

Hybrid Cuckoo-ABC Search: A comprehensive framework for vulnerability solutions in cloud computing

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ABSTRACT

In the increase in cloud technology, data security became an concern over from application service (SaaS) to Infrastructure services (IaaS).As term virtualization, Vulnerability is one of the major concerns over Private and hybrid-Clouds have been Soft target in attacks, So perceived as a relatively impervious deployment model among Cloud models. Confidentiality, integrity, availability, authenticity, and accountability are the essence of security objectives for information systems and the services they offer. In this paper , artificial bee colony algorithm and Hybrid Cuckoo-ABC Search algorithm have been analyzed , The optimization problem solving successes of above algorithms compared statistically by testing over different files , which build a security framework approach for vulnerabilities which coverage and cost optimization .And found the run-time performance of the Cuckoo Search algorithms are statistically better than the ABC algorithm.

Keywords – Artificial bee colony, Cuckoo search, vulnerability, cloud computing.

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I. INTRODUCTION

Now a day's Cloud Computing technology its reaching every corner of organization from especially Small and Medium Business (SMB) enterprises, This organization getting benefits by placing their application and sensitive data into the cloud[1].Cloud is good in virtualization , scalability in distributed computing system, in tern high computational recourse are provided as a service , which becomes next generation internet. The difficulty to fix the old problems or issues with new setting related to clouds which are more acute[2].There is huge gap or hidden levels in cloud between physical infrastructure and the owner of the information being store data and process on those data . This hidden or gap leads to vulnerabilities, if not matched with new settings [3]. Every level of services model provided by cloud have ways to mitigation vulnerability and threats [4]. In cloud structure paradigm, the different way of storing and processing are done in single data center, its one of the advantage in using a cloud computing environment[5]. This rapid transition towards the clouds, has fuelled concerns on a critical issue for the success of information systems, communication and information security. Dimitrios Zissis *et al.* [7], have introduced a Trusted Third Party, tasked with assuring specific security characteristics within a cloud environment. In Communication consists for security related solution like cryptography, specifically Public Key Infrastructure operating in concert with SSO and LDAP, to ensure the authentication, integrity and confidentiality. In cloud

word 'security' is interchanged as "risk , threat and vulnerability". And in every level in cloud a new vulnerability is added.

II. PROPOSED METHODOLOGY

Since there is a level of abstraction between the infrastructure level and the application user /owner of the information being stored and processed. Such indirect control of recourses / infrastructure environment (storage) introduces vulnerabilities which was unaware in previous settings , So we should concentrate on levels security like portability; governance; interoperability; business continuity; disaster recovery; data center operations; incident reporting and response; application security; identity and access management; encryption and key management. The objective of the paper is to propose a cloud security framework and an approach for vulnerabilities coverage and cost optimization using Hybrid Cuckoo search - Artificial Bee Colony optimization algorithm and Artificial Bee Colony optimization algorithm. The objective is to mitigate an identified set of vulnerabilities using a selected set of techniques when minimizing cost and maximizing coverage. This paper also proposed to compare and find the optimize solution to selection process of a set of security techniques to cover a set of security vulnerabilities, when minimizing the cost and the new vulnerabilities resulting from the security between Hybrid Cuckoo search - Artificial Bee Colony optimization algorithm(HCA) and Artificial Bee Colony optimization algorithm (ABC). The general

cloud architecture with various threats is shown in the below figure 1.

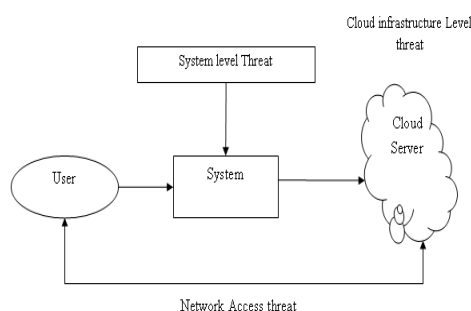


Fig 1: Cloud architecture with various threats.

The rest of the paper organized in two sections: Concepts of ABC algorithm and hybrid Cuckoo-ABC search .Next is Experimental results and find the best solution between HCS-ABC and ABC algorithm.

III. ARTIFICIAL BEE COLONY ALGORITHM

The ABC algorithm was proposed by [6], algorithm inspired by foraging working of honeybees. The working under go three phases in the ABC algorithm: employed, onlooker and scout bees. Employed bees are considered for computing nectar amounts of the food sources and the number of employed bees is equal to the number of the food sources at the foraging area. Onlooker bees phase considered to collect the food sources which have quality nectar amounts and the number of onlooker bees is equal to the number of employed bees. In Scout bees phase, it used to discover new food sources from abandoned from early phases and this food source is replaced with the new one found by the scout bee. The employee bee is selected whose probability of food source has higher quality is treated as better solution. The quality is depends on fitness

First, an initial population which contains SN (number of food sources) solutions is generated randomly according to following equation:

$$x_{i,j} = x_j^{\min} + \varphi_{i,j} (x_j^{\max} - x_j^{\min}) \quad (1)$$

where $\varphi_{i,j}$ random value for dimension j
 x_j^{\min} , x_j^{\max} is the minimum and maximum limit value of the search range on dimension j.

Every solution x_i ($i = 1,2,3, \dots, SN$) is an n-dimensional vector are initialized and considered as abandoned and has fitness value. In the ABC algorithm, the fitness value (*fitness*) is calculated by the following equation:

$$\text{fitness}_i = 1 / (1 + |f_i|), \text{ if } f_i \geq 0, \\ \text{otherwise } 1 + \text{abs}(f_i), \text{ if } f_i < 0 \quad (2)$$

where f_i is fitness w.r.t food source i . After the initialization of the population, employed bees searches better food sources with its neighbors

$$v_{i,j} = x_{i,j} + \varphi_{i,j} (x_{i,j} - x_{k,j}), i \neq k \quad (3)$$

where k and i are from values of $(1,2,3, \dots, SN)$, j is a randomly selected dimension ($j = 1,2,3, \dots, D$), $\varphi_{i,j}$ is a uniform random number in $[0, 1]$, $x_{i,j}$ and $x_{k,j}$ are the position of food source i and k (randomly selected which is neighbor of i) of dimension j , respectively. If the new food source is better than the old one, it is replaced with the old one. Next phase, onlooker bees will compute the food sources quality which are from employed bees phase and selects the food source based on quality probability which is determined by any food source i as follows:

$$p_i = \text{fitness}_i / \sum_{n=1}^{SN} \text{fitness}_n \quad (4)$$

The above process is used to search good solutions over area to carry out the exploitation. To get out of local optimums, algorithm must explore new solutions. To explore new solutions from exhausted solution, the last phase scout bees is considered which utilizes search space for avoiding local optimums.

IV. HYBRID-CUCKOO-ABC ALGORITHM

Cuckoo search is an optimization algorithm developed by Xin-she Yang and Suash Deb in 2009. The Cuckoo search algorithm based on meta-heuristic algorithm which owes their eggs in the nests of other host birds. If host eggs identifies the eggs are not their own, it will abandon its nest and build a new nest.

The working of cuckoo search algorithm :

Initialization of population $X_i \{ 1,2,3, \dots, N$
 N is number of nest or Vulnerability solutions .

The equation of the HCS-ABC algorithm is uses random walk to select better solution ,given below

$$X_{i+1} = X_i + \alpha \text{ XOR } \text{levy}(\lambda) \quad (5)$$

Here ,in this phase we compare X_{i+1} and X_i , if the fitness of X_{i+1} is better than X_i then X_{i+1} is replaced by X_i . The fitness is calculated by

$$P_{\max} = P_s / P_T \quad (6) \\ (P_{\max}) = \text{best Fitness} \\ P_s = \text{selected population fitness} \\ P_T = \text{Total population fitness}$$

V. GENERATING DATA SET

Data Set are acquire on three parameters as vulnerabilities: The vulnerably as Data Breach , data loss and data leak attack on files of different virtual machine(VM) (VM are nest or food source for HCA and ABC algorithm respectively).

Data breach : An attacker hacking into a virtual machine in cloud network to steal sensitive data. Consider, If an unauthorized employee sees the file(information or data) on a computer over the shoulder of an authorized employee, that also constitutes a data breach.

Solution: i) Periodically change the password
 ii)Encrypt the data.

Data loss: An attacker hacks the data and get control on the system and delete or remove the sensitive data which are not recoverable.

*Solution:*i)Store in multiple copy(backup)
 ii)use homomorphic encryption .

Data leakage : An attacker ,attacks while data flows between network (sending or communication between system) critical systems, which are systems of records or files ,this happens at peer level communication.

Solution: i) keep strong keys
 ii) Use digital signatures.

With above data set vulnerability is applied on various virtual machine or clouds. And searches, which virtual machine can withstand when compared with rest of the virtual machine is considered as the best virtual machine. With above data set vulnerability is applied on various virtual machine or clouds. And searching or finding out which virtual machine can withstand attacks when compared with rest of the virtual machine is considered as the best virtual machine. We generated data set from 10 virtual machines with above parameters. For example the snapshot of data set given below (Table 1) where “virtual machine 3” is attacked by data breach ,data loss and data leak which corrupted the number of files as 2,2 and 3 respectively .

Table 1: Data set of 10 virtual machine on 20 files.

VM Name	Data Breach	Data Loss	Data Leak
VM1	3	2	0
VM2	5	1	1
VM3	2	2	3
VM4	1	2	1
VM5	0	0	2
VM6	2	4	1
VM7	1	2	2
VM8	0	2	2
VM9	6	6	2
VM10	2	5	0

Table 2: Computation cost, memory usage and Computational time for different number of files using ABC algorithm

No of files	Computati on cost(sec)	Memory usage (KB)	Computational Time (s)
15	15.7454	598743	19347
30	18.9154	787424	20035
45	20.1240	996586	29984
60	25.9958	107479	31185

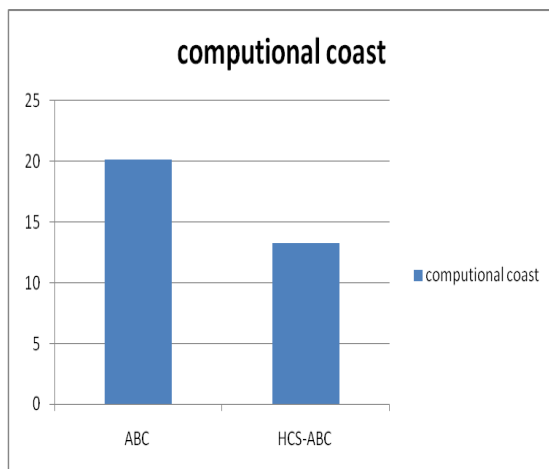
Table 3: Computation cost, memory usage and Computational time for different number of files using HCA algorithm.

No of files(s)	Computation cost(sec)	Memory usage (KB)	Computational Time (s)
15	10.9912	725631	15246
30	11.6651	897852	17241
45	14.1454	952146	20125
60	16.2134	992512	24216

Table 4: Compression result between HCS-ABC and ABC algorithm.

Method	Computational Cost
(HCS – ABC) algorithm	13.253
ABC algorithm	20.195

Graph: Compression result between HCA and ABC algorithm



VI. COMPRESSION BETWEEN ABC AND HYBRID- CUCKOO-ABC ALGORITHM WITH EXPERIMENTAL RESULTS

Exploration and exploitation are the two essential concepts in the evolutionary based algorithms. Exploration used to search entire space (global) to find good new solutions. Exploitation is the ability to find the optimum solution locally in given search space which includes the optimum solution. In ABC algorithm, employed and onlooker bees ensure exploitation, But weak in exploration done by scout bees. Whereas hybrid Cuckoo-ABC(HC-ABC) algorithm uses both Exploitation (neighbor) local search and exploration done with help of levy flight (global), in order to improve convergence with low cost. So in our work we replaces scout bee with levy flight to improve the performance. As we can see the graph representation taken from table2, table3 and table4 the time complexity of HCS-ABC is better than ABC algorithm.

VII. CONCLUSION AND FUTURE WORK

This paper presents compression between ABC and hybrid cuckoo-ABC search(HC-ABC) optimization algorithm which can search best Virtual machine for various vulnerability solutions on Cloud computing, keeping bandwidth constant, Cloud computing needs to be operated in a stable system. Therefore, between HCS-ABC algorithm and ABC algorithm, HCS-ABC algorithm is suitable for Cloud computing environment because it converge maximum vulnerability solutions with minimum cost. The experimental results illustrated that the proposed method HCS-ABC algorithm

performed effective results than ABC algorithm method by comparing time taken by both methods and its performance increases as virtual machine and files added, so it supports good scalability. For future work as technology increases vulnerability also increases, so we can incorporate many other vulnerability in cloud environment and test on it.

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