Mis-informed Ego-Centric Decision Aggravated by Social Network

Detection and Mitigation of Fake News and it's Role in Creating an Connected and Reliable News Source

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Abstract

The proposal starts with the grand challenges the world is currently facing. One of the challenges that was identified related to assistance in decision making. The divide and the bias that exists when it comes to news were delineated. Most millennials believe the news they see in non-credible non-news sources such as facebook, twitter, and other social media platform. The causes and mitigation of echo chamber and confirmation bias were dissected and related to the propagation of fake news. These problems were summated into three research questions, which forms major point of discussion for this proposal. First, an algorithm was theorized based on blockchain, three-way byzantine problem and concepts of crowd-powered systems to create a quorum for dependable consensus. Further, ways of integrating agent crawlers in the proposed system was discussed. Next, some of the possible ways to create awareness and educate people about the fake news were discussed. Finally, the implementation of the fake news detection system in the social media platform and other internet platform was deliberated.

1. Grand challenges

As we proceed through the silicon age and fourth industrial revolution, the world is facing certain important challenges. Most of the challenges appear due to the division in ideologies and how people arrive at solution. Bias has a major role to play in this, since humans like to hear and socialize with people who show agreement with their thoughts and beliefs. This accounts for a certain echo chamber (Purpose, 2016). This fact was well articulated in a study conducted by (Barberá, Jost, Nagler, Tucker, & Bonneau, 2015). They found results by analyzing the ideological preferences of 3.8 million Twitter users and their 150 million posts. This included multiple political alignments and certain nonpolitical issues as well. They found that information was exchanged primarily among individuals with similar ideological preferences in case of political issues. However, it was also found that certain political discussions especially from conservatives did have access to other ideologies. This research further looks into this division pertaining to challenges on a global level.

The Millennium project identifies about 15 global challenges that banes humanity ("15 Global Challenges", 2016). They are mentioned as follows:

1. Sustainable development and climate change
2. Clean Water
3. Population and Resources
4. Democratization
5. Global foresight and decision making
6. Global convergence of IT
7. Rich – Poor Gap
8. Health issues
9. Education and Learning
10. Peace and conflict
11. Transnational organized crime
12. Status of Women
13. Energy
14. Science and Technology
15. Global ethics

Most of the problems that are mentioned are not entirely new to hear. They have for the most part of this century a problem, however, there are new found challenges present as well. Some of the debates lead into discussion which has division embedded into it. Such discussions also shows lack of collaboration which is deliberated as follows.

1.1 Sustainable development and climate change

Lu, Nakicenovic, Visbeck, and Stevance (2015) discuss some priorities of how scientific community should participate in effort to mitigate climate changes. They mention that scientists,

social scientists and economists need to design a set of indices to track the progress of Sustainable development goals of UN ("Sustainable development goals - United Nations", 2016). They also endorse global collaboration between the governments. It is important to note the collaboration, where scientific bodies will be essential in setting up programs and monitoring assistance to developing nations. Further, they call for evaluation of such development and enhance the infrastructure. Lu, Nakicenovic, Visbeck, and Stevance (2015) they also mention that we must help in integrated monitoring and evaluations into policy-making at all levels.

Arriving at consensus has always been a major challenge for humanity. There is a deep division between the believes in climate change and faction of people who do not. There are certain websites which seems to claim the climate change as myth. However, the data presented are not supported by reliable sources. For example most of the times, the arguments are distorted to show incomplete truths. A website claimed that there was a record ice in 2014 and a link from NASA website was cited. However, upon inspection, it was found that “The upward trend in the Antarctic, however, is only about a third of the magnitude of the rapid loss of sea ice in the Arctic Ocean.”

Furthermore, they also cite that “The planet as a whole is doing what was expected in terms of warming. Sea ice as a whole is decreasing as expected, but just like with global warming, not every location with sea ice will have a downward trend in ice extent,” ("Antarctic Sea Ice Reaches New Record Maximum", 2016). In contrast there are number of peer reviewed and verified journals which seems to not only accept that global warming is not a myth, but tried to understand the reasons for not accepting this reality (Douglas & Sutton, 2015; Lu, Nakicenovic, Visbeck, & Stevance, 2015; Steffen, 2013).

1.2. Democratization

Democracy is generally accepted as the better way of doing things. However, democracy does not fit everywhere. As with everything, there a both pros and cons associated with democracy. While democracy promotes involvement, imposes equality, allows for reasonable policy changes, and provides obligation to citizens among other things. It lacks risk of knowledge among the people, slow decision making and change reflection, cause minority to get the short hand, allow mob influence, and might involve election fraud (direct and indirect) (Vanhanen, 2013; Moran, Moran, & Parry, 2015). Again, we can observe the conflict of thought as to why people support or oppose democracy.

1.3. Peace and Conflict

Another deep divide perhaps present from decade in this world is peace and conflict. It is arguable that nobody desires war, but prefers peace. However, the current and past trends speak otherwise. Conflict or ideologies, beliefs and expansionist mindset of humanity has always invited war. Such a trend of conflict is well exemplified by the doomsday clock ("Science and Security Board", 2016). It is a symbolic clock which represents a countdown to possible

global catastrophe. It considers primary criteria namely nuclear threats, climate change, biosecurity, neuroweapons and AI. The closer the clock is set to twelve, closer the global disaster. Its advisory board includes 18 Nobel laureates and accounts for all the criteria as accurately as possible.

In 1947, the clock was set to seven minutes to midnight which was the time of cold war. Accounting for the latest issues, the clock was decreased by a minute from six minutes to five due to lack of global political action to address global climate change, nuclear stockpiles, the potential to regional nuclear conflict, and nuclear power safety in 2012. Further in 2015, the clock was reduced by devastating two minutes making it three minutes to midnight, due to the concerns amid continued lack of global political action on addressing climate change, modernization of nuclear weapons in USA and Russia, and problem of nuclear waste.
It is important to observe that most of these problems arise due to the lack of cooperation to arrive at a consensual decision. A divide in the political alignment, divide in peace and conflict, divide in democratization and divide in climate change agreement contributes to this disagreement on a larger scale. Notwithstanding these, there still might be a possibility to try and arrive at a consensual solution, which is discussed in the next section.

1.3. Global foresight and decision making

Strategic planning plays an important part in the Global foresight and decision making. Various problem might arise at organizational level, national level and even at the global level. All these changes and changes that invites problems are generally not-predictable. Since predictions are not often reliable, it becomes important to prepare the managers and leaders of the organization to handle the future (Vecchiato, 2012). However, local decision making and individual autonomy might lead to management anarchy unless account for their decisions (Senge & Sterman, 1992). Vecchiato (2012) also assert that it is important to sense the changes in the environment, seize these changes and reconfigure both tangible and intangible assets to keep its alignment with environment. This is consistent with the Theory U proposed and operationalized by U.lab ("U.Lab | Presencing Institute", 2016). This invites for a more global decision making my not just sensing self but environment as well. Furthermore, even though it is hard to predict and leaders are prepared, if satisfactory and effective tools are not provided, it may be difficult to make timely decision and be ready with strategic preparedness. Cook, Inayatullah, Burgman, Sutherland, and Wintle (2014) mention strategic tools as such to account for foresight and decision making. They mention six steps of strategic foresight and how it can be viewed through a broader lens.

Cook, Inayatullah, Burgman, Sutherland, and Wintle (2014) conclude by saying as follows:

> Although social and political context can sometimes be an impediment to implementation, a rigorous foresight process that uses tools such as backcasting to help overcome resistance to taking action should yield better outcomes. It is encouraging to see the increasing recognition of the power of foresight tools, but it is important to ensure their application is based on a rigorous foresight process. Applying these lessons and

utilizing specialists in the foresight discipline could maximize the value of strategic activities for environmental management (p. 539).

As discussed above, some of the global challenges can indeed be addressed by arriving at consensus on a global level and strategic planning. UN is striving to address some of the global issues as well. A factor that influences this disconnect can be due to echo chamber or creation of social bubbles. This might create some distortion in making decisions and people might be subjected to confirmation bias. This will be discussed in detail in the next chapter.

2. Related Research: Causes/possible factors

2.1. Polarization

For a very long time now the media has made a major shift, from great networks and newspapers to some news that target a specific audience. In essence, we tend to consider much about news that interest us and leave out other news that we don't like. This has made us turn into a politically polarized nation, where we have specialized media sources and a lack of common understanding, leading to an **ego-centric decision making**. This is the problem. Media these days seem to have a polarizing effect since what they cover emphasizes more on polarization. Survey of the mass public shows that how the media covers polarization influences political attitudes. To be specific, the effect of this coverage is that it increases opposition of the other party.

2.1.1. Polarization as a possible factor

Ordinary people think there is some form of division in the electorate than it actually is. Research in social psychology has found out that there always exists massive rival groups, just to mention, blacks and whites, men and women, and Democrats and Republicans. This is the psychology of categorization. How blacks and whites or Democrats and Republicans perceive each other always leads to a false polarization – an interpersonal bias on judgement. A population based survey experiment was conducted to prove that media coverage of the electorate which tends to focus more on polarization and discord will worsen false polarization. The conduction was that a certain group of people were assigned to read media accounts of a polarized electorate while others focused on media accounts of a more sensible electorate. The results was that the ones who focused on reading the polarized electorate perceived greater electoral polarization. This again brings me back to my point that media these days seem to have a polarizing effect since what they cover emphasizes more on polarization.

2.1.2. Political implications of polarization

2.1.2.1. Moderation of citizens issue positions

Almost all Americans agree to a two-party system, consensus and compromise. This forms a categorical kind of nation such that when one group is portrayed out negatively then disagreements ensue. However, subject end up moderating their issue positions as they are

told what not to believe. This clearly shows that false polarization is not necessarily a self-fulfilling prophecy.

2.1.2.2. Hatred for the opposing party

As explained above, people listen to polarized media and respond very negatively to them, hating the opposing party. This affective polarization occurs among all subjects. Research still show that subjects rate the opposing party lower in the feeling thermometer after reading a polarized article, something below 4 degrees. Many things of the opposing party have been reported to be hated and evaluations of members is on the negative scale on a number of different criterion.

2.1.3. Solution

One great possible solution to tackling fake news is having an informed population and teaching information literacy to the public (Matt L. , 2016). This work is solely for the librarians, they have a key role. There are so many things that librarians can do to curb fake news.

- Distinction in information technology and dissemination should be something that is taught continually, not forgetting the library database. The main reason for this is that these are credible sources that come from professionals who keep journalistic standards and academic principles.
- Traditional sources of information should be reinforced through subscriptions and library purchases.
- Invention of new technologies that will prioritize on credible information source. Sites that focus of fact-checking should be supported and librarians should put emphasis on this as well.
- The spread of fake news should be stopped through the addition of design elements to online news.
- There should also be a validation of any news that is marked suspicious. This can be done by use of a blockchain algorithm.

2.1.4. Conclusion on polarization

The end result of the media alteration in the way they portray a party is increased antipathy for the opposition. This is a clear indication that the media helps in the segmentation of the electorate, all through polarization. Their coverage of polarization is what steams up flow of information that may not be all gospel true. It’s therefore a high time for both the government and individuals alike to stop believing everything covered by the media and they should instead get the facts right by being information literate.

2.2. Echo chamber: Causes and mitigation

Echo chamber is not a new concept. It is the idea where information, beliefs and thoughts are amplified in a metaphorical enclosed system (Jamieson & Cappella, 2008). Hosanagar (2016) argues that it is the media’s responsibility to try and avoid the filter bubble by democratizing information. In the digital media platforms, such as social networks, the algorithms perform the curation function. This curation was previously performed by editors of news articles and telecast. Mitchell, Gottfried, and Matsa (2016) mention that over 60% of the

millennials use Facebook as their primary source of news and information. However, Facebook refuses to accept its identity as news source (Gilbert, 2016). In a study conducted by Hosanagar, Fleder, Lee, and Buja (2014), about 1700 iTunes users were shown personalized content recommendations. The users were initially fragmenting due to personalization. However, when the recommendations were turned on, the overlap in media consumption between the users started increasing. This resulted in no observation of significant echo chamber characteristics. However, echo chamber is context dependent. It is more likely to happen in a political setting. Hosanagar (2016) mentions that people are less likely to polarize over things like music, compared to political agenda. In the next section, the evidence of polarization in the social media is discussed in detail.

2.2.1 Understanding Echo Chamber

Facebook researchers attempted to understand how social network influences human exposure to diverse perspectives (Bakshy, Messing, & Adamic, 2015). Newsfeeds of 10.1 million active Facebook users in US were analyzed. The participants were from US and they self-reported their political alignment (conservative, moderate or liberal). Facebook algorithmically ranked News Feed and studied user's choices to interact with ideologically discordant content. When the results were compared, it was found that individual's choices played greater role in limiting exposure to algorithmically generated cross-cutting content. Hosanagar (2016) asserts that on a social network like Facebook, three factors influence the extent to which cross-cutting news is observed:

1. Who are the friends of the user and what stories are shared by them?
2. Among all news stories shared by friends, which ones are displayed by newsfeed algorithm?
3. Which of the displayed news stories users click on?

By examining the above questions, the factor that influences the creation of echo chamber can be understood. It was further found that, like mindedness of our Facebook friends indeed traps the users in an echo chamber (Hosanagar, 2016). Because, we try to engage more with like-minded friends and ideologically similar websites. The recommendation algorithms continue to suggest such sites and posts, further phasing out from the contradicting ideologies. This means that the results from the Facebook study might have provided inappropriate conclusion (Bakshy, Messing, & Adamic, 2015). However, although it is true that our friend circle is not diverse enough, the algorithms can still suggest some cross-cutting friends and provide cross-cutting articles.

Nevertheless, there are some conflicting thoughts and results emerging from other research as well. Some researches indicate that using the concept of echo chamber, the political orientation of a user can be predicted. Using this, they went to analyze if the issue at hand is an instance of echo chamber or political sphere. They found that the issue may indeed be a result of political spheres (Colleoni, Rozza, & Arvidsson, 2014). However, it does that satisfactorily explain how the political sphere was created in web setting.

Barbera, Jost, Nagler, Tucker, and Bonneau (2015) estimated about 3.8 million ideological preferences of 3.8 million Twitter users, and data set of about 150 million tweets associated with 12 political and non-political issues. They wanted to understand if the online communication resembles an echo chamber or a national conservation. They found that the notion of echo chamber may indeed be overestimated. Further Harris and Harrigan (2015) assert as follows: “Much like the business world, social media communications can add significant value at the local level when implemented as part of a systematic and long-term online and offline relationship-building strategy but are not well suited to short-term applications intended to influence the outcome of particular campaigns” (p. 251).

Nevertheless, Bishop and Cushing, (2016) mention that over the last thirty years the Americans have sorted themselves into like-minded neighborhoods. It is interesting that this might indeed be happening in the web media as well. It was also found that rumors and infectious messages have significant role in amplifying rumors (Liao & Fu, 2014; Shrestha, Scarpino, & Moore, 2015). Even if the users themselves are responsible for creating political sphere or the echo chamber, it is beyond doubt that social media platforms have some role associated with it (Fleder, Hosanagar, & Buja, 2010; Hosanagar, 2016; Hosanagar, Fleder, Lee, and Buja, 2014). In the next section, some of the attempts to mitigate echo chamber is discussed.

2.2.2. Mitigation of Echo Chamber

This accounts for three distinct ways of mitigating echo chamber. The three approaches are discussed as follows.

2.2.2.1. Diffusion and correction of rumor

Shin, Jian, Driscoll, and Bar (2016) mention that social media can sometimes act as double edged sword. Along with bringing people together by networking and providing entertainment, they can act as sources of rumors. Shin, Jian, Driscoll, and Bar (2016) tracked a collection of political rumors on Twitter during 2012 US presidential election. They found that although rumors were popularized, there were few groups which debunked the rumors. However, they did not propagate this again to create awareness. A suite of interactive tools such as RumorLens ("Google Award Program stimulates Journalism and CS collaboration", 2016), can help journalists identify new rumors in social media websites. Such a tool may be implemented algorithmically to detect and correct/avoid rumors.

2.2.2.2. Mitigating echo chamber using source position indicators

Liao and Fu (2014) analyzed the mechanism of source position indicators showing the valences (pros and cons) and magnitudes (moderate to extreme) of user’s diverse selection and opinions in online discussions. This mostly involved certain controversial topics. Liao and Fu (2014) summarized the results as follows:

Analysis revealed that it was mainly caused by the fact that the presence of position indicator increased the selection of moderately inconsistent sources for participants with high accuracy motives but decreased the selection of them for participants with low accuracy motives. The indicator also helped participants differentiate between sources with moderate and extreme positions, and increased their tendency to agree with attitude-challenging information from sources with moderately inconsistent positions. Participants with high accuracy motives were also found to learn significantly more about the arguments put forward by the opposite side with the help of the position indicator. We discussed the implications of the results for the nature of the echo chamber effect, as well as for designing information systems that encourage seeking of diverse information and common ground seeking (p. 184)

2.2.2.3. Message-passing approach to avoid echo-chambers

Shrestha, Scarpino, and Moore (2015), mention that dynamic message-passing (DMP) is an algorithm that can be used to stimulate epidemic models on networks. This can particularly predict when a given node in the network becomes infectious. They proposed an approach which takes correlations between the adjacent nodes while preventing the causal signals from backtracking the immediate source. Doing so can avoid the amplification of infection there by reducing the echo-chamber effects. This method was founded to be computationally efficient as well which can help in avoiding infectious messages.
Overall it was found that the political behavior of people is not very different from the real world, but there is a greater chance that people polarize on the social media. The recommender systems have a considerable role to play in amplifying such polarization there by creating echo-chambers. Since rumors have some role to play as well, assistance of algorithms can be greatly appreciated. Such algorithms can be used in breaking down the polarization by providing, at occasion some conflicting suggestions. Further, it can also help in detecting and avoiding rumors. The next chapter discusses about the polarization and its role in decision making.

2.3 Fake news

The issue of fake news and its potential impact is linked to the 2016 presidential election. Facebook was filled with fake news stories that contributed to confirmation bias, understood as the bias that develops when a view is repeatedly confirmed by exposure to supporting positions. Kottasova (2016, p1) reported that Google and Facebook have responded to criticisms of their policies that have allowed fake news to flourish and have announced that they will no longer let fake news services use their advertising services. This is a reaction to complaints from many social media users about the proliferation of fake news purporting to present valid and verified news. Facebook, for example, will not place ads from fake news publishers on third party apps or websites, because the content falls under the broader category of "illegal, misleading or deceptive" content (Kottasova, 2016).

However, simply tweaking Google search algorithms or applying more rigorous vetting to Facebook posts is unlike to satisfy critics who argue Facebook, Google, Twitter and other big

Internet companies must do more to stop fake news from appearing in search results and feeds (Kottasova, 2016).

Fake news stories are definitely linked to confirmation bias (Ng, 2016). David Ng (2016), an educator, wrote that to debunk such news stories, it is ultimately necessary to use critical thinking/reading skills and to test one's own biases and preconceptions against valid and factual reporting. The problem, of course, is that people want to find support for their dearly held opinions; fake news that provide such support (and thereby confirms the belief itself as well as one's own capacity for intellectual reasoning and decision-making) can be hard to ignore or to invalidate.

Recently, pictures of a large number of dark-skinned, bearded men demarking from a plane presented on Facebook and Google as evidence of a mass exodus of thousands of potential Syrian and other Middle Eastern terrorists entering various U.S. airports and other points of entry (LaCapria, 2016) Though ultimately debunked by Snopes and other fact-checkers, these pictures effectively convinced millions already antagonistic toward taking in refugees that it was dangerous to do so. This certainly illustrates the problem of fake news and of confirmation bias. Those who fear the possibility of terrorist attacks are unlikely to believe that these pictures and similar stories are false.

2.3.1. Affecting Beliefs: Strategies for Interventions

Psychologists and other social scientists are well aware that all people, regarding of the culture, nationality, religion, socio-economic status, age, or gender invariably are influenced by what is called counterfactual thinking, or thinking that is rooted in some type of stereotype, bias, overt or covert prejudice, or cognitive distortion that predisposes them to accept as valid an idea or belief that may be easily debunked (Baron & Kalsher, 2008). From birth throughout the course of one's life, beliefs, values and attitudes are formed, modified, and reformed via exposure to a variety of significant influences consisting in part of family, friends, schoolmates and work colleagues, education, social events or encounters, religion, national identity, race or ethnicity, and culture itself. In many cases, the result is an inaccurate understanding of important issues or events; this can lead to misconceptions that are remarkably persistent and difficult to change. Fake news stories such as those that have been a feature of social media in recent years and months contribute to this phenomenon and offer confirmation for a bias that has no actual or substantial basis in reality (Love & Cooke, 2016; O'Neil, 2014).

The question thus emerges as to how such distorted thinking or reasoning patterns can be overcome or eliminated. Research suggests that once a particular perspective is established as fact, most (but not all) people will resist changing that perspective even in the face of clear and seemingly compelling evidence that it is invalid (Wilkins, 2016). Psychologist Peter Wilkins (2016) makes the case that biases or views established early in one's life are difficult to change, even when the individual enters the period of cognitive development in early adolescence in which critical thinking skills are beginning to emerge as part of one's cognitive processes. Generally, it is through educational experiences that critical thinking skills are emphasized; as

one learns the scientific method of reasoning, in which hypotheses are proposed and then tested against evidence, some dearly held convictions are likely to be refined or eliminated.

Unfortunately, this in and of itself does not guarantee that biases will be eliminated, that an individual will not continue to seek out confirmation of those views, or that rational and careful thought processes will be brought to bear on the analysis of events, experiences or news. Even when confronted with definitive proof that one's acceptance of a false view or an inaccurate perspective is based on invalid evidence (or no evidence at all other than faked evidence) , many people refuse to change their positions (Baron & Kalsher, 2008). The role of education – formal as well as informal –in overcoming such resistance is seminal. Beginning in early childhood, student should be actively taught to challenge ideas and to examine texts and concepts critically.

For example, Baron and Byrne (2012) call for deliberately engendering cognitive dissonance in students of all ages as a strategy for encouraging them to confront their cognitive biases and overcome the tendency toward seeking out confirmation of those biases or rejecting evidence that the biases are invalid. Cognitive dissonance refers to the feeling of psychological discomfort produced by the combined presence of two thoughts that do not follow from one another. The greater the discomfort, the greater the desire to reduce the dissonance of the two cognitive elements (Cooper, 2007)." Educators – and this certainly includes university level academics can employ deliberately constructed cognitive dissonance to evoke the willingness of individuals to reconsider their beliefs or values or assumptions and to then modify those beliefs. Theory and hypothesis testing, formally and informally undertaken in academic work, is a very useful tool in this regard.

Beyond what schools can do to eliminate the willingness of individuals to accept as valid those constructs that are faulty - or to eliminate reliance of fake news – it becomes incumbent on news media of all kinds to take responsibility for promulgating such materials. Surely social media outlets such as Facebook, Instagram and Twitter are surely responsible for identifying "fake news" as "fake" and modifying whatever algorithms are used to allow such materials to be disseminated; this is apparently underway, but more needs to be done to eliminate the proliferation of dubious "news" sites that exist to advance an agenda that serves an ideological purpose but has no regard for veracity (O'Neil, 2014). This is not to suggest that an overtly ideological legitimate news outlet (such as Fox on the Conservative side and CNN on the Liberal side of the ideological spectrum) should not be permitted to comment on issues. As long as the reporting on such outlets is labeled as reporting and the commentary as opinions, critical thinkers will be free to make up their own minds about the legitimacy of the materials they are given.

2.4. Absence of validation

There are many works done on fake news validation. Storyful is the world's first social media news agency which aims to discover breaking news and verify them at the same time. Also, a lot of fact-check websites are currently working on fighting against fake news. Sina

Weibo has an official service platform encourage users to report fake news and reported fake news will be validated by official committee members. Twitter's Trust and Safety team launched a new service that strikes a major blow against phishing and other deceitful attacks to protect users and enhance trust of Twitter.

However, fake news are getting better and better at disguising. Some quote the words of experts, include vivid photos, and have lots of reposts, which makes them hardly distinguishable. Also, the huge amount of social media content also make it impossible to validate fake news manually. Even for computers, fake news containing same keywords as normal news makes the detection task harder. As a result, advanced automatically fake news validation is urgently needed.

2.4.1. Credibility factors

2.4.1.1. User features

Credibility of a user may be influenced by his/her social reputation and profile completeness, as can be measured using the following factors: number of friends, followers, and status updates; profile linked to other social media or not; officially verified account or not; time and location of the account registration (Ke Wu, Song Yang, & Kenny Q. Zhu, 2015); the user profile containing a description, URL, profile image, location or not (Manish Gupta, Peixiang Zhao, & Jiawei Han, 2012).

For user features, Jin et al (2014) indicate that statistic data showing a lot of fake news are published by credible users. Therefore, we should be careful when taking user features into account or be better to minimize users' influence.

2.4.1.2. Content features

Credibility of the posted content may be influenced by the following factors: professionally written usually without slang words, '?', '!', and emoji; containing supportive evidence in the form of external URLs; number of words with first, second, third person pronouns; the location where the content published; completeness; sentiment matching with overall sentiment or not (Manish Gupta, Peixiang Zhao, & Jiawei Han, 2012).

2.4.1.2.1. Linguistic features

The most significant features among content are emotions, opinion words and sentiment scores (positive or negative) (Ke Wu, Song Yang, & Kenny Q. Zhu, 2015).

2.4.1.3. Structural features

Structural features contains both the message propagation tree and the user friendship network. All researches focus on the numeric summary of graph structure (Ke Wu, Song Yang, & Kenny Q. Zhu, 2015).

2.4.1.4. Event features

Credibility of an event may be influenced by the following factors: number of posts and reposts related to the event; number of distinct URLs, domains, hashtags, user mentions, users, locations related to the event; number of hours for which the event has been popular; percentage tweets related to the event on the day when the event reached its peak popularity (Manish Gupta, Peixiang Zhao, & Jiawei Han, 2012).

2.4.2. Validation Approach

Due to the need and the lack in fake news validation, many researches has aimed at automatic fake news validation on social media. There are two main methods in this research area: classification-based approach and propagation-based approach.

2.4.2.1. Classification-based approach

The classification-based approach uses supervised learning algorithms to identify news credibility (Manish Gupta, Peixiang Zhao, & Jiawei Han, 2012). By leveraging the information, a large number of lexical and semantic features can be analyzed and a supervised learning algorithm can be learned from labeled data (Xing Zhou, Juan Cao, Zhiwei Jin, Fei Xie, Yu Su, Junqiang Zhang, Dafeng Chu, & Xuehui Cao, 2015).

However, the usage of machine learning classifiers has some defects: First, they ignore inter-entity relationship. Second, their approach attributes all the features to the event entity, while many of the features belong to content and users, rather to the events. For example, credible users are more likely to provide credible content; average credibility of credible events is higher than non-credible events (Manish Gupta, Peixiang Zhao, & Jiawei Han, 2012). Overall, it does not take entity and network into consideration.

2.4.2.2. Propagation-based approach

The propagation-based approach has been proven to be effective and outperforms the classification-based approach. With initial credibility values learned from a classifier, propagation-based approach construct a network to propagate credibility value among users, pieces of content and events(Zhiwei Jin, Juan Cao, Yu-Gang Jiang, & Yongdong Zhang, 2014).

Based on the observation of Zhou et al (2015), the event changing along the time and the propagation pattern is different between rumor and normal news. They found distinct differences between rumor and normal news after natural fluctuations of event removed. Fake news is more fluctuate with time after processing while normal news become smoothing and the peak node is reduced. Therefore, propagation analysis can enhance the validation accuracy.

2.4.2.2.1. Hierarchical propagation-based approach

Based on propagation-based approach, Jin et al (2014) proposed a hierarchical propagation-based approach to evaluate the credibility of news on social media. The approach

is presented as a three-layer hierarchical credibility network with links built with semantic and social relations among these entities. The three layers are: events(news), sub-events, and messages. An event is considered as a set of messages containing certain keywords during a certain period of time. A subevent is a subpart of an event which covers a small topic of this event. They are reports from different views, controversial opinions or extended stories. And a message is a piece of content posted by a user.

By formulating credibility propagation on social network as a graph optimization problem, they provide the globally optimal solution with an iterative algorithm.

2.5. Personalization

When we login to Facebook on average there are 1500 news available to each person but only 100 will be shown to the user. This is a switch from a chronological feed to an algorithm-based feed. Each post in your feed was given a "relevancy score" to compare it with thousands of other posts. The personalization algorithms are based on model-free analysis that observes the user search history (Yoganarasimhan, 2016). This limits the search results only based on users search behaviour that forms a bubble limiting the user's search results. Consequently, the current personalization algorithms decrease the diversity of search results. A proper way to mitigate this issue is including features into the personalization algorithms that are not hundred percent match with user's preference that allows search results outside of the personalized bubbles.

3. Research Questions

The following are the research questions to attempt a solution for mitigating and possibly curbing fake news. Moreover these questions provide a summary of problems that needs to address to effectively create and validate a credible news content.

1. Can we mitigate the spread and impact of fake news in a user acceptable way?
2. How to affect people's beliefs and behaviors in a non-intrusive and informed way? Indirectly by diversifying social circles or directly through education
3. Can we do 1) and 2) in an integrated way with social media?

4. Approach

The following approaches are taken to mitigate the fake news and further, discuss some approaches to educate people about the fake news. Additionally, as social media has recently become a source for fake news and confirmation bias, the system's integration in the social media websites can be beneficial.

4.1. Mitigating Spread of Fake News

To find an effective solution for mitigating the spread of fake news, an amalgamation of two methods are discussed below. The crowd power can effectively compensate the effectiveness of algorithms to find an efficient solution.

4.1.1 Crowd Power

In order to effectively mitigate the spreading of fake news we may bring two distinct ideologies together. While algorithms automate the tasks effectively, it needs to be compensated by efficient and effective human intelligence.
According to Bernstein (2012), “Crowd-powered systems combine computation with human intelligence, drawn from large groups of people connecting and coordinating online. These hybrid systems enable applications and experiences that neither crowds nor computation could support alone”. (p. 69)

The idea is to have specific set of people voting fake or not-fake for a news post, and establish credibility over the period of time by approving real news. The approval rating and consensus of a news validity can be done by using blockchain algorithm. Blockchain algorithm, out of many advantages provides a decentralized way to store user scores and track the history of user’s scores effectively. Further, blockchain algorithm can also provide defense against database attacks (Nakamoto, 2008; Swan, 2015).

The idea of blockchain can be applied to crowdsourcing. When individuals react to certain news post being real or fake, this responsibility can be considered as chunks of business similar to blockchain algorithm. Using such an algorithm, penalty or points can be awarded by determining if individuals are worthy of credit. The distribution system (a decentralized system) can only give credit if the provided reaction is indeed true (for, example if the user deems a fake news fake and the real news real) and penalty will be awarded otherwise.
This can be deemed as crowd-powered blockchain. Such crowd-powered blockchain can have two important components.

1. Initiation of crowd-powered blockchain
2. Sustenance of crowd-powered blockchain

4.1.1.1. Initiation of crowd-powered blockchain

To have a trusted distribution, the crowd-powered blockchain needs to be initialized by group of experts or credible resources. Initially, the credibility of the vote can be determined by inducing such trusted sources in the distribution and gradually the new users will gain points based on their reaction to the news posts. This will create a pool of trusted approvers for the news post.

4.1.1.2. Sustenance of crowd-powered blockchain

After gaining ample number of trusted users in the system, the credible sources can be gradually phased out of the distribution. A specific time and position needs to be determined. Further, these credible sources can continue to work with the system as independent approvers/ moderators to randomly identify fake news. At this point of time, users with enough honesty score will act as credible sources. To particularly assign the credibility another algorithm based on 3 way byzantine problem will be discussed later.

As discussed in the beginning, the crowd-powered systems needs to be compensated by other algorithms to increase the odds of identifying fake news. This will be discussed in detail in the next section.

4.1.2. Consensus Using Quorum

When a news is detected people can vote it as *fake* or *real*. Blockchain allows maintaining all the votes history further based on the votes history the users will be divided into two categories: (1) *honest* and (2) *biased*. We form Quorums of users who voted for a story to achieve achieve consensus regarding the validity of a story. Our approach is inspired by the Byzantine Generals Problem introduced by Lamport (1982). Consensus can be achieved by majority of votes if all members of a quorum are *honest*. For example, three generals can achieve consensus, if two of them (majority) decide to attack or retreat. However, Lamport (1982) proved the impossibility of achieving consensus if there is a traitor within the three generals. The Equation 1 depicts the minimum number of *honest* members required to form a quorum that is resilient to a maximum number of biased votes.

$$\text{number of } honest \text{ members} > \frac{\text{number of all members} - \text{number of } biased \text{ members}}{2}$$

Equation 1 - minimum number of *honest* members to form a correct quorum

4.1.3. Agent Crawlers

While the crowd-powered systems determine the credibility of the post, the system integrity needs to be checked regularly, to ensure that no lose-fake news are crawling into the system. This can be done by using agent crawlers. While the agent crawlers by themselves may effectively determine the fake news every time, they can be resource intensive, time-consuming and sometimes may be unreliable. This was one of the reasons why crowd-powered systems were chosen to complete the task. However, to ensure the integrity of the system, Agent crawlers can be used. They can sort of act like police to randomly watch and identify fake news, if present in the system. This can be done using existing algorithms such as rumor Lens, which

tries to determine source of the news to deem it fake or real. Other algorithms exist to debunk such rumor in social media as well.

For example, Zhao, Resnick, and Mei (2015) conducted a study to determine rumors in the social media, based on its early trending:

> Many previous techniques identify trending topics in social media, even topics that are not predefined. We present a technique to identify trending rumors, which we define as topics that include disputed factual claims. Putting aside any attempt to assess whether the rumors are true or false, it is valuable to identify trending rumors as early as possible. It is extremely difficult to accurately classify whether every individual post is or is not making a disputed factual claim. We are able to identify trending rumors by recasting the problem as finding entire clusters of posts whose topic is a disputed factual claim.

Similarly Zhao (2016) discusses another method to determine the rumors within the social media. These algorithms can act as agent crawlers in the system.
Further, if the agent crawlers or the moderators determine if a fake news has been passed, the persons endorsing fake news will incur heavy penalties and the people who deemed the news to be fake will get bonus points. However, if the news was found to be not fake, the users will not be awarded with extra points or deducted with penalties.

4.2. Affecting People's Behaviour for Detecting Fake News

Along with designing an effective system to detect fake news, educating people to detect fake news can have good impact.

Detecting fake news is a challenging task and censorship is not an option. However, the Internet itself should carefully assess and identify all sites that have an agenda and identify the nature of that agenda. Free speech rights require that hate groups, advocacy groups, and other organizations of individuals with a cause have access to new media. Stating unequivocally that "XYZ News" represents the views of – as an example – the American NeoNazi Party and not the views of Google, Yahoo or the search engine where the site is accessed may be useful. Ultimately, however, each individual must ask questions as to who is telling the story, why they are telling it, what is intended by the story, when did it supposedly occur, and where did it supposedly take place. A sensible person will view extravagant claims of all types with a degree of skepticism (O'Neil, 2014). Doing personal research can eliminate a tendency to accept news that confirms one's beliefs and biases at face value.

Let's look at the image below showing maps that claim to relate crime rates and Democratic votes, circulated via emails. Visiting snopes.com – a fact checking website for hoaxes – I found that it was indeed fake. Snopes says that the maps are actually electoral maps. The image below shows it all.

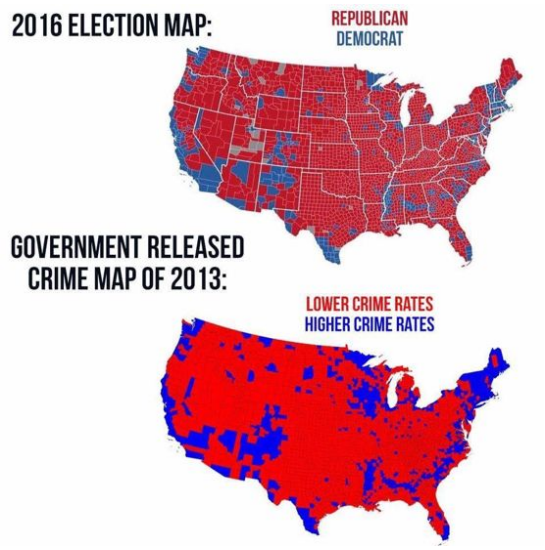

Figure 1: Fake maps claiming to correlate crime rates and Democratic votes

These images were published by a Facebook page “Subject Politics”. The truth of the matter is that the image at the bottom shows a 2012 electoral map. There was no indication of the source of the first map because Snopes was unable to identify it. How Snopes works is that they use human editors to check for truth in a story. That’s something good, but they just can’t find everything that’s in a story. The fake Facebook post has since been taken down as one visits the link is taken to a **“Sorry, this content isn’t available right now”** alert message.

With further research into trying to find the truth about the claims by “Subject Politics”, I came across an article from Business Insider that shows maps of how Americans commit crime. There was a totally different picture from the one above. This data matched that of the FBI Uniform Crime Report, the main source of the information.

My explanation is meant to show that as people are trying to find the truth or falsity of news, they should not think that it is the work for humans only. The information from Business Insider shows that the process can be done algorithmically by a computer, more quickly and thoroughly than when done by human. One ought to consider the following algorithm when trying to find truth or falsity to an information.

1. If there are no sources for a given information, then one needs to be skeptical about believing whatever is put into their ears.
2. Make sure the source say what the article says, just like the information from Business Insider and the FBI data. Failure to rely on the source is what influences the spread of fake news, people need to use computers to check the source of any information as they are the best when it comes to that.
3. Put more consideration to authoritative sources. A good example is the Google’s PageRank algorithm, which uses many techniques from how many papers has given it reference to the reputation of the people making the references.
4. Existence of multiple independent accounts saying the same story is a technique that has long been used by human reporters since those days, truth was very critical. No news would be reported if there was only a single source of evidence.

5. A story referencing quantitative data should be done in a way that the statistics are correct. Anyone with a sound statistical mind would know that the statistics in the picture above is not correct.

In the event that fake news is detected, a number of things can be done to respond to them.

1. Flag the fake stories. It can be done through the use of security alerts by the available social platforms like Facebook and Gmail.
2. Give less priority to such stories, often seen in Google when it ranks pages lower, shown down in a search.
3. Suppress entirely the fake stories. This is brutal but we have to if we need to keep off making misinformed judgments, it's what Gmail has been using to keep off spams anyway.

Algorithms are there not to eliminate all error but to make results stand out from false information. Limiting the spread of fake news to new victims is what should be the concern, not stopping the disease by finding infections at their source.

4.3 Utilize Social Media to Diversifying Social Circles and Mitigate Impact of Fake News

Finally, while mitigating fake news and educating people to be aware of it forms an important task, integrating such a system in social media can have major impact in curbing fake news. Since, most fake news are endorsed and propagated in social media platforms, integrating an effective system within social media is critical.

We are going to use the current social media frameworks to jump start our proposal. There are two components required to initiate the process:

1. News Miner: a software agent to collect news from social media
2. Vote Interface: an interface to interact with users
3. WikiNews: a public website in wikipedia style which will act as credible news website

4.3.1 News Miner

The News Miners are software agents that monitor the social media to collect news posts and normalise redundant stories. Therefore, a same story presented in multiple context such as video or text will be aggregated as one single news. This will increase the number of participants in the quorums mentioned in the section 4.1.2 therefore the likelihood of forming correct quorums will increase.

4.3.2 Vote Interface

The Vote Interface component directly interact with final users. It can be implemented as a browser add-on allow users vote for the stories while they are surfing the social medias.

Later, when a minimum number of *honest* users voted for a story the interface will mark a story as fake or real.

4.3.3 WikiNews

WikiNews will be a public website that act is credible source for people who wants to get news or check validity of current news in social media. Another goal is providing a resource that find the validity of a news as simple as possible i.e. with a simple search query.

5. Conclusion

The proposal started with the grand challenges the world is currently facing. One of the challenges that was identified related to assistance in decision making. The divide and the bias that exists when it comes to news were delineated. Most millennials believe the news they see in non-credible non-news sources such as facebook, twitter, and other social media platform. The causes and mitigation of echo chamber and confirmation bias were dissected and related to the propagation of fake news. These problems were summated into three research questions, which forms major point of discussion for this proposal. First, an algorithm was theorized based on blockchain, three-way byzantine problem and concepts of crowd-powered systems to create a quorum for dependable consensus. Further, ways of integrating agent crawlers in the proposed system was discussed. Next, some of the possible ways to create awareness and educate people about the fake news were discussed. Finally, the implementation of the fake news detection system in the social media platform and other internet platform was deliberated. Although, this is a carefully considered proposal, some of the gaps and feasibility issues might remain. For example, how effective is this system in creating a consensus needs to be seen. Performance and optimization, cost-analysis, implementation of this system as a whole needs more research.

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