

**CLOUD WORM DETECTION AND RESPONSE TECHNIQUE BY
INTEGRATING THE ENHANCED GENETIC ALGORITHM AND
THREAT LEVEL**

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ABSTRACT

A worm is known as a malicious code that can replicate, infect and propagate itself without attaching itself to any host. Unlike other malicious codes, such as a Trojan horse and a virus, a worm can cause serious damage due to its payload and interrupt or stop cloud resources and services which then lead to loss of money, confidential information and productivity for organisations or users that rely on data storage, services and applications that run on the cloud. Detecting and stopping cloud worm attacks have become a hard and challenging endeavour. Therefore, this research proposes a cloud worm classification based on its features. The research also develops a cloud worm detection technique by integrating the enhanced genetic algorithm and proposes a cloud response technique based on threat levels. The proposed cloud worm detection and response technique is evaluated based on accuracy rates. The novelty and strengths of the proposed technique for cloud worm detection and response lies in the worm cloud classification, the integration of the enhancement genetic algorithm and the threat level measurement that impact confidentiality, integrity and availability. For the enhanced genetic algorithm (EGA), new parameters have been constructed for the existing genetic algorithm based on the selection proportional of fitness, tree mutation, tree crossover and evolution controller to increase the accuracy rate of the cloud worm detection technique. The genetic algorithm is based on the idea of the natural selection process and genetics which imitates the biological process, thereby helping solve unconstrained and constrained optimisation problems. The method of new offspring creation from the fittest parents has been mapped and used to detect unknown future cloud worm attacks. Threat level is measured by security metrics on the basis of confidentiality, integrity and availability impact. An experiment has been conducted in a controlled lab environment based on knowledge discovery techniques using open source tools. This research used 1195 datasets in the experiment wherein dynamic analysis and security metrics have been applied. From the experimental result, the EGA technique has produced an overall detection accuracy rate of 99.749 % with 0.014 % false positive rate, thus outperforming the existing work of the OlexGA technique with 41.05% improvement. This research has produced a technique that can detect and respond to cloud worm attacks.

ABSTRAK

Cecacing dikenal sebagai kod berbahaya yang boleh mereplikasi, menjangkiti dan menyebarkan dirinya tanpa kemunculan dirinya kepada mana-mana hos. Tidak seperti kod berbahaya yang lain, seperti Trojan horse dan virus, cecacing boleh menyebabkan kerosakan yang serius akibat muatan dan mengganggu atau menghentikan sumber dan perkhidmatan yang kemudiannya menyebabkan kehilangan wang, maklumat sulit dan produktiviti untuk organisasi atau pengguna yang bergantung pada penyimpanan data, perkhidmatan dan aplikasi yang dilaksanakan di awan. Mengesan dan menghentikan serangan cecacing awan telah menjadi usaha yang sukar dan mencabar. Oleh itu, kajian ini mencadangkan pengelasan cecacing awan berdasarkan ciri-cirinya. Penyelidikan ini juga membangunkan teknik pengesanan cecacing awan dengan mengintegrasikan algoritma genetik yang dipertingkatkan dan mencadangkan teknik tindak balas awan berdasarkan tahap ancaman. Cadangan pengesanan cecacing awan dan teknik tindak balas dinilai berdasarkan kadar ketepatan. Keberkesanan dan kekuatan teknik yang dicadangkan untuk pengesanan dan tindak balas cecacing awan terletak pada klasifikasi cecacing awan, integrasi algoritma genetik peningkatan dan pengukuran tahap ancaman yang memberi kesan kerahsiaan, integriti dan ketersediaan. Untuk algoritma genetik yang dipertingkatkan (EGA), parameter baru telah dibina untuk algoritma genetik yang sedia ada berdasarkan pemilihan berkadar kecergasan, mutasi pokok dan crossover pokok dan pengawal evolusi untuk meningkatkan kadar ketepatan pengesanan cecacing awan. Algoritma genetik adalah berdasarkan kepada proses pemilihan semulajadi dan genetik yang meniru proses biologi, dengan itu membantu menyelesaikan masalah pengoptimuman yang tidak terkawal dan terkawal. Kaedah penciptaan anak baru dari ibu bapa yang paling tepat telah dipetakan dan digunakan untuk mengesan serangan cecacing awan masa depan yang tidak diketahui. Tahap ancaman diukur oleh metrik keselamatan berdasarkan kerahsiaan, integriti dan kesan ketersediaan. Eksperimen telah dijalankan di persekitaran makmal terkawal berdasarkan teknik penemuan pengetahuan menggunakan alat sumber terbuka. Kajian ini menggunakan 1195 dataset dalam eksperimen di mana analisis dinamik dan metrik keselamatan telah digunakan. Daripada hasil eksperimen, teknik EGA telah menghasilkan kadar ketepatan pengesanan keseluruhan sebanyak 99.749% dengan kadar positif palsu 0.014%, dengan itu mengatasi kerja sedia ada teknik OlexGA dengan peningkatan 41.05%. Penyelidikan ini telah menghasilkan satu teknik yang dapat mengesan dan bertindak balas terhadap serangan cecacing awan.

ملخص

تعرف الدودة في الحوسبة على أنها نوع من أنواع الرموز الخبيثة، والتي لديها القدرة على تكرار وإصابة ونشر نفسها من دون إضافتها إلى أي مضيف. وبالمقارنة مع الرموز الخبيثة الأخرى، مثل حصان طروادة والفيروس، يمكن للدودة أن تسبب أضراراً جسيمة؛ بسبب حملتها ومقاطعتها وإيقافها لخدمات وموارد الحوسبة السحابية. وبالتالي هذا يؤدي إلى فقدان المال والمعلومات السرية والإنتاجية للمنظمات، أوللمستخدمين الذين يعتمدون على تخزين البيانات والخدمات والتطبيقات في الحوسبة السحابية. وعملية إيقاف وكشف هجمات الدودة في الحوسبة السحابية أصبحت مسعاً وتحدياً صعباً لا بد من دراستها والتركيز عليها، لذلك هذه الدراسة تقوم على تصنيف دودة الحوسبة السحابية وبيان أساس خصائصها. بالإضافة إلى ذلك، فإن هذه الدراسة طوّرت تقنية إكتشاف الدودة في الحوسبة السحابية من خلال دمج الخوارزمية الجينية المحسنة، وإقتراح تقنية الإستجابة في الحوسبة السحابية وبيان مستويات التهديد. تم تقييم التقنية المقترحة؛ للكشف والإستجابة عن الدودة في الحوسبة السحابية إستناداً إلى معدلات الدقة. وتكمن قوة وإبداع التقنية المقترحة للكشف والإستجابة عن دودة الحوسبة السحابية من خلال تصنيف دودة الحوسبة السحابية، ودمج الخوارزمية الجينية المحسنة، وقياس مستوى التهديد الذي يؤثر على سرية ونزاهة البيانات ومدى توافر البنية التحتية للحوسبة السحابية. وفيما يتعلق في الخوارزمية الجينية المحسنة تم إنشاء متغيرات جديدة لتحسين الخوارزمية الجينية على أساس إختيار الحلول النسبية الأمثل، والطفرة الجينية، والتزاوج الجيني، ووحدة تحكم التطور الجيني بهدف زيادة مستوى الدقة لتقنية الكشف عن الدودة في الحوسبة السحابية. تقوم الخوارزمية الجينية على فكرة عملية الإنتقاء الطبيعي وعلم الوراثة التي تقلد العملية البيولوجية، مما يساعد على تحسين حل المشاكل المعقدة، والغير مقيدة. وطريقة إنشاء ذرية جديدة من الأبناء يتم إستنباطها من خلال المزاجية المثلى بين الآباء والأمهات لإستخدامها في الكشف عن هجمات الديدان الغير معروفة و المستقبلية للحوسبة السحابية. ويقاس مستوى التهديد للديدان في الحوسبة السحابية اعتماداً على المقاييس الأمنية إستناداً إلى مستوى تأثير السرية والنزاهة للبيانات والمعلومات، بالإضافة إلى مدى توافر البنية التحتية للحوسبة السحابية. وتم إجراء التجارب في بيئة عمل مختبرية تحت الرقابة لتحليل ومراقبة سلوك الديدان في الحوسبة السحابية وكان ذلك اعتماداً على تقنية إكتشاف المعرفة بإستخدام أدوات مفتوحة المصدر. وقد استخدمت هذه الدراسة 1195 مجموعة من العينات في التجارب حيث تم تطبيق التحليل الديناميكي والمقاييس الأمنية. بناءً على نتائج التجارب؛ أنتجت التقنية الخوارزمية الجينية المحسنة ما يعادل 99.749% من معدل كشف الدودة في الحوسبة السحابية، بالإضافة إلى نسبة 0.014% من معدل الإكتشاف الكاذب، وبالتالي فإن هذه النتيجة حسنت على تقنية الخوارزمية الجينية أولكس بنسبة 41.05%. هذه الدراسة ساهمت في تقديم تقنية جديدة لديها القدرة على الكشف والإستجابة لهجمات الدودة في الحوسبة السحابية.

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ABBREVIATIONS

API	Application Program Interface
CSA	Cloud Computing Usage
DDoS	Distributed Denial-of-Service
DM	Data Mining
DoS	Denial-of-Service
DST	Dempster-Shafer Theory
DT	Decision Tree
EC2	Elastic Compute Cloud
EGA	Enhanced Genetic Algorithm
FAT	File Allocation Table
FN	False Negative
FP	False Positive
FTA	Fault-Tree Analysis
GA	Genetic Algorithm
IaaS	Infrastructure as a Service
IBK	K-nearest Neighbours
IDPS	Intrusion Detection and Prevention Systems
IDS	Intrusion Detection System
IRC	Internet Relay Chat
KDD	Knowledge discover database
LAN	Local Area Network
MD5	Message-digest 5
OlexGA	Olex Genetic Algorithm

PaaS	Platform as a Service
PE	Portable Executable
SaaS	Software as a Service
SMB	Server Message Block
TCP	Transmission Control Protocol
TN	True Negative
TP	True Positive
UDP	User Datagram Protocol
VM	Virtual Machine
VMM	Virtual Machine Monitor