Notes: Transformer in CSec : A Survey

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Outline

- Proposed Problem Statements / Ideas:
  - Detect Adversarial Behaviour by Applying NLP Techniques to Command Lines
  - NLP methods in HIDS
  - Use of Transformer Arch. over Network Flow Data

Proposed Problem Statements / Ideas

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Detect Adversarial Behaviour (1/2)

Operations on computer systems frequently use the command line. Applications perform simple tasks (such as software updates) via tools or scripts, sysadmins deploy jobs that run on multiple machines, and technical users spend a great deal of their time in console windows. Adversaries also heavily utilize the command line. If a system has been compromised, an attacker will perform a majority of their actions using built-in system tools, at the command line. This strategy benefits the attacker, since their actions will look very similar to other normal tasks performed on the system. Methodology designed to automatically detect whether a system has been compromised needs to be able to tell the difference between benign and malicious command line operations. In order to build mechanisms capable of classifying command lines in this way, we first need to understand what they do – in other words, we need to be able to parse them in a similar way to how we parse natural languages. This article describes the process we've been using to develop methodology capable of parsing and categorizing command lines at F-Secure.

Source

Detect Adversarial Behaviour (2/2)

Using NLP techniques to perform NER and POS tagging as shown in the source.

Effort is required for data annotation but use of NLP techniques over CLI Commands are something new.

NLP methods in HIDS (1/4)

- This paper discuss several NLP methods for Host-based Intrusion Detection System.

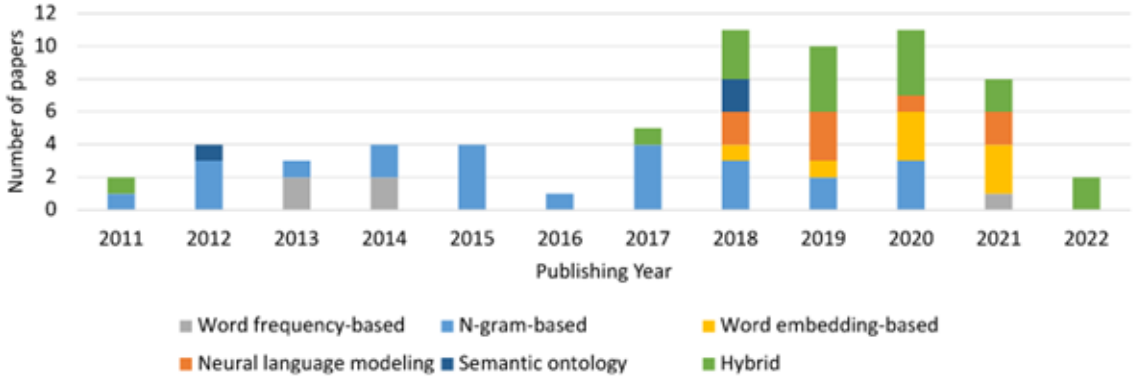
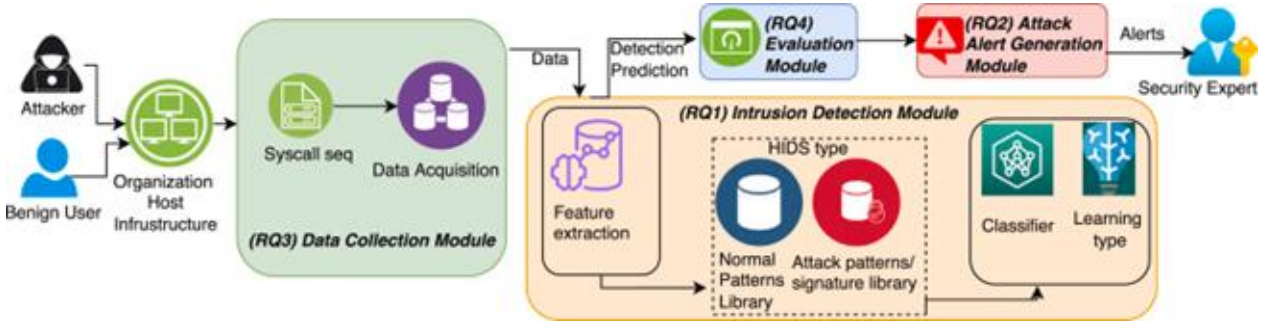


Fig. 4. Number of papers in NLP method categories used in HIDS which are published in each year from 2011 to 2022.



NLP methods in HIDS (2/4)

- Data Representation

Table 1. Example syscall sequences for reading two files (Grimmer et al., 2021).

Seq1	"open, read, write, open, read, write"
Seq2	"open, open, read, write, read, write"
Seq3	"open, open, read, read, write, write"

NLP method	Strengths	Weaknesses
Neural lang model	• Predicts a future syscall sequence possibly to be executed during an attack. • Combining the known invoked syscall traces with predicted future syscall sequences helps to improve the intrusion detection performance • Modeling syscalls helps to capture interword relationships.	• Modeling the system behavior requires a huge amount of data
Hybrid	• Makes HIDS more reliable and resilient against evasion and adversarial attacks by combining decisions from heterogeneous detectors • Gains the advantages of multiple features or models to lower FAR	• Requires high computation overhead compared to single methods.

NLP methods in HIDS (3/4)

Neural language modeling methods:

- RNN-VED-based language model
- LSTM-based language model
- GRU-based language model

Hybrid:

- Combination of heterogeneous classifiers using different NLP methods.
- Combination of n-gram and TF-IDF.
- Combination of n-gram and statistical approaches.
- Combination of n-gram and data augmentation methods.

NLP methods in HIDS (4/4)

As previous slide suggest there are several hybrid methods being used for HIDS, but there is no method that uses new STOA.

As there are sequence of ***open, read and write***, one can create a sequential model with attention capabilities for greater results.

Use of Transformer Arch. over Network Flow Data

There are limited paper which uses transformer arch. over network flow data.

In depth analysis shows that one can work on the embeddings of transformer to feed new embeddings in Transformer Arch.

Systematic Literature Review: One can work on SLA about transformer + Network Flow / Packet Flow data.

Todo - Finding good dataset with little class imbalance and have structured information

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Transformer :

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- Sutskever, Ilya, Oriol Vinyals, and Quoc V. Le. "Sequence to sequence learning with neural networks." *Advances in neural information processing systems* 27 (2014). (**Seq-to-Seq**)
- Illustrated Guide to Transformers- Step by Step Explanation
- The Illustrated Transformer
- Transformers from Scratch
- Understanding LSTM Networks
- Word Vectors

Problem statements :

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