In [202...
```python
import re
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import warnings
warnings.filterwarnings('ignore')
# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory

from nltk.stem import WordNetLemmatizer

# Tensorflow libraries
# Tensorflow libraries
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing import text, sequence
# from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras import regularizers

import tensorflow_hub as hub


# sklearn libraries
from sklearn.model_selection import train_test_split
from sklearn.utils import class_weight
from sklearn.metrics import roc_auc_score

from gensim.models import Word2Vec # Word2Vec module
from gensim.parsing.preprocessing import preprocess_string, strip_tags, strip_punctuation, remove_stopwords, strip_numeric, stem_text


import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 5GB to the current directory (/kaggle/working/) that gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
```

```
/kaggle/input/fake-news-content-detection/train.csv
/kaggle/input/fake-news-content-detection/test.csv
/kaggle/input/fake-news-content-detection/sample submission.csv
```

Load Dataset

In [203...
```python
train_data = pd.read_csv("/kaggle/input/fake-news-content-detection/train.csv")
test_data = pd.read_csv("/kaggle/input/fake-news-content-detection/test.csv")
submission_data = pd.read_csv("/kaggle/input/fake-news-content-detection/sample submission.csv")
```

In [204...
```python
# Sample data from training data
train_data.sample(3)
```

Out[204...

	Labels	Text	Text_Tag
8026	4	Rick Santorum says Rick Perry requested 1,200 ...	congress,federal-budget
5841	0	Studies suggest the 2017 College Football Play...	jobs,sports
9682	1	The debt comes up all the time in town meeting...	debt,federal-budget

In [205...
```python
# Dataset information
train_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10240 entries, 0 to 10239
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Labels    10240 non-null  int64
 1   Text      10240 non-null  object
 2   Text_Tag  10238 non-null  object
dtypes: int64(1), object(2)
memory usage: 240.1+ KB
```

In [206...
```python
train_data[train_data.duplicated(['Text'])]
```

Out[206...

	Labels	Text	Text_Tag
1014	2	On abortion	abortion,candidates-biography
1814	1	On support for gay marriage.	civil-rights,families,gays-and-lesbians,marriage
1846	1	Obama says Iran is a 'tiny' country, 'doesn't ...	foreign-policy
2697	1	On repealing the 17th Amendment	debates,elections,states
2846	3	Four balanced budgets in a row, with no new ta...	job-accomplishments,jobs,state-budget,state-fi...
3256	1	On a cap-and-trade plan.	cap-and-trade,climate-change,environment
4386	1	On the Trans-Pacific Partnership.	trade
4839	2	During Sherrod Browns past decade as a D.C. po...	economy,job-accomplishments,jobs
4940	1	On changing the rules for filibusters on presi...	congressional-rules
6759	2	On torture.	human-rights,terrorism
6784	1	On support for the Export-Import Bank	trade
7248	2	On the status of illegal immigrants	immigration
7647	5	Six justices on the U.S. Supreme Court have be...	congress,legal-issues,supreme-court
8906	5	Says Mitt Romney flip-flopped on abortion.	abortion,message-machine-2012
9400	2	Twenty million Americans are out of work.	jobs
9642	1	On changing the rules for filibusters on presi...	congressional-rules
9750	0	Some 20,000 Delphi salaried retirees lost up t...	corporations,economy

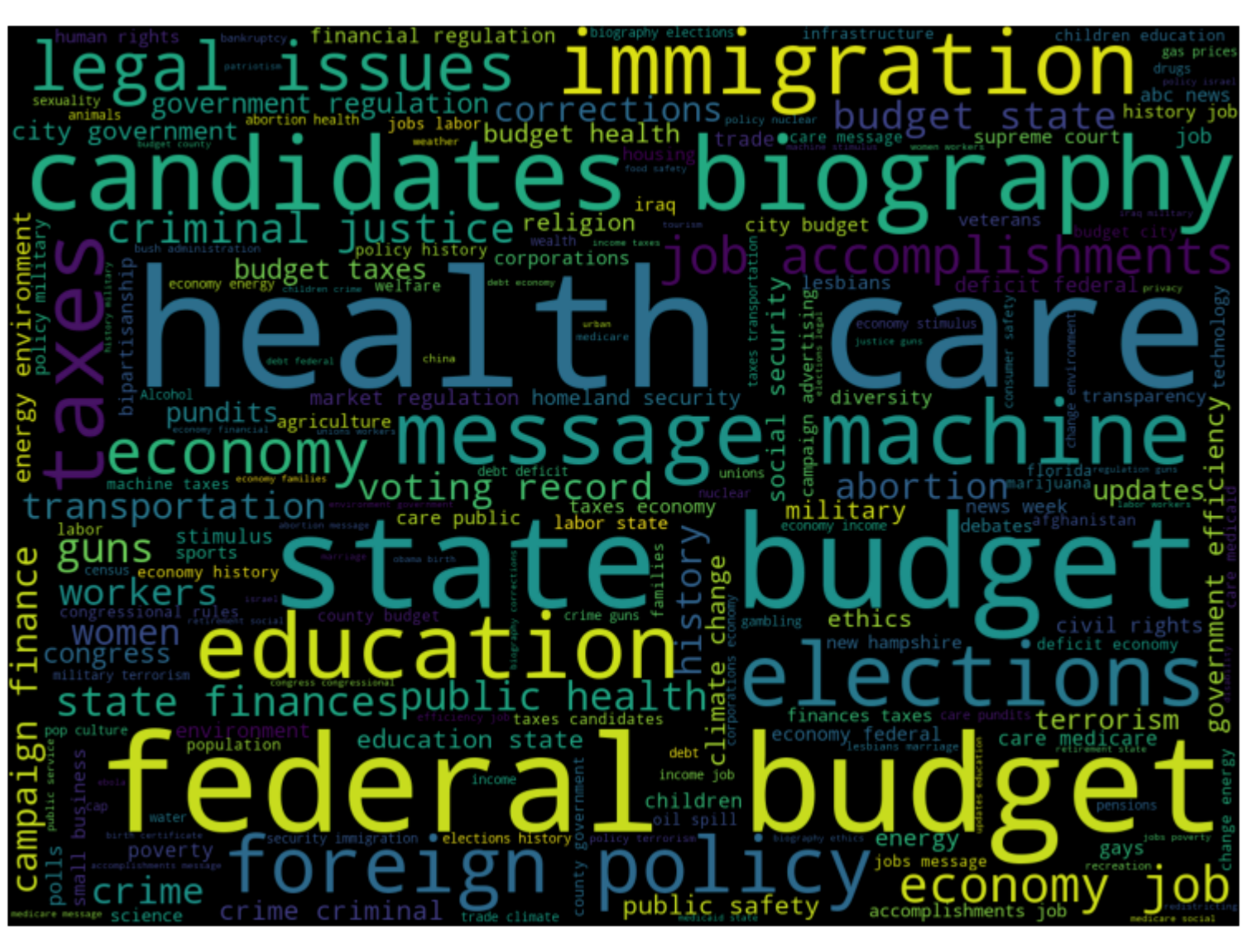
In [207...
```python
train_data = train_data.drop_duplicates(['Text'])
```

In [208...
```python
train_data.sample(3)
```

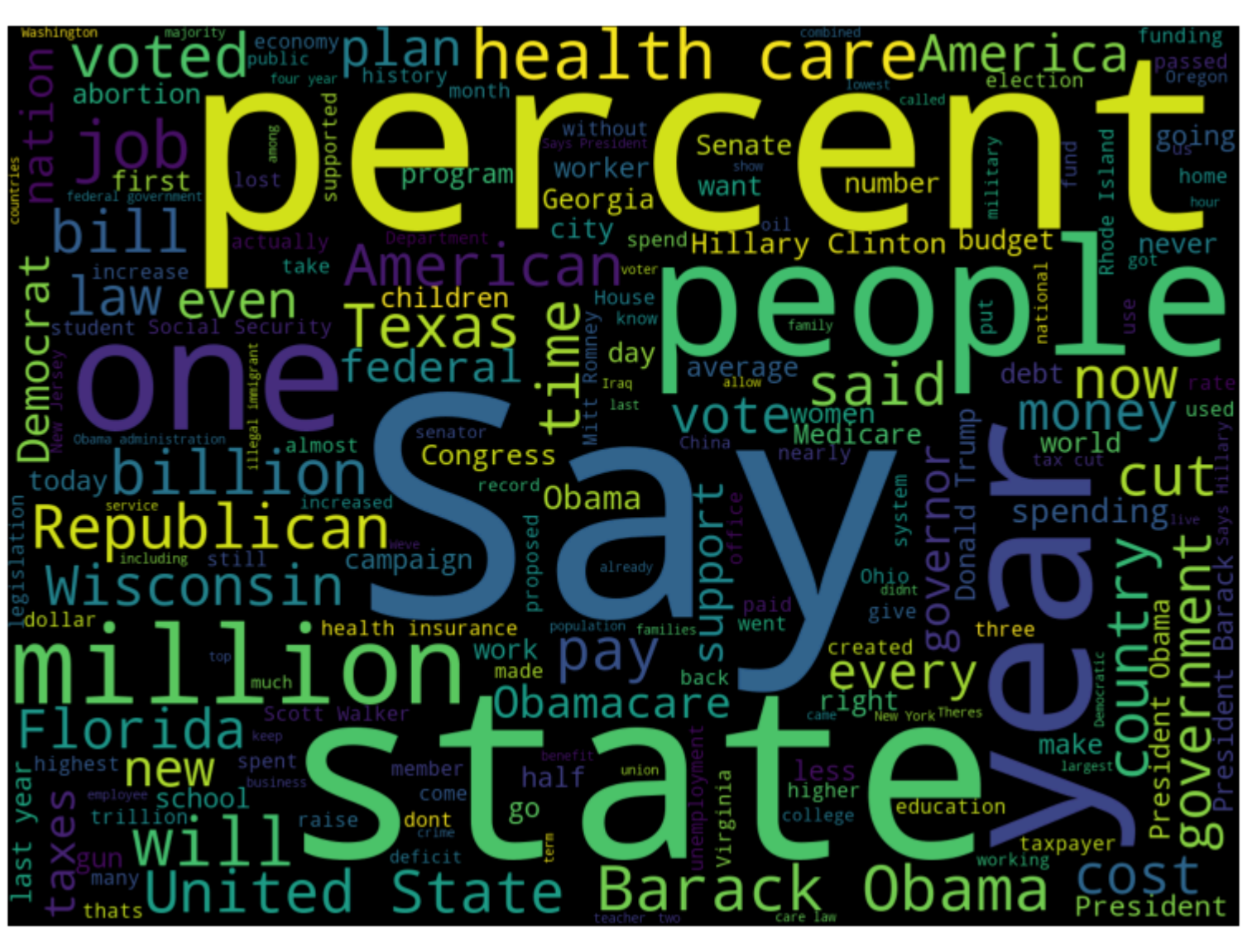
Out[208...

	Labels	Text	Text_Tag
1767	4	Nobody is leaving Memphis. Thats a myth.	census,population,taxes
3299	2	Says black women are fastest-growing demograph...	guns
4179	5	Ken Buck wants to outlaw abortion, even in cas...	abortion,message-machine

In [ ]:
```python
## word cloud for text_tag
cloud = WordCloud(width=1300, height=950).generate(" ".join(train_q.astype(str)))
plt.figure(figsize=(15, 10))
plt.imshow(cloud)
plt.axis('off')
```



In [ ]:
```python
from wordcloud import WordCloud
cloud = WordCloud(width=1300, height=950).generate(" ".join(train_qs.astype(str)))
plt.figure(figsize=(15, 10))
plt.imshow(cloud)
plt.axis('off')
```



In [252...
```python
X = train_data['Processed']
y = train_data['Labels']

y_category = keras.utils.to_categorical(y, 6)

# Split data into Train and Holdout as 80:20 ratio
X_train, X_valid, y_train, y_valid = train_test_split(X, y_category, shuffle=True, test_size=0.33, random_state=111)

print("Train shape : {}, Holdout shape: {}".format(X_train.shape, X_valid.shape))
```

```
Train shape : (6849,), Holdout shape: (3374,)
```

In [253...
```python
def word_embedding(train, test, max_features, max_len=200):
    try:
        # Keras Tokenizer class object
        tokenizer = text.Tokenizer(num_words=max_features)
        tokenizer.fit_on_texts(train)

        train_data = tokenizer.texts_to_sequences(train)
        test_data = tokenizer.texts_to_sequences(test)

        # Get the max_len
        vocab_size = len(tokenizer.word_index) + 1

        # Padd the sequence based on the max-length
        x_train = sequence.pad_sequences(train_data, maxlen=max_len, padding='post')
        x_test = sequence.pad_sequences(test_data, maxlen=max_len, padding='post')
        # Return train, test and vocab size
        return tokenizer, x_train, x_test, vocab_size
    except ValueError as ve:
        raise(ValueError("Error in word embedding {}".format(ve)))
```

In [308...
```python
max_features = 5000
max_len = 128
output_dim = len(np.unique(y))

# Test data
X_test = test_data['Processed']

tokenizer, x_pad_train, x_pad_valid, vocab_size = word_embedding(X_train, X_valid, max_features)
```

In [309...
```python
# Test data
X_test = test_data['Processed']

tokenizer.fit_on_sequences(X_test)

X_test_seq = tokenizer.texts_to_sequences(X_test)
x_pad_test = sequence.pad_sequences(X_test_seq, maxlen=max_len, padding='post')
```

In [310...
```python
def compute_classweights(target):
    """
    Computes the weights of the target values based on the samples
    :param target: Y-target variable
    :return: dictionary object
    """
    # compute class weights
    class_weights = class_weight.compute_class_weight('balanced',
                                                      np.unique(target),
                                                      target)

    # make the class weight list into dictionary
    weights = {}

    # enumerate the list
    for index, weight in enumerate(class_weights):
        weights[index] = weight

    return weights

# Get the class weights for the target variable
weights = compute_classweights(y)
```

In [311...
```python
weights
```

Out[311...
```
{0: 1.0307521677757612,
 1: 0.8574903539674551,
 2: 0.8078868342026236,
 3: 0.868859425463199,
 4: 2.0307906237584428,
 5: 1.017821585025886}
```

In [312...
```python
X_train.sample(3)
```

Out[312...
```
3960    taxes new funding state sent floridians billio...
6085    tens texas voters rick perrys wendy defeat law...
6655    voted baldwin candidate extreme increase budge...
Name: Processed, dtype: object
```

In [313...
```python
rnn_model = Sequential([
keras.layers.Embedding(vocab_size,128,
                            input_length=max_len),
keras.layers.BatchNormalization(),
keras.layers.Dense(128, activation='relu', kernel_regularizer=tf.keras.regularizers.L2(0.002)),
keras.layers.GlobalMaxPool1D(), # Remove flatten layer
keras.layers.Dense(64, activation='relu', kernel_regularizer=tf.keras.regularizers.L2(0.002)),
keras.layers.Dropout(0.3),
keras.layers.Dense(32, activation='relu', kernel_regularizer=tf.keras.regularizers.L2(0.002)),
keras.layers.Dropout(0.3),
keras.layers.Dense(output_dim, activation='softmax')

return rnn_model
```

In [314...
```python
rnn_model.summary()
```

```
Model: "sequential_25"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_26 (Embedding)     (None, 128, 128)          1515520
_________________________________________________________________
batch_normalization_26 (Batc (None, 128, 128)          512
_________________________________________________________________
dense_99 (Dense)             (None, 128, 128)          16512
_________________________________________________________________
global_max_pooling1d_24 (Glo (None, 128)               0
_________________________________________________________________
dense_100 (Dense)            (None, 64)                8256
_________________________________________________________________
dropout_51 (Dropout)         (None, 64)                0
_________________________________________________________________
dense_101 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_52 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_102 (Dense)            (None, 6)                 198
=================================================================
Total params: 1,543,078
Trainable params: 1,542,822
Non-trainable params: 256
_________________________________________________________________
```

In [315...
```python
# Compile the model
rnn_model.compile(optimizer=tf.keras.optimizers.Adam(1e-3),
                  loss=keras.losses.CategoricalCrossentropy(from_logits=True),
                  metrics=[tf.metrics.AUC()])
```

In [316...
```python
history = rnn_model.fit(x_pad_train,
                        y_train,
                        batch_size=512,
                        epochs=20,
                        verbose=1,
                        validation_data=(x_pad_valid, y_valid),
                       class_weight=weights)
```

```
Epoch 1/20
14/14 [==============================] - 1s 72ms/step - loss: 2.2825 - auc_29: 0.4780 - val_loss: 2.2350 - val_auc_29: 0.4785
Epoch 2/20
14/14 [==============================] - 1s 51ms/step - loss: 2.1977 - auc_29: 0.5346 - val_loss: 2.1701 - val_auc_29: 0.5168
Epoch 3/20
14/14 [==============================] - 1s 53ms/step - loss: 2.1246 - auc_29: 0.5849 - val_loss: 2.1146 - val_auc_29: 0.5480
Epoch 4/20
14/14 [==============================] - 1s 59ms/step - loss: 2.0554 - auc_29: 0.6176 - val_loss: 2.0714 - val_auc_29: 0.5562
Epoch 5/20
14/14 [==============================] - 1s 59ms/step - loss: 1.9910 - auc_29: 0.6624 - val_loss: 2.0377 - val_auc_29: 0.5565
Epoch 6/20
14/14 [==============================] - 1s 51ms/step - loss: 1.9194 - auc_29: 0.7001 - val_loss: 2.0130 - val_auc_29: 0.5636
Epoch 7/20
14/14 [==============================] - 1s 52ms/step - loss: 1.8560 - auc_29: 0.7401 - val_loss: 1.9953 - val_auc_29: 0.5627
Epoch 8/20
14/14 [==============================] - 1s 53ms/step - loss: 1.7867 - auc_29: 0.7808 - val_loss: 1.9821 - val_auc_29: 0.5729
Epoch 9/20
14/14 [==============================] - 1s 54ms/step - loss: 1.7134 - auc_29: 0.8230 - val_loss: 1.9731 - val_auc_29: 0.5707
Epoch 10/20
14/14 [==============================] - 1s 51ms/step - loss: 1.6528 - auc_29: 0.8517 - val_loss: 1.9666 - val_auc_29: 0.5693
Epoch 11/20
14/14 [==============================] - 1s 61ms/step - loss: 1.5954 - auc_29: 0.8770 - val_loss: 1.9604 - val_auc_29: 0.5792
Epoch 12/20
14/14 [==============================] - 1s 57ms/step - loss: 1.5475 - auc_29: 0.8965 - val_loss: 1.9553 - val_auc_29: 0.5816
Epoch 13/20
14/14 [==============================] - 1s 52ms/step - loss: 1.5043 - auc_29: 0.9118 - val_loss: 1.9523 - val_auc_29: 0.5705
Epoch 14/20
14/14 [==============================] - 1s 52ms/step - loss: 1.4662 - auc_29: 0.9211 - val_loss: 1.9479 - val_auc_29: 0.5763
Epoch 15/20
14/14 [==============================] - 1s 52ms/step - loss: 1.4406 - auc_29: 0.9309 - val_loss: 1.9445 - val_auc_29: 0.5735
Epoch 16/20
14/14 [==============================] - 1s 54ms/step - loss: 1.4158 - auc_29: 0.9352 - val_loss: 1.9411 - val_auc_29: 0.5725
Epoch 17/20
14/14 [==============================] - 1s 53ms/step - loss: 1.3916 - auc_29: 0.9427 - val_loss: 1.9378 - val_auc_29: 0.5699
Epoch 18/20
14/14 [==============================] - 1s 63ms/step - loss: 1.3690 - auc_29: 0.9470 - val_loss: 1.9337 - val_auc_29: 0.5702
Epoch 19/20
14/14 [==============================] - 1s 53ms/step - loss: 1.3553 - auc_29: 0.9502 - val_loss: 1.9285 - val_auc_29: 0.5761
Epoch 20/20
14/14 [==============================] - 1s 53ms/step - loss: 1.3436 - auc_29: 0.9524 - val_loss: 1.9256 - val_auc_29: 0.5748
```

In [317...
```python
results = rnn_model.evaluate(x_pad_valid, y_valid)
```

```
106/106 [==============================] - 0s 4ms/step - loss: 1.9256 - auc_29: 0.5748
```

In [318...
```python
y_preds = rnn_model.predict_proba(x_pad_test, batch_size=256)
```

In [319...
```python
y_preds[:,0]
```

Out[319...
```
array([0.10799249, 0.10470885, 0.20419715, ..., 0.11288042, 0.07156285,
       0.0953638 ], dtype=float32)
```

In [320...
```python
final_df = pd.DataFrame({'0': y_preds[:,0],
                         '1': y_preds[:,1],
                         '2': y_preds[:,2],
                         '3': y_preds[:,3],
                         '4': y_preds[:,4],
                         '5': y_preds[:,5]}, index=test_data.index)
```

In [321...
```python
final_df
```

Out[321...

	0	1	2	3	4	5
0	0.107992	0.101322	0.150519	0.378211	0.134148	0.127807
1	0.104709	0.158395	0.332498	0.163373	0.189925	0.051100
2	0.204197	0.133102	0.249838	0.167857	0.143589	0.101418
3	0.167783	0.325967	0.100499	0.088033	0.130143	0.187575
4	0.174848	0.282983	0.110808	0.102282	0.210029	0.119051
...	...	...	...	...	...	...
1262	0.125772	0.097854	0.083867	0.338114	0.165196	0.189197
1263	0.142004	0.104889	0.095647	0.265502	0.085052	0.306905
1264	0.112880	0.168333	0.251629	0.280145	0.070717	0.116296
1265	0.071563	0.260155	0.113663	0.235579	0.170863	0.148177
1266	0.095364	0.361185	0.258039	0.103341	0.052368	0.129703

1267 rows × 6 columns

In [22]:
```
final_df.to_csv("fake_news_aus_22.csv", index=False)
```