In [1]:

```
#Import Libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from transformers import AutoTokenizer, AutoModelForSequenceClassification
import torch
import re
from textblob import TextBlob
import tweepy as tw
import credentials
%matplotlib inline
```

Instantiate the Bert Model

In [2]:

```
tokenizer = AutoTokenizer.from_pretrained('nlptown/bert-base-multilingual-uncased-sentiment')
model = AutoModelForSequenceClassification.from_pretrained('nlptown/bert-base-multilingual-uncased-sentiment')
```

Classes Secction

In [2]:

```
#Classes for collecting Data and Authentication
class Twitter_Authentication:
    #Function used to connect with the Twitter API
    def app_authenticate(self):
        auth =tw.OAuthHandler(credentials.API_KEY, credentials.KEY_SECRET)
        auth.set_access_token(credentials.ACCESS_TOKEN,credentials.ACCESS_TOKEN_SECRET)
        return auth

class Data_collection:
    def __init__(self,user=None):
        au=Twitter_Authentication()
        self.auth =au.app_authenticate()
        self.api = tw.API(self.auth, wait_on_rate_limit=True)
        self.user=user

    #Function to search for a specific word, query or hashtag in Twitter and get tweets
    def get_tweets(self,word_to_search,tweets_num,date):
        tweets=tw.Cursor(self.api.search_tweets,q=word_to_search,lang="en",until=date,result_type="mixed").items(
        collected_tweets=[i for i in tweets]
        return collected_tweets

    #Function to get tweets from specific user
    def get_tweets_from_user(self,tweets_num):
        tweets=tw.Cursor(self.api.user_timeline,screen_name=self.user).items(tweets_num)
        collected_tweets=[i for i in tweets]
        return collected_tweets

    #Function that used in collecting all the collected data into a Pandas DataFrame
    def tweets_to_DataFrame(self,tweets):
        pre=Data_preprocessing()
        tweets_data=[{
            "tweets":pre.clean_tweets_content(tweet.text),
            "tweet_len":len(tweet.text),
            "date":tweet.created_at,
            "source":tweet.source,
            "likes":tweet.favorite_count,
            "retweets":tweet.retweet_count,
            "No._followers":tweet.user.followers_count,
            "lang":tweet.lang
        } for tweet in tweets]

        df=pd.DataFrame(tweets_data)
        return df
```

In [3]:

```
#Classes for Dealing with Data, preparing it and analysing it

class Data_preprocessing:
    #Function use for dealing with missing data
    def handle_missing_data(self,df,column,fill_with):
        df[column]=df[column].replace(np.nan,fill_with)

    # Function used to remove and clean tweets from special chracters
    def clean_tweets_content(self, tweet):
        return ' '.join(re.sub("(@[A-Za-z0-9]+)|([^0-9A-Za-z \t])|(\w+:\/\/\S+)|(RT)", " ", tweet).split())

    #This function is used to get the percentage of dataset column
    def get_col_percentage(self,col,df):

        total=df[col].value_counts()
        percentage=round(df[col].value_counts(dropna=False,normalize=True)*100,3)
        # or percentage=round((df[col]/df[col].sum())*100,2)
        res=pd.concat([total,percentage],axis=1,keys=["Total No.","Percentage"])
        #res['Percentage'] = res['Percentage'].astype(str) + '%'
        return res


class Sentiment_Analysis:

    def __init__(self,analyze_method):
        self.analyze_method=analyze_method

    #Function used for applying sentiment analysis based on the input method "Object"
    def sentiment_analysis_method(self,tweet_content):
        pre=Data_preprocessing()
        try:
            if self.analyze_method == "TextBlob":
                analysis = TextBlob(pre.clean_tweets_content(tweet_content))
                if analysis.sentiment.polarity > 0:
                    return 1
                elif analysis.sentiment.polarity == 0:
                    return 0
                else:
                    return -1

            elif self.analyze_method =="Bert":
                tokens = tokenizer.encode(pre.clean_tweets_content(tweet_content), return_tensors='pt')
                result = model(tokens)
                return int(torch.argmax(result.logits))+1

            else:
                return 7

        except Exception:
            print("Error!!!, Check Your Inputs Again, Please")
```

In [57]:

```
#Class for Data Visualization

class Data_Visualization:

    #For Plotting Pie Charts
    def plot_pie_chart(self,df,col,lbl,title):
        plt.figure(figsize=(6,6))
        pie=plt.pie(df[col].value_counts(),autopct='%1.1f%%',labels=lbl,rotatelabels =True,
                startangle=180,shadow=True,textprops={'fontweight': "bold"})
        plt.title(title,fontweight="bold",fontsize=15)
        plt.setp(pie[1], rotation_mode="anchor", ha="center", va="center")
        for tx in pie[1]:
            rot = tx.get_rotation()
            tx.set_rotation(rot+90+(1-rot//180)*180)
        plt.show()

    #For Plotting Bar Plots
    def b_plot(self,df,x,y,title):
        sns.barplot(x = x,y = y,data =df)
        plt.xticks(rotation=45)
        plt.title(title,fontweight="bold",fontsize=15)
        plt.show()

    #Time Series Function
    #"For each date in x axis,
    #it will show the number of the crossponding
    #feature like No.likes or retweets for example"
    def time_series(self,df,col,date_col):
        time_likes = pd.Series(data=df[col].values, index=pd.to_datetime(df[date_col],utc=False))
        time_likes.plot(figsize=(12, 4), color='r',linewidth=1.5)
        plt.ylabel(col,fontweight="bold",fontsize=10)
        plt.xlabel(date_col,fontweight="bold",fontsize=10)
        plt.show()




class Predictions:

    #Function to apply Simple Linear Regression
    def SLRegression_and_eval(self,df,feature1,feature2):
        X=df[feature1].values
        Y=df[feature2].values
        x_mean=X.mean()
        y_mean=Y.mean()

        #Formula: ax+b=y
        #Calulating a and b values
        a=sum([(xi-x_mean)*(yi-y_mean) for xi,yi in zip(X,Y)])/sum([(xi-x_mean)**2 for xi in X])
        b=y_mean-(a*x_mean)

        #Getting the Y_pred
        Y_pred=lambda x: a*x+b
        #Plotting the Regression Line
        plt.scatter(X,Y,color="y");
        plt.xlabel(feature1,fontweight="bold",fontsize=10)
        plt.ylabel(feature2,fontweight="bold",fontsize=10)
        plt.plot([X.min(),X.max()],[Y_pred(X.min()),Y_pred(X.max())],color="r")
        plt.scatter(x_mean,y_mean,color="purple",marker="s");

        RSS=sum([(yi-Y_pred(xi))**2 for xi,yi in zip(X,Y)])
        TSS=sum([(yi-y_mean)**2 for yi in Y])
        R2_score=1-(RSS/TSS)

        print("RSS={}\nTSS={}\nR2_score={}".format(RSS,TSS,R2_score))


    #Function For Evaluating Classifiers
    def Display_Scores_clf(self,classifier,X_test, y_test,y_pred,ModelName,labels):
        print(ModelName+" recall score: ", str(round(recall_score(y_test,y_pred ,average='micro'),3)*100)+"%")
        print(ModelName+" precision score: ", str(round(precision_score(y_test,y_pred, average='micro'),3)*100)+'
        print(ModelName+" f1 score: ", str(round(f1_score(y_test,y_pred, average='micro'),3)*100)+"%")
        print(ModelName+' Testing Accuracy : ',str(round(accuracy_score(y_test,y_pred),3)*100)+"%")
```

Data Collection and preparation process

In [30]:

```
#Collecting the tweets process
d=Data_collection()
#Specifying a date to get tweets from and before the specified date "maximum a week before"
date = "2022-01-09"
s=d.get_tweets("Bitcoin",1000,date)
#s2=d.get_tweets_from_user(200)
```

In [7]:

```
#Constructing the dataset
df=d.tweets_to_DataFrame(s)
```

Exploring The Data

In [8]:

```
df.head()
```

Out[8]:

	tweets	tweet_len	date	source	likes	retweets	No._followers	lang
0	Ok ID 10t I m going to school you again not be...	140	2022-01-08 22:44:26+00:00	Twitter for iPhone	21536	4350	3321072	en
1	Milton Friedman predicting Bitcoin back in 1999	74	2022-01-08 21:50:08+00:00	Twitter Web App	5004	1257	1921879	en
2	Happy birthday bitcoin Still not a teen yet ea...	85	2022-01-03 15:23:17+00:00	Twitter Web App	16732	3681	4838531	en
3	Bitcoin network power slumps as Kazakhstan cra...	132	2022-01-08 23:59:58+00:00	Twitter for Android	0	59	1270	en
4	I am not asking much i just need 1 BitCoin	44	2022-01-08 23:59:58+00:00	Twitter Web App	5	2	395	en

In [9]:

```
df.shape
```

Out[9]:

```
(1000, 8)
```

In [10]:

```
df.dtypes
```

Out[10]:

```
tweets                        object
tweet_len                      int64
date             datetime64[ns, UTC]
source                        object
likes                          int64
retweets                       int64
No._followers                  int64
lang                          object
dtype: object
```

In [11]:

```
df.describe()
```

Out[11]:

	tweet_len	likes	retweets	No._followers
count	1000.000000	1000.00000	1000.000000	1.000000e+03
mean	121.069000	43.95700	1131.872000	1.341680e+04

std	31.852862	876.15652	3293.789997	2.010528e+05
min	18.000000	0.00000	0.000000	0.000000e+00
25%	111.000000	0.00000	0.000000	3.400000e+01
50%	139.000000	0.00000	39.000000	1.570000e+02
75%	140.000000	0.00000	687.000000	5.075000e+02
max	148.000000	21536.00000	28830.000000	4.838531e+06

In [12]:

```
df.isna().sum()
```

Out[12]:

```
tweets          0
tweet_len       0
date            0
source          0
likes           0
retweets        0
No._followers   0
lang            0
dtype: int64
```

In [13]:

```
#In case, if there is any empty tweets "Empty Strings"
df.drop(df.index[df.tweets == ""], inplace = True)
```

Sentiment Analysis

In [14]:

```
s=Sentiment_Analysis("TextBlob")
df["TB_Sentiment"]=np.array([s.sentiment_analysis_method(tweet) for tweet in df.tweets])
```

In [15]:

```
s2=Sentiment_Analysis("Bert")
df["Bert_Sentiment"]=np.array([s2.sentiment_analysis_method(str(tweet)) for tweet in df.tweets])
```

In [16]:

```
df.head()
```

Out[16]:

	tweets	tweet_len	date	source	likes	retweets	No._followers	lang	TB_Sentiment	Bert_Sentiment
0	Ok ID 10t I m going to school you again not be...	140	2022-01-08 22:44:26+00:00	Twitter for iPhone	21536	4350	3321072	en	1	3
1	Milton Friedman predicting Bitcoin back in 1999	74	2022-01-08 21:50:08+00:00	Twitter Web App	5004	1257	1921879	en	0	1
2	Happy birthday bitcoin Still not a teen yet ea...	85	2022-01-03 15:23:17+00:00	Twitter Web App	16732	3681	4838531	en	1	4
3	Bitcoin network power slumps as Kazakhstan cra...	132	2022-01-08 23:59:58+00:00	Twitter for Android	0	59	1270	en	0	1
4	I am not asking much i just need 1 BitCoin	44	2022-01-08 23:59:58+00:00	Twitter Web App	5	2	395	en	1	1

In [17]:

```
df.to_csv("bitcoin-twitter.csv",index=False)
```

In [90]:

```
df=pd.read_csv("bitcoin-twitter.csv")
```

In [91]:

```
#Labeling and changing both Bert and TextBlob Sentiment columns values
bert_scales={1:"Negative",2:"N_to_N",3:"Neutral",4:"N_to_P",5:"Postive"}
textblob_scales={-1:"Negative",0:"Neutral",1:"Postive"}
df["labeled_TB"]=df.TB_Sentiment.map(lambda x:textblob_scales.get(x))
df["labeled_Bert"]=df.Bert_Sentiment.map(lambda x:bert_scales.get(x))
```

In [92]:

```
#Percentage of Bert Column
d=Data_preprocessing()
bert_res=d.get_col_percentage("labeled_Bert",df)
bert_res
```

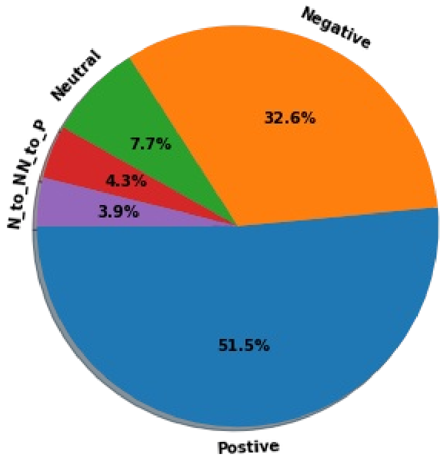
Out[92]:

	Total No.	Percentage
Postive	515	51.5
Negative	326	32.6
Neutral	77	7.7
N_to_P	43	4.3
N_to_N	39	3.9

In [93]:

```
#Visuallizing sentiment analysis
vis=Data_Visualization()
vis.plot_pie_chart(df,"Bert_Sentiment",list(df.labeled_Bert.value_counts().index)
                    ,"Opinions about Bitcoin Topic using Bert")
```

Opinions about Bitcoin Topic using Bert



In [94]:

```
#Percentage of TextBlob Column
TB_res=d.get_col_percentage("labeled_TB",df)
TB_res
```

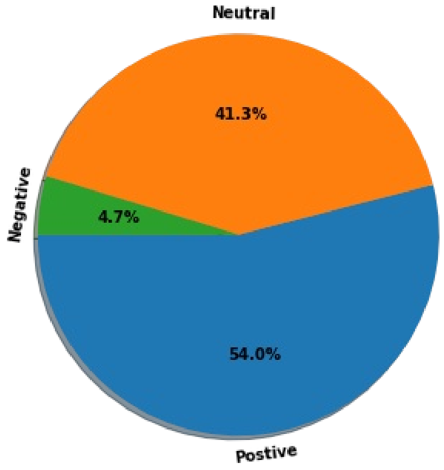
Out[94]:

	Total No.	Percentage
Postive	540	54.0
Neutral	413	41.3
Negative	47	4.7

In [95]:

```
#Visuallizing sentiment analysis using TextBlob
vis=Data_Visualization()
vis.plot_pie_chart(df,"TB_Sentiment",list(df.labeled_TB.value_counts().index)
                    ,"Opinions about Bitcoin Topic using TextBlob")
```

Opinions about Bitcoin Topic using TextBlob



In [96]:

```
#Getting the Highest used sources
'''
Information like this could be useful in knowing
where the most tweets which are related to Bitcoin
Topic comes from

'''
#Getting the highest used sources, collecting them in a DataFrame
Highest_used_sources=df.source.value_counts()[:3]
Highest_used_sources=Highest_used_sources.rename_axis('sources').reset_index(name='counts')

#Getting the remaining used sources
```

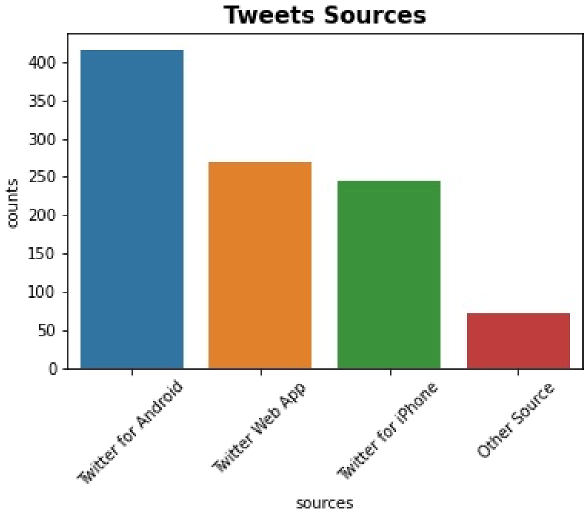
```
#collecting and appending them in the previous DataFrame
remaining_sources=df.source.value_counts()[3:]
other_sources_total=np.sum(list(remaining_sources))

#DataFrame Includes all Sources
all_used_sources =Highest_used_sources.append({"sources":"Other Source","counts":other_sources_total}, ignore_inc
all_used_sources
```

Out[96]:

	sources	counts
0	Twitter for Android	417
1	Twitter Web App	268
2	Twitter for iPhone	244
3	Other Source	71

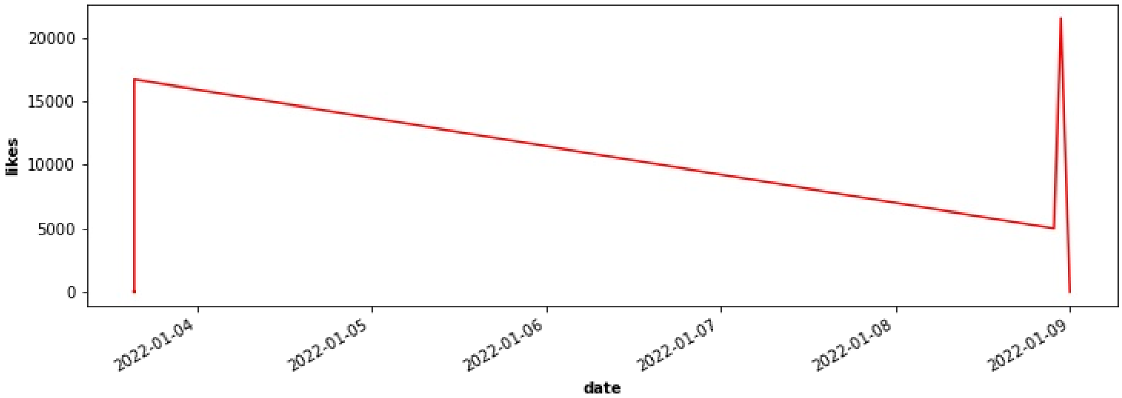
In [97]:

```
#Now visualize it
vis.b_plot(all_used_sources,"sources","counts","Tweets Sources")
```



In [98]:

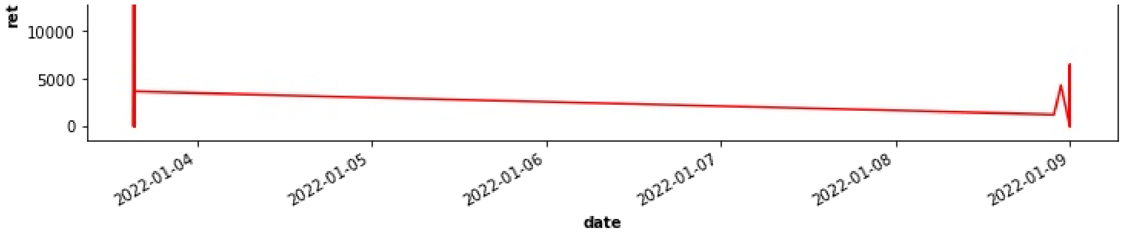
```
'''
This Plot shows that the most number of
likes that a tweet talking about bitcoin get
was between 01-08 and 01-09

'''
vis.time_series(df,"likes","date")
```



In [99]:

```
'''
This Plot shows that the most number of
retweets for a tweet which talking about bitcoin
was between 01-03 and 01-04

'''
vis.time_series(df,"retweets","date")
```

30000
25000
20000
15000
weets



Conclusions

In [100…

```
print("#Number of Likes for the most liked tweet was: ",df.likes.max())
print("#Average Number of the retweets: ",df.retweets.mean())
print("#The most used source was: ",all_used_sources.sources[0])
print("#The Average Number of likes between all tweets was: ",df.likes.mean())
print("#From Previous Sentiment Analysis Results:\n",
      "Both Bert model and TextBlob models prove that:\n",
      "Most of opinions about bitcoin between 2022-01-03 to 2022-01-09",
      "\n were Positive"
     )

print("\n#Bert_Results:\n",
      "Negative: {}%".format(bert_res.Percentage[1]),
      "\nNegative to Neutral: {}%".format(bert_res.Percentage[4]),
      "\nNeutral: {}%".format(bert_res.Percentage[2]),
      "\nNeutral to Postive: {}%".format(bert_res.Percentage[3]),
      "\nPostive: {}%".format(bert_res.Percentage[0]),
      "\n\n#TextBlob_Results:\n",
      "Negative: {}%".format(TB_res.Percentage[2]),
      "\nNeutral: {}%".format(TB_res.Percentage[1]),
      "\nPostive: {}%".format(TB_res.Percentage[0]),
     )
```

```
#Number of Likes for the most liked tweet was:  21536
#Average Number of the retweets:  1131.872
#The most used source was:  Twitter for Android
#The Average Number of likes between all tweets was:  43.957
#From Previous Sentiment Analysis Results:
 Both Bert model and TextBlob models prove that:
 Most of opinions about bitcoin between 2022-01-03 to 2022-01-09
 were Positive

#Bert_Results:
 Negative: 32.6%
Negative to Neutral: 3.9%
Neutral: 7.7%
Neutral to Postive: 4.3%
Postive: 51.5%

#TextBlob_Results:
 Negative: 4.7%
Neutral: 41.3%
Postive: 54.0%
```

Predictive data analysis (PDA) Section

In [101…

```
#Normalizing values in Numerical columns
normalized_df=(df-df.mean())/df.std()

#getting a subset of the normalizied data set
# Preparing it for Regression
normalized_df=normalized_df[["likes","retweets","No._followers"]]
normalized_df.head()
```

Out[101…

	likes	retweets	No._followers
0	24.529913	0.977029	16.451674
1	5.661138	0.037989	9.492343
2	19.046874	0.773919	23.999239
3	-0.050170	-0.325726	-0.060416
4	-0.044464	-0.343031	-0.064768

In [102…

```
#There is a poor correlation between likes and retweets
```

```
#Thus, they might be independent
#normalized_df.likes.corr(normalized_df["retweets"])

#There is a High correlation between likes and user Number of followers
#So, that may help when we start using simple linear regression
normalized_df.likes.corr(normalized_df["No._followers"])
```

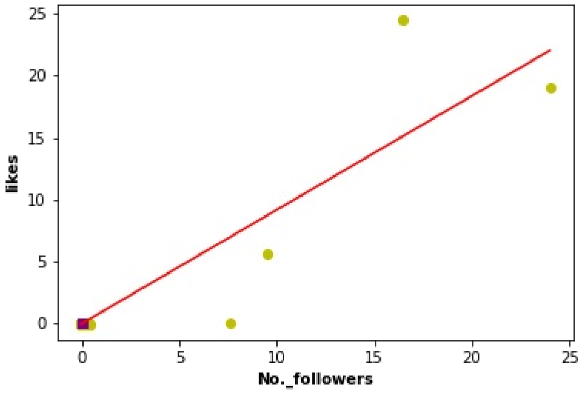
Out[102…

```
0.918370877530643
```

In [103…

```
p=Predictions()
p.SLRegression_and_eval(normalized_df,"No._followers","likes")
```

```
RSS=156.43833637229085
TSS=999.0000000000337
R2_score=0.8434050686964109
```



In [104…

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import recall_score, precision_score, accuracy_score, f1_score

#Example for a Multiclass classification problem
selected_features=["likes","retweets","tweet_len","No._followers"]
x=df[selected_features]
y=df['TB_Sentiment']
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2)

#Standard scaler used for scaling the columns values
#because there is a big difference
sc = StandardScaler()
x_train=sc.fit_transform(x_train)
x_test=sc.transform(x_test)
```

In [105…

```
#Testing Random Forest Classifier
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
ypred2=rfc.predict(x_test)
labels=["Negative","Neutral","Positive"]
#Evaluate The Accuracy of the Classifier
p.Display_Scores_clf(rfc, x_test, y_test,ypred2,'Random Forest Classifier',labels)
```

```
Random Forest Classifier recall score:  71.5%
Random Forest Classifier precision score:  71.5%
Random Forest Classifier f1 score:  71.5%
Random Forest Classifier Testing Accuracy :  71.5%
```

$$Metric:\ Accuracy = \frac{tp+tn}{N}\ , Recall = \frac{tp}{tp+fn}\ , Percision = \frac{tp}{tp+fp}\ , F1Score = 2 * \frac{perscision * recall}{perscision + recall}$$

In [ ]:

Processing math: 100%