National College of Ireland

Configuration Manual

MSc Research Project
Data Analytics

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MSc Project Submission Sheet

School of Computing

Student Name:	Ravi Sahal
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Module:	MSc Research Project
Lecturer:	Dr. Catherine Mulwa
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Configuration Manual

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1 Introduction

Implementation of a framework that combines contextual-based embedding ELMo Embedding with a recurrent neural network and recommends to investors a list of the top 10 cryptocurrencies to maximize their profits. This configuration manual includes information on the system configuration, software, and hardware requirements, and the procedures used to accomplish the Research Project.

2 System Configuration

The system configuration that was used to carry out the project is described in this part of the configuration manual.

2.1 Hardware Requirement

Operating System	macOS 13.0.1
Processor	Mac M1 Chip
RAM	8.00GB
Storage	256GB

2.2 Software Requirements

Programming Language	Python 3.9.15
Tools	Jupyter Notebook, PyCharm IDE, Excel

3 Project Development

The framework's development is primarily separated into two sections: the first focuses on the model's construction, and the second on its deployment on the console-based application.

3.1 Important Libraries

The implementation of this framework requires different libraries like pandas, numpy, seaborn, matplotlib, os, tensorflow, tensorflow_hub, keras, sklearn, glob, datetime, nltk, time, json, and twint. The libraries of sklearn and TensorFlow was used for model development, calculation of model performance and loading the different neural network modules for which the relevant code snippets are mentioned in this sections.

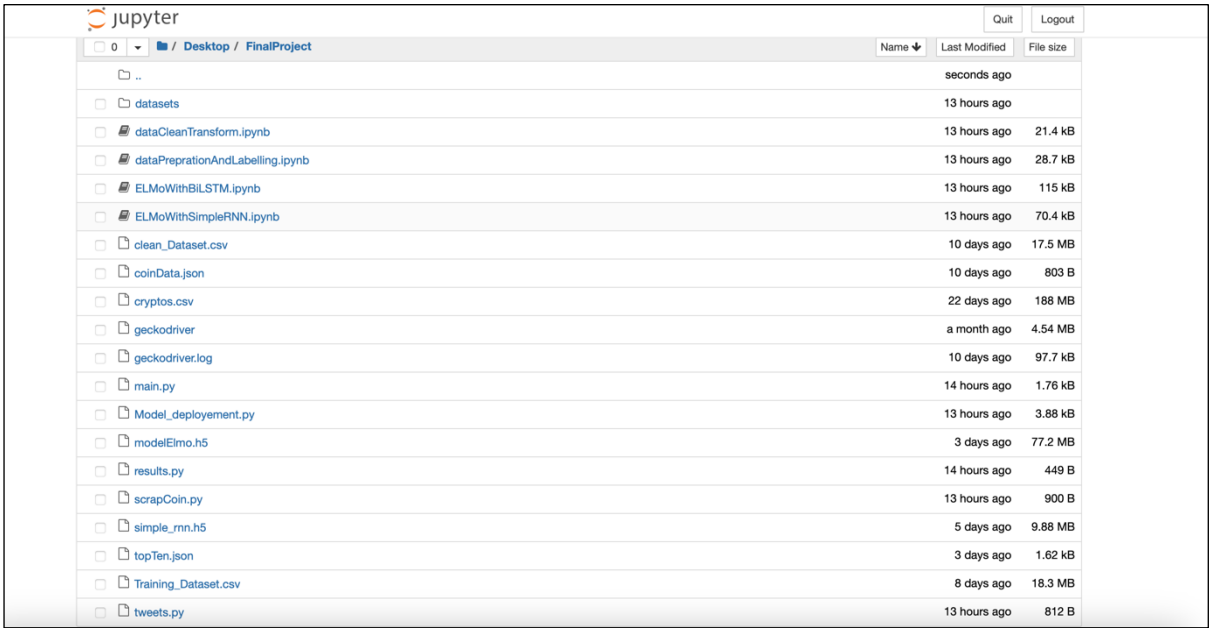


Figure 1: Framework Overview

3.2 Model Development

Data preparation, data transformation, and data modelling utilizing ELMo embedding with the recurrent neural network are all included in this section. These developments were all carried out using Jupyter Notebook.

Data Preparation

To prepare the training data for data modelling, the data preparation and transformation phase for model construction include data collection, cleaning, and transformation employing labelling of the cleaned and transformed data using the Flair framework and K-means Clustering. The figures below depict each phase of this development:

tweets.py

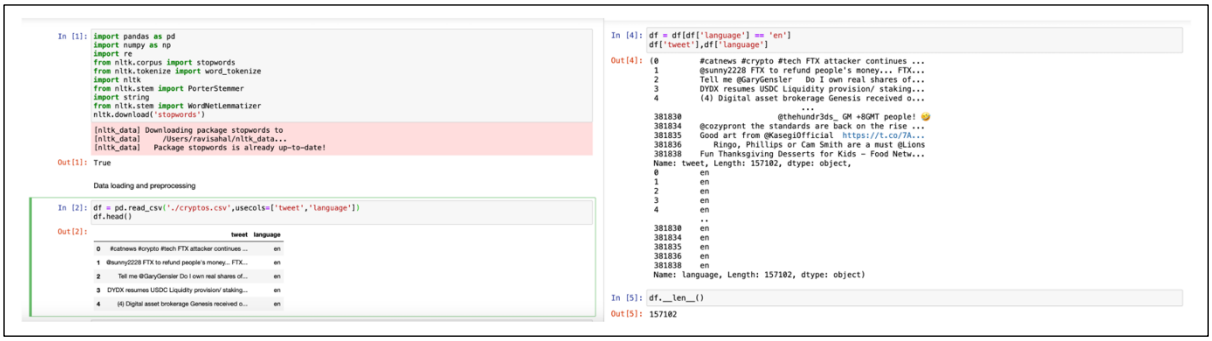
```
import twint

# This script is using Twint API to scrape the tweets

def fetchTweets(tags):
    HashTags= tags
    # search wit one by one hashtag from HashTags list
    for tag in HashTags:
        c = twint.Config()   # get configuration
        c.Search = tag      # search hashtag
        # c.Limit = 10000      # limit number of Tweets to 10000 for scraping
        c.Store_csv = True   # store tweets in a csv file
        c.Hide_output=True
        c.Pandas = True
        c.Since = "2022-01-23"
        c.Output = './cryptos.csv'     # This is for training data acquisition
        # c.Output = './'+ tags[0]+'.csv'
        twint.run.Search(c)
    import pandas as pd
    df = pd.read_csv('./cryptos.csv',low_memory=False)
    print(df.__len__())


fetchTweets(['crypto','Cryptocurrency','Bitcoin','ETH','digital currency']) #almost 4+hrs for scrapping tweets
```

Figure 2: Scrapping Tweets for Model Training



```
In [1]: import pandas as pd
        import numpy as np
        import re
        from nltk.corpus import stopwords
        from nltk.tokenize import word_tokenize
        import nltk
        from nltk.stem import PorterStemmer
        import string
        from nltk.stem import WordNetLemmatizer
        nltk.download('stopwords')

        [nltk_data] Downloading package stopwords to
        [nltk_data]     /Users/ravisahal/nltk_data...
        [nltk_data]   Package stopwords is already up-to-date!

Out[1]: True

        Data loading and preprocessing

In [2]: df = pd.read_csv('./cryptos.csv',usecols=['tweet','language'])
        df.head()

Out[2]:
                                                tweet language
0  #catnews #crypto #tech FTX attacker continues ...       en
1  @sunny2228 FTX to refund people's money... FTX...       en
2  Tell me @GaryGensler  Do I own real shares of...       en
3  DYDX resumes USDC Liquidity provision/ staking...       en
4  (4) Digital asset brokerage Genesis received o...       en

In [4]: df = df[df['language'] == 'en']
        df['tweet'],df['language']

Out[4]: (0         #catnews #crypto #tech FTX attacker continues ...
         1         @sunny2228 FTX to refund people's money... FTX...
         2         Tell me @GaryGensler  Do I own real shares of...
         3         DYDX resumes USDC Liquidity provision/ staking...
         4         (4) Digital asset brokerage Genesis received o...
                                      ...
         381830                      @thehundr3ds_ GM +8GMT people! 😉
         381834    @cozypront the standards are back on the rise ...
         381835    Good art from @KasegiOfficial  https://t.co/7A...
         381836       Ringo, Phillips or Cam Smith are a must @Lions
         381838    Fun Thanksgiving Desserts for Kids - Food Netw...
         Name: tweet, Length: 157102, dtype: object,
         0         en
         1         en
         2         en
         3         en
         4         en
                   ..
         381830    en
         381834    en
         381835    en
         381836    en
         381838    en
         Name: language, Length: 157102, dtype: object)

In [5]: df.__len__()

Out[5]: 157102
```

Figure 3: Loading the Important Libraries and Visualization of the Data

```
In [9]: # Data cleaning for tweets
        stop_words=set(stopwords.words('english'))
        if 'not' in stop_words:
            print(stop_words.remove('not'))
        def dataPreprocessing(tweet):
            cleanTweet = tweet.lower()
            pattern = re.compile(r'[\u4e00-\u9fff]+')
            if pattern.search(cleanTweet) !=None:
                return

            cleanTweet = re.sub(r'(@[A-Za-z0-9_]+)|[^\w\s]|#|http\S+', '', cleanTweet)

            cleanTweet = cleanTweet.translate(str.maketrans('','',string.punctuation))
            cleanTweet_tokens = word_tokenize(cleanTweet)
            # print('---' ,cleanTweet_tokens)
            # cleanTweet_words= [word for word in cleanTweet_tokens if word not in stop_words]
            if len(cleanTweet_tokens)<5:
                return
            filtered_sentence = [w for w in cleanTweet_tokens if not w.lower() in stop_words]

            # stemObj = PorterStemmer()
            # stemWords = [stemObj.stem(word) for word in filtered_sentence]

            lemObj = WordNetLemmatizer()
            lemWords = [lemObj.lemmatize(word, pos ='a') for word in filtered_sentence]

            return ' '.join(lemWords)
```

Figure 4: Data Cleaning Method

```
In [7]: from flair.models import TextClassifier
        from flair.data import Sentence

        classifier = TextClassifier.load('en-sentiment')
        sentence = Sentence('The food was great!')
        classifier.predict(sentence)

        # print sentence with predicted labels
        print('Sentence above is: ', sentence.labels)

        2022-12-07 13:07:37,913 loading file /Users/ravisahal/.flair/models/sentiment-en-mix-distilbert_4.pt
        Sentence above is:  ["Sentence: "The food was great !"/'POSITIVE' (0.9961)]

In [8]: # print sentence with predicted labels
        print('Sentence above is: ', sentence)

        Sentence above is:  Sentence: "The food was great !" → POSITIVE (0.9961)

In [13]: def getSentiment(tweet):
         #     classifier = TextClassifier.load('en-sentiment')
             sentence = Sentence(tweet)
             classifier.predict(sentence)
             sentScore = ''
             if sentence.labels[0].value.lower() == 'positive':
                 return '+'+str(sentence.labels[0].score)[:4]
             return '-'+str(sentence.labels[0].score)[:4]

In [9]: type(sentence.labels[0].to_dict())

Out[9]: dict

In [26]: # Classifying labels with KMeans with k size =2
         from sklearn.cluster import KMeans
         kmeans = KMeans(n_clusters=2, random_state=0).fit(sentiment)
         df['sentiment'] = kmeans.labels_

In [29]: df.head()

Out[29]:
   Unnamed: 0  cleanedTweets                                  tweet  sentimentScore  sentiment
0           0  catnews crypto tech ftx attacker continues swa...  #catnews #crypto #tech FTX attacker continues ...  0.520020  1
1           1  2228 ftx refund peoples money ftx value going ...  @sunny2228 FTX to refund people's money... FTX...  -0.990234  0
2           2  tell real shares amc lame ass ftx tokens imma ...  Tell me @GaryGensler Do I own real shares of...  -0.990234  0
3           4  4 digital asset brokerage genesis received 1 b...  (4) Digital asset brokerage Genesis received o...  -0.990234  0
4           5  ftx employees paid ftt token oof  JUST IN: Some FTX employees were paid with the...  0.890137  1

In [30]: df['sentiment'].value_counts()

Out[30]: 0    38652
         1    27001
         Name: sentiment, dtype: int64

In [33]: df[df['sentimentScore']>=0.5]['sentiment'].value_counts()

Out[33]: 1    27001
         Name: sentiment, dtype: int64

In [34]: df.to_csv('./Training_Dataset.csv')
```

Figure 5: Data Labelling using Flair and K-means Clustering

Data Modelling

The Elmo embedding is utilized to create the model, which uses two deep-learning models. This part covers model creation since the cleaned and labelled dataset is prepared for model training.

1. Implementation of ELMo with biLSTM model

```
In [1]: !pip install "tensorflow>=1.7.0"
        !pip install tensorflow-hub

In [2]: import tensorflow.compat.v1 as tf
        #To make tf 2.0 compatible with tf1.0 code, we disable the tf2.0 functionalities
        tf.disable_eager_execution()

In [3]: # to hide warnings
        import warnings
        # warnings.filterwarnings('ignore')
        warnings.filterwarnings("ignore", category=DeprecationWarning)

        import tensorflow_hub as hub
        import tensorflow as tf

        elmo = hub.Module("https://tfhub.dev/google/elmo/2", trainable=True)

In [5]: import pandas as pd

In [6]: df= pd.read_csv('./Training_Dataset.csv')

In [7]: df.head()
Out[7]:
```

	Unnamed: 0.1	Unnamed: 0	cleanedTweets	tweet	sentimentScore	sentiment
0	0	0	catnews crypto tech ftx attacker continues swa...	#catnews #crypto #tech FTX attacker continues ...	0.52	1
1	1	1	2228 ftx refund peoples money ftx value going ...	@sunny2228 FTX to refund people's money... FTX...	-0.99	0
2	2	2	tell real shares amc lame ass ftx tokens imma ...	Tell me @GaryGensler Do I own real shares of...	-0.99	0
3	3	4	4 digital asset brokerage genesis received 1 b...	(4) Digital asset brokerage Genesis received o...	-0.99	0
4	4	5	ftx employees paid ftt token oof	JUST IN: Some FTX employees were paid with the...	0.89	1

```
In [8]: df2=df[['cleanedTweets','sentiment']]

In [9]: df2.head()
Out[9]:
```

	cleanedTweets	sentiment
0	catnews crypto tech ftx attacker continues swa...	1
1	2228 ftx refund peoples money ftx value going ...	0
2	tell real shares amc lame ass ftx tokens imma ...	0
3	4 digital asset brokerage genesis received 1 b...	0
4	ftx employees paid ftt token oof	1

Figure 6: Loading Important Packages and Preprocessed Dataset into Data frame

```
In [12]: from sklearn.preprocessing import LabelEncoder

In [13]: train_df, val_df, test_df = train_validate_test_split(df2)

         print('Train: {}, Validation: {}, Test: {}'.format(train_df.shape, val_df.shape, test_df.shape))

         print(colored('\nTRAIN DATA','magenta',attrs=['bold']))
         display(train_df.head())

         train_text = train_df['cleanedTweets'].tolist()
         train_text = np.array(train_text, dtype=object)[:, np.newaxis]
         # train_label = np.asarray(pd.get_dummies(train_df['sentiment']), dtype = np.int8)
         train_label = train_df['sentiment'].values

         val_text = val_df['cleanedTweets'].tolist()
         val_text = np.array(val_text, dtype=object)[:, np.newaxis]
         # val_label = np.asarray(pd.get_dummies(val_df['sentiment']), dtype = np.int8)
         val_label = val_df['sentiment'].values


         test_text = test_df['cleanedTweets'].tolist()
         test_text = np.array(test_text, dtype=object)[:, np.newaxis]
         # test_label = np.asarray(pd.get_dummies(test_df['sentiment']), dtype = np.int8)
         test_label = test_df['sentiment'].values
         test_label

         Train: (39391, 2), Validation: (13130, 2), Test: (13132, 2)

         TRAIN DATA
```

	cleanedTweets	sentiment
26706	craftingthefuture web2 web3 web3gaming minecra...	1
20884	eth price 117676 right compared last tweet pri...	0
34184	im arms cleo sol	1
15367	ftx claims owes 31 billion top 50 creditors re...	0
30881	cyberpunk solympus 271 purchased magic eden ra...	0

```
Out[13]: array([0, 0, 0, ..., 1, 0, 1])
```

Figure 7: Data Splitting and Model Creation

```
In [14]: import numpy as np
         from tensorflow import keras
         from tensorflow.keras.layers import Input, Lambda, Bidirectional, Dense, Dropout
         from tensorflow.keras.models import Model
         from tensorflow.keras import layers
         from tensorflow.python.keras import backend as K

In [15]: def ELMoEmbedding(input_text):
             return elmo(tf.reshape(tf.cast(input_text, tf.string), [-1]), signature="default", as_dict=True)["elmo"]
         def build_model():
             input_layer = Input(shape=(1,), dtype="string", name="Input_layer")
             embedding_layer = Lambda(ELMoEmbedding, output_shape=(1024, ), name="Elmo_Embedding")(input_layer)
             BiLSTM = Bidirectional(layers.LSTM(512, return_sequences= False, recurrent_dropout=0.2, dropout=0.2), name
             Dense_layer_1 = Dense(128, activation='relu')(BiLSTM)
             Dropout_layer_1 = Dropout(0.5)(Dense_layer_1)
         #     Dense_layer_2 = Dense(64, activation='relu')(Dropout_layer_1)
         #     Dropout_layer_2 = Dropout(0.5)(Dense_layer_2)
             output_layer = Dense(1, activation='sigmoid')(Dropout_layer_1)
             model = Model(inputs=[input_layer], outputs=output_layer, name="BiLSTM with ELMo Embeddings")
             model.summary()
             model.compile(loss='binary_crossentropy',optimizer='adam',metrics=['accuracy'])
             return model

In [17]: elmo_BiDirectional_model = build_model()
         INFO:tensorflow:Saver not created because there are no variables in the graph to restore
```

Figure 8: Model Creation for First Experiment

Figure 9: Model Training, Results and Prediction

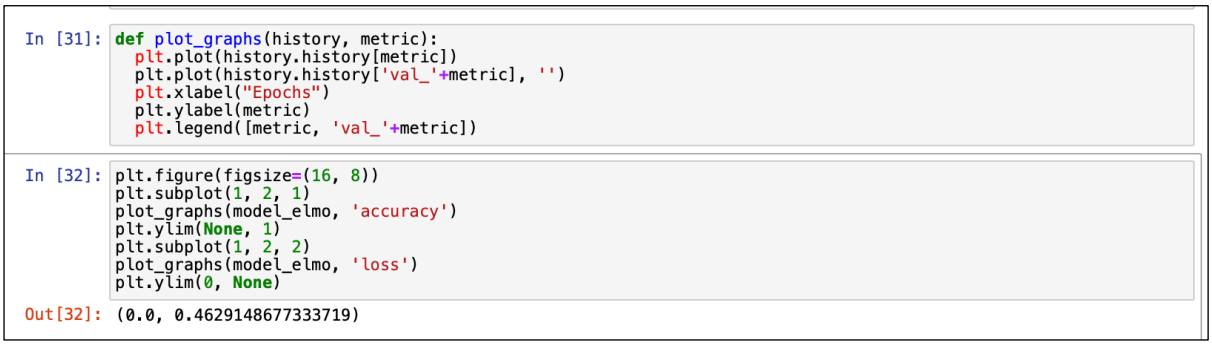


Figure 10: Method for Plotting accuracy and loss learning graph

2. Implementation of ELMo with Simple RNN model

For both the first experiment, the data preparation, dataset splitting functions and plotting, graphs are the same.

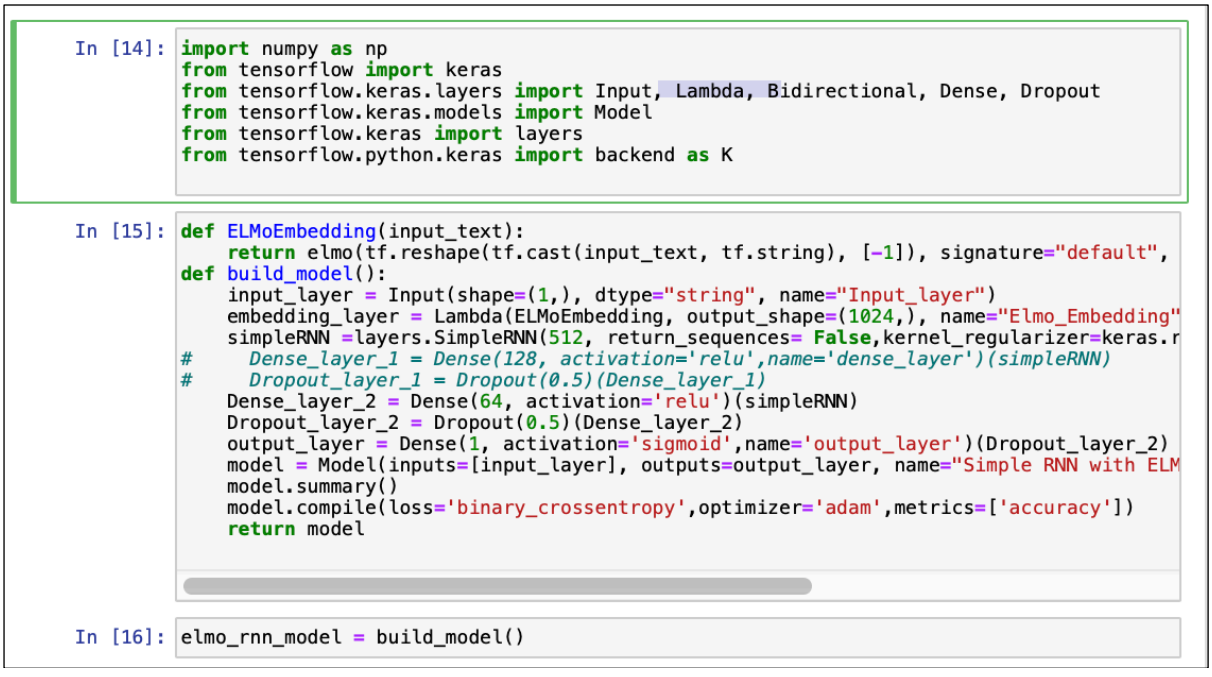


Figure 11: Model Creation for Second Implementation

```
In [26]: with tf.Session() as session:
           K.set_session(session)
           session.run(tf.global_variables_initializer())
           session.run(tf.tables_initializer())

           model_elmo = elmo_rnn_model.fit(train_text, train_label,validation_data=(val_text, va
         #   train_prediction = elmo_BiDirectional_model.predict(train_text)
           elmo_rnn_model.save('simple_rnn.h5')

Train on 39391 samples, validate on 13130 samples
Epoch 1/7
39391/39391 [==============================] - 5930s 151ms/sample - loss: 0.8472 - acc
uracy: 0.5876 - val_loss: 0.6920 - val_accuracy: 0.5856
Epoch 2/7
39391/39391 [==============================] - 5913s 150ms/sample - loss: 0.6873 - acc
uracy: 0.5889 - val_loss: 0.6787 - val_accuracy: 0.5853
Epoch 3/7
39391/39391 [==============================] - 5930s 151ms/sample - loss: 0.6774 - acc
uracy: 0.5901 - val_loss: 0.6786 - val_accuracy: 0.5853
Epoch 4/7
39391/39391 [==============================] - 6291s 160ms/sample - loss: 0.6768 - acc
uracy: 0.5901 - val_loss: 0.6792 - val_accuracy: 0.5853
Epoch 5/7
39391/39391 [==============================] - 6844s 174ms/sample - loss: 0.6769 - acc
uracy: 0.5901 - val_loss: 0.6785 - val_accuracy: 0.5853
Epoch 6/7
39391/39391 [==============================] - 6894s 175ms/sample - loss: 0.6768 - acc
uracy: 0.5901 - val_loss: 0.6785 - val_accuracy: 0.5853
Epoch 7/7
39391/39391 [==============================] - 7439s 189ms/sample - loss: 0.6768 - acc
uracy: 0.5901 - val_loss: 0.6786 - val_accuracy: 0.5853

In [27]: from numpy import loadtxt
         from tensorflow.keras.models import load_model

         # load model
         with tf.Session() as session:
           K.set_session(session)
           session.run(tf.global_variables_initializer())
           session.run(tf.tables_initializer())
           elmo_rnn_model=load_model('simple_rnn.h5')
           _, train_acc = elmo_rnn_model.evaluate(train_text, train_label)
           _, test_acc = elmo_rnn_model.evaluate(test_text, test_label)

         print('__Train Accuracy__: {}, __Test Accuracy__: {}'.format(round(train_acc,4), round(

INFO:tensorflow:Saver not created because there are no variables in the graph to resto
re

INFO:tensorflow:Saver not created because there are no variables in the graph to resto
re

__Train Accuracy__: 0.5900999903678894, __Test Accuracy__: 0.5879999995231628
```

Figure 12: Model Training and Results

3.3 Model Deployment

We used the PyCharm IDE to build a console-based application that also helped us grasp the structure of the project for quicker deployment. An application called main.py is developed to establish a one-touch automation framework. This script carries out several operations, including scraping the top thirty trending cryptocurrency names, retrieving tweets mentioning cryptocurrency names, loading the best-trained TensorFlow saved model, and emotional categorization for each of the thirty cryptocurrencies. Additionally, the main.py script will show the outcome on the console.

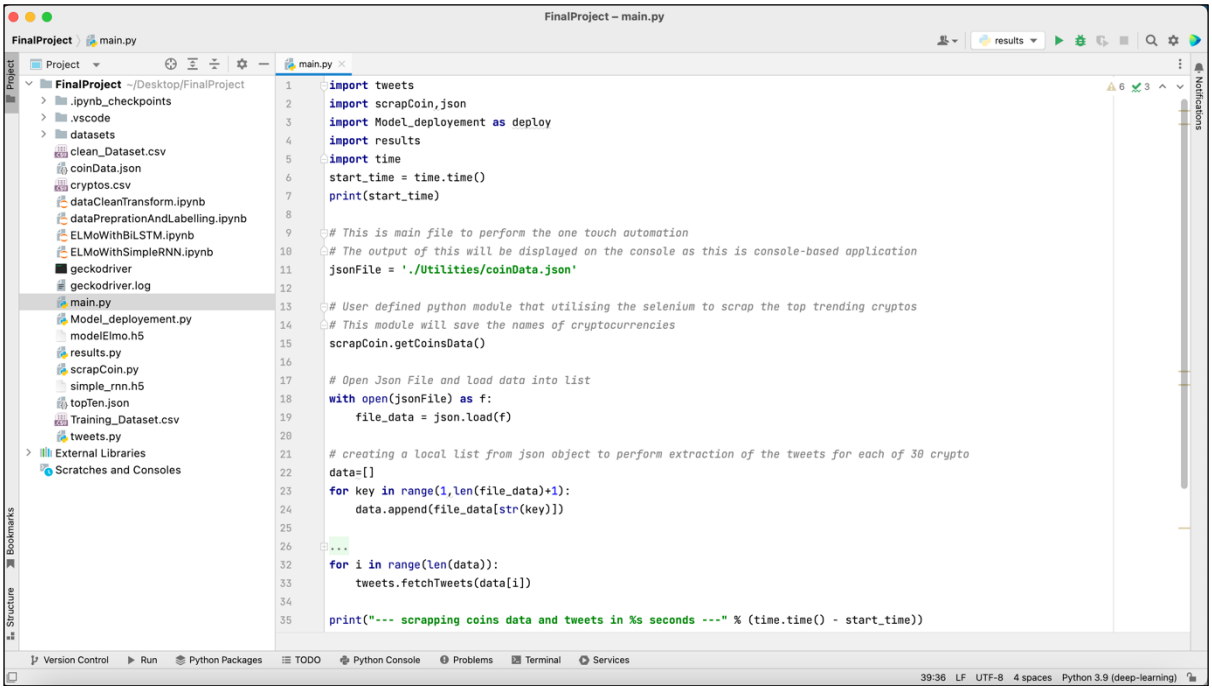


Figure 13: Project Framework Overview in PyCharm

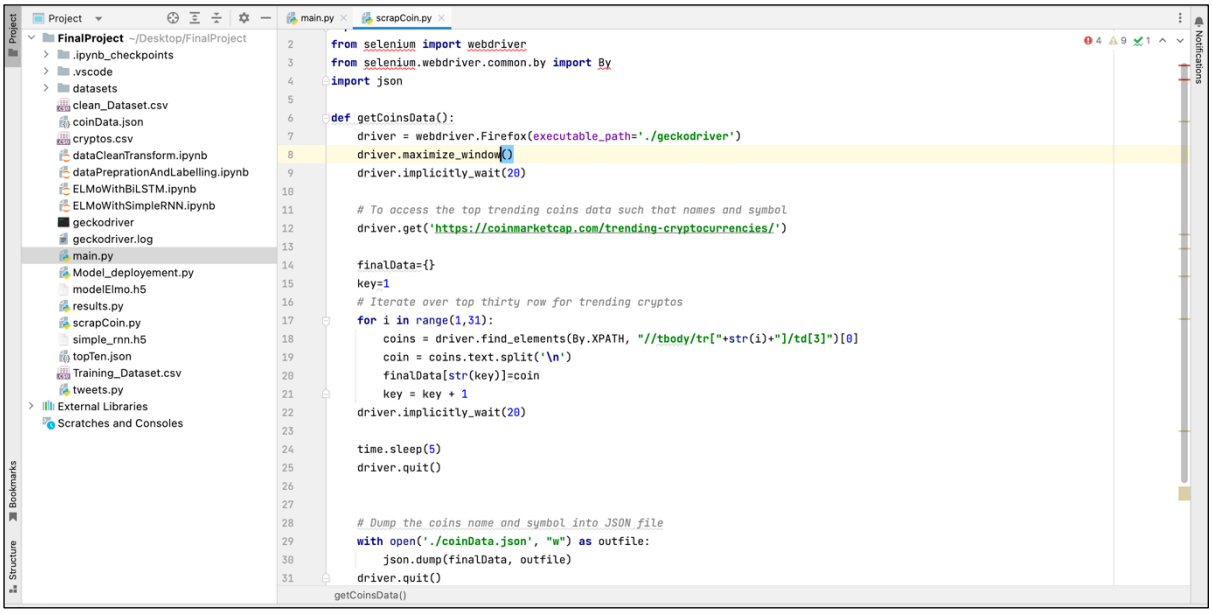


Figure 14: Scrapping and Storing the top 30 trending Cryptocurrency Names using Selenium

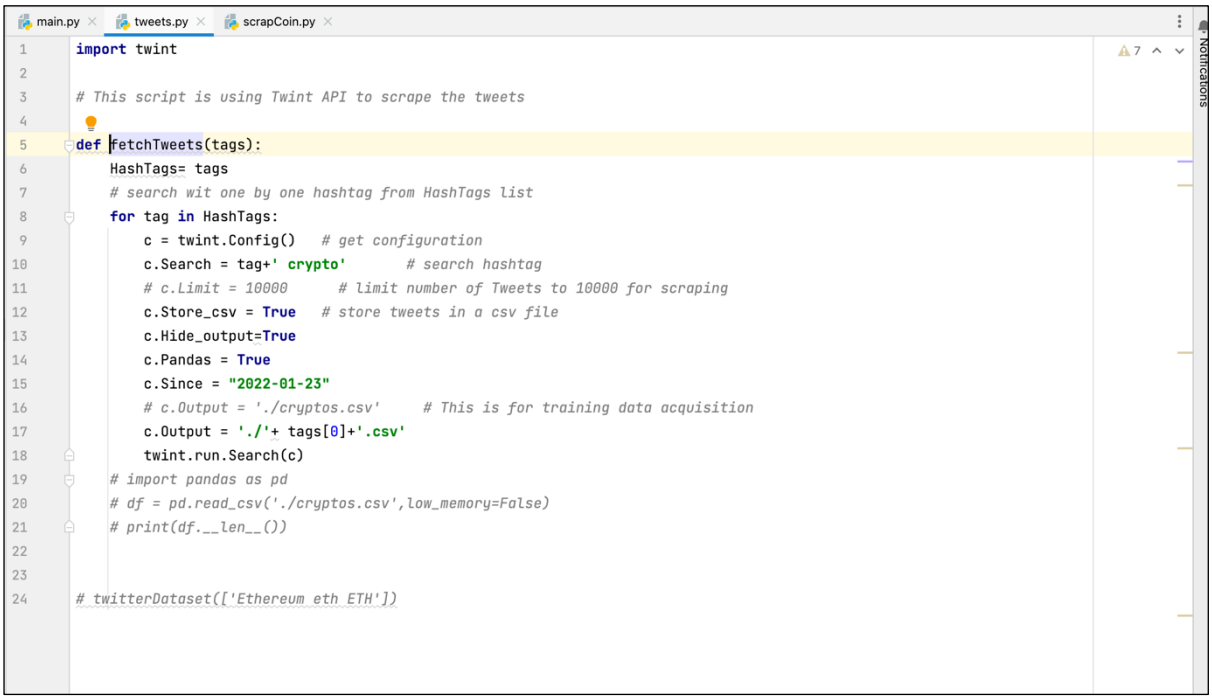


Figure 15: Fetching Tweets for each of the top 30 Cryptocurrencies

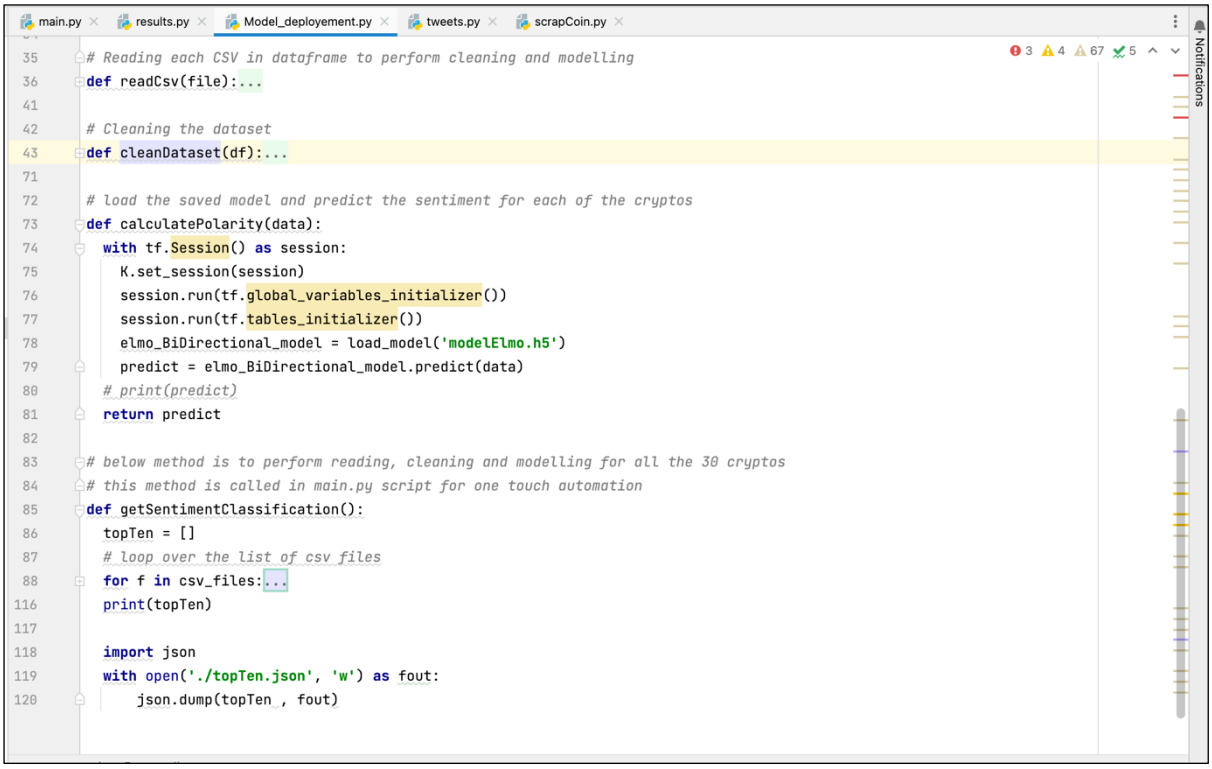


Figure 16: Generic Method Sentimental Classification for each of the top 30 cryptocurrencies

Figure 17: Cleaning and Loading the Saved Model

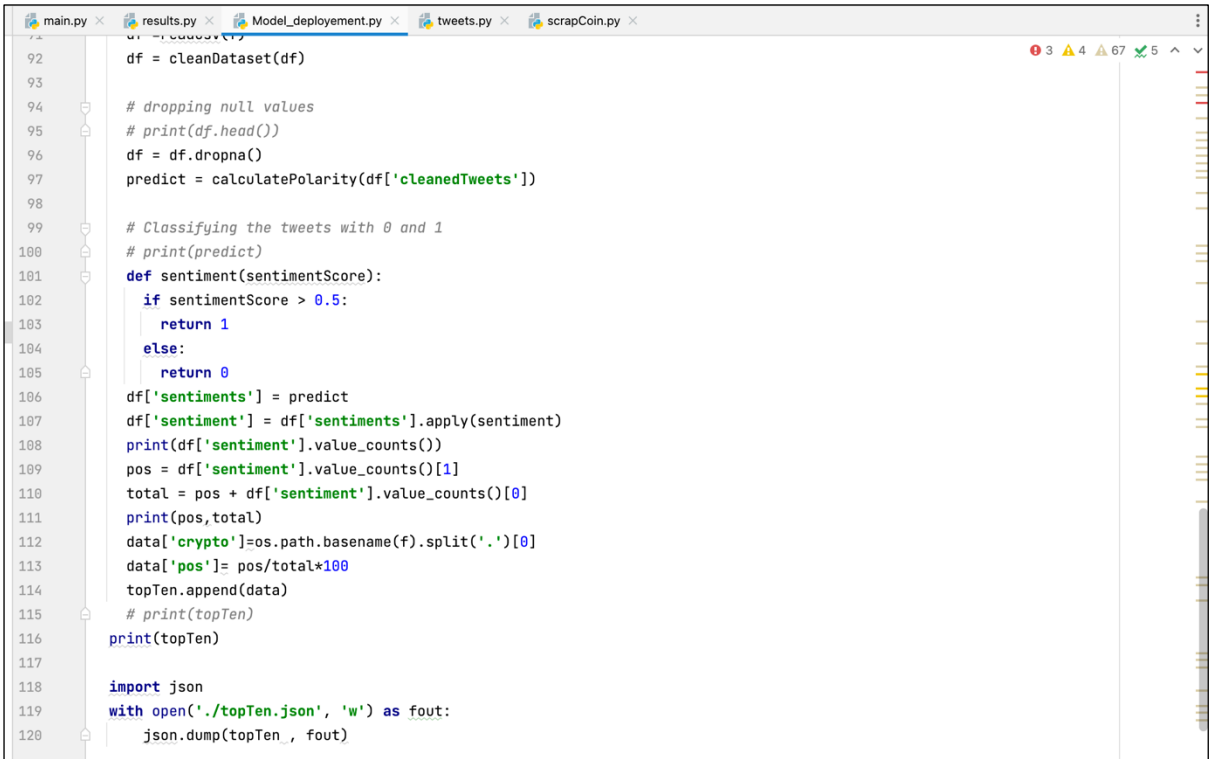


Figure 18: Sentiment Score Mapping with 0 and 1 after Sentimental Classficaiton

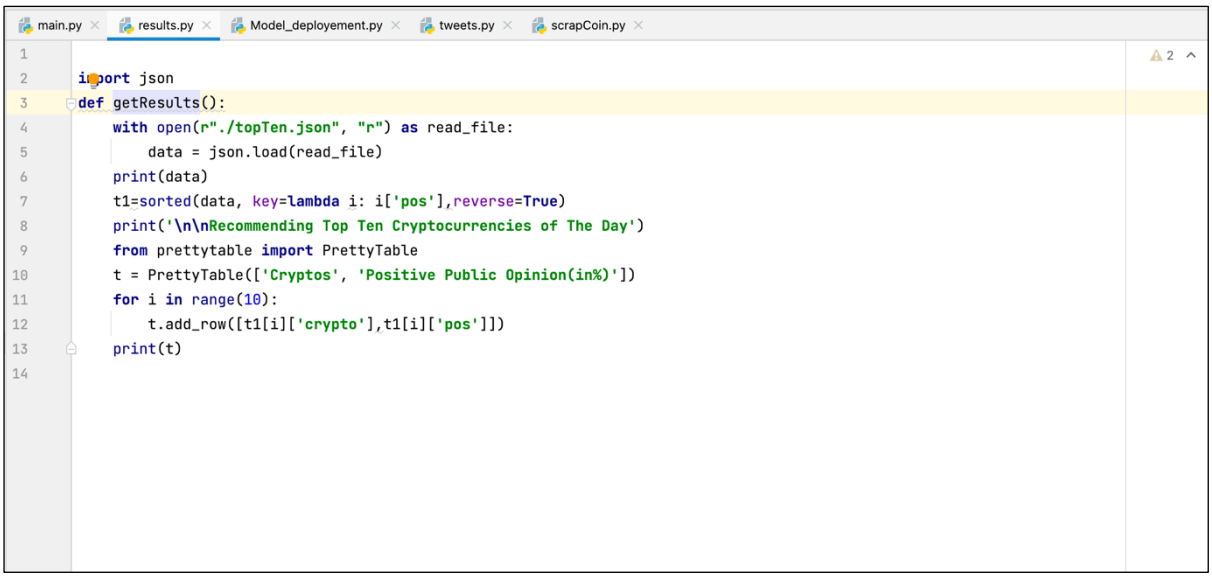


Figure 19: Method to Show the list of Top 10 Most Favourable Cryptocurrencies based on the Sentimental Classification