Inspecting Irresponsible Hypes: Rumors in Social Media Networks

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***Abstract*— Online Social Networks such as Facebook, Twitter, Instagram have gained a lot of popularity among the people. Nowadays people simply tend to hype in social media for publicity or promotion which is source for huge amount of online deception. The data shared may or may not be true and commonly falls in as rumor and non-rumor. Identifying the bogus news socializing as rumor and the starting place via Jordan source center with SI, SIR, SIRI infection models is the precise way out for isolating a rumor. Jordan source center is the best optimal source calculator which overcomes the error rate, infection rates and other parameters when compared with other centralities. It helps in finding the source of the rumor and proceed further in recycling the infections in social media networks.**

Keywords- Social media networks; rumor; non-rumor; Jordan center; SI; SIR; SIRI infection modes

I. INTRODUCTION

Social networking is an online platform in which people interact with other people. Online social networks such as Facebook, Twitter [3], LinkedIn, Google+ have became an fundamental modes of human interactions every day. Social media sites acts as a hub for information sharing, where users produce and consume a wide variety of information and thoughts. Social websites create mobile and web-based technologies for the benefit of the users to interact with their circle. The main idea behind social media is to bring people together and to interact with each other. It uses different routines like blogs, micro-blogs, business networks, photo sharing, products and service reviews to reach the end users [1].

In the current digitally connected world, nearly all internet connected individuals uses social media to interact with others from simple chatting to official file sharing. Sharing the user information and news publicly, brings lots of change to the simple observer online. Social media is used as a source of spreading news instantly during emergency and disaster situations. This information helps to provide recovery and response to the people. At the same time, many unconfirmed news about a trending event spreads very quickly which brings greater impact to the society.

Rumors can be defined as unverified information or of events that circulate from person to person. When a piece of information leaks out in a social network, it spreads quickly because of its increasing popularity. It extends from static email services to live chat. It takes only few second to share the content without knowing the integrity of the message. Business people have higher number of impacts because of this rumors. The most commonly spreading social media rumors are celebrity deaths, chain mail, disaster news, political news, share market news etc. Some of the notable rumors that brought huge consequences in past were the following: Boston bombing attack, Paris attack and Malaysian airlines missing(MH370). This type of rumor spreading in social media sites is referred as infection. This infection is spread among all the online users and can cause unnecessary panic among public and loss in case of trade markets.

Anything that is posted in social media travels faster without being verified. People just forward the news without verifying the originality of the news. Sometimes this may also create some problem. For example: “Happy New Year ” wishes also posted by people at the same time some fake news related to new year like “bomb blast on new year eve” also spreads infinitely. Mostly the speed at which it spreads is considered but obviously not the context. The text needs to analyzed properly in order to verify it as rumor. Cyber criminal often use social media networks as a medium to discuss about their cyber attacks, identify potential victims to achieve their target. They post anything related to the cyber attacks without the knowledge of the user who acts as the tool to spread the rumor. Monitoring social media discussions to find non-rumor phrases at that instance helps to identify all these attacks. Analysts try to discover and track the news that spreads by manual searches using metadata, such as thread or currently discussing topics, account names etc. We define keywords that broadly refer to an ongoing event, which is not a rumor but is expected to spark rumors. Having obtained collections of events, our attempt focuses on visualizing the timeline which is associated with an event, to enable identification of rumors.

The infection that spreads in social media is defined with various models as infection spreading models. The models are: Susceptible Infected(SI model), Susceptible Infected and Recovered (SIR model),Susceptible Infected Recovered and Infected (SIRI model) In the SI model, each node takes on one of 3 possible states: susceptible (s), infected (i) and non-susceptible (n). The set of uninfected nodes that have infected node as neighbors are in state s, and called as Susceptible nodes. While infected node never retains its infection forever once it is infected. In the SIR model, the possible node states are susceptible (s), infected (i), recovered (r). The only difference is that in a time slot, state (i) may recover to state (r). An infected node can recover from an infection by removing its post which contains the rumor with a given probability at each step, and will never post the rumor again. In the SIRI model, the difference is that recovered node may become infected again at a future time slot with positive probability. After an individual removes a rumor post, later may change and repost the rumor, for example they may discover a new evidence that supports the rumor.

II. LITERATURE REVIEW

A. How to identify an Infection Souce with Limited Observations

Rumors spreading in social media is similar to that of a n infectious disease. It spreads so quickly among the users. Finding the rumor spreading source is a challenging tasks. By considering all the model like SI we are deriving a source estimator which is known as Jordan center estimator. It will be a great advantage if it is a tree network. An efficient Jordan center estimation algorithm to calculate the source which is suitable for tree networks. Message passing algorithm is computed at each node in a distributed environment.

Jordan center estimation algorithm chooses a non leaf node as root node and follows message passing algorithm. It divides as Upward message passing and Downward passing and continues its work.

1) In Upward message passing starting from leaf node up to root where the message passed to parent node. Each node passes one message to its parent. It terminates when root receives all messages from the child.
2) In Downward message passing the root identifies two paths. If the difference in both values are lesser than the value one then it returns the Jordan center. Same process is repeated until a leaf node is reached.

B. Network Centrality and Super-Spreaders in Infectious Disease Epidemiology

If disease spreads quickly among the people then it is referred as “Super-spreaders”. In a similar way the rumors which is being spreaded is referred as super spreaders. In social media networks “Centrality” is used to calculate the source of the rumors. The main reason behind every rumors that is going viral in social media. In SIR model these centralities helps to identify the main source of the rumor spreading.

There are many centralities such as Closeness centrality, Degree centrality, Eigen vector centrality, Valued centrality, Jordan centrality, Betweenness centrality.

1. Closeness centrality

It is the reciprocal of average of shortest path between nodes is calculated as,

$$C_c(x) = \frac{n-1}{\sum_{y \neq x} D(x,y)} = \frac{1}{\underset{y\neq x}{AVGD(x,y)}}$$

2. Valued centrality

It is similar to that of closeness centrality but rather it calculates the average value as,

$$C_v(x) = \frac{1}{n-1}\left(\sum_{y\neq x}\frac{1}{D(x,y)}\right) = \underset{y\neq x}{AVG}\left(\frac{1}{D(x,y)}\right)$$

3. Jordan centrality

It finds the smallest maximum distance of all the nodes in a graph. Minimum eccentricity value is calculated by using,

$$C_J(x) = \frac{1}{\underset{y\neq x}{MAXD(x,y)}}$$

4. ***Betweenness centrality***

It is computed only to the network that do not contain any multiple edges. It is the number of shortest path from all vertices to all others pass through that node by using,

$$C_B(Z) = 0.001 + \frac{2}{(n-1)(n-2)} \sum_{x \neq z} \sum_{y \neq z} \frac{g_{xy}(2)}{g_{xy}}$$

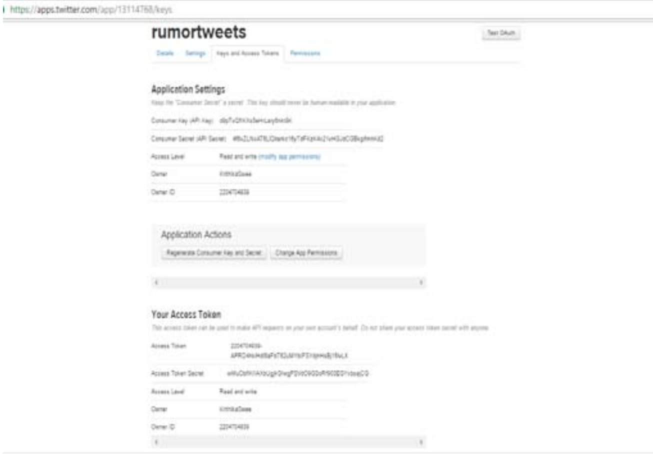
5. Eigen vector centrality

It takes all unique positive values by using,

$$C_E(i) = \frac{1}{\lambda} \sum_j A_{ij} C_E(j)$$

III. Experimental results

A. Twitter Streaming API



https://apps.twitter.com/app/13114768/keys

rumortweets

Application Settings

Keep the "Consumer Secret" a secret. This key should never be human-readable in your application.

Consumer Key (API Key) [illegible]

Consumer Secret (API Secret) [illegible]

Access Level Read and write (modify app permissions)

Owner KrithikaDeee

Owner ID [illegible]

Application Actions

Your Access Token

This access token can be used to make API requests on your own account's behalf. Do not share your access token secret with anyone.

Access Token [illegible]

Access Token Secret [illegible]

Access Level Read and write

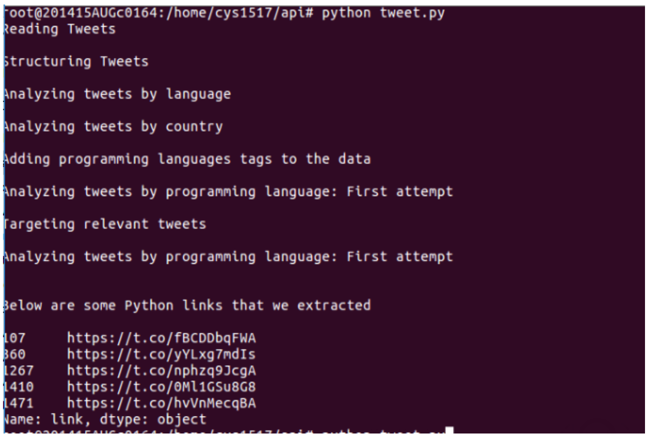
Owner KrithikaDeee

Owner ID [illegible]

Figure 1. Twitter Streaming API

Twitter streaming API's tracks the tweets [2] for a particular circulating story with the main keywords and hash tags. Collection of conversation with this API is done, before which OAuth tokens are generated[4].

B. Downloading the Data



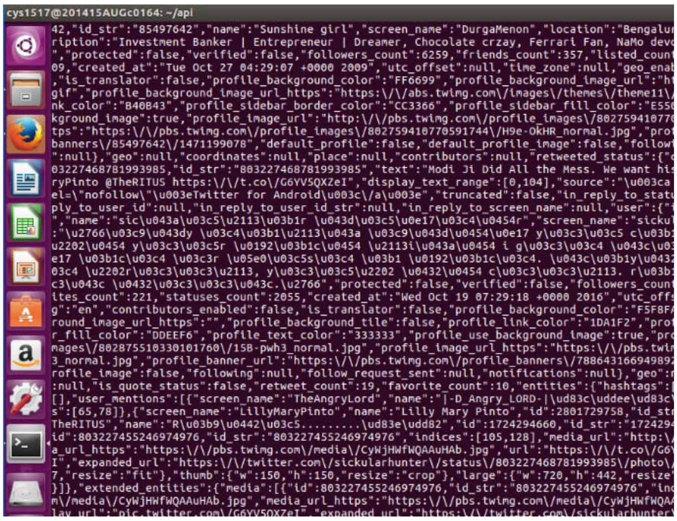
```
root@201415AUGc0164:/home/cys1517/api# python tweet.py
Reading Tweets

Structuring Tweets

Analyzing tweets by language

Analyzing tweets by country

Adding programming languages tags to the data

Analyzing tweets by programming language: First attempt

Targeting relevant tweets

Analyzing tweets by programming language: First attempt


Below are some Python links that we extracted

107     https://t.co/fBCDDbqFWA
360     https://t.co/yYLxg7mdIs
1267    https://t.co/nphzq9JcgA
1410    https://t.co/0Ml1GSu8G8
1471    https://t.co/hvVnMecqBA
Name: link, dtype: object
root@201415AUGc0164:/home/cys1517/api# python tweet.py
```

Figure 2. Collection of data

The data we gathered is stored as JSON format which is referred as JavaScript Object Notation. It helps to read the data in human readable form and for the machines to parse the data.

C. Annotation Task

Annotation task is done by the annotators to identify the rumor and non-rumor.



```
42,"id_str":"85497642","name":"Sunshine girl","screen_name":"DurgaMenon","location":"Bengalur
ription":"Investment Banker | Entrepreneur | Dreamer, Chocolate crzay, Ferrari Fan, NaMo devo
","protected":false,"verified":false,"followers_count":6259,"friends_count":357,"listed_coun
09,"created_at":"Tue Oct 27 04:29:07 +0000 2009","utc_offset":null,"time_zone":null,"geo_enab
,"is_translator":false,"profile_background_color":"FF6699","profile_background_image_url":"ht
gif","profile_background_image_url_https":"https:\/\/abs.twimg.com\/images\/themes\/theme11\/
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tps":"https:\/\/pbs.twimg.com\/profile_images\/802759410770591744\/H9e-OkHR_normal.jpg","pro
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03227468781993985,"id_str":"803227468781993985","text":"Modi Ji Did All the Mess. We want his
ryPinto @TheRITUS https:\/\/t.co\/G6YV5QXZeI","display_text_range":[0,104],"source":"\u003ca 
el=\"nofollow\"\u003eTwitter for Android\u003c\/a\u003e","truncated":false,"in_reply_to_statu
ply_to_user_id":null,"in_reply_to_user_id_str":null,"in_reply_to_screen_name":null,"user":{"
","name":"sic\u043a\u03c5\u2113\u03b1r \u043d\u03c5\u0e17\u03c4\u0454r","screen_name":"sicku
:"\u2766\u03c9\u043dy \u03c4\u03b1\u2113\u043a \u03c9\u043d\u0454\u0e17 y\u03c3\u03c5 c\u03b
u2202\u0454 y\u03c3\u03c5r \u0192\u03b1c\u0454 \u2113i\u043a\u0454 i g\u03c3\u03c4 \u043c\u0
e17 \u03b1c\u03c4 \u03c3r \u05e0\u03c5s\u03c4 \u03b1 \u0192\u03b1c\u03c4. \u043c\u03b1y\u043
03c4 \u2202r\u03c3\u03c3\u2113, y\u03c3\u03c5\u2202 \u0432\u0454 c\u03c3\u03c3\u2113. r\u03b
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mages\/802875510330101760\/15B-pwh3_normal.jpg","profile_image_url_https":"https:\/\/pbs.twim
3_normal.jpg","profile_banner_url":"https:\/\/pbs.twimg.com\/profile_banners\/78864316694989
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7,"resize":"fit"},"thumb":{"w":150,"h":150,"resize":"crop"},"large":{"w":720,"h":442,"resize"
}]},"extended_entities":{"media":[{"id":803227455246974976,"id_str":"803227455246974976","inc
m\/media\/CyWjHWfWQAAuHAb.jpg","media_url_https":"https:\/\/pbs.twimg.com\/media\/CyWjHWfWQAA
lay_url":"pic.twitter.com\/G6YV5QXZeI","expanded_url":"https:\/\/twitter.com\/sickularhunter\
```
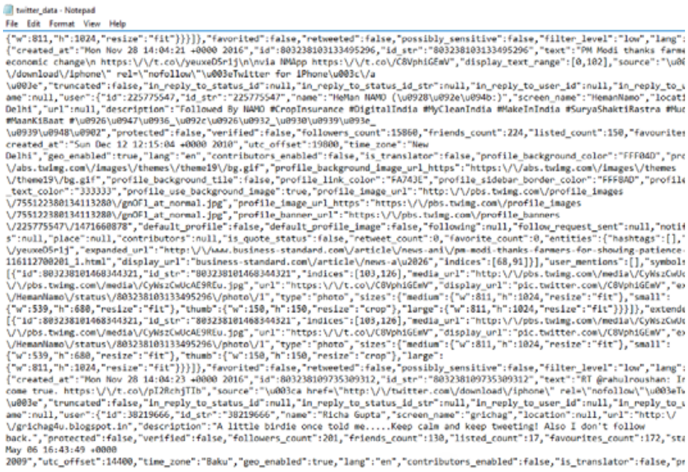

Figure 3. Data in JSON Format



```
{"w":811,"h":1024,"resize":"fit"}}}]},"favorited":false,"retweeted":false,"possibly_sensitive":false,"filter_level":"low","lang":
{"created_at":"Mon Nov 28 14:04:21 +0000 2016","id":803238103133495296,"id_str":"803238103133495296","text":"PM Modi thanks farme
economic change\n https:\/\/t.co\/yeuxeD5r1j\n\nvia NMApp https:\/\/t.co\/C8VphiGEmV","display_text_range":[0,102],"source":"\u00
\/download\/iphone\" rel=\"nofollow\"\u003eTwitter for iPhone\u003c\/a
\u003e","truncated":false,"in_reply_to_status_id":null,"in_reply_to_status_id_str":null,"in_reply_to_user_id":null,"in_reply_to_u
ame":null,"user":{"id":225775547,"id_str":"225775547","name":"HeMan NAMO (\u0928\u092e\u094b:)","screen_name":"HemanNamo","locati
Delhi","url":null,"description":"Followed By NAMO #CropInsurance #DigitalIndia #MyCleanIndia #MakeInIndia #SuryaShaktiRastra #Mud
#MaanKiBaat #\u0926\u0947\u0936_\u092c\u0926\u0932_\u0930\u0939\u093e_
\u0939\u0948\u0902","protected":false,"verified":false,"followers_count":15860,"friends_count":224,"listed_count":150,"favourites
created_at":"Sun Dec 12 12:15:04 +0000 2010","utc_offset":19800,"time_zone":"New
Delhi","geo_enabled":true,"lang":"en","contributors_enabled":false,"is_translator":false,"profile_background_color":"FFF04D","pro
\/abs.twimg.com\/images\/themes\/theme19\/bg.gif","profile_background_image_url_https":"https:\/\/abs.twimg.com\/images\/themes
\/theme19\/bg.gif","profile_background_tile":false,"profile_link_color":"FA743E","profile_sidebar_border_color":"FFF8AD","profile
_text_color":"333333","profile_use_background_image":true,"profile_image_url":"http:\/\/pbs.twimg.com\/profile_images
\/755122380134113280\/gnOF1_at_normal.jpg","profile_image_url_https":"https:\/\/pbs.twimg.com\/profile_images
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\/225775547\/1471660878","default_profile":false,"default_profile_image":false,"following":null,"follow_request_sent":null,"noti
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\/grichag4u.blogspot.in","description":"A little birdie once told me.....Keep calm and keep tweeting! Also I don't follow
back.","protected":false,"verified":false,"followers_count":201,"friends_count":130,"listed_count":17,"favourites_count":172,"sta
May 06 16:43:49 +0000
2009","utc_offset":14400,"time_zone":"Baku","geo_enabled":true,"lang":"en","contributors_enabled":false,"is_translator":false,"pr
```
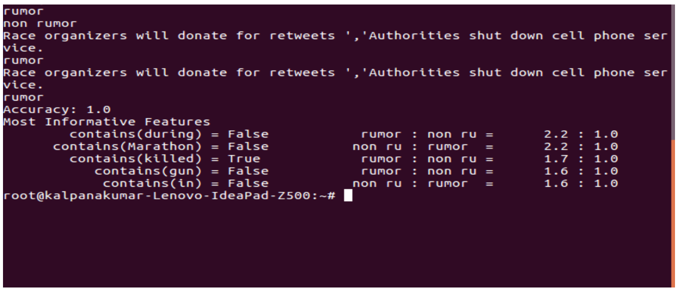

Figure 4. Streaming data in text file

D. *Using TextBlob*

TextBlob classifier helps to classify the text based on Naive Bayes classifier in python. Here, from the annotated list the rumor and non-rumor data is trained and tested from which we get the classified rumor and non-rumor text [5].



```
rumor
non rumor
Race organizers will donate for retweets ','Authorities shut down cell phone ser
vice.
rumor
Race organizers will donate for retweets ','Authorities shut down cell phone ser
vice.
rumor
Accuracy: 1.0
Most Informative Features
        contains(during) = False           rumor : non ru =      2.2 : 1.0
      contains(Marathon) = False          non ru : rumor  =      2.2 : 1.0
        contains(killed) = True            rumor : non ru =      1.7 : 1.0
           contains(gun) = False           rumor : non ru =      1.6 : 1.0
            contains(in) = False          non ru : rumor  =      1.6 : 1.0
root@kalpanakumar-Lenovo-IdeaPad-Z500:~# 
```

Figure 5. Using TextBlob as Rumor or Non-rumor

Streaming data in data file. Annotation task is done by the annotators to identify the rumor and non-rumor for particular Boston Bombing event. Annotated rumor and non-rumor data is given in the table as shown below:

TABLE I. ANNOTATED RUMOR AND NON-RUMOR

Rumor	Non-Rumor
false flag	brothers are suspect
suspect robbed	pressure cooker bomb
man proposal	finish line blast
shut down cell service	one suspect died
retweets awarded	misidentified man
sandy runner	suspects account
library explosion	multiple blast
many dead	three dead
pressure cooker ad	nails used
children died	firing during arrest

IV. CONCLUSION AND FUTURE WORK

We conducted a literature survey on Rumor detection and in finding the source of the rumor. We classified a particular event that is circulating in social media networks as rumor and non-rumor. With the TextBlob (NLTK), we classified the text as rumor or non-rumor. We addressed the problem of finding the source of a rumor. Jordan center source estimator is the best optimal source estimator to find the center, i.e., the source of the rumor.

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