A Comparative Study of Deep Learning Models used for Object identification

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Abstract: *Unstructured data remains a challenge in almost all data intensive application fields such as business, universities, research institutions, government funding agencies, and technology intensive companies Eighty percent of data about an entity (person, place, or thing) are available only in unstructured form. They are in the form of reports, email, views, news, etc. Object mining/ analytics analyzes the hitherto hidden relationships between entities in a dataset to derive meaningful patterns which reflect the knowledge contained in the dataset. This knowledge is utilized in decision making. Object analytics converts object into numbers, and numbers in turn bring structure to the data and help to identify patterns. The more structured the data, the better the analysis, and eventually the better the decisions would be. It is also difficult to process every bit of data manually and classify them clearly. This led to the emergence of intelligent tools in object processing, in the field of natural language processing, to analyze lexical and linguistic patterns. It has been found more important to study and understand the nature of data before proceeding into mining. The automation of object identification process is required, with the increasing amount of data and need for accuracy. Another interesting research opportunity lies in building intricate object data models with deep learning systems. It has the ability to execute complex Natural Language Processing (NLP) tasks with semantic requirements. Object identification forms the base of data analytics and acts as the engine be- hind knowledge discovery. It supports state-of-the-art decision making, for example, predicting an event before it actually occurs, classifying a transaction as 'Fraudulent' etc. The results of this study could be used for developing applications dedicated to assisting decision making processes. These informed decisions will help to optimize resources and maximize benefits to the man- kind.*

In the future, better methods for parameter optimization will be identified by selecting better parameters that reflects effective knowledge discovery. The role of streaming data processing is still rarely explored when it comes to object identification.

Keywords: object identification, **classification, machine learning, statistical methods, analysis**

1. INTRODUCTION

Classification algorithms form the crust of object mining techniques. Generally, a classification technique could be divided into statistical and Deep Learning learning (ML) approaches. Statistical techniques purely satisfy the proclaimed hypotheses manually, therefore the need for algorithms is little, but ML techniques were specially invented for automation. In Figure 1, the algorithms are broadly divided into supervised, unsupervised, and semi supervised categories according to the learning criteria followed.

Among the supervised classification algorithms, there are two categories, namely, parametric and non-parametric, based on the supremacy of parameters in the data. Logistic regression and Naïve Bayes are the most widely used parametric classification algorithms Support Vector Machine (SVM), Decision Tree, Rule Induction, KNN and Neural Networks are their non-parametric counterparts. Fuzzy c-means, k-means clustering and Hierarchical clustering are unsupervised learning approaches and co-training, self-training, transductive SVM and graph based methods form the constituents of semi-supervised learning methods.

Below are some of the object identification techniques and their research directions.

2. OBJECT IDENTIFICATION ALGORITHMS

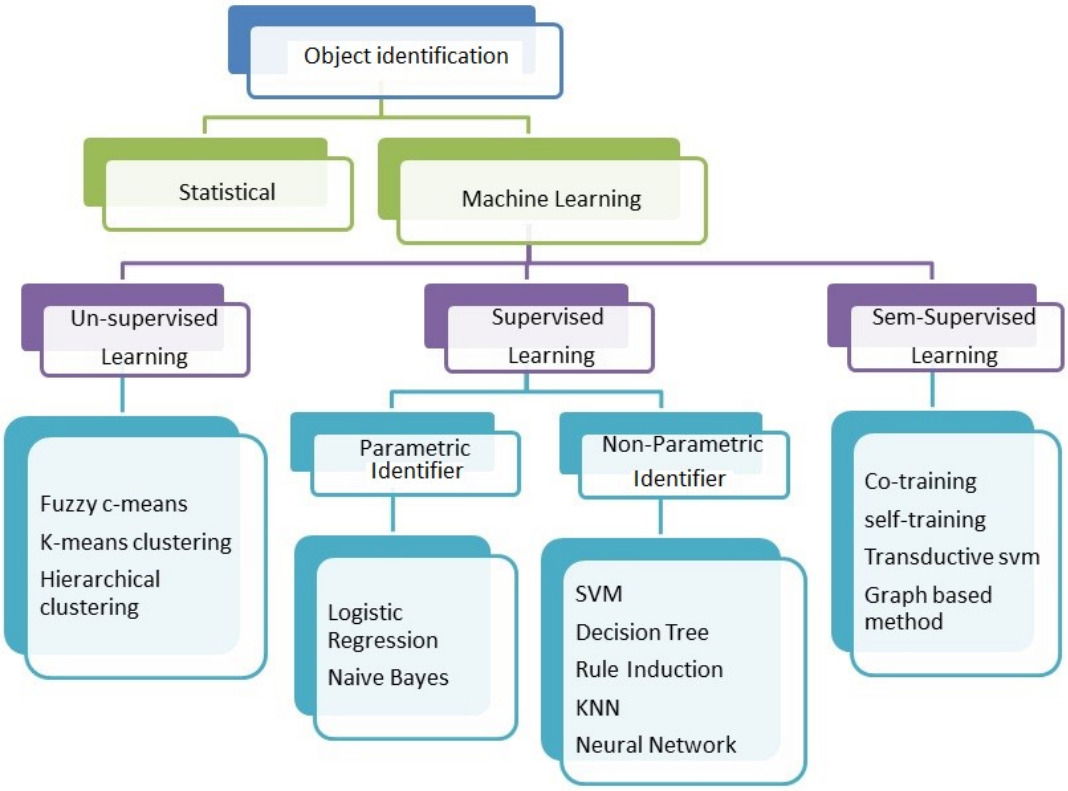

Figure1 Representation of Object identifiers

Statistical approach

Statistical techniques are purely mathematical processes, and they act as the mathematical foundation for all other object classifiers. It works similar to a computer program, executing the given instructions without any ability of its own, To achieve a good classification, the amount of information to be handled by the application has to be concise and it is achieved by reducing the dimensionality (number of variables to be considered, for example in a census dataset, “age”, “gender”, “locality”, etc., are variables) in the data. Data in e-mails are complex and multi-dimensional. Statistical feature extraction techniques, such as Principal Component Analysis (PCAII), Biased Discriminant Analysis (BDA), and Average Neighborhood Margin Maximization (ANMM) have been proven to be better dimensionality reduction techniques. They are ordered by relevance but not suitable for non-linear data.

Machine learning approach

The increase in data volume, velocity, and variety called for automation in object processing techniques including object identification. In some situations, defining a set of logical rules using knowledge- engineering techniques and based on expert opinions to classify documents helps to automate the classification task. Object identification could be divided into three categories: supervised object identification, unsupervised object identification, and semi-supervised object identification based on the learning principle followed by the data model.

In machine learning terminology, the classification problem comes under the supervised learning principle, where the system is trained and tested on the knowledge about classes before the actual classification process. Unsupervised learning occurs when labeled data is not accessible. The process is complicated and has performance issues. It is suitable for big data. Semi-supervised learning is followed when data is partly labeled and partly unlabeled.

However, establishing a concrete relationship between labeled and unlabeled data is difficult. The efficiency is measured using metrics, like Accuracy, Precision and Recall. When the dataset is large, the classification errors tend to be less. It has also been known that selection of suitable algorithms for a particular dataset plays a major role in object identification.

Supervised learning

Supervised learning is the most expensive and highly difficult of the three. The main reason behind this notion is that it requires a human intervention while assigning labels to classes which is not possible in large datasets. Though the work flow mimics the techniques followed in AI processes, it is time consuming. It is also called inductive learning in ML. Supervised learning becomes expensive when different data distributions, different outputs and different feature spaces occur as in heterogeneous object corpora. One of the most widely used supervised methods is maximum likelihood estimation. Here; the learning process could be simplified by prior assumptions. These kinds of assumptions about data introduce two approaches such as parametric and non-parametric.

Parametric models

The model that could summarize data based on underlying parameters is called a parametric model. Logistic regression and Naïve Bayes algorithms are parametric classifiers. Support vector machines, k-nearest neighbor, rule induction, decision trees and neural networks are non- parametric classifiers.

Naive Bayes Identifier

These are probabilistic classifiers commonly used in ML. However, the Bayesian classifiers are statistical and also possess learning ability. Multinomial model is used by Naïve Bayes for large datasets.

The performance could be enhanced by searching the dependencies among attributes. It is mainly used in data pre-processing applications due to ease of computation. Bayesian reasoning and probability inference are employed in predicting the target class. Attributes play an important role in classification. Therefore, assigning different weight values to attributes can potentially improve the performance.

Though these feature weighting techniques come with some defects like, inadequate improvement to performance, compromised simplicity and increased execution time of models, it acts to reduce the computational cost of the data model. Also, Naïve Bayes approach could represent arbitrary attribute dependencies.

Although, learning an optimal Bayesian network from high-dimensional object data increases time complexity. So, a structure extended multi nominal Naive Bayes classifier is applied to improve the attribute independence assumption by averaging all the weighted one-dependence multinomial estimators is suggested[2].

The performance of Naïve Bayes depends on the accuracy of the estimated conditional probability terms. It is hard to accurately estimate these terms when the training data is scarce.

Logistic regression

Logistic Regression in supervised learning, selecting the best subjects to be labeled to achieve good classification, is an opportunity to reduce temporal costs. Active learning is employed to find the best subjects to label in ML models, which is a growing field of research in object mining. It has proven to minimize the generalization error of models. Auto adapting regularization parameters and applying a penalized logic regression based active learning to multi-class problems is suggested for future research. Linear classifiers are good for large and high-dimensional datasets. The automatic object categorization is the process of assigning, one or more objectual documents to pre- defined categories based on its contents. However, it encounters a problem when the number of features exceeds the number of observations.

Non parametric models

The model that could not summarize data based on underlying parameters is called a non-parametric model. Support vector machines, k-nearest neighbor, rule induction, decision trees and neural net- works are mostly non-parametric classifiers.

Support vector machine

The Support Vector Machine (SVM) algorithm is one of the supervised machine learning algorithms that is employed for various classification problems. It has its applications in credit risk analysis, medical diagnosis, object categorization, and information extraction. SVMs are particularly suitable for high dimensional data. There are so many reasons supporting this claim. Specifically, the complexity of the classifiers depends on the number of support vectors instead of data dimensions, they produce the same hyper plane for repeated training sets, and they have better generalization abilities. SVMs also perform with the same accuracy even when the data is sparse.

Decision trees

Decision trees are highly comprehensible models when compared to neural nets. These work in a sequence, to test a decision against a particular threshold value among the available values. Testing happens according to certain logical rules similar to the concept of weights of neural networks. The tree growth phase partitions the training set and the pruning phase generalizes data over it. Fuzzy ID3 is another popular variant that incorporates the fuzziness of attributes into decision rules.

Decision trees have always been a problem with high dimensional data. To solve this problem, cluster trees are suggested. Streaming data is another challenge in the data processing arena. The space to accommodate such data and speed required to handle the same are two lingering issues in high speed data. Incremental decision trees are best fit for data streams as they have the ability to stabilize according to the accumulating data. It uses multiple attributes for trainable functions. An evolving fuzzy min-max decision tree learning algorithm is recommended in this direction for future researchers. It splits non-linearly to produce shallow trees that increase precision.

Though, decision trees work well for data with few highly relevant attributes, the computational complexity increases with increased complexity among relationships. Despite all the capabilities of these trees mentioned above, the ordinary end user may still struggle to understand the background details that led to a particular decision in a classification problem.

Rule induction

Classification of free object with minimal label description is a major problem in object categorization. A rule-based framework of lexical syntactic patterns is chosen as classification features that reduces common classification errors. In this approach, the performance is measured using a metric called sensitivity analysis. It optimizes the

number of rules that support efficient categorization. The rules are dependent on the lexicon entries which further describe the domain of documents under consideration; therefore, the categorization is more effective.

RIPPER is another famous rule induction technique. The learning order for the framed rules is mandatory for efficient classification, as a random order of rules will result in errors. Rule order is optimized using ant colony algorithm on the decision list. The decision list is mostly in the form of 'if, then and else if' structure. Simulated annealing, genetic algorithm and particle swarm optimization are other rule order optimization techniques widely followed. Some of the major pitfalls in this technique are the nature of rules being dependent on previously generated rules and rule learning occurs sequentially, further delaying the learning process for a new class. Selecting the best routing scheme for ordering the rules is another good research direction.

K-Nearest Neighbor

K-Nearest Neighbor (k-NN) works on the principle of closest training samples, those data points that are close to each other belong to one particular class, commonly called instance-based learning. Though it is robust for noisy data, deciding the value of k is complicated. Computational complexity further increases with increase in dimensionality. To reduce the cost of computing k value, Tree based k-NN is used. It reduces search scope through better traversing techniques. Some distributed techniques like Map Reduce are also integrated with k-NN to reduce memory constraints in large scale data. An open source spark package is particularly built for handling distributed datasets for k-NN classification.

Spark supports in-memory operations, cloud integration and also streaming algorithms. In the future, missing value imputation, multi-view approaches for multiple features, instance selection techniques can be tried with spark-based k-NN by using semi-supervised learning approach. k-NNs are also specificity-oriented learning algorithms, where no data models are derived explicitly and classification decisions are formulated locally. By adjusting the induction bias of k-NNs the class imbalance problem of datasets can be addressed through rare class modeling, which is major ad- vantage of k-NNs especially when it is a classification task.

Some of the other existing learning strategies for this problem are, re-sampling, cost-sensitive learning and learning algorithm-specific approaches. The extension of this work could be carried out for multiple rare class situations and rank instances based on posterior probability of each class. k-NNs are also most popular for classifying instances based on the conobject of data points through majority voting. This method is highly suitable for small datasets.

Artificial neural networks

Artificial neural networks (ANNs) work in the same way as human brain in arriving at a decision. Swarm intelligence and evolution algorithm are used to generalize a neural network model. It works on the virtue of learning and evolution with minimal or no human intervention. For data classification, competitive co-evolution algorithm based neural network model is suggested. Radial Basis Function is the ANN component as it employs faster learning algorithms. It has a compact network architecture that increases classification accuracy. Also, evolutionary algorithms have a tendency to perform well in dynamic environments by learning rules on the fly and highly adaptive of 'fuzzy' characteristics.

Neural networks are also popular among cases where a hierarchical multi-label classification approach is required. This kind of classification is complex as each sample may belong to more than one class and predictions of one level is fed as inputs to next level to make a final decision. Also in a similar setup, linear regression could be used for

feature selection in an ensemble boosted classifier. Neural network forms the base of the ensemble with the help of composite stumps.

The ANNs have good application value, development potential and it is also not necessary to train the individual binary classifiers for multi class problems therefore they form better base classifiers in an ensemble approach.

Unsupervised learning

Unsupervised learning is a type of ML algorithm where, inferences are drawn from the data by clustering data into different clusters without labeled responses (expected outcomes). In other words, no training data is provided to the system. It appears complex initially, but when more data is fed into the model, the algorithm refines itself to efficiency. Principal component analysis, clustering and self- organizing maps are frequently used in unsupervised learning. In many scenarios clustering is the same as unsupervised learning. Many times, expert knowledge required to label the samples is either non-existent or inadequate. In such case, self-organizing maps and correlation coefficient are used to cluster the documents and use it to label the documents for further classification. It eliminates the curse of dimensionality and expert intervention as well. This kind of hybrid model is more suitable for high volume data.

Statistical cluster analysis could be used for feature extraction in high dimensional data, as they are iterative in facilitating periodical updates, given the volume of data. Clustering techniques also reduce the time and cost complexity of complicated pre-processing procedures [4]. Query type classification is one more interesting direction, considering the categories of search queries and labeling them as navigational, informational etc. [5]

Transactional query classification is seen as a problem of unsupervised learning approach [6] Transaction is what a user executes after a search engine returns the queried da- ta. These queries could be converted to patterns to derive knowledge about the information need behind the queries. Form clicks help to generalize the queries based on the information contained in the forms. In the future, the web forms can also be used to optimize search engine performance by ranking the search results.

Many of the latest ML tools have built in support for parallelizable algorithms and automatic tuning options. However, exchanging confidential data in a big data platform is still a challenge. Data locality property plays a major role in such situations. One area of caution is, being solely dependent on the ML algorithms as it may lead to spurious relationships therefore, it is always suggested that a minimal human intervention is required. Efficiency of iterations is also primal for effective computational ability of these algorithms.

In document clustering, number of data points, their dimensionality and number of clusters would increase with time, so the algorithms should have enough room for expansion in such cases. Filtering untrustworthy data from data sources is an interesting option for future researchers in such cases. Some of the famous unsupervised learning algorithms are, anomaly detection, Hebbian learning, expectation maximization algorithm, principal component analysis, independent component analysis, non-negative matrix factorization, singular value decomposition and also those mentioned in Figure 1.

Semi-supervised learning (SSL)

Semi-supervised learning is a combination of supervised and unsupervised learning techniques. This type of learning employs small amount of labeled data and large amount of unlabeled data for training. The labels are assigned by combining labeled and unlabeled instances, as unlabeled data mitigate the effect of insufficient labeled data on classifier accuracy. Some of the SSL techniques include, self- training or self-teaching or

bootstrapping, co-training, transductive SVMs, generative models and graph-based methods

Vector space models are mostly used in language processing problems to address natural language semantics that supposes words in similar conobjects have similar meanings. Meaning values are calculated according to the Helmholtz principle. This model is non-iterative but effective in augmenting the efficiency of classifier. The system can be combined with semantic kernels that smooth document term vectors using term to term semantic relations. Finding out more approaches to extract the information from the conobject of a class could be tried in the future.

Traditional object identification approaches become null when there is no labeled data for a particular class of the dataset, for example, the labeled data is only available for positive samples and not for negative samples. A semi-supervised algorithm based on tolerance roughest and ensemble learning is recommended for the same. The unavailable class is extracted approximately from the dataset and set as the labeled sample. The ensemble classifier iteratively builds the margin between positive and negative classes to further approximate negative data, since negative data is mixed with the positive data. Therefore, without the need for training samples, classification is achieved through a hybrid approach. It eliminates the cost of hand labeling data, especially in big data.

The application of semi-supervised algorithms is highly useful in information filtering requirements. The role of semi-supervised algorithms in multi-label hierarchical classification is an area where there is still a need for more exploration. Self-training along with semi-supervised classifier is recommended for multi-label hierarchical classification. It has also proven a better way to achieve automatic label attribution.

Table1. Summary of various object identifaction techniques

Method	Advantages	Disadvantages	Applications
Logistic Regression	Simple parameter estimation, works well for categorical predictions.	Requires large sample size, not suitable for non-linear problems, vulnerable to over-confidence.	Financial forecasting, Software cost prediction, software effort prediction software quality assurance, Crime data mining
Naïve Bayes	Fast classifier, converges earlier than discriminative models like logistic regression, requires less training, applies for both binary and multi-class problems	Interactions between the features cannot be achieved. The probabilities calculated are not mathematically accurate, but relative probabilities.	To mark email as spam/ham, classify articles based on content, sentiment/emotion analysis.
SVM	Regularization parameter avoids over fitting. Kernel engineering helps to incorporate expert knowledge.	Selecting the best kernel and time consumed for training and testing.	Good for biological datasets, hyperobject categorization, etc.,
Decision Trees	Simple to understand after providing explanation. Insights based on expert knowledge and dynamic.	Not suitable for multilevel categorical variables, biased information gain, complex for uncertain and multiple valued attributes.	Marketing data and customer intelligence,

Method	Advantages	Disadvantages	Applications
Rule Induction	Optimized rules are built based on lexical patterns of the domain	Inter-dependency among Rules and sequential rule learning slows learning process for new class.	Healthcare systems
K-NN	Simpler implementation, Flexible feature selection, good for multi- class problem	Searching nearest neighbors and estimating optimal *k* value	Recommender Systems
Artificial Neural Networks	Easier to use, approximates any kind of function, and almost matches human brain	Requires large training and test data, much of the operations are hidden and difficult to increase accuracy.	Sales forecast, data validation, risk management and target marketing
K- Means	Easy to implement, faster than hierarchical clustering and easy to interpret results.	Not good for global clusters and sensitive to outliers	Customer service segmentation, health care, fraud detection and Segmentation,
Hebbian Algorithm	Suitable for multi-class models in neural net-works. Easy to interpret layer-wise operations.	It could take only orthogonal inputs that are not correlated.	Suitable for Image and Speech recognition in artificial intelligence models.
Anomaly Detection	Interdependency between variables and pre- diction is clearly encoded, can integrate both historical information and current data	Difficulty in framing rules, sometimes outliers occur almost similar to original patterns.	Fraud detection, faults reporting, healthcare systems and networks
Expectation Maximization	Better suitable for heterogeneous datasets and simple to implement	It takes longer duration to converge	Image reconstruction, Probabilistic conobject free grammars and risk management in item response theory.
Singular Value Decomposition (SVD)	Robust to numerical errors, Reduces data dimensionality	Data has to be de- trended before applying SVD and it must contain outliers / anomalies.	Digital signal and image processing applications. Recommender systems to predict ratings.

3. DISCUSSIONS

In general, object identification techniques form the basis for any knowledge discovery process. As they provide formal structure to raw data. Some of the major issues in object identification methods are pre- processing to remove tags, stop words, feature extraction to remove non-informative terms, storage, access, parameter estimation, data imbalance, overfitting, etc.

Based on the available literature, it is known that different kinds of classifiers exist. Therefore, Identifying the optimal classifier, performance boosting for large datasets and handling large taxonomies in heterogeneous data are some other issues encountered while building a data model.

Extracting deep meaning or concepts from documents is difficult in data mining procedures. The semantic techniques face more issues in natural language processing scenarios especially for automation. This is mainly due to the problem of ambiguity in natural languages. The issues like Polysemy (one word-multiple meanings) and synonymy (multiple words-similar meaning) are two prominent issues in object mining. The presence of heterogeneous components in object documents like, emails, multilingual objects, abbreviations, slangs, SMS codes further challenge the existing object mining tools, as each require a different algorithm to be sorted.

Mitigating data breach in data storage facilities is another important requirement in object analytics. Though it's a matter of data security, the need for object analytics applications to accommodate security operations has been found to be rising.

4. CONCLUSION

Based on this literature review, various object identification techniques have been identified with their strengths, possibilities and weaknesses in extracting knowledge from data. At this stage, it is vital to realize the problems present in object identification techniques, so that judging various classifiers would be easier.

However, based on the literature, semi-supervised object identification is gaining importance in object mining due to its classification efficiency. It reduces temporal costs. Some of the other crucial issues are, performance boosting, handling large taxonomies, feature selection, document zones and data imbalance.

It is also interesting to infer that it is still impractical to prescribe one particular classifier for a particular problem. Nevertheless, the number of 'trial and errors' to select the best classifier could be minimized based on the information provided in this study. Simpler yet powerful algorithms for parameter optimization and streaming data processing are other areas to be explored by researchers in future.

REFERENCES

[1] *Ahmad, S., Lavin, A., Purdy, S., & Agha, Z. (2017). Unsupervised real-time anomaly detection for streaming data. Neurocomputing, 262(1), 134-147. https://doi.org/10.1016/j.neucom.2017.04.070*

[2] *Aliwy, A. H., & Ameer, E. (2017). Comparative study of five object identification algorithms with their improvements. International Journal of Applied Engineering Research, 12, 4309-4319.*

[3] *Allahyari, M., Pouriyeh, S. A., Assefi, M., Safaei, S., Trippe, E. D., Gutierrez, J. B., &Kochut, K. J. (2017). A brief survey of object mining: classification, clustering and extraction techniques.*

[4] *Altınel, B., & Ganiz, M. C. (2016). A new hybrid semi-supervised algorithm for object identification with class- based semantics. Knowledge-Based Systems, 108, 50–64. https://doi.org/10.1016/j.knosys.2016.06.021*

[5] *Altınel, B., Ganiz, M. C., &Diri, B. (2015). A corpus-based semantic kernel for object identification by using meaning values of terms. Engineering Applications of Artificial Intelligence, 43, 54–66. https://doi.org/10.1016/j.engappai.2015.03.015*

[6] *An, Y., Tang, X., & Xie, B. (2017). Sentiment analysis for short Chinese object based on character-level methods. Proceedings of the 9th international conference on knowledge and smart technology (KST). IEEE. Chonburi. Thailand. https://doi.org/10.1109/KST.2017.7886093*

[7] *Arar, O. F., & Ayan, K. (2017). A feature dependent Naive Bayes approach and its application to the software defect prediction problem. Applied Soft Computing, 59, 197-209. https://doi.org/10.1016/j.asoc.2017.05.043*

[8] *Asadi, S., &Shahrabi, J. (2016). ACORI: A novel ACO algorithm for rule induction. Knowledge-Based Systems,97,174-187. https://doi.org/10.1016/j.knosys.2016.01.005*

[9] *Asadi, S., & Shahrabi, J. (2017). Complexity-based parallel rule induction for multiclass classification. Information Sciences, 380, 53–73. https://doi.org/10.1016/j.ins.2016.10.047*

[10] *Dr.R.P.Singh, P.Karunakar 'Importance, Applications and Challenging Routing Requirements in VANETs' ISSN: 2455-3085 (Online) Issue-05 RESEARCH REVIEW International Journal of Multidisciplinary. May 2019*

[11] *Aseervatham, S., Antoniadis, A., Gaussier, E., Burlet, M., &Denneulin, Y. (2011). A sparse version of the ridge logistic regression for large-scale object categorization. Pattern Recognition Letters, 32, 101–106 https://doi.org/10.1016/j.patrec.2010.09.023*

[12] *Brindha, S., Sukumaran, S., & Prabha, K. (2016). A survey on classification techniques for object mining. Proceed- ings of the 3rd International Conference on Advanced Computing and Communication Systems. IEEE. Coimbatore, In- dia. https://doi.org/10.1109/ICACCS.2016.7586371*

[13] *Dr.R.P.Singh, P.Karunakar 'A comparative study on position based routing over topology based routing concerning the position of vehicles in VANET', AIRO International Research Journal Volume XV, ISSN: 2320-3714 April, 2018*

[14] *Brownlee, J. (2016). Parametric and non-parametric machine learning algorithms. Retrieved on March 14 from http://machinelearningmastery.com/parametric-and-nonparametric-machine-learning-algorithmsCerchiello, P., & Giudici, P. (2012). Non parametric statistical models for on-line object identification. Advanced Data Analysis and Classification, 6, 277–288. https://doi.org/10.1007/s11634-012-0122-2*

[15] *Cerri, R., Barros, R. C., & Carvalho, A. (2014). Hierarchical multi-label classification using local neural net- works. Journal of Computer and System Sciences, 80, 39–56. https://doi.org/10.1016/j.jcss.2013.03.007*

[16] *Demidova, L., Klyueva, I., Sokolova, Y., Stepanov, N., &Tyart, N. (2017). Intellectual approaches to improvement of the classification decisions quality on the base of the SVM classifier. Procedia Computer Science, 103, 222-230. https://doi.org/10.1016/j.procs.2017.01.070*

[17] *Merinopoulou, E., Ramagopalan, S., Malcolm, B., & Cox, A. (2017). RM3 - Methods for extracting treatment patterns for renal cell carcinoma (RCC) from social media (SM) forums using natural language processing (NLP) and machine learning (ML). Value in Health, 20(9), A402. https://doi.org/10.1016/j.jval.2017.08.021*

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