MALWARE DETECTION SYSTEM USING MACHINE LEARNING

Project report submitted in partial fulfillment of the requirement for the degree of
Bachelor of Technology

In
Computer Science and Engineering

By

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Under the supervision of

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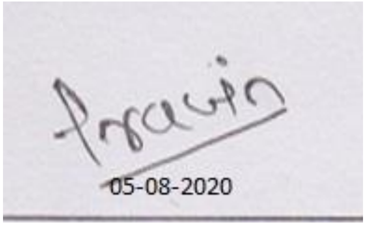
Candidate's Declaration

We hereby declare that the work presented in this report entitled **"MALWARE DETECTION SYSTEM USING MACHINE LEARNING"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is authentic record of our own work carried out over a period from August 2019 to December 2019 under the supervision of **Mr.Praveen Modi**(Assistant Professor), Computer Science and Engineering and information technology.

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Rajat Kumar Puri,161269

This is to certify that the above statement made by the candidate is true to the best of my knowledge.



Mr. Praveen Modi
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Computer Science and Engineering/ Information Technology

Dated:

Acknowledgement

We would like to express our special thanks of gratitude to our teacher and mentor **Mr. Praveen Modi** who gave us the great opportunity to do the project on the topic **MALWARE DETECTION SYSTEMUSING MACHINELEARNING**, which also helped us in doing a lot of Research and we came to know about so many new things. We are really thankful to him. Secondly, we would also like to thank Lab assistants who helped us a lot in finalizing this project within the limited time frame.

Rajat Kumar Puri, 161269

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List of Abbreviation

- ML- Machine learning
- LR- Logistic Regression
- DL- Deep Learning
- KNN- K nearest neighbors
- SVM- Support Vector Machines
- AI- Artificial Intelligence
- CSV- Comma Separated Values
- CNN- Convolutional neural network
- OS - Operating Systems

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Abstract

Malware is risky these day and age for those web clients. It can compromise the host pc. By polymorphic malware we mean the one that changes its signature regularly to fool detection. We can define malware as piece of code or malicious code that harm the data or device. here, we made a alternative of virus detection by using machine learning techniques and created a dataset and used machine learning algorithms for categorizing the file into malicious or not and compared their results to determine the best algorithm suiting for our dataset.

Chapter-1

INTRODUCTION

As the internet users increasing day by day Malware become the major problem in the field of internet. We can define the malware as a malicious code that can harm the file or software in the computer.

As the technology will increasing day by day the types of malwares also increasing and become more powerful from the previous ones. According to a research around 3900 different malware objects were identified. Expertise plays a important role for handling the malware as the malware are polymorphic now a days so there is a need of expert algorithms that will detect the malware accurately.

Now days it is very difficult to handle the malware for most of the companies because the samples of the malware increased very rapidly. There are around four lakhs malware samples so protection from the malware become the major task because due to malware a big amount of data will lost that is beneficial for us.

There are many ways to deal with the malware. The techniques are static analyses, dynamic analyses, and at last machine learning for detecting malware. In our project we focus on the last techniques. we use different types of algorithms for malware detection such as KNN ,decision tree ,Logistic Regression etc. and analyze the result of all the algorithms at the last.

(1.1) Terminologies

1. **Machine Learning-** These algorithms are a type of algorithms that makes the system or the software application to be smart enough to be able to more accurate without being explicitly programmed and can predict outcomes. The main idea behind these types of algorithms is that it receives input data in the form of text or images and the system or the model is trained with the statistical inputs to identify or predict the output and even updated the outputs as new data becomes available. It requires the algorithm to search through the dataset and look for patterns or similarities and manipulating or adjusting the system accordingly.

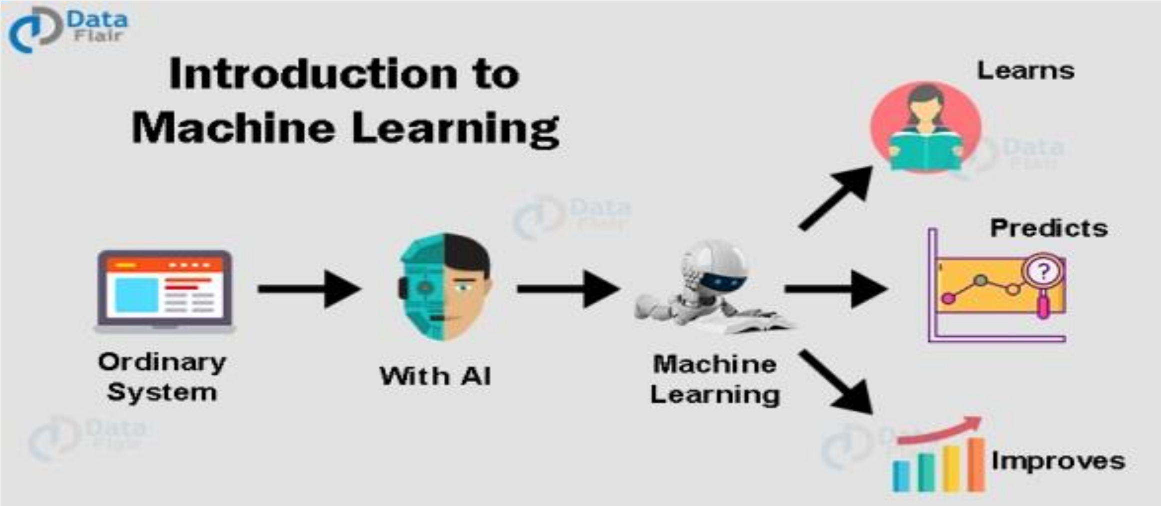

Fig 1.1: Introduction to ML [**1**]

2. **How ML works -** The procedure of machine learning begins with the assortment of information or perceptions as the info dataset which can be as pictures, content, tables and so on. Further, numerous predefined AI calculations are applied to the info information which either characterize the information into gatherings or distinguishes designs among the dataset to anticipate the yield and give fitting outcomes.

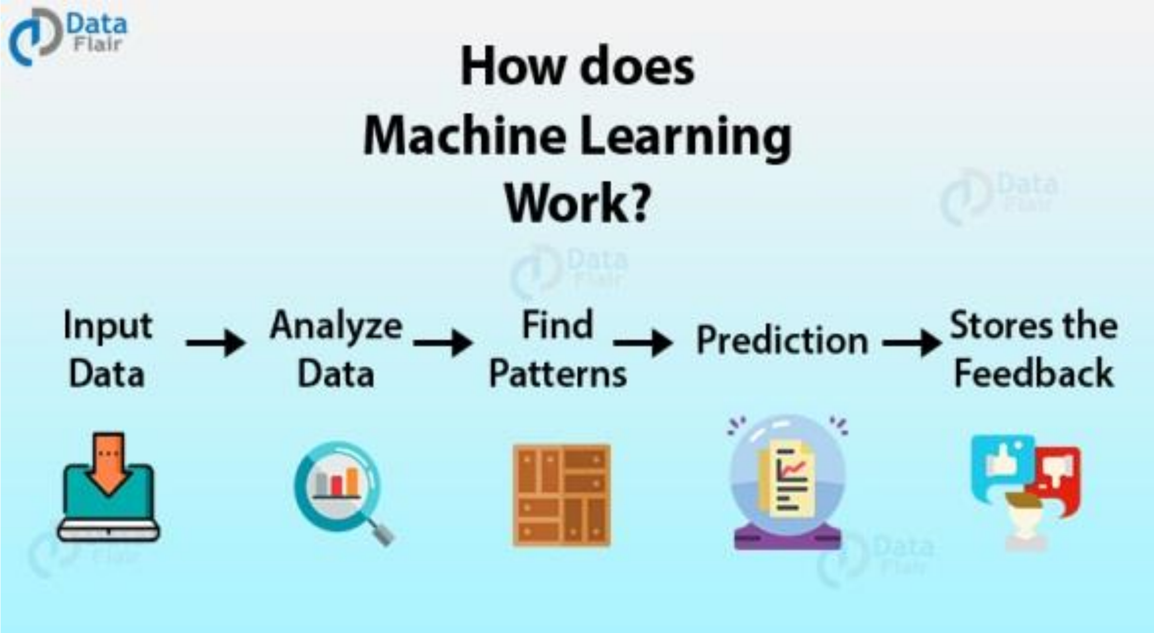

Fig 1.2: ML algorithm workflow [**1**]

3. **Types of machine learning**
   - **Supervised learning-**here algorithms works for a dataset that is as of now being prepared by past yields and results of the past utilizing marked information to foresee the result of the new information. It can also analyze the data and the outcome and compare it with the previously stored data to find errors and to be able to modify and train the model accordingly.

   - **Unsupervised learning-** it is different from the supervised learning as it is used to calculate result where the target value is not provided and we have to make a prediction. The most form of unsupervised learning is cluster analysis which used to analyze hidden pattern and helps in maintaining the data into the groups.

   - **Semi supervised learning-**it is the mix of both learning's that discuss above for training the datasets and produce much productive and powerful clusters. the model uses both labeled and unlabelled data for the training and it mostly need a small quantity of labeled data and a relatively huge quantity of unlabelled data which are used simultaneously to train the model.
   - **Reinforcement learning-**basically it is a reward based learning in which the

model will interact with the environment by doing action and discovering error or rewards. We can say that in this model learns from its mistakes and maximize the performance.

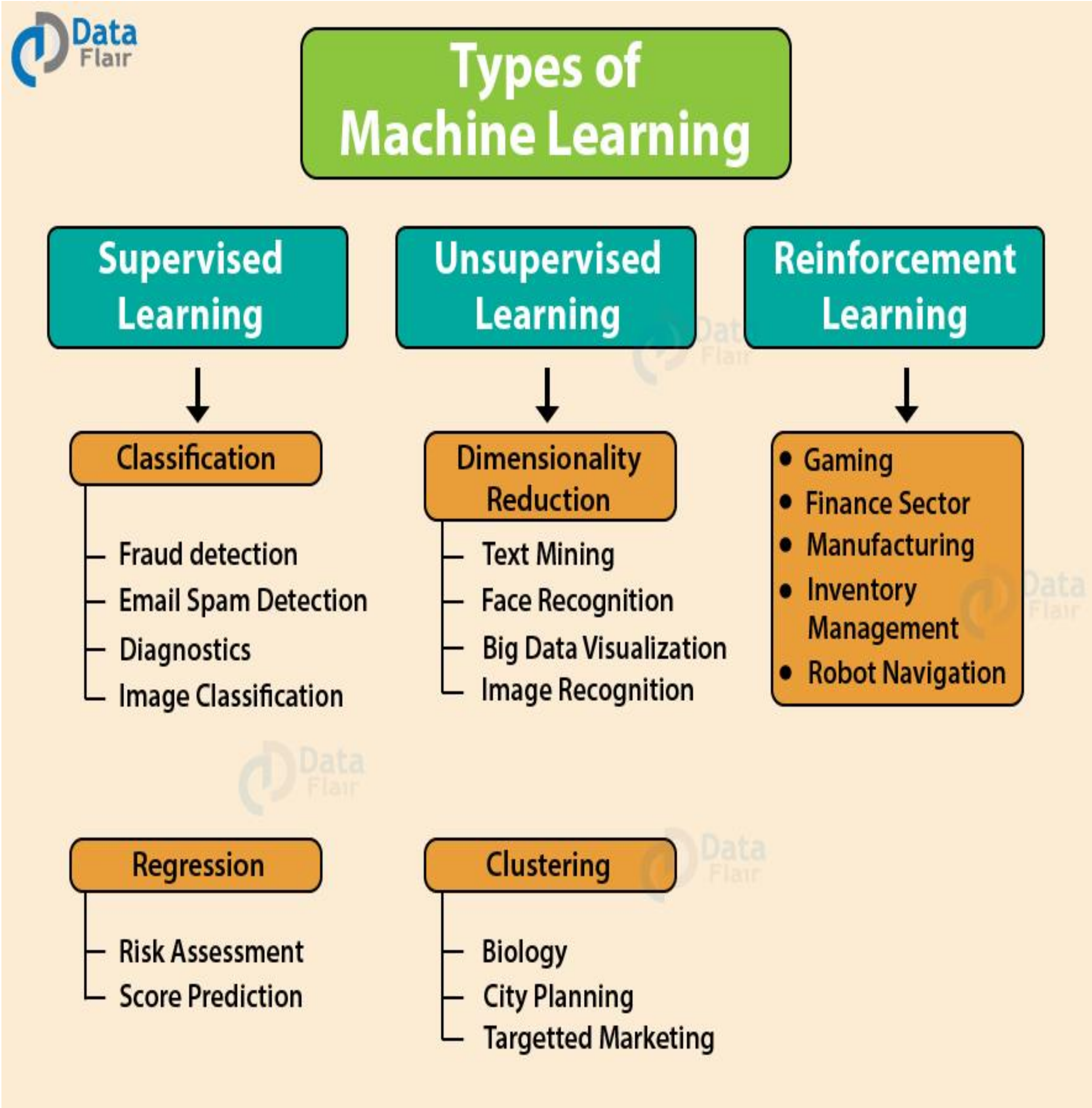

Fig 1.3: Types of machine learning [**1**]

4. **Interpretation of Performance Measures-** We can evaluate the performance in many ways. We can find the performance with the help of confusion matrix.

Actual		Predicted	
		Positive	Negative
	Positive	True Positive (TP)	False Negative (FN)
	Negative	False Positive (FP)	True Negative (TN)

Fig 1.4: Confusion Matrix [**2**]

Confusion matrix has four tables it is type of two way table as shown in the diagram. The 2 sections in the green are the true positive and crimson is true negative and the results which are correctly predicted. The other 2 sections are in crimson are wrong because these values are wrongly calculated and thus needs to be decreased. These 2 sections are called as false negative and false positive respectively and this happens when there is a contradiction between true class and the calculated class.

- **True Positive**–This is the value that is correctly calculated and is positive value which can be defined as the +ve value of true class and +ve value of calculated class. It is shown with TP.
- **True Negative** – This is the value which is correctly calculated but negative result which refers to the negation of true class and negation of calculated class. It is shown by TN.
- **False Positive**–This is the value which is wrongly calculated but is true in existence that is when we have true values of actual class but negation in calculated class.
- **False Negative** – This is the value which is calculated wrong and -ve in true class.

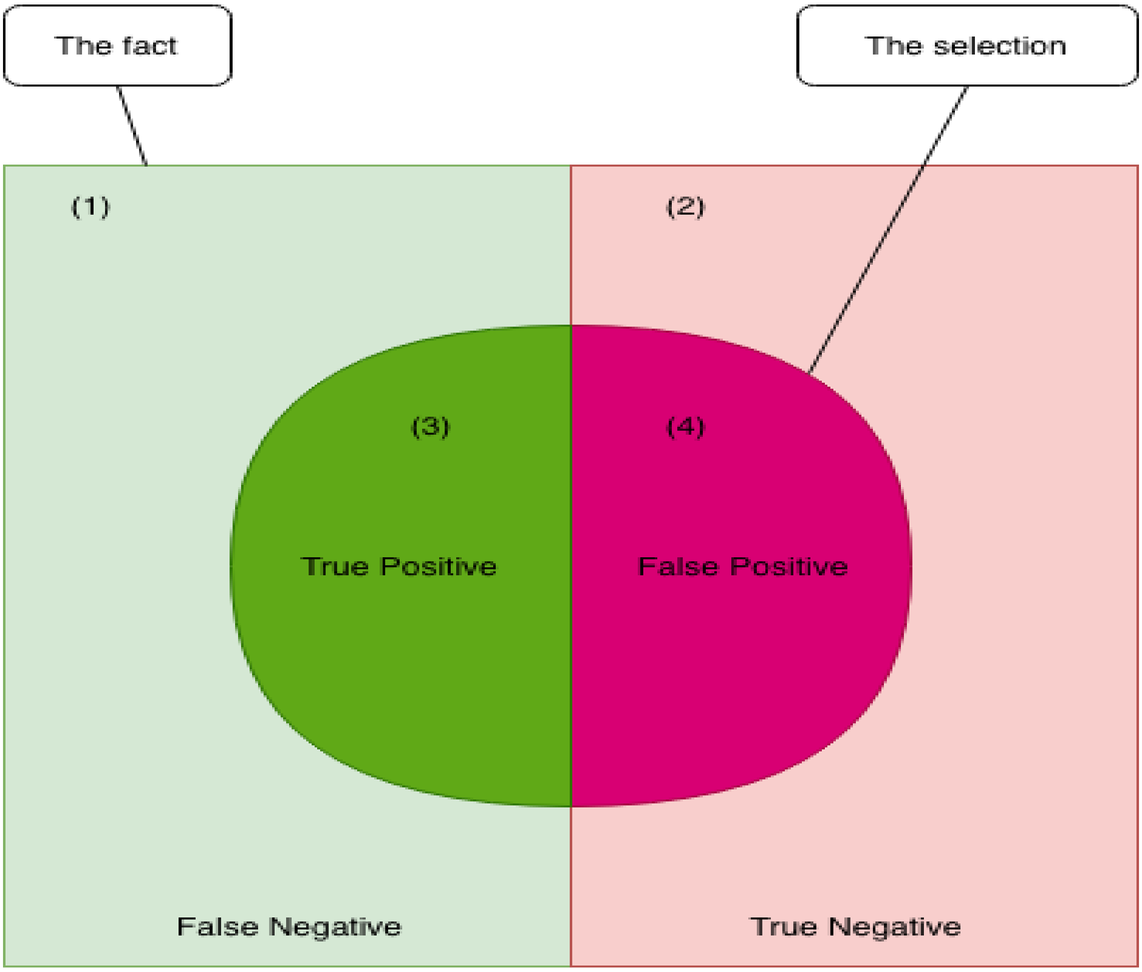

Fig 1.5: Pictorial representation of confusion matrix [**3**]

- **Accuracy** – Accuracy is the most common execution measurement and it is specifically a proportion of effectively calculated perception to the aggregate perceptions. Some might imagine that on the chances of high trueness, our model is good. Truly exactness a unique quantity yet just you have symmetrical data where estimations of FP and FN are relatively same. In this manner, you need to take a gander at different parameters to achieve the execution of your model. For our model, we have 0.982939 which equals to 98%.

Accuracy = TrueP+TrueN/TrueP+FalseP+FalseN+TrueN

- **Precision-**Precision is the ratio of accurately found positive perceptions to the aggregate calculated +ve perceptions .The inquiry that this acquired answer is of all travelers with name dasendure, what number of really endure? High precision shows with the low false positive rate.

Precision = TrueP/TrueP+FalseP

- **Recall (Sensitivity)** - The Recall actually calculates how much of the true Positives our model calculates through labeling it as true (True Positive). Applying the same knowledge, we know that the Recall should be the model metric we used to choose our best model when there is a high price associated with False Negative.

Recall = TrueP/TrueP+FalseN

- **F1Score-** It is the weighted normal of Precision with addition to Recall. Consequently, this score finds both FP and FN. Instinctively it isn't as right as exactness, yet F1 is normally more essential than precision, mainly on the off chance of odd class. Precision works good if FP , FN have comparable expense. On the off chance that the price of FP and FN are together dissimilar, it is good to take a gander at both Precision with Recall.

F1 Score = 2*(R * P) / (R + P)

(1.2) Problem Statement

With the development of innovation, the quantity of malware is likewise expanding step by step. Malware now are structured with transformation trademark which causes a huge development in number of the variety of malware (Ahmadi, M. et al., 2016). Not just that, with the assistance of robotized malware created apparatuses, beginner malware creator is currently ready to effortlessly produce another variety of malware (Lanzi, A. et al., 2010). With these developments in new malware, conventional mark based malware identification are demonstrated to be incapable against the huge variety of malware (Feng, Z. et al., 2015). Then again, AI strategies for malware recognition are demonstrated powerful against new malwares. Simultaneously, AI strategies for malware identification have a high false positive rate for identifying malware (Feng, Z. et al., 2015).So we have to achieve the false rate as low as possible with machine leaning Algorithms.

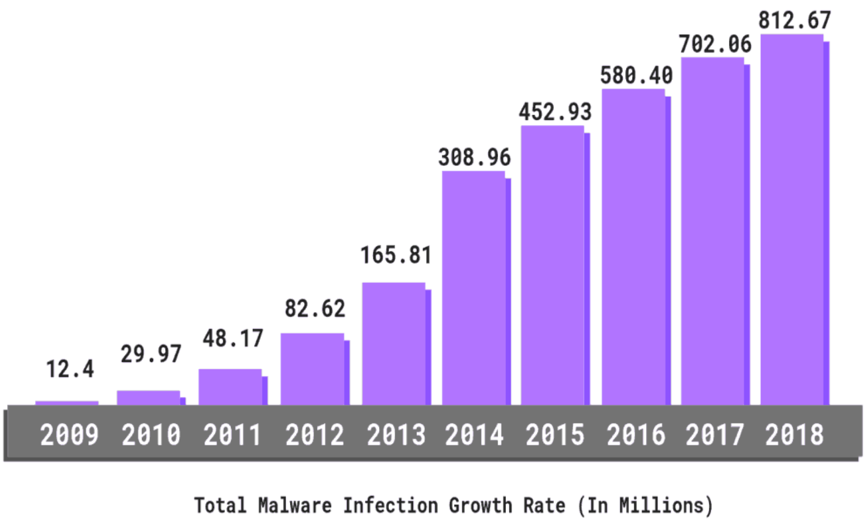

Fig 1.6: Graphical representation of total malware infection growth rate [**4**]

(1.3)Aims and Objectives

The aim of the project is to the purpose of this project is to get the best accuracy for malware detection and also to get the best algorithm which provides the result on this dataset.

Objectives-

- Download the dataset which contain both malicious and benign file and list them into CSVfile.

- Use the various ML algorithms and compare the algorithms on the behalf of parameters like accuracy, precision and reduce the FP rate.

- Use various methods such as feature extraction, feature scaling, to improve the accuracy and to avoid over fitting.

(1.4)Methodology

Malware detection is the most crucial step in securing the host computers. There are many machine learning algorithms that are important in the machine learning and we classified them into many techniques some of the examples are SVM, K-nearest neighbors clustering, Decision Trees etc. Our main aim is to find out whether a file contains malware or not.

We gathered the dataset from kaggle. As our problem statement comes under the category of classification. It is a single class classification in which a file is

1. Malicious
2. Benign

So our motive is to classify the following dataset into these classifications. Firstly we analyze the dataset. As there are so many columns in the dataset we use different techniques such as feature extraction, feature scaling etc. to avoid over fitting and to improve the accuracy of the project.

We can train our model in different ways. It depends how the dataset appeared after applying feature extraction and feature scaling techniques. we used

1. Decision Tree
2. XG Boost
3. KNN
4. Random Forest
5. Logistic regression

(1.5) Organization of Report

In Chapter 2, literature review, we study about two research paper. First of all there is a abstract of research paper then display some figure related to this and at last we write conclusion in which we saw the accuracy of the algorithms.

In Chapter 3,in this we write the system requirement so we can run all the algorithms and here we discuss all the libraries needed and why these libraries needed.

In Chapter 4, it is the algorithm part here we list all the algorithms we used in the project, so we can apply these algorithms in the project and get better results.

In Chapter 5,here we discuss about the dataset and the observation towards our result such as accuracy in all the algorithms.

InChapter6,here we compare the result of each algorithms without feature extraction and then with feature extraction and see which algorithm is best suited that is having high accuracy.

InChapter7, At last we concluded all we did in the project and more over we discuss the future work also such as we run the malware on the virtual environment.

Chapter-2

LITERATUREREVIEW

(2.1)EktaGandotra, DivyaBansal, SanjeevSofat "Malware analysis and classification: A survey, Journal of Information Security, 2014" [5]

The greatest danger on internet is the safety of the user pc they over and over again get attacked by a malicious code infected file. The malwares being planned by aggressors are polymorphic and changeable which can change their code as they engender. It has become very difficult to keep track of all these new malwares and provide the customer with protection against all these new types of attacks by traditional methods.

ML for recognizing Malwares – In this we use various types of algorithms such as SVM, Decision Tree, Random Forest, Naive Bayes and Clustering. The result that is obtained gave insight that the best machine learning algorithm is a J48 decision tree.

Dataset and Methodology-dataset is small about 220 malicious samples or 250 Benign samples with and without feature selection. They are using five different Classifiers. Names of the classifiers are SVM, KNN, J48 decision tree and SVM.

Result- the best machine learning algorithm is a J48 decision tree providing a recall of 96.01%, a FPR of 3.39%, a precision of 96.97%, and an accuracy of 97.2%.

Now a days with increasing population in the developed malwares it has possessed a great danger to various online resources like host connected to internet or the web servers, etc. Identifying malwares on the basis of their digital signature is not a very efficient approach we have used machine learning approach. Firstly we analyze the malware file size and signature and apply static approach and then we apply dynamic if the classification could not be performed. The techniques that are developed are not sufficient to rectify the problem of detecting and removing the malwares efficiently without much adverse effect and some better methods needs to be developed to solve this issue.

(2.2)Ivan Firdausi, Charles Lim "ANALYSIS OF VARIOUS MACHINE LEARNING TECHNIQUES USED FOR BEHAVIOR-BASED MALWARE DETECTION"[**6**]

The increasing amount of malware that are coming daily became a greatest computer threat. Manually correcting is no longer taken as effective and efficient or good as compared against the high increasing rate of malware. Therefore dynamic or automatic malware detection on the basis of behavior using ML techniques is taken to be the best in the market.

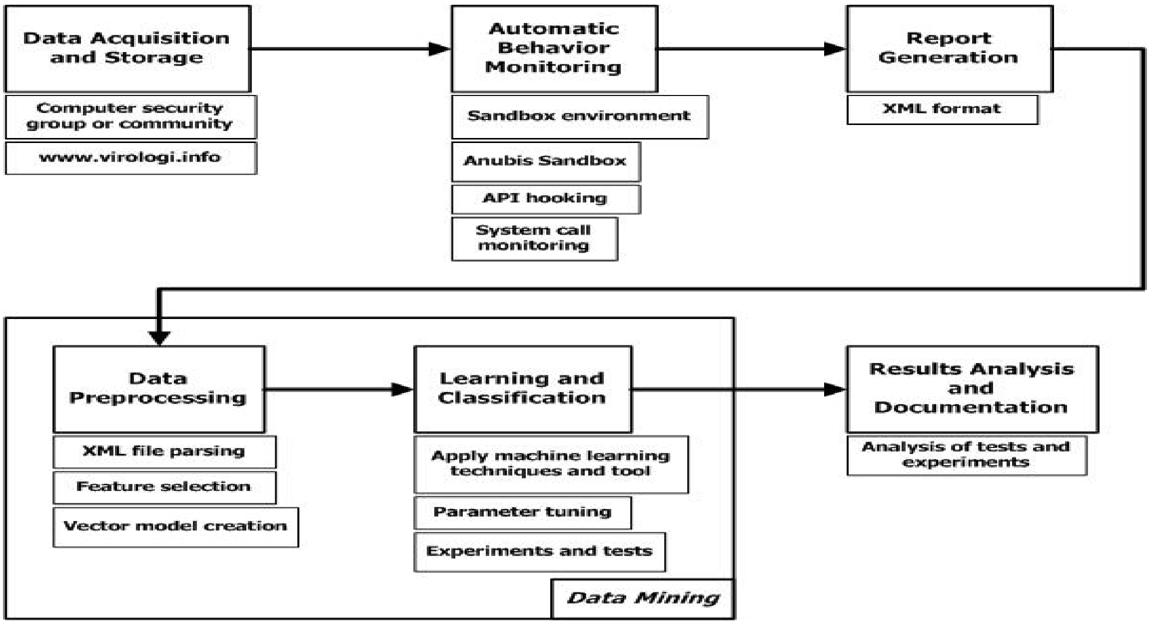

Fig 2.2 Overview of the research methodology [**6**]

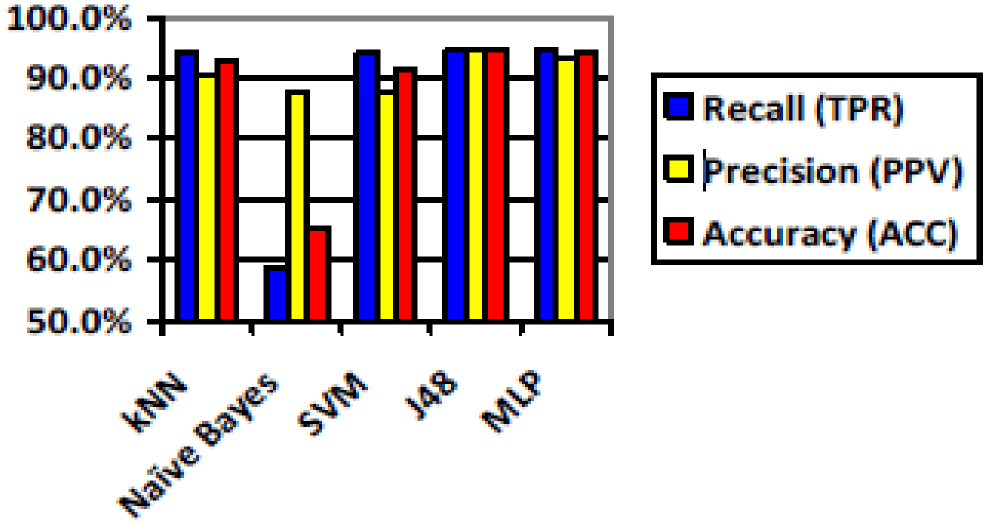

Fig 2.3 classifier performance comparison without feature selection [**6**]

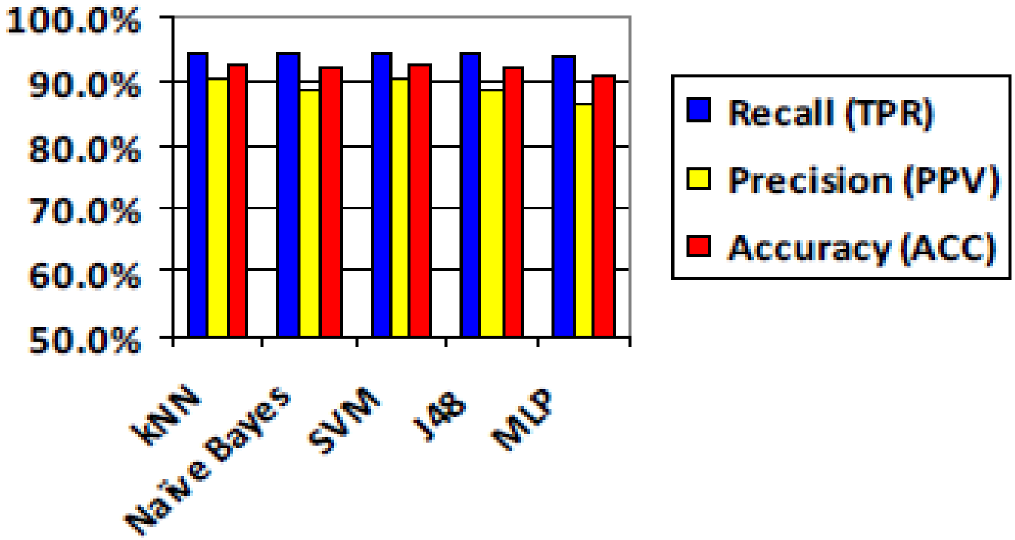

Fig 2.4 classifier performance comparison with feature selection [**6**]

we can be say that By adding feature selection, the features were decreased to a large amount such as attributes reduced from 5191 to 116 in binary weighted data set and the time taken for training and building the model got shorter at the expense of the performance depreciation slightly. In some cases, the performance of the project can also get hiked a little bit.The evaluation of five unique models was also presented. The overall best accuracy was achieved by the decision tree called J48 decision tree using frequency-weight and not using feature selection data set, with a TP rate of 94.6%, a FPR of 3.6%, a +ve predictive value of 96.76%, and a score of 98.02%. The examination of the tests and experimental reports concluded that this approach is very useful to find out malware.

Chapter-3
SYSTEM DESIGN

(3.1) System Requirements

Algorithms being implemented in this project requires some generic system for the processing of algorithms.

- Windows 10 (64-bit)
- ANACONDA
- Python
- 8 GBRAM
- Intel(R) Core(TM) i5-6200U CPU @ 2.50GHz

(3.2) Why Python

Python is a programming language with a huge group of spectators and it is exceptionally straightforward and can be effectively coherent. Moreover, python offers the assortment of bundles which makes the most scary calculations or ventures more straightforward. Python has libraries for pretty much every usable record for example - with working with pictures, working with content or working with audio records. In any event, when working with another OS, python is truly pliable. Python has a huge network which makes it simpler to look for help and tips and tricks.

(3.3) Why ANACONDA

ANACONDA is widely popular as it provides all the libraries pre-installed and make the user free from hassle of the otherwise installing all libraries. Approximately it has 100 packages which can be used for data science, machine learning or statistical analysis.

(3.4) SCIKIT LEARN

it is in python usually used for machine learning and create a lot of features for ML algorithms and in statistical modeling like regression, classification, clustering.

(3.5) PANDAS

It is software library offer a data structures and perform various operations like tables time series. It provides high-performance data manipulation and analysis tool using its powerful data structures. It used in various domains like finance, Analytics, Statistics etc.

Chapter-4
ALGORITHMS

This section contains of various machine learning algorithms which are to be used in the project and discussed-

Supervised learning

- **K-Nearest Neighbors-** This algorithm used for both for the regression tasks as well as classification tasks but for most of the time in classification problems. This algorithm quite easy in implementation and need very less computation time and therefore is widely used machine learning algorithm. K in this algorithm stands for the number of neighbors which are specified by the user. In this the mathematical formula used to measure the K-nearest neighbors of the data points and then depending on the classes to which these data points belong it makes the prediction of the output.

Distance Functions

Euclidean	$\sqrt{\sum_{i=1}^{k}(x_i - y_i)^2}$
Manhattan	$\sum_{i=1}^{k} \lvert x_i - y_i \rvert$
Minkowski	$\left(\sum_{i=1}^{k}(\lvert x_i - y_i \rvert)^q\right)^{1/q}$

- **Decision Trees-** This it is the type of algorithms in which we use tree data structure for the solution of the given problem. In this algorithm the terminal node stands for the any given class or category and the internal nodes between the root and the leaf are the nodes which define the attributes. The prediction that is made is based on some series of questions based on the features and upon reaching the terminal node by following the questions from root the final leaf node is the required class.

Formulation-

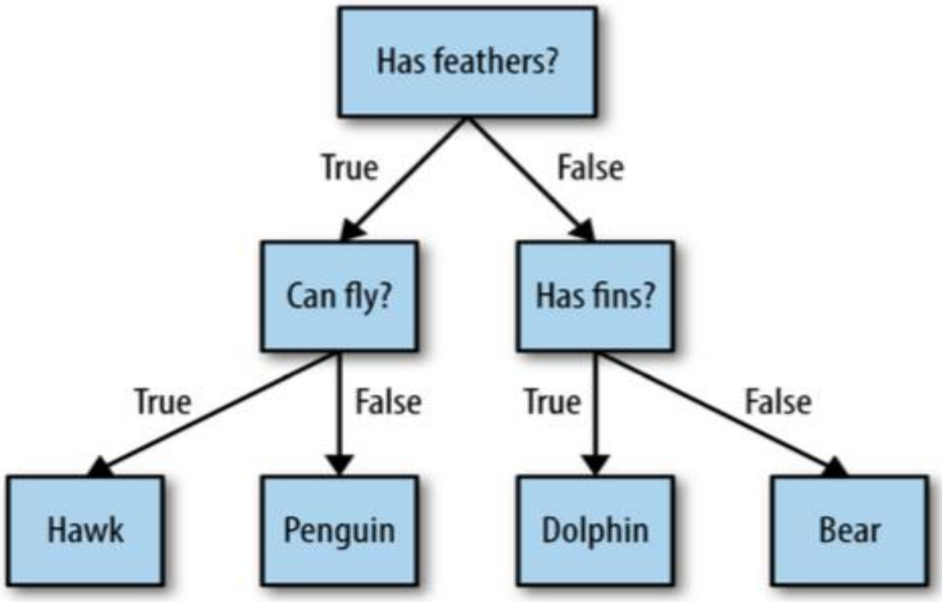

Fig 4.1 diagram of decision tree[7]

- **Random Forest**- Random forest belongs to the ensemble category of machine learning. In ensemble method several machine learning models are used to make a decision. In this algorithm several decision trees are created to make the classification or regression tasks. In this several decision trees are made and each of them is slightly different from the other this uniqueness is achieved by two methods firstly by not selecting all the data points in decision making instead using only some data points and then repeating some of them to make the count equal and the other method is not selecting all the features instead selecting only a subset of features to make different predictions and then taking average of all the decision trees. In this way the problem of over fitting which is in decision trees is also overcome. Here nestimators shows the number of decision trees to be made and maxfeatures shows the number of features to be selected for the subset.

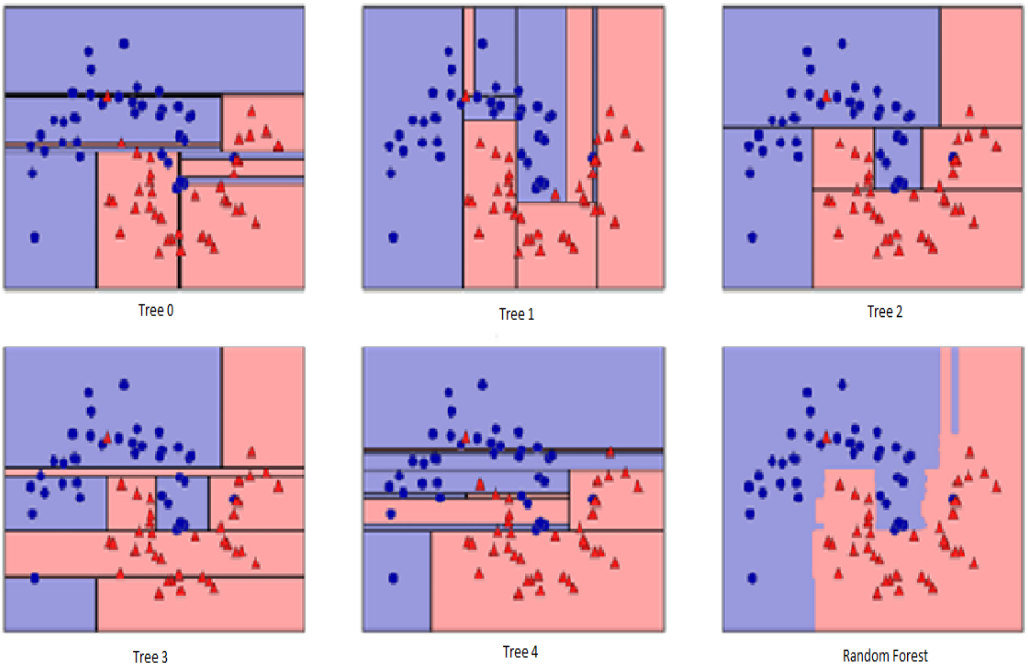

Fig4.2diagram of random forest

- **Support Vector Machines-** It is mostly applied for classification problems in this search data point is plotted in n dimensional space and n equals to number of features present and the value that each feature represents is the value of each coordinate. separate hyper plane is used to differ as a boundary for classes.we can also call it support vector network.it can solve both linear and non linear problems.

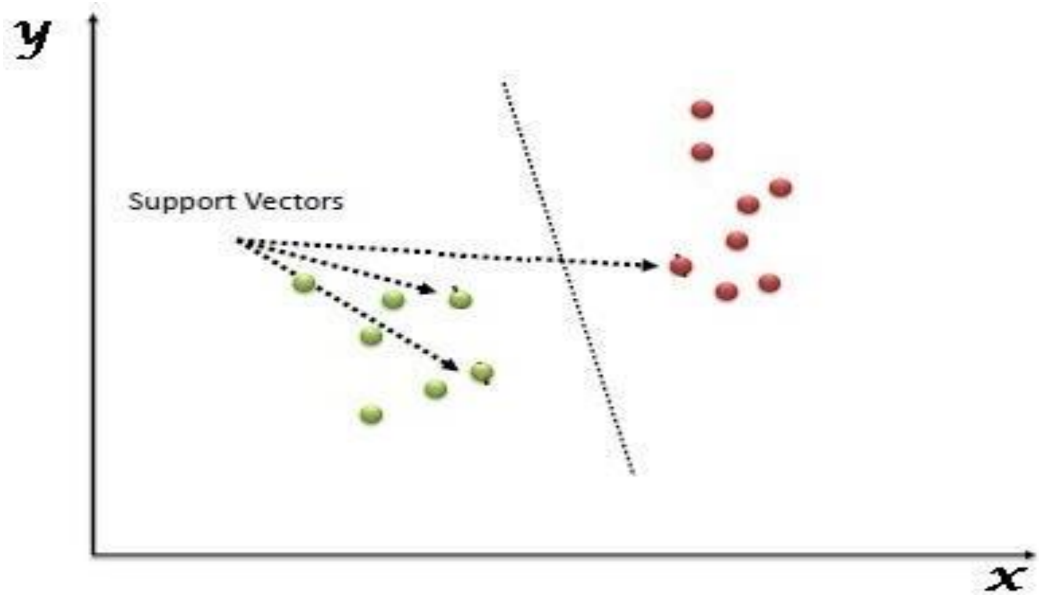

Fig 4.3: Pictorial representation of SVM [**8**]

- **XGBoost-** full form is extreme gradient boosting technique. It is ensemble machine learning technique which is an implementation of gradient boosted decision trees. In gradient boosted decision trees several decision trees are made and instead of randomly selecting the features the succeeding trees learn from the preceding trees to improve the accuracy of the algorithm, in order to achieve this the decision trees are mostly prepared shallow with depth of around 5 in order for easy interpretation it also has a learning rate which defines how much a tree will learn from its preceding tree. The height and learning rate parameters are mostly set low in order to achieve and to reduce over fitting to a large extent.

- **Naïve Bayes-** It is a classification technique based on Bayes theorem. It thinks that one feature is not in relation with other features. eg. We take an example of apple if it is red , round and has a diameter of around 3 inches. All these factoring individually contribute to the probability that it is an apple. Due to this property it is known as naïve. Bernoulli Naive Bayes Algorithm is used to binary classification problems. Gaussian Naïve Bayes used for normal classification problem but it is popular.

Formula of Bayes theorem used in Naïve Bayes

Likelihood Class Prior Probability

$$P(c|x) = \frac{P(c|x)P(c)}{P(x)}$$

Posterior Probability Predictor Prior Probability

$$P(c|X) = P(x_1|c) \times P(x_2|c) \times \ldots \times P(x_n|c) \times P(c)$$

- **Logistic Regression- -**.it is the simplest for applying to binary classification. in short LR take the features values and calculate the probability using sigmoid or softmax function.

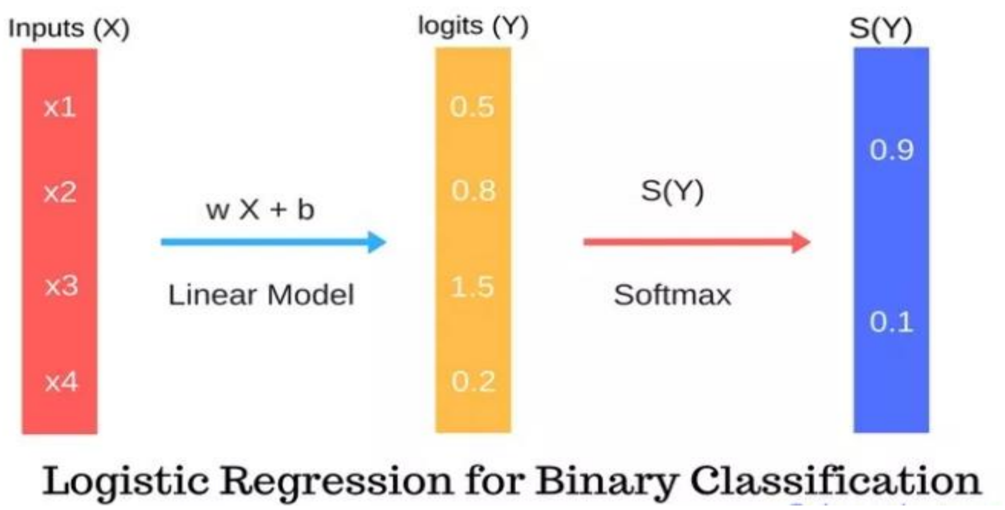

Fig 4.4: Pictorial representation of Logistic Regression

Algorithms	**Problem Type**	**Average predictive accuracy**	**Training speed**	**Prediction speed**
KNN	Either	Lower	Fast	Depend on (n)
Linear Regression	Regression	Lower	Fast	Fast
Logistic Regression	Classification	Lower	Fast	Fast
Naïve Bayes	Classification	Lower	Fast	Fast
Decision Trees	Either	Lower	Fast	Fast
Random Forest	Either	Higher	Slow	Moderate

Table 4.1: Difference between various ML Algorithms

Chapter-5

TEST PLAN

Here, we focused on working out our algorithms on the project to apply the machine learning algorithms and to carry out comparative analysis and store the results for further analysis. we have a dataset with 10539 rows and 57 columns.

Features:

'Machine','SizeOfOptionalHeader','Characteristics','MajorLinkerVersion', 'MinorLinkerVersion', 'SizeOfCode','SizeOfInitializedData', 'SizeOfUninitializedData''AddressOfEntryPoint', 'BaseOfCode', 'BaseOfData', 'ImageBase','SectionAlignment', 'FileAlignment', 'MajorOperatingSystemVersion','MinorOperatingSystemVersion','MajorImageVersion','MinorImageVersion','MajorSubsystemVersion','MinorSubsystemVersion', 'SizeOfImage','SizeOfHeaders', 'CheckSum', 'Subsystem', 'DllCharacteristics','SizeOfStackReserve', 'SizeOfStackCommit', 'SizeOfHeapReserve','SizeOfHeapCommit', 'LoaderFlags', 'NumberOfRvaAndSizes', 'SectionsNb', 'SectionsMeanEntropy', 'SectionsMinEntropy', 'SectionsMaxEntropy', 'SectionsMeanRawsize', 'SectionsMinRawsize', 'SectionMaxRawsize', 'SectionsMeanVirtualsize', 'SectionsMinVirtualsize', 'SectionMaxVirtualsize', 'ImportsNbDLL', 'ImportsNb', 'ImportsNbOrdinal','ExportNb','ResourcesNb','ResourcesMeanEntropy', 'ResourcesMinEntropy', 'ResourcesMaxEntropy', 'ResourcesMeanSize', 'ResourcesMinSize', 'ResourcesMaxSize', 'LoadConfigurationSize', 'VersionInformationSize', Activities Fri Nov 29, 10:43 PM

dataset - DataFrame

Index	Name	md5	Machine	eOfOptionalHea	Characteristics	ajorLinkerVersic	inorLinkerVersic	SizeOfCode	:eOfInitializedDa	:OfUninitializedD	ldressOfEntryPoi	E
0	Windows.Int…	09e83f1d1c9…	34404	240	8226	14	12	779776	253952	0	56256	40
1	hidserv.dll	3030f19c6a7…	34404	240	8226	14	12	21504	13312	0	22816	40
2	DmApiSetExt…	8271846f8f5…	34404	240	8226	14	12	33792	27648	0	32192	40
3	FSResizerSe…	5802b421556…	332	224	271	6	0	23552	164864	1024	12515	40
4	asc-setup.e…	8cb1fb45489…	332	224	33167	2	25	87040	71680	0	91076	40
5	PeerDistHtt…	ff42a597ecd…	34404	240	8226	14	12	38912	16384	0	38768	40
6	shutdownux.…	d38dfef6c48…	34404	240	8226	14	12	104448	176640	0	100768	40
7	OnlineArmor…	d69d127fb52…	332	224	33167	2	25	37888	17920	0	39960	40
8	tapiperf.dll	383af082659…	34404	240	8226	14	12	5120	7680	0	6208	40
9	tscfgwmi.dll	5d6c8631b0b…	34404	240	8226	14	12	130048	77312	0	127776	40
10	mcupdate_Au…	365dd269e50…	34404	240	34	14	12	4608	91136	0	110608	40
11	dafpos.dll	d65a5fd868d…	34404	240	8226	14	12	202752	88064	0	189424	40
12	httpprxc.dll	400cb5e63b7…	34404	240	8226	14	12	7168	11776	0	8528	40
13	Scrivener-0…	d18b0589dc5…	332	224	271	6	0	602112	49152	1445888	2047984	14
14	upnp.dll	3445b6e05d8…	34404	240	8226	14	12	225280	165376	0	18544	40
15	mbussdapi.d…	2d7ab2226e6…	34404	240	8226	14	12	52736	29696	0	51792	40
16	Chandler_wi…	c1cc014a9a8…	332	224	271	6	0	23040	119808	1024	12491	40
17	comcat.dll	590c68e5aec…	34404	240	8226	14	12	3584	6656	0	4768	40
18	Windows.UI.…	49a78f5dfeb…	34404	240	8226	14	12	0	612864	0	0	40
19	appmgr.dll	236316a1fbc…	34404	240	8226	14	12	223232	236032	0	204560	40

Format Resize Background color Column min/max Save and

Fig 5.1: Created dataset

First of all we remove first two columns as they have categorical values. Then we applied feature scaling using algorithms called standard scalar. By this the mean of all the columns became zero and standard deviation became one.

	0	1	2	3	4	5	6	7	8	9	10	11	12
0	-0.665677	-0.654523	-0.618849	0.668023	-0.710192	-0.0349932	-0.0384227	-0.013322	-0.198884	-0.0545115	-0.0351425	-0.653887	-0.24438
1	1.50223	1.4657	0.164965	0.398797	0.286981	-0.0277247	-0.0341763	-0.0207522	-0.0400486	-0.0545115	-0.0351425	1.27654	-0.24438
2	-0.665677	-0.654523	-0.618849	0.398797	-0.800844	-0.0342783	0.0460876	-0.0207522	-0.198699	-0.0545115	-0.0327705	-0.653887	-0.24438
3	1.50223	1.4657	0.164965	0.398797	0.286981	-0.0302985	-0.0189962	-0.0207522	-0.178274	-0.0545115	-0.0351425	1.55808	-0.24438
4	1.50223	1.4657	0.164965	0.398797	0.286981	-0.0200631	-0.0247305	-0.0207522	0.119626	-0.0545115	-0.0351425	1.55808	-0.24438
5	1.50223	1.4657	0.164965	0.398797	0.286981	-0.0350408	-0.0381051	-0.0207522	-0.195559	-0.0545115	-0.0351425	1.55808	-0.24438
6	-0.665677	-0.654523	-0.568385	-1.08194	-0.800844	-0.00182042	-0.038289	0.107651	1.71774	2.04846	0.143749	-0.653887	-0.24438
7	-0.665677	-0.654523	-0.618849	0.398797	0.196329	-0.0286065	-0.00430093	-0.0207522	-0.123282	-0.0545115	-0.0211079	-0.653887	-0.24438
8	1.50223	1.4657	0.164965	0.398797	0.286981	-0.0275579	-0.0334741	-0.0207522	-0.0298134	-0.0545115	-0.0351425	1.55808	-0.24438
9	-0.665677	-0.654523	-0.61757	-0.678105	-0.800844	-0.0338493	-0.037219	-0.0207522	-0.181834	-0.0545115	-0.0319798	-0.653887	-0.24438
10	-0.665677	-0.654523	-0.618849	0.398797	-0.800844	-0.0333727	0.010712	-0.0207522	-0.182479	-0.0545115	-0.0309914	-0.653887	-0.24438
11	-0.665677	-0.654523	-0.618849	0.398797	0.196329	-0.0286065	-0.00430093	-0.0207522	-0.123282	-0.0545115	-0.0211079	-0.653887	-0.24438
12	-0.665677	-0.654523	2.61832	-1.21656	1.46546	-0.0249603	0.00872253	-0.0207522	0.0300904	-0.0545115	-0.0133988	-0.653887	-0.24438
13	-0.665677	-0.654523	-0.618849	-0.274267	-0.800844	-0.00551423	0.00185136	-0.0207522	0.369937	-0.0545115	0.026926	-0.653887	-0.24438
14	-0.665677	-0.654523	2.61842	-1.21656	1.46546	-0.0344093	-0.0378543	-0.0207522	-0.181131	-0.0545115	-0.0329681	-0.653887	-0.24438
15	-0.665677	-0.654523	2.61832	-1.21656	1.46546	-0.0329914	-0.0275893	-0.0207522	3.25308	-0.0545115	-0.0302007	-0.653887	-0.24438
16	-0.665677	-0.654523	-0.618849	0.398797	0.196329	-0.0291784	-0.0101189	-0.0207522	-0.132798	-0.0545115	-0.0222939	-0.653887	-0.24438
17	-0.665677	-0.654523	2.61832	-1.21656	1.46546	-0.0249603	0.00872253	-0.0207522	0.0300904	-0.0545115	-0.0133988	-0.653887	-0.24438
18	-0.665677	-0.654523	-0.61757	-0.678105	-0.800844	-0.034731	-0.0345107	-0.0206941	-0.194947	-0.0545115	-0.0337588	-0.653887	-0.24438

Fig 5.2: Created dataset with feature scaling

After that we apply the entire algorithm without feature extraction such as logistic regression, decision tree, XGBoost, Random Forest, KNN .and then compare the result of all the algorithms. The 75% of the data used to train the model and remaining 25% data is used to test the model in all the algorithms.

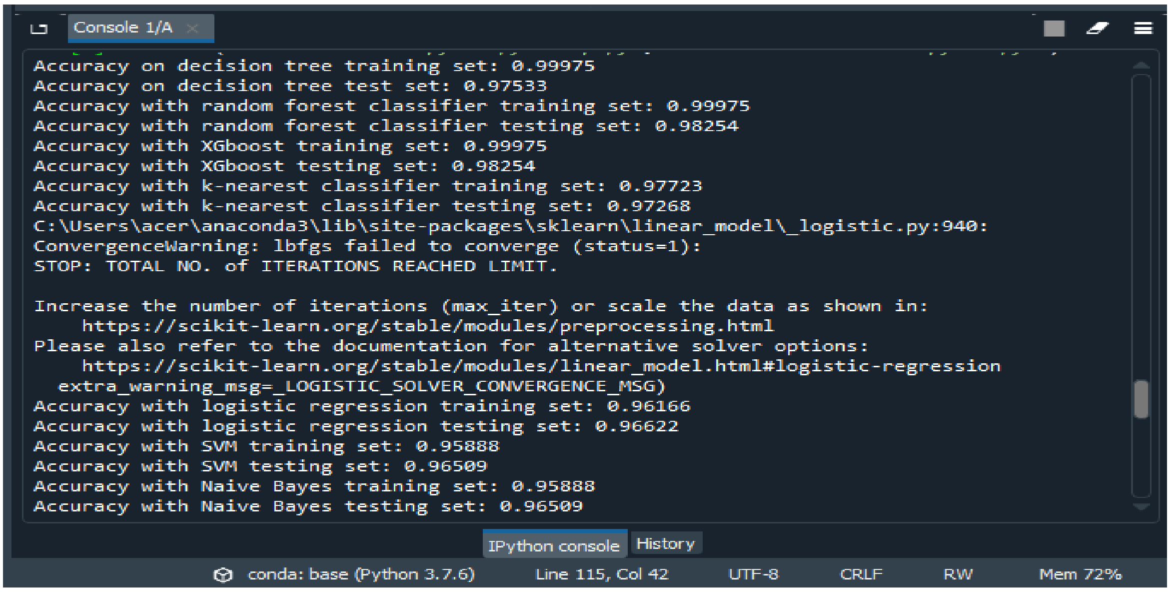

Fig 5.3: result without feature scaling

After that we apply the entire algorithms with feature extraction such as logistic regression, decision tree, XGBoost, Random Forest, KNN and then compare the result of all the algorithms. The 75% data used to train the model and remaining 25% data is used to test the model in all the algorithms.

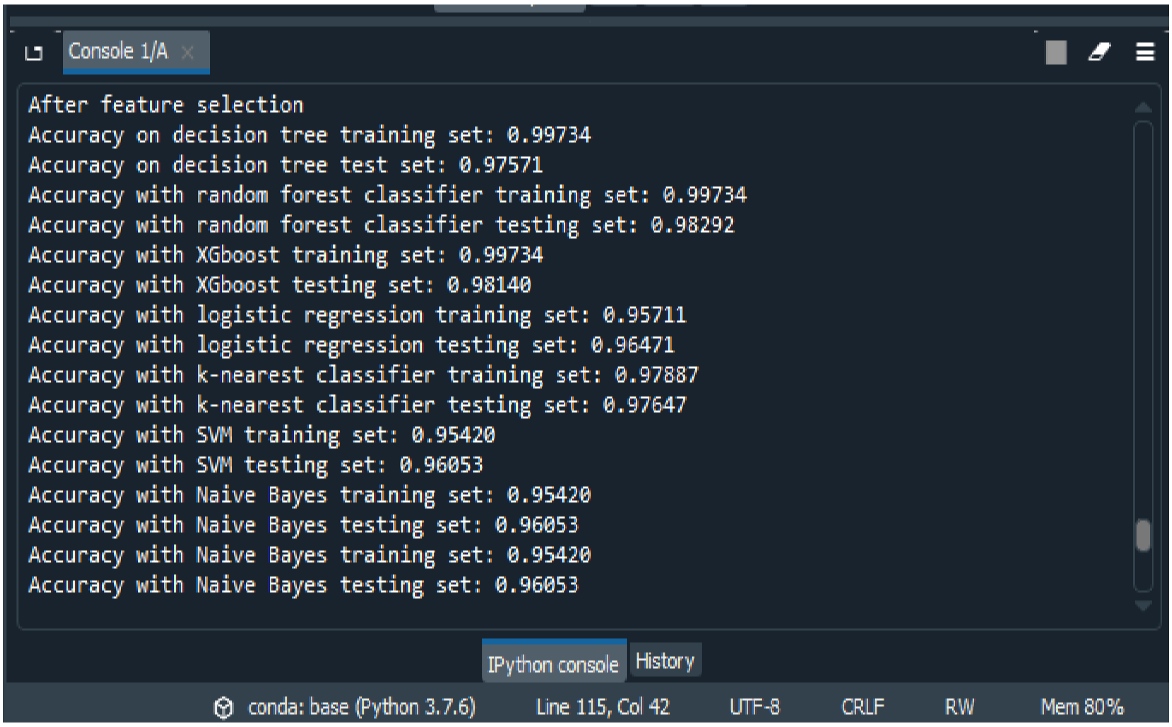

Fig 5.4: result with feature scaling

Chapter-6

RESULT AND PERFORMANCE ANALYSIS

Here we find the accuracy of different algorithms without feature extraction and then with feature extraction after that we compare the accuracy of both the algorithms. The algorithms are

1. Decision Tree
2. Random forest
3. XGBoost
4. K-nearest
5. Logistic Regression
6. SVM
7. Naïve Bayes

Now we show the accuracy of the algorithms without feature extraction on both training and testing set .

Algorithms	**Accuracy**	
	Training set	**Testing Set**
Decision Tree	99.975	97.533
Random forest	99.975	98.254
XG Boost	99.975	98.254
KNN	97.723	97.268
Logistic Regression	96.179	96.622
SVM	95.888	96.589
Naïve Bayes	95.888	96.589

Table 6.1: Results without feature extraction

Now we show the accuracy of the algorithms with feature extraction on both training and testing set.

Algorithms	**Accuracy**	
	Training set	**Testing Set**
Decision Tree	99.734	97.571
Random forest	99.734	98.292
XG Boost	99.734	98.140
KNN	97.887	97.647
Logistic Regression	95.711	96.471
SVM	95.420	96.053
Naïve Bayes	95.420	96.053

Table 6.2: Results with feature extraction

After comparing all the algorithms the algorithm **Random Forest** gives the most accurate result after features extraction that is **98.292%** .without feature extraction **Random Forest** and **XGBOOST** both gives the same result with highest accuracy that is **98.254%.**

Now we discuss the accuracy of each algorithm with their confusion matrix. First we display the confusion matrix without feature extraction and then with feature extraction. Confusion matrix has four tables. These sections are false negative and False Positive respectively and this occurs when there is a contradiction between actual class and the predicted class. The two sections are the True Positive and True Negative and these are the observations which are correctly predicted.

CONFUSION MATRIX WITOUT FEATURE EXTRACTION

1. Decision Tree

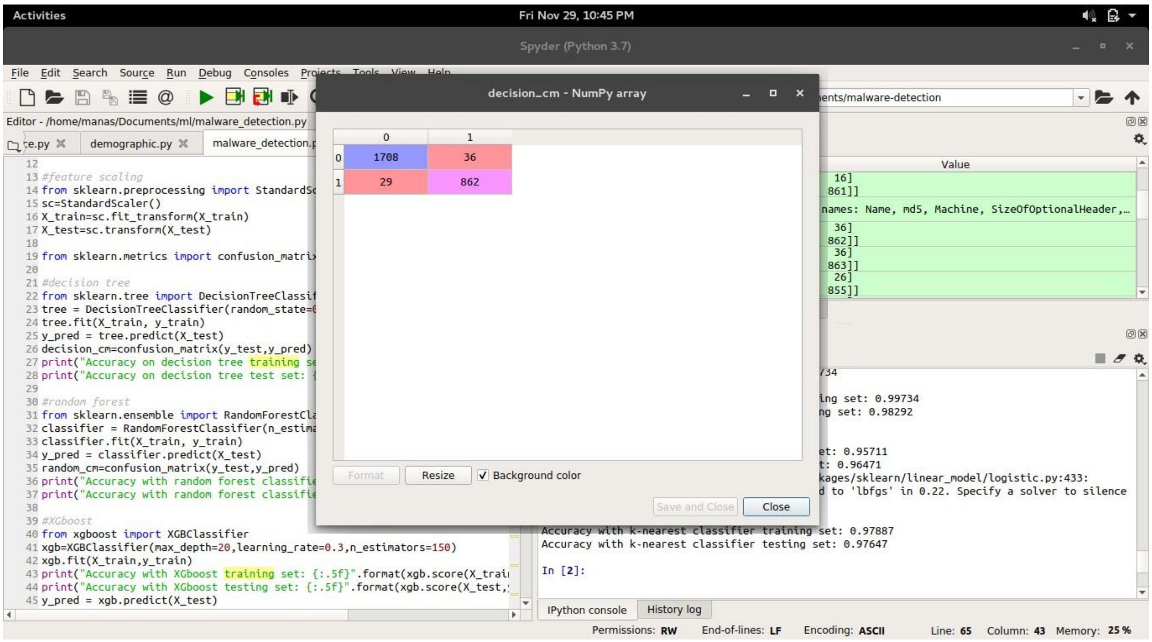

Fig 6.1: decision tree confusion matrix

2. Random Forest

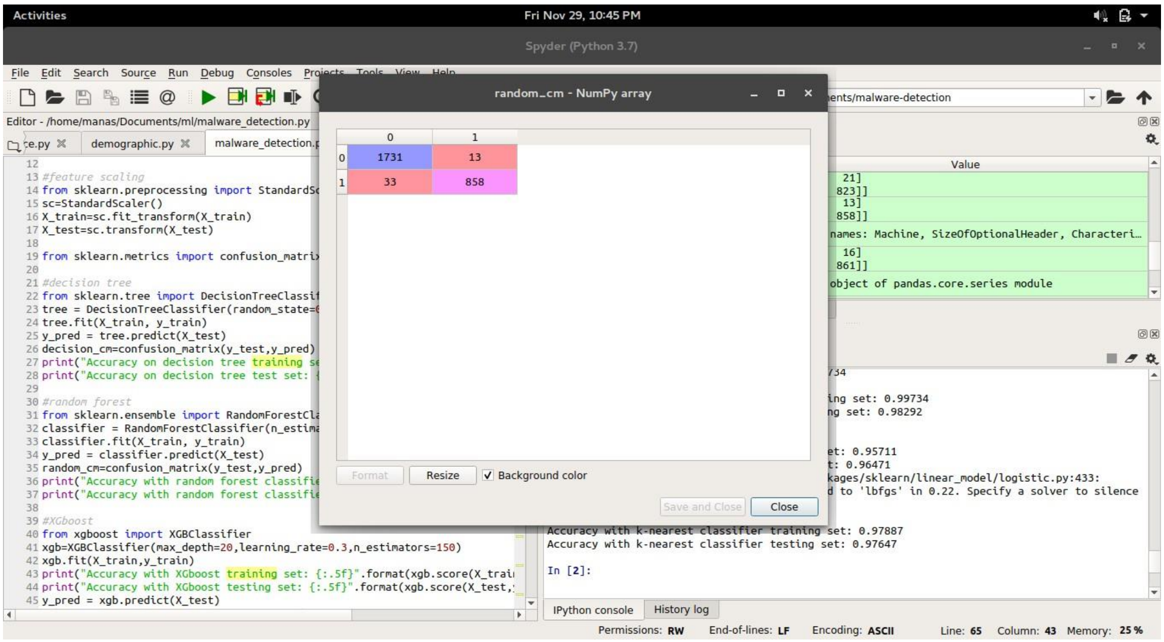

Fig 6.2: random forest confusion matrix

3. XG Boost

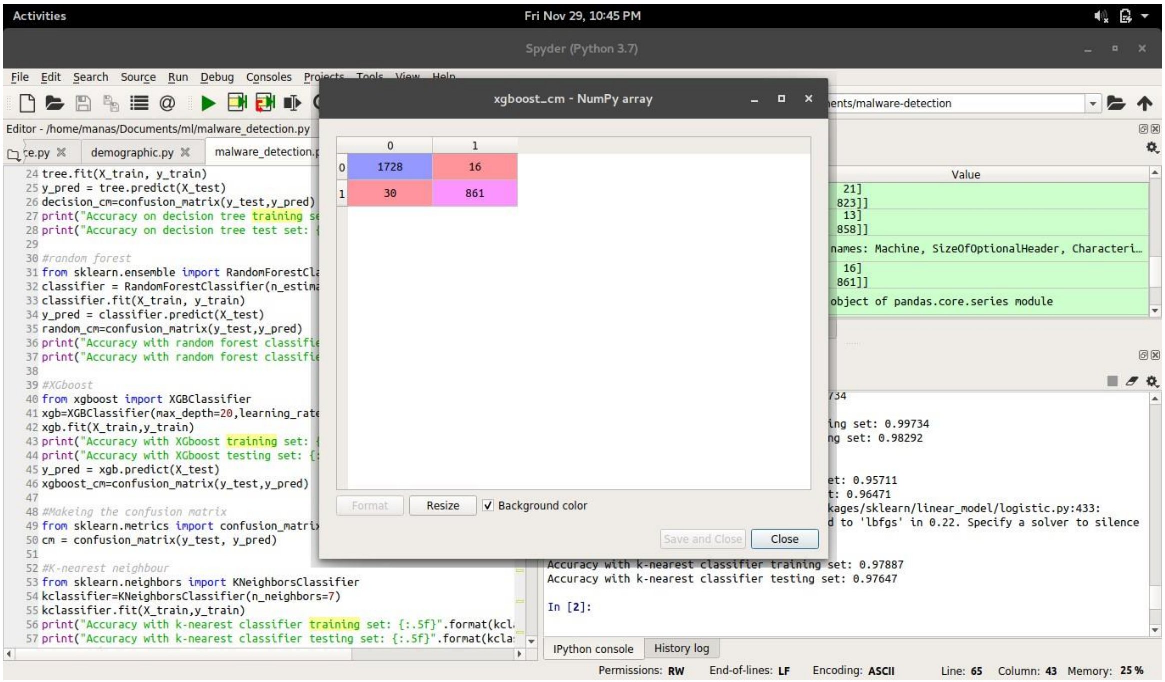

Fig 6.3: XG Boost confusion matrix

4. KNN

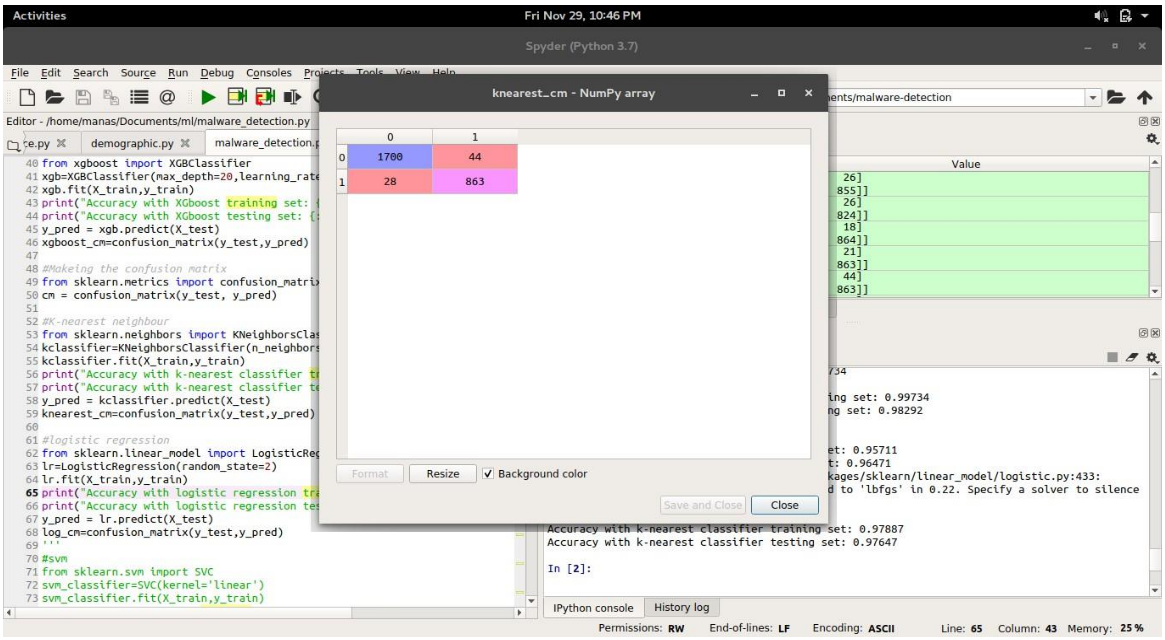

Fig 6.4: KNN confusion matrix

5. Logistic Regression

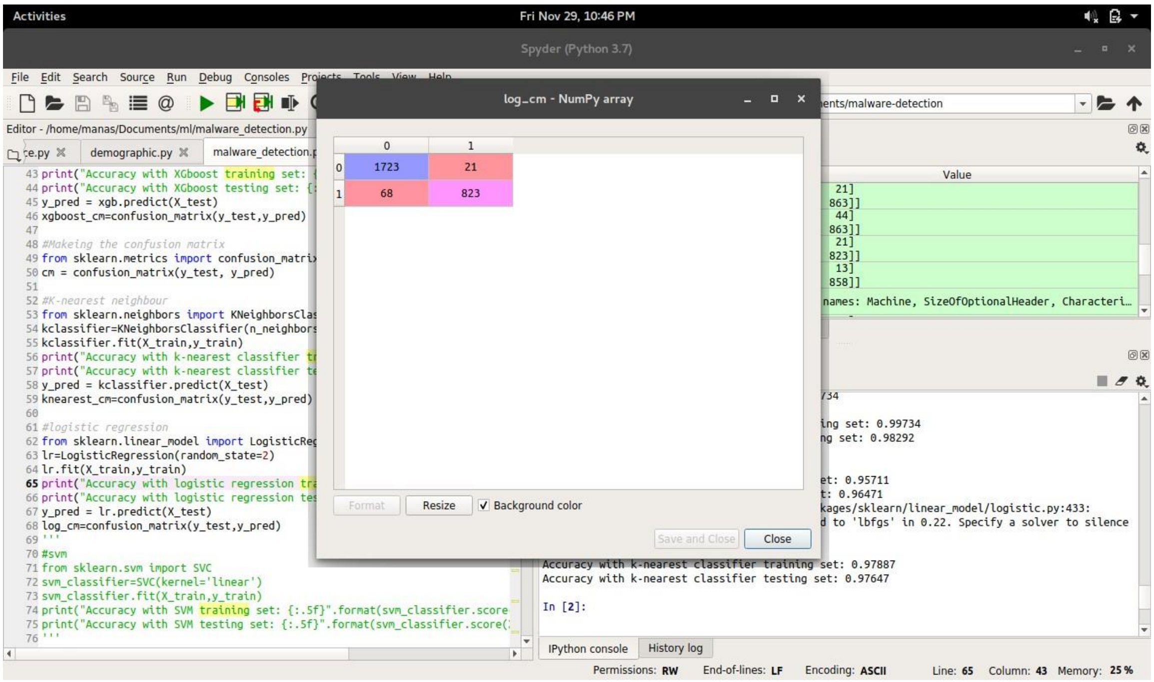

Fig 6.5: Logistic Regression confusion matrix

6. SVM

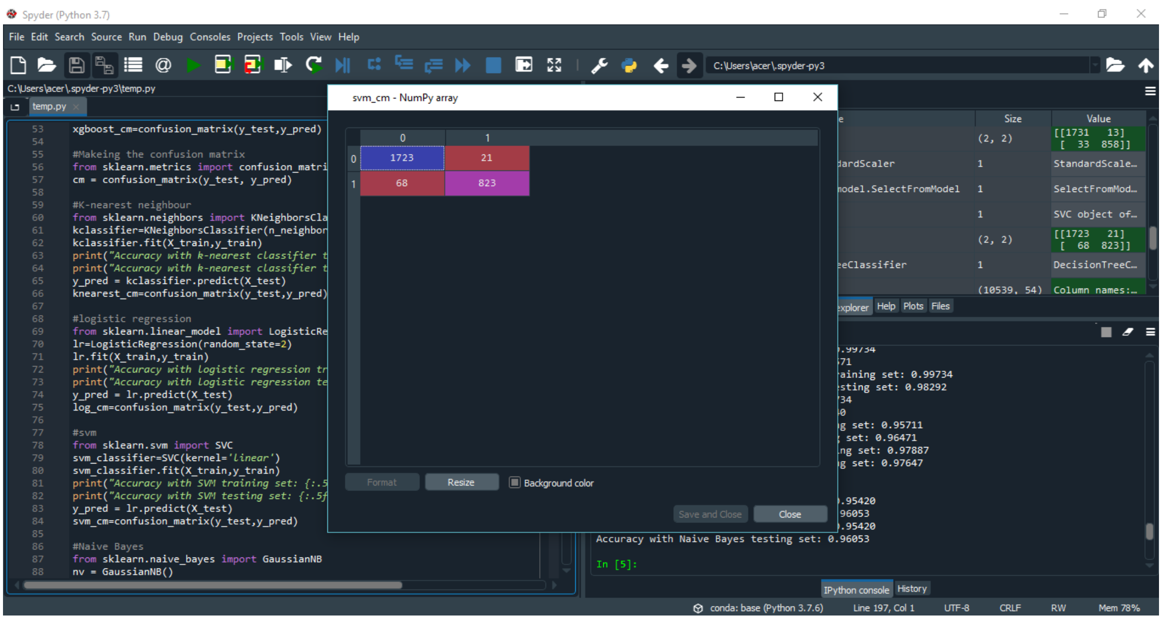

Fig 6.6 : SVM confusion matrix

7. GaussianNB

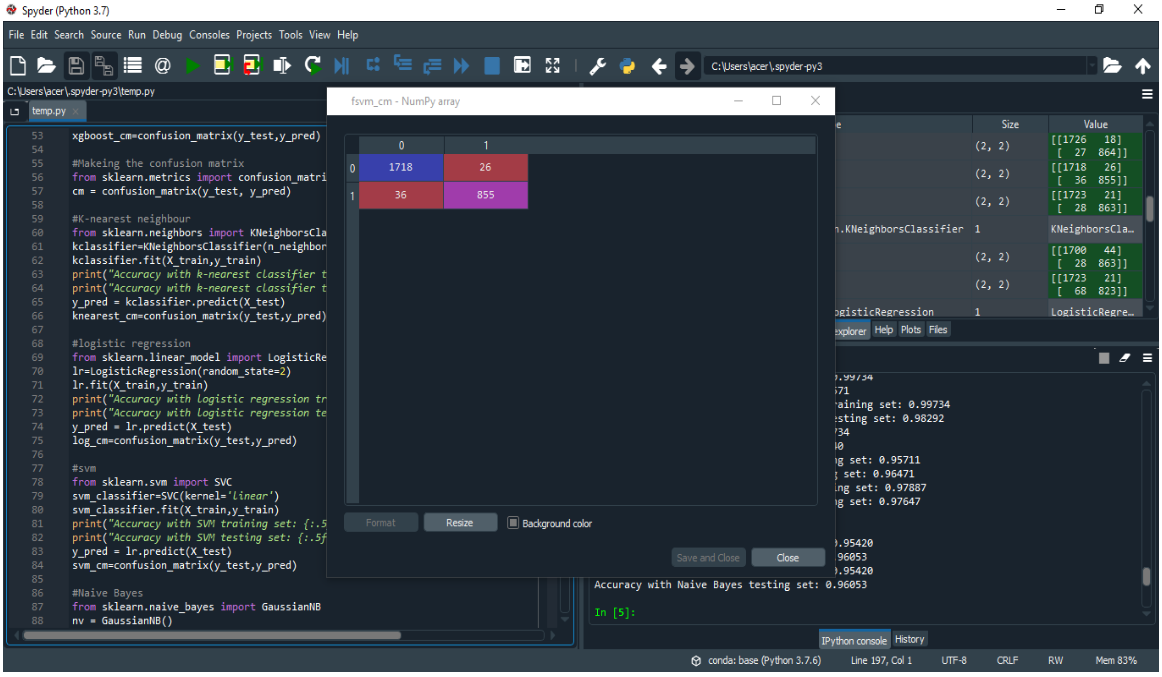

Fig 6.7: Gaussian Naïve Bayes confusion matrix

CONFUSION MATRIX WITH FEATURE EXTRACTION

1. Decision Tree

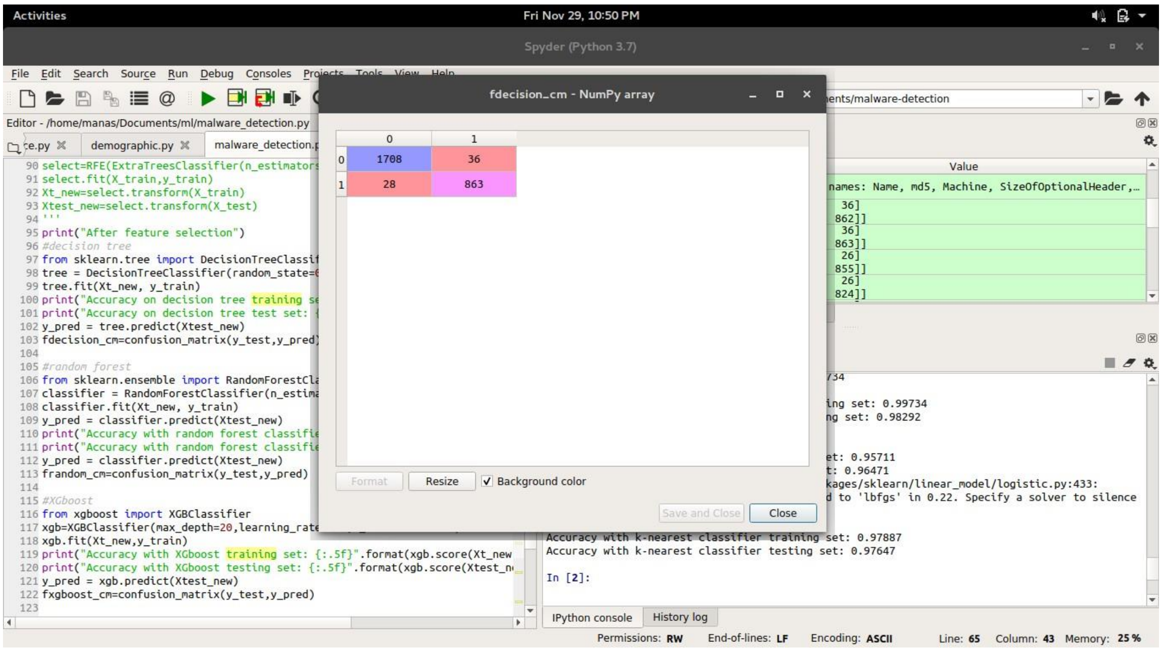

Fig 6.8: After feature extraction decision tree confusion matrix

2. Random Forest

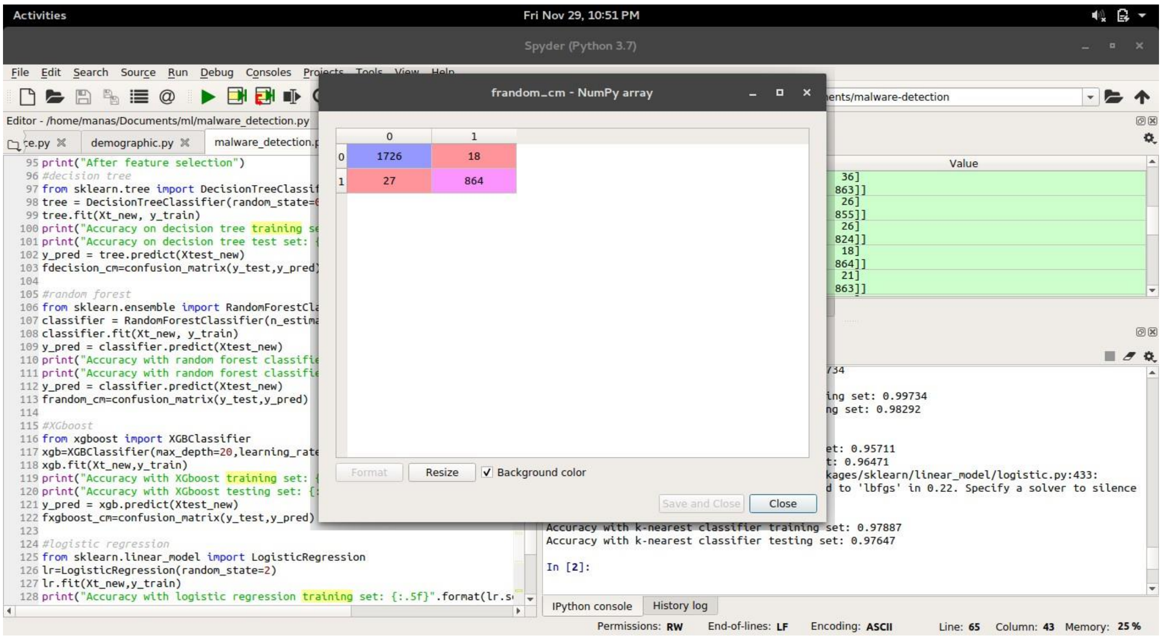

Fig 6.9: After feature extraction Random Forest confusion matrix

3. XG Boost

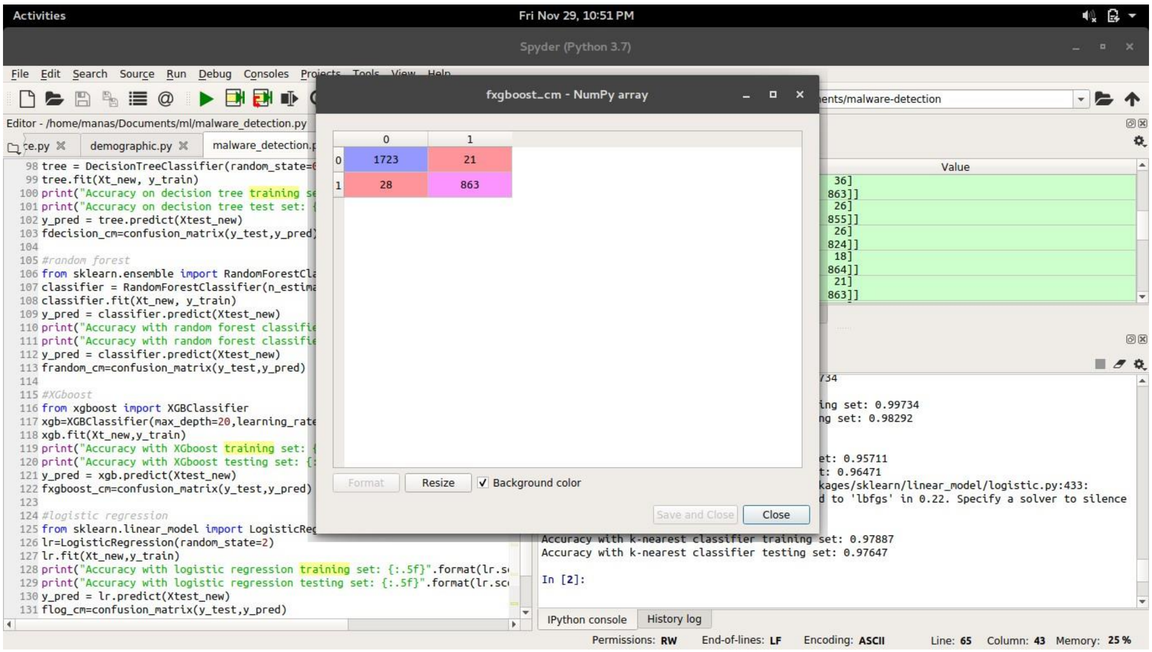

Fig 6.10: After feature extraction XGBoost confusion matrix

4. Logistic Regression

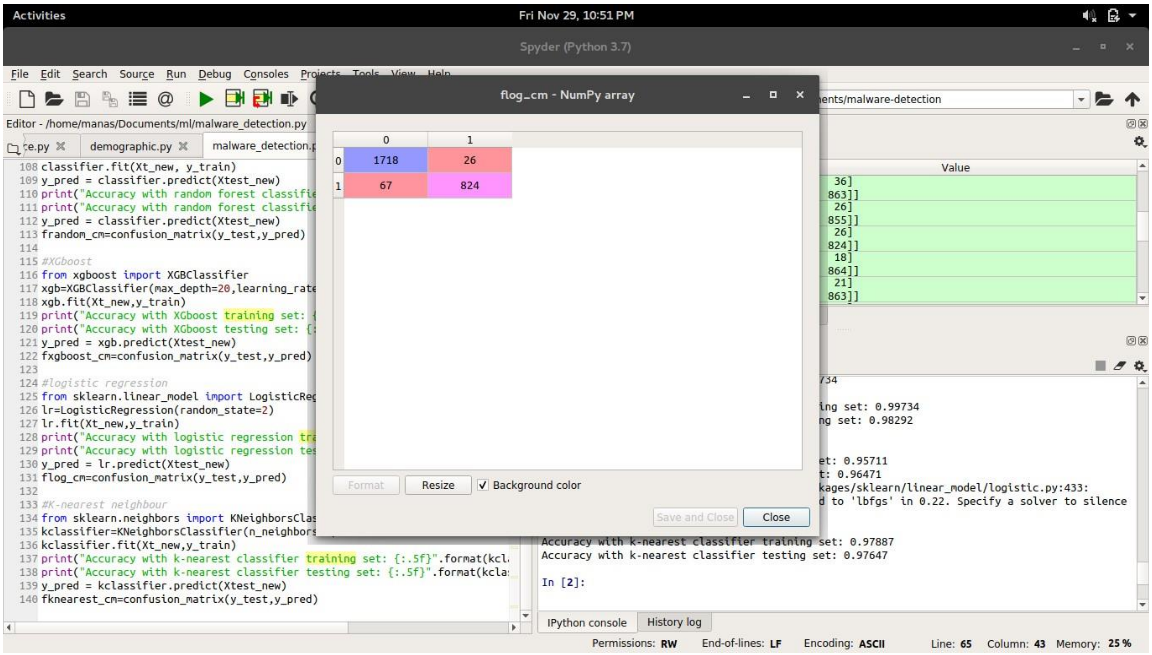

Fig 6.11: After feature extraction logistic regression confusion matrix

5. KNN

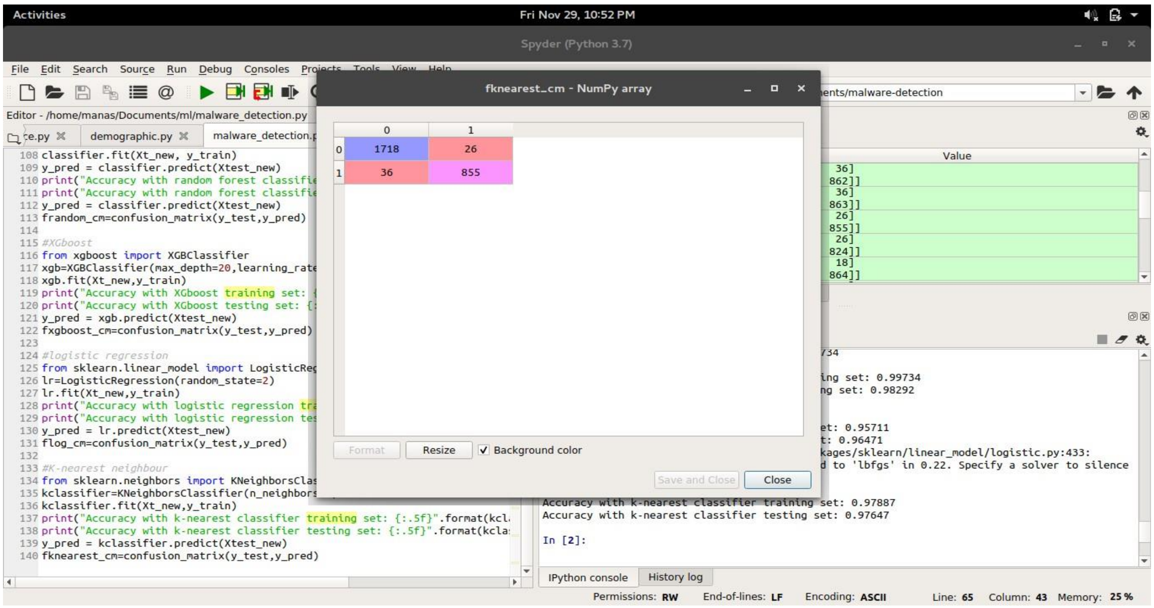

Fig 6.12: After feature extraction KNN confusion matrix

6. SVM

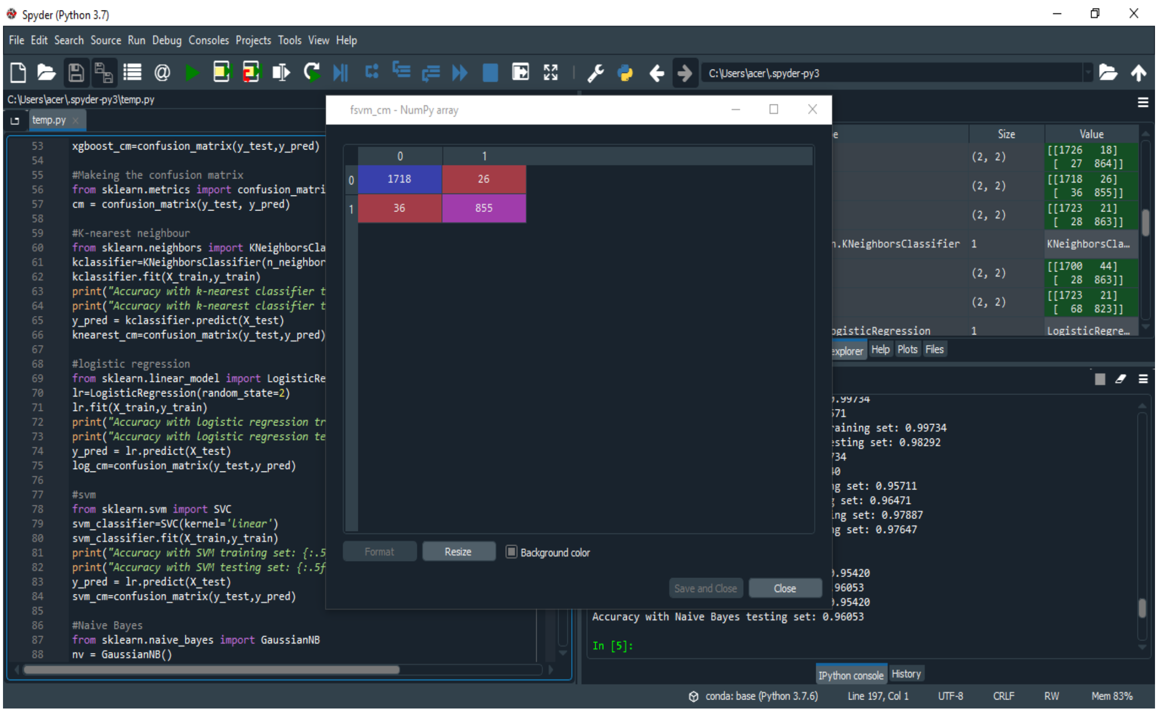

Fig 6.13: After feature extraction SVM confusion matrix

7. GaussianNB

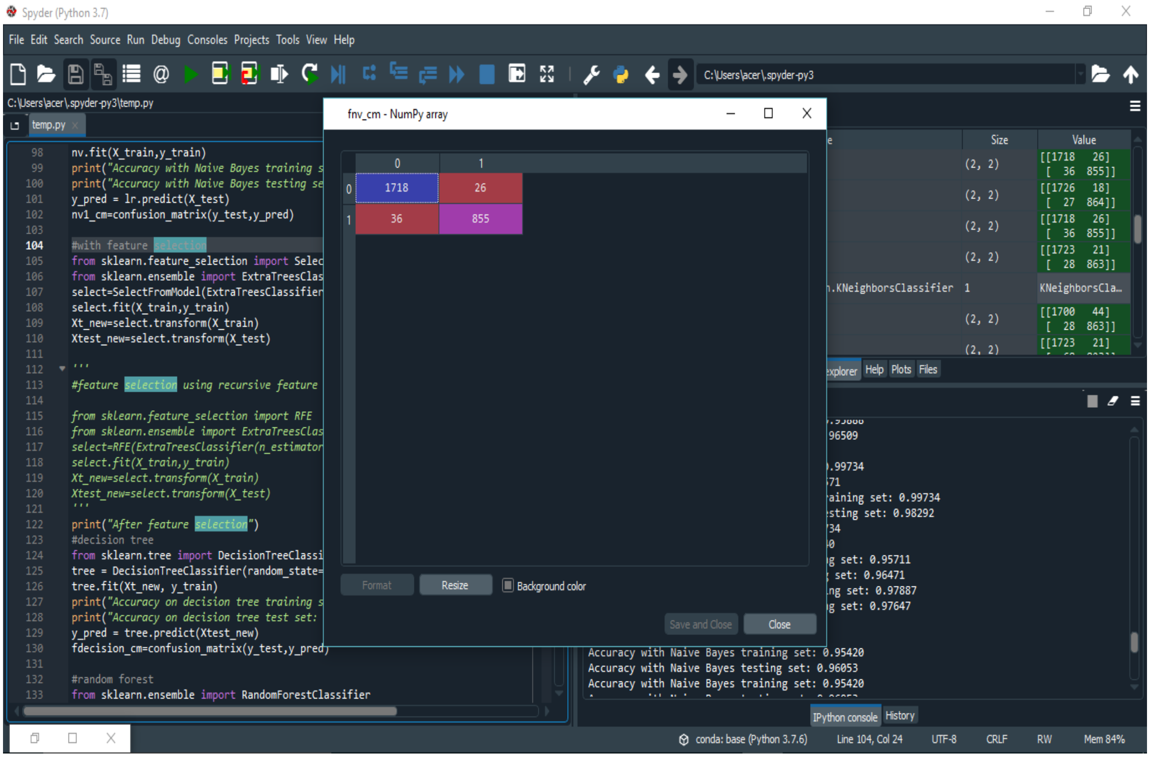

Fig 6.14: After feature extraction Gaussian Naïve Bayes confusion matrix

Chapter-7

CONCLUSION&FUTURE SCOPE

CONCLUSION

Various ML algorithms of supervised learning has been applied for the detection and removal of infected malware files or anomaly in the given dataset samples and classified them into 2 categories that is malicious and benign. We used a dataset that was taken from kaggle. We were able to get a labeled dataset and then applied various supervised ML algorithms and split the dataset into 75% training and 25% testing set. With this dataset, we evaluated the values of different accuracies of algorithms and thus evaluated the parameters and features for various supervised algorithms and concluded that the machine learning algorithm which gave the best accuracy is the Random Forest. Thus with an accuracy of 98.29% after feature extraction and 98.25% before feature extraction, it is the best algorithm for this dataset.

FUTURE SCOPE

For the future work we will implement deep learning and use neural networks for the recognition of rare malwares and we will also run a live malware file on a virtual environment like Anubis and then get its log file for filling the entries in the data set and hen using the predefined machine learning algorithm for predicting whether the file is malicious or not. And with more features and parameters of algorithms added to increase the accuracy of performance matrix. Evaluation of malwares only on the basis of static approach also can be used like prediction of malware on the basis of analysis of code and signatures.

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