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Sentiment Analysis of Blogger Data using Hybrid Approach

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***Abstract*—**Blogs, micro blogs, review sites, twitter, and other social networks are the most common platforms that are used by people and organizations for posting their views. This information is of great importance for mining useful information from the text which can be done through opinion mining. In this research work, new hybrid classification method is proposed based on coupling classification methods using arcing classifier and their performances are analyzed in terms of accuracy. A Classifier ensemble is designed using Naive Bayes (NB), Support Vector Machine (SVM) and Genetic Algorithm (GA) as base classifiers. The feasibility and the benefits of the proposed approaches are demonstrated by means of blogger dataset that is widely used in the field of sentiment classification. The main originality of the proposed approach is based on five main parts: preprocessing phase, document indexing phase, feature reduction phase, classification phase and combining phase to aggregate the best classification results. A wide range of comparative experiments are conducted and finally, some in-depth discussion is presented and conclusions are drawn about the effectiveness of ensemble technique for sentiment classification.

***Keywords*—**Accuracy, Arcing, Genetic Algorithm, Naive Bayes, Sentiment Mining, Support Vector Machine.

INTRODUCTION

Sentiment analysis is ultimately related to natural language processing. It tracks the public feelings and mood about a certain product or service they are using. People give their feedbacks and share their opinions in blogs, review sites and other social networking sites like Twitter and Face book. Sentiment analysis or opinion mining is used to build a system that collect and analyze feedbacks of customers about the specific product or service.

With the growth of social media (forum discussions, reviews, blogs, comments and postings in social network sites, micro-blogs, Twitter) on the Web, organizations and individuals are using content in such media to make decisions. Generally, overall contextual polarity or writer sentiment about some aspect is determined using sentiment analysis. The challenge in sentiment classification is sentiment may be judgment, mood or evaluation of an object like a film, book or a product which can be a document or sentence or feature that is labeled positive or negative (Buche, A et al., 2013). But, finding and monitoring opinion web sites and distilling information in them are a formidable task due to the proliferation of diverse sites.

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Each site has a huge volume of opinion text not always easily deciphered in long blogs and forum postings. An average human reader has difficulty identifying relevant sites and extracting and summarizing opinions in them. Hence, automated sentiment analysis systems are required. (Liu, B., 2012).

Opinion mining aims to extract attributes and components of the object that have been commented on documents. Opinions of people's always play an important role in decision making process because whenever one need to make a decision one wants to hear other's opinions. This is true for individuals as well as for organizations. The analysis of sentiments of people, and accessing their emotions, attitudes and opinions is the main task of opinion mining (Poornima Singh et al., 2015).

This paper proposes new ensemble classification method to improve the classification accuracy. Organization of this paper is as follows: Section 2 describes the related work. Section 3 presents proposed methodology and Section 4 explains the performance evaluation measures. Section 5 focuses on the experimental results and discussion. Finally, results are summarized and concluded in section 6.

RELATED WORK

Blogs are usually published in a timely manner and contain people's opinions or impressions. Because of these features, there has been much work on using blogs to obtain trends, opinions, or sentiment on a variety of things.

With an increasing usage of the internet, blog pages and blogging are growing rapidly; blog pages have become the most popular means to express one's personal opinions. The name associated to universe of all the blog sites called blogosphere. Bloggers record the daily events in their lives and express their opinions, feelings, and emotions in a blog. Blogs are used as a source of opinion in many of the studies related to sentiment analysis. Many of these blogs contain reviews on many products, issues, etc. Blogs provide a type of website that contains information and personal opinions of the individual authors (D. E. O'Leary, 2011).

Machine learning experiments regarding sentiment analysis in forum texts, blog, and reviews seen on the World Wide Web and written in French, English, and Dutch were presented by Boiy and Moens, (2009). This paper trains from a set of example sentences or statements that are annotated manually as positive, negative or neutral regarding a certain entity. It is interested in feelings expressed by people regarding consumed products. Also, it learns and evaluates many classification models configured in a cascaded pipeline.

It deals with several problems, being the input texts noisy character, sentiment attribution to a particular entity and the training set's small size.

Three supervised machine learning algorithms like Naïve Bayes, SVM and character based N-gram model was compared for sentiment classification of reviews on travel blogs for 7 popular travel destinations in the US and Europe by Ye et al., (2009). Empirical findings revealed that SVM and N-gram approaches outperformed Naïve Bayes approach, and when training datasets had many reviews, all 3 approaches had at least 80%accuracy.

Mustafa Hajeer et al., (2012) proposed the concept of "Node of Attraction" (NoA) which represents the most active node in a network community. This NoA is identified as the origin/initiator of a post/communication which attracted other nodes and formed a cluster at any point in time. In this research, a genetic algorithm (GA) is used as a data mining method where the main objective is to determine clusters of network communities in a given OSN dataset. This approach is efficient in handling different type of discussion topics in our studied OSN - comments, emails, chat expressions, etc. and can form clusters according to one or more topics.

Asad et al., (2012) proposed a suffix tree data structure to represent syntactic relationships between opinions targets and words in a sentence that are opinion- bearing. Their baseline system is the initial setting of the labels for the sampler and next system involve combination of our SRT factors with the observed linguistic features. Authors also experiment with including and excluding combinations of POS, role, and word features. The accuracy measure does show overall improvement with the inclusion of more feature factor combinations.

Xia et al. (2011) ensemble framework is applied to sentiment classification tasks with the aim of integrating different feature sets and different classification algorithms to produce a more accurate classification procedure.

Freund and Schapire (1995,1996) proposed an algorithm the basis of which is to adaptively resample and **c**ombine (hence the acronym--arcing) so that the weights in the resampling are increased for those cases most often misclassified and the combining is done by weighted voting. A hybrid model can improve the performance of basic classifier (Tsai 2009).

In this research work, proposes a new hybrid method for sentiment mining problem. A new architecture based on coupling classification methods (NB, SVM and GA) using arcing classifier adapted to sentiment mining problem is defined in order to get better results.

PROPOSED METHODOLOGY

Several researchers have investigated the combination of different classifiers to from an ensemble classifier (D. Tax et al, 2000). An important advantage for combining redundant and complementary classifiers is to increase robustness, accuracy, and better overall generalization. This research work aims to make an intensive study of the effectiveness of ensemble techniques for sentiment classification tasks. In this work, first the base classifiers such as Naive Bayes (NB), Support Vector Machine (SVM), Genetic Algorithm (GA) are constructed to predict classification scores. All classification experiments were conducted using 10 × 10-fold cross-validation for evaluating accuracy. Secondly, well known heterogeneous ensemble technique is performed with base classifiers to obtain a very good generalization performance. The feasibility and the benefits of the proposed approaches are demonstrated by means of blogger dataset that is widely used in the field of sentiment classification. A wide range of comparative experiments are conducted and finally, some in-depth discussion is presented and conclusions are drawn about the effectiveness of ensemble technique for sentiment classification.

This research work proposes new hybrid method for sentiment mining problems. A new architecture based on coupling classification methods using arcing classifier adapted to sentiment mining problem is defined in order to get better results. The main originality of the proposed approach is based on five main parts: Preprocessing phase, Document Indexing phase, feature reduction phase, classification phase and combining phase to aggregate the best classification results.

Data Pre-processing

Different pre-processing techniques were applied to remove the noise from out data set. It helped to reduce the dimension of our data set, and hence building more accurate classifier, in less time.

The main steps involved are i) document pre-processing, ii) feature extraction / selection, iii) model selection, iv) training and testing the classifier.

Data pre-processing reduces the size of the input text documents significantly. It involves activities like sentence boundary determination, natural language specific stop-word elimination and stemming. Stop-words are functional words which occur frequently in the language of the text (for example, „a", "the", "an", "of" etc. in English language), so that they are not useful for classification. Stemming is the action of reducing words to their root or base form. For English language, the Porter"s stemmer is a popular algorithm, which is a suffix stripping sequence of systematic steps for stemming an English word, reducing the vocabulary of the training text by approximately one-third of its original size. For example, using the Porter"s stemmer, the English word "generalizations" would subsequently be stemmed as "generalizations → generalization → generalize → general → gener". In cases where the source documents are web pages, additional pre-processing is required to remove / modify HTML and other script tags.

Feature extraction / selection helps identify important words in a text document. This is done using methods like TF-IDF (term frequency-inverse document frequency), LSI (latent semantic indexing), multi-word etc. In the context of text classification, features or attributes usually mean significant

words, multi-words or frequently occurring phrases indicative of the text category.

After feature selection, the text document is represented as a document vector, and an appropriate machine learning algorithm is used to train the text classifier. The trained classifier is tested using a test set of text documents. If the classification accuracy of the trained classifier is found to be acceptable for the test set, then this model is used to classify new instances of text documents.

Document Indexing

Creating a feature vector or other representation of a document is a process that is known in the IR community as *indexing*. There are a variety of ways to represent textual data in feature vector form, however most are based on word co-occurrence patterns. In these approaches, a vocabulary of words is defined for the representations, which are all possible words that might be important to classification. This is usually done by extracting all words occurring above a certain number of times (perhaps 3 times), and defining your feature space so that each dimension corresponds to one of these words.

When representing a given textual instance (perhaps a document or a sentence), the value of each dimension (also known as an attribute) is assigned based on whether the word corresponding to that dimension occurs in the given textual instance. If the document consists of only one word, then only that corresponding dimension will have a value, and every other dimension (i.e., every other attribute) will be zero. This is known as the ``bag of words" approach. One important question is what values to use when the word is present. Perhaps the most common approach is to weight each present word using its frequency in the document and perhaps its frequency in the training corpus as a whole. The most common weighting function is the *tfidf* (term frequency-inverse document frequency) measure, but other approaches exist. In most sentiment classification work, a binary weighting function is used. Assigning 1 if the word is present, 0 otherwise, has been shown to be most effective.

Dimensionality Reduction

Dimension Reduction techniques are proposed as a data pre-processing step. This process identifies a suitable low-dimensional representation of original data. Reducing the dimensionality improves the computational efficiency and accuracy of the data analysis.

Steps:

- ✓ Select the dataset.
- ✓ Perform discretization for pre-processing the data.
- ✓ Apply Best First Search algorithm to filter out redundant & super flows attributes.
- ✓ Using the redundant attributes apply classification algorithm and compare their performance.
- ✓ Identify the Best One.

1) Best first Search

Best First Search (BFS) uses classifier evaluation model to estimate the merits of attributes. The attributes with high merit value is considered as potential attributes and used for classification Searches the space of attribute subsets by augmenting with a backtracking facility. Best first may start with the empty set of attributes and search forward, or start with the full set of attributes and search backward, or start at any point and search in both directions.

Existing Classification Methods

1) Naive Bayes (NB)

The Naïve Bayes assumption of attribute independence works well for text categorization at the word feature level. When the number of attributes is large, the independence assumption allows for the parameters of each attribute to be learned separately, greatly simplifying the learning process.

There are two different event models. The multi-variate model uses a document event model, with the binary occurrence of words being attributes of the event. Here the model fails to account for multiple occurrences of words within the same document, which is a more simple model. However, if multiple word occurrences are meaningful, then a multinomial model should be used instead, where a multinomial distribution accounts for multiple word occurrences. Here, the words become the events.

2) Support Vector Machine (SVM)

The support vector machine (SVM) is a recently developed technique for multi dimensional function approximation. The objective of support vector machines is to determine a classifier or regression function which minimizes the empirical risk (that is the training set error) and the confidence interval (which corresponds to the generalization or test set error).

Given a set of N linearly separable training examples $S = \left\{ x_i \in R^n | i = 1,2,...,N \right\}$, where each example belongs to one of the two classes, represented by $y_i \in \{\div 1,-1\}$, the SVM learning method seeks the optimal hyperplane w.x +b = 0, as the decision surface, which separates the positive and negative examples with the largest margins. The decision function for classifying linearly separable data is:

$$f(\mathrm{X}) = sign(W.X + b) \quad (1)$$

Where w and b are found from the training set by solving a constrained quadratic optimization problem. The final decision function is

$$f(x) = sign\left(\sum_{i=1}^{N} a_i y_i (x_i . x) + b \right) \quad (2)$$

The function depends on the training examples for which a_i s is non-zero. These examples are called support vectors. Often the number of support vectors is only a small fraction of

the original data set. The basic SVM formulation can be extended to the non linear case by using the nonlinear kernels that maps the input space to a high dimensional feature space. In this high dimensional feature space, linear classification can be performed. The SVM classifier has become very popular due to its high performances in practical applications such as text classification and pattern recognition.

The support vector regression differs from SVM used in classification problem by introducing an alternative loss function that is modified to include a distance measure. Moreover, the parameters that control the regression quality are the cost of error C, the width of tube ε and the mapping function ϕ .

In this research work, the values for polynomial degree will be in the range of 0 to 5. In this work, best kernel to make the prediction is polynomial kernel with epsilon = 1.0E-12, parameter d=4 and parameter c=1.0.

3) Genetic Algorithm (GA)

The genetic algorithm is a model of machine learning which derives its behaviour from a metaphor of some of the mechanisms of evolution in nature. This done by the creation within a machine of a population of individuals represented by chromosomes, in essence a set of character strings.

The individuals represent candidate solutions to the optimization problem being solved. In genetic algorithms, the individuals are typically represented by n-bit binary vectors. The resulting search space corresponds to an n–dimensional boolean space. It is assumed that the quality of each candidate solution can be evaluated using a fitness function.

Genetic algorithms use some form of fitness-dependent probabilistic selection of individuals from the current population to produce individuals for the next generation. The selected individuals are submitted to the action of genetic operators to obtain new individuals that constitute the next generation. Mutation and crossover are two of the most commonly used operators that are used with genetic algorithms that represent individuals as binary strings. Mutation operates on a single string and generally changes a bit at random while crossover operates on two parent strings to produce two offsprings. Other genetic representations require the use of appropriate genetic operators.

The process of fitness-dependent selection and application of genetic operators to generate successive generations of individuals is repeated many times until a satisfactory solution is found. In practice, the performance of genetic algorithm depends on a number of factors including: the choice of genetic representation and operators, the fitness function, the details of the fitness-dependent selection procedure, and the various user-determined parameters such as population size, probability of application of different genetic operators, etc.

The basic operation of the genetic algorithm is outlined as follows:

Procedure:
begin
t <- 0
initialize P(t)
while (not termination condition)
t <- t + 1
select P(t) from p(t - 1)
crossover P(t)
mutate P(t)
evaluate P(t)
end
end.

Our contribution relies on the association of all the techniques used in our method. First the small selection in grammatical categories and the use of bi-grams enhance the information contained in the vector representation, then the space reduction allows getting more efficient and accurate computations, and then the voting system enhance the results of each classifier. The overall process comes to be very competitive.

E. Proposed NB-SVM-GA Hybrid System

Given a set D, of d tuples, arcing (Breiman. L, 1996) works as follows; For iteration i (i =1, 2,…..k), a training set, D_i, of d tuples is sampled with replacement from the original set of tuples, D. some of the examples from the dataset *D* will occur more than once in the training dataset D_i. The examples that did not make it into the training dataset end up forming the test dataset. Then a classifier model, M_i, is learned for each training examples *d* from training dataset D_i. A classifier model, M_i, is learned for each training set, D_i. To classify an unknown tuple, X, each classifier, M_i, returns its class prediction, which counts as one vote. The hybrid classifier (NB-SVM-GA), M^*, counts the votes and assigns the class with the most votes to X.

Algorithm: Hybrid NB-SVM-GA using Arcing Classifier
Input:

- D, a set of d tuples.
- k = 3, the number of models in the ensemble.
- Base Classifiers (NB, SVM, GA)

Output: Hybrid NB-SVM-GA model, M^*.
Procedure:

1. For i = 1 to k do // Create k models
2. Create a new training dataset, D_i, by sampling D with replacement. Same example from given dataset *D* may occur more than once in the training dataset D_i.
3. Use D_i to derive a model, M_i
4. Classify each example d in training data D_i and initialized the weight, W_i for the model, M_i, based on the accuracies of percentage of correctly classified example in training data D_i.
5. endfor

To use the hybrid model on a tuple, X:

1. if classification then
2. let each of the k models classify X and return the majority vote;

3. if prediction then
4. let each of the k models predict a value for X and return the average predicted value;

The basic idea in Arcing is like bagging, but some of the original tuples of D may not be included in Di, where as others may occur more than once.

PERFORMANCE EVALUATION MEASURES

Cross Validation Technique

Cross-validation, sometimes called rotation estimation, is a technique for assessing how the results of a statistical analysis will generalize to an independent data set. It is mainly used in settings where the goal is prediction, and one wants to estimate how accurately a predictive model will perform in practice. 10-fold cross validation is commonly used. In stratified K-fold cross-validation the folds are selected so that the mean response value is approximately equal in all the folds.

Criteria for Evaluation

The primary metric for evaluating classifier performance is classification Accuracy - the percentage of test samples that are correctly classified. The accuracy of a classifier refers to the ability of a given classifier to correctly predict the label of new or previously unseen data (i.e. tuples without class label information). Similarly, the accuracy of a predictor refers to how well a given predictor can guess the value of the predicted attribute for new or previously unseen data.

EXPERIMENTAL RESULTS

Dataset Description

The data set consists of 100 blogs. These were downloaded from UCI Machine Learning Repository web page: https://archive.ics.uci.edu/ml/datasets/BLOGGER

Results and Discussion

The blogger dataset is taken to evaluate the proposed hybrid NB-SVM-GA classifier.

TABLE I
THE PERFORMANCE OF BASE AND PROPOSED HYBRID CLASSIFIER FOR BLOGGER DATA

Dataset	Classifiers	Accuracy
Blogger Data	Naive Bayes	71.00 %
	Support Vector Machine	73.00 %
	Genetic Algorithm	77.00 %
	Proposed Hybrid NB-SVM-GA	94.00 %

In this research work, new hybrid classification methods are proposed for heterogeneous ensemble classifiers using arcing classifier and their performances are analyzed in terms of accuracy. The data set described in section 5 is being used to test the performance of base classifiers and hybrid classifier. Classification accuracy was evaluated using 10-fold cross validation (Kohavi, R, 1995). In the proposed approach, first the base classifiers NB, SVM and GA are constructed individually to obtain a very good generalization performance. Secondly, the ensemble of NB, SVM and GA is designed. In the ensemble approach, the final output is decided as follows: base classifier's output is given a weight (0–1 scale) depending on the generalization performance as given in Table 1. According to figure 1, the proposed hybrid models show significantly larger improvement of classification accuracy than the base classifiers and the results are found to be statistically significant.

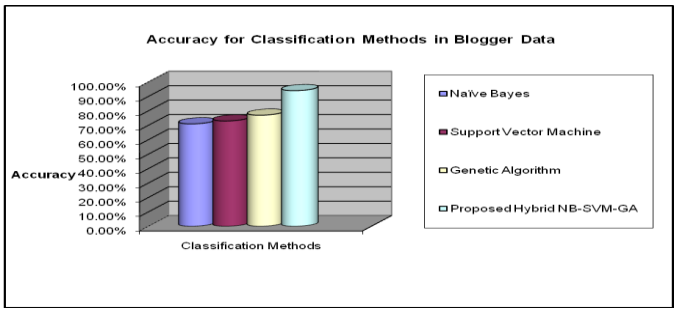

Fig.1.Classification Accuracy of Base and Proposed hybrid NB-SVM-GA Classifier using Blogger Data

The experimental results show that proposed hybrid NB-SVM-GA is superior to individual approaches for blogger dataset in terms of classification accuracy.

CONCLUSION

In this research, a new hybrid technique is investigated and evaluated their performance based on the blogger data and then classifying the reduced data by NB, SVM and GA. Next a hybrid NB-SVM-GA model and NB, SVM, GA models as base classifiers are designed. Finally, a hybrid system is proposed to make optimum use of the best performances delivered by the individual base classifiers and the hybrid approach. The hybrid NB-SVM-GA shows higher percentage of classification accuracy than the base classifiers and enhances the testing time due to data dimensions reduction.
The experiment results lead to the following observations.

- GA exhibits better performance than NB and SVM in the important respects of accuracy.
- The hybrid NB-SVM-GA shows higher percentage of classification accuracy than the base classifiers.
- Comparison between the individual classifier and the hybrid classifier: it is clear that the hybrid classifier show the significant improvement over the single classifiers.

The future research will be directed towards developing more accurate base classifiers particularly for the blogger dataset.

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