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A WIDE SCALE SURVEY ON CLUSTERING TECHNIQUES FOR MALWARE DETECTION

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ABSTRACT

Use of internet has enhanced the problem of malwares. At the same time the advancement in technology has given rise to evolution of portable mobile devices. It has become the danger point of day today activities like mails, mobile banking etc. Our purpose is to trace various clustering techniques for malware detection.

KEYWORDS: Classifiers, Classification Methods, Computer Virus.

INTRODUCTION

Internet has become target of malicious codes due to its increasing use. Malicious codes are executable code and have the capability to replicate. It makes their survival strong. Viruses design and evolution attached with the area of programming. Similar to other computer programs viruses carry functions that are intelligent for providing protection in such a manner that detection remains not easy for virus scanner [1].

Viruses have to take various procedures of intellect for continued existence. That is why they may have complex encrypting and decrypting engines. These are the most frequent methods used by computer viruses in current scenario. They make use of these techniques to mask the antivirus and to adopt the certain environment for their expansion [2].

Figure 1: Assembly code of Virus File

Polymorphic viruses try to hide the decrypting module. More complex methods were developed enabling the virus designers to change the code of one virus file and make multiple morphed copies while maintaining its functionalities. These are the type of viruses which have the ability to mutate itself with the code changed but without changing its functionalities. Metamorphic virus can become a serious threat considering the fact that there can be thousands of variants of one virus file with their signature being totally different.

Metamorphic viruses transform its code in a specific manner very frequently and require to be prohibited. Their analysis will lead to evolve a framework where the overall process of detection will be bounded in specific outcomes of continuing evolving results. It is essential to make a distinction between replicating programs and its similar forms. Reproducing programs will not necessarily damage your system [3] [4] [5]. There is big fight between designers of virus and antivirus. The enhanced knowledge about the certain patterns, specifications can be designed. Various malicious codes can be evolved and incremented in well precise and efficient manner. For

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perfect identification of a metamorphic virus, identification routines must be written that can generate the essential instruction set of the virus code from the actual occurrence of the infection.

Code obfuscation is one of the important properties adopted by metamorphic viruses. The mutating behavior of metamorphic viruses is due to code obfuscation techniques .There are various code obfuscation techniques.

a. Dead code insertion
b. Variable renaming
c. Break and join transformation
d. Expressing reshaping
e. Statement reordering

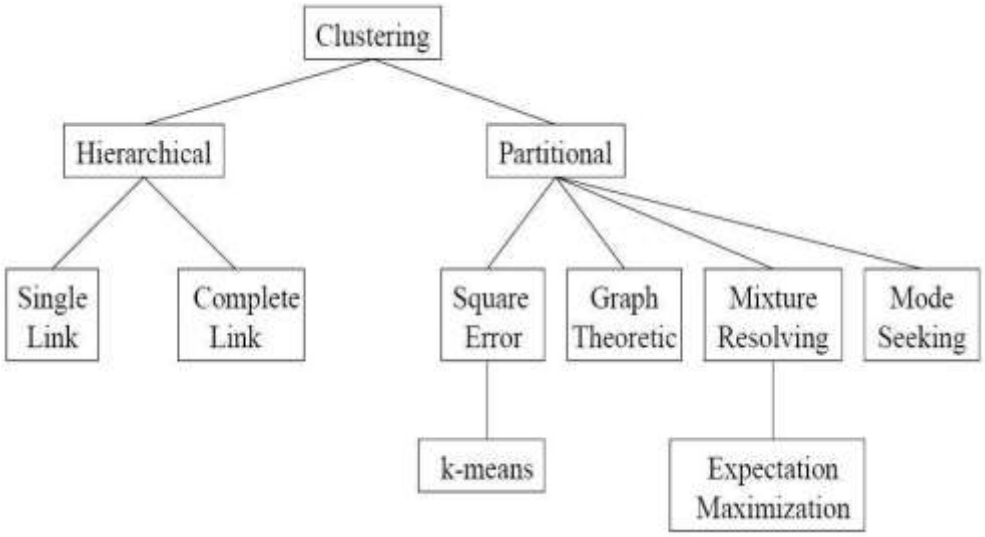

Figure 2: Types of Clustering

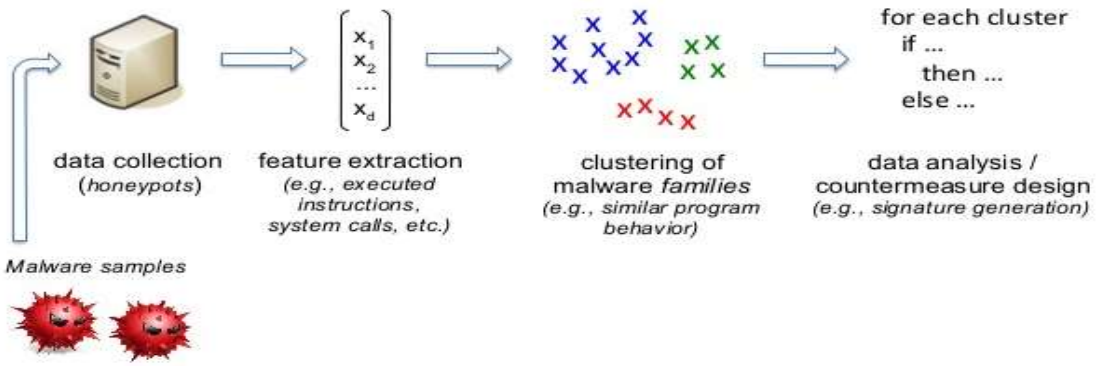

Figure 3: Malware Clustering Process

Based on detailed system events, Bayer proposed a scalable malware clustering technique. This technique was not good for network level behavioral signatures.

Perdisci proposed a method to get malware clusters that can aid the automatic creation of fine quality malware signatures. This process proved very useful to detect botnet command and control. With this processing time is being reduced from several hours to few minutes.

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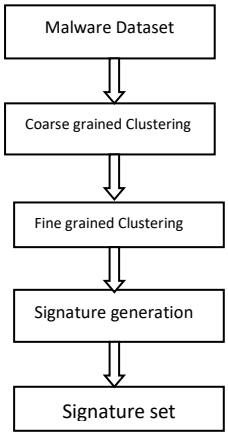
Overview of proposed technique



Authors observed various peculiar points about malware behavioral clustering:-

1. Draw plot between BIRCH radius and separation index
2. Draw plot between BIRCH radius and cohesion index
3. Time required completing the clustering and signature generation process for different values of BIRCH radius.
4. Number of coarse and fine grain clusters generated for different values of the BIRCH radius.

Analysis is done on 65000 different malware samples explains the importance of work that reduced processing time from several hours to few minutes.

Perdisci designed fully automated clustering validity tool for the detection of malware. The results after analysis shows that VAMO outperforms with voting based malware detector. Some of important results are shown here.

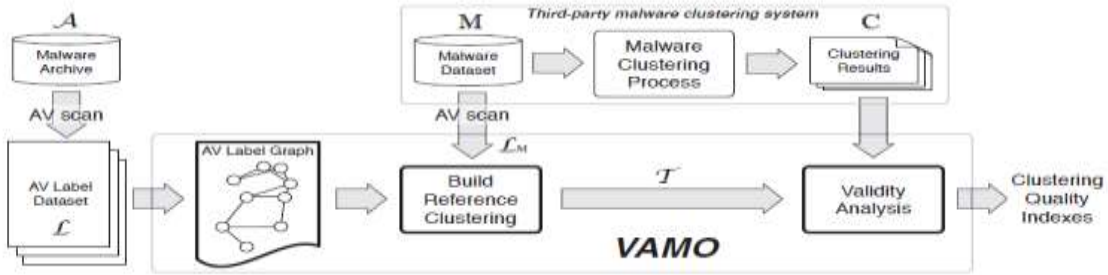


Figure 4: VAMO System Overview

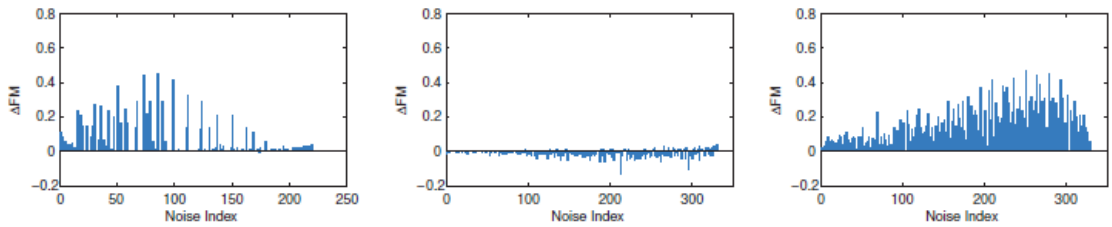


Figure 5: VAMO vs Majority Voting

Ciprian proposed malware clustering using suffix trees. Suffix tree data structure is used to find long enough substring that corresponds to portions of a program's code. Based on common substring clustering is done. Deq distance method is used to calculate distance between opcode sequences. A clustering technique based on Ukkonen's suffix tree is used.

Usha Narra explained clustering technique for malware detection. Author used K-means and Expectation

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Maximization (EM) for malware clustering.

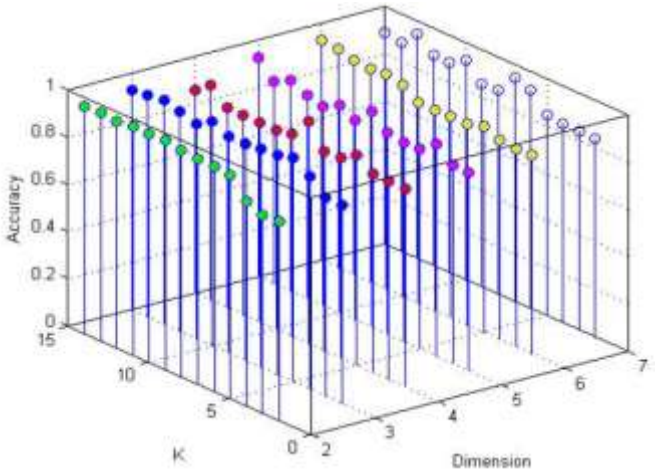

Figure 6: Accuracy measure for EM clustering

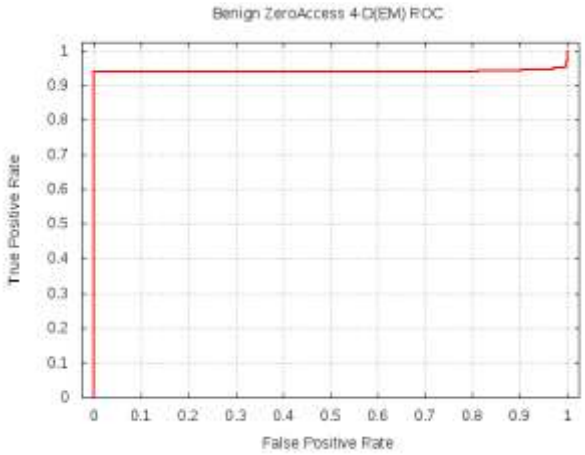

Figure 7: ROC curve of EM Clustering (4D)

EM and K-means algorithms are used to cluster 8000 malware samples. Expectation maximization clustering is an iterative method for finding maximum a posteriori map (MAP) in order to determine parameters in statistical model where the model focuses on unobserved latent variables. K means is a technique of vector quantization and used for cluster analysis.

Matthew Asquith proposed a technique for clustering of malware metadata and use of data structure called aggregation overlay graphs. Mondal and Deshpande introduced the idea of aggregation overlay graph in which

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virtual nodes are added to bipartite graphs connecting each node of a sub graph to a new virtual node reduces the total number of edges.

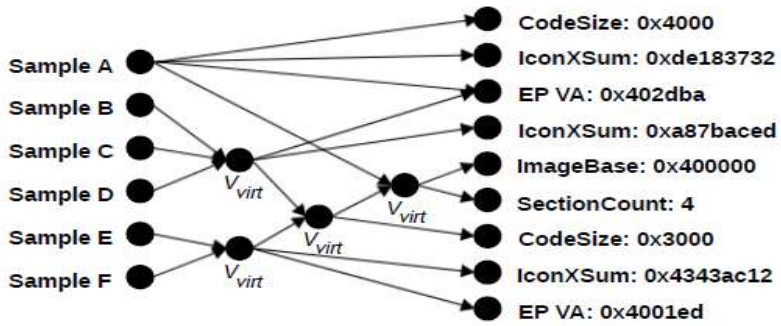

Figure 8: An aggregation overlay graph designed from metadata

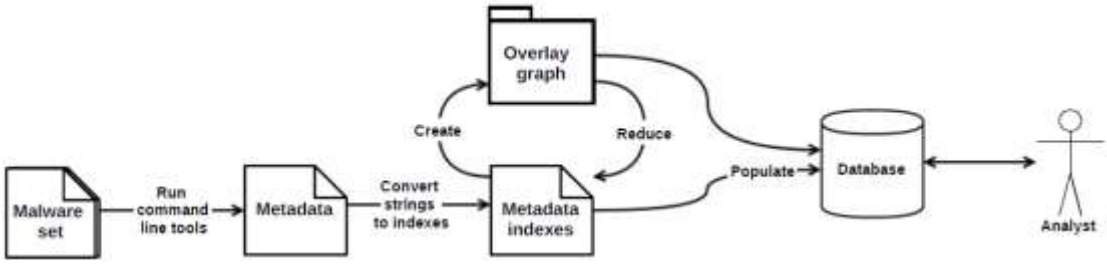

Figure 9: Complete system with aggregation overlay graph

Spectral malware behavior clustering

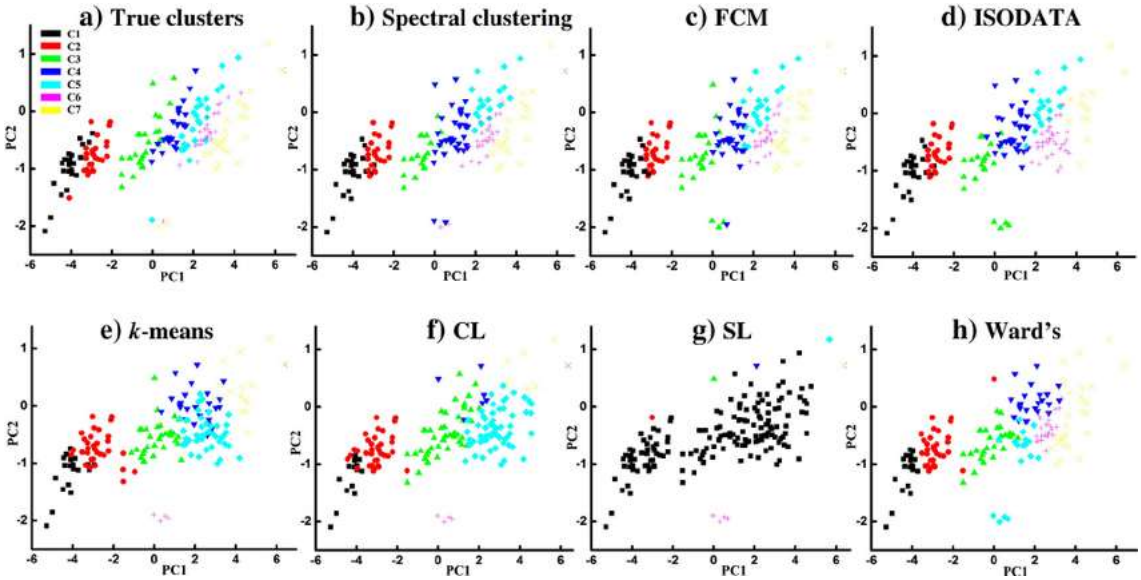

Figure 10: Comparison among different clustering methods for clustering e-nose dataset of adulteration. (a) True clusters, (b) spectral clustering, (c) FCM, (d) ISODATA, (e) k -means, (f) complete linkage, (g) single linkage, and (h) Ward's linkage. [10]

Chris Giannella and Eric Bloedorn proposed a technique using spectral malware behavior clustering better than Hierarchical agglomerative clustering. The run time of proposed algorithm is smaller than Rieck's algorithm.

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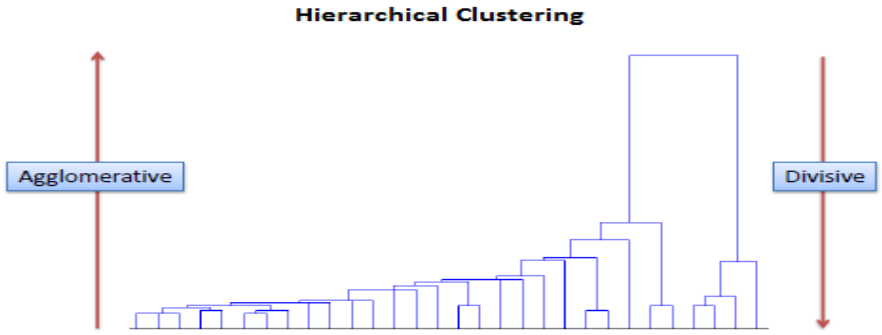

Figure 11: Agglomerative Clustering

Peng Li et al. explained about challenges and scope of malware clustering evaluation. Authors focused on the importance of BCHKK algorithm. The important analysis lies in identifying the capability of plagiarism detectors in malware clustering. Some important results are depicted in following graphs.

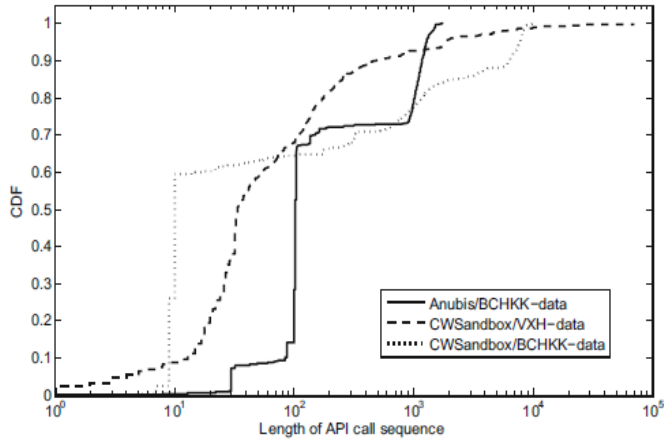

Figure 12 : API sequence call length extracted from BCHKK data using CWSandbox

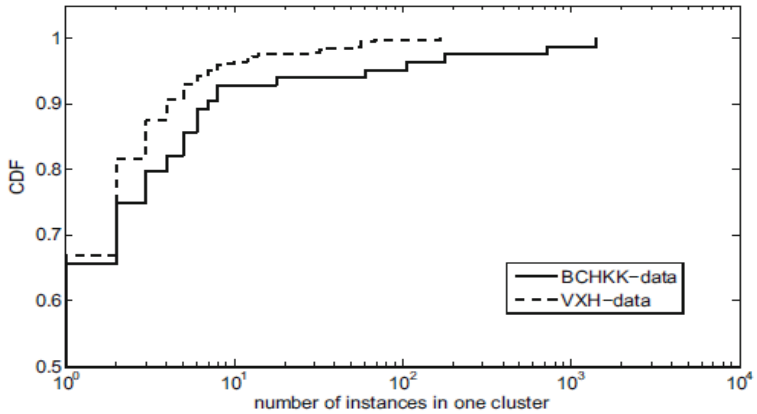

Figure 13: Reference cluster size distribution of BCHKK data and VXH data

CONCLUSIONS

Large number of research papers has been written in the field of malware clustering techniques. Our purpose in this paper is to address the problem of malwares and its solutions using clustering. After analyzing various articles in concerned domain, we found that clustering can be used for real time mitigation of malwares.

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