

## Eric Nunes

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### CONTACT INFORMATION

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### EDUCATION

**Arizona State University**, Tempe, Arizona USA

Ph.D. Computer Engineering (GPA: 4.0/4.0), August 2014 - Present

- Dissertation Topic: “Reasoning about Cyber Threat Actors”
- Advisor: Paulo Shakarian
- Ph.D. Candidate - May 2017

**Syracuse University**, Syracuse, New York USA

M.S. Electrical Engineering, May 2012

**University of Mumbai**, Mumbai, India

B.S. Electronics and Telecommunication, June 2010

### HONORS AND AWARDS

- IEEE/ACM International Symposium on Foundations of Open Source Intelligence and Security Informatics (FOSINT-SI), 2016 **Best Paper Award** for “Argumentation Models for Cyber Attribution”.
- “Systems and Methods for Data Driven Malware Task Identification” – Selected for TechConnect 2016 Innovation Showcase.
- Business Category - Most commercial potential winner (Idea: Weight Estimation from Anthropometric features), Medical Center of The Americas Foundation, 2014 (\$1000).
- Graduate Scholarship to pursue M.S. at Syracuse University (2010 - 2012)

### ACADEMIC EXPERIENCE

**Arizona State University**, Tempe, Arizona USA

**Graduate Research Assistant (CySIS Lab)**

**August, 2014 - present**

Tools: *Python, Spark, PostgreSQL, Prolog, tcpflow.*

#### 1. Proactive Cyber-threat Intelligence

- Developed an operational system for cyber threat intelligence gathering from darknet and deepnet sites.
- The system employs data mining and machine learning techniques to collect information from hacker forum discussions and marketplaces offering products and services focusing on malicious hacking.
- Currently, this system collects high-quality cyber threat warnings each week. These threat warnings include information on newly developed malware and exploits.
- Developed data analysis tools to gather meaningful insights from this data to aid security experts for better threat analysis.
- *Relevant publications:* [B-1, J-1, C-10, C-9, C-7]

#### 2. Reasoning framework for Cyber-attribution

- Proposed a knowledge representation - machine learning (KR-ML) framework to reason about threat actors.

- The framework combines an argumentation model based on DeLP (Defeasible Logic Programming) and machine learning classifiers to evaluate evidence and reason about actors responsible for an attack.
- The framework was evaluated by building a dataset from the capture-the-flag event held at DEFCON – 10 million network attacks.
- Achieved higher precision than previously reported approaches (evaluated on the same dataset) that rely on machine learning classifiers alone—a jump from 37% to 64.5%.
- *Relevant publications:* [B-2, J-3, C-3, C-5, C-6, C-8, BC-1]

### 3. Malware task identification

- Developed a novel cognitive learning model to identify tasks (e.g. logging keystrokes, recording video, establishing remote access, etc.) that the malware was designed to perform.
- The proposed model was tested on different malware collections - including mutated and encrypted malware samples.
- The model outperformed standard machine learning approaches in identifying the tasks.
- *Relevant publications:* [J-2, C-1, C-2, C-4]

**Dartmouth College**, Hanover, New Hampshire USA

**Research Associate** ([Brain Engineering Lab](#))

**June, 2012 - July, 2014**

*Tools:* MATLAB, C++, OpenCV.

- Learning representations for Object recognition and localization from image and video datasets using biologically inspired algorithms.
- Proposed a supervised object recognition algorithm that achieves corresponding classification rates in comparison with standard machine learning approaches - at a fraction of the time and space costs.

**SUNY Upstate Medical University**, Syracuse, New York USA

**Research Assistant**

**May, 2011 - June, 2012**

*Tools:* MATLAB, C++.

Registering Multi-Spectral Retinal images to find features and points of interest to estimate the abundance of Oxygen saturation in the blood vessels in retinal images to diagnose retinal disorders.

#### PATENTS

- “Systems and Methods for Data Driven Malware Task Identification.”  
U.S. Provisional Patent: 62/182,006, Submitted (Non-provisional), 2016.
- “Intelligent darkweb crawling infrastructure for cyber threat intelligence collection.”  
U.S. Provisional Patent: 62/409,291, Licensed by CYR3CON, 2016.

#### PUBLICATIONS

**\*B** - Book, **\*J** - Journal, **\*C** - Conference, **\*BC** - Book Chapter

- [B-2] **E. Nunes**, P. Shakarian, G. Simari, A. Ruef “Artificial Intelligence Tools for Cyber Attribution”, *Under Preparation*, 2017.
- [B-1] J. Robertson, A. Diab, E. Marin, **E. Nunes**, V. Paliath, J. Shakarian, P. Shakarian “Darkweb Cyber Threat Intelligence Mining”, Cambridge University Press, 2017.
- [J-3] **E. Nunes**, P. Shakarian, G. Simari, A. Ruef “Hybrid Structured Argumentation Models for Cyber Attribution: An Empirical Study on Identifying Threat Actors” *submitted (under review)*, 2017.
- [J-2] **E. Nunes**, C. Buto, P. Shakarian, C. Lebiere, S. Bennati, R. Thomson “Cognitively-Inspired Inference for Malware Task Identification” *submitted (under review)*, 2017.

- [J-1] J. Robertson, A. Diab, E. Marin, **E. Nunes**, V. Paliath, J. Shakarian, P. Shakarian “Darknet Mining and Game Theory for Enhanced Cyber Threat Intelligence” The Cyber Defense Review, 2016.
- [C-10] M. Almukaynizi, A. Grimm, **E. Nunes**, J. Shakarian, P. Shakarian “Predicting Cyber Threats through User Connectivity in Darkweb and Deepweb Forums” ACM Computational Social Science (CSS), 2017.
- [C-9] M. Almukaynizi, **E. Nunes**, K. Dharaiya, M. Senguttuvan, J. Shakarian, P. Shakarian “Proactive Identification of Exploits in the Wild Through Vulnerability Mentions Online” International Conference on Cyber Conflict (CyCon-US), 2017.
- [C-8] A. Ruef, **E. Nunes**, G. Simari, P. Shakarian “Measuring Cyber Attribution In Games” IEEE APWG Symposium on Electronic Crime Research (eCrime), 2017.
- [C-7] **E. Nunes**, A. Diab, A. Gunn, E. Marin, V. Mishra, V. Paliath, J. Robertson, J. Shakarian, A. Thart, P. Shakarian “Darknet and Deepnet Mining for Proactive Cybersecurity Threat Intelligence” IEEE Conference on Intelligence and Security Informatics (ISI), 2016.
- [C-6] **E. Nunes**, P. Shakarian, G. Simari, A. Ruef “Argumentation Models for Cyber Attribution” IEEE/ACM International Symposium on Foundations of Open Source Intelligence and Security Informatics (FOSINT-SI), 2016 – **Best Paper Award**.
- [C-5] **E. Nunes**, P. Shakarian, G. Simari “Toward Argumentation-Based Cyber Attribution” AAAI Workshop on Artificial Intelligence and Cyber security (AICS), 2016.
- [BC-1] **E. Nunes**, N. Kulkarni, P. Shakarian, A. Ruef, J. Little “Cyber-Deception and Attribution in Capture-the-Flag Exercises” (extended version) in Cyber Deception: Building the Scientific Foundation (editors: S. Jajodia, V.S. Subrahmanian, V. Swarup, C. Wang) Springer, 2016.
- [C-4] **E. Nunes**, C. Buto, P. Shakarian, C. Lebiere, S. Bennati, R. Thomson, H. Jaenisch “Malware Task Identification: A Data Driven Approach” IEEE/ACM International Symposium on Foundations of Open Source Intelligence and Security Informatics (FOSINT-SI), 2015.
- [C-3] **E. Nunes**, N. Kulkarni, P. Shakarian, A. Ruef, J. Little “Cyber-Deception and Attribution in Capture-the-Flag Exercises” IEEE/ACM International Symposium on Foundations of Open Source Intelligence and Security Informatics (FOSINT-SI), 2015.
- [C-2] C. Lebiere, S. Bennati, R. Thomson, P. Shakarian, **E. Nunes** “Functional Cognitive Models of Malware Identification” 13th International Conference on Cognitive Modeling (ICCM), 2015.
- [C-1] R. Thomson, C. Lebiere, S. Bennati, P. Shakarian, **E. Nunes** “Malware Identification Using Cognitively-Inspired Inference” 24th Conference on Behavior Representation in Modeling and Simulation (BRIMS), 2015.

#### INVITED TALKS

- **Cyber-Deception and Attribution in Capture-the-Flag Exercises**  
The International Information System Security Certification Consortium (ISC2), Phoenix chapter, October, 2016.  
Army Research Office’s Cyber Deception Workshop, Washington, July 2015.
- **Automatic identification of malware tasks**  
Cactus-Con, Tempe, Arizona, March, 2015.

#### PROFESSIONAL EXPERIENCE

- Security Automation Intern (Data Science), [PayPal](#) May, 2017 - August, 2017**
- Analyzed user login activity using Akamai logs and enriched it with other data feeds such as threat intelligence, merchant data, credential dumps.
  - Implemented operational Anomaly detection models to detect Account Takeover (ATO) attacks to raise alerts for automated mitigation.
  - Visualized ATO attacks in real time on a dashboard in Splunk.

**Data Scientist, [Cyber Reconnaissance Inc. \(CYR3CON\)](#) August, 2016 - April, 2017**

- Developed data analysis tools for threat intelligence to draw meaningful insights from data mined from darknet and deepnet markets /forums (including detection of 0-day exploits, identifying exploits targeting specific vulnerabilities, trend analytics in cyber threat landscape etc.) for customer specific requirements. In particular, built learning models for predicting likelihood of exploitation of a vulnerability, named-entity recognition using RNN/LSTM seq2seq models.
- Consulted for SiteLock to improve their malicious web script detection model using machine learning techniques to make it more robust and less susceptible to false alarms

**Research Consultant, CYR3CON (Client: SiteLock)**

**June 2016 - August 2016**

- Analyzed large dataset of malicious web scripts (PHP/HTML) to generate features indicative of malicious activity.
- Developed classification models to classify web scripts as malicious or not using the generated features in Python.
- Visualized the performance of the trained model overtime and analyzed the classification errors for further improvement through Plotly dashboard.
- **Achieved malicious web script detection rate of >90%.**

**TECHNICAL SKILLS**

- **Machine Learning:** Classification, regression, clustering, anomaly detection, feature engineering, online learning, Experience with deep learning.
- **Programming Languages:** Python, MATLAB, C++, Prolog, HTML, LaTeX. Familiar with C, PHP, LISP, R.
- **Libraries:** scikit-learn, Weka, Pandas, OpenCV, Theano, Caffe.
- **Databases:** SQL, PostgreSQL, MYSQL, Familiar with MongoDB.
- **Operating System:** Windows, Linux, Mac OS X.
- **Tools:** Eclipse, MS Visual Studio, PyCharm.
- **Big Data and Cloud:** Splunk, Familiar with Big Data Processing Platforms: Hadoop, Spark and Cloud tools: Amazon S3.

**PRESS**

- [Hacking the hackers](#), ASU now: Access, Excellence, Impact. September 7, 2016.
- [Arizona State Builds Darknet Mining Model, Finds 16 Zero Days](#), Cisco Continuum. August 18, 2016.
- [Over 300 new cyber threats pop up on underground markets each week](#), HelpNetSecurity. August 10, 2016.
- [Machine Learning Goes Dark And Deep To Find Zero-Day Exploits Before Day Zero](#), Forbes. August 8, 2016.
- [Machine-Learning Algorithm Combs the Darknet for Zero Day Exploits, and Finds Them](#), MIT Tech Review. August 5, 2016. ACM TechNews. August 5, 2016.

**SERVICE**

**Journal Reviewer:**

- Social Network Analysis and Mining (SNAM), 2017.
- Sustainability, 2017.

**Conference Reviewer:**

- ACM SIGKDD Conferences on Knowledge Discovery and Data Mining (KDD), 2015, 2016.
- AAAI Conference on Artificial Intelligence (AAAI), 2016.
- International Conference on Autonomous Agents and Multiagent Systems, 2015.

## REFERENCES

Available on request