

MAL3018 Computing Project

2024/2025

Project Title

ScholarChain: Blockchain-Driven Framework for E-Transcript Validation

Links

Source code: <https://github.com/honsheang/MAL3018-ScholarChain.git>

Project Vision

Employers, universities, and students all face significant challenges in the process of verifying academic E-Transcripts. Employers currently rely on manual methods, such as directly contacting universities to validate credentials, which can be time-consuming, error-prone, and vulnerable to fraud. This process often leads to delays, administrative burdens, and the risk of forged documents slipping through. For students, this creates an extended job application process and concerns about the authenticity of their qualifications, potentially leading to mistrust or rejection from employers. Universities, on the other hand, need a secure, reliable method to issue credentials and ensure their legitimacy.

Proposed Product/Solution: The ScholarChain Web Application

- **ScholarChain** is a blockchain-backed web application designed for universities, students, and employers to securely issue and verify academic credentials. By leveraging blockchain technology, ScholarChain ensures transparency and tamper-proof verification of E-Transcripts, offering a decentralized, immutable record for E-Transcript authentication.
- The application allows **universities** to digitally issue and securely store E-Transcripts on the blockchain, which acts as a transparent, verifiable source of truth.
- **Students** can access these verified E-Transcripts and share them directly with employers, reducing the need for manual verification and minimizing the risk of fraud.
- **Employers** can easily verify the authenticity of academic records in real-time, improving hiring efficiency and trust in the process.

a) Key Feature or Benefits:

- **Data Integrity and Security:** Blockchain technology ensures that E-Transcripts issued by universities are cryptographically signed and securely stored, preventing unauthorized alterations and ensuring access only to legitimate, verified documents.
- **Efficient E-Transcript Verification:** Employers can obtain verified E-Transcripts with just a few clicks, significantly reducing delays in the hiring process.
- **Simplified Credential Sharing:** Students can easily share their verified E-Transcripts digitally, eliminating the need to request additional copies from universities.

- **Fraud Prevention:** The immutability of blockchain makes it easy to detect forged or tampered E-Transcripts, ensuring that only authentic credentials are utilized.

b) **New Feature: Gamification and Badges for Academic Achievements:**

- ScholarChain will incorporate gamification to encourage academic success by rewarding students with blockchain-based digital badges or certificates for achieving milestones.
- Students can earn badges for accomplishments such as high GPA scores, top marks in specific subjects, or other notable academic achievements. These badges are securely issued on the blockchain and can be shared on social media platforms or added to professional profiles such as LinkedIn. This not only motivates students but also increases the visibility of their achievements to potential employers.
- **Benefit:** The gamification feature enhances student engagement and recognition while providing verifiable, shareable academic achievements that are secured on the blockchain.

c) **Programming Language**

- Solidity (Smart Contract)
- JavaScript (front-end and back-end development)
- HTML/CSS (For designing front-end interfaces)

d) **Technologies to be used**

- Blockchain – Ethereum testnet (Sepolia)
- Truffle – for smart contract development, testing, and deployment
- Web3.js – for blockchain interaction
- IPFS – for decentralized file storage
- MetaMask – for wallet integration and signing transactions
- Visual Studio Code – development framework

Market Comparison

Table 1.0: ScholarChain vs. Competitors: Key Feature Comparison

Feature	Blockcerts	Learning Machine	Sony Global Education	TrustED	ScholarChain
Blockchain-Based E-Transcript Verification	Yes	Yes	Yes	Yes	Yes
Decentralized and Tamper-Proof Credentials	Yes	Yes	Yes	Yes	Yes
Real-Time Verification for Employers	Yes	Yes	Yes	Yes	Yes
Gamification and Badges for Academic Success	No	No	No	No	Yes
Social media Sharing of Achievements	No	No	No	No	Yes
Student Engagement Features	No	No	No	No	Yes

a) **Blockcerts**

- Blockcerts is an open standard for creating, issuing, and verifying blockchain-based certificates. Developed by MIT Media Lab, it provides decentralized credential issuance and validation.

b) **Learning Machine (now Hyland Credentials)**

- Learning Machine uses the Blockcerts protocol to issue blockchain-based credentials. Their platform is used by educational institutions for secure digital E-Transcript issuance.

c) **Sony Global Education**

- Sony partnered with IBM to create a blockchain-based platform for secure academic record verification. It focuses on the transparent and secure sharing of academic achievements.

d) **TrustED**

- TrustED is a blockchain-based verification platform designed for academic institutions. It aims to prevent fraud and streamline the process of validating academic credentials.

Risk Plan

a. Risk Assessment

Table 2.0: Risk Assessment

Risk ID	Risk category	Likelihood	Impact	Risk Level	Risk Category
R1	Technical Skills Gap	Medium	High	4	High Risk
R2	Time Management and Delays	High	High	5	Critical Risk
R3	Resource Constraints	Medium	Medium	3	Medium Risk
R4	Scope Creep	Medium	High	4	High Risk
R5	Integration Challenges	Medium	High	4	High Risk
R6	Testing and Debugging Complexity	Medium	High	4	High Risk

Based on Table 2.0, a more detailed description of the risk assessment is below:

1. Technical Skills Gap

- Risk: The development team may lack adequate skills in blockchain, smart contracts, or other technologies critical for the project.
- Impact: High
- Likelihood: Medium
- Mitigation Strategy:
 - Collaborate with mentors or industry experts for guidance.
 - Participate internal training workshops and review technical documentation of chosen frameworks.

2. Time Management and Delays

- Risk: Delays in completing tasks due to unforeseen issues, like bugs or difficulty in implementing specific features.
- Impact: High
- Likelihood: High
- Mitigation Strategy:
 - Break down tasks into smaller, manageable milestones.
 - Use project management tools (Teamhood) to monitor progress.
 - Allocate buffer time in the Gantt chart for testing and debugging.

3. Resource Constraints

- Risk: Limited access to required resources, such as blockchain nodes, testing environments, or collaboration tools.
- Impact: Medium
- Likelihood: Medium
- Mitigation Strategy:
 - Use free blockchain test networks like Sepolia's testnet.
 - Leverage free tools like GitHub for version control and collaboration.

4. Scope Creep

- Risk: Expanding the project scope beyond the original objectives, adding unnecessary features, which can lead to missed deadlines.
- Impact: Medium
- Likelihood: High
- Mitigation Strategy:
 - Clearly define the scope at the beginning and stick to it.
 - Use a scope management plan to address any proposed changes.

5. Integration Challenges

- Risk: Issues may arise when integrating blockchain with the web application or ensuring that different modules work together smoothly.
- Impact: High
- Likelihood: Medium
- Mitigation Strategy:
 - Start with smaller, independent modules and test them separately before integration.
 - Perform thorough integration testing early in the project to identify and resolve issues.

6. Testing and Debugging Complexity

- Risk: Blockchain systems can be challenging to debug and test due to their decentralized nature.
- Impact: High
- Likelihood: Medium
- Mitigation Strategy:
 - Use blockchain simulators or testnets to conduct extensive testing.
 - Implement automated testing and continuous integration (CI) pipelines to reduce errors.
 - Allocate additional time for testing within the project timeline.

Proposed Gantt Chart

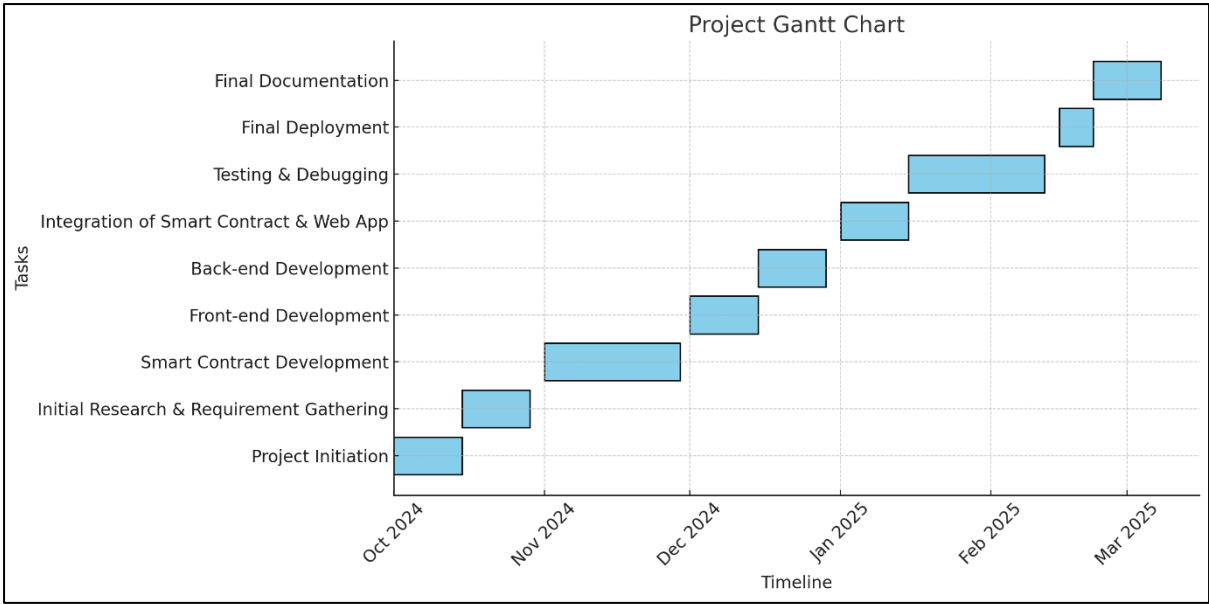


Figure 1.0: Project Gantt Chart

Table 3.0: Gantt Chart

Task/Phase	Duration	Start Date	End Date
Project Initiation	2 weeks	October 2024	21st October 2024
Initial Research & Requirement Gathering	2 weeks	Mid-October 2024	November 2024
Smart Contract Development	4 weeks	November 2024	December 2024
Front-end Development	2 weeks	December 2024	Mid-December 2024
Back-end Development	2 weeks	Mid-December 2024	End of December 2024
Integration of Smart Contract & Web App	2 weeks	January 2025	Mid-January 2025
Testing & Debugging	4 weeks	Mid-January 2025	Mid-February 2025
Final Deployment	1 weeks	Mid-February 2025	End of February 2025
Final Documentation	2 weeks	End of February 2025	Mid-March 2025

Keywords

Blockchain, E-Transcript Verification, Document Authentication, Machine Learning, OCR, Smart Contracts, ScholarChain