

Enhancing Financial Data Security in AI-Driven Cloud Platforms: A Comparative Study of Fully Homomorphic Encryption and Conventional Encryption Techniques

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Abstract – The finance industry is undergoing a profound transformation through the integration of Artificial Intelligence (AI), which is reshaping traditional business models and unlocking new growth opportunities. AI-driven tools, such as predictive analytics, machine learning, and natural language processing, are revolutionizing financial operations and customer interactions. However, the reliance on AI and cloud platforms for processing extensive and sensitive financial data introduces significant security challenges. Maintaining the confidentiality and integrity of this data is crucial to prevent breaches and safeguard against potential threats. This research investigates the application of Fully Homomorphic Encryption (FHE) to enhance data security in AI-driven cloud-based applications within the finance sector. FHE allows computations to be carried out directly on encrypted data, ensuring that sensitive information remains protected throughout the entire processing lifecycle. This capability is critical in financial contexts, where preserving client data privacy is essential while enabling advanced AI analytics and modeling. Homomorphic encryption employs ciphertexts to keep data encrypted during processing, which is fundamental to its security model. By performing operations on encrypted data, FHE maintains data confidentiality even when exposed to AI systems. This study provides a comparative analysis of FHE against traditional encryption methods, highlighting its advantages in reducing vulnerabilities, enhancing security, and meeting rigorous regulatory standards. Preliminary findings suggest that FHE not only preserves data privacy but also offers improved efficiency by reducing processing time and resource usage. These attributes make FHE a promising solution for secure, real-time AI applications in the financial sector. This paper offers valuable insights into implementing FHE Algorithms for securing cloud-based AI systems and proposes a framework for future advancements in protecting sensitive financial data against emerging threats.

Keywords: Homomorphic Encryption, Fully Homomorphic Encryption (FHE), AI-Driven Cloud Platforms, Financial Data Security, Data Privacy, Machine Learning, Encryption Techniques, Big Data, Data Protection, Encryption Methods