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BLOCKCHAIN EXP 5

AIM: Deploying a Voting/Ballot Smart Contract

Tasks:

1. Open [**Remix IDE**](#)
2. Under **Workspaces**, open **contracts** folder
3. Open **Ballot.sol**, contract.
4. Understand **Ballot.sol** contract.
5. Deploy the contract by changing the Proposal name from **bytes32 → string**

THEORY:

1. Relevance of require Statements in Solidity Programs

In Solidity, the require statement acts as a guard condition within functions. It ensures that only valid inputs or authorized users can execute certain parts of the code. If the condition inside require is not satisfied, the function execution stops immediately, and all state changes made during that transaction are reverted to their original state. This rollback mechanism ensures that invalid transactions do not corrupt the blockchain data.

For example, in a Voting Smart Contract, require can be used to check:

- Whether the person calling the function has the right to vote
`(require(voters[msg.sender].weight > 0, "Has no right to vote"));).`
- Whether a voter has already voted before allowing them to vote again.
- Whether the function caller is the chairperson before granting voting rights.

Thus, require statements enforce security, correctness, and reliability in smart contracts. They also allow developers to attach error messages, making debugging and contract interaction easier for users.

2. Keywords: mapping, storage, and memory

mapping:

- A mapping is a special data structure in Solidity that links keys to values, similar to a hash table. Its syntax is `mapping(keyType => valueType)`. For example:

```
mapping(address => Voter) public voters;
```

Here, each address (Ethereum account) is mapped to a Voter structure. Mappings are very useful for contracts like Ballot, where you need to associate voters with their data (whether they voted, which proposal they chose, etc.). Unlike arrays, mappings do not have a length property and cannot be iterated over directly, making them gas efficient for lookups but limited for enumeration.

storage:

- In Solidity, storage refers to the permanent memory of the contract, stored on the Ethereum blockchain. Variables declared at the contract level are stored in storage by default. Data stored in storage is persistent across transactions, which means once written, it remains available unless explicitly modified. However, because writing to blockchain storage consumes gas, it is more expensive. For example, a voter's information saved in the voters mapping remains available throughout the contract's lifecycle.

memory:

- In contrast, memory is temporary storage, used only for the lifetime of a function call. When the function execution ends, the data stored in memory is discarded. Memory is mainly used for temporary variables, function arguments, or computations that don't need to be permanently stored on the blockchain. It is cheaper than storage in terms of gas cost. For instance, when handling proposal names or temporary string manipulations, memory is often used.

Thus, a smart contract developer must balance between storage and memory to ensure efficiency and cost-effectiveness.

- **bytes32** is a fixed-size type, meaning it always stores exactly 32 bytes of data. This makes storage simple, comparison operations faster, and gas costs lower. However, it limits proposal names to 32 characters, which is not very flexible for user-friendly names.
- **string** is a dynamically sized type, meaning it can store text of variable length. While it is easier for developers and users (since names can be written normally), it requires more complex handling inside the Ethereum Virtual Machine (EVM). This increases gas usage and may slow down comparisons or manipulations.

To make the system more user-friendly, modern implementations of the Ballot contract often convert from bytes32 to string. Tools like the Web3 Type Converter help developers easily switch between these two types for deployment and testing.

CODE:

```
// SPDX-License-Identifier: GPL-  
3.0 pragma solidity >=0.7.0 <0.9.0;  
  
/**  
 * @title Ballot  
 * @dev Implements voting process along with vote  
 delegation */  
  
contract Ballot {  
  
    struct Voter {  
        uint weight;  
        bool voted;  
        address delegate;  
        uint vote;  
    }  
  
    struct Proposal {  
        string name; // CHANGED from bytes32 →  
        string uint voteCount;  
    }  
  
    address public chairperson;  
    mapping(address => Voter) public voters;  
    Proposal[] public proposals;  
  
    /**  
     * @dev Create a new ballot
```

```
* @param proposalNames names of  
proposals */
```

```
constructor(string[] memory proposalNames) {  
    chairperson = msg.sender;  
    voters[chairperson].weight = 1;
```

```

for (uint i = 0; i < proposalNames.length; i++) {
    proposals.push(
        Proposal({
            name: proposalNames[i],
            voteCount: 0
        })
    );
}

function giveRightToVote(address voter) external {
    require(msg.sender == chairperson, "Only chairperson can give right to vote");
    require(!voters[voter].voted, "The voter already voted");
    require(voters[voter].weight == 0, "Voter already has right");

    voters[voter].weight = 1;
}

function delegate(address to) external {
    Voter storage sender = voters[msg.sender];
    require(sender.weight != 0, "No right to vote");
    require(!sender.voted, "Already voted");
    require(to != msg.sender, "Self-delegation not allowed");

    while (voters[to].delegate != address(0)) {
        to = voters[to].delegate;
        require(to != msg.sender, "Delegation loop detected");
    }
}

```

```
Voter storage delegate_ = voters[to];  
require(delegate_.weight >= 1, "Delegate has no right");  
  
sender.voted = true;
```

```

    sender.delegate = to;

    if (delegate_.voted) {
        proposals[delegate_.vote].voteCount += sender.weight;
    } else {
        delegate_.weight += sender.weight;
    }
}

function vote(uint proposal) external {
    Voter storage sender = voters[msg.sender];
    require(sender.weight != 0, "No right to vote");
    require(!sender.voted, "Already voted");

    sender.voted = true;
    sender.vote = proposal;

    proposals[proposal].voteCount += sender.weight;
}

function winningProposal() public view returns (uint winningProposal_) {
    uint winningVoteCount = 0;

    for (uint p = 0; p < proposals.length; p++) {
        if (proposals[p].voteCount > winningVoteCount)
            { winningVoteCount = proposals[p].voteCount;
              winningProposal_ = p;
            }
    }
}

```

```
function winnerName() external view returns (string memory)
{ return proposals[winningProposal()].name;
```

```
}
```

OUTPUT:

Step 1: Open Remix

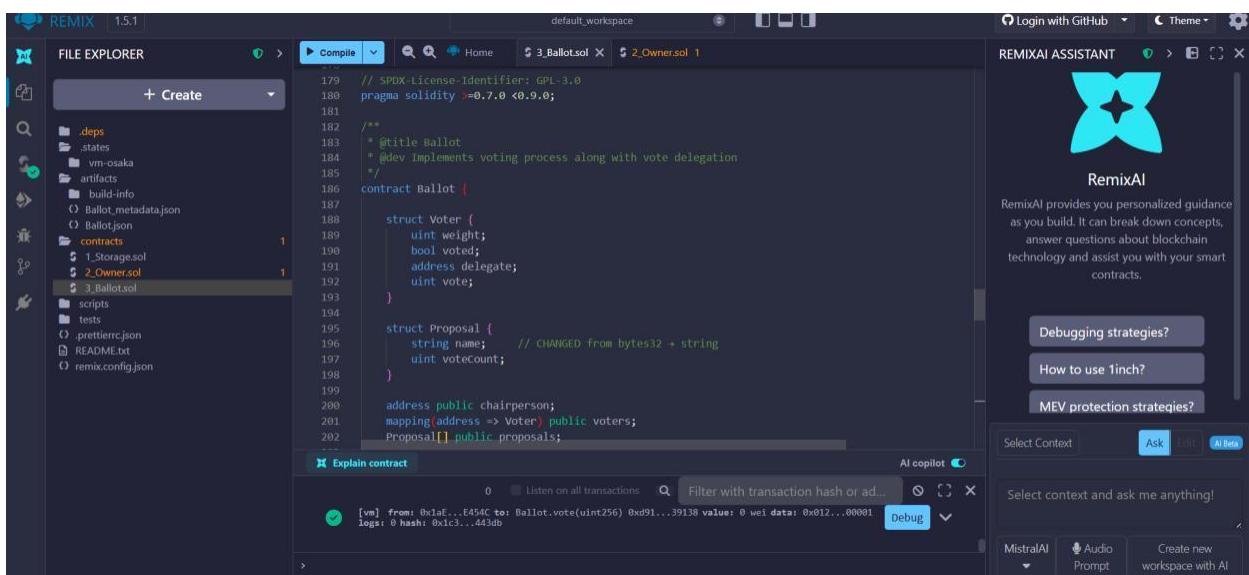
Go to <https://remix.ethereum.org>

No install needed.

Step 2: Create the file

- In File Explorer

Ballot.sol



The screenshot shows the Remix IDE interface. On the left, the FILE EXPLORER sidebar lists files: .deps, .states, vm-osaka, artifacts, build-info, Ballot_metadata.json, Ballot.json, contracts (with 1 Storage.sol and 2 Owners.sol), scripts, tests, .prettierc.json, README.txt, and remix.config.json. The contracts folder is expanded, showing Storage.sol and Owners.sol. The Owners.sol file is selected. The main workspace displays the Solidity code for Ballot.sol. The code defines a contract Ballot with a Voter struct containing weight, voted, delegate, and vote, and a Proposal struct containing name, weight, and voteCount. It also includes a chairperson address and a mapping of address to Voter. The RemixAI ASSISTANT panel on the right provides personalized guidance and AI-powered features like Debugging strategies, How to use 1inch?, and MEV protection strategies. A green checkmark icon in the bottom left corner indicates no errors.

```
// SPDX-License-Identifier: GPL-3.0
pragma solidity >=0.7.0 <0.9.0;

/*
 * @title Ballot
 * @dev Implements voting process along with vote delegation
 */
contract Ballot {
    struct Voter {
        uint weight;
        bool voted;
        address delegate;
        uint vote;
    }

    struct Proposal {
        string name; // CHANGED FROM bytes32 + string
        uint weight;
        uint voteCount;
    }

    address public chairperson;
    mapping(address => Voter) public voters;
    Proposal[] public proposals;
}
```

Step 3: Compile the contract

1. Open Solidity Compiler (left sidebar)
2. Click Compile Ballot.sol
3. Make sure green tick appears (no errors)

Step 4: Deploy the contract

1. Open Deploy & Run Transactions

2. Set:

- Environment → **Remix VM**

- Account → keep default

- Contract → **Ballot**

The screenshot shows the Remix IDE interface. On the left, the Solidity Compiler panel displays the code for a Ballot contract. The code includes a struct Voter and a mapping of address to Voter. The middle section shows the Contract Editor with the Ballot contract selected. The right side features the RemixAI Assistant, which provides personalized guidance and AI copilot features.

```
// SPDX-License-Identifier: GPL-3.0
pragma solidity >0.7.0 <0.9.0;

/*
 * @title Ballot
 * @dev Implements voting process along with vote delegation
 */
contract Ballot {
    struct Voter {
        uint weight;
        bool voted;
    }
    mapping(address => Voter) voters;
    Proposal[] proposals;
}

string name; // CHANGED from bytes32 + string
uint voteCount;

address public chairperson;
mapping(address => Voter) public voters;
Proposal[] public proposals;
```

Step 5: Enter constructor input (IMPORTANT)

Your constructor is:

constructor(string[] memory proposalNames)

So input must be a string array

Example:

["PranavP", "Bob", "Charlie"]

```

179 // SPDX-License-Identifier: GPL-3.0
180 pragma solidity >=0.7.0 <0.9.0;
181
182 /**
183 * @title Ballot
184 * @dev implements voting process along with vote delegation
185 */
186 contract Ballot {
187
188     struct Voter {
189         uint weight;
190         bool voted;
191         address delegate;
192         uint vote;
193     }
194
195     struct Proposal {
196         string name;           // CHANGED from bytes32 -> string
197         uint voteCount;
198     }
199
200     address public chairperson;
201     mapping(address => Voter) public voters;
202     Proposal[] public proposals;
203 }

```

Deploy ["PanavP","Bob","Charlie"]

Transactions recorded 36

Step 6: Click Deploy

- Click Deploy
- Contract appears under Deployed Contracts
- The deployer is automatically the chairperson

giveRightToVote (address voter)

What to add:

Paste a Remix account address (NOT the chairperson).

Important:

- You must be using Account 1 (chairperson) when clicking this
- Switch account at the top if needed

Click Transact

The screenshot shows the Remix IDE version 1.5.1. On the left, the 'DEPLOY & RUN TRANSACTIONS' sidebar is open, showing settings for 'Remix VM (Osaka)', account '0xAb8...35cb2 (100.0 ETH)', gas limit 'Custom 3000000', and value '0 Wei'. Below that is the 'CONTRACT' section with 'Ballot - contracts/3_Ballot.sol' selected. A dropdown menu shows 'Deploy ["PranavP","Bob","Charlie"]' and buttons for 'At Address' and 'Load contract from Address'. At the bottom of the sidebar, it says 'Transactions recorded 36'. The main area displays the Solidity code for the Ballot contract:

```

179 // SPDX-License-Identifier: GPL-3.0
180 pragma solidity >0.7.0 <0.9.0;
181 /**
182 * @title Ballot
183 * @dev Implements voting process along with vote delegation
184 */
185 contract Ballot {
186     struct Voter {
187         uint weight;
188         bool voted;
189         address delegate;
190         uint256
191     }
192     struct contracts/3_Ballot.sol 196:10 bytes32 + string
193     str
194     uint voteCount;
195
196     address public chairperson;
197     mapping(address => Voter) public voters;
198     Proposal[] public proposals;
199
200     function propose(string memory proposalName) public {
201         require(proposalName != "", "Proposal name cannot be empty");
202         proposals.push(Proposal(proposalName));
203     }
204
205     function vote(uint proposalIndex, address voter) public {
206         Voter storage sender = voters[msg.sender];
207         require(!sender.voted, "You have already voted");
208         require(proposalIndex < proposals.length, "Proposal index out of bounds");
209         sender.weight += 1;
210         sender.voted = true;
211         proposals[proposalIndex].voteCount += 1;
212     }
213
214     function getVotes(address voter) public view returns (uint) {
215         return voters[voter].weight;
216     }
217
218     function getProposals() public view returns (string[] memory) {
219         string[] memory names = new string[](proposals.length);
220         for (uint i = 0; i < proposals.length; i++) {
221             names[i] = proposals[i].name;
222         }
223         return names;
224     }
225
226     function getVoter(address voter) public view returns (Voter memory) {
227         return voters[voter];
228     }
229
230     struct Proposal {
231         string name;
232         uint voteCount;
233     }
234 }

```

Below the code, there's an 'Explain contract' button and a transaction log entry: '[vm] from: 0x583...addC4 to: Ballot.(constructor) value: 0 wei data: 0x608...00000 logs: 0 hash: 0xf85...03a21'. The bottom right corner has 'AI copilot' and 'Debug' buttons.

Then vote

2 vote (uint256 proposal)

What to add:

A number, based on proposal index:

0 → PranavP

1 → Bob

2 → Charlie

Example:

0

Important:

- Switch to the voter account (the one you gave rights to)
- Then click Transact

The screenshot shows the REMIX IDE interface with the following details:

- Deploy & Run Transactions**: A sidebar on the left.
- Deployed Contracts**: Shows a deployed contract named "BALLOT AT 0x091...39138 (METH)".
- Balance**: 0 ETH.
- Low level interactions**: Buttons for "delegate", "giveRightToVote", "vote", "chairperson", "proposals", "voters", "winnerName", and "winningProposal".
- Contract Code (Ballot.sol)**:

```
// SPDX-License-Identifier: GPL-3.0
pragma solidity >0.7.0 <0.9.0;

/*
 * @title Ballot
 * @dev Implements voting process along with vote delegation
 */
contract Ballot {

    struct Voter {
        uint weight;
        bool voted;
        address delegate;
        uint vote;
    }

    struct Proposal {
        string name; // CHANGED from bytes32 + string
        uint voteCount;
    }

    address public chairperson;
    mapping(address => Voter) public voters;
    Proposal[] public proposals;
}
```
- Explain contract**: A button to explain the contract.
- Transactions**: A log window showing a transaction:[vm] from: 0x5B3...edd4 to: Ballot.(constructor) value: 0 wei data: 0x608...00000 logs: 0 hash: 0xf85...03a21
- AI copilot**: A toggle switch.

This screenshot is nearly identical to the first one, showing the REMIX IDE interface with the same contract and deployment details. The main difference is in the transaction log:

```
[vm] from: 0xAb8...35cb2 to: Ballot.vote(uint256) 0xd91...39138 value: 0 wei data: 0x012...00000 logs: 0 hash: 0xc66...d2510
```

```

179 // SPDX-License-Identifier: GPL-3.0
180 pragma solidity >=0.7.0 <0.9.0;
181
182 /**
183 * @title Ballot
184 * @dev Implements voting process along with vote delegation
185 */
186 contract Ballot {
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188     struct Voter {
189         uint weight;
190         bool voted;
191         address delegate;
192         uint vote;
193     }
194
195     struct Proposal {
196         string name; // CHANGED from bytes32 + string
197         uint voteCount;
198     }
199
200     address public chairperson;
201     mapping(address => Voter) public voters;
202     Proposal[] public proposals;

```

proposals (uint256)

What to add:

Proposal index:

0

Returns proposal details.

```

179 // SPDX-License-Identifier: GPL-3.0
180 pragma solidity >=0.7.0 <0.9.0;
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188     struct Voter {
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193     }
194
195     struct Proposal {
196         string name; // CHANGED from bytes32 + string
197         uint voteCount;
198     }
199
200     address public chairperson;
201     mapping(address => Voter) public voters;
202     Proposal[] public proposals;

```

0x4820993Bc481177ec7E8f571ceCaE8A9e22C02db [call] from: 0x4820993Bc481177ec7E8f571ceCaE8A9e22C02db to: Ballot.winnerName() data: 0xe2b...a53f0

Conclusion:

In this experiment, a Voting/Ballot smart contract was deployed using Solidity on the Remix IDE. The concepts of require statements, mapping, and data location specifiers like storage and memory were explored to understand their role in ensuring security, efficiency, and correctness in smart contracts. The difference between using bytes32 and string for proposal names was also studied, highlighting the trade-off between gas efficiency and readability. Overall, the experiment provided practical insights into the design and deployment of voting contracts on the blockchain.