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Ing. Constantin-Andrei ZAMFIRA, student doctorand

Teza: *Contributii la Dezvoltarea si Standardizarea Web-ului Semantic (eng. Contributions to the Development and Standardization of Semantic Web)*

1. Lucrări științifice publicate în reviste indexate Web of Science-WoS (ISI)

1. A.Zamfira, R.Fat, C.Cenan; „Applying Semantic Web Technologies to Discover an Ontology of Computer Attacks”, Scalable Computing: Practice and Experience Journal, West Univ. of Timisoara, vol.20, no.4 (2019)
2. A.Zamfira, H.Ciocarlie; „Inference System to Achieve Saturation of (F,R,N) Knowledge Bases”, Acta Technica Napocensis: Series Applied Mathematics, Mechanics and Engineering, Technical University of Cluj-Napoca, vol.62,no3 (2019)
3. A.Zamfira, H.Ciocarlie; „A Network Intrusion Detection System Using Artificial Intelligence and Semantic Web Techniques”, Acta Technica Napocensis: Series Applied Mathematics, Mechanics and Engineering, Technical University of Cluj-Napoca, vol.63,no4 (2020)

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7. A.Zamfira, R.Fat, C.Cenan; „Description Logics: Some Complexity Results for the Main Languages”, Journal of Automation, Control and Applied Mathematics (ACAM), Technical University of Cluj-Napoca, vol.29 (2021)

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DEVELOPING AN ONTOLOGY OF CYBER-OPERATIONS IN NETWORKS OF COMPUTERS

By: Zamfira, AC (Zamfira, Andrei C.)¹; Ciocarlie, T (Ciocarlie, Tioria)¹

Edited by: Slavescu, RR (Slavescu, RR)

2018 IEEE 14TH INTERNATIONAL CONFERENCE ON INTELLIGENT COMPUTER COMMUNICATION AND PROCESSING (ICCP)

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Abstract

Many detection techniques have been proposed until now that struggle to keep up with the inherent complexity of applications, networks and protocols, resulting also in the growing rate of attacks that exploit them. Security frameworks that are created using an ontological approach are the next-gen systems of defense that have some advantages over the conventional techniques because they can capture the context of information and are capable to filter these contents depending on some certain factors. This paper proposes a method of creating an ontology that can be used for improving detection capabilities of attacks at all application levels. The ontology serves as a data model and knowledge base of the cyber-operations domain that conceptualizes and stores various types of data needed in the process of detecting an aware situation, such as information about attacks (types), OSI stack levels to which are targeted (software, network, hardware), countermeasure methods, resources necessary, knowledge required etc. The quality of the proposed model was assessed using a methodology known as OntoClean, that is a comprehensive suite of metrics for ontology evaluation that can comprise up to 15 criteria, as will be discussed during this paper. The ontology was tested in attack detection using a prototype web application firewall. In the evaluation process we used the famous dataset Kyoto2006+ proposed by the University of Kyoto in this scope. The results yielded for attacks detection by our proposed system were compared to other existing security solutions, like ModSecurit and Snort. In the conclusion section are stated the future directions of this research towards constructing reliable systems for cyber-security.

Keywords

Author Keywords: cyber-security; IDS; ontology; Semantic Web; domain modeling; knowledge integration and sharing

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Categories/Classification

Research Areas: Computer Science; Telecommunications

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By: Zamfira, A (Zamfira, Andrei)¹

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Date: APR 11-12, 2019

Sponsors: European Secur & Def Coll; Romania Partnership Ctr; Natl Def Univ Carol I

Abstract

In this paper is proposed an object-oriented reasoning system that is used to obtain the saturation of any type of logical knowledge base. A logical knowledge base is a triple (F,R,N) constituted from a set of facts, rules and negative constraints. The main objective is to implement an algorithm for derivation (i.e. a reasoner system) that works by successively applying the set of rules on the set of facts in order to derive new (implicit) knowledge from the explicitly stated ones and at the same time not to violate any negative constraints from the set N. This is known in logics as the Modus Ponens principle. The process continues until is obtained the saturation of the knowledge base, that is when new facts cannot be produced from the application of rules on the set of facts. The concrete implementation of the algorithm was done in Java. The knowledge base is comprised of sets of objects of classes in form of collections. The algorithm takes as input the sets of the knowledge base, (F, R, N) and produces as output the new (saturated) set of facts. In the process of matching the rules on the facts to derive conclusions, the algorithm relies on the backtracking algorithm in order to find all the possible solutions (i.e. all sets of facts that match the conjuncts of a rule) in an iterative, progressive and ordered manner. Experiments were made on three types of knowledge bases of various sizes: small, medium and large. Had been shown the computation times of the algorithm in each case in order to obtain its goals. Our backtracking-based solution has been compared with a more general one, who works by searching all possible combinations of facts that match a rule. Are shown the results of comparisons in graphical form for each of the 3 types of knowledge bases.

Keywords

Author Keywords: knowledge base; facts; rules; inference; reasoning system; derivation algorithm

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Abstract

The main scope of this paper is to present a methodology of engineering an ontology and to demonstrate how it is applied for designing and evaluating cyber-defense systems. The ontology is intended to be a vast model of the cybersecurity domain that captures a lot of information about attacks, source and target systems, methods, vulnerabilities exploited, consequences, controls for mitigation etc. For evaluating the quality of the proposed model we headed towards state-of-art methodologies comprised of a suite of metrics for assessing, among others: correctness, consistency, accuracy, completeness, soundness, task orientation. For the most important task, evaluation of efficacy in attacks detection, the proposed ontology was used as a knowledge model of a prototype web application firewall and we tested the system on a known evaluation dataset. The proposed system yielded a good detection rate and a low rate of false positives and negatives on the test data, and it was compared with other existing solutions in the field.

Keywords

Author Keywords: Ontology; data model; IDS; Semantic Web technology; knowledge representation and sharing

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By: **Zamfira, A (Zamfira, Andrei)**¹; Ciocarlie, H (Ciocarlie, Horia)¹

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Abstract

In this paper is proposed an intrusion detection system (IDS) that makes use of some of the newest and innovative technologies that began to be used also in this field, as are those from Artificial Intelligence and Semantic Web. From the first category the most important are multi-agents and clustering techniques, and from the latter ontologies. The main objective of the current work is to overcome the problems of traditional IDSs, that use a centralized architecture in realizing the detections of attacks, by employing a distributed approach, thus avoiding all inherent problems, as it will be described more broadly during this article. Proposed solution combines a multi-agent technology with a semantic data model and a data mining algorithm. Experiments have been performed and the results were compared with other 2 IDSs from literature, one centralized and one distributed in terms of two functional requirements: scalability and detection accuracy.

Keywords

Author Keywords: network IDS; Semantic Web; ontology; agents; machine learning; detection accuracy

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ACTA TECHNICA NAPOCENSIS SERIES-APPLIED MATHEMATICS MECHANICS AND ENGINEERING
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Abstract
This article aims to present a system for making inference (derivation) on any logical knowledge base with the goal to achieve its saturation. Typical knowledge bases from literature are comprised of facts and deduction rules. In our work was considered an extra layer of this ontology: the one of constraints. So, in our case, the KB is a triple: (F,R,N). The concrete implementation of the system for derivation was made in the object-oriented language C#. The KB is represented in OO environment as a collection of objects of classes corresponding to each type of knowledge. The system takes at input the knowledge base (in OO representation), applies the derivation algorithm and produces at output the saturated set of facts. The testing was done on three types of KBs: small, medium and large. Results and comparisons are presented to the reader in tabular form.

Keywords
Author Keywords: knowledge base; derivation algorithm; inference engine; saturation; forward chaining

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Articolul "Towards the Next-Gen Technologies for Internet: The Internet of Things", avand autorii Constantin Zamfira, Calin Cenan, Raluca Fat a fost acceptat pentru publicare in revista Automation, Computers, Applied Mathematics (ACAM), insa mai trebuie facute unele ajustari. In acest sens, cele mai relevante sugestii ale review-erilor se gasesc in attachment.

Va rugam sa faceti modificarile necesare in decurs de 10 zile calendaristice, apoi sa ne retrimiteti articolul in forma finala.

Va informam, de asemenea, ca volumele conferintei ICCP din anii 2018 si 2019 au fost indexate in ISI Web of Knowledge.

Conf. Dr. Ing. Delia Mitrea,
Prof. Dr. Ing. Sergiu Nedevschi

Review_CZamfira_I...

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F Bul.Inst.Polit.Iasi 2019; 69 (3) : 23-37; Language: EN

Semantic Web., Artificial Intelligence., process automation., ontology., logical representation formalism., OWL.


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Using Artificial Intelligence and Semantic Web Technologies Inside Cyberdefense Systems

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Abstract

In this paper we will make a study and analyses regarding the new techniques used in the construction of Intrusion Detection Systems (IDS). Because most of these techniques, as it is stated in the literature, come from the Artificial Intelligence domain, here we will focus our attention also on it, more specifically Machine Learning. Are discussed some of the most important techniques from this domain and it is shown how they can be used to improve the detection of attacks. Models in the form of UML diagrams are presented with the scope to also visually illustrate the role of each technique in the intrusion detection process. From the articles studied in the literature by authors in conducting the current research was compiled a list of some commercial/research IDS products that use Machine Learning algorithms in their detection methodologies. Like in any review paper, the reader is provided with references in literature where one can find more information to enrich its knowledge for the particular discussed domain.

Keywords

artificial intelligence., machine learning., deep learning., semantic web., intrusion detection system., intelligent technology.

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