70, ...,    0,    0,    0],
       [ 152, 2077,   13, ...,    0,    0,    0],
       [ 783,   34,  116, ...,    0,    0,    0],
       ...,
       [   6,    1,  772, ...,    0,    0,    0],
       [   9,   60,   93, ...,    0,    0,    0],
       [ 797,  148,   62, ...,    0,    0,    0]], dtype=int64)
```

In [27]:
```
batch_X.shape
```

Out[27]:
```
(16, 1800)
```

In [28]:
```
batch_y
```

Out[28]:
```
array([[0, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 1, 0, 1, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 1, 0, 1, 0]], dtype=int64)
```

In [29]:
```
batch_y.shape
```

Out[29]:
```
(16, 6)
```

In [30]:
```
len(dataset)    #batches --> actual data 9974*16
```

Out[30]:
```
9974
```

In [31]:
```
train = dataset.take(int(len(dataset)*.7))
val = dataset.skip(int(len(dataset)*.7)).take(int(len(dataset)*.2))
test = dataset.skip(int(len(dataset)*.9)).take(int(len(dataset)*.1))
```

In [32]:
```
int(len(dataset)*.7)
```

Out[32]:
```
6981
```

In [33]:
```
len(train)
```

Out[33]:
```
6981
```

In [34]:
```
len(val)
```

Out[34]:
```
1994
```

In [35]:
```
len(test)
```

Out[35]:
```
997
```

In [36]:
```
train.as_numpy_iterator().next()
```

Out[36]:
```
(array([[    94,     13,      2, ...,      0,      0,      0],
        [  1112,    880,    179, ...,      0,      0,      0],
        [     7,     72,    165, ...,      0,      0,      0],
        ...,
        [    70,     15,    187, ...,      0,      0,      0],
        [   257,      9,      6, ...,      0,      0,      0],
        [170960,     37,      7, ...,      0,      0,      0]], dtype=int64),
 array([[0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [1, 0, 0, 0, 0, 0],
        [1, 1, 1, 1, 1, 0],
        [1, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 1, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0],
        [0, 0, 0, 0, 0, 0]], dtype=int64))
```

2. Create Sequential Model

In [37]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dropout, Bidirectional, Dense, Embedding
```

In [38]:
```
model = Sequential()
```

```
# Create the embedding layer
model.add(Embedding(MAX_FEATURES+1, 32))
# Bidirectional LSTM Layer
model.add(Bidirectional(LSTM(32, activation='tanh')))
# Feature extractor Fully connected layers
model.add(Dense(128, activation='relu'))
model.add(Dense(256, activation='relu'))
model.add(Dense(128, activation='relu'))
# Final layer
model.add(Dense(6, activation='sigmoid'))
```

In [39]:
```
model.compile(loss='BinaryCrossentropy', optimizer='Adam')
```

In [40]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, None, 32)          6400032

 bidirectional (Bidirection  (None, 64)                16640
 al)

 dense (Dense)               (None, 128)               8320

 dense_1 (Dense)             (None, 256)               33024

 dense_2 (Dense)             (None, 128)               32896

 dense_3 (Dense)             (None, 6)                 774

=================================================================
Total params: 6491686 (24.76 MB)
Trainable params: 6491686 (24.76 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

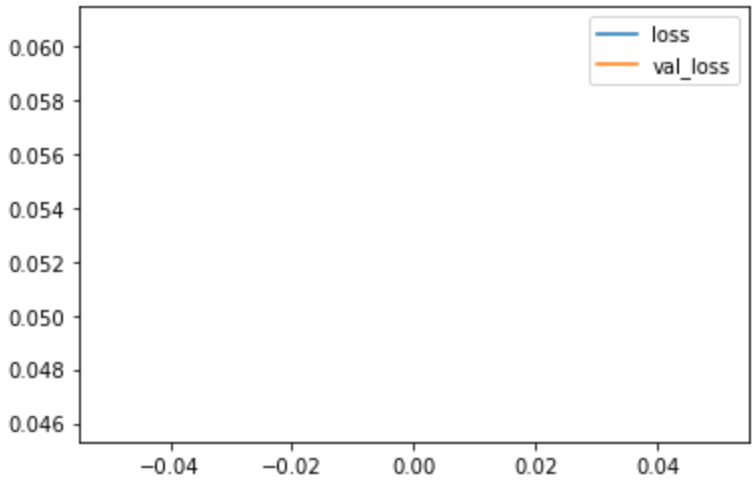
In [42]:
```
history = model.fit(train, epochs=1, validation_data=val)
```

```
6981/6981 [==============================] - 18326s 3s/step - loss: 0.0607 - val_loss:
0.0460
```

In [43]:
```
from matplotlib import pyplot as plt
```

In [44]:
```
plt.figure(figsize=(8,5))
pd.DataFrame(history.history).plot()
plt.show()
```

```
<Figure size 576x360 with 0 Axes>
```



3. Make Predictions

In [46]:
```
input_text = vectorizer('You freaking suck! I am going to hit you.')
input_text
```

Out[46]:
```
<tf.Tensor: shape=(1800,), dtype=int64, numpy=array([   7, 7158,  397, ...,    0,    0,
   0], dtype=int64)>
```

In [49]:
```
#we need to pass it as a batch or else it will fail
model.predict(np.array([input_text]))
```

Out[49]:
```
1/1 [==============================] - 3s 3s/step
array([[0.961524  , 0.11802247, 0.75394416, 0.04971987, 0.6408938 ,
        0.16319373]], dtype=float32)
```

In [50]:
```
model.predict(np.expand_dims(input_text,0))
```

Out[50]:
```
1/1 [==============================] - 0s 235ms/step
array([[0.961524  , 0.11802247, 0.75394416, 0.04971987, 0.6408938 ,
        0.16319373]], dtype=float32)
```

In [51]:
```
batch=test.as_numpy_iterator().next()
```

In [54]:
```
batch_X , batch_Y = test.as_numpy_iterator().next()
```

In [55]:
```
model.predict(batch_X)
```

Out[55]:
```
1/1 [==============================] - 6s 6s/step
array([[4.50850045e-03, 2.59418630e-06, 5.89346688e-04, 5.91314802e-06,
        4.64477984e-04, 3.69019363e-05],
       [1.77046400e-03, 5.13831537e-07, 2.35924264e-04, 1.24589712e-06,
        1.59405899e-04, 9.69309258e-06],
       [1.93284685e-03, 6.62488162e-07, 2.76593200e-04, 1.56323381e-06,
        1.85518438e-04, 1.17782174e-05],
       [6.06712012e-04, 1.63474887e-08, 1.68531478e-05, 5.62562903e-08,
        1.14478744e-05, 7.14955490e-07],
       [1.59990694e-02, 1.59575920e-05, 1.04969554e-03, 3.92799011e-05,
        9.82388388e-04, 1.86011021e-04],
       [2.15792507e-02, 5.39309003e-05, 3.30712157e-03, 1.12968955e-04,
        3.03054834e-03, 4.44345642e-04],
       [1.90880185e-03, 5.76597245e-07, 2.50680314e-04, 1.39684403e-06,
        1.71880863e-04, 1.06934085e-05],
       [1.29472837e-02, 8.72027795e-06, 8.79514497e-04, 2.08021629e-05,
        9.09198017e-04, 1.10779547e-04],
       [5.07204950e-01, 1.36037413e-02, 1.58960536e-01, 1.48583092e-02,
        1.91050380e-01, 3.96840684e-02],
       [1.23664457e-03, 2.74918108e-07, 1.66895770e-04, 6.78650167e-07,
```

```
        1.06457592e-04, 5.76967477e-06],
       [5.71070332e-03, 1.98996440e-06, 3.55501979e-04, 5.03754154e-06,
        3.25425586e-04, 3.27858615e-05],
       [5.48279583e-01, 2.31544375e-02, 2.25438535e-01, 2.31442284e-02,
        2.59833544e-01, 5.99118620e-02],
       [7.00560305e-03, 2.35169455e-06, 3.58894293e-04, 6.28689850e-06,
        3.36984609e-04, 3.89805937e-05],
       [1.41342566e-03, 2.49342492e-07, 1.37791998e-04, 6.35295748e-07,
        9.73706046e-05, 5.50550612e-06],
       [1.29067979e-03, 3.05653771e-07, 1.72154294e-04, 7.35487106e-07,
        1.12599104e-04, 6.22002790e-06],
       [1.42857060e-01, 1.51019997e-03, 2.85696220e-02, 2.78590573e-03,
        3.17012258e-02, 7.37080956e-03]], dtype=float32)
```

In [56]:
```
model.predict(batch_X > 0.5)
```

```
1/1 [==============================] - 6s 6s/step
```

Out[56]:
```
array([[0.07986351, 0.00035409, 0.01171489, 0.00071133, 0.01269556,
        0.00230559],
       [0.08740343, 0.00039909, 0.01275005, 0.00078889, 0.01399588,
        0.0025556 ],
       [0.07888258, 0.00036947, 0.01205757, 0.00075035, 0.01294691,
        0.00237308],
       [0.1296341 , 0.00103509, 0.02298508, 0.00192973, 0.02586812,
        0.00542858],
       [0.16884047, 0.0017227 , 0.02826667, 0.00305232, 0.03394142,
        0.00815296],
       [0.09125415, 0.00052837, 0.01516997, 0.00105395, 0.01636561,
        0.00316396],
       [0.08903708, 0.00041021, 0.01299538, 0.00080866, 0.01429937,
        0.00261569],
       [0.0992744 , 0.00062549, 0.01688943, 0.00123035, 0.01837791,
        0.0036272 ],
       [0.1669277 , 0.00173373, 0.02706859, 0.00307945, 0.03269962,
        0.00817173],
       [0.09358343, 0.0004469 , 0.01374996, 0.00087513, 0.01521413,
        0.002809  ],
       [0.11167132, 0.00078428, 0.01943828, 0.00150883, 0.02145046,
        0.00435066],
       [0.0812544 , 0.00036172, 0.01189505, 0.00072386, 0.01292384,
        0.002349  ],
       [0.13913822, 0.00118522, 0.02471884, 0.0021776 , 0.02815026,
        0.00604866],
       [0.07845698, 0.00034919, 0.01160268, 0.0007051 , 0.01252738,
        0.00227515],
       [0.08329204, 0.00037352, 0.01216885, 0.00074411, 0.01326842,
        0.00241524],
       [0.08070921, 0.00039575, 0.01260007, 0.00080243, 0.01350989,
        0.00250535]], dtype=float32)
```

In [57]:
```
(model.predict(batch_X)>0.5).astype(int)
```

```
1/1 [==============================] - 0s 477ms/step
```

Out[57]:
```
array([[0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
```

```
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0]])
```

In [58]:
```
batch_Y
```

Out[58]:
```
array([[0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [1, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0],
       [0, 0, 0, 0, 0, 0]], dtype=int64)
```

4. Evaluate Model

In [60]:
```
from tensorflow.keras.metrics import Precision, Recall, CategoricalAccuracy
```

In [61]:
```
pre = Precision()
re = Recall()
acc = CategoricalAccuracy()
```

In [62]:
```
for batch in test.as_numpy_iterator():
    # Unpack the batch
    X_true, y_true = batch
    # Make a prediction
    yhat = model.predict(X_true)

    # Flatten the predictions
    y_true = y_true.flatten()
    yhat = yhat.flatten()

    pre.update_state(y_true, yhat)
    re.update_state(y_true, yhat)
    acc.update_state(y_true, yhat)
```

```
1/1 [==============================] - 6s 6s/step
1/1 [==============================] - 1s 922ms/step
1/1 [==============================] - 1s 813ms/step
1/1 [==============================] - 1s 641ms/step
1/1 [==============================] - 1s 562ms/step
1/1 [==============================] - 1s 531ms/step
1/1 [==============================] - 1s 578ms/step
1/1 [==============================] - 1s 656ms/step
1/1 [==============================] - 0s 453ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 437ms/step
1/1 [==============================] - 1s 515ms/step
1/1 [==============================] - 0s 375ms/step
1/1 [==============================] - 0s 390ms/step
1/1 [==============================] - 0s 497ms/step
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 422ms/step
1/1 [==============================] - 0s 422ms/step
```

```
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 329ms/step
1/1 [==============================] - 0s 390ms/step
1/1 [==============================] - 0s 390ms/step
1/1 [==============================] - 1s 537ms/step
1/1 [==============================] - 1s 515ms/step
1/1 [==============================] - 0s 360ms/step
1/1 [==============================] - 0s 360ms/step
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 405ms/step
1/1 [==============================] - 0s 399ms/step
1/1 [==============================] - 0s 480ms/step
1/1 [==============================] - 1s 586ms/step
1/1 [==============================] - 2s 2s/step
1/1 [==============================] - 0s 422ms/step
1/1 [==============================] - 0s 391ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 281ms/step
1/1 [==============================] - 0s 375ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 375ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 367ms/step
1/1 [==============================] - 0s 281ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 320ms/step
1/1 [==============================] - 0s 313ms/step
1/1 [==============================] - 0s 367ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 313ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 390ms/step
1/1 [==============================] - 0s 352ms/step
1/1 [==============================] - 0s 360ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 383ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 361ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 313ms/step
1/1 [==============================] - 0s 320ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 313ms/step
1/1 [==============================] - 0s 391ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 305ms/step
1/1 [==============================] - 0s 297ms/step
```

```
1/1 [==============================] - 0s 430ms/step
1/1 [==============================] - 0s 322ms/step
1/1 [==============================] - 0s 375ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 344ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 320ms/step
1/1 [==============================] - 0s 305ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 305ms/step
1/1 [==============================] - 0s 336ms/step
1/1 [==============================] - 0s 281ms/step
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 328ms/step
1/1 [==============================] - 0s 455ms/step
1/1 [==============================] - 1s 723ms/step
1/1 [==============================] - 0s 312ms/step
1/1 [==============================] - 0s 399ms/step
1/1 [==============================] - 0s 308ms/step
1/1 [==============================] - 0s 396ms/step
1/1 [==============================] - 0s 340ms/step
1/1 [==============================] - 0s 424ms/step
1/1 [==============================] - 0s 395ms/step
1/1 [==============================] - 1s 517ms/step
1/1 [==============================] - 0s 367ms/step
1/1 [==============================] - 0s 339ms/step
1/1 [==============================] - 0s 420ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 498ms/step
1/1 [==============================] - 0s 411ms/step
1/1 [==============================] - 1s 630ms/step
1/1 [==============================] - 0s 387ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 307ms/step
1/1 [==============================] - 0s 329ms/step
1/1 [==============================] - 0s 313ms/step
1/1 [==============================] - 0s 352ms/step
1/1 [==============================] - 0s 289ms/step
1/1 [==============================] - 0s 315ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 1s 545ms/step
1/1 [==============================] - 0s 411ms/step
1/1 [==============================] - 1s 501ms/step
1/1 [==============================] - 0s 402ms/step
1/1 [==============================] - 0s 345ms/step
1/1 [==============================] - 0s 348ms/step
1/1 [==============================] - 0s 412ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 430ms/step
1/1 [==============================] - 0s 428ms/step
1/1 [==============================] - 0s 384ms/step
1/1 [==============================] - 0s 376ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 330ms/step
1/1 [==============================] - 0s 367ms/step
1/1 [==============================] - 0s 359ms/step
1/1 [==============================] - 0s 311ms/step
1/1 [==============================] - 0s 306ms/step
```

```
1/1 [==============================] - 0s 406ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 295ms/step
1/1 [==============================] - 0s 297ms/step
1/1 [==============================] - 0s 297ms/step
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In [66]:
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print(f'Precision: {pre.result().numpy()}, Recall:{re.result().numpy()}, Accuracy:{acc.r
```

```
Precision: 0.8918918967247009, Recall:0.6209186315536499, Accuracy:0.4774323105812073
```

5. Test and Gradio

In [ ]:
```
pip install typing-extensions==4.7.1
```

In [86]:
```
pip install gradio jinja2
```

```
Requirement already satisfied: gradio in c:\users\kkliv\anaconda3\lib\site-packages (4.
8.0)
Requirement already satisfied: jinja2 in c:\users\kkliv\anaconda3\lib\site-packages (2.1
1.3)
Requirement already satisfied: aiofiles<24.0,>=22.0 in c:\users\kkliv\anaconda3\lib\site
-packages (from gradio) (23.2.1)
Requirement already satisfied: altair<6.0,>=4.2.0 in c:\users\kkliv\anaconda3\lib\site-p
ackages (from gradio) (5.2.0)
Requirement already satisfied: fastapi in c:\users\kkliv\anaconda3\lib\site-packages (fr
om gradio) (0.104.1)
Requirement already satisfied: ffmpy in c:\users\kkliv\anaconda3\lib\site-packages (from
gradio) (0.3.1)
Requirement already satisfied: gradio-client==0.7.1 in c:\users\kkliv\anaconda3\lib\site
-packages (from gradio) (0.7.1)
Requirement already satisfied: httpx in c:\users\kkliv\anaconda3\lib\site-packages (from
gradio) (0.25.2)
Requirement already satisfied: huggingface-hub>=0.14.0 in c:\users\kkliv\anaconda3\lib\s
ite-packages (from gradio) (0.19.4)
Requirement already satisfied: importlib-resources<7.0,>=1.3 in c:\users\kkliv\anaconda3
\lib\site-packages (from gradio) (6.1.1)
Requirement already satisfied: markupsafe~=2.0 in c:\users\kkliv\anaconda3\lib\site-pack
ages (from gradio) (2.0.1)
Requirement already satisfied: matplotlib~=3.0 in c:\users\kkliv\anaconda3\lib\site-pack
ages (from gradio) (3.5.1)
Requirement already satisfied: numpy~=1.0 in c:\users\kkliv\anaconda3\lib\site-packages
(from gradio) (1.26.1)
Requirement already satisfied: orjson~=3.0 in c:\users\kkliv\anaconda3\lib\site-packages
(from gradio) (3.9.10)
Requirement already satisfied: packaging in c:\users\kkliv\anaconda3\lib\site-packages
(from gradio) (21.3)
Requirement already satisfied: pandas<3.0,>=1.0 in c:\users\kkliv\anaconda3\lib\site-pac
kages (from gradio) (1.4.2)
Requirement already satisfied: pillow<11.0,>=8.0 in c:\users\kkliv\anaconda3\lib\site-pa
ckages (from gradio) (10.1.0)
Requirement already satisfied: pydantic>=2.0 in c:\users\kkliv\anaconda3\lib\site-packag
es (from gradio) (2.5.2)
Requirement already satisfied: pydub in c:\users\kkliv\anaconda3\lib\site-packages (from
gradio) (0.25.1)
Requirement already satisfied: python-multipart in c:\users\kkliv\anaconda3\lib\site-pac
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Requirement already satisfied: pyyaml<7.0,>=5.0 in c:\users\kkliv\anaconda3\lib\site-pac
kages (from gradio) (6.0)
Requirement already satisfied: requests~=2.0 in c:\users\kkliv\anaconda3\lib\site-packag
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Requirement already satisfied: semantic-version~=2.0 in c:\users\kkliv\anaconda3\lib\sit
e-packages (from gradio) (2.10.0)
Requirement already satisfied: tomlkit==0.12.0 in c:\users\kkliv\anaconda3\lib\site-pack
ages (from gradio) (0.12.0)
Requirement already satisfied: typer<1.0,>=0.9 in c:\users\kkliv\anaconda3\lib\site-pack
ages (from typer[all]<1.0,>=0.9->gradio) (0.9.0)
Requirement already satisfied: typing-extensions~=4.0 in c:\users\kkliv\anaconda3\lib\si
te-packages (from gradio) (4.8.0)
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ages (from gradio) (0.24.0.post1)
Requirement already satisfied: fsspec in c:\users\kkliv\anaconda3\lib\site-packages (fro
m gradio-client==0.7.1->gradio) (2023.5.0)
Requirement already satisfied: websockets<12.0,>=10.0 in c:\users\kkliv\anaconda3\lib\si
te-packages (from gradio-client==0.7.1->gradio) (10.4)
Requirement already satisfied: jsonschema>=3.0 in c:\users\kkliv\anaconda3\lib\site-pack
ages (from altair<6.0,>=4.2.0->gradio) (4.4.0)
Requirement already satisfied: toolz in c:\users\kkliv\anaconda3\lib\site-packages (from
altair<6.0,>=4.2.0->gradio) (0.11.2)
Requirement already satisfied: filelock in c:\users\kkliv\anaconda3\lib\site-packages (f
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rom huggingface-hub>=0.14.0->gradio) (3.6.0)
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s (from huggingface-hub>=0.14.0->gradio) (4.64.0)
Requirement already satisfied: zipp>=3.1.0 in c:\users\kkliv\anaconda3\lib\site-packages
(from importlib-resources<7.0,>=1.3->gradio) (3.7.0)
Requirement already satisfied: cycler>=0.10 in c:\users\kkliv\anaconda3\lib\site-package
s (from matplotlib~=3.0->gradio) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\kkliv\anaconda3\lib\site-pa
ckages (from matplotlib~=3.0->gradio) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\kkliv\anaconda3\lib\site-pa
ckages (from matplotlib~=3.0->gradio) (1.3.2)
Requirement already satisfied: pyparsing>=2.2.1 in c:\users\kkliv\anaconda3\lib\site-pac
kages (from matplotlib~=3.0->gradio) (3.0.4)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\kkliv\anaconda3\lib\site
-packages (from matplotlib~=3.0->gradio) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\users\kkliv\anaconda3\lib\site-package
s (from pandas<3.0,>=1.0->gradio) (2021.3)
Requirement already satisfied: annotated-types>=0.4.0 in c:\users\kkliv\anaconda3\lib\si
te-packages (from pydantic>=2.0->gradio) (0.6.0)
Requirement already satisfied: pydantic-core==2.14.5 in c:\users\kkliv\anaconda3\lib\sit
e-packages (from pydantic>=2.0->gradio) (2.14.5)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in c:\users\kkliv\anaconda3\lib\sit
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Requirement already satisfied: certifi>=2017.4.17 in c:\users\kkliv\anaconda3\lib\site-p
ackages (from requests~=2.0->gradio) (2021.10.8)
Requirement already satisfied: charset-normalizer~=2.0.0 in c:\users\kkliv\anaconda3\lib
\site-packages (from requests~=2.0->gradio) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\kkliv\anaconda3\lib\site-package
s (from requests~=2.0->gradio) (3.3)
Requirement already satisfied: click<9.0.0,>=7.1.1 in c:\users\kkliv\anaconda3\lib\site-
packages (from typer<1.0,>=0.9->typer[all]<1.0,>=0.9->gradio) (8.0.4)
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Requirement already satisfied: shellingham<2.0.0,>=1.3.0 in c:\users\kkliv\anaconda3\lib
\site-packages (from typer[all]<1.0,>=0.9->gradio) (1.5.4)
Requirement already satisfied: rich<14.0.0,>=10.11.0 in c:\users\kkliv\anaconda3\lib\sit
e-packages (from typer[all]<1.0,>=0.9->gradio) (13.7.0)
Requirement already satisfied: h11>=0.8 in c:\users\kkliv\anaconda3\lib\site-packages (f
rom uvicorn>=0.14.0->gradio) (0.14.0)
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packages (from fastapi->gradio) (3.7.1)
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\site-packages (from fastapi->gradio) (0.27.0)
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Requirement already satisfied: exceptiongroup in c:\users\kkliv\anaconda3\lib\site-packa
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Requirement already satisfied: attrs>=17.4.0 in c:\users\kkliv\anaconda3\lib\site-packag
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Requirement already satisfied: pyrsistent!=0.17.0,!=0.17.1,!=0.17.2,>=0.14.0 in c:\users
\kkliv\anaconda3\lib\site-packages (from jsonschema>=3.0->altair<6.0,>=4.2.0->gradio)
(0.18.0)
Requirement already satisfied: six>=1.5 in c:\users\kkliv\anaconda3\lib\site-packages (f
rom python-dateutil>=2.7->matplotlib~=3.0->gradio) (1.16.0)
Requirement already satisfied: markdown-it-py>=2.2.0 in c:\users\kkliv\anaconda3\lib\sit
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ite-packages (from rich<14.0.0,>=10.11.0->typer[all]<1.0,>=0.9->gradio) (2.17.2)
Requirement already satisfied: mdurl~=0.1 in c:\users\kkliv\anaconda3\lib\site-packages
(from markdown-it-py>=2.2.0->rich<14.0.0,>=10.11.0->typer[all]<1.0,>=0.9->gradio) (0.1.
2)
Note: you may need to restart the kernel to use updated packages.
```

In [94]:
```
import tensorflow as tf
import gradio as gr
```

```
---------------------------------------------------------------------------
ImportError                               Traceback (most recent call last)
Input In [94], in <cell line: 2>()
      1 import tensorflow as tf
----> 2 import gradio as gr

File ~\anaconda3\lib\site-packages\gradio\__init__.py:3, in <module>
      1 import json
----> 3 import gradio._simple_templates
      4 import gradio.components as components
      5 import gradio.image_utils

File ~\anaconda3\lib\site-packages\gradio\_simple_templates\__init__.py:1, in <module>
----> 1 from .simpledropdown import SimpleDropdown
      2 from .simpletextbox import SimpleTextbox
      4 __all__ = ["SimpleDropdown", "SimpleTextbox"]

File ~\anaconda3\lib\site-packages\gradio\_simple_templates\simpledropdown.py:6, in <mod
ule>
      3 import warnings
      4 from typing import Any, Callable
----> 6 from gradio.components.base import FormComponent
      7 from gradio.events import Events
     10 class SimpleDropdown(FormComponent):

File ~\anaconda3\lib\site-packages\gradio\components\__init__.py:1, in <module>
----> 1 from gradio.components.annotated_image import AnnotatedImage
      2 from gradio.components.audio import Audio
      3 from gradio.components.bar_plot import BarPlot

File ~\anaconda3\lib\site-packages\gradio\components\annotated_image.py:11, in <module>
      8 from gradio_client.documentation import document, set_documentation_group
      9 from PIL import Image as _Image  # using _ to minimize namespace pollution
---> 11 from gradio import processing_utils, utils
     12 from gradio.components.base import Component
     13 from gradio.data_classes import FileData, GradioModel

File ~\anaconda3\lib\site-packages\gradio\processing_utils.py:22, in <module>
     19 from PIL import Image, ImageOps, PngImagePlugin
     21 from gradio import wasm_utils
---> 22 from gradio.data_classes import FileData, GradioModel, GradioRootModel
     23 from gradio.utils import abspath
     25 with warnings.catch_warnings():

File ~\anaconda3\lib\site-packages\gradio\data_classes.py:12, in <module>
      9 from enum import Enum, auto
     10 from typing import Any, List, Optional, Union
---> 12 from fastapi import Request
     13 from gradio_client.utils import traverse
     14 from pydantic import BaseModel, RootModel, ValidationError

File ~\anaconda3\lib\site-packages\fastapi\__init__.py:7, in <module>
      3 __version__ = "0.104.1"
      5 from starlette import status as status
----> 7 from .applications import FastAPI as FastAPI
      8 from .background import BackgroundTasks as BackgroundTasks
      9 from .datastructures import UploadFile as UploadFile

File ~\anaconda3\lib\site-packages\fastapi\applications.py:16, in <module>
      1 from enum import Enum
      2 from typing import (
      3     Any,
```

```
      4     Awaitable,
   (...)
     13     Union,
     14 )
---> 16 from fastapi import routing
     17 from fastapi.datastructures import Default, DefaultPlaceholder
     18 from fastapi.exception_handlers import (
     19     http_exception_handler,
     20     request_validation_exception_handler,
     21     websocket_request_validation_exception_handler,
     22 )

File ~\anaconda3\lib\site-packages\fastapi\routing.py:22, in <module>
      7 from enum import Enum, IntEnum
      8 from typing import (
      9     Any,
     10     Callable,
   (...)
     19     Union,
     20 )
---> 22 from fastapi import params
     23 from fastapi._compat import (
     24     ModelField,
     25     Undefined,
   (...)
     29     lenient_issubclass,
     30 )
     31 from fastapi.datastructures import Default, DefaultPlaceholder

File ~\anaconda3\lib\site-packages\fastapi\params.py:5, in <module>
      2 from enum import Enum
      3 from typing import Any, Callable, Dict, List, Optional, Sequence, Union
----> 5 from fastapi.openapi.models import Example
      6 from pydantic.fields import FieldInfo
      7 from typing_extensions import Annotated, deprecated

File ~\anaconda3\lib\site-packages\fastapi\openapi\models.py:4, in <module>
      1 from enum import Enum
      2 from typing import Any, Callable, Dict, Iterable, List, Optional, Set, Type, Uni
on
----> 4 from fastapi._compat import (
      5     PYDANTIC_V2,
      6     CoreSchema,
      7     GetJsonSchemaHandler,
      8     JsonSchemaValue,
      9     _model_rebuild,
     10     with_info_plain_validator_function,
     11 )
     12 from fastapi.logger import logger
     13 from pydantic import AnyUrl, BaseModel, Field

File ~\anaconda3\lib\site-packages\fastapi\_compat.py:20, in <module>
      4 from enum import Enum
      5 from typing import (
      6     Any,
      7     Callable,
   (...)
     17     Union,
     18 )
---> 20 from fastapi.exceptions import RequestErrorModel
     21 from fastapi.types import IncEx, ModelNameMap, UnionType
     22 from pydantic import BaseModel, create_model

File ~\anaconda3\lib\site-packages\fastapi\exceptions.py:3, in <module>
      1 from typing import Any, Dict, Optional, Sequence, Type, Union
----> 3 from pydantic import BaseModel, create_model
```

```
      4 from starlette.exceptions import HTTPException as StarletteHTTPException
      5 from starlette.exceptions import WebSocketException as StarletteWebSocketExcepti
on

File ~\anaconda3\lib\site-packages\pydantic\__init__.py:372, in __getattr__(attr_name)
    370     return import_module(f'.{attr_name}', package=package)
    371 else:
--> 372     module = import_module(module_name, package=package)
    373     return getattr(module, attr_name)

File ~\anaconda3\lib\importlib\__init__.py:127, in import_module(name, package)
    125             break
    126         level += 1
--> 127 return _bootstrap._gcd_import(name[level:], package, level)

File ~\anaconda3\lib\site-packages\pydantic\main.py:11, in <module>
      8 from copy import copy, deepcopy
      9 from typing import Any, ClassVar
---> 11 import pydantic_core
     12 import typing_extensions
     13 from pydantic_core import PydanticUndefined

File ~\anaconda3\lib\site-packages\pydantic_core\__init__.py:30, in <module>
      4 from typing import Any as _Any
      6 from ._pydantic_core import (
      7     ArgsKwargs,
      8     MultiHostUrl,
   (...)
     28     validate_core_schema,
     29 )
---> 30 from .core_schema import CoreConfig, CoreSchema, CoreSchemaType, ErrorType
     32 if _sys.version_info < (3, 11):
     33     from typing_extensions import NotRequired as _NotRequired

File ~\anaconda3\lib\site-packages\pydantic_core\core_schema.py:15, in <module>
     12 from decimal import Decimal
     13 from typing import TYPE_CHECKING, Any, Callable, Dict, Hashable, List, Set, Tupl
e, Type, Union
---> 15 from typing_extensions import deprecated
     17 if sys.version_info < (3, 12):
     18     from typing_extensions import TypedDict

ImportError: cannot import name 'deprecated' from 'typing_extensions' (C:\Users\kkliv\an
aconda3\lib\site-packages\typing_extensions.py)
```

In [ ]:
```
pip uninstall typing_extensions --yes
```

In [84]:
```
pip install fsspec==2023.5.0
```

```
Collecting fsspec==2023.5.0
  Downloading fsspec-2023.5.0-py3-none-any.whl (160 kB)
     ---------------------------------- 160.1/160.1 kB 127.9 kB/s eta 0:00:00
Installing collected packages: fsspec
  Attempting uninstall: fsspec
    Found existing installation: fsspec 2022.7.1
    Uninstalling fsspec-2022.7.1:
      Successfully uninstalled fsspec-2022.7.1
Successfully installed fsspec-2023.5.0
Note: you may need to restart the kernel to use updated packages.
```

In [71]:
```
model.save('toxicity.h5')
```

```
C:\Users\kkliv\anaconda3\lib\site-packages\keras\src\engine\training.py:3079: UserWarnin
g: You are saving your model as an HDF5 file via `model.save()`. This file format is con
sidered legacy. We recommend using instead the native Keras format, e.g. `model.save('my
```

```
_model.keras')`.
  saving_api.save_model(
```

In [73]:
```
model.save('toxicity.keras')
```

In [74]:
```
model = tf.keras.models.load_model('toxicity.keras')
```

In [75]:
```
input_str = vectorizer('hey i freaken hate you!')
```

In [76]:
```
res = model.predict(np.expand_dims(input_str,0))
```

```
1/1 [==============================] - 19s 19s/step
```

In [77]:
```
res
```

Out[77]:
```
array([[0.75085115, 0.03104699, 0.35907194, 0.02500144, 0.3752753 ,
        0.08845621]], dtype=float32)
```

In [78]:
```
def score_comment(comment):
    vectorized_comment = vectorizer([comment])
    results = model.predict(vectorized_comment)

    text = ''
    for idx, col in enumerate(df.columns[2:]):
        text += '{}: {}\n'.format(col, results[0][idx]>0.5)

    return text
```

In [79]:
```
interface = gr.Interface(fn=score_comment,
                         inputs=gr.inputs.Textbox(lines=2, placeholder='Comment to score
                        outputs='text')
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Input In [79], in <cell line: 1>()
----> 1 interface = gr.Interface(fn=score_comment,
      2                          inputs=gr.inputs.Textbox(lines=2, placeholder='Comment
 to score'),
      3                         outputs='text')

NameError: name 'gr' is not defined
```

In [ ]:
```
interface.launch(share=True)
```