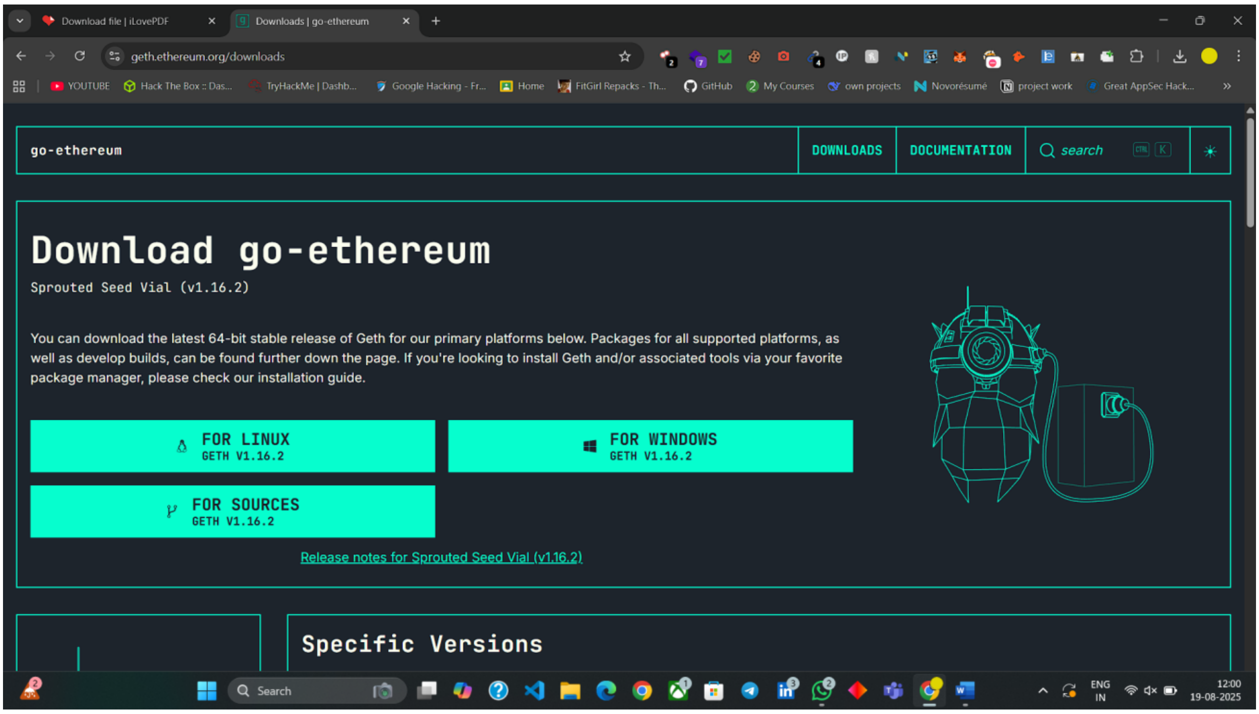
Practical No - 1

AIM: Introduction to Block Chain

Description: This practical focuses on understanding the concept of blockchain and implementing a private Ethereum blockchain network using Geth (Go Ethereum). A blockchain is a distributed digital ledger that stores transactions in blocks linked in sequential order. In this activity, instead of connecting to the public Ethereum mainnet, we build a private network where only authorized nodes can participate.

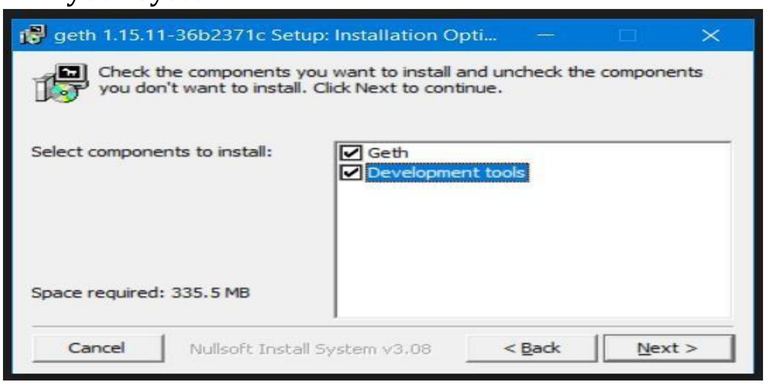
Step-01:

- Now install Ethereum in your system to build a private blockchain using it



Step-02:

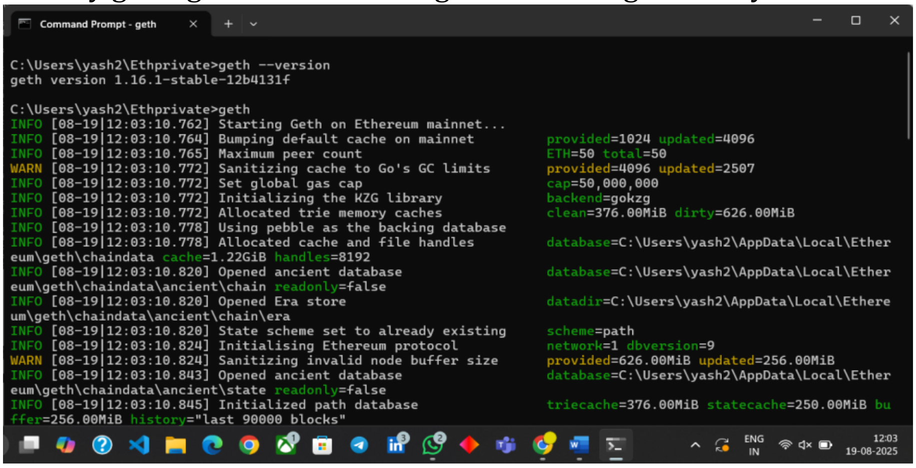
- Now install Ethereum in your system



- Add its path to the environment variables

Step-03:

- Now create the folder name “eth private” by using this floder we wil start to build or private blockchain.
- Now open the terminal and give command “cd <eth private folder location >
- Now in that directory give “geth” to check the geth is running on the system

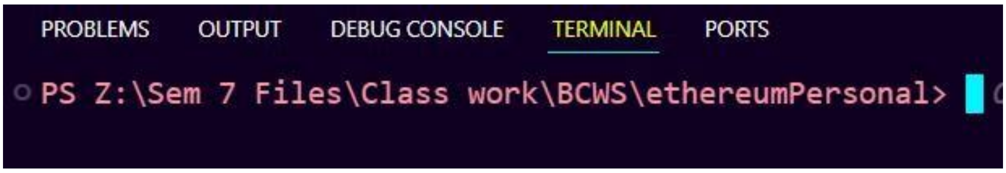


Step-04:

- Now open vs code and develop a code to build genesis block(First block) of the private block chain in json format

Step-05:

- Now open the terminal in vscode and change the directory into”eth private”

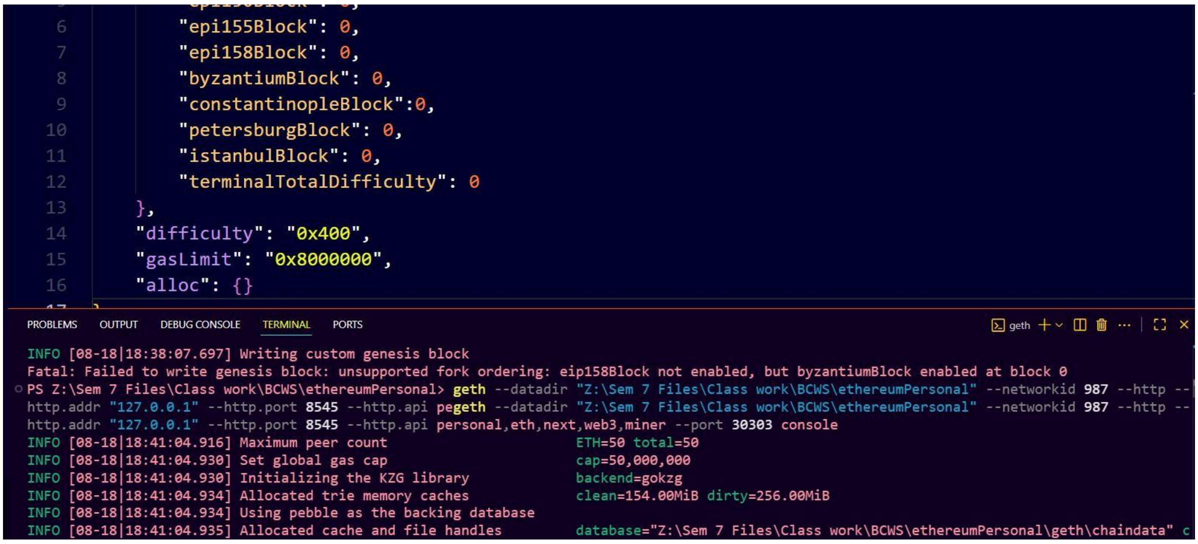


Step-06:

- Now execute the genesis file by giving command ” **geth --datadir "C:\Users\sarik\ethprivate" init "C:\Users\sarik\Ethprivate\genesis.json"**
- By exceuting this command we sucessfully write the genesis block in our blockchain

Step-07:

- Initialize the private network Launch the private network in which various nodes can add new blocks for this we have to run the command” **geth --datadir "C:\User\sarik\ethprivate" --networkid 987**
  --http --http.addr "127.0.0.1" --http.port 8545 --http.api personal,eth,net,web3,miner --port 30303 console”



- After the we will get Geth javascript console where we can monitor how many peer are available in network and how many have connected to our private blockchain network it will show the peercount

Conclusion:

By performing this practical we learn the concept of blockchain and we learnt create genesis block which is first block in our private blockchain network.

Practical No - 2

Aim: Smart Contracts Development:

1. **Understanding smart contracts.**
2. **Developing and deploying a basic smart contract.**
3. **Interacting with smart contracts.**

1. Understanding smart contracts.

Description: Smart contracts have gained significant attention and popularity in the world of blockchain and cryptocurrency. Ethereum, with its robust blockchain infrastructure, has emerged as a leading platform for deploying dApps and executing smart contracts. While Web2 developers may be accustomed to building centralized applications, transitioning to Web3 development on Ethereum opens up a world of decentralized possibilities.

Prerequisites:

- Before diving into the process of deploying a smart contract on Ethereum, it is essential to have a basic understanding of the following concepts and meet the requirements:
- Familiarity with the fundamentals of blockchain technology (distributed ledger, consensus mechanisms, immutability).
- Key differences between centralized and decentralized applications (decentralized consensus, peer-to-peer networks, significance of smart contracts).
- Knowledge of Solidity, the programming language used to write smart contracts on the Ethereum Blockchain.
- Familiarity with blockchain terminologies (wallets, gas, block explorers, etc.).
- Ensure that you have Metamask browser extension using this link set up on your PC. If you haven't done so already, you can add the Metamask to your preferred web browser.
- Get the Sepolia testnet faucet here to enable you to cover the gas fees for deploying your smart contract on the Ethereum testnet.
- A text editor: For this tutorial, we will make use of REMIX, a development environment that allows you to write and test smart contracts. It provides a user friendly interface and a range of features to facilitate the development and deployment of smart contracts.

Decentralized applications (DApps)

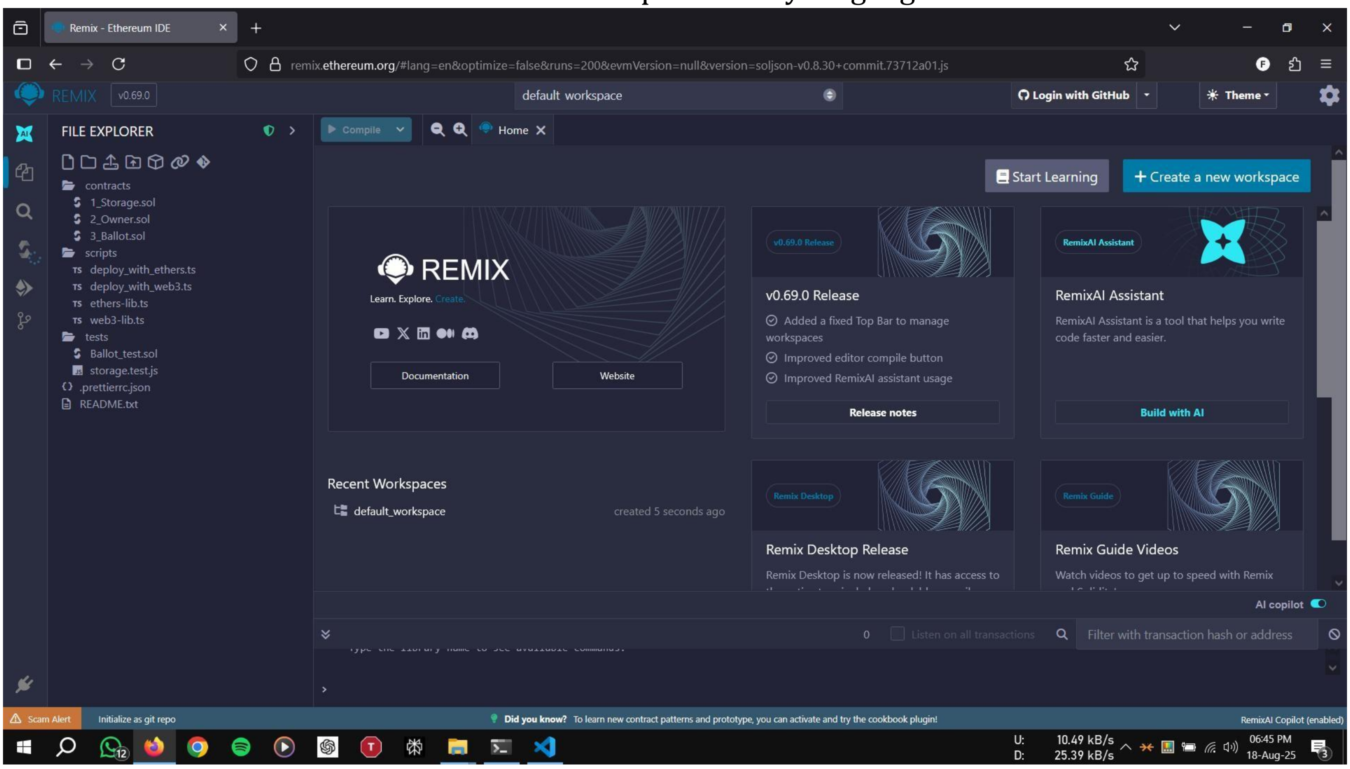
A Dapp is an application that operates in a decentralized manner. It utilizes smart contracts to store the application's business logic and state, replacing the traditional server-side component. However, it's important to note that DApps encompass more than just smart contracts. At the minimum, a DApp consists of:

- Smart contracts on a blockchain, and
- A web user interface. BCWS LABORATORY 303105416 2203031260056 Page | 8 In a broader sense, a Dapp is a web application that leverages open, decentralized, peer-to peer infrastructure services.

2. Developing and Deploying smart

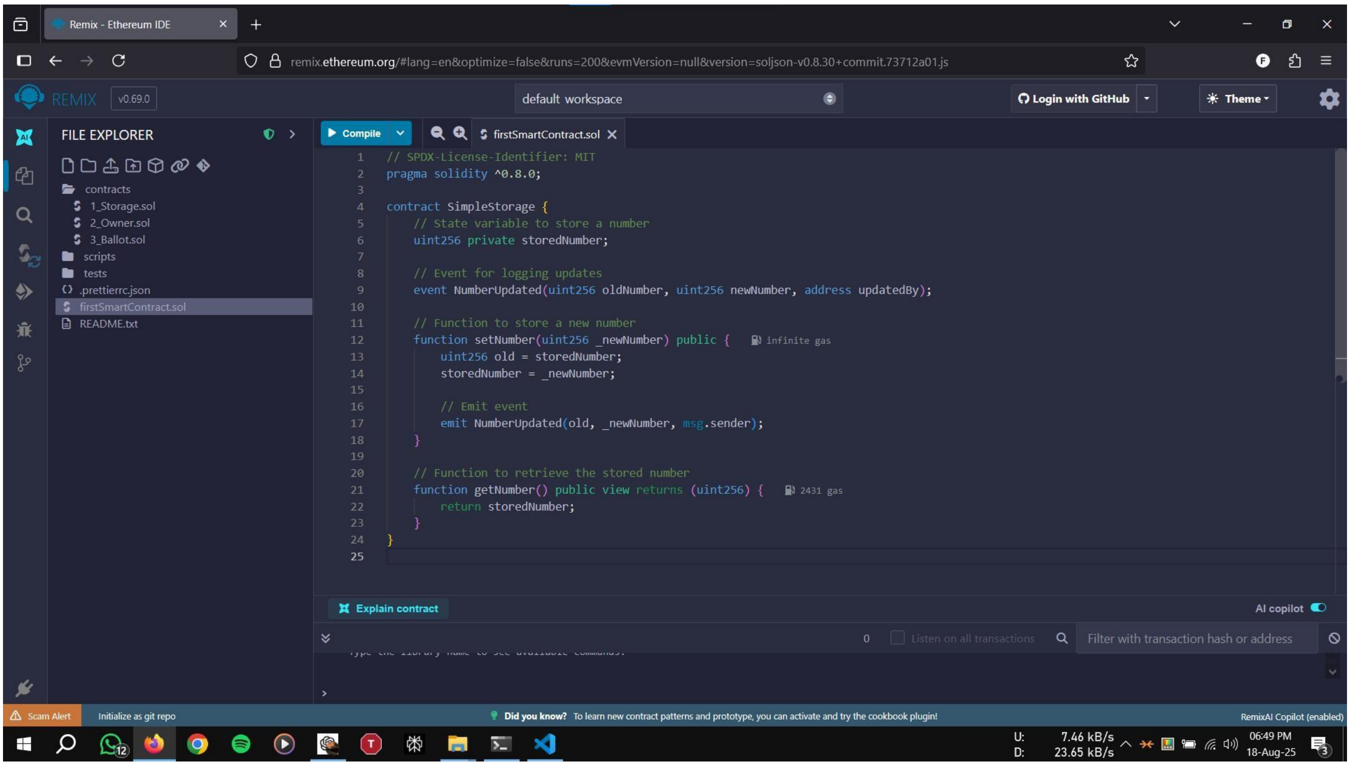
Contracts Step-01:

- Now open remix.ethereum.org where we can create and store our smart contract it is a ethereum IDE that we can write smart contract with help of solidity language.



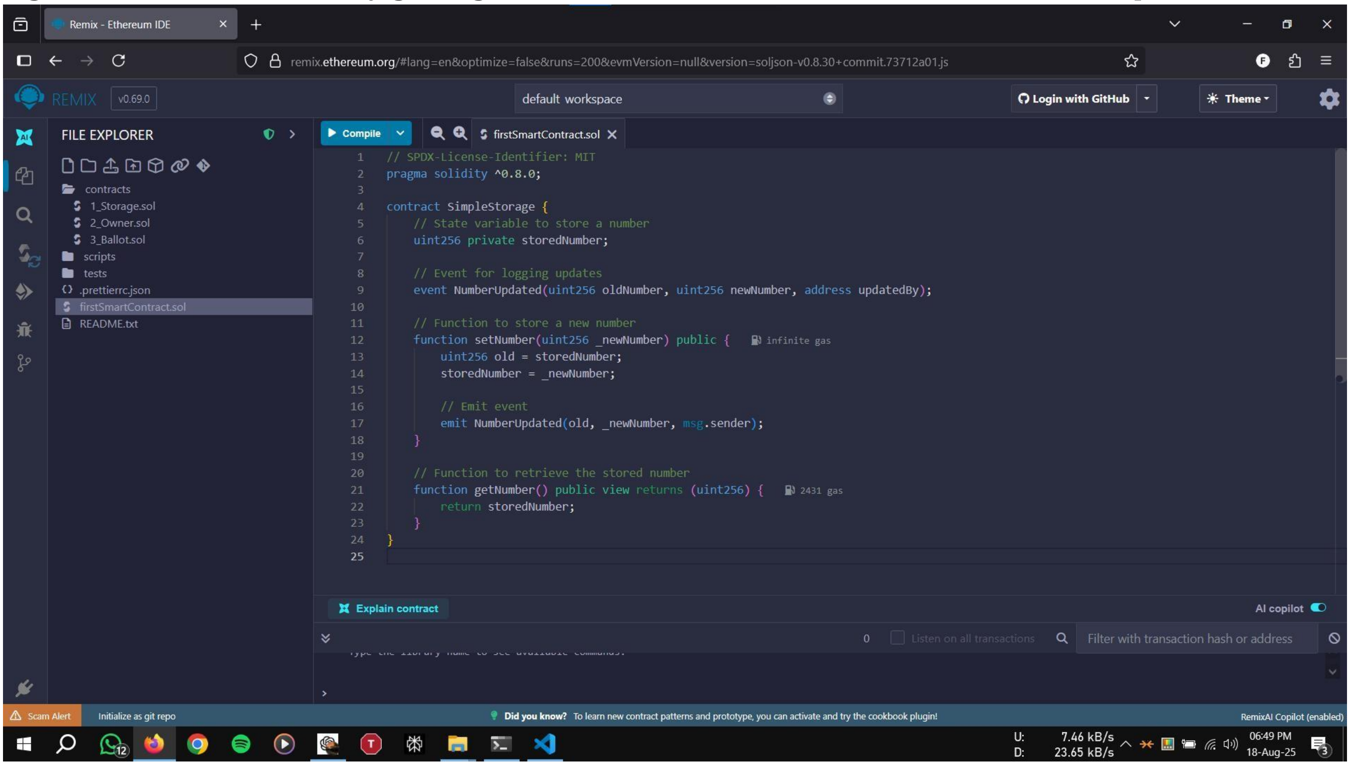
Step-02:

- Now create a new file from the top right corner while creating new file give the extension of the file**.sol** by giving .sol extension its helps remix to identify that the the smart contract is written in solidity programming language.



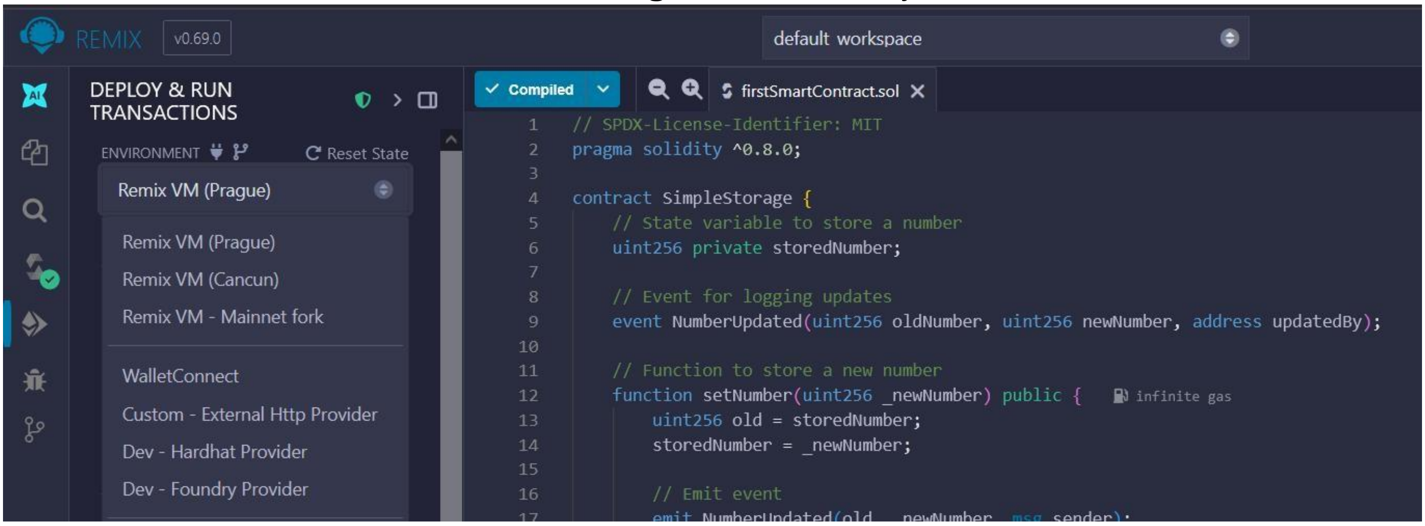
Step-03:

- Now after writing the contract compile the contract after compiling the contract we should get a green color check mark by getting it we can know that the smart contract has compiled successfully.



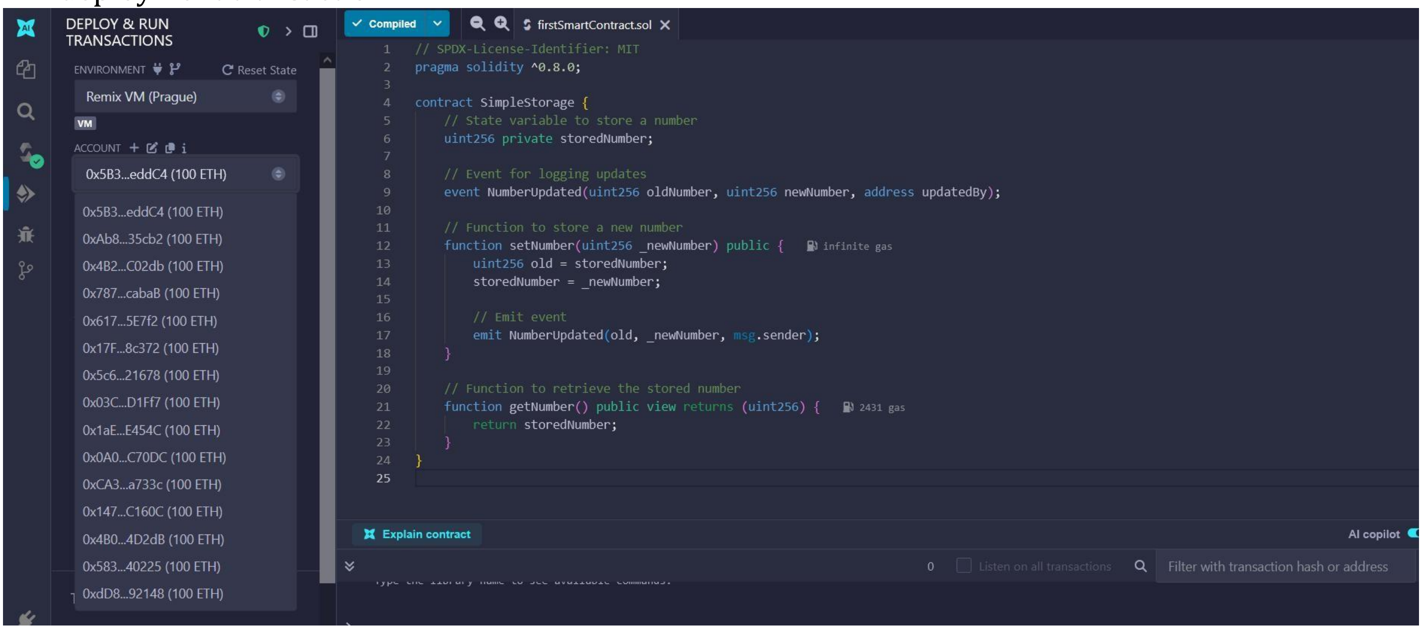
Step -04:

- Now after successful compilation of the contract go to the section deployment on the left side taskbar.
- In that section select we have to set the environment to deploy the smart contract such as java VM but we are deploying this contract directly on the Ethereum testnet.
- So click on the environment and select "**Prague**" to connect to your wallet.



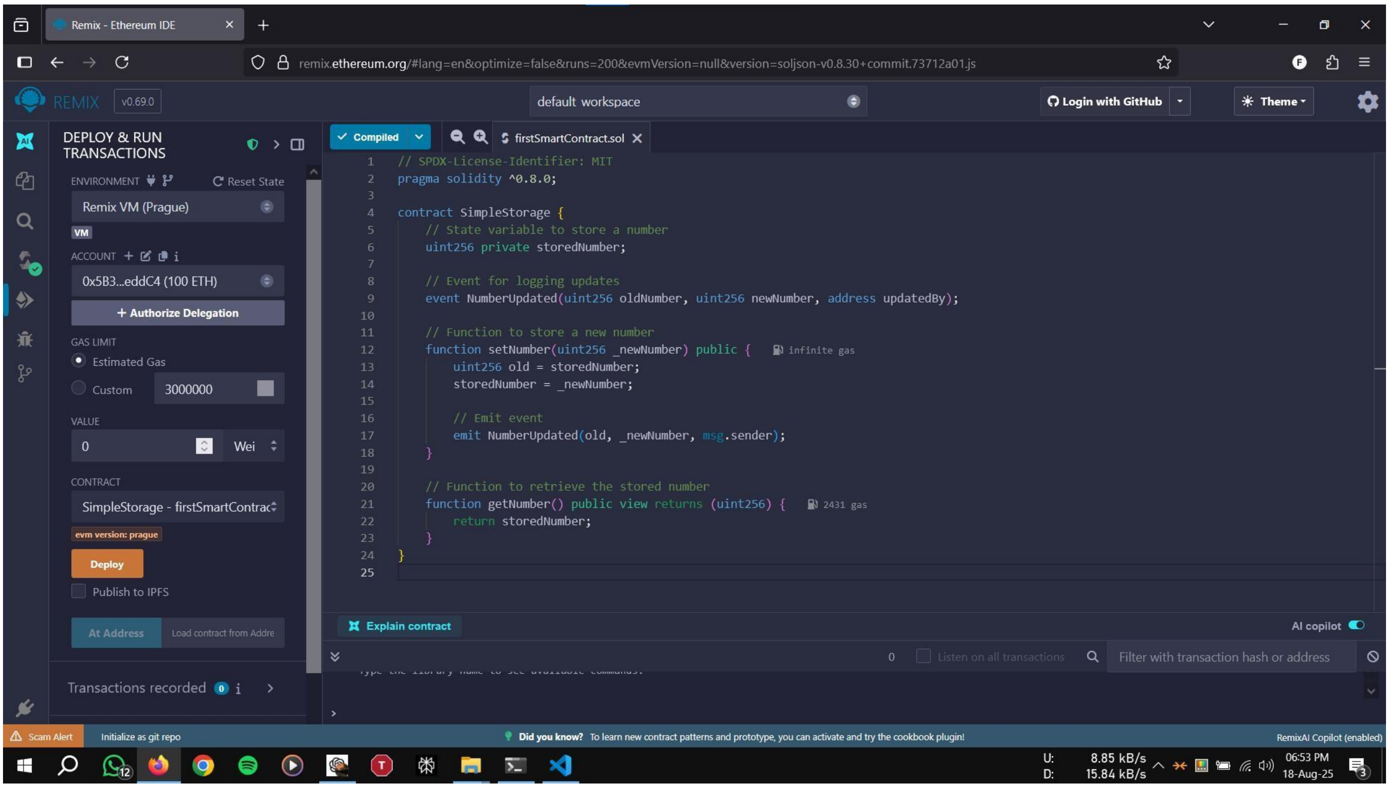
Step-05:

- After setting the environment we have select the account which acts as a sender of the deployment transaction.



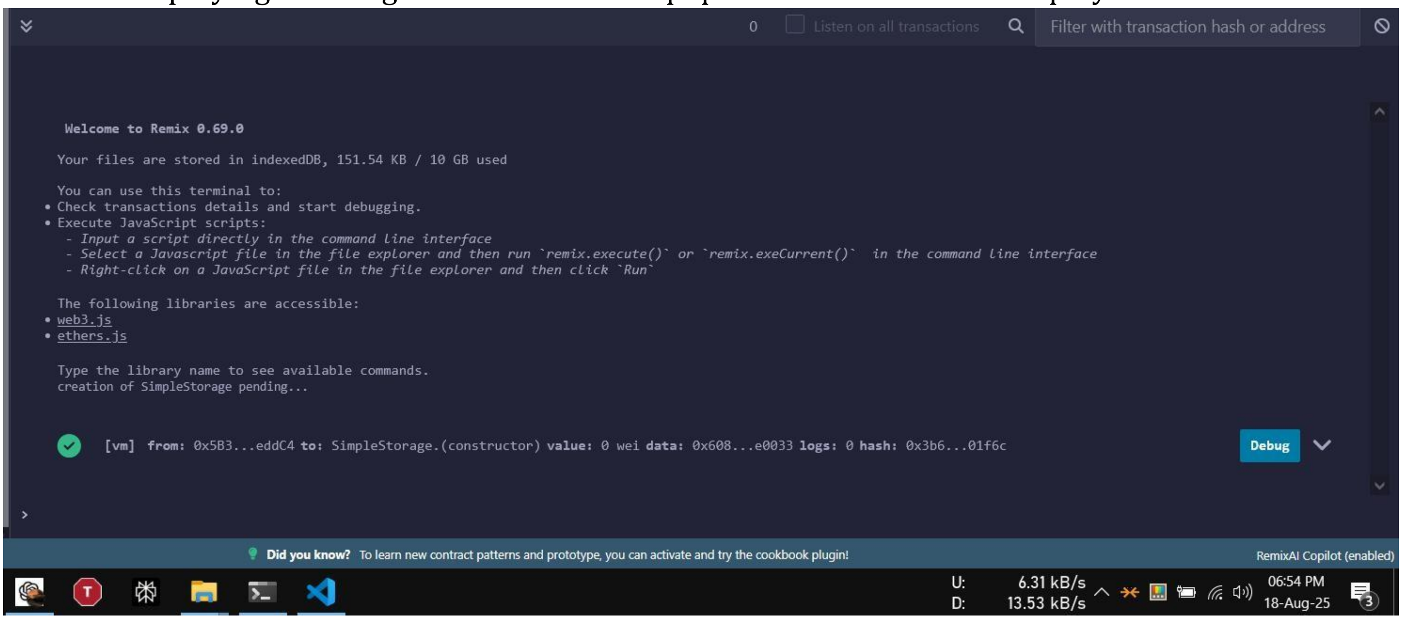
Step-06:

- After setting theaccount also click on the deployment option by this we can successfully deploy our smart contract.



Step-07:

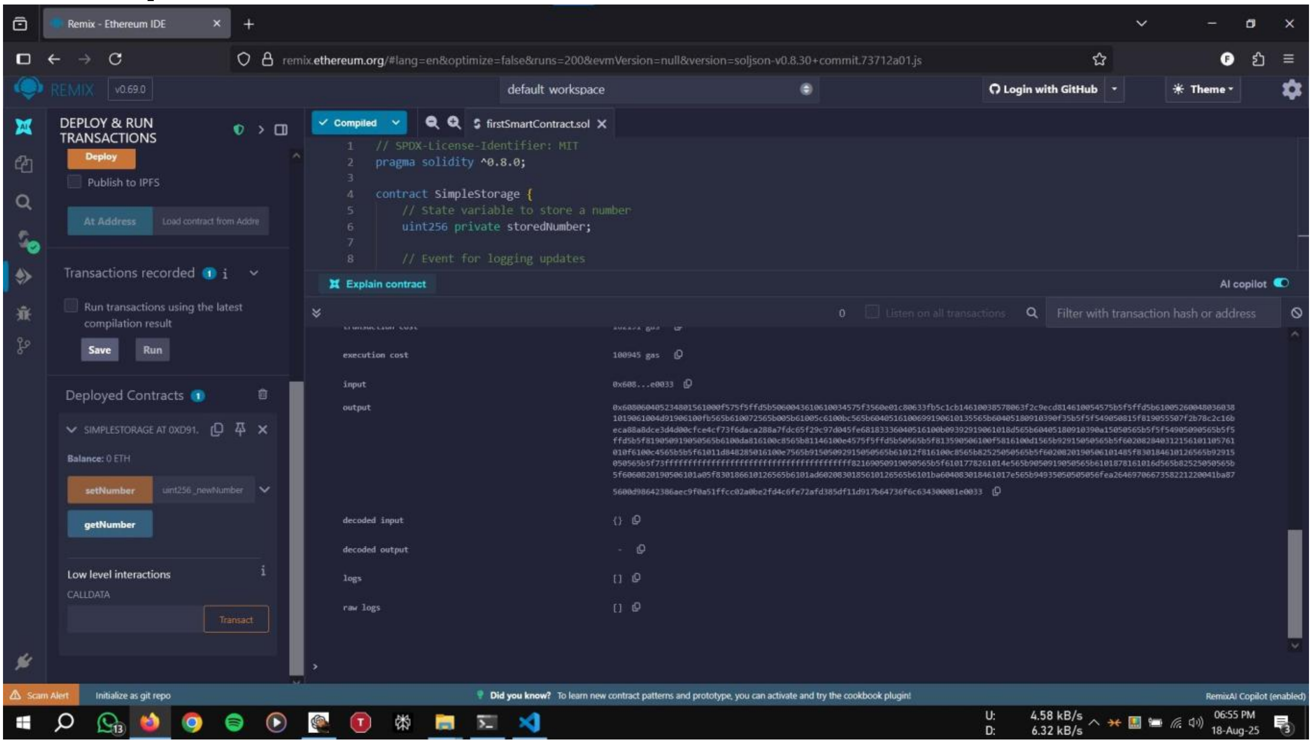
- After deploying we will get the confirmation pop that our contract has deployed in the terminal.



3. Interact with the Deployed

Contract Step-8:

- Once the contract developed you can interact with it with the help of its user interface that remix provides.



<u>Conclusion</u>:

By performing this practical we get to know what are smart contract and their working .we learnt to develop and deploy the our first smart contract using remix Ethereum IDE .we can interact with the smart contract for future of further purposes.

Practical No - 3

Aim: Identifying and Mitigating Common Vulnerabilities.

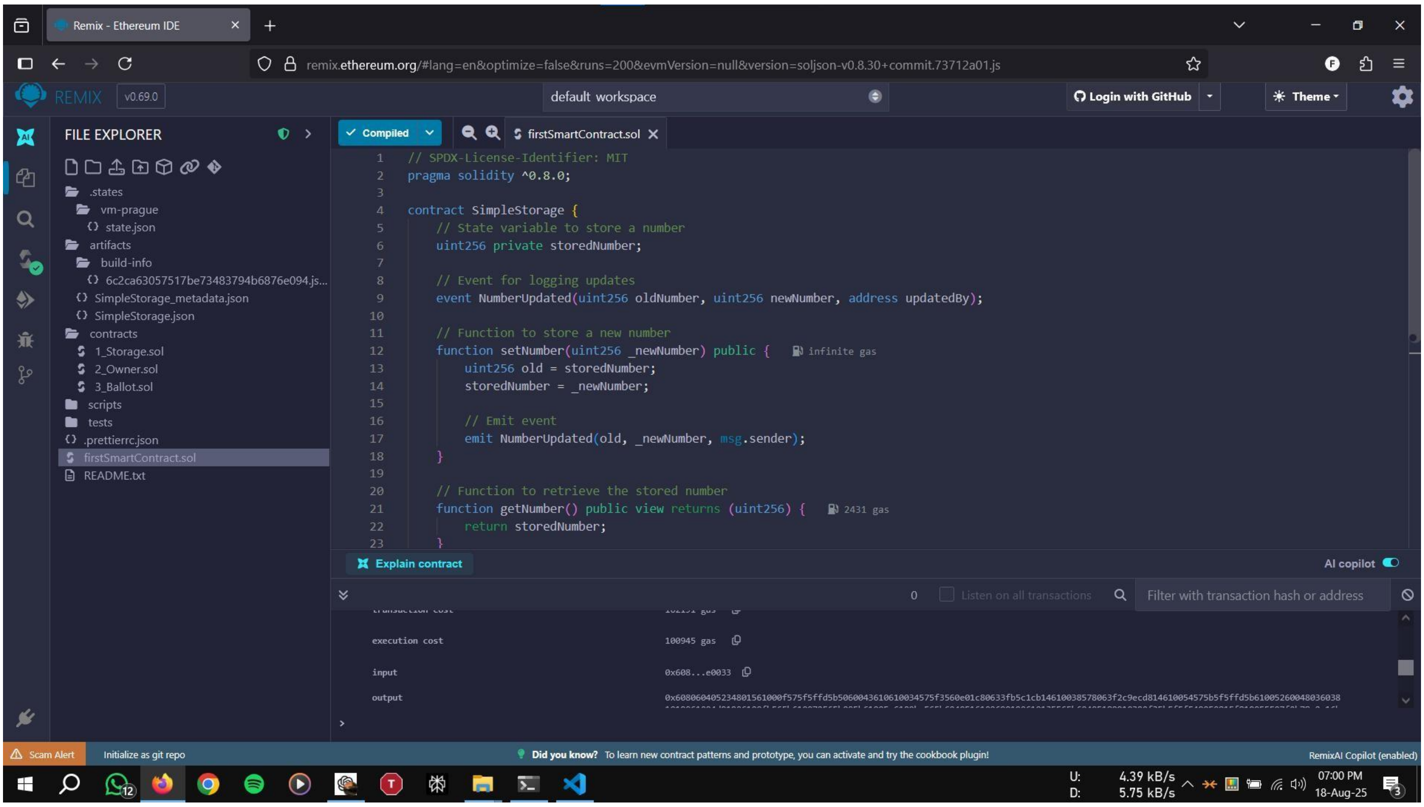
1. **Exploring common security vulnerabilities in blockchain.**
2. **Implementing security best practices.**
3. **Conducting code reviews for security.**

SOL: Identifying and mitigating common vulnerabilities in blockchain systems. This manual covers the exploration of common security vulnerabilities, the implementation of security best practices, and conducting code reviews for security.

1. Exploring Common Security Vulnerabilities in Blockchain.

Step 1:

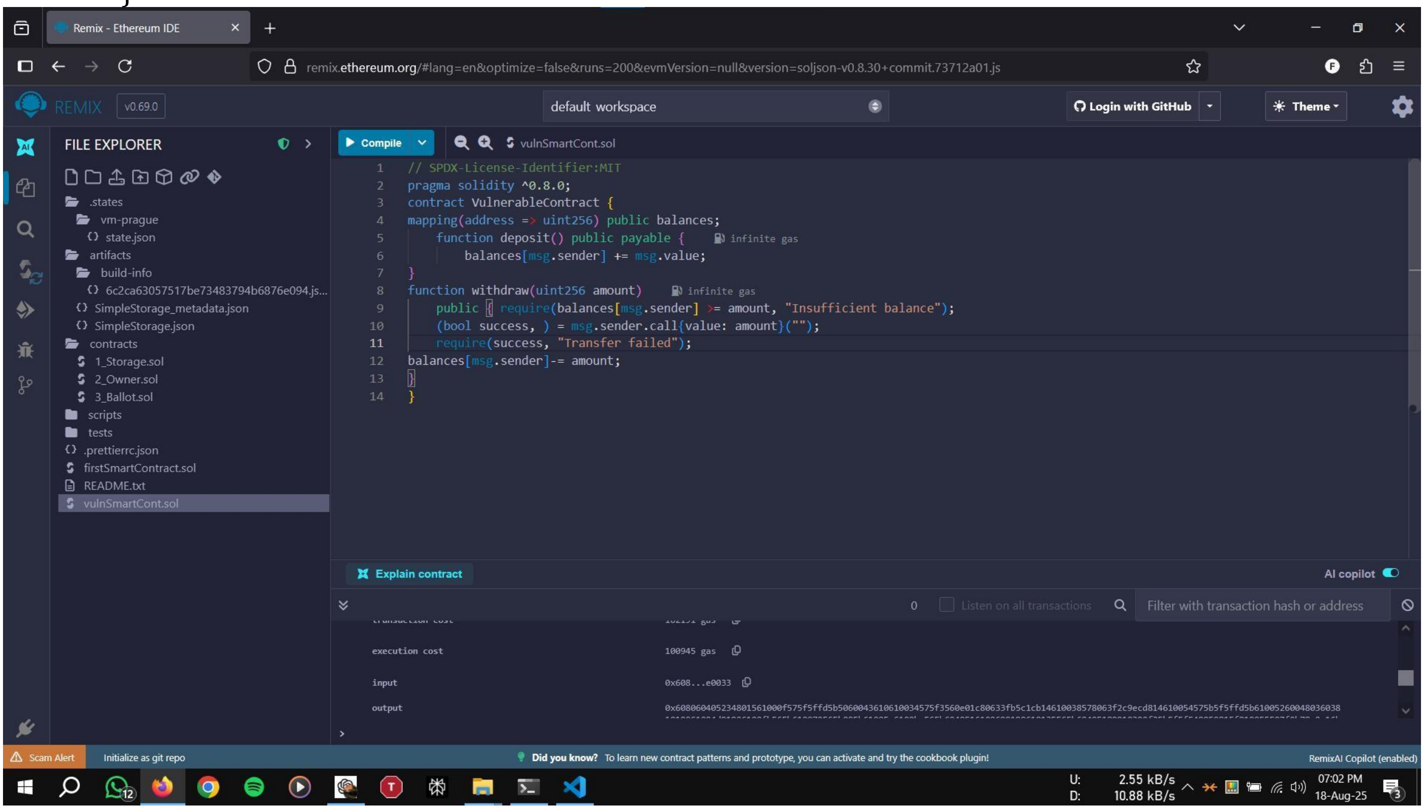
- Open remix and create a new file with extension. sol as we have done in the practical 2.



Step 2:

- Write a Vulnerable Smart Contract
- **Create a Smart Contract with Common Vulnerabilities:**

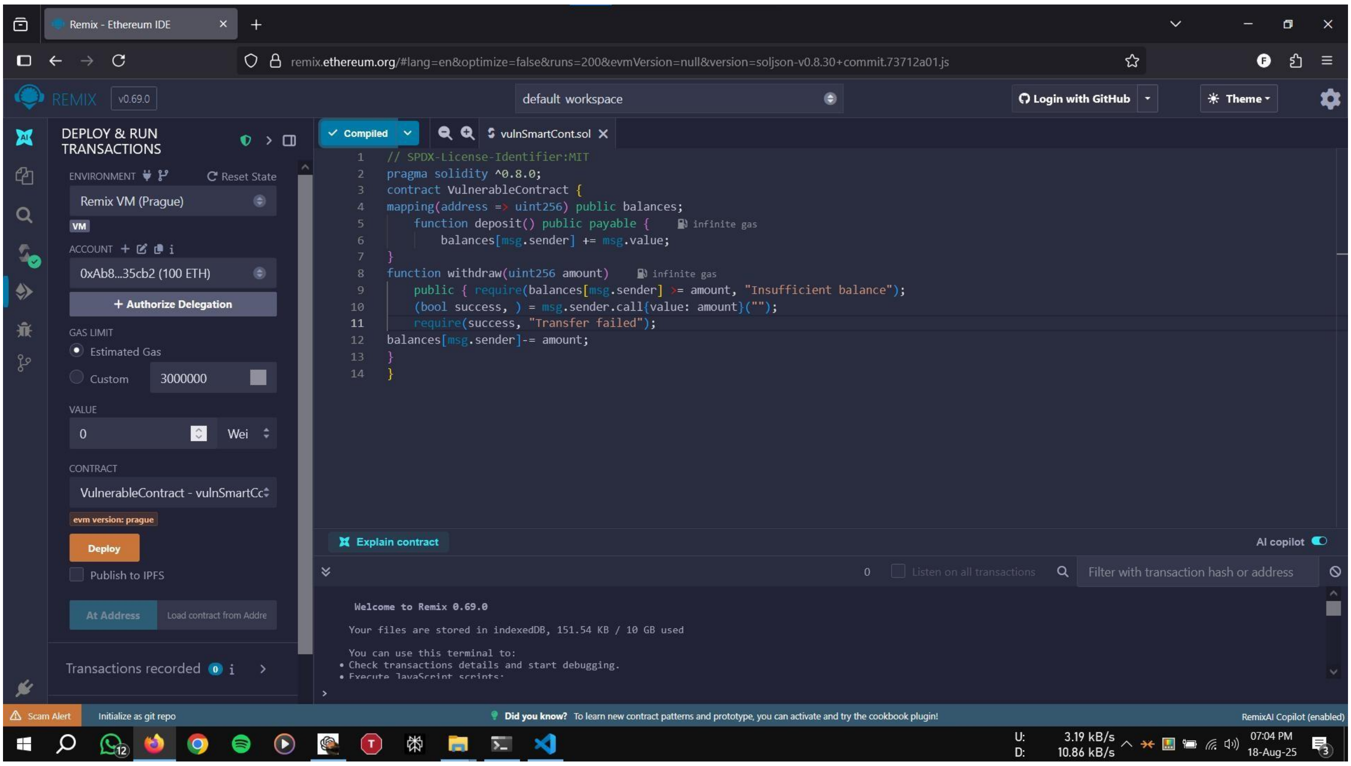
```
pragma solidity ^0.8.0; contract
 VulnerableContract {
 mapping(address => uint256) public balances; function deposit()
 public payable { balances[msg.sender] += msg.value;
}
 function withdraw(uint256 amount) public { require(balances[msg.sender] >= amount,
 "Insufficient balance"); (bool success, ) = msg.sender.call{value: amount}("");
 require(success, "Transfer failed");
 balances[msg.sender]-= amount;
}
}
```



Step-03

Deploy the Smart Contract:

- Compile the contract using the Remix IDE compiler.
- Deploy the contract using the Remix IDE.



Step 4:

Identify Vulnerabilities

1. **Analyze the Contract for Vulnerabilities:**
   - Identify the Reentrancy Vulnerability: In the `withdraw` function, the balance is updated after sending Ether, making it susceptible to reentrancy attacks.
   - Identify the Integer Overflow/Underflow: Ensure all arithmetic operations are safe from overflow or underflow, especially in versions of Solidity before 0.8.0.

2. Implementing Security Best

Practices Step 4:

Fix the Vulnerabilities

1. **Mitigate Reentrancy:**

```
function withdraw(uint256 amount) public {

require(balances[msg.sender]   >=   amount,   "Insufficient   balance");
balances[msg.sender]-= amount;

(bool success, ) = msg.sender.call{value: amount}(""); require(success,
"Transfer failed");

}
```

2. **Use SafeMath Library (for Solidity versions below 0.8.0):**

```
//import"https://github.com/OpenZeppelin/openzeppelin
contracts/blob/master/contracts/utils/math/SafeMath.sol";
// using SafeMath for uint256;

 // function deposit() public payable {
// balances[msg.sender] = balances[msg.sender].add(msg.value);
 // }
```

Step 5:

Add Security Measures

1. **Implement Security Best Practices:**
   - Use Latest Solidity Version: Ensure you are using the latest stable version of Solidity.
   - Check External Calls: Always check the return value of external calls.
   - Limit Gas: Use `transfer` or `send` instead of `call` to limit gas and mitigate reentrancy.
   - Use Modifiers: Implement access control using `onlyOwner` or similar modifiers.

3. Conducting Code Reviews for Security

Step 6: Perform a Security Audit

1. **Review Code for Common Vulnerabilities:**
   - Ensure no presence of reentrancy, integer overflow/underflow, unchecked external calls, and other known issues.
   - Follow a checklist to ensure all security best practices are implemented.
2. Use Automated Tools:
   - MythX: Use MythX for automated smart contract security analysis.
   - Slither: Use Slither for static analysis and vulnerability detection.
   - Oyente: Use Oyente for symbolic execution and security analysis.

Step 7: Conduct Manual Code Review

1. **Peer Review**:
   - Have another developer review the code for potential vulnerabilities and best practices compliance.
   - Discuss any findings and apply necessary fixes.
2. **Document Findings:**
   - Document all identified vulnerabilities and the steps taken to mitigate them.
   - Ensure the documentation is thorough for future reference and audits

Conclusion:

By following this lab manual, you will have explored common security vulnerabilities in blockchain, implemented security best practices, and conducted thorough code reviews to identify and mitigate potential security issues. This process helps ensure the robustness and security of your blockchain applications.