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Automatic malware classification and new malware detection using machine learning

Key words: Malware classification; Machine learning; Malware detection; Feature extraction; Gray scale

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Motivation

- Traditional malware analysis methods based on artificial experience are difficult to detect various variants of malicious code and dig useful information from massive information.
- Traditional anti-virus systems based on signature fail to classify unknown malware into corresponding families and detect new malware.
- Automated malware analysis based on machine learning is gaining more and more attention from researchers.

Main idea

- Inspired by the image processing technology, we try to combine the analysis of malicious code with the image processing technology, trying to find more efficient malicious code feature extraction method.
- In order to effectively detect new malicious code, we try to improve the clustering algorithm to make it more suitable for high dimensional space.

Method

The paper propose an incremental malware detection system, which is able to classify malware families and detect the new malware. This system is divided into three main parts:

1. It proposes a feature extraction method based on gray scale image, opcode n-gram and import functions.
2. It creates decision-making system to assign unknown malware to corresponding family and screen out suspicious software.
3. It presents an improved shared near neighbors algorithm to mine new malicious code.

Major results

- Experiment 1 shows that our feature extraction method has a higher accuracy rate on malware classification compared with other methods.

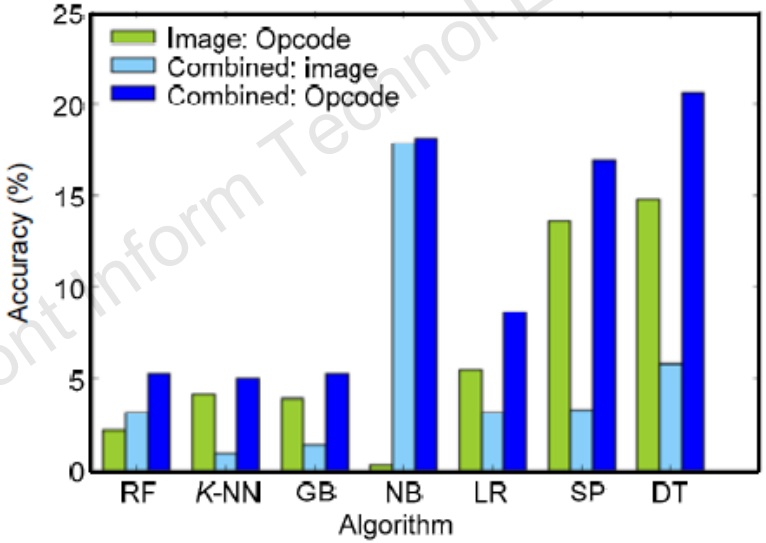
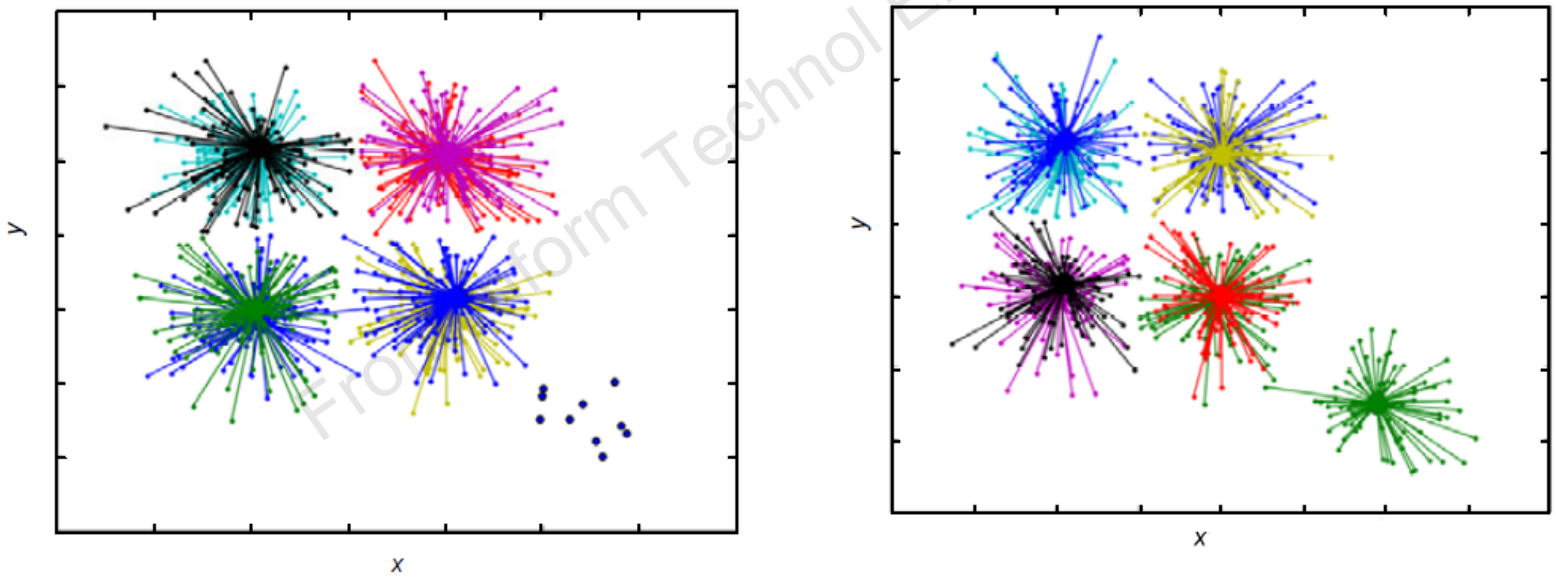


Fig. 11 Improved accuracies of different classifiers

RF: random forest; *K*-NN: *K*-nearest neighbor; GB: gradient-boosting; NB: Naïve Bayes; LR: logistic regression; SP: support vector machine-poly; DT: decision tree

Major results

- Experiment 2 shows that our SNN model can detect new malicious samples. And a new family can be clustered in an incremental manner



New malware detection(left); new malicious family clustering (right)

Conclusions

- We propose the texture of malware which effectively describes the features of the difference programs.
- SNN algorithm can accurately detect abnormal samples in high dimensional space, and through the incremental strategy to explore new malicious family.
- Finally, the results of the experiments show that our method effectively improves the accuracy of malware classification, but also can effectively discover new malware.