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BLOCK CHAIN

2026 - 2027

TITLE & ABSTRACT

Advanced Academic Final Year Projects

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Explainable AI-Enabled Privacy-Preserving Query Processing on Blockchain Ledgers With Statistical Metadata

This project proposes a privacy-preserving query processing framework that combines Explainable Artificial Intelligence with blockchain technology. Statistical metadata is used to support efficient query processing without exposing sensitive ledger information. The system applies privacy mechanisms to protect confidential data while maintaining the transparency and integrity of blockchain records. Explainable AI techniques provide understandable insights into query results and system decisions. The proposed approach can improve secure, transparent, and privacy-aware data analysis over distributed blockchain ledgers.

Differentially Private Zeroth-Order Methods for Scalable Large Language Model Fine-Tuning

This project focuses on privacy-preserving fine-tuning of large language models using differential privacy and zeroth-order optimization. The approach reduces the need to directly access or expose sensitive training information during model adaptation. Zeroth-order optimization enables parameter updates using function evaluations rather than conventional gradient calculations. Differential privacy mechanisms provide protection against potential information leakage from training data. The framework aims to achieve scalable and privacy-aware language model fine-tuning while maintaining useful model performance.

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rPBFT: Reliable Practical Byzantine Fault Tolerance Mechanism for Faulty Distributed Networks

rPBFT is a reliable consensus mechanism designed to improve fault tolerance in distributed blockchain networks. The system addresses situations where participating nodes may behave incorrectly or become unavailable during consensus. An enhanced Practical Byzantine Fault Tolerance mechanism is used to maintain agreement among reliable nodes. The approach evaluates node communication and consensus behavior to improve network reliability. It aims to provide secure, consistent, and efficient transaction processing in faulty distributed environments.

Turbo: Optimistic Execution Framework for Low-Latency Cross-Chain Transactions

Turbo is a blockchain framework designed to reduce the latency of transactions performed across multiple blockchain networks. The system uses optimistic execution to process transactions before complete confirmation of all cross-chain operations. Validation and rollback mechanisms are incorporated to maintain transaction consistency when conflicts or failures occur. The framework coordinates transactions between heterogeneous blockchain networks efficiently. It aims to improve cross-chain transaction speed while maintaining reliability and correctness.

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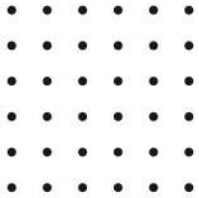

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Do Automated Fixes Truly Mitigate Smart Contract Exploits?

This project investigates the effectiveness of automated techniques for repairing vulnerabilities in blockchain smart contracts. Different automated fixes are analyzed against common smart contract exploits and security weaknesses. The system evaluates whether generated patches actually eliminate vulnerabilities without introducing new problems. Security testing and vulnerability analysis are used to compare original and repaired contracts. The study provides insights into the reliability and limitations of automated smart contract repair approaches.

Enhancing Modularity in Business Ecosystems Through Blockchain Tokens: A Multiple Case Study

This project explores how blockchain-based tokens can improve modularity and coordination within business ecosystems. Token mechanisms are analyzed for their ability to support interactions between independent organizations and participants. Multiple business cases are examined to understand how token-based models influence collaboration, resource exchange, and governance. Blockchain provides transparent and traceable transaction management across ecosystem participants. The study identifies opportunities and challenges associated with token-enabled business model structures.

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Furion: Efficient and Atomic Cross-Blockchain Transactions Through Multi-Future Exploration

Furion is a blockchain transaction framework designed to improve the efficiency and atomicity of cross-chain transactions. The approach explores multiple possible execution outcomes before selecting suitable transaction paths. Atomic transaction mechanisms ensure that cross-chain operations either complete successfully or are safely rolled back. The framework aims to reduce delays and coordination overhead between independent blockchains. It provides a reliable approach for executing complex transactions across heterogeneous blockchain networks.

GCL-MIH: A Generative-Based Coverless Multi-Image Hiding Method

GCL-MIH is a generative approach for hiding information across multiple images without directly modifying their visual content. The system uses generative learning techniques to establish relationships between secret information and selected cover images. Since the method avoids conventional embedding modifications, it can improve resistance to image-based steganalysis. Multiple images can collaboratively represent hidden information through generated features or associations. The approach provides a secure method for covert information sharing and multimedia data protection.

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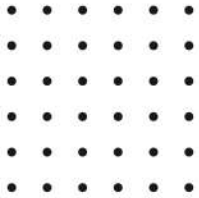

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EVMx: An FPGA-Based Accelerator for Smart Contract Processing

EVMx is an FPGA-based hardware acceleration framework designed to improve the execution efficiency of smart contracts. The system implements selected components of an Ethereum Virtual Machine-compatible processing architecture on programmable hardware. Computationally intensive operations can be accelerated compared with conventional software-only execution. The architecture focuses on improving throughput, latency, and resource efficiency for blockchain workloads. It provides a hardware-assisted approach for scalable and high-performance smart contract processing.

Blockchain Cooperative Spectrum Management for Wi-Fi and LTE-Unlicensed Coexistence Networks

This project proposes a blockchain-based framework for cooperative spectrum management between Wi-Fi and LTE-Unlicensed networks. Blockchain provides a distributed and tamper-resistant mechanism for recording spectrum allocation and usage information. Participating network nodes can collaboratively coordinate available spectrum resources without relying entirely on a centralized authority. Smart contracts can automate allocation rules and usage verification. The approach aims to improve spectrum utilization, transparency, and fairness in shared wireless environments.

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From Isolation to Integration: A Reputation-Backed Auditable Model for Cohort Data Sharing

This project presents a secure data-sharing framework for organizations or research groups that need to exchange cohort information. A reputation mechanism evaluates participating entities based on their data-sharing behavior and trustworthiness. Blockchain or distributed ledgers can maintain auditable records of data access and exchange activities. Privacy controls help protect sensitive cohort information while enabling authorized collaboration. The framework promotes accountable, transparent, and trustworthy data sharing between participating organizations.

Detecting Suspicious Activity in the NFT Ecosystem Using Temporal Graph Analysis

This project develops a graph-based approach for detecting suspicious activities in NFT ecosystems. Blockchain transaction records are represented as temporal graphs connecting wallets, collections, marketplaces, and transactions. Graph analysis techniques identify unusual transaction patterns, repeated interactions, and potentially coordinated activities. Temporal information helps detect suspicious behavior that may not be visible through individual transactions alone. The system supports monitoring of NFT ecosystems for potential fraud, manipulation, and abnormal trading activity.

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A Replicable Framework to Drive Business Model Innovation Enabled by Web3: A Case Study in the Agrifood Sector

This project investigates how Web3 technologies can support innovation in agrifood business models. Blockchain, decentralized applications, digital assets, and smart contracts are analyzed for their ability to improve transparency and collaboration. A replicable framework is developed using a representative agrifood business case. The framework evaluates opportunities for decentralized transactions, traceability, and stakeholder participation. The study provides practical guidance for organizations exploring Web3-enabled business transformation.

Exploring the Impact of Industry 4.0 Information Technologies on Supply Chain Responsiveness: A Dynamic Capabilities Theory Perspective

This project analyzes how Industry 4.0 technologies influence the responsiveness of modern supply chains. Technologies such as blockchain, IoT, cloud computing, artificial intelligence, and advanced analytics are examined in relation to supply chain operations. The study evaluates how organizations use these technologies to sense changes, respond quickly, and reconfigure resources. Dynamic capabilities provide a theoretical foundation for understanding technology-driven supply chain adaptation. The research identifies factors that can improve agility, visibility, and operational responsiveness.

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Survey of Cooperative NOMA for Beyond 5G: State-of-the-Art, Applications and Research Directions

This project provides a comprehensive study of cooperative Non-Orthogonal Multiple Access techniques for beyond-5G wireless communication. The survey examines communication principles, cooperative transmission mechanisms, resource allocation, and performance characteristics. Applications in emerging wireless networks and IoT environments are analyzed. Existing challenges related to interference, security, energy efficiency, and scalability are discussed. The study identifies potential research directions for developing efficient cooperative NOMA systems in future networks.

MALTree: Maliciously Secure Decision Tree Inference Using MPC With a Helper

MALTree is a privacy-preserving machine learning framework designed to perform decision tree inference using secure multi-party computation. The system allows multiple parties to collaboratively evaluate a trained decision tree without directly revealing their private input data. A helper entity assists with secure computation while cryptographic protocols protect sensitive information. The framework is designed to resist malicious participants attempting to manipulate the computation. It enables privacy-aware machine learning inference for applications involving confidential datasets.

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Reversible Data Hiding in Shared Images Using Overlapped Coefficients in Polynomials

This project develops a reversible data-hiding technique for securely embedding information into shared images. Polynomial-based secret sharing and overlapped coefficients are used to distribute hidden information across multiple image components. The technique allows authorized users to recover the embedded data while reconstructing the original image without permanent modification. The approach improves security and reversibility for sensitive image communication. It can be applied to secure multimedia sharing and confidential image storage.

Enforcing Global Usage Constraints in Distributed Systems: A Formal Model of Directed Traceability

This project proposes a formal framework for enforcing usage constraints across distributed systems. Directed traceability is used to track how data and resources move between different components and participants. The model represents access relationships and usage conditions to verify whether global policies are being followed. Formal analysis can identify policy violations across complex distributed workflows. The approach supports accountable data usage and improves control over resources shared across distributed environments.

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Lightweight CNN-Based Intrusion Detection for CAN Bus Networks

This project develops a lightweight convolutional neural network for detecting cyber attacks on Controller Area Network bus systems used in vehicles. CAN communication data is collected and transformed into suitable input representations for the CNN model. The model learns patterns associated with normal and malicious messages and classifies potential attacks. Lightweight architecture enables deployment in resource-constrained automotive environments. The system supports real-time monitoring and improved cybersecurity for connected vehicles.

Comparative Analysis of Unsupervised Anomaly Detection Algorithms for Bitcoin Transaction Fraud Detection: A Large-Scale Empirical Study

This project evaluates different unsupervised machine learning algorithms for detecting suspicious Bitcoin transactions. Since labeled fraud datasets can be limited, anomaly detection techniques are used to identify unusual transaction behavior without requiring predefined labels. Large-scale blockchain transaction data is analyzed using multiple algorithms and performance metrics. The study compares their ability to identify abnormal transaction patterns and potential fraudulent activity. The results provide insights into selecting effective unsupervised techniques for cryptocurrency transaction monitoring.

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Digital Twins in Sustainability Initiatives: A Review From Life Cycle Assessment Perspective

This project reviews the role of digital twin technology in supporting sustainability initiatives across product and industrial life cycles. Digital twins can continuously represent physical assets using sensor, operational, and environmental data. The study examines how digital twin technologies can support life cycle assessment, resource optimization, energy efficiency, and environmental monitoring. Different application areas and technological challenges are analyzed. The review identifies opportunities for combining digital twins with sustainability assessment methodologies.

Rarity Defense: A Formal and Empirical Analysis of NFT Trait Systems for Wash Trading Mitigation

This project analyzes how NFT trait rarity can be used to identify and mitigate potential wash trading activities. NFT collections are examined based on their attributes, rarity distributions, ownership changes, and transaction patterns. Formal and empirical analysis is used to identify unusual trading behaviors associated with artificially manipulated transactions. Rarity-based indicators are combined with blockchain transaction information to improve suspicious activity detection. The approach supports greater transparency and trust in NFT marketplaces.

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Transformation of Vulnerability Management Through Artificial Intelligence: An Overview of Generative and Learning Models

This project reviews the application of artificial intelligence in modern cybersecurity vulnerability management. Machine learning, deep learning, and generative AI techniques are examined for vulnerability identification, prioritization, remediation, and prediction. The study analyzes how AI can process security data and assist security teams in handling large numbers of vulnerabilities. Benefits, limitations, reliability, and potential risks of AI-assisted security are discussed. The work provides an overview of emerging AI-driven approaches to vulnerability management.

Cryptographic Randomness Testing of Block Ciphers: SAC Tests

This project evaluates the randomness and cryptographic properties of block cipher outputs using the Strict Avalanche Criterion. The SAC test examines whether a small change in an input bit produces appropriate changes across output bits. Experimental analysis can be performed on selected block cipher implementations using multiple input samples. Statistical measurements are used to evaluate the avalanche behavior and identify potential weaknesses. The project supports systematic assessment of cryptographic algorithm quality and security characteristics.

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VDDPI: Verifiable Decentralized Data Processing Infrastructure for Data Usage Control and Confidential Data Processing

VDDPI is a decentralized framework designed to provide verifiable control over data processing and usage. The system combines distributed technologies with cryptographic mechanisms to ensure that data is processed according to predefined policies. Access and processing activities can be recorded and verified without exposing confidential information unnecessarily. Smart contracts or policy mechanisms can enforce authorized data usage across participating entities. The framework supports secure, auditable, and privacy-preserving data processing in decentralized environments.

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