Experiment No.5
To design a smart contract using Solidity and Remix IDE
Date of Performance:07—09—23
Date of Submission:08—09—23

AIM: To design a smart contract using Solidity and Remix IDE

Objective: To develop a program in solidity to demonstrate smart contract in ethereum blockchain

Theory:

Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without any intermediary's involvement or time loss. They can also automate a workflow, triggering the next action when conditions are met.

Smart contracts work by following simple "if/when…then…" statements that are written into code on a blockchain. A network of computers executes the actions when predetermined conditions have been met and verified. These actions could include releasing funds to the appropriate parties, registering a vehicle, sending notifications, or issuing a ticket. The blockchain is then updated when the transaction is completed. That means the transaction cannot be changed, and only parties who have been granted permission can see the results.

Within a smart contract, there can be as many stipulations as needed to satisfy the participants that the task will be completed satisfactorily. To establish the terms, participants must determine how transactions and their data are represented on the blockchain, agree on the "if/when...then…" rules that govern those transactions, explore all possible exceptions, and define a framework for resolving disputes.

Then the smart contract can be programmed by a developer – although increasingly, organizations that use blockchain for business provide templates, web interfaces, and other online tools to simplify structuring smart contracts.

Solidity for smart contracts

Solidity is an object-oriented programming language created specifically by the Ethereum Network team for constructing and designing smart contracts on Blockchain platforms.

It's used to create smart contracts that implement business logic and generate a chain of transaction records in the blockchain system.

It acts as a tool for creating machine-level code and compiling it on the Ethereum Virtual Machine (EVM).

It has a lot of similarities with C and C++ and is pretty simple to learn and understand. For example, a "main" in C is equivalent to a "contract" in Solidity.

Like other programming languages, Solidity programming also has variables, functions, classes, arithmetic operations, string manipulation, and many other concepts.

- The Ethereum Virtual Machine (EVM) provides a runtime environment for Ethereum smart contracts.
- It is primarily concerned with ensuring the security and execution of untrusted programs through the use of an international network of public nodes.
- EVM is specialized in preventing Denial-of-Service attacks and certifies that the programs do not have access to each other's state, as well as establishing communication, with no possible interference.

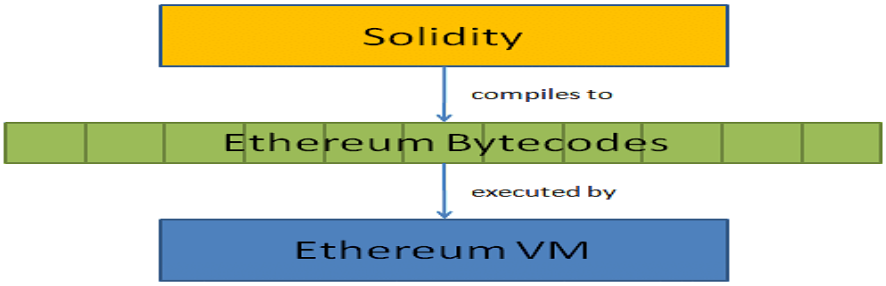


Fig.5.1 EVM in Ethereum Blockchain

- Smart contracts refer to high-level program codes compiled into EVM before being posted to the Ethereum blockchain for execution.
- It enables you to conduct trustworthy transactions without the involvement of a third party; these transactions are traceable and irreversible.

Process:

Step 1. Open Remix **IDE** by typing URL https://remix.ethereum.org/.

Step 2. In Remix IDE select 'Solidity' plugins

Step 3. Click on File Explorer

Step 4. In the default workspace click on 'create new file'

Step 5. Give suitable name to the *file* with extension .sol

Step 6. Type the (smart contract) code in the editor section of the Remix IDE for newly created file (.sol)

Step 7. After typing the code for the smart contract in the newly creates .sol file,click on the compiler option available and then compile the file

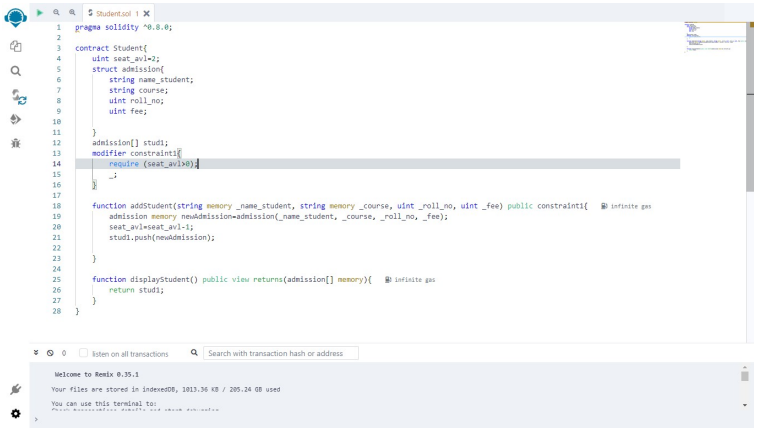
Step 8. If no error, then click on the 'Deploy and Run' to execute the smart contract

Code:

```
pragma solidity ^0.8.0;

contract Student{

    uint seat_avl=2;

    struct admission{

        string name_student;

        string course;

        uint roll_no;

        uint fee;
```

```
    }

    admission[] stud1;

    modifier constraint1{

        require (seat_avl>0);

        _;

    }

      function addStudent(string memory _name_student, string memory _course, uint _roll_no,
uint _fee) public constraint1{

        admission memory newAdmission=admission(_name_student, _course, _roll_no, _fee);

        seat_avl=seat_avl-1;

        stud1.push(newAdmission);

    }

    function displayStudent() public view returns(admission[] memory){

        return stud1;

    }

}
```

Output:


Student.sol 1
pragma solidity ^0.8.0;
contract Student{
uint seat_avl=2;
struct admission{
string name_student;
string course;
uint roll_no;
uint fee;
}
admission[] stud1;
modifier constraint1{
require (seat_avl>0);
_;
}
function addStudent(string memory _name_student, string memory _course, uint _roll_no, uint _fee) public constraint1{
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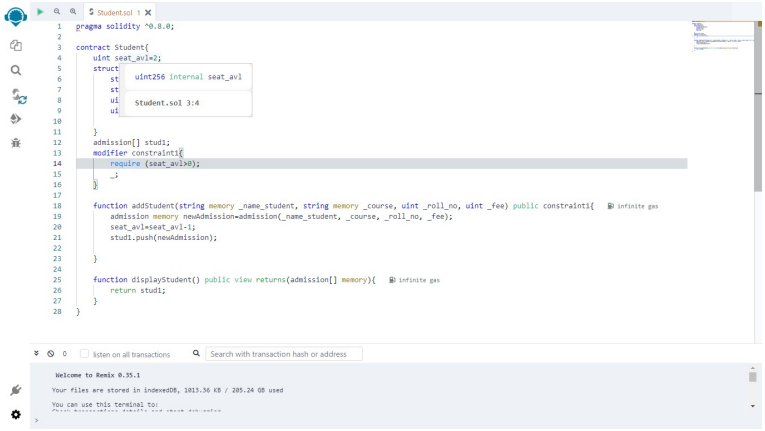
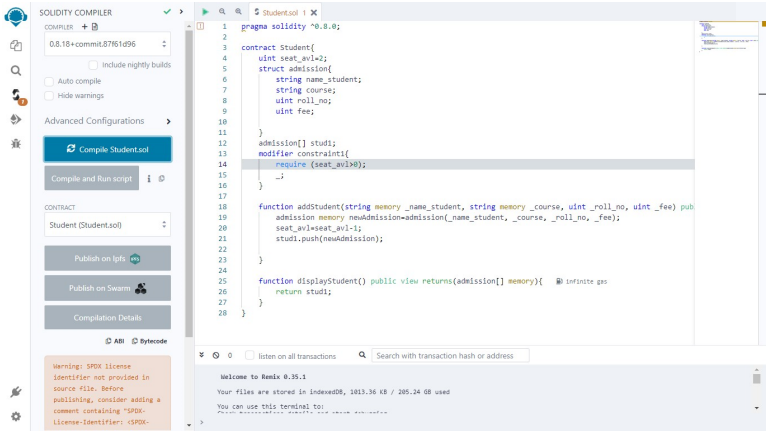
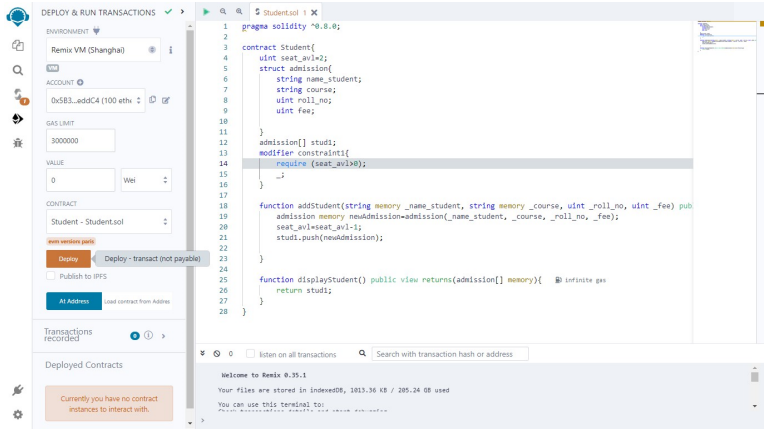
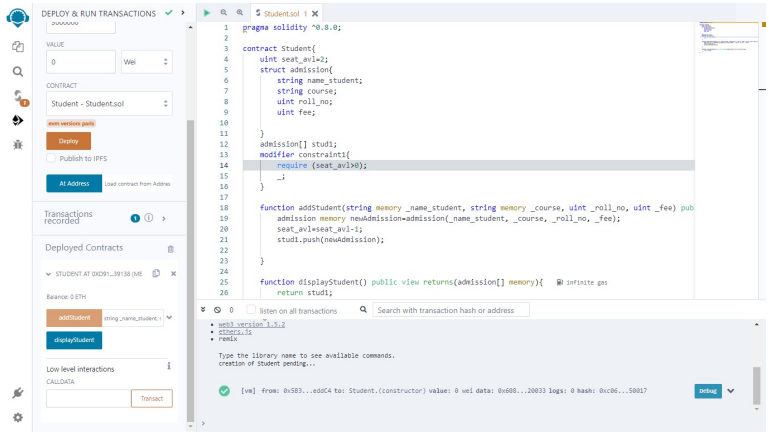
seat_avl=seat_avl-1;
stud1.push(newAdmission);
}
function displayStudent() public view returns(admission[] memory){
return stud1;
}
}
Welcome to Remix 0.35.1
Your files are stored in indexedDB, 1013.36 KB / 205.24 GB used
You can use this terminal to:


Student.sol 1
uint256 internal seat_avl
Student.sol 3:4
Welcome to Remix 0.35.1
Your files are stored in indexedDB, 1013.36 KB / 205.24 GB used
You can use this terminal to:


SOLIDITY COMPILER
0.8.18+commit.87f61d96
Advanced Configurations
Compile Student.sol
Compile and Run script
Student (Student.sol)
Publish on Ipfs
Publish on Swarm
Compilation Details
Student.sol 1
Welcome to Remix 0.35.1
Your files are stored in indexedDB, 1013.36 KB / 205.24 GB used
You can use this terminal to:


DEPLOY & RUN TRANSACTIONS
Student.sol
pragma solidity ^0.8.0;
contract Student{
uint seat_avl=2;
struct admission{
string name_student;
string course;
uint roll_no;
uint fee;
}
admission[] stud1;
modifier constraint1{
require (seat_avl>0);
_;
}
function addStudent(string memory _name_student, string memory _course, uint _roll_no, uint _fee) pub
admission memory newAdmission=admission(_name_student, _course, _roll_no, _fee);
seat_avl=seat_avl-1;
stud1.push(newAdmission);
}
function displayStudent() public view returns(admission[] memory){
return stud1;
}
}
Remix VM (Shanghai)
Student - Student.sol
Deploy
Publish to IPFS
At Address
Transactions recorded
Deployed Contracts
Currently you have no contract instances to interact with.
Welcome to Remix 0.35.1
Your files are stored in indexedDB, 1013.36 KB / 205.24 GB used
You can use this terminal to:


DEPLOY & RUN TRANSACTIONS
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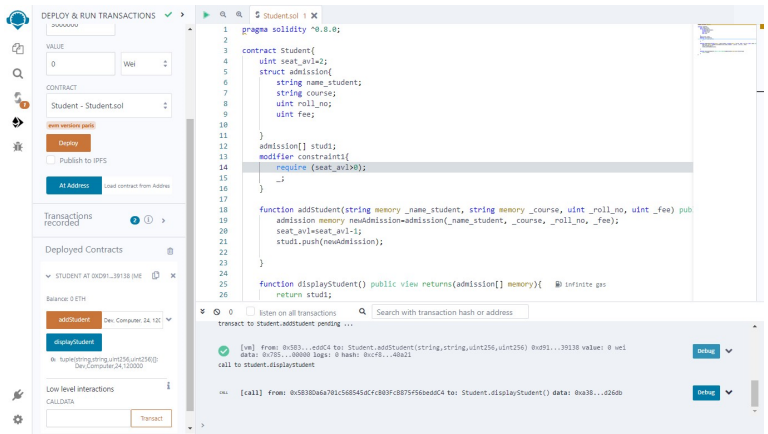
seat_avl=seat_avl-1;
stud1.push(newAdmission);
}
function displayStudent() public view returns(admission[] memory){
return stud1;
}
Student - Student.sol
Deploy
Publish to IPFS
At Address
Transactions recorded
Deployed Contracts
displayStudent
Low level interactions
Transact
web3 version 1.5.2
ethers.js
remix
Type the library name to see available commands.
creation of Student pending...


DEPLOY & RUN TRANSACTIONS
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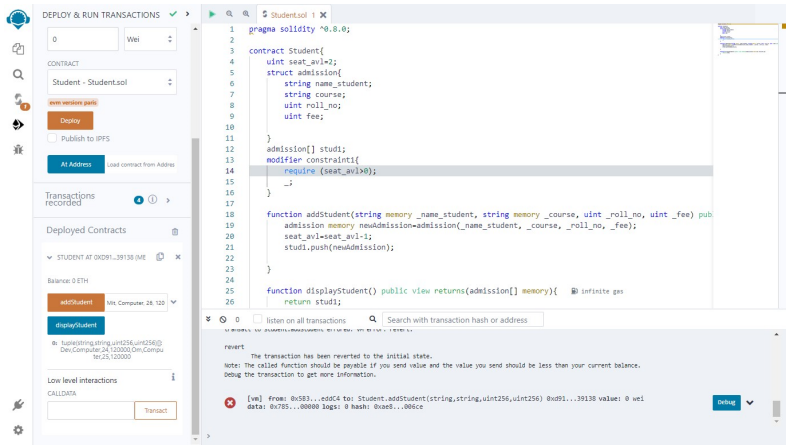
stud1.push(newAdmission);
}
function displayStudent() public view returns(admission[] memory){
return stud1;
}
Student - Student.sol
Deploy
Publish to IPFS
At Address
Transactions recorded
Deployed Contracts
displayStudent
Low level interactions
Transact
transact to Student.addStudent pending ...
call to Student.displayStudent



Conclusion:

1. Tailored for Ethereum: Solidity has been specifically crafted for the Ethereum ecosystem, making it the natural choice for developing smart contracts on this blockchain. Being Ethereum's native programming language, it seamlessly integrates with the Ethereum Virtual Machine (EVM).

2. Emphasis on Safety and Security: Solidity comes equipped with features such as static analysis tools and automated testing frameworks that assist developers in creating secure smart contracts. Extensively tested and widely understood security patterns within Solidity mitigate the risks of vulnerabilities.

3. Robust Community and Extensive Documentation: Solidity enjoys a vibrant and sizable developer community. This ensures a wealth of resources, tutorials, and documentation, facilitating learning and troubleshooting. This strong support network simplifies the process of building dependable smart contracts.

4. EVM Compatibility: Solidity is purpose-built to compile into EVM bytecode, the code executed on the Ethereum blockchain. This compatibility guarantees that smart contracts authored in Solidity can run on the Ethereum network seamlessly, without compatibility concerns.

5. Broad Adoption: Solidity ranks among the most commonly used programming languages for Ethereum smart contracts. Its widespread usage means that a multitude of existing projects and decentralized applications (DApps) are coded in Solidity, fostering opportunities for interoperability and integration.