Machine Learning Classification Algorithms for Rumours Detection in Facebook Arabic Posts

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Abstract

In the last few years, the online social network sites have enabled the people around the world to access and share information at tremendous speed from anywhere which makes a lot of them adopted it as the main source of information. The information is circulated in the public domain without adequate awareness and confirmation to support its legitimacy making rumours and fake news increased rapidly. In this work the rumours are detected in the Facebook social site posts that are written in Arabic language. Basically, the post will be classified into real or rumour using machine learning classification algorithms after performing pre-processing, and feature extraction operations. The obtained results acquired from the utilized five machine learning classification algorithms were uneven within high and low accuracy results.

Keywords: Text Mining, Sentiment analysis (SA), Rumours detection, Feature Extraction, Classification, Deep Learning (DL).

1. Introduction

The growth development of modernistic social media platforms has confirmed their main role for illustration, and promulgation news in the society and there are lot of these sites that have a big influence like Facebook, Twitter, and Instagram [1]. The social media owns its role as an adequate online platform to acquire the desired information by the users, view their opinions and connect within other users. Furthermore, the users become more enthusiastic to participated in talking about the main highly rated topics and interchange their ideas and thoughts on social media, which makes the appearance of rumours increase [2]. Rumour has a variety of significance in multiple contexts, it may be defined as mysterious assumption that are unverified, related to an intended domain of interest and uncertain facts about a participatory subject or as a "circulating story of questionable veracity, which seems credible but hard to verify [3]. The Sentiment analysis (SA), also renowned as Opinion Analysis/Mining (OM), turn out as one of the most attractive fields of research in the computer science topic, and it significant growth within the social media sites, and basically used in order to detect and recognize

the thoughts, feelings and opinions from the text data [4]. It is adopted basically to perceive Natural Language Processing (NLP) and its major goal is to define the overall polarity of a text or document, by performing an extraction and retrieval operations of information from unstructured data raw, and provides them as verdict or assessment and taking into account all kinds of emotions [5]. Various nations in Middle East speak Arabic language that is distinguished from other in which it has a many vocabularies, in which it is polysemous (multiple meanings could lead to the same word), within complex structure of morphological [6] Machine Learning (ML) algorithms are widely utilized in classification in which it is an offshoot of Artificial Intelligence (AI), that owns the ability in dealing with data of huge size, and can process them and give a reproducible features and learn about how are these intended features related with each other to output the desired target [7].

2. Related Work

A vast amount of researchers adopts multiple different kinds of ML algorithms in order to classify and determine if the text refer to a rumour or not in different languages on different social media platforms, some of the previous works will be illustrated in this section. **Zamani S et al. in 2017 [8]** present a rumour detection on Twitter Community using Persian language by allocating, and analysing the importance of two denominations of rumour features including; Structural, along with Contentfeatures, and utilize 4 ML algorithms: J48, Naïve Bayes (NB), Support Vector Machines (SVM), K-Nearest Neighbour (KNN), and Sequential Minimal Optimization (SMO). **Sabbeh SF, et al. [9]** proposes a model depending on ML for Arabic news credibility speculation on Twitter using of three ML techniques including DT, SVM, and NB. **Alkhair M et al. [10]**, illustrate a novel Arab frame for analysing fake news, about the hottest topics that are noticed as rumours and test the probability of segregation between rumour and unrumour comments on YouTube depending on three ML, SVM, DT and Multinomial Naıve Bayes (MNB). **Jardaneh G, et al. [11]** adopt both features of content, and user and apply the SA to produce an unprecedented feature in order to determine fake Arabic news by four algorithms known as; RF, DT, AdaBoost, and LR. **Alzanin SM, et al. [12],** detect rumours in Arabic tweets using a set of features obtained from the user and the content, and Semi-Supervised Expectation–Maximization (E-M) is employed to train the proposed system with newsworthy tweets. **Kesarwani A et al. [13],** give an unpretentious approach for detecting news that are bogus on social media sites with the aid of KNN classifier depending on dataset of Facebook posts about the latest news **Saeed F, et al. [14],** handle the rumour related about health treatments about the cancer disease that are prevalence over social media in Arabic language and society within SVM, LR, Bernoulli Naive Bayes (BNB), SGD K-NN, J48, DT, RF, AdaBoost (Ada), and Bagging (Bag). **Mahlous, AR, et al. [15],** allocate the bogus news related about COVID-19 virus in Arabic tweets within a set of features obtained from tweets depending on N-Gram-level Term Frequency-Inverse Document Frequency (TF-IDF) and enumerate vector of features for training ML classifiers including; NB, LR, SVM,

Multilayer Perceptron (MLP), RF, and Extreme Gradient Boosting Model (XGB).

3. Methodology

This subsection outlines the system approaches in depth, starting with data collection, feature extraction, machine learning classification. In this work the text data is classified into real and rumour in the posts of the Facebook social sit. The post is written using one of widely languages which it is the Arabic one. The architecture of the presented system in this work is illustrated in figure 1, which is composed of a main phases including: Data Gathering, Pre-Processing, Feature extraction, and finally classification within ML classifiers
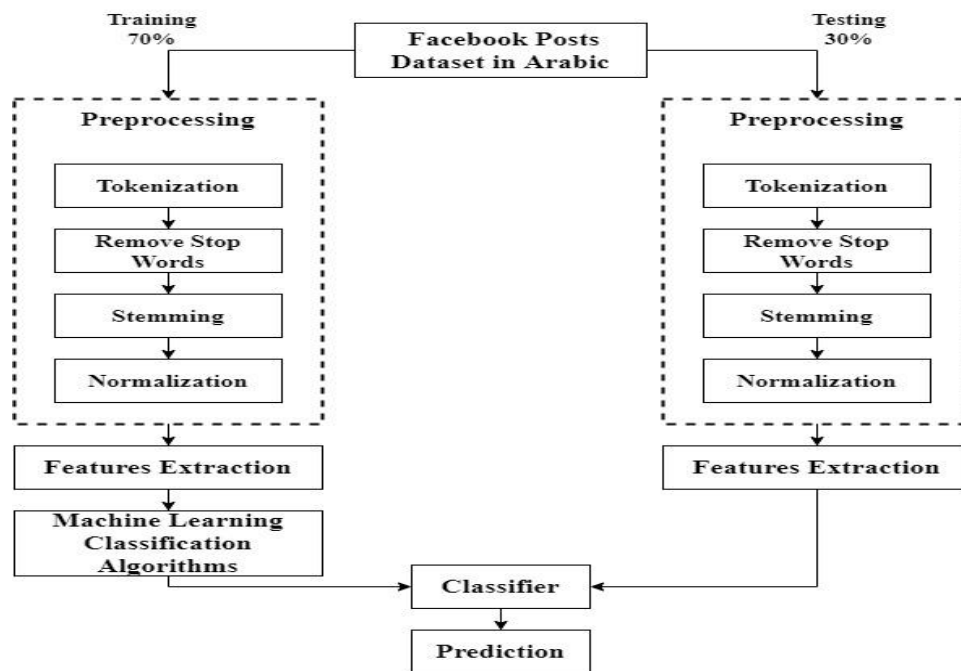

Figure 1.The architecture of the Rumour detection presented system

Its noticed from the previous figure 1, the Arabic text dataset at first separated into two main subsets, including Training of 70% in order to train the classifiers, and Testing of 30% to check the performance of the classifier.

3.1 Dataset Gathering

The utilized dataset is gathered from Facebook social site that is depending and composed of the public posts of the users and pages related to different manners and subjects. The posts are collected in the beginning by signing in into the Facebook website using phone number or email address, or just performing a logging in if already having an account. Afterword, searching about any confidential and must famous and trustworthy pages, and profiles, and find the posts in that are written in Arabic language about the hot topics in the general society. The Arabic posts that are gathered include 2000 posts written, which 1000 posts of them are real, and the other 1000 posts are rumours.

3.2 Pre-processing

The text data is unstructured, amorphous, and difficult to deal with algorithmically, so pre-processing in significant and have its own effect on the detection and classification of

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rumours. Text pre-processing is performed depending on SA which included some common cleaning steps and removing inappropriate information to make the text ready to the next stage. Mainly it composed of a set of steps that performed in sequence

1. Tokenization: this operation responsible of isolating the words, symbols, or any other character from each other depending on the whitespace between them.

2. Stop words Removal: its main operation is illuminate every word that do not own an effect on the classification procedure, which are the words that recurs a lotin the text.

3. Stemming: utilized to elicit the sub-part that called as stem of a specific term, which is used to delete any suffix that leads to decrease the quantity of terms, to have precisely matching roots, to reduce package needs and increase the effectiveness of information retrieval style to maximum level the Arabic language have a complicated form, with multiple, infixes, suffixes, and prefixes that are hard to tear out. In this work the (Information Science Research Institutes) "ISRI Arabic stemmer" is adopted as stemming approach [16]

4. Normalization: its main procedure to cleaning the text from all unwanted information including symbols, punctuation, links, any characters from another language, numbers, usernames, and so on.

3.3 Feature Extraction based on TF-IDF

Considered to be as the most important step in text mining which responsible about giving an intended information depending on text such as the maximum and minimum terms of frequency for every document. TF-IDF is a popular renowned, that is basically utilized as a technique of weighting [17]. TF-IDF is concentrate on give a definition for the proportional frequency concerning features appearance in a specific document opposite to the inverse ratio concerning to the same feature on the intended text in the set of training. Give a determination about the relevance of particular feature in the intended text is the reason of this computation. Through using equation(1) it can be calculated [18]

$$\textbf{TF-IDF} = (\textbf{TF}i \ \textbf{xlog} \ (N/N^{i}))$$
$$1$$

TF refer to the count of word i appeared in the text.

N refer the total text.

Ni refer to in count of the word i occurred in the group of posts in the data set

3.4 Classification

The rumour detection and classification is the last presented phase in this work that performed depending on the usage of ML techniques. Machine learning is one of the most popular artificial intelligent approaches and has been popularly obtained in many areas in which it can automatically extract a useful information from a determined data collection, and provide accurate predictions based on historical data and automatically learns how to make decisions [19]. six ML algorithms are adopted in this work to highlight the discrepancy and the difference between the obtained results from them. The adopted ML include:

1. **Random Forest (RF):** is a supervised learning algorithm used for regression and

classification problems, within a fabulous performance in implementation, when the count of variables is much higher than observations, can conquer the complex connection structures, also, the variables that are correlated in high manner, and give measures of variable significant. RF methodology is utilized to determine two major classes of the intended problems to create a prediction rule for a supervised learning issue, and give an evaluation and ranking of variables based on their ability to predict the response [20].

2. **Naïve Bayes (NB):** It is a supervised ML algorithm obtained for classification problems, and it is an efficient and commonly used for the text classification. NB is a probabilistic learning classifier depend on Bayes' theorem, which assumes that all features in the dataset are mutually independent [21], in which It uses standard probabilitydistribution methods to learn relative frequencies of different classes and feature values in the training data to estimate the class probability and the conditional probability distribution of a class given the feature values [22]

3. **Logistic Regression (LR):** points as a language processing having an extreme entropy illustration, which own a role in the group of classifiers that named as the log-linear, or exponential classifiers. It operates by extracting some configurations of weighted focus on the input information, obtaining logs, and gathering them explicitly. The classifier classified within a comprehension into one of two intended classes, while the multinomial kind is habitual to

characterize into more number of classes [23]

4. **K-nearest Neighbour (KNN):** it is considered as one of the popular learning method, that depends on the instance in the domain of pattern recognition, in which it is supervised learning algorithm. K-NN is a **lazy learner due to it does not have** a training phase and operate fine if all the data owns the same scaling [24]. KNN operate depending on the hypothesis within similar points of data are close to each other. The resemblance idea is attained by computing the distance lay between points of data on the graph, and labelled within KNN by calculating the distance between the intended KNNs, and it will own those neighbours' votes. ''K'' in KNN denoted to the count of neighbours checked by the algorithm [25]

5. **Decision Tree (DT):** is a supervised learning algorithm, which it is a tree of a binary construction, in which the node refers to the feature, the branch of the tree illustrated the rule of decision, and a leaf node exemplify a class label [26]. The J48 is the kind of DT utilized which it is a top-down recursive type, that its style is divide-and-conquer, in which at first, all the training examples are at the root that will be separated recursively according to the selected attributes, the test attributes are selected on the foundation of a statistical or even a heuristic measure [27].

6. **Stochastic Gradient Descent Learning (SGD):** Gradient Descent is a redundant technique, in which the goal is to decrease the cost function. In SGD the calculation of the error is performed for every training sample belonging to a specific dataset and

parameters are updated for each one of training samples [28]. SGD considered to an effective algorithm for datasets that are big, due to its utilization of a single random sample of data to find out the cost function rather than using all the data and, therefore, it consumes less memory storage in every iteration.

4. Results and Discussion

The performance of implementing the six classification algorithms after performing both pre-processing and feature extraction on the collected dataset of Facebook posts is illustrated and measured using four measurements metrics including; Accuracy, Precision, Recall, and F-measure. Table 1, show the obtained results from the six classification algorithms on the resulted features from the TF-IDF feature extractor, as well as figure 2, and 3, show the difference between these algorithms in term of accuracy, and precision

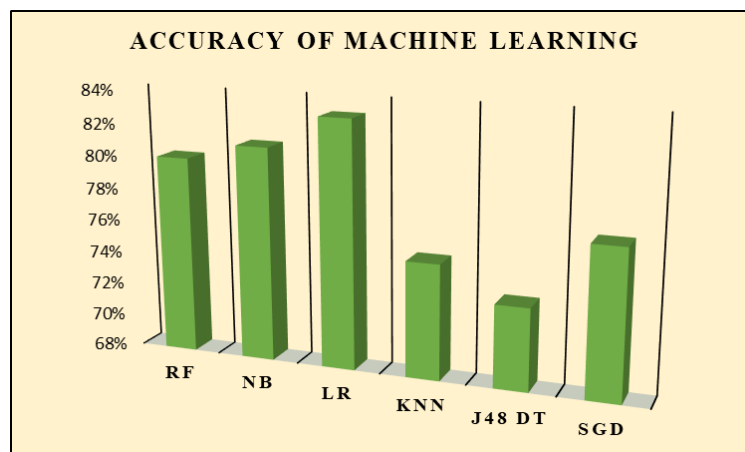| Table 1. The classification results within machine learning Algorithms				
Algorithm	Accuracy	Precision	Recall	F-Measure
RF	80%	81%	81%	81%
NB	81%	82%	82%	82%
LR	83%	84%	83%	83%
KNN	75%	80%	75%	76%
J48 DT	73%	75%	73%	74%
SGD	77%	78%	78%	78%

Figure 2. Flow chart of the Accuracy results of six ML Classification Algorithms

As noticed from the previous flow chart the best accuracy result gained from the LR algorithm, while the less accuracy has been obtained from the J48 DT algorithm. The RF, and NB has close accuracy rate in providing prediction of fake and real posts
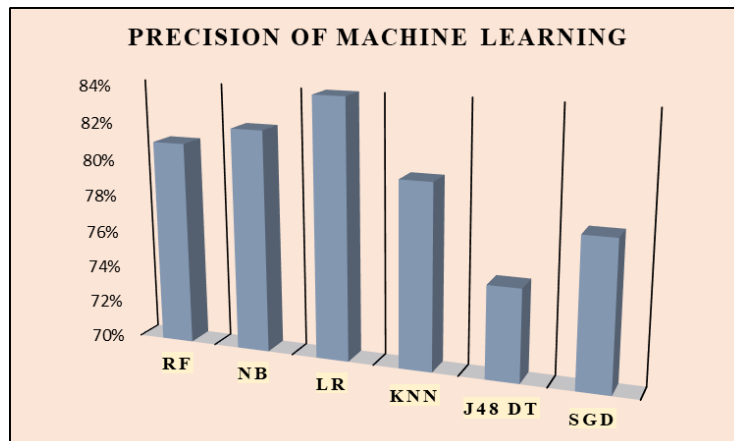
Figure 3. Flow chart of the Precision results of six ML Classification Algorithms

Also in term of precision the Logistic regression provide the highest result, and the decision tree provide the worse. In addition, the confusion matrix four all the Six classification algorithms are shown as follow.

Random Forest		
	Real	Fake
Real	251	62
Fake	54	233

Naïve Bayes		
	Real	Fake
Real	251	55
Fake	54	240

Logistic Regression		
	Real	Fake
Real	234	31
Fake	71	264

KNN		
	Real	Fake
Real	276	119
Fake	29	176

J48 Decision Tree		
	Real	Fake
Real	248	103
Fake	57	192

SGD		
	Real	Fake
Real	246	74
Fake	59	221

Figure 4. Confusion Matrix of the Six ML Algorithms

Table 2. A compression between related work and the proposed system results				
Work	Dataset	Language	Approaches	Results
[8]	Collected dataset of 783 tweets	Persian	J48, NB, KNN, SMO	95% by SMO
[9]	800 news collected from Twitter	Arabic	DT, SVM, NB	80% by SVM and DT
[10]	4079 of 3 stories Collected from YouTube comments	Arabic	DT, SVM , MNB	95.56% by DT

[11]	1862 tweets covering the Syrian crisis [29]	Arabic	RF,DT, Ada-Boost, LR	76% by RF, and LR.
[12]	collected 271,000 tweets	Arabic	semi-supervised system	80%
[13]	Collected 2282 Facebook news posts dataset	English	KNN	79%
[14]	Collected 18,684 tweets of cancer treatment	Arabic	SVM, LR, SGD, KNN, J48DT, Bernoulli Naive Bayes (BNB), RF , Ada-Boost, Bagging (Bag).	83.50%. by RF, and SGD
[15]	5.5 million collect tweets related to COVID-19 from Jan.1, 2020, to May 31, 2020.	Arabic	NB, LR, Multilayer Perceptron (MLP), RF, extreme Gradient Boosting Model (XGB)	93.4% by LR
Proposed system	2000 collected Facebook posts	Arabic	RF,NB,LR, KNN, J48DT, SGD	83% by LR

5. Conclusion

Fake news, and rumours detection is a critical yet challenging problem and has a high effect because social media have a big impact on all individuals in the public society. The rapid growth of social networking domains has not only maximized the ability of access information, but also quickened the prevalence of rumours. In this work the rumours are detected in the posts of Facebook social site written in Arabic language and a set of pre-processing steps are implemented using the Sentiment analysis technique which approved its effectiveness in providing clear data in order to extract its features within the TF-IDF method. Six machine learning classification algorithms are applied and the highest accuracy rate obtained from the Logistic Regression of 83% rate, while the worst result acquired from J48 Decision Tree of accuracy equal to 73%. The acquired results considered to be nearly accepted an always have a percentage of error which approved the weakness of utilizing the machine learning algorithms in classifying the obtained features from the text data, and require an enhancement in order to provide better results.

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