ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

An Efficient Fuzzy Logic Classification over Semantically Secure Encrypted Data

P. Hemalatha[1] Dr. S. M. Jagatheesan[2]

Research Scholar, Department of Computer Science & Engineering, Gobi Arts & Science College, Gobichettipalayam, Tamilnadu, India [1]

Associate Professor, Department of Computer Science & Engineering, Gobi Arts & Science College, Gobichettipalayam, Tamilnadu, India [2]

ABSTRACT: Data mining is the method of extraction of hidden and useful information from huge data. It is a knowledge domain subfield of computer science and the computational process of discovering patterns in massive data sets. Classification is one of the ordinarily used tasks in data mining applications. It is used to predict membership for data instances. For the past decade, due to the increase of various privacy problems, many theoretical and practical solutions to the classification drawback have been proposed under completely different security models. However, with the recent popularity of cloud computing, users currently have the opportunity to outsource their data, in encrypted form, as well as the data mining tasks to the cloud. In existing the k-Nearest Neighbor (k-NN) classifier is used to encrypted data or information within the cloud. The k-NN classifier had less efficient when compared to the fuzzy logic classifier. The protocols are used in the existing k-NN classifier has less efficiency. The proposed fuzzy logic classifier protects the high confidentiality of information, privacy of users input query, and hides the data access patterns.And it secure encrypted data in the cloud. This paper reviews the cost and efficiency of the fuzzy logic classifier with k-NN classifier.

KEYWORDS: k-NN Classifier, Encryption, Security, Fuzzy Logic

I. INTRODUCTION

Data mining, the extraction of hidden predictive information from large databases, is a powerful new technology with great potential to help companies focus on the most important information in their data warehouses. Data and Information or Knowledge has a significant role on human activities. Data mining is the knowledge discovery process by analyzing the large volumes of data from various perspectives and summarizing it into useful information. Due to the importance of extracting knowledge/information from the large data repositories, data mining has become an essential component in various fields of human life including business, education, medical and scientific methods.

Classification is a data mining strategy used to anticipate bunch participation for data occasions. The data is scrambled utilizing the Knapsack cryptosystem algorithm. In past utilizing there were used the paillier cryptosystem algorithm. The scrambled data is ordered semantically utilizing the fuzzy logic calculation. In the past technique therewill be utilized K- Nearest Neighbor classifier. This type of order calculation gives the low Efficiency to compare with the Fuzzy classifier. Enhancing the effectiveness of Secure Minimum Protocol, convention is vital in first stride for development of the entire classifier. In the K- Nearest Neighbor classifier, the Secure Minimum Protocol convention productivity is less in this way, so the effectiveness of the K- Nearest Neighbor is less compare with the fuzzy logic classifier.

The issue of registering n^{th}residue deposit range is accepted to be computationally troublesome. The classification is critical in the data mining. For the high privacy and efficiency process here go for fuzzy logic classifier.

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II. LITERATURE REVIEW

Chuenchein lee[4] has proposed the fuzzy control has emerged as one of the most active and fruitfulareas for research in the applicationsof fuzzy set theory, especially in the realm of industrial processes, whichdo not lend themselves to control by conventional methods because of alack of quantitative data regarding the input-output relations. Fuzzycontrol is based on fuzzy logic-a logical system that is much closer inspirit to human thinking and natural language than traditional logicalsystems. The fuzzy logic controller (FLC) based on fuzzy logic provides ameans of converting a linguistic control strategy based on expert knowledgeinto an automatic control strategy. A general methodology for constructing an FLC and assessing its performance is described, and problems that need further research arepointed out. In particular, the exposition includes a discussion offuzzification and defuzzification strategies, the derivation of thedatabaseand fuzzy control rules, the definition of fuzzy implication, and ananalysis of fuzzy reasoning mechanisms.Another direction of recent exploration is the conceptionand design of fuzzy systems that have the capabilityto learn from experience. In this research, a combination of techniques drawn from both fuzzy logic theories may provide a powerful tool for the design ofsystems which can emulate the remarkable human abilityto learn and adapt to changes in environment.

E. Keogh and S. Kasetty [5] haveproposedTime series classification which is an important topic in data mining research. It is concerned about discovering classification models or classifiers in a database of pre classified time series and using them to classify unseen time series. Time series data typically contain a large amount of noises. The ability to handle noises effectively is therefore crucial for a classifier to be useful. To better handle the noises in time series data, where proposed a new data mining technique to discover fuzzy rules in the data.In this work, the fuzzy rules discovered employ fuzzy sets to represent the revealed regularities and exceptions. The resilience of fuzzy sets to noises allows the proposed approach to better handle the noises embedded in the data.

Later Jung-Yi Jiang, Ren-Jia Liou and Shie-Jue Lee [10] proposed a fuzzy similarity based self-constructing feature clustering algorithm, which is an incremental feature clustering approach to reduce the number of features for the text classification task. Words in the feature vector those are similar to each other grouped into the same cluster. Each cluster is characterized by a fuzzy membership function with statistical mean and deviation. The Fuzzy membership with mean and deviation represents the similarity between a word and cluster. It takes each cluster as a reduced feature. The extracted feature represents to a cluster is a weighted combination of the words contained in the cluster. In this work proposed a novel fuzzy similarity-based clustering approach using an efficient split Gaussian fuzzy membership function.

RenuBala and Saroj[2] proposed a genetic algorithm approach for discovery of Fuzzy CensoredClassification Rules from datasets. The discovery of FCCRs provides the advantages of Fuzzy Classification Rules (FCRs), as well as it offers an excellent exception handling mechanism. Discovery of a classifier in the form of FCCRs makes it more interesting as the classifier is now capable of giving right predictions even in exceptional cases. The proposed discovery may also prove to be very useful for fuzzy control applications to predict the behavior of a system in rare circumstances. The major limitation of the proposed system is that fuzzifying the attributes in pre-processing phase employing the same membership function is a very simpleidea. This fuzzification technique may not suit the distribution of data values across all thepredicting attributes with respect to the class attribute. In fact, use of a single fuzzy membershipfunction with same number of linguistic labels for all the predicting attributes may lead to thediscovery of a classifier with unacceptable predictive accuracy. The proposedsystem needs to be applied and tested on some real world datasets in the fields of medicaldiagnosis and fuzzy controllers.

WH Au and Keith CC Chan[24] it presents a Time series classification is concerned about discovering classification models in a database of pre classified time series and using them to classify unseen time series. To better handle the noises and fuzziness in time series data, the authors propose a new data mining technique to mine fuzzy rules in the data. The authors proposed a new data mining technique to discover fuzzy rules in time series data. The fuzzy rules employ fuzzy sets to represent the revealed regularities and exceptions hidden in the data. The use of fuzzy set allows the proposed approach to be resilient the noises hidden in the time series data. To distinguish interesting association relationship from uninteresting ones, their approach utilizes the residual analysis, which has an advantage that it does not require any user-specified thresholds.

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III. PROPOSED METHODOLOGY

- **Fuzzy logic** is a form of many valued logic in which the truth value of variables may be any real number between 0 and 1. By contrast, in Boolean logic, the truth values of variables may only be 0 or 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. Furthermore, when linguistic variables are used, these degrees may be managed by specific functions.
- Any fuzzy theory is recursively enumerable. In particular, the fuzzy set of logically true formulas is recursively enumerable in spite of the fact that the crisp set of valid formulas is not recursively enumerable, in general.
- It is an open question to give supports for a "Church thesis" for fuzzy mathematics, the proposed notion of recursive innumerability for fuzzy subsets is the adequate one. To this aim, an extension of the notions of fuzzy grammar and fuzzy Turing machine should be necessary.
- It is known that any Boolean logic function could be represented using a truth table mapping each set of variable values into set of values $\{0, 1\}$.

3.1 SECURITY PROTOCOLS:

- **Secure Minimum (SMIN):-** In this protocol, P1holds private input (u′, v′) and P2 holds sk, where u′ = ([u],Epk(su)) and v′ = ([v],Eik(sv)). Here su (resp., sv) denotes the secret associated with u(resp., v). The goal of SMIN is for P1 and P2 to jointly here, present a set of generic sub-protocols that will be used in constructing the proposed k-NN protocol.All of the below protocols are considered under twoclients semi-honest setting. In particular, consider the presence of two semi honest clients P1 and P2 such that the Pallier's secret key sk is known only to P2 whereas ik is public.
- **Secure Minimum out of n Numbers (SMINn):-** In this protocol, consider P1 with n encrypted vector's ([d1], [dn]) along with their corresponding encrypted secrets and P2 with sk. Here[dp] = hEik(dp,1), . . . ,Eik(dp,l)i where dp,1 anddi,l are the most and least significant bits of integer irrespectively, for 1 ≤ p≤ n. The secretordp is given by sdi. P1 and P2 jointly compute[min(d1, . . . , dn)]. In addition, they compute Epk(smin(d1,...,dn)). At the end of this protocol ,the output ([min(d1, . . . , dn)],Epk(smin(d1,...,dn)))is known only to P1. During SMINn, no information regarding any of dp's and their secrets is revealed to P1 and P2.
- **Secure Frequency (SF):-** Here P1 with private input (hEik(c1), . . .Eik(cw)p, hEik(c′1), . . . ,Eik(c′k)p)and P2 securely compute the encryption of the frequency of cq , denoted by f(cq), in the listhc′1, . . . , c′kp, for 1 ≤ q≤ w. Here explicitly assume that cq 's are unique and c′p∈{c1, . . . , cw}, for 1 ≤ p≤ k. The output Eik(f(c1)), . . . ,Eik(f(cw))p will be known only to P1. During the SF protocol, no data regarding c′p, cq , and f(cq) is revealed to P1 andP2, for 1 ≤ p≤ k and 1 ≤ q≤ w.

3.2 FUZZY-LOGIC STEPS

(1) Fuzzification: Determines an input's membership in overlapping sets.
(2) Rules: Determine outputs based on inputs and rules.
(3) Combination/ Defuzzification: Combine all fuzzy actions into a single fuzzy action for executable system output.

Step1: Fuzzification

The first step is to convert the input data into a fuzzy one. It had two types of values. The first value is the level of project staffing. The second value is the level of project funding.

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Vol. 5, Issue 5, May 2017

Conversion of input into fuzzy set is,

Fuzzy set= [T F I]; Where T=logical true F=logical False I=Intermediate value

Step2: (Rules)

Applying the IF THEN rules based on the input.

Rule1: Rules containing disjunctions, *OR*, are evaluated using the *UNION* operator**.**
(And alternative way of computing the disjunction is via the algebraic)
Rule2: Conjunction in fuzzy rules are evaluated using the *INTERSECTION* operator.
(Alternatively the same rule can be evaluated using multiplication)
Rule3: This is evaluated by using both union and intersection

Step3: Defuzzification

The defuzzification can be performed in several different ways. The most popular method is the centroid method. And some other types of methods are given below:

- ***Centroid method***
  Centroid method is used to calculate the center of gravity for the area under the curve.
- ***Mean of maximum***
  Assuming there is a plateau at the maximum value of the final function takes the mean of the values it spans.
- ***Smallest value of maximum***
  Assuming there is a plateau at the maximum value of the final function takes the smallest of the values it spans.
- ***Largest value of maximum***
  Assuming there is plateaus at the maximum value of the final function take the largest of the values it spans.

IV. EXPERIMENTAL RESULTS

4.1 DATA SET AND EXPERIMENTAL RESULT

In this experiment, were used the Car Evaluation Dataset from the UCI KDD archive. It consists of 1,728 records and six attributes. Also, there is a separate class attribute and the data set is categorized into different classes. Here encrypted this dataset attribute wise, using the knapsack cryptosystem encryption whose key size is varied in these experiments and the encrypted data were stored on the particular machine. Based on the fuzzy protocol, were executed a random query over this encrypted data. Evaluate and analyze the performances of the two stages in fuzzy logic separately.

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4.2 COMPARISION GRAPH FOR K-NN AND FUZZY LOGIC

The X-axis shows the existing algorithm k-NN and proposed algorithm fuzzy logic classifier and the Y-axis shows the efficiency value.

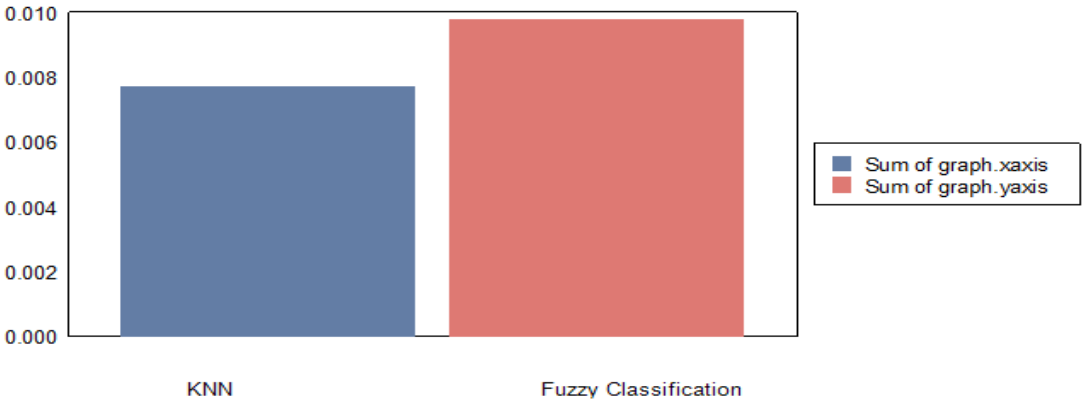

Figure 4.1 Comparision of k-NN and Fuzzy Logic

From the graph can observe that k-NN performs for small data sets and give low efficiency, but fuzzy logic classifier can give high efficiency to compare the existing method.

4.3 PERFORM OUTPUT PHASE

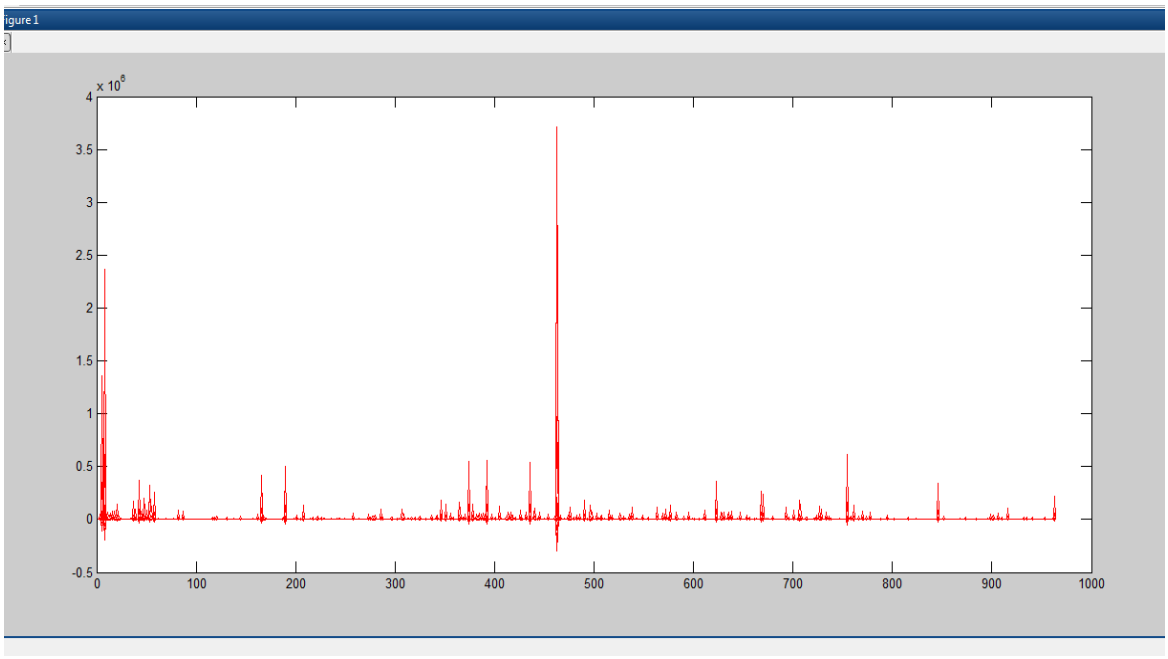

Figure 4.2 Perform output phase

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In Figure 3.2displayed the performance of fuzzy logic classification in privacy patterns. The efficiency of time should be changed every time, because that can be based on different values of dataset in encryption.

V. CONCLUSION

Classification is one of the commonly used tasks in data mining. It is used to predict membership for data instances. Many types of classification algorithms were used in data mining. The proposed work develop An Efficient Fuzzy Logic Classification Semantically Secure Encrypted Data in the cloud.This research work proposes an confidentiality of the required data, user's input query, and hides the data access patterns and also evaluated the performance of the protocol under different parameter settings. The proposed work improving the efficiency of fuzzy logic classifier. This classifier were compared with the existing classifiers, found that more efficiency and have less time consuming to encrypt the data.

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