Blockchain-Based Certificate Issuance and Verification System

Project Report Submitted to the

SRM University-AP, Andhra Pradesh

for the partial fulfillment of the requirements to award the degree of

Bachelor of Technology in

Computer Science & Engineering

School of Engineering & Sciences

submitted by

K. Bala Thripura Venkata Srivalli (AP22110011471)

D. Vaishnavi (AP22110011373)

D. Poornima (AP22110011395)

P. Farhana (AP22110011431)

Under the Guidance of

Dr. Uma Sankararao Varri

Department of Computer Science & Engineering

SRM University-AP

Neerukonda, Mangalagiri, Guntur

Amaravati, Andhra Pradesh - 522 240

Dec 2025

Table of Contents

1. Introduction

In the digital era, academic institutions, organizations, and training platforms frequently issue certificates to validate a learner’s achievements and qualifications. Traditionally, certificates were issued in physical form or as PDFs stored in centralized databases. With the rapid growth of online education and remote learning, the demand for digital certification has increased significantly. However, along with this growth, the risk of certificate fraud and unauthorized duplication has also risen.
To overcome these challenges, this project implements a **blockchain-based certificate verification** that ensures: Transparency, Immutability, Easy, instant verification, Secure identity management.

2. Problem Statement

To eliminate certificate fraud and enable instant verification by developing a secure blockchain-based platform for issuing and validating academic certificates.

3. Objectives

The objectives of this project are:

- To build a secure and tamper-proof certificate management system using blockchain technology.
- To prevent certificate forgery by storing academic records on an immutable ledger.
- To enable institutions (issuers) to issue and revoke certificates digitally with full transparency.
- To allow students to safely access and verify their certificates anytime.
- To create a public verification system that allows employers or anyone to validate certificates instantly.
- To implement role-based access (Admin, Issuer, Student, Public) for enhanced security and controlled operations.
- To provide an easy-to-use Streamlit interface for interacting with the blockchain.

3.1 Key Features

- Role-Based Access Control (Admin, Issuer, Student)
- On-chain certificate storage using bytes32 certificate hashes
- Issuance, revocation, verification of certificates
- Public certificate verification without login
- Student dashboard displaying all issued certificates
- Issuer dashboard for creating and revoking certificates
- Admin dashboard managing users and permissions

4. Methodology

The project follows a structured decentralised application development method:

4.1 Requirement Analysis

- Need for secure certificate verification.
- Blockchain for immutability and transparency.
- Role-based access control (Admin, Issuer, Student, Public).

4.2 Smart Contract Design (Solidity)

The smart contract includes:

- Certificate issuance and revocation.
- Role management for Admin, Issuer, Students.
- Certificate storage using bytes32 hashed identifiers.
- Getter functions for certificate details.

4.3 Blockchain Network Setup

- Ganache used to simulate an Ethereum local blockchain.
- RPC connection established via Web3.py.

4.4. Frontend Development (Streamlit)

Streamlit provides a clean, interactive UI with multiple dashboards:

- Login page
- Admin panel
- Issuer panel
- Student dashboard
- Public certificate verification page

4.5 Integration of Frontend with Smart Contract

- The ABI from OCertificate.json is loaded.
- Contract functions are accessed using Web3.py.
- Transactions are signed from Ganache wallet addresses.

5. Implementation Details

5.1 System Architecture

The architecture follows a 3-tier DApp structure:

- Frontend: Streamlit UI
- Middleware: Web3.py connecting Python to smart contract
- Backend: Ethereum blockchain via Ganache

5.2 Key Functionalities Implemented

Admin Functionalities

- Add / remove issuer
- Add / remove student
- Verify certificates

Issuer Functionalities

- Issue certificate to a student
- Revoke certificate they issued.

Student Functionalities

- View all certificates issued to them
- View their certificate details using certificate ID

Public Verifier

- Check validity of any certificate using its hash

5.3 Code Structure

- Login System: Detects role using wallet address
- Role-Based Routing: Redirects to respective dashboard
- Hex to bytes32 conversion: Ensures correct blockchain format
- Transaction handling: .transact({from: address}) pattern used for writing data
- Smart contract calls: .call() for reading data

5.4 Smart Contract ABI Usage

The ABI in OCertificate.json is loaded to enable:

- CertificateIssued event
- CertificateRevoked event
- Role checks (isIssuer, isStudent)
- Certificate storage & retrieval

6. Technology Stack

Languages: Python, Solidity

Frontend: Streamlit (UI Framework)

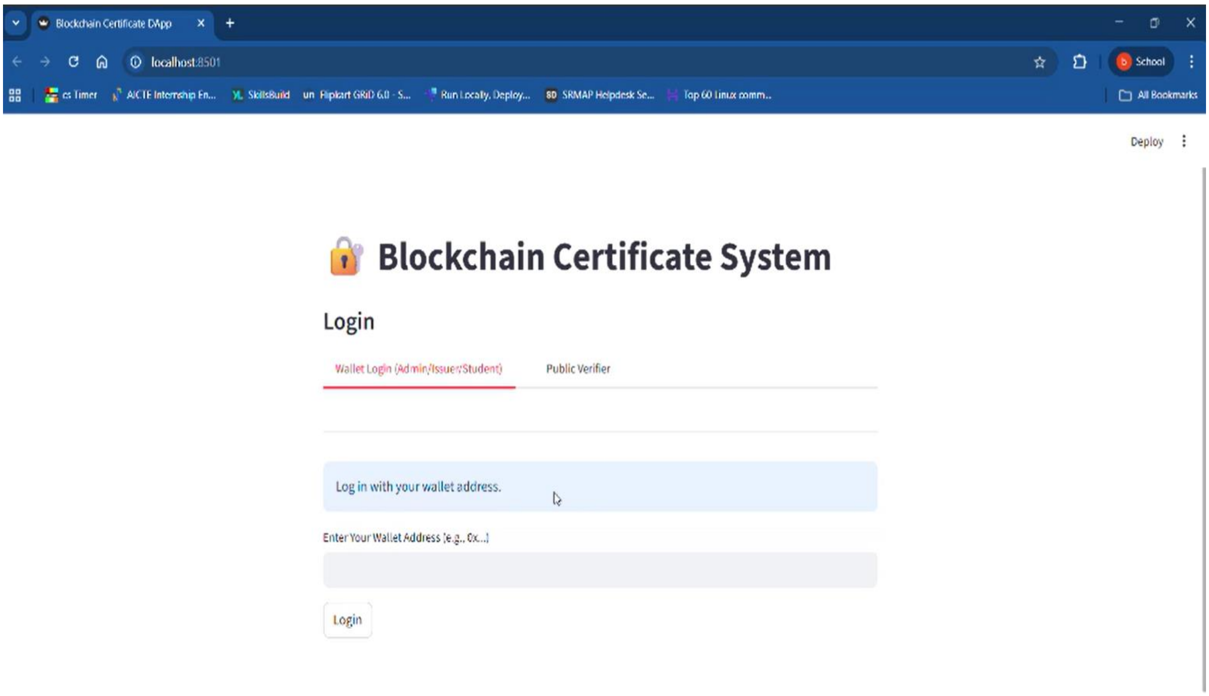
Blockchain Interaction: Web3.py (Python–Blockchain communication)

Blockchain Network: Ganache (Local Ethereum test blockchain)

Smart Contract:

OCertificate.sol - ABI used for interacting with the contract from Streamlit/Python

7. Results

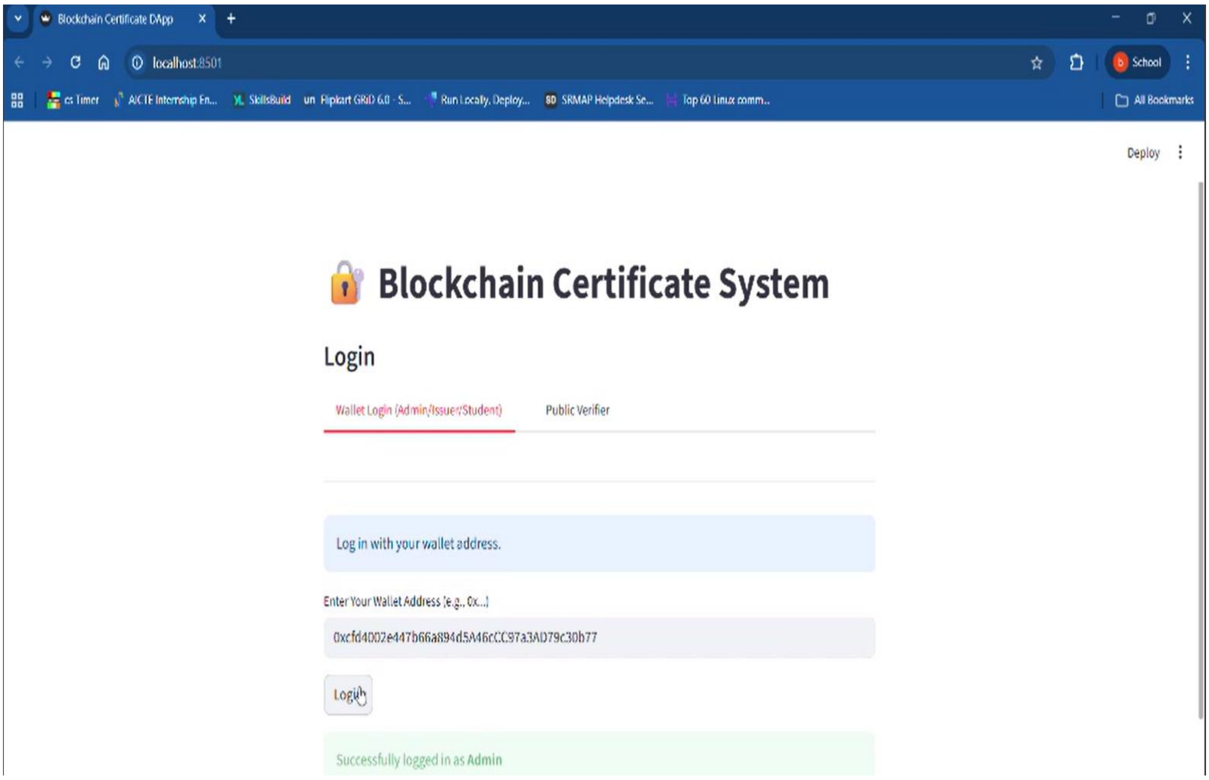


Blockchain Certificate System

Login

Log in with your wallet address.

Enter Your Wallet Address (e.g., 0x...)



Blockchain Certificate System

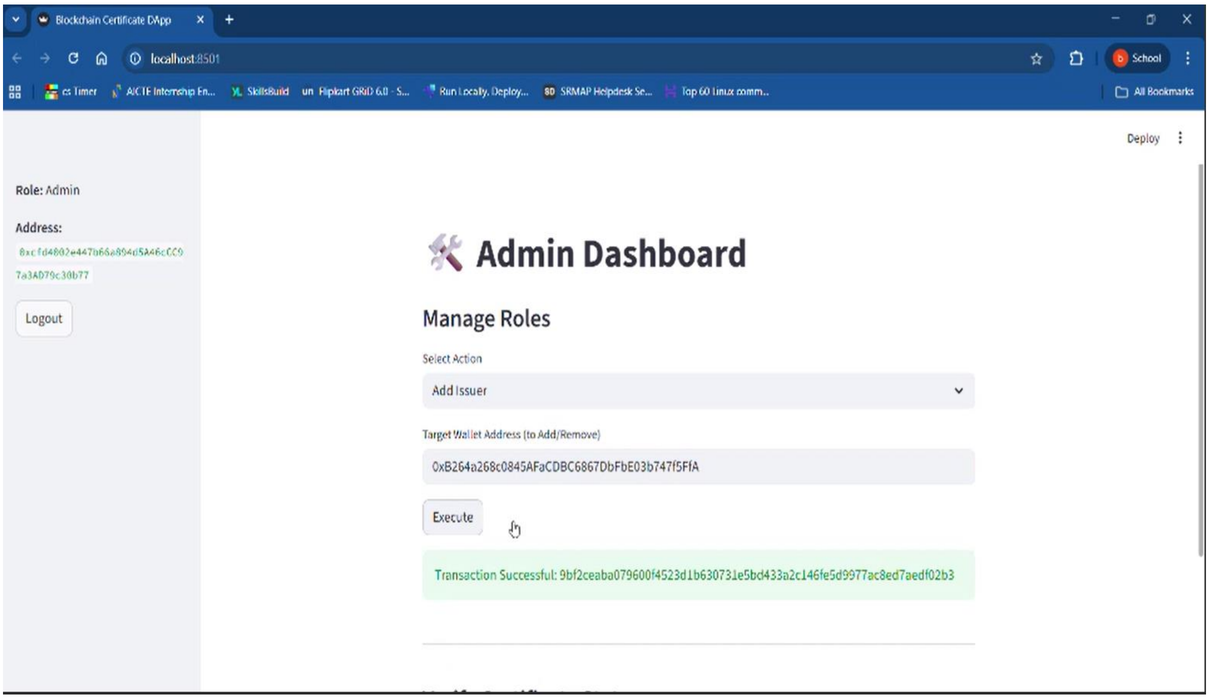
Login

Log in with your wallet address.

Enter Your Wallet Address (e.g., 0x...)

0xcfd4D02e447b66a894d5A46cCC97a3AD79c30b77

Successfully logged in as **Admin**



Role: Admin

Address:

0xcfd4802e447b66a894d5A46cCC9
7a3AD79c30b77

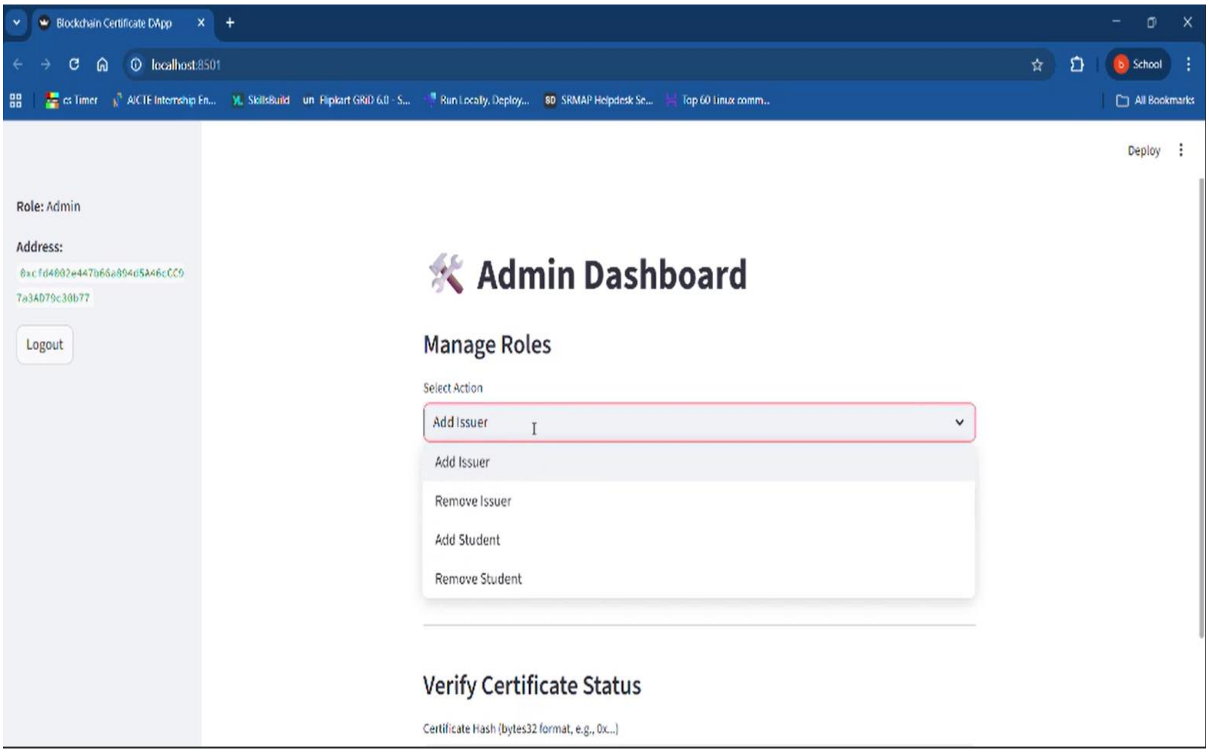
Admin Dashboard

Manage Roles

Select Action: Add Issuer

Target Wallet Address (to Add/Remove): 0xB264a268c0845AFaCDBC6867DbFbE03b747f5FfA

Transaction Successful: 9bf2ceaba079600f4523d1b630731e5bd433a2c146fe5d9977ac8ed7aedf02b3



Role: Admin

Address:

0xcfd4802e447b66a894d5A46cCC9
7a3AD79c30b77

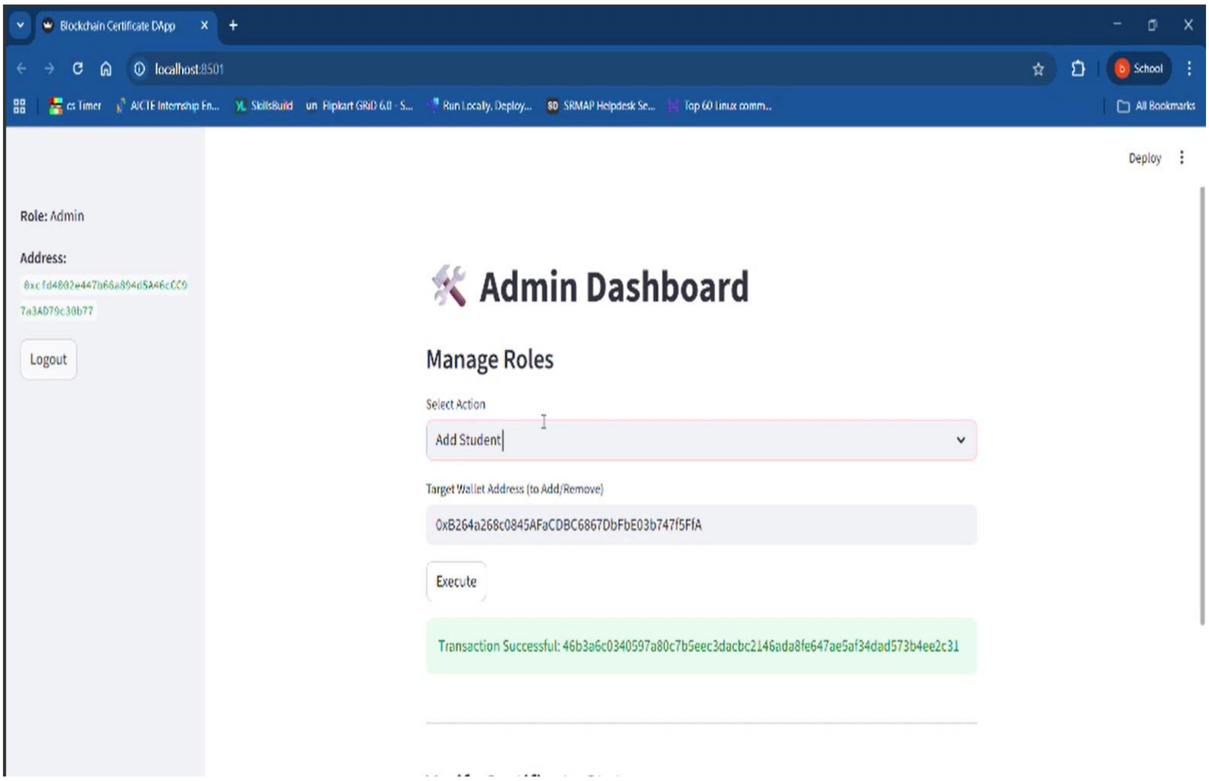
Admin Dashboard

Manage Roles

Select Action: Add Issuer

Verify Certificate Status

Certificate Hash (bytes32 format, e.g., 0x...)



Role: Admin

Address:

0xcfd4802e447b66a894d5A46cCC9
7a3AD79c30b77

Logout

🛠️ Admin Dashboard

Manage Roles

Select Action

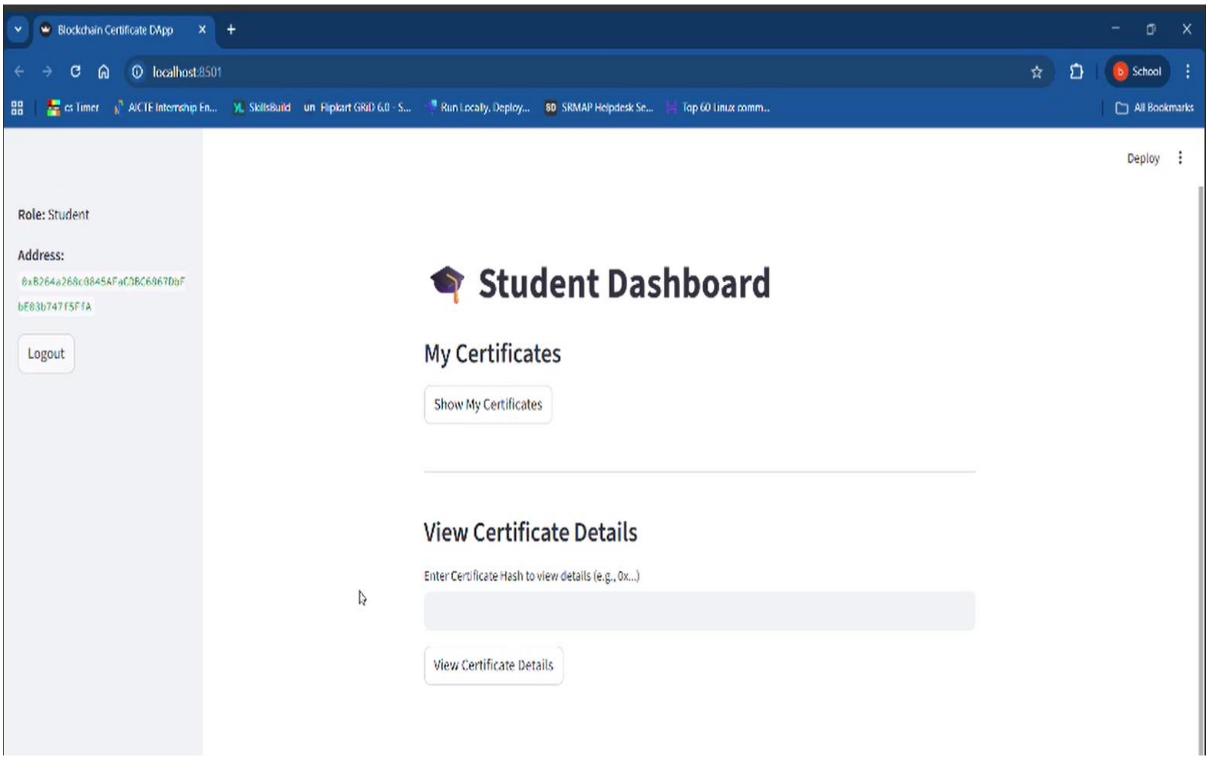
Add Student

Target Wallet Address (to Add/Remove)

0xB264a268c0845AFaCDBC6867DbFbE03b747f5FfA

Execute

Transaction Successful: 46b3a6c0340597a80c7b5eec3dacbc2146ada8fe647ae5af34dad573b4ee2c31



Role: Student

Address:

0xB264a268c0845AFaCDBC6867DbF
bE03b747f5FfA

Logout

🎓 Student Dashboard

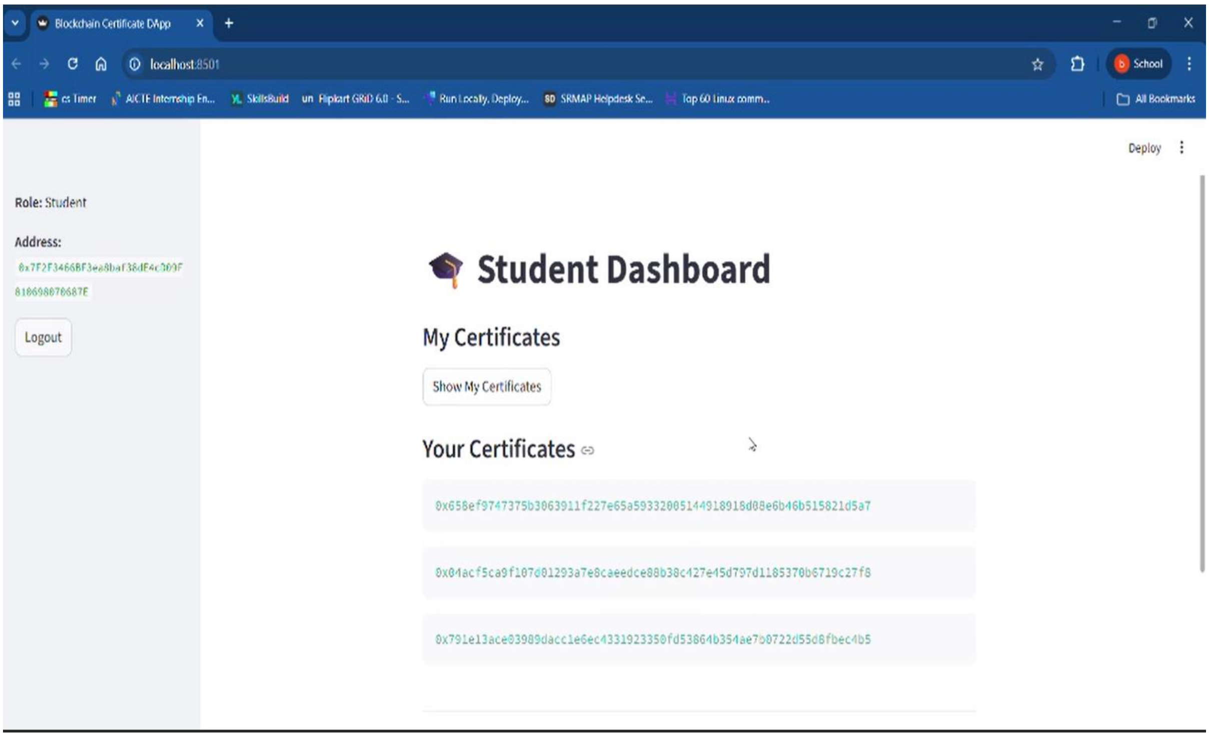
My Certificates

Show My Certificates

View Certificate Details

Enter Certificate Hash to view details (e.g., 0x...)

View Certificate Details



Role: Student

Address:

0x7F2F3466BF3ea8baf38dE4c009F818698070687E

Logout

🎓 Student Dashboard

My Certificates

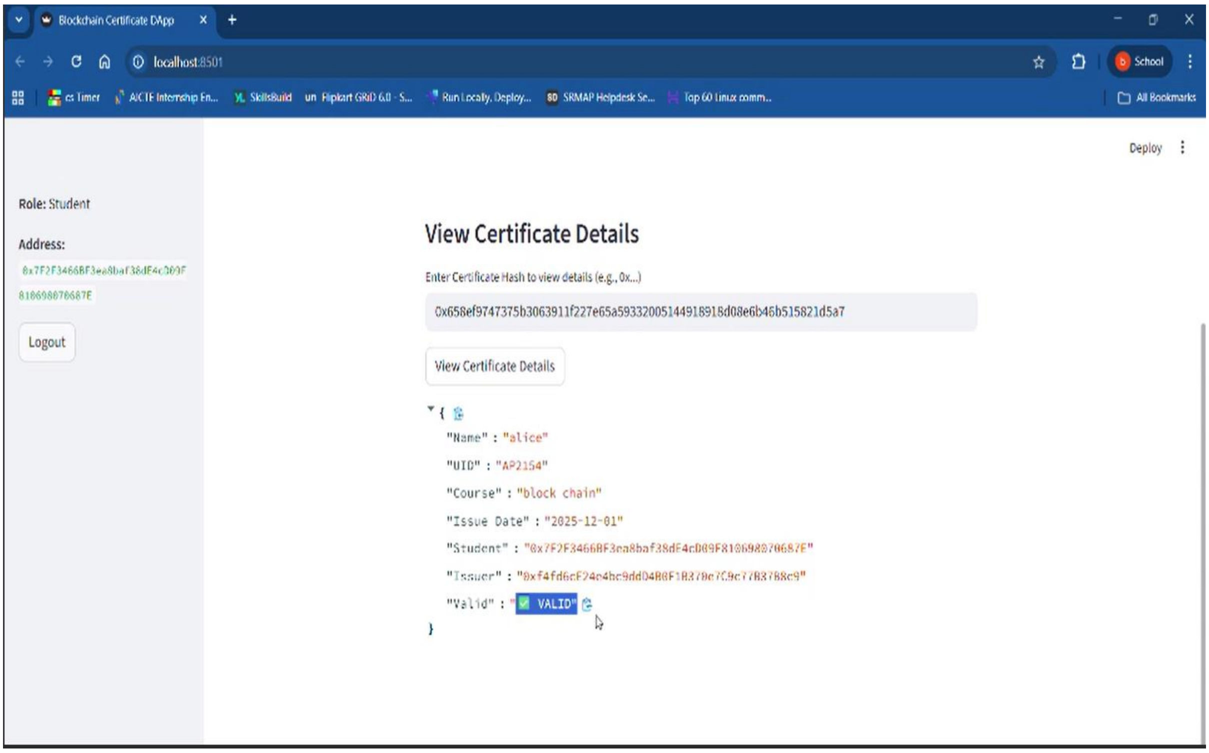
Show My Certificates

Your Certificates

```
0x658ef9747375b3063911f227e65a5933200514491891 8d08e6b46b515821d5a7
```

```
0x04acf5ca9f107d01293a7e8caeedce88b38c427e45d797d1185370b6719c27f8
```

```
0x791e13ace03989dacc1e6ec4331923350fd53864b354ae7b0722d55d8fbec4b5
```



Role: Student

Address:

0x7F2F3466BF3ea8baf38dE4c009F818698070687E

Logout

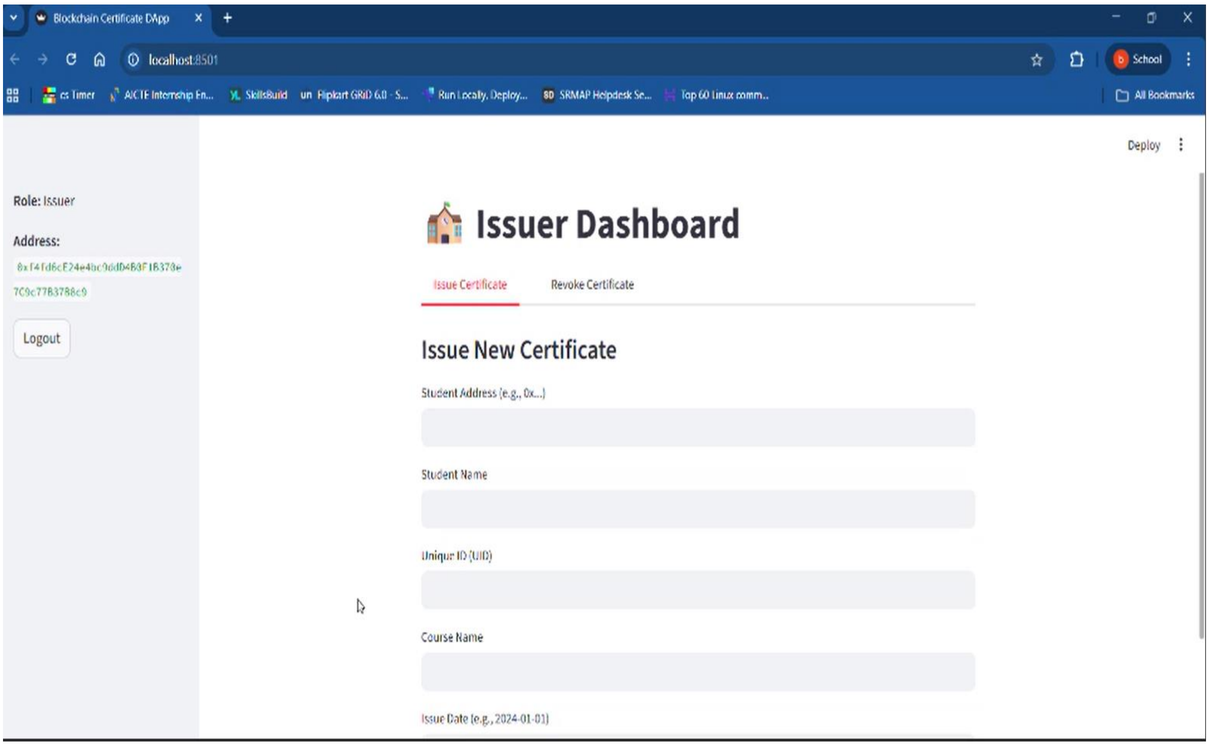
View Certificate Details

Enter Certificate Hash to view details (e.g., 0x...)

0x658ef9747375b3063911f227e65a59332005144918918d08e6b46b515821d5a7

View Certificate Details

```
{
  "Name" : "alice"
  "UID" : "AP2154"
  "Course" : "block chain"
  "Issue Date" : "2025-12-01"
  "Student" : "0x7F2F3466BF3ea8baf38dF4cD09F810698070687E"
  "Issuer" : "0xf4fd6cF24e4bc9dd04B0F1B379c7C9c77B37B8c9"
  "Valid" : "✅ VALID"
}
```



Role: Issuer

Address:

0xf4fd6cE24e4bc9ddD4B3F1B370e7C9c77B3788c9

Issuer Dashboard

Issue New Certificate

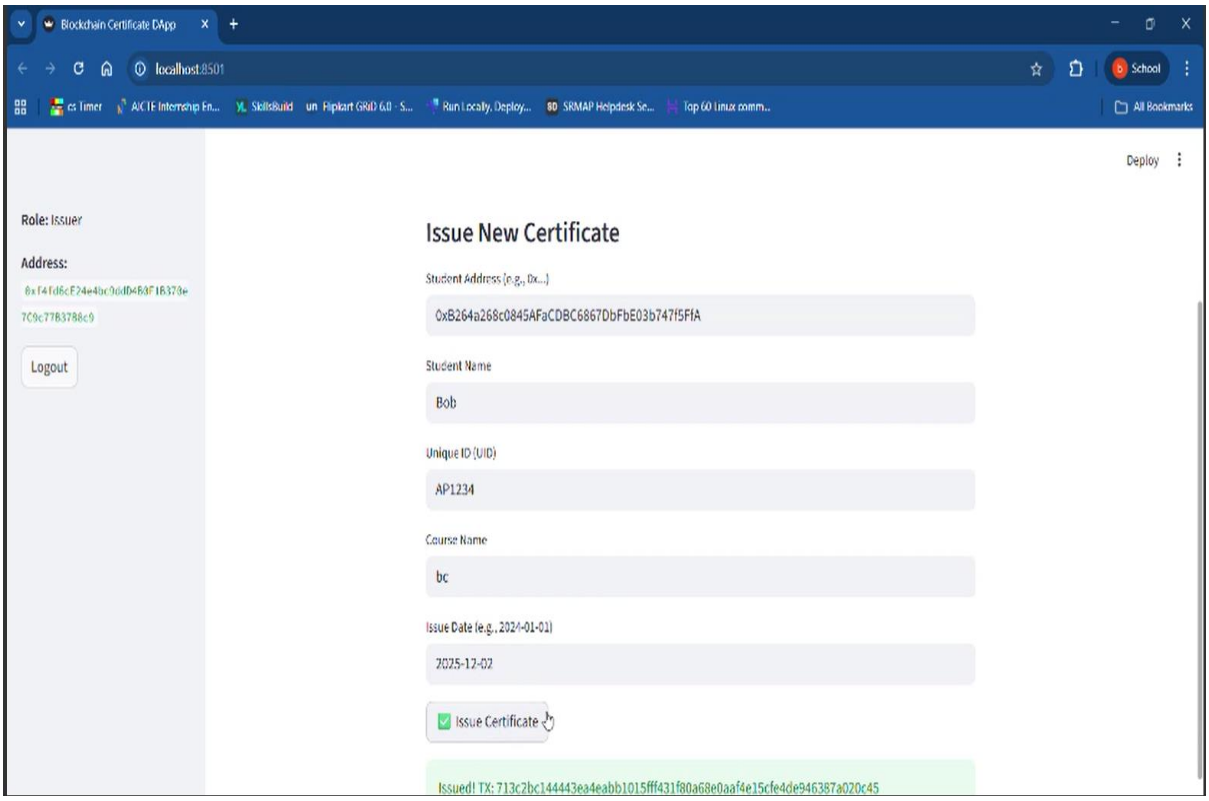
Student Address (e.g., 0x...)

Student Name

Unique ID (UID)

Course Name

Issue Date (e.g., 2024-01-01)



Role: Issuer

Address:

0xf4fd6cE24e4bc9ddD4B3F1B370e7C9c77B3788c9

Issue New Certificate

Student Address (e.g., 0x...)

0xB264a268c0845AFaCDBC6867DbFbE03b747f5FfA

Student Name

Bob

Unique ID (UID)

AP1234

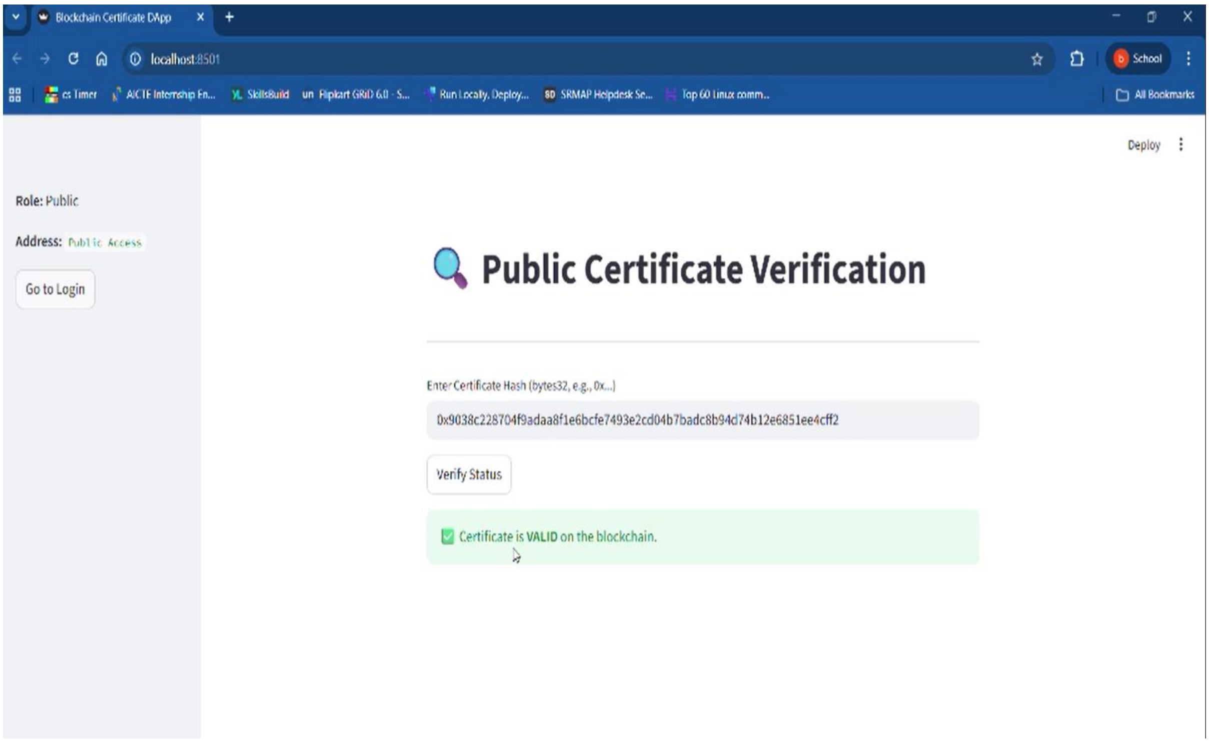
Course Name

bc

Issue Date (e.g., 2024-01-01)

2025-12-02

Issued! TX: 713c2bc144443ea4eabb1015fff431f80a68e0aaf4e15cfe4de946387a020c45



Role: Public

Address: `Public Access`

Go to Login

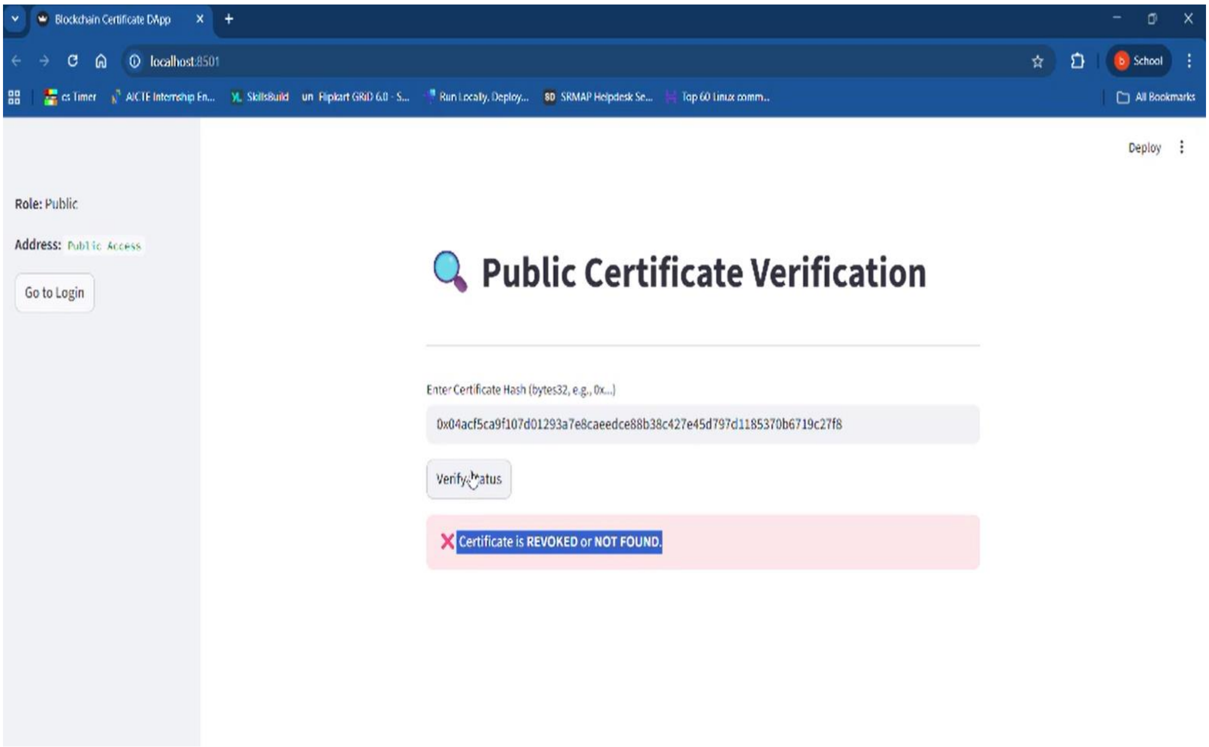
🔍 Public Certificate Verification

Enter Certificate Hash (bytes32, e.g., 0x...)

0x9038c228704f9adaa8f1e6bcfe7493e2cd04b7badc8b94d74b12e6851ee4cff2

Verify Status

✅ Certificate is **VALID** on the blockchain.



Role: Public

Address: `Public Access`

Go to Login

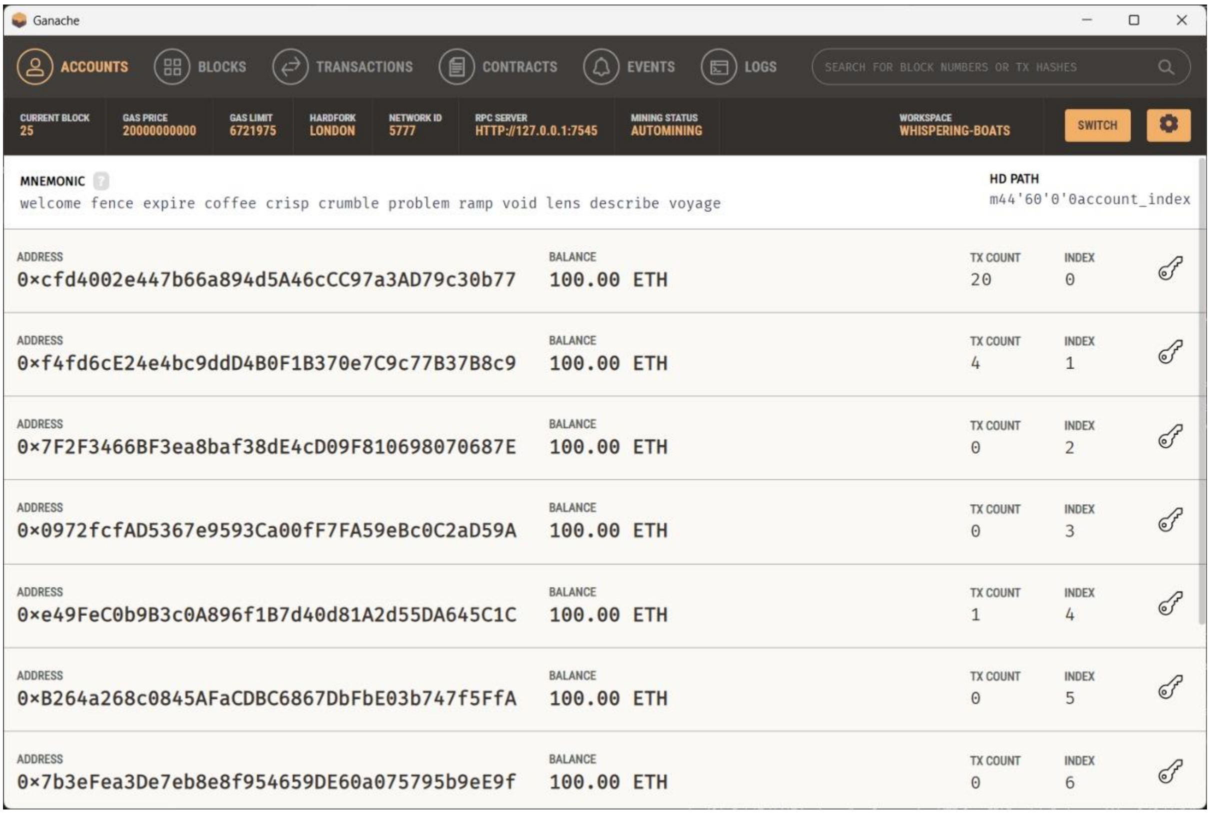
🔍 Public Certificate Verification

Enter Certificate Hash (bytes32, e.g., 0x...)

0x04acf5ca9f107d01293a7e8caeedce88b38c427e45d797d1185370b6719c27f8

Verify Status

❌ Certificate is **REVOKED** or **NOT FOUND.**

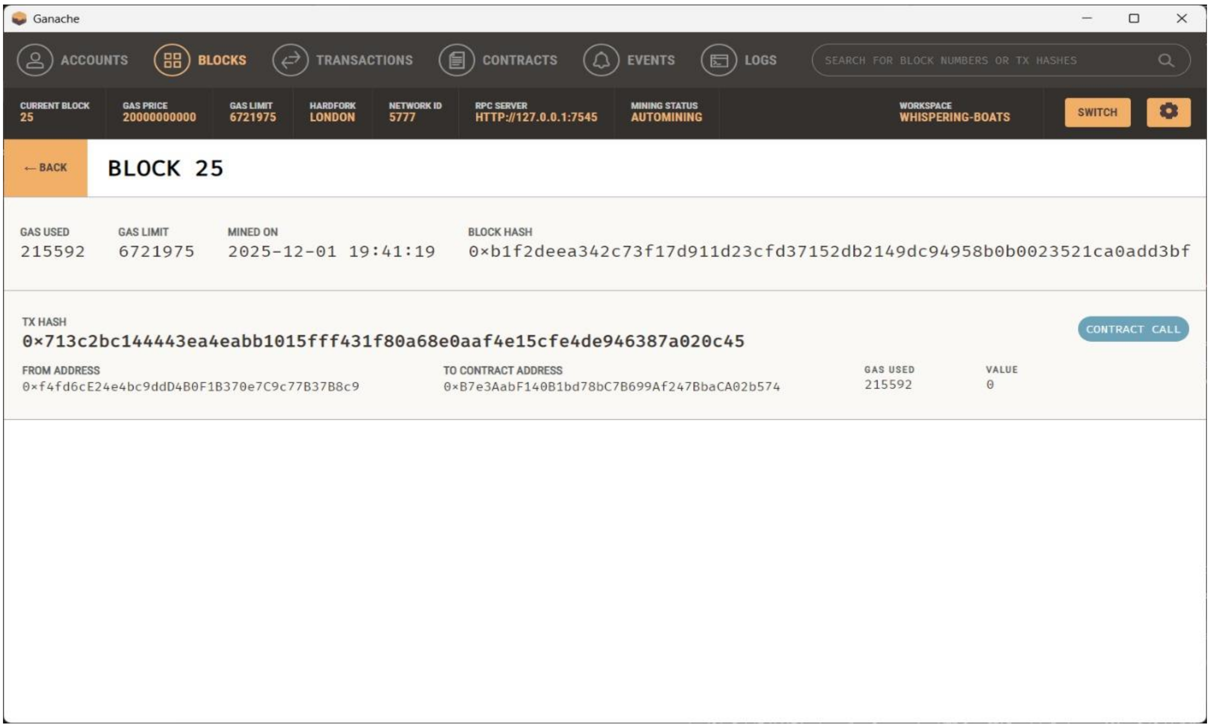


CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
25	20000000000	6721975	LONDON	5777	HTTP://127.0.0.1:7545	AUTOMINING	WHISPERING-BOATS

MNEMONIC
welcome fence expire coffee crisp crumble problem ramp void lens describe voyage

HD PATH
m44'60'0'0account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×cfd4002e447b66a894d5A46cCC97a3AD79c30b77	100.00 ETH	20	0
0×f4fd6cE24e4bc9ddD4B0F1B370e7C9c77B37B8c9	100.00 ETH	4	1
0×7F2F3466BF3ea8baf38dE4cD09F810698070687E	100.00 ETH	0	2
0×0972fcfAD5367e9593Ca00fF7FA59eBc0C2aD59A	100.00 ETH	0	3
0×e49FeC0b9B3c0A896f1B7d40d81A2d55DA645C1C	100.00 ETH	1	4
0×B264a268c0845AFaCDBC6867DbFbE03b747f5FfA	100.00 ETH	0	5
0×7b3eFea3De7eb8e8f954659DE60a075795b9eE9f	100.00 ETH	0	6



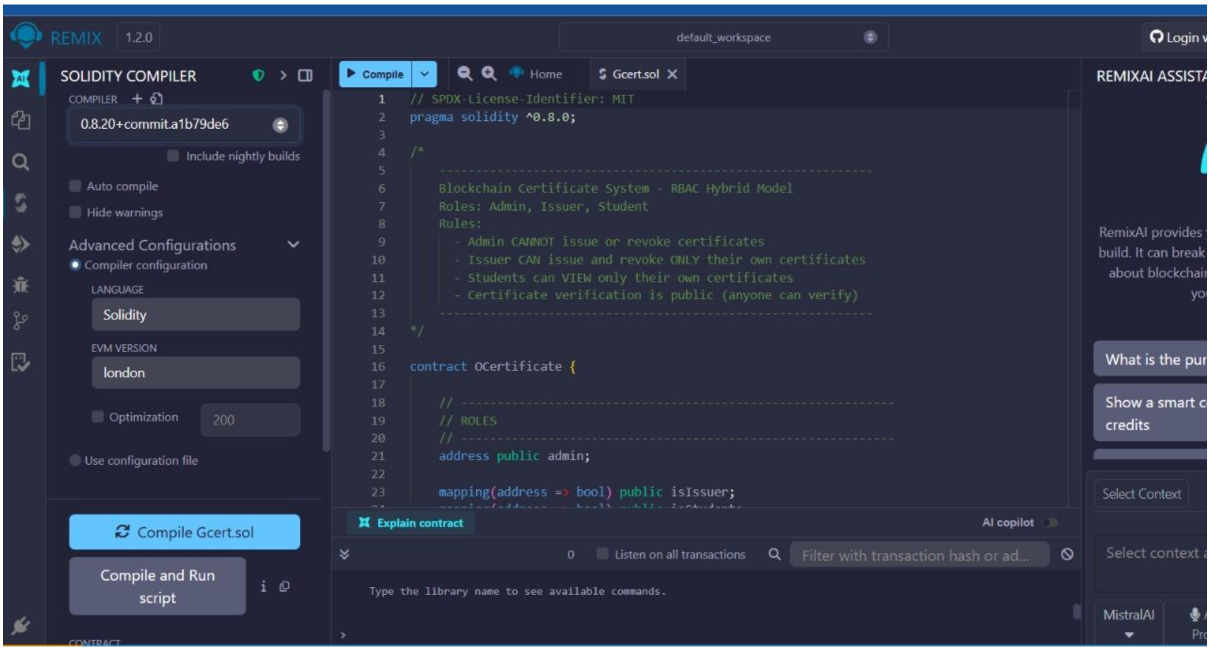
CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
25	20000000000	6721975	LONDON	5777	HTTP://127.0.0.1:7545	AUTOMINING	WHISPERING-BOATS

BLOCK 25

GAS USED	GAS LIMIT	MINED ON	BLOCK HASH
215592	6721975	2025-12-01 19:41:19	0×b1f2deea342c73f17d911d23cfd37152db2149dc94958b0b0023521ca0add3bf

TX HASH
0×713c2bc144443ea4eabb1015fff431f80a68e0aaf4e15cfe4de946387a020c45

FROM ADDRESS	TO CONTRACT ADDRESS	GAS USED	VALUE
0×f4fd6cE24e4bc9ddD4B0F1B370e7C9c77B37B8c9	0×B7e3AabF140B1bd78bC7B699Af247BbaCA02b574	215592	0



COMPILER: 0.8.20+commit.a1b79de6

LANGUAGE: Solidity

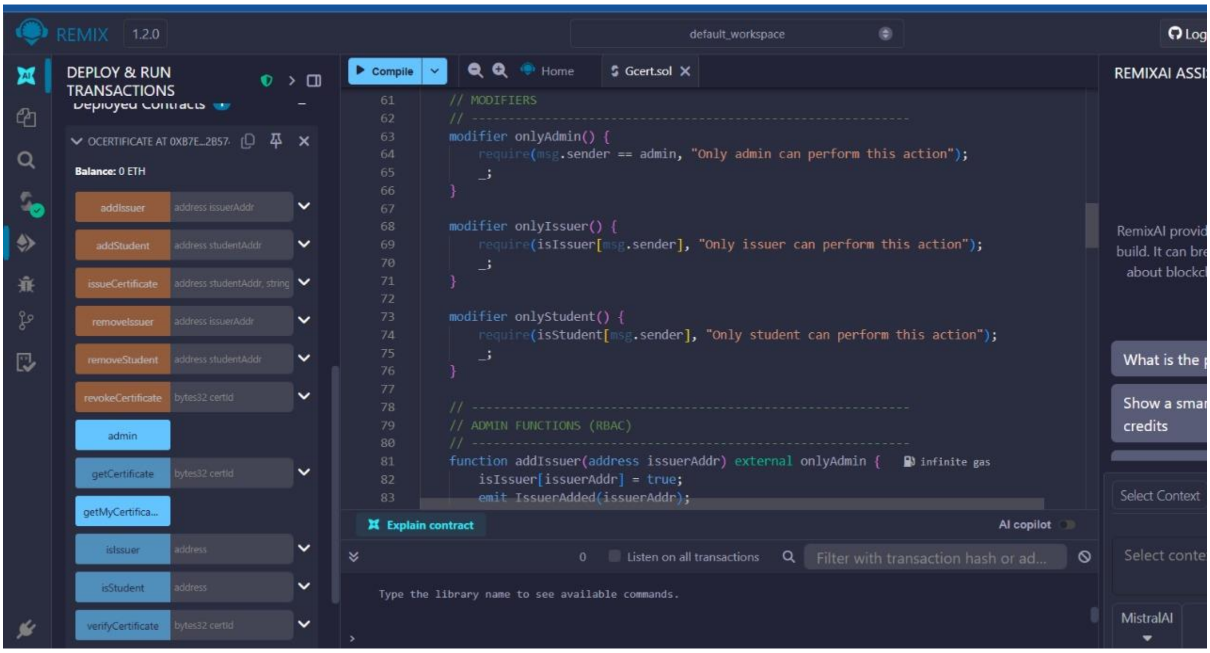
EVM VERSION: london

Optimization: 200

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

/*
    ------------------------------------------------------------
    Blockchain Certificate System - RBAC Hybrid Model
    Roles: Admin, Issuer, Student
    Rules:
      - Admin CANNOT issue or revoke certificates
      - Issuer CAN issue and revoke ONLY their own certificates
      - Students can VIEW only their own certificates
      - Certificate verification is public (anyone can verify)
    ------------------------------------------------------------
*/

contract OCertificate {

    // ------------------------------------------------------------
    // ROLES
    // ------------------------------------------------------------
    address public admin;

    mapping(address => bool) public isIssuer;
```

```
Type the library name to see available commands.
```

RemixAI provides ... build. It can break ... about blockchai...



Balance: 0 ETH

```
    // MODIFIERS
    // ------------------------------------------------------------
    modifier onlyAdmin() {
        require(msg.sender == admin, "Only admin can perform this action");
        _;
    }

    modifier onlyIssuer() {
        require(isIssuer[msg.sender], "Only issuer can perform this action");
        _;
    }

    modifier onlyStudent() {
        require(isStudent[msg.sender], "Only student can perform this action");
        _;
    }

    // ------------------------------------------------------------
    // ADMIN FUNCTIONS (RBAC)
    // ------------------------------------------------------------
    function addIssuer(address issuerAddr) external onlyAdmin {    infinite gas
        isIssuer[issuerAddr] = true;
        emit IssuerAdded(issuerAddr);
```

```
Type the library name to see available commands.
```

RemixAI provid... build. It can bre... about blockc...

8. Future Scope

- Integration with IPFS for Decentralized Storage

- Deployment on Public Blockchain Networks
- QR Code–Based Instant Verification
- Multi-Institution and Large-Scale Expansion

9. References

- Pathak, Shivani, Vimal Gupta, Nitima Malsa, Ankush Ghosh, and R. N. Shaw. "Blockchain-based academic certificate verification system—a review." Advanced Computing and Intelligent Technologies: Proceedings of ICACIT 2022 (2022): 527-539.
- Priyadarshini, R., Pandey, R., Ankit, K.C., Bhandari, D., Khadka, B., Barik, R.K. and Saikia, M.J., 2025. A faster, integrated and trusted certificate authentication and issuer validation system based on blockchain. IEEE Access.
- Lamkoti, R.S., Maji, D., Gondhalekar, A.B. and Shetty, H., 2021. Certificate verification using blockchain and generation of transcript. Int. J. Eng. Res. Technol, 10(3).
- Rustemi, A., Dalipi, F., Atanasovski, V., & Risteski, A. (2023). A systematic literature review on blockchain-based systems for academic certificate verification. Ieee Access, 11, 64679-64696.