Comparison of Intrusion Detection Systems for Low-Powered Devices

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Introduction

- Security in low powered devices
- Rise of IoT and WSN
- Intrusion Detection System (IDS)

Problem Definition

- Why IDS for low powered devices?
- Signature based IDS
- Anomaly based IDS
- Problems with low powered devices

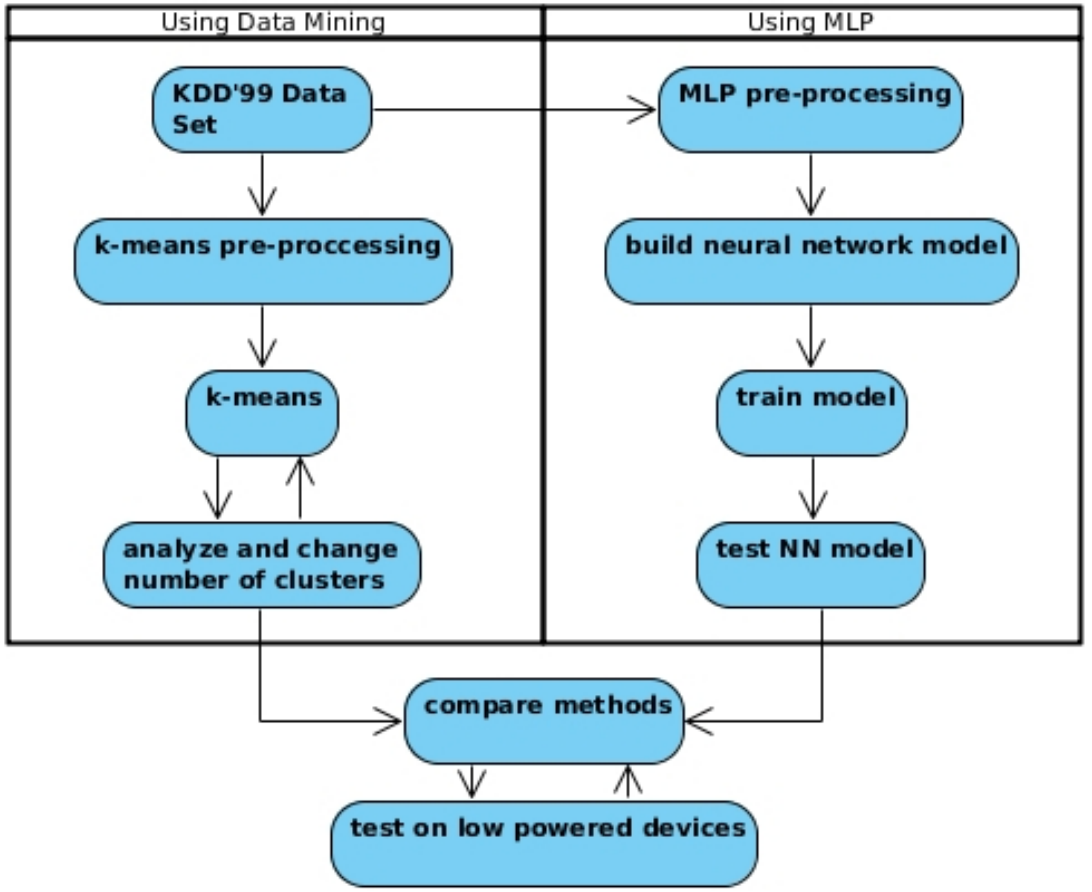
Objectives

- To find and choose a dataset that resembles a network dump as closely as possible while conforming with modern trends to make sure the IDS is well trained for novel attacks.
- To develop IDSs based on two very popular classification algorithms, K-Means and Multilayer Perceptron.
- To analyze and compare the two algorithms based on similar parameters.
- To compare the effects of decreased computational power by testing the algorithms in low powered devices.

Scope

- Cyber Security service providers
- People working in IoT/WSN
- Further research

Methodology



Methodology: Dataset

- KDD’99 vs. UNSW-NB15
- 9 types of attacks:
  - Fuzzers
  - Analysis
  - Backdoor
  - DoS
  - Exploit
  - Generic
  - Reconnaissance
  - Shell Code
  - Worm

Methodology: Dataset

- 49 features divided into 6 categories:
- Flow Features(5), Basic Features(13), Content Features(8), Time Features(10), Additional Generated Features(11), Labeled Features(2)

Methodology: Pre-processing

- Import data (python pandas)
- Fill empty values
- Transform nominal to numeric
- Add feature names to Pandas DataFrame

Methodology: K-Means

- Unsupervised clustering algorithm.
- To reduce computational load, 2 clusters. (attack/normal)

Methodology: Multilayer Perceptron

- A class of Artificial Neural Networks, with at least 3 layers and non-linear activation functions (except input nodes)
- Learning: Backpropogation.
- Optimization: Binary weights.

Methodology: Performance Parameters

- True Positive (TP): correctly classified attacks.
- True Negative (TN): correctly classified normal.
- False Positive (FP): incorrectly classified attacks.
- False Negative (FN): incorrectly classified normal.
- $$accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

Work Done: Overview

- Week 1: Finding research material and datasets.
- Week 2 – Week 5: Learning python for data science.
- Week 6: Started work on project.
- Week 7: Change dataset.
- Week 8: Application and performance testing.

Work Done: Week 1

- Finding research papers
- Problems with selected papers
- KDD’99 dataset

Work Done: Week 2 - 5

- Learning python for data science
- IPython basics
- Numpy
- Pandas
- Scikit-learn
- matplotlib

Work Done: Week 6

- Process KDD’99 with pandas
- Removing duplicates
- Nominal to numeric
- Apply k-means

Work Done: Week 7

- Problems with KDD’99
- UNSW-NB15
- UNSW-NB15 vs. KDD’99
- Started working on UNSW-NB15

Work Done: Week 8

- Processing UNSW-NB15 [Figure 2 (report)]
- Applied k-means
- Analysis using performance parameters [Figure 3 (report)]
- TP: 43,350
  TN: 327,461
  FP: 319,790
  FN: 9,399
- Accuracy: 52.97%

Remaining Work

- Implement MLP
- Analyze and compare on regular device
- Analyze and compare on low powered device

References

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