Proceedings of the International Conference on Industrial Engineering and Operations Management
Bangkok, Thailand, March 5-7, 2019

Network security analysis using Markov Models

Shwetank Sharan, Manish Agrawal, Anubhav Shukla
Department of Industrial and Systems Engineering
Indian Institute of Technology
Kharagpur, 721302, INDIA
shwetank@iitkgp.ac.in, manishagrawal.iitkgp@gmail.com, nickeyanubhav@gmail.com

Abstract

Uncertainties in the systems are increasing at an unprecedented rate, with the advent of fast paced changes in technology. A report which mentions the proliferation of IoT and industrial internet projects estimates that almost 50% of the manufacturing organizations will adopt Industry 4.0 standards in the upcoming years. Encapsulating the uncertain aspects of IoT and cybersecurity has become the prime focus of organizations working with digital networks. Organizations transmit sensitive information across networks and cyber security is dedicated to protecting the information systems. Dynamic modus operandi of the attackers pose a great challenge in detecting the anomalies. There are several layers of security having different levels of vulnerability and independent attributes.

In this paper, we have modeled the layers of the system as states of a Markov model. We have attempted to predict the mean time spent in the transient states. Each state of the model corresponds to vulnerable layers on the network which possess individual factors of vulnerability. The model also incorporates the effect of interactions among various layers of security. The dependency of layers is modeled as a Markov Graph. The transition probabilities of security layers are obtained using Bayesian techniques which provides computational tractability and flexibility for prior elicitation. This work will help organizations to design preventive strategies based on the attributes of the attack.

Keywords:

Cyber security, Markov Models, Expected path length, Bayesian Networks

Acknowledgements

The authors are grateful for the generous support from the Department of Industrial and Systems Engineering, Indian Institute of Technology, Kharagpur.

Biographies

Shwetank Sharan is an undergraduate student, pursuing integrated dual degree course in the Department of Industrial and Systems Engineering, Indian Institute of Technology Kharagpur. He recently published a conference paper on 'Survival Analysis using probit stick breaking process', which aimed to obtain improved posterior predictive density of time-to-failure. Currently, he is working on the statistical modelling of a Bayesian Non-parametric mixture model to detect anomaly in credit card transactions. His research interests include manufacturing, logistics and supply chain management, design of experiments, total quality management and anomaly detection.

Manish Agrawal is an undergraduate student, pursuing integrated dual degree course in the Department of Industrial and Systems Engineering, Indian Institute of Technology Kharagpur. Currently, he is working on finding optimal scheduling policy for production lines using Reinforcement Learning techniques. His research interest lies in the field of decision science, machine learning, and optimization methods.

Anubhav Shukla is an undergraduate student, pursuing integrated dual degree course in the Department of Industrial and Systems Engineering, Indian Institute of Technology Kharagpur. Currently working on classifying and detecting pneumonia in Chest X ray using auto-encoders and other deep learning model. He is also working on finding bias recommendation in Movie Recommendations platform (Netflix and Amazon Prime).