CPS: Medium: Detecting and Controlling Unwanted Data Flows in the Internet of Things

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https://netml.io/

Challenge:

- IoT devices generate abnormal flows
- Each type of device generates new types of activities
  - Denial of service (DoS) attacks
  - New types of devices
  - New activities
  - Privacy and security threats

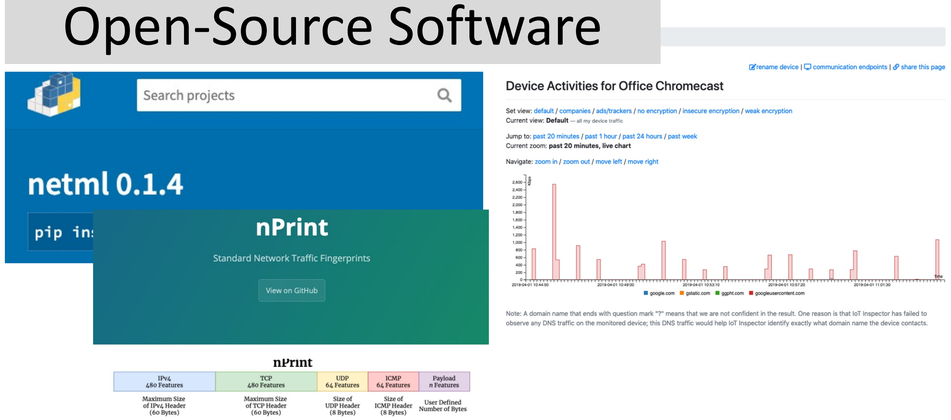
Scientific Impact:

- Fast anomaly detection (up to 20x speedup over state of the art)
- General representations of network traffic, anomalous/normal behavior
- Largest dataset of (consumer) IoT devices (6,000+ homes)
- Public software libraries for novelty detection in IoT, with reference implementations

Fast Algorithms

Method \ Dataset	UNB	CTU	MAWI	MACCDC	SFRIG	AECHO	DWSHR
OC-KJL: AUC Retained	1.42 ± 0.03	1.15 ± 0.07	0.99 ± 0.02	1.08 ± 0.03	1.00 ± 0.01	1.06 ± 0.01	1.01 ± 0.02
Train Speedup	1.98 ± 0.04	2.24 ± 0.05	3.82 ± 0.15	2.02 ± 0.06	2.19 ± 0.11	2.35 ± 0.06	1.96 ± 0.05
OC-KJL-QS: AUC Retained	1.41 ± 0.04	1.06 ± 0.04	0.91 ± 0.05	1.01 ± 0.02	1.00 ± 0.01	1.04 ± 0.02	0.98 ± 0.01
Train Speedup	1.23 ± 0.03	1.03 ± 0.02	1.88 ± 0.07	1.03 ± 0.03	1.03 ± 0.05	1.27 ± 0.03	1.00 ± 0.02
OC-Nyström: AUC Retained	1.56 ± 0.01	1.35 ± 0.05	0.98 ± 0.02	1.08 ± 0.02	0.98 ± 0.02	1.06 ± 0.01	1.04 ± 0.01
Train Speedup	2.56 ± 0.06	2.20 ± 0.05	3.74 ± 0.15	2.05 ± 0.06	2.30 ± 0.11	2.50 ± 0.07	1.97 ± 0.05
OC-Nyström-QS: AUC Retained	1.55 ± 0.01	1.20 ± 0.06	0.96 ± 0.02	1.04 ± 0.04	1.00 ± 0.01	1.05 ± 0.01	0.99 ± 0.01
Train Speedup	1.04 ± 0.02	1.02 ± 0.02	1.88 ± 0.07	1.03 ± 0.03	1.06 ± 0.05	1.23 ± 0.03	0.95 ± 0.02

Open-Source Software



Algorithms:

- Fast One-Class Support Vector Machine (OCSVM)
- Data Aggregation/Representation for Network Traffic

Software:

- NetML (Python library)
- IoT Inspector
- nPrintML
- Automated IoT firewall (AutoT)

Applications:

- Critical Infrastructure
- Health and Medicine
- Consumer Protection

External Partners and Outreach:

- University of Chicago Medicine
- Northwestern Medicine
- University of Chicago IT
- Federal Trade Commission
- Media

Applications and Testbeds

2021 NSF Cyber-Physical Systems Principal Investigators' Meeting
June 2-4, 2021

Award ID#: 1953740