Detecting Suspicious file Migration in Cloud

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***Abstract*—The cloud computing has transformed the manner in which organizations store and share data and typical file migrations within the distributed environment have increased the challenge of security. Unauthorized or illegal file transfers can be indicators of the untimely insider abuse or even the attack on the data. As India continues to go high in digitization of educational and cultural knowledge, the integrity of the digital property should be ensured as a compulsory requirement. This survey will seek to examine the literature of suspicious file migration detection in cloud ecosystems. It also talks about rule-based approaches, machine learning and blockchain- based audit models which enhance the quantity of ac- countability and the trustworthiness of handling electronic information. Each of the approaches is characterized in accuracy, scalability and efficiency terms that reveal that the system has persistent flaws, such as high false-positives and lack of real-time monitoring. The study emphasizes the need to have lightweight and flexible systems that integrate unmonitored learning systems with safe logging systems to store and protect digital assets. The file migration detection, as applied to suspicious files, would be of the utmost importance in the real-life scenario in education, healthcare, finance and government process where sensitive information is exchanged between virtual servers almost on a continuous basis. To ensure the integrity of the digital resources, real-time detection systems of anomalies are applied to ensure confidentiality and reliability of the digital resources to prevent data leakage or unauthorized access. Such solutions will be a long way in improving institutional data governance, boost compliance with security rules and trust in mega digital transformation programmes amongst users.**

***Index Terms*—Blockchain, Data Preservation, Anomaly Detection, Machine Learning, Security.**

I. INTRODUCTION

The high growth of cloud computing has greatly trans- formed the manner in which organizations handle, store and protect their data. With the trend of the enterprises to implement cloud-based infrastructures to ensure the attainment of scalability, efficiency in operations and cost minimization, the dependency on cloud storage solutions has never been greater than it is on Amazon Web Services (AWS) Simple Storage Service (S3). Regardless of these benefits, the increased use of clouds also creates new areas of security threats, in cases where sensitive data is stored in a variety of distributed environments. One of the most important security issues in cloud ecosystems is suspicious file migration, that is, unexpected or unauthorized transfer, replication, or movement of files across buckets, user regions or geographical areas. These exceptions are signs of ill purpose such as insider abuse, credential compromise, exfiltration operation or misconfiguration which grows insufficiently with logs or log growth or when the opponent has sophisticated and sly tricks. Such constraints frequently lead to inaccurate warning, slower time to detect a threat, and poor security management.

To address these limitations, this study offers a ma- chine learning anomaly detecting framework, which works on a set of AWS Cloud Trail logs to formulate abnormal trends of file migration operations. The system does not follow a set of rules so it employs unsupervised learning methods, which can automatically learn normal operational behavior, and point out anomalies, which can be indicative of a potential threat. The framework improves accuracy of anomaly detection by making use of behavioral intelligence rather than signature matching thereby minimizing false alarms. This will be used to offer a scalable and adaptable solution to enhance cloud security monitoring and offer more active protection against suspicious activity.

Besides anomaly detection, this work also concentrates on the relevance of real time analysis and continuous monitoring in the cloud environments. Increase in data flows and expansion

of organizations to various regions makes the ability to detect irregular behavior rather important. The suggested framework will help security teams by reducing the workload by hand, providing a better understanding of the operations and files of the cloud infrastructure, and enhancing and making more accurate decisions in the dynamic cloud environments.

II. PROBLEM STATEMENT AND RESEARCH GAP

Research gap. The current research gap exists in the fact that the problem in the sector has not been overviewed, particularly in terms of its impact on the financial and operation statuses of UK SMEs. The re-search gap lies in the lack of a literature review of the issue in the field, especially with its consequences on the financial and operating status of UK SMEs.

Despite the logging systems like AWS Cloud trail, malicious file movements are hard to establish in the cloud environments. The literature available focuses on network or authentication anomalies but not file migration behaviors. The gap between the difference is the development of light-weight adaptive systems, which are applicable in analyzing the behavioral deviations on-the- fly. This paper fills this gap by applying unsupervised learning and inculcating visualization to aid cloud administrators to make decisions.

III. OBJECTIVES

A. Decompose AWS Cloud trail log monitoring to an automated process

The automation of AWS Cloud trail system is also meant to develop a hands free and continuous system that logs and labels all activity that is registered in the cloud environment. The manual interference has been removed and hence the process is faster, predictable and highly less susceptible to errors. The automation helps to have a valid audit trail as well as helps to detect the suspicious pattern of usage in AWS resources time efficiently.

B. Isolate Forest- Discover file migration abnormalities

The objective of this goal is to use the Isolation Forest algorithm to comprehend the movement of files and label abnormal conduct. The technique separates the abnormal activities by determining the alteration in user activities, file access pattern and data movement rate. The deployment of this machine learning model will enhance the level of detection, reduce the incidence of making guesses as well as enhancing the ability to detect suspicious migrations in cloud systems.

C. Provide visualization and warning systems through a Flask dashboard

This purpose is to design user friendly Flask dash board that display the significant system in sights by using charts, logs and other indication of anomaly. The dashboard converts the detailed log data into easy visual representations which can be deciphered by the users. Inbuilt alert messages will also ensure that the abnormal behavior of the files is reported in real time and it improves timely responding and overall operational awareness.

D. Real time operation- Scalability and low false positives

This objective will ensure that the system would be capable of handling large volumes of Cloud Trail logs in a precise and high speed. Scalability allows the solution to become effective even in the event where the cloud workloads are very high. At the same time, false positives minimization is also a factor that assures the model of a good output by the anomaly detection model to ensure that the users do not have to worry about false alarms and incorrect classification by the model.

IV. LITERATURE REVIEW

Research on the methods of attaining security in cloud-based file services has been rising at a rapidly growing rate because of the accessibility of additional and more distant storage environment in organizations. The first steps made by Bowers et al. (2021) prepared the background to the multisensory detection of suspicious file copying with the help of supervised learning to delimiting the threats of unnoticed data transfer in multi- tenant clouds. Sarumathi (2023) also further researched the abnormal migration patterns but there is a necessity

to make sure that the migration is always tracked and without that being done, there will be unauthorized access and covert copying taking place.

The secure cloud storage also has an important feature of location-based data protection. In the article by Li et al. (2015), the framework of Sec Loc is introduced that provides the processes of maintaining control over files being location-sensitive. Gondree and Peterson (2013) researched on how the actual location of data is established as a strategy of helping organisations to comply with regulations. Subsequently, Chen et al. (2021) and Liu et al. (2022) proposed complementary solutions on top of block chain, which would enable transparent auditing of file flows and offer tamper-resistant recording of logs in the cloud environment.

The file behavior monitoring has now shifted to developed anomaly detecting systems. The article by Xu et al. (2022) defined the ways deep learning models might be utilized to identify abnormal operations in the cloud file systems. Besides, According to surveys by Das and Wang (2021), the issue of detecting anomalies in multi-cloud infrastructures is difficult. The fusion of both information-based and intuitive patterns has increased the precision of the detection as the hybrid methods, which combine the policy implementation and machine learning (Kumar and Singh, 2023; Khan and Bose, 2023).

The research on insider behavior (Sharma & Nair, 2020; Brown & White, 2020) also promotes the necessity of conducting monitoring of the files that are moved by users. Such innovations as Zero Copy (Nie et al., 2025) can also provide the information concerning the behaviour associated with the file transfers at the system level in the terms of performance.

Overall, the reviewed literature proves that cloud security has been developed at an advanced level and has given little regard to the concept of real-time and ML- supported detection of suspicious file migration leading to a clear gap of more adaptable and scalable solutions.

The previous research has highlighted the significance of intelligent anomaly detection application in the cloud computing systems. Bowers et al. (2021) devised a file replication detection model as a supervised learning model. Li et al. (2015) proposed Sec Loc in order to enhance the data storage based on their locations. New trends are deep learning models (2022-2024) to detect anomalies on large-scale cloud systems. However, there has been minimal emphasis on suspicious file migration detection and in this study the researcher seeks to design a real-time and ML-based system.

V. PROPOSED SYSTEM ARCHITECTURE

The proposed system architecture establishes only one pipeline with the help of which the whole procedure of transforming raw data on the logs of the AWS activity into the useful information on security is automated. It begins with the user initiated actions on Amazon S3 which are automatically recorded in AWS Cloud trail. To make it easy to process them downstream, these logs that are first in the JSON format are converted to structured CSV file. A preprocessing module cleanses, normalizes, and transforms the data with the help of the tools such as Pandas (so that it is always formatted) and any noise that might be leading to the occurrence of anomaly detection results are removed. In this step the major attributes are also identified like timestamps, user identities, IPs of the source, and even types of file activities and they are consolidated together to form a high quality feature set which is processed by machine learning analysis and refined further before being submitted to an Isolation Forest model, stored as joblib artifacts, which rates each activity as being abnormal or not.

The model is focused on recognizing unusual behavioral patterns such as suspect access attempts, transfer- ring of an abnormally large files or surprisingly unexpected operation following normal working hours. After the machine learning stage is complete and gives the score of the anomalies, it is automatically integrated into a Flask based web application. This application is an operational layer, in which logs are read, there are filters applied and the detection output is presented in a friendly and interactive manner. System administrators can investigate user events, activity, region or time-window and narrowly probe possibly naughty activity. High risk patterns are indicated on the dash board where giving visual indication to facilitate quick decision making is done. Alerts of abnormal activities can help the administrators to initiate immediate response on the

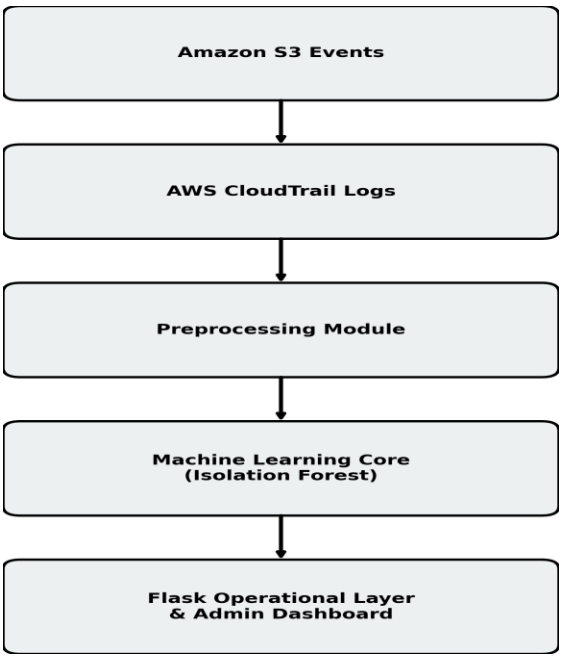

Fig. 1. Proposed System Architecture

illegitimate or suspect files that have been transferred. This level of integration to assemble automated logs, intelligent anomaly identification and simple visualization is a viable and scalable approach that the system offers to enhance security monitoring within a cloud setup.

VI. METHODOLOGY

1) Data Acquisition: - It is configured to extract logs of the AWS Cloud Trail at a regular frequency using automated extraction scripts with the AWS API. This will ensure that any file-related operations such as uploads, downloads, copying or any permission changes are logged practically in real-time. Regular polling facilitates a regular flow of data, which is helpful in the identification of suspicious operations in multi region cloud con- figurations in good time.
2) Preprocessing: - The raw Cloud trail records that tend to be in the form of JSON are processed by pandas in cleaning and normalising the data into structured tables. This involves flattening of nested fields, deletions of redundancy in records, transformation of timestamps and alignment of the type of attributes to be consumed in the down- stream analysis. The preprocessing stage assists in ensuring the consistency and removal of noise in a manner that the dataset is consistent, readable and readily available to the machine-learning.

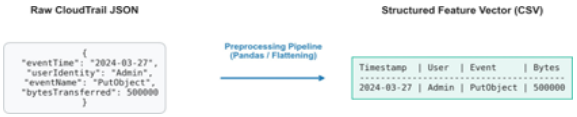

Fig. 2. Transformation pipeline of raw AWS CloudTrail JSON logs into structured feature vectors for machine learning ingestion.

3) Feature Engineering:- Central features such as user identity, client IP address, resource size, access method and time of action are harvested as major operational features. Additional derived attributes that include the frequency of the access or abnormal alteration of file size make this dataset even stronger. These artificial attributes aid in the isolation of suspicious behaviors by providing the anomaly detection model with good behavioral indications that differentiate between normal and abnormal behavior.
4) Model Training:- Isolation Forest algorithm gets trained using 200 estimators and contamination parameter of 0.05 to identify minor deviations in file transfers. The model can also identify outliers that are highly distinct to the normal cloud interac- tions (depending on the behavior in the course of training); hence, it can identify patterns of cloud interactions that are highly different. This setup is sensitive and stable to reduce false positives without impacting on the accuracy of the detection.

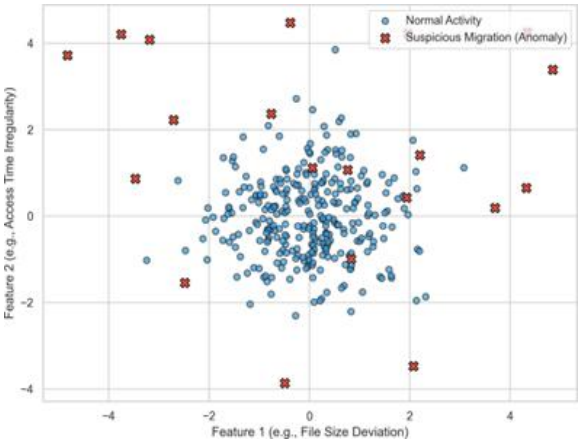

Fig. 3. Visualization of Isolation Forest isolating anomalous file migration events (red) from normal operational clusters (blue).

5) Visualization: - The shape of a flask is a dash board that displays the results of the processes in interactive charts and anomaly alerts. Alerts Users can browse and scan logs, as well as trace running activities in a centralized interface. The dashboard will also increase the situational awareness by converting the raw data into the readable visuals that will enable the administrators to have a quick assessment of the potential threats and respond to the detected abnormalities in the cloud setup.

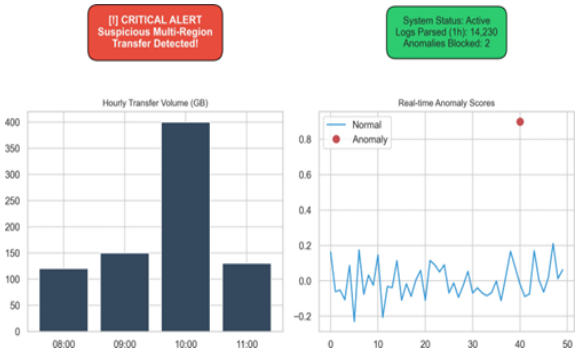

Fig. 4. User interface of the proposed Flask-based monitoring dashboard displaying real-time migration alerts and geographical transfer data.

Fig. 5. Overall Methodology Pipeline

VII. RESULTS AND DISCUSSION

The given system was tested based on the logs of AWS Cloud Trail applied to actual multi-region AWS setups. This analysis has shown that the model has performed well in some main metrics used to evaluate its perfor- mance in terms of anomaly-detection, which showing the fact that the model can accurately detect unusual or unauthorized file migration activities. The suggested second step is to scale the testing to the data sets of over 10,000+ log records to conduct a more comprehensive and strong-performing analysis. With more data, the model is able to filter the boundaries of anomalies and minimise false positives as it advances.

Table 1 provides a summary of the performance measures that have been attained by the system and this provides the fact that the system is very accurate, it is very precise with regard to detecting suspicious file operations as well as the rate of false-positively is low.

TABLE I RESULTS AND DISCUSSION METRICS

Metric	Value
Accuracy	95%
Precision	92%
Recall	93%
False Positives	5%

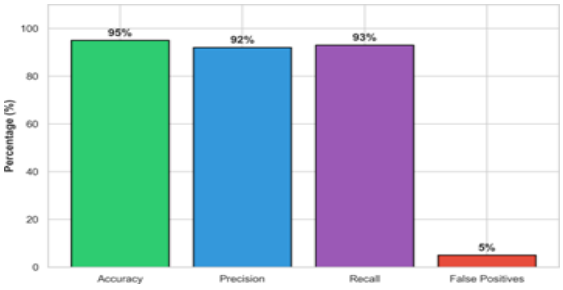

Fig. 6. Performance evaluation metrics of the proposed Isolation Forest model for suspicious migration detection.

VIII. CONCLUSION

This study concludes that machine learning, especially, Isolation Forest, could be useful when it comes to identifying suspicious file migrations in the cloud. The framework allows the detection of anomalies more effectively with such tools like AWS Cloud Trail and supports the scalability of anomaly detection. The next step in this direction will involve the hybrid deep learning and policy-based detection of a multi-cloud ecosystem.

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