

RUMOUR CLASSIFICATION IN FOOTBALL TRANSFER WINDOW TWITTER DATA

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1. Introduction

Fake news is a phrase which has been circulating through popular media and culture in recent years. Since the 2016 US presidential election the term has gained increasing traction and has been used to criticize all forms of media. The issue which originated with small groups manipulating social media algorithms and online advertising for personal financial gain didn’t stop there and went onto spark worldwide debate about the credibility of the news sources which we use today[[1]](#footnote-1). The term soon became a sound bite and theme coherent with the presidency of Donald Trump.

This scandal exposed a series of vulnerabilities in these platforms. It became intertwined with other scandals such as alleged Russian Government and other organizations interfering with elections using fake social media profiles and the hacking of personal emails[[2]](#footnote-2). This coupled with news that political consulting firms like Cambridge Analytica were able to develop digital profiles that represented individuals of certain political beliefs and demographics provided a scary outlook for the everyday social media user[[3]](#footnote-3). Not only are there groups creating fake accounts and profiles to manipulate these applications but the data they themselves provided was being used to facilitate political advert targeting.

The fake news frenzy forced US, Irish and EU Government bodies to summon social media companies’ representatives before them and to seriously start thinking about heavier regulation for such companies. That being said these social media platforms are still being used daily by millions of Users and the same vulnerabilities that were present before still exist today. The potential for personal financial gain still exists on these platforms and the efforts made so far by these companies involve large teams sifting through accounts rather an automated, more scalable approach[[4]](#footnote-4).

The ability to extract meaning or sentiment from a piece of text is something which has been made increasingly possible through natural language processing. In the last decade companies have turned toward Machine Learning solutions to attempt to solve classification and prediction problems. A potential solution to the issue of “fake news” on social media may be possible through the creation of a model capable of classifying social media posts as “fake” or “real” news[[5]](#footnote-5).

An area where rumours and fake news is not new is in sport and particularly with relation to football transfers in the English Premier League. Twice a year there are transfer window periods where clubs can buy and sell players amongst one another. This leads to a lot transfer rumour speculation amongst the press, increasingly on social media platforms such as twitter. There are numerous accounts which have been set up with the sole purpose of reporting on this, claiming to be the some of the first individuals to be “in the know”[[6]](#footnote-6).

This area gives an ideal test case of a fake news in social media. By taking a specific transfer period in the past one can look at rumours posted on social media, specifically Twitter, and use them as ground truth to label whether this rumour actually became true. Twitter provides a medium to access the hundreds of thousands of rumours and true claims, all of which can be fact checked through official records of confirmed transfers. This gives a training set to develop a model capable of determining the veracity of a new, unseen transfer rumour or a social media post.

* 1. Research Question

The purpose of this research project is to answer the following question:

*“To what extent can supervised machine learning approaches be used to predict the accuracy of a Tweet or Twitter account, in relation to a football transfer?”*

From this question the following research objectives were defined:

* Data gathering and knowledgebase building: Create python scripts which handle the retrieval of football transfer Tweets. This process also involves creating a database of confirmed transfers which happened and English premier league club names and synonyms.
* A Natural Language Processing (NLP) technique for Name Entity Recognition (NER): This objective involves using existing models to extract information from the data in order to determine the meaning behind the text. This process is to be conducted to ensure the training set examples are labelled correctly.
* Classification model development: This objective involves creating classification models using different supervised machine learning techniques, using the training data gathered in the previous stages.
  1. Hypothesis

This research is aimed at identifying the set of text feature which can be used to accurately predict the accuracy of a rumour. It also aims to identify suited approaches to text classification in the context of fake news social media content. The research aims to measure the effectiveness of different text vectorization, feature set generation methods and supervised machine approaches at predicting whether or not and football transfer tweet is “fake news” or correct.

*(H0)*

*(H1)*

* 1. Overview of this Dissertation

The first section of this paper gives a background of the research and details the problem which it is trying to address. It also defines the research question itself and defines the hypothesis of the research.

Section two gives an overview of existing research on the topic and separate topics which are related. It also gives our definition of “fake news”. \*\*\*

Sections three details the methodology of the research. The methodology of this research can be spilt up into three distinct sections: Data Gathering; Named Entity Recognition; Classification.

The data gathering section details the process of gathering the corpus of transfer tweets, English football club names and past transfers which we know to have happened. In order to perform any supervised machine learning task suitable training data is necessary and this section details the steps taken in gathering this data.

The named entity recognition stage involved extracting meaning from the tweets gathered in data gathering. In order to correctly label each tweet as “happened/didn’t happen” the ability to entities and names from the texts of tweets was needed. The NER section details the methods used in extracting entities and player names from the tweets gathered, and how they were labelled.

Lastly once the training set was available classification experiments were carried out to investigate the accuracy of different methods. The classification section details the different methods involved in constructing the feature set and the different model architectures used.

2. Existing Work

2.1 Fake News

2.1.1 Overview

Manipulating news and media outlets for personal, political and financial gain is not a new concept, and has been around so far as news and media has itself[[7]](#footnote-7). However, in 2016 we appeared to witness and ill-fitting combination between these practises and social media. The origin of the fake news social media as we have come to know it today can be traced back to the unlikely and infamous Macedonian town of Veles. In a town with an average monthly salary of $371, a group of young teens had figured out a way to make $16000[[8]](#footnote-8), around about the same time a report found that over one hundred pro-Trump fake news websites were registered to Veles. These two happenings of course were not a coincidence and as it turned out this group of teens had found a way of exploiting social media websites such as Twitter and Facebook to generate thousands of clicks to their websites which would in turn lead to a payday via Google ads for themselves.

This idea of enticing users to a click onto a website in the hope of revenue is also not new, and these so called “clickbait” tactics to generating clicks have emerged ever since it has been incentivised to prioritise clicks over good journalistic reporting[[9]](#footnote-9). However, its relevance has become increasingly important in this post-truth politics era, due to the easy access to advertising revenue and polarizing political beliefs.

Aside from groups using these techniques for financial gain, a number of reports have alleged that states such as Russia have faced allegations of disseminated false information to influence the 2016 US presidential election[[10]](#footnote-10).

The phrase quickly turned into a sound bite to refer to the “lying press” for politicians as the social media fake news epidemic became mainstream news itself. Although many primarily associate the phrase with political jargon, the problem of groups using fake news to exploit social media algorithms is still an ever-present issue[[11]](#footnote-11). Facebooks CEO Mark Zuckerberg even testified before the US Congress as a result. In late 2018 some of the world’s leading tech firms agreed upon a code of conduct to do more to tackle the spread of fake news. However, as many reports have suggested this code of conduct provided little transparency on how to implement it. Most efforts to deter these practises have come in the form of manual human labour of shutting down payments and preventing the setup of fake accounts. However, automated detection of fake news accounts and posts still poses a real challenge[[12]](#footnote-12).

2.1.2 Definition

Irrespective of the research which has gone into the area, there does not seem to be one agreed upon definition of “Fake News”. However, the consensus from most studies is that it can be defined as news which include false information designed at purposefully misleading readers [[13]](#footnote-13) [[14]](#footnote-14). At the core of the definition of Fake News definition is comprised of misinformation and intent. This is true for both articles and social media posts as the intent behind one binds it to the other. In other words, the sole reason for a fake news social media post is to generate clicks to the article linked in it. Therefore, for the purposes of this research, we define the definition of fake news as follows,

*Fake News: A social media post or news article that is created with the intention of misinforming the reader.*

2.1.3 Academic research

In term of fake news there have numerous studies conducted with the aim of investigating fake news and researching possible detection methods. One research paper detailing the BuzzFeed-Webis[[15]](#footnote-15) fake news corpus investigation detailed the research into what mainly comprises of a fake news post. The report found that hyper-partisan and mainstream publishers all earned verified checkmarks (official account badge) with no favourable bias toward any one type earning the badge. The same report concluded that manual binary classification between fake and real news was infeasible, as most linked articles included true and false news. Despite this, it was noted that the majority of mixed fake/reals news articles belonged to hyper-partisan “right-wing” sources. Another report aimed at defining fake news[[16]](#footnote-16) also confirmed the mixed true/false news nature of articles in their corpus, as it was in the BuzzFeed-Webis report.

Aside from research into investigating the contents of fake news and defining it, research has also gone into possible methods of fake news detection. Fake news detection using a naïve Bayes classifier [[17]](#footnote-17)on the same BuzzFeed data set names above produced interesting results. The implementation aimed to correctly classify the BuzzFeed article dataset as True or Fake news. The research showed that even using a simple classification approach can yield classification accuracy of 75.4%. Despite having a precision value of 0.71 and a high classification accuracy, the classifiers recall value was only 0.13. Each research paper using this corpus of articles reported the presence of mixed true/fake news articles and this low recall value further backs up their claim. The aforementioned paper results suggest that machined learning techniques could be successful in tackling this problem.

Another research papers approach[[18]](#footnote-18) to the detection issue was to extract linguistic features and create linguistic feature sets. Then using said feature sets define and SVM classifier with Five-fold cross validation was used in the experiment. This approach showed promise, with one classifier producing accuracy scores of 0.73 and 0.74 on different datasets. The input features were a combination of punctuation, Ngrams, syntax and readability features. The same models achieved recall value of 0.74 and 0.73 respectively.

Previous academic research into defining fake news and fake news classification methods provides confidence that further advancements can be made through the use of supervised machine learning techniques to addressing the detection of fake news.

2.2 Football Transfer Rumours

2.2.1 Overview

Fake news within reporting on football transfers has is also prevalent. During each January transfer and Summer transfer window journalists and supposed sports media accounts report on player transfers, of which they claim to be “in the know”, in advance of the deal being confirmed or publicly announced. Tactics used during the election are also at play here, however it has undergone the same scrutiny, most likely due to the difference in nature between the two. Nonetheless, the thousands of football transfer rumour tweets available gives the opportunity to investigate the feasibility of a model capable of classifying the veracity of a rumour, or the account which posted it.

2.2.2 Fake News

It is important to point out the similarities between football transfer fake news and the political fake news mentioned above. If we take our definition of fake news a lot of these accounts claiming to be “in the know” are intended to misinform the reader with exaggerated scenarios and eye-catching premises. Furthermore, they usually contain links aimed at re-directing the user to a cite in hope of financial gain rather than true news.

2.2.3 Academic research \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

In term of football transfers themselves there has been numerous cites of research. One frequent point of research within the area Is the relationship between club expenditure and success[[19]](#footnote-19). Research into the increasing prices of players and even using transfer markets to investigate labour mobility and globalization[[20]](#footnote-20) have been conducted. However, this paper finds that research into football transfer rumours is limited, especially in relation to the rumour veracity detection.

It is important to note that due to the similar nature and outcome and nature of political and football transfer rumours social media rumours, that one can employ some of the existing techniques discussed in the other. In other words, this paper aims to take some the previous academic research in political fake news social media account is completely relevant to football transfer rumours.

3. Methodology

3.1 Introduction

This section details the methodology of carrying out this research. This methodology can be split up into three distinct sections. The first section is the data gathering section. This involved gathering the tweets to be used as the training set for performing the classification experiment. It also involved gathering other information to be used in NER. The second section involved Named Entity Recognition (NER). This section involved ensuring that the data gathered was labelled correctly, in other words was a tweet about a past transfer correctly labelled “happened” or “didn’t happen” (rumour/fact).

The last section involved constructing different feature sets using different methods. It also involved constructing different classification models using different supervised ML approaches.

3.2 Data Gathering

3.2.1 Overview

The tweets required for this research had some distinct characteristics. Firstly, for any given tweet in the data set, the tweet had to be talking about a potential transfer. Figure 3.1 illustrates an example of this. It had to be talking about a player either transferring to or from and English Club from another team, whether its eventually happened or not.



Figure 3.1

It also had to have been posted during the before and during the transfer window period but not after. During section three if the transfer in a tweet was confirmed to have happened, the tweet had to be checked against the official transfer confirmation date. If the tweet took place after this date, then it was discarded from the dataset as it was no longer someone speculating.

In order to perform NER other information has to be gathered. To check if the entities (clubs) extracted from the tweet text was and English club, a database of English teams has to be constructed. Also, as people tend to use nicknames and synonyms for English clubs this information needed to be retrieved also. In order to check if transfer talked about in the tweet text was in fact a rumour or not, a database of known transfers to have happened during these periods also needed to be constructed.

3.2.2 Methods Used

BeautifulSoup is an open source python library which was used in this stage to scrape information from web pages in order to store information about confirmed transfers, club names and club synonyms. The library allows you to parse the html of a given URL into a tree of Python objects[[21]](#footnote-21). From here one can extract the elements of the html they want.

The gathered tweets and information were stored on a local database. In order to have fast access to transfer tweets, known transfers, club names and club synonyms Mongo DB was used. Mongo DB is a NoSQL database program which allows one to store JSON-like documents[[22]](#footnote-22). The draw to Mongo DB is that it allows for fast access to the database information, while providing a simple method for defining a database schema and making entries. It also allows for easy deployment in any location and provides extensive documentation. For the purpose of this project Mongo DB was deployed to a local machine using PyMongo, a python driver for MongoDB. This allowed for information to be scraped from the source sites and then be saved directly into a database collection. The “reset\_collections” method in db.py is set up that so as long your local machine has MongoDB installed, the method will scrape and store locally the transfer information corresponding to the provided links.

<more about collections>

Twitter provide the means to search through the history of tweets posted on their site through the Twitter API[[23]](#footnote-23), however the tweets retrieved is limited to tweets within the last 7 days for non-paying users. “GetOldTweets” is an open source project which allows one to bypass this[[24]](#footnote-24). This project takes advantage of the JSON loader used by modern web browsers and allows you to query tweets that go as far back as Twitters beginning. The tool allows you to pass in a query term or sentence along with date parameters so you can choose the specific period to return the tweets from. This tool was used to build the training data set.

3.2.3 Implementation

Gather Confirmed Transfer Information

The first information collected was the known confirmed transfer to have happened. The modules KBuilder.py, relations.py and db.py contain all the methods used to gather this information. For known transfers the source used was Wikipedia[[25]](#footnote-25).

Each transfer window Wikipedia page contained a table of transfers and loans which happened during a given window. The first information that was scraped and stored were confirmed transfers. Using BeautifulSoup this information was parsed, extracted and written to a local database. A MongoDB database was created for the whole research project called “transferdb”, and a collection (table) was created in this to store confirmed transfers. As detailed in section 3.3 this information was eventually used to check if the transfer being discussed in a tweet actually happened or not.

Gather Known True Tweets

Two types of transfers tweets needed to be retrieved. Tweets which contained transfer speculation which eventually went onto becoming confirmed (true tweets), and tweets containing transfer speculation which never ended up happening (rumours). GetOldTweets allows you to execute the script with command line arguments as shown in figure 3.2.



Figure 3.2

Figure 3.2 shows an example which will return all tweets from the 1st – 31st January 2018, limiting them to the most recent 4000 and outputting the results to res.txt.

Due to the massive amount of content in Twitter the quality of the content returned from GetOldTweets, solely depending on the “querysearch” parameter leads to un related tweets being returned. In other words, terms like “in the know” or “deadline”, which are usually associated with football transfer content, return tweets completely un related to football when used by themselves.

The first approach taken was to take the known transfers which had been retrieved earlier and using them generate a query containing the name of the player and club. This way the results returned would be narrowed down to specific tweets talking about a specific football transfer.

For example, if we take the confirmed transfer of {Romelu Lukaku, from Everton, to Manchester United, 10/07/17} the “make\_true\_commands” method in relations.py takes this transfer and generates commands using this information. The query terms generated would be in the form described in figure 3.3, and the process of how the query terms were generated is described in figure 3.4.

<Figures>

This was done for every known confirmed transfer of a given window. Many of the function present in relations.py were created with the intention of iteratively going through each confirmed transfer, generating the query terms for that transfer and writing the GetOldTweets command corresponding to it to a bash script. The “—until” flag was set to the day before each transfer was officially announced, this way only speculative tweets would be retrieved and not tweets after the transfer has been confirmed.

The “make\_true\_commands” handled all of this and created a bash script containing all the confirmed transfer GetOldTweets command. The function was set up to write a “wait” command every ten lines, so the script could run 10 python processes whilst not slowing the operating system of the machine. This way, upon running the script, ten different GetOldTweets commands with different query variations would execute and write their result to a shared text file. Figure 3.5 shows a snippet from the bash script generated for summer 2015 confirmed transfers.



Figure 3.5

Figure 3.5 shows three different commands. All commands query terms contain *N’Golo Kanté*. However, each query term differs in that they all contain different transfer talk appended at the end. Each of these commands with different “*–querysearch”* parameters would run in parallel and write their results to the shared text file. Also note the “*–until”* parameter is set to the day before this signing’s official announcement date (3 Aug 2015). The “transfer talk” appended to each query term was a set of phrases constructed after manually reading through known transfer news Twitter accounts and observing the most common words used in these Tweets synonymous with a player moving from one club to another.

After running the bash script for each transfer window period, a collection of known true tweets were returned. Although they were retrieved using query terms generated from known true transfers, they were not labelled true until the Name Entity Recognition methods were performed, as detailed in section 3.3. The results text file generated from running this bash script was then written to a database collection using methods constructed in the db.py module.

Gather Rumour Tweets

The previous process resulted in gathering tweets with which mainly contained claims of transfer which happened. However as stated before, for a balanced training set you need examples of transfers which didn’t happen (rumours).

Generating the query terms for these GetOldTweets commands provided to be much more difficult. For these three main approaches were used. It’s important to note that none of the tweets could be labelled as a false rumour until the Named Entity Recognition methods described in section 3.4 were performed, so in many ways there was a lot of back and forth between the two sections.

< Top 10 False>

The first approach to this method was to observe the gathered tweets and determine the most frequently occurring Twitter accounts in the collection. In other words, identify accounts that actively tweet about football transfers. By doing so one can retrieve all the tweets they sent within a given period using GetOldTweets’s *“–username”* flag instead of using a query phrase. Pandas is Python Library which allows you read data into a Data-Frame structure which has a range of functions and operations associated with them to extract data or operations on the data contained in it[[26]](#footnote-26). Using this the *“find\_top\_tweeters”* method was constructed in the *relations.py* module, which read the collection of tweets gathered in the previous section and returned the top N tweeting accounts. Then using the account usernames retrieve all of their tweets sent within a transfer window time period. This method was somewhat effective but lead to the retrieval of unrelated, non-transfer related tweets. Despite having methods dedicated to filtering out non-transfer talk in section 3.4, there still were un wanted Tweets which slipped through. Also the larger the corpus that had to be filtered the longer this process took, so having a data gathering method which retrieved as much useless information and useful was massively inefficient.

<General Query and filter>

The second approach to this method involved creating general transfer talk query terms and passing them as the “*—querysearch”* parameter to the GetOldTweets command. These query terms contained transfer phrases such as “in the know”, “having a medical”, “close to signing”. The idea was that a corpus a Tweets would be stored, and the methods defined in 3.4 would filter out the Rumours and True Tweets. This, similarly to the previous approach, returned numerous amount of Tweets unrelated to transfers, or containing vague material not talking about an exact transfers.

<Synthetic Rumour>

Club name gather .. based on leagues etc

Knick name gather

3.2.4 Issues

<Making queries>

<Making false queries>

<Biasing?>

<Imbalance dataset>

<Proxy>

<Retweets>

1. https://www.theatlantic.com/video/index/577033/fake-news-fairytale/ [↑](#footnote-ref-1)
2. https://www.theguardian.com/us-news/2016/dec/16/qa-russian-hackers-vladimir-putin-donald-trump-us-presidential-election [↑](#footnote-ref-2)
3. https://www.nytimes.com/2018/03/19/technology/facebook-cambridge-analytica-explained.html [↑](#footnote-ref-3)
4. https://uk.reuters.com/article/us-eu-tech-fakenews/facebook-google-to-tackle-spread-of-fake-news-advisors-want-more-idUKKCN1M61AG [↑](#footnote-ref-4)
5. https://www.ll.mit.edu/news/using-machine-learning-detect-fake-news [↑](#footnote-ref-5)
6. https://www.bbc.com/news/blogs-trending-40574049 [↑](#footnote-ref-6)
7. https://www.wired.com/story/free-speech-issue-tech-turmoil-new-censorship/?CNDID=50121752 [↑](#footnote-ref-7)
8. https://www.wired.com/2017/02/veles-macedonia-fake-news/ [↑](#footnote-ref-8)
9. https://www.bbc.com/news/uk-wales-34213693 [↑](#footnote-ref-9)
10. https://www.bbc.com/news/technology-46590890 [↑](#footnote-ref-10)
11. https://www.theguardian.com/commentisfree/2019/feb/28/facebook-twitter-fake-news-eu-elections [↑](#footnote-ref-11)
12. https://uk.reuters.com/article/us-eu-tech-fakenews/facebook-google-to-tackle-spread-of-fake-news-advisors-want-more-idUKKCN1M61AG [↑](#footnote-ref-12)
13. https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.31.2.211 [↑](#footnote-ref-13)
14. [arXiv:1703.06988](https://arxiv.org/abs/1703.06988) [cs.SI] [↑](#footnote-ref-14)
15. arXiv:1702.05638 [↑](#footnote-ref-15)
16. https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.31.2.211 [↑](#footnote-ref-16)
17. https://ieeexplore.ieee.org/abstract/document/8100379 [↑](#footnote-ref-17)
18. https://arxiv.org/pdf/1708.07104.pdf [↑](#footnote-ref-18)
19. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0156504 [↑](#footnote-ref-19)
20. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-9485.2007.00423.x [↑](#footnote-ref-20)
21. <https://www.crummy.com/software/BeautifulSoup/bs4/doc/#making-the-soup> [↑](#footnote-ref-21)
22. <https://www.mongodb.com/> [↑](#footnote-ref-22)
23. <https://developer.twitter.com/en/docs/tweets/search/overview> [↑](#footnote-ref-23)
24. <https://github.com/Jefferson-Henrique/GetOldTweets-python> [↑](#footnote-ref-24)
25. <https://en.wikipedia.org/wiki/List_of_English_football_transfers_summer_2018> [↑](#footnote-ref-25)
26. <https://pandas.pydata.org/> [↑](#footnote-ref-26)