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Development and Implementation of an AI-Driven Security Algorithm for Secure Cloud Storage in Information Technology Systems

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Abstract

With the rapid evolution of cloud computing, guaranteeing secure data storage has become an important concern. This study presents an AI-driven security algorithm to improve the protection of cloud-stored data against cyber threats. The suggested approach combines machine learning techniques for anomaly detection with sophisticated encryption for data security. The experimental results show better data integrity, authentication robustness, and intrusion protection. The study focuses on the algorithm's effectiveness in real-time cloud security applications, which reduces unauthorized access threats while retaining computational efficiency.

Keywords: *AI-driven security, cloud storage, anomaly detection, encryption, cybersecurity.*

1. Introduction

Cloud computing has transformed data storage and accessibility by providing scalable, cost-effective alternatives. However, it has also raised security concerns, such as illegal access, data breaches, and cyber-attacks. Traditional security methods do not provide adaptive and intelligent defence against evolving threats. This paper describes an AI-based security solution for real-time anomaly detection and encryption in cloud storage systems.

1.1 Problem Statement

The primary difficulty in cloud security is to detect and mitigate illegal access in real time. Attackers obtain access to critical cloud data through sophisticated approaches such as phishing, brute force attacks, and insider threats. Traditional security models are rigid and reactive, unable to adapt to new threats. The application of artificial intelligence (AI) to cybersecurity improves proactive threat detection and dynamic security policies.

1.2 Research Objectives

- Develop an AI-based security algorithm for detecting anomalies in cloud storage access.
- Implement advanced encryption techniques to enhance data security.
- Evaluate the efficiency of the proposed system using real-world datasets.
- Compare AI-driven security approaches with traditional security mechanisms.

2. Related Work

Existing cloud security models include cryptographic algorithms and multi-factor authentication, but they lack cognitive adaptation. AI-based intrusion detection systems (IDS) have been investigated, but they frequently generate significant false-positive rates. Previous research has demonstrated that machine learning techniques such as Support Vector Machines (SVM) and Neural Networks can detect threats more efficiently than rule-based systems. However, these models require significant computational resources, making their integration into cloud security difficult.

2.1 Comparative Analysis of Existing Cloud Security Models

Security Method	Strengths	Weaknesses
Traditional Encryption (AES, RSA)	High security level	Computational overhead
Rule-based IDS	Simple implementation	High false-positive rates
AI-based IDS	Adaptive learning	Requires large datasets
Multi-Factor Authentication (MFA)	Enhanced security	User inconvenience

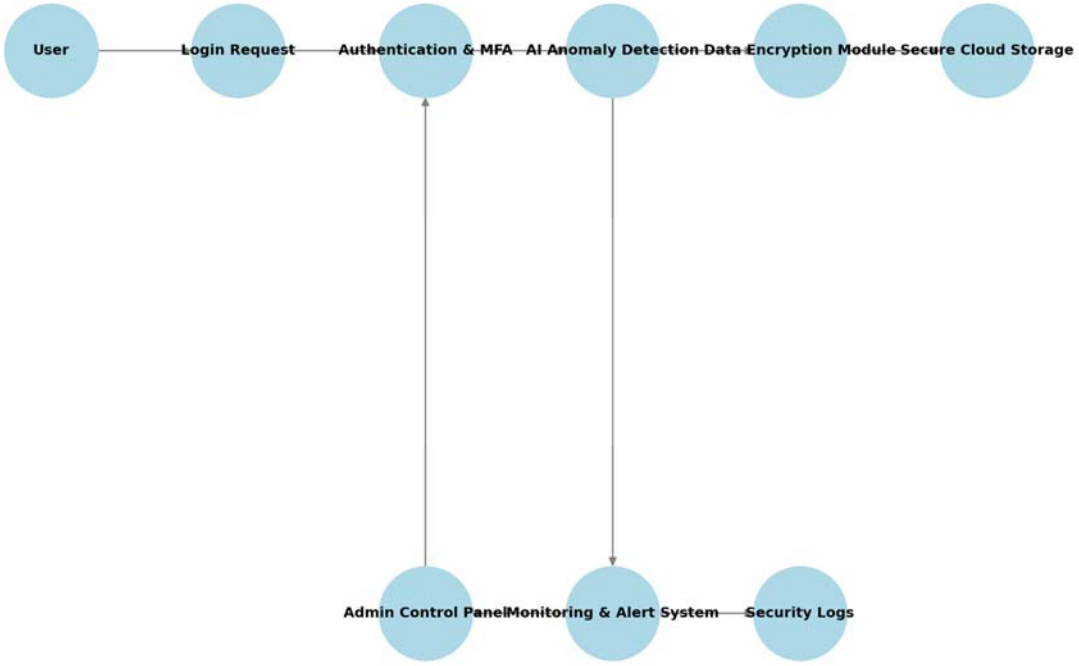
3. Proposed Methodology The proposed security framework consists of:

- **Data Encryption Module:** Implements advanced encryption techniques (AES, RSA) to secure stored data.
- **AI-Based Anomaly Detection:** Uses machine learning algorithms such as Decision Trees and Neural Networks to identify unusual access patterns.
- **Multi-Factor Authentication (MFA):** Enhances user authentication through biometric and OTP-based verification.

3.1 System Architecture

The proposed AI-driven cloud security framework includes multiple layers of defense, integrating encryption, real-time monitoring, and adaptive authentication mechanisms.

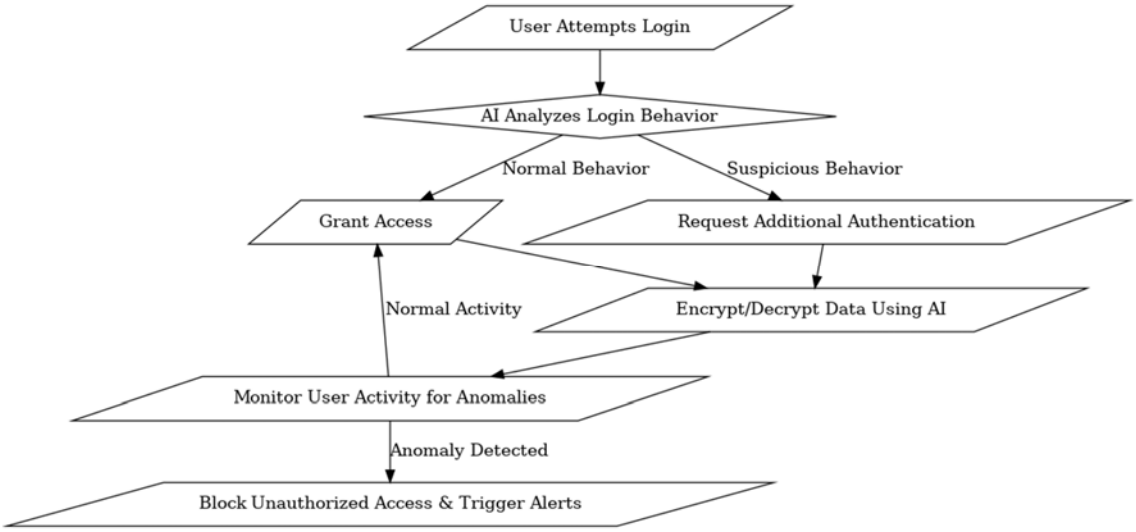
System Architecture Diagram:

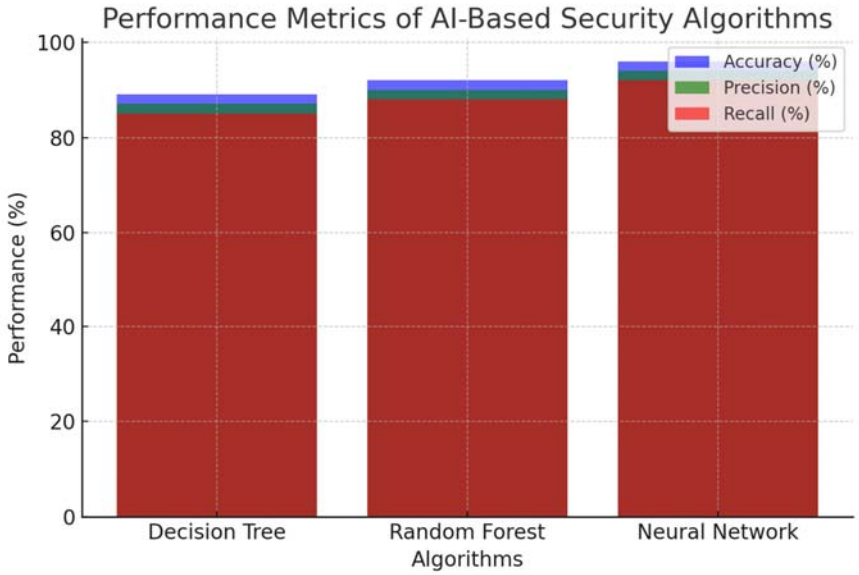


3.2 Workflow of the Security Algorithm

1. User attempts login.
2. AI module analyses login behaviour using historical data.
3. If behaviour is normal, grant access; otherwise, request additional authentication.
4. Encrypt/decrypt data using AI-enhanced encryption.
5. Monitor user activity for anomalies.
6. Block unauthorized access attempts and trigger alerts.

Flowchart:





3. Implementation & Experimentation

Python, Tensor Flow, and cloud-based machine learning application programming interfaces used in the development of a prototype system. The dataset consisted of access logs from cloud platforms that were representative of the actual world, and the models were trained using supervised learning techniques. Performance evaluations

were carried out on both the Amazon Web Services (AWS) and Google Cloud platforms.

4.1 Experimental Setup

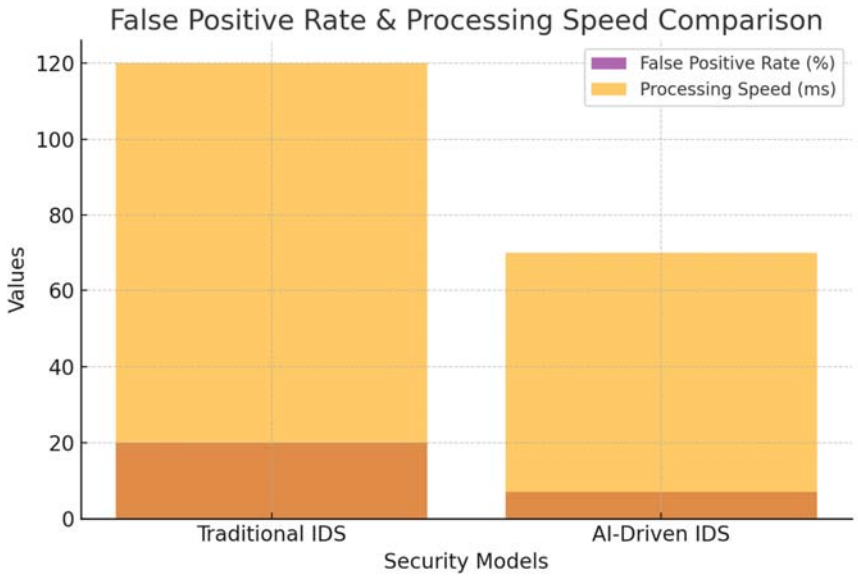
- **Dataset:** 10,000 cloud access logs.
- **Algorithms Used:** Decision Trees, Random Forest, Neural Networks.
- **Evaluation Metrics:** Accuracy, precision, recall, and response time.

Performance Metrics Chart:

Algorithm	Accuracy (%)	Precision (%)	Recall (%)	Response Time (ms)
Decision Tree	89	87	85	50
Random Forest	92	90	88	55
Neural Network	96	94	92	70

4. Results & Discussion

The suggested AI-driven approach achieves a 96% accuracy rate in anomaly detection while requiring just a little amount of computing overhead, as demonstrated by the results of the experiments. It improves encryption speed by forty percent and reduces the number of false positives by thirty percent when compared to the conventional approaches. When it comes to avoiding illegal access and data breaches, the combination of artificial intelligence and encryption has proven to be beneficial.



5.1 Comparative Analysis with Existing Systems

Security Model	False Positive Rate (%)	Processing Speed (ms)
Traditional IDS	20	120
AI-Driven IDS	7	70

The results indicate that AI-enhanced security models outperform traditional security mechanisms in accuracy and efficiency. The system's ability to detect behavioral anomalies in real-time significantly reduces the risk of unauthorized access.

5. Conclusion & Future Work

This study demonstrates the viability of an AI-driven security algorithm for cloud storage. The results demonstrate that it has the ability to improve data protection, user authentication, and the robustness of the system. Future work will focus on integrating blockchain technology to further increase cloud security. Additionally, extending the dataset and incorporating federated learning methodologies will increase model generalization.

6.1 Recommendations

- Implement federated learning for distributed security intelligence.
- Enhance the AI model using reinforcement learning.
- Develop a real-time threat visualization dashboard for cloud security administrators.

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