Tutorial 2: Deploy and develop a smart contract on Ethereum

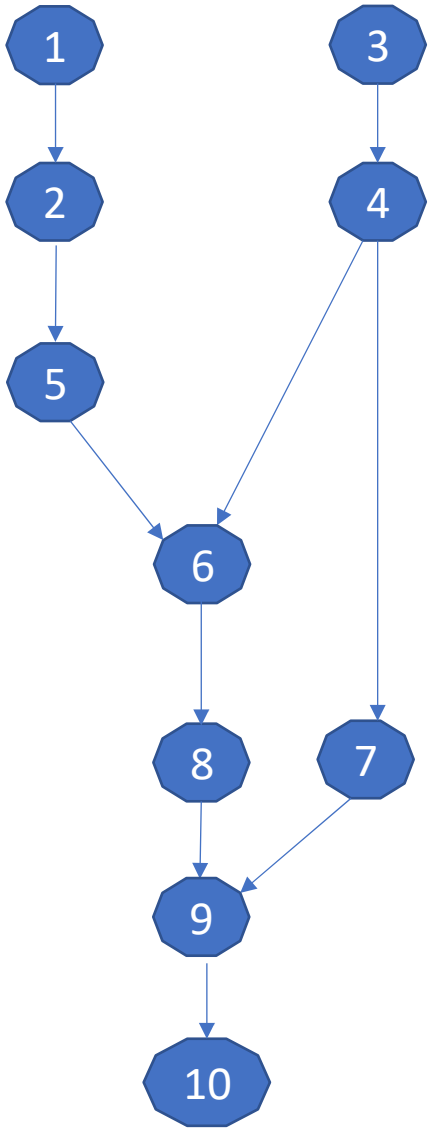
Part 1 – Deploy and interact with your smart contrat in your Private Network

At the end of your exercise push the code of the smart contract on your github project Blockchain distributed system & Smart contract where you create a repository name “Tutorial 2 : Part 1”.

When you finished to complete the Quest please provide your github account with all files (configuration files, smart contract code…) created for this tutorial. You have to create also a report with all print screens for each steps.

Different tools provide different functionality

	Tools / Activities	Remix	Ganache	MyEtherWallet	Geth
1	Configure the Blockchain	-	-	-	+
2	Deploy the Blockchain	Not Persistent	+	-	+
3	Develop the contract	+	-	-	+
4	Compile the contract	+	-	-	+
5	Create user account	+	+	+	+
6	Deploy the contract	+	-	+	+
7	Create the UI for interacting	+	-	+	+
8	Run the client	+	-	+	+
9	Interact with the contract & have fun	+	-	+	+
10	Monitor the execution	-	+	-	+

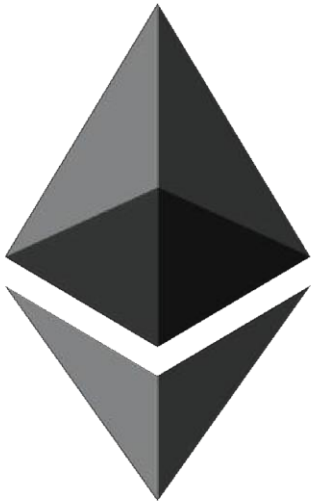


https://remix.ethereum.org/

http://truffleframework.com/ganache/

Use which tool for what purpose? (1/2)

- Use Geth for everything?
  - Powerful but command-line only

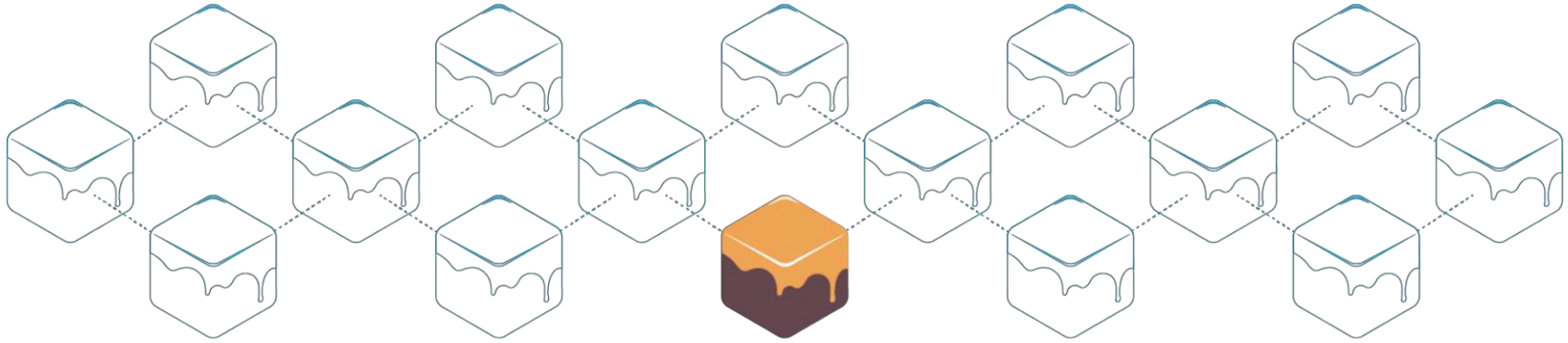


- What should I use?
  - As a starting point for developing contracts – mostly Remix
- What cannot Remix do?
  - Configure the blockchain
  - Create real (non-test) user accounts and transfer funds between user accounts
  - Monitor the execution
  - Other advanced operations

Use which tool for what purpose? (2/2)

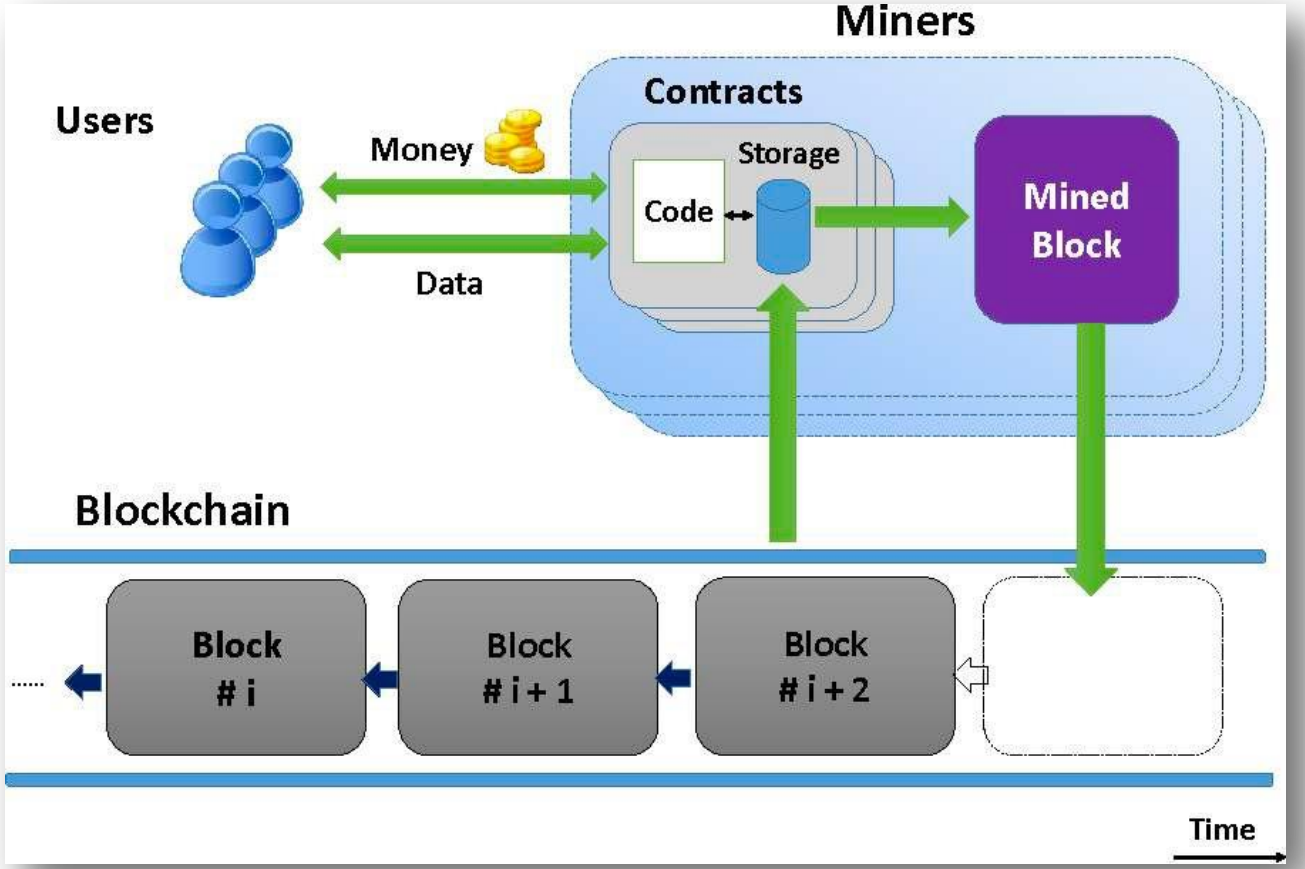
- Why use Ganache?
  - To inspect and monitor the execution
  - To visualize certain elements in a better way

- Why use MyEtherWallet?
  - To create a personal wallet (real user account), transfer funds between user accounts, and interact with contracts
  - Metamask as another alternative



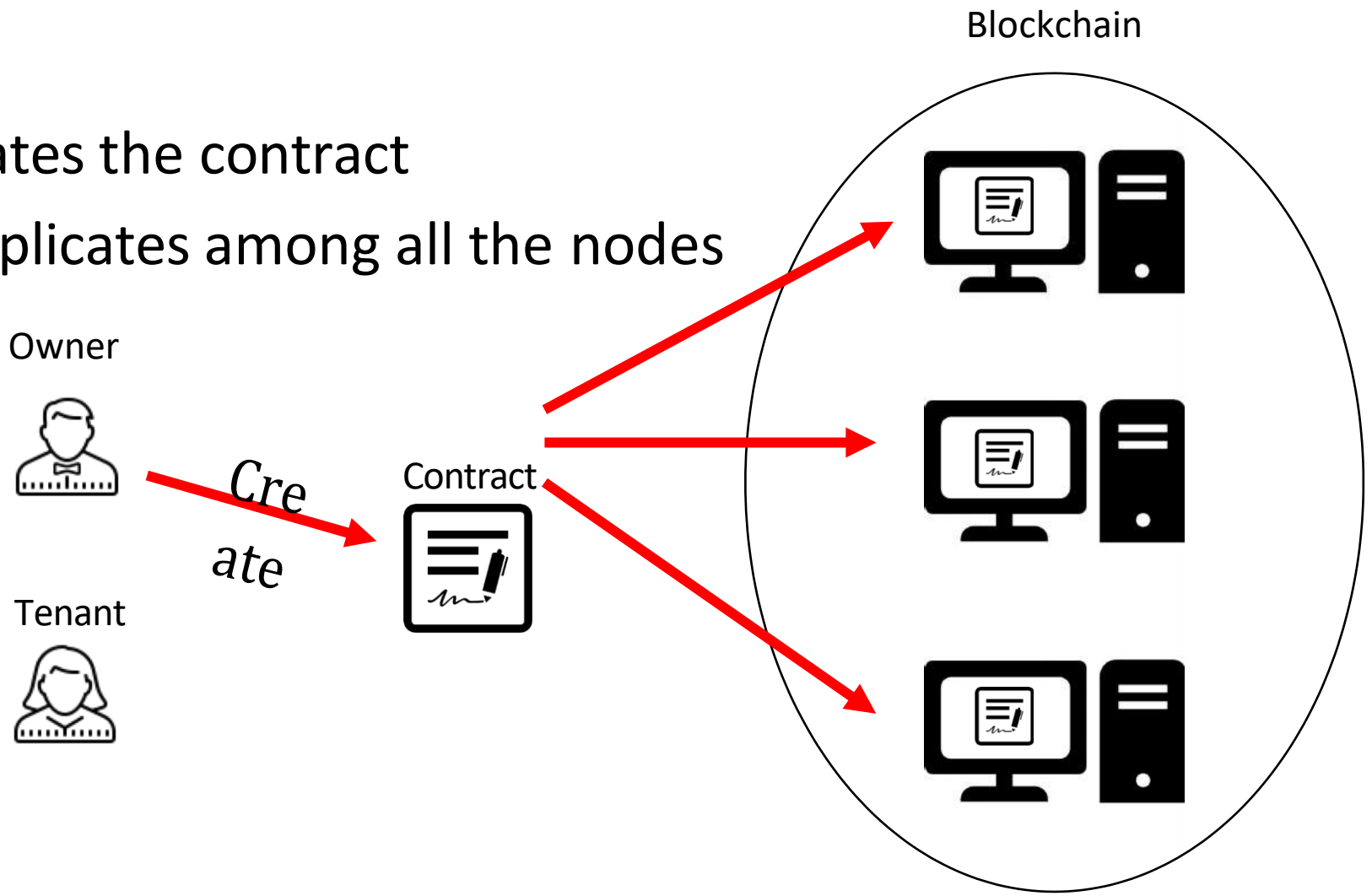
Smart Contracts

- In the form of code
- Stored on a blockchain
- Executes under given conditions



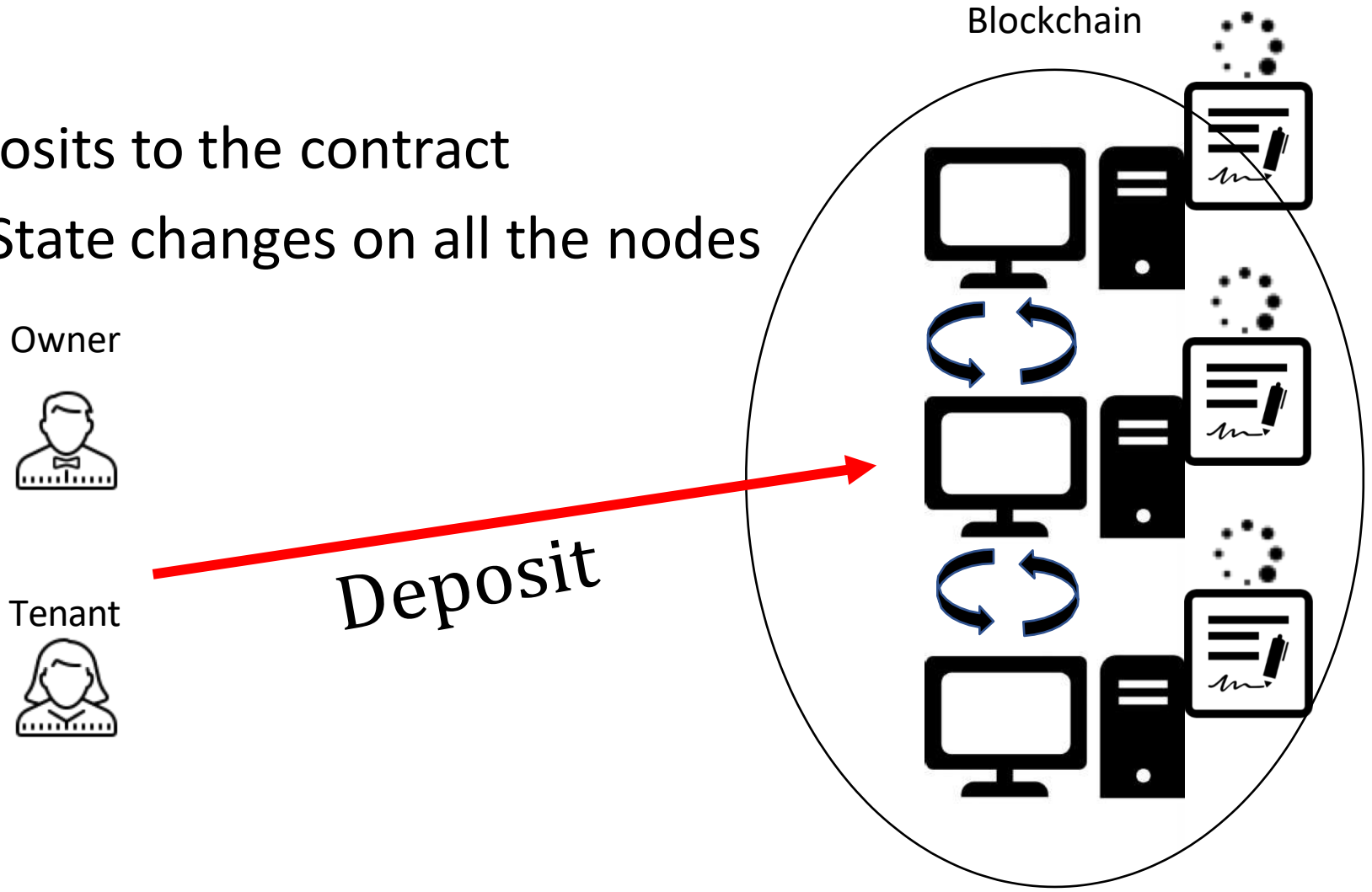
Smart Contracts Example (1/3)

- Owner creates the contract
- Contract replicates among all the nodes



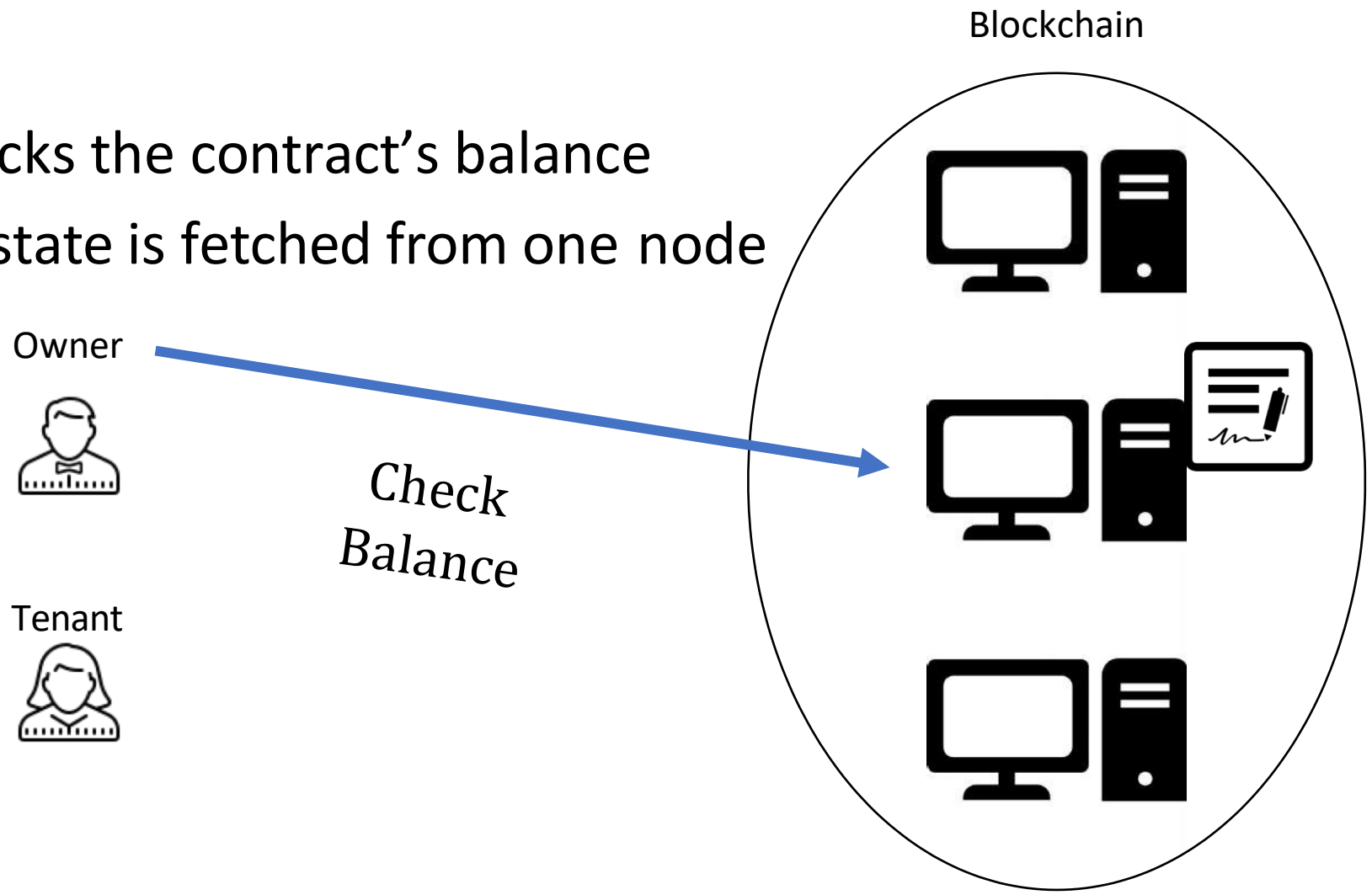
Smart Contracts Example (2/3)

- Tenant deposits to the contract
- Contract's State changes on all the nodes



Smart Contracts Example (3/3)

- Owner checks the contract's balance
- Contract's state is fetched from one node

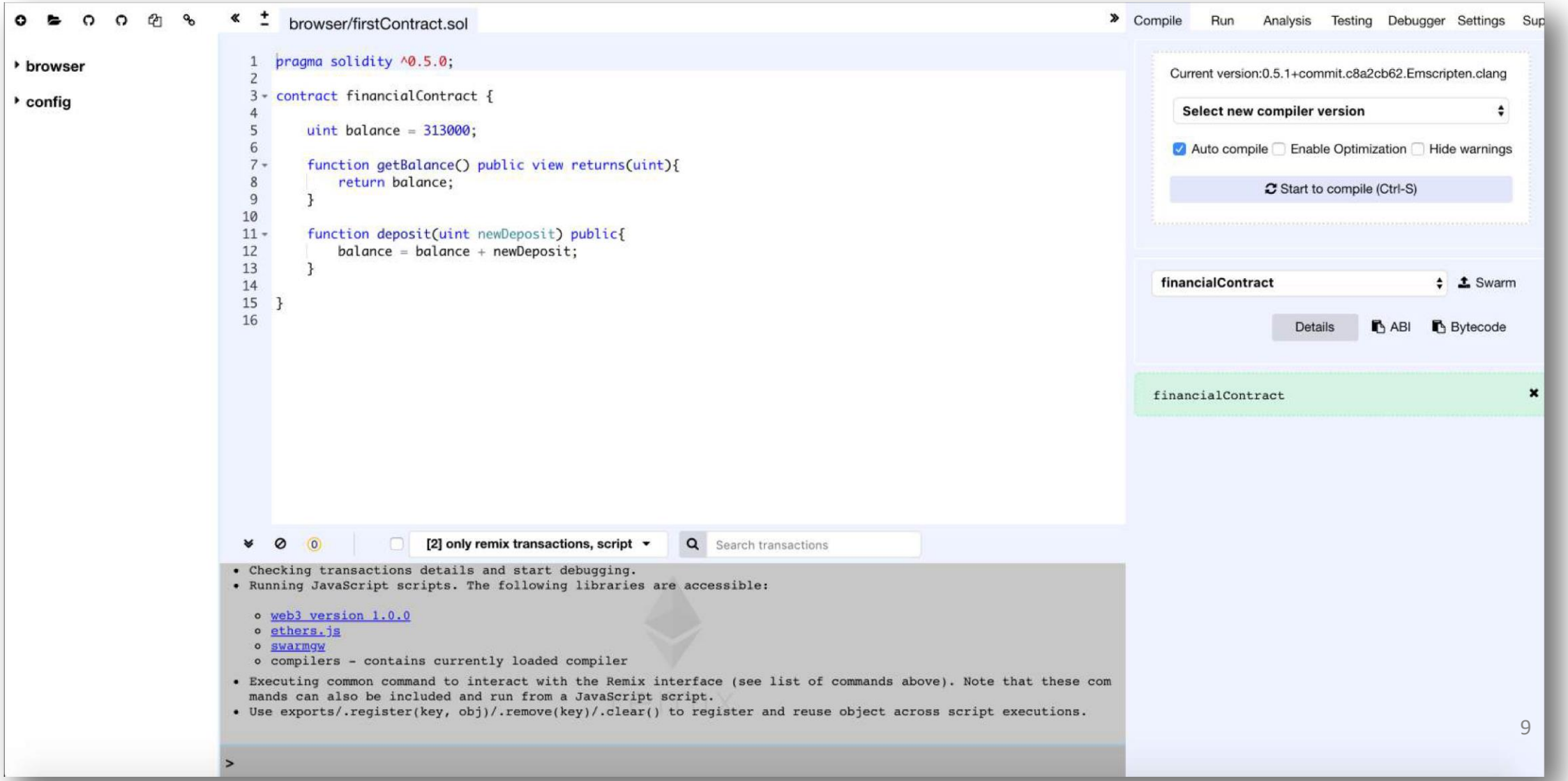


Smart Contracts

1. Developing a simple contract
2. Compiling the contract
3. Deploying the contract
4. Interacting with the contract
5. Adding more functions to our code to make it more practical

Open Remix : remix.ethereum.org

- An open source tool for writing, compiling and testing Solidity contracts



Solidity

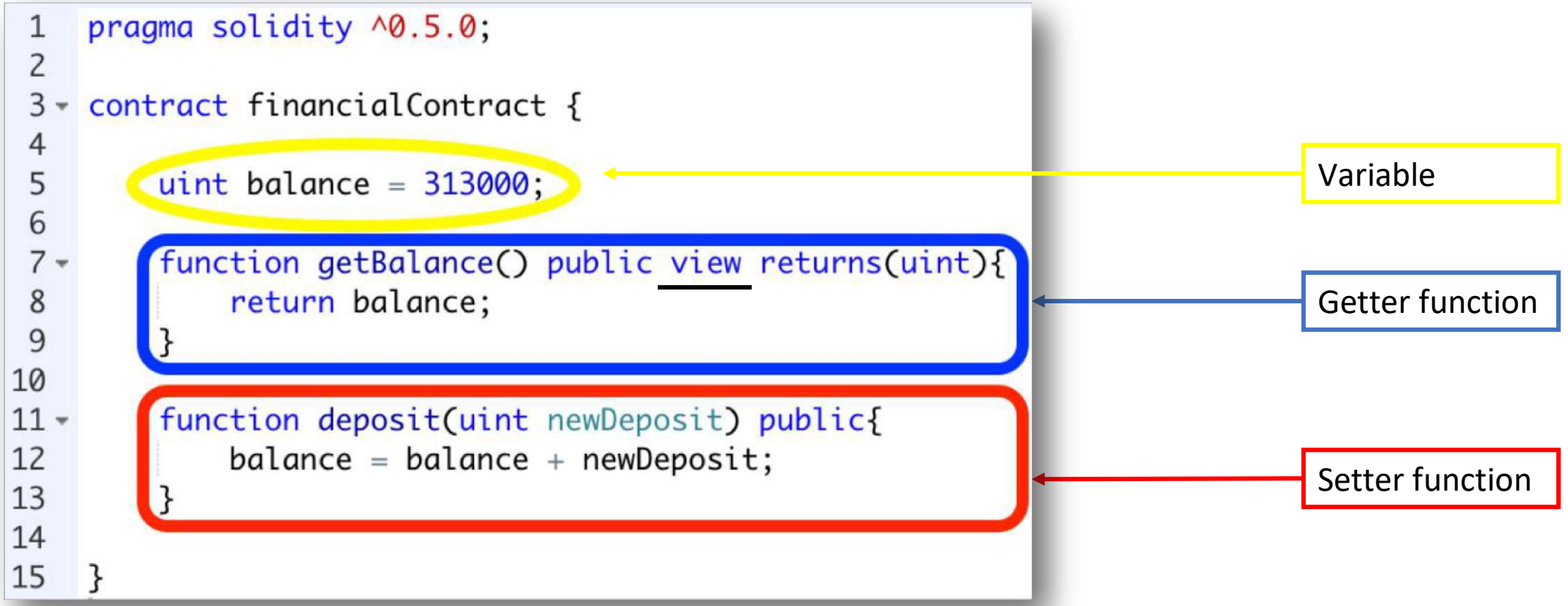
- Object-oriented
- Contract-oriented
- High-level language
- Influenced by C++, Python, and JavaScript
- Target Ethereum Virtual Machine (EVM)

Serpent as an Alternative?

- Low-level language
- Complex compiler

Start Coding

- Setter and Getter: Set and get the information.



Compile the Contract

- Compile tab: Start to compile button

Set Deployment Parameters (1/2)

- Run tab: Environment = JavaScript VM

Set Deployment Parameters (2/2)

- JavaScript VM: All the transactions will be executed in a sandbox blockchain in the browser. Nothing will be persisted and a page reload will restart a new blockchain from scratch, the old one will not be saved.
- Injected Provider: Remix will connect to an injected web3 provider. Mist and Metamask are example of providers that inject web3, thus they can be used with this option.
- Web3 Provider: Remix will connect to a remote node. You will need to provide the URL address to the selected provider: geth, parity or any Ethereum client.

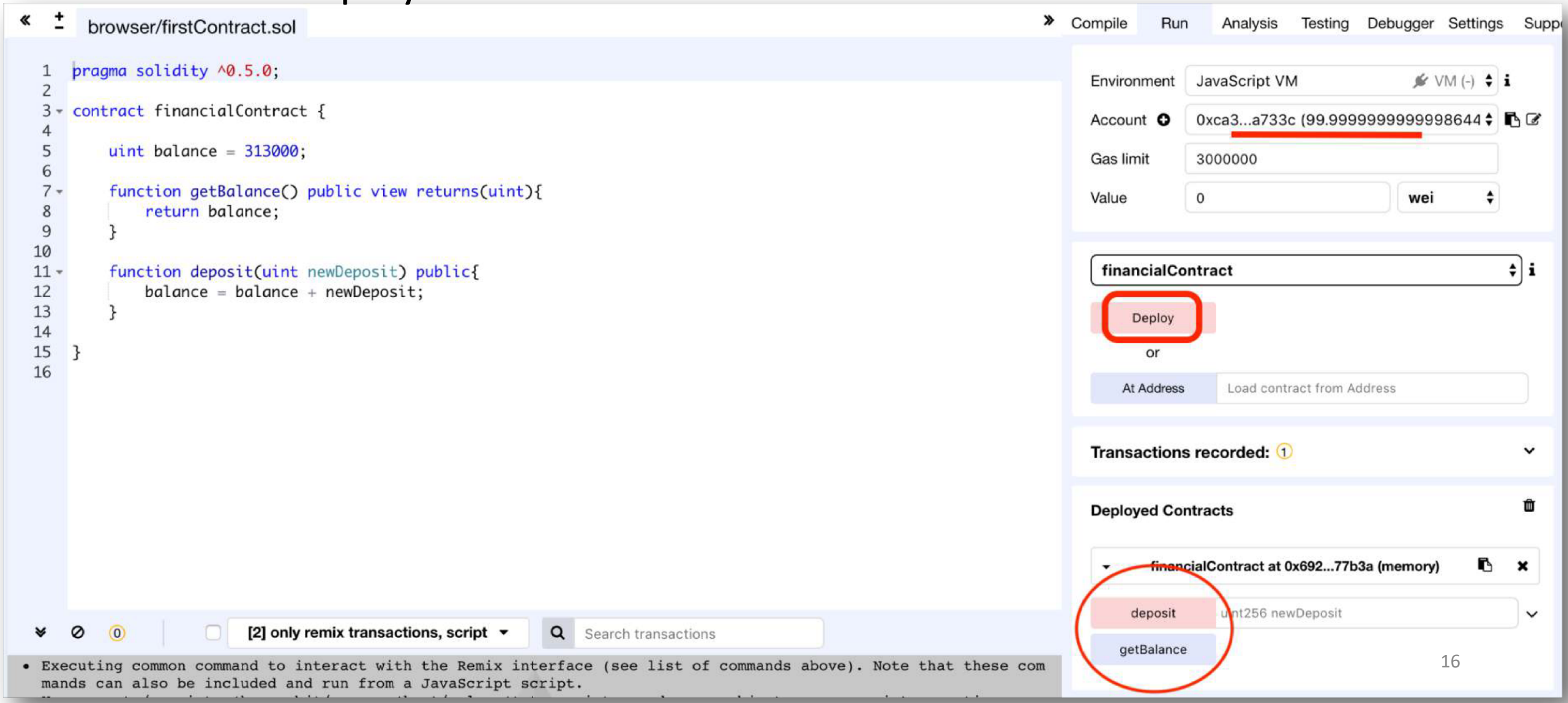
- Gas Limit: The maximum amount of gas that can be set for all the instructions of a contract.
- Value: Input some ether with the next created transaction (wei = 10^{-18} of ether).

Types of Blockchain Deployment

- Private: e.g., Ganache sets a personal Ethereum blockchain for running tests, executing commands, and inspecting the state while controlling how the chain operates.
- Public Test (Testnet): Like Ropsten, Kovan and Rinkeby which are existing public blockchains used for testing and which do not use real funds. Use faucet for receiving initial virtual funds.
- Public Real (Mainnet): Like Bitcoin and Ethereum which are used for real and which available for everybody to join.

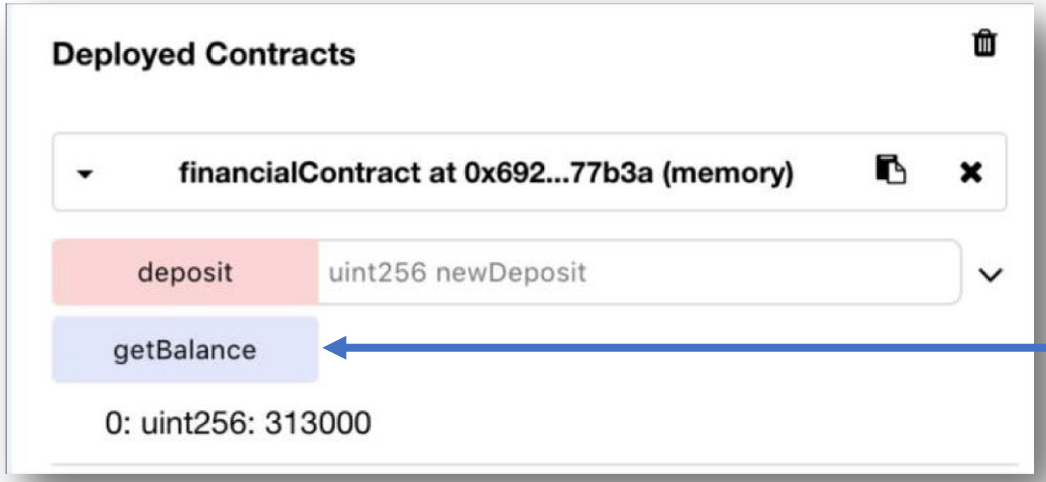
Deploy the Contract on the Private Blockchain of Remix

- Run tab: Deploy button

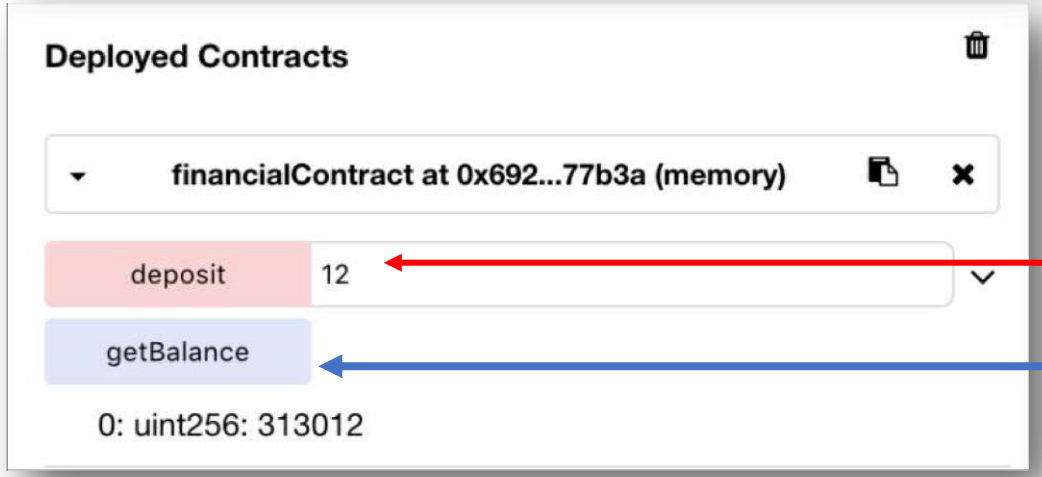


Interact with the Contract

- Setter = Red Button: Creates transaction
- Getter= Blue Button: Just gives information



Press getBalance to see the initial amount 1



Input a value and press deposit button to create and confirm the transaction 2

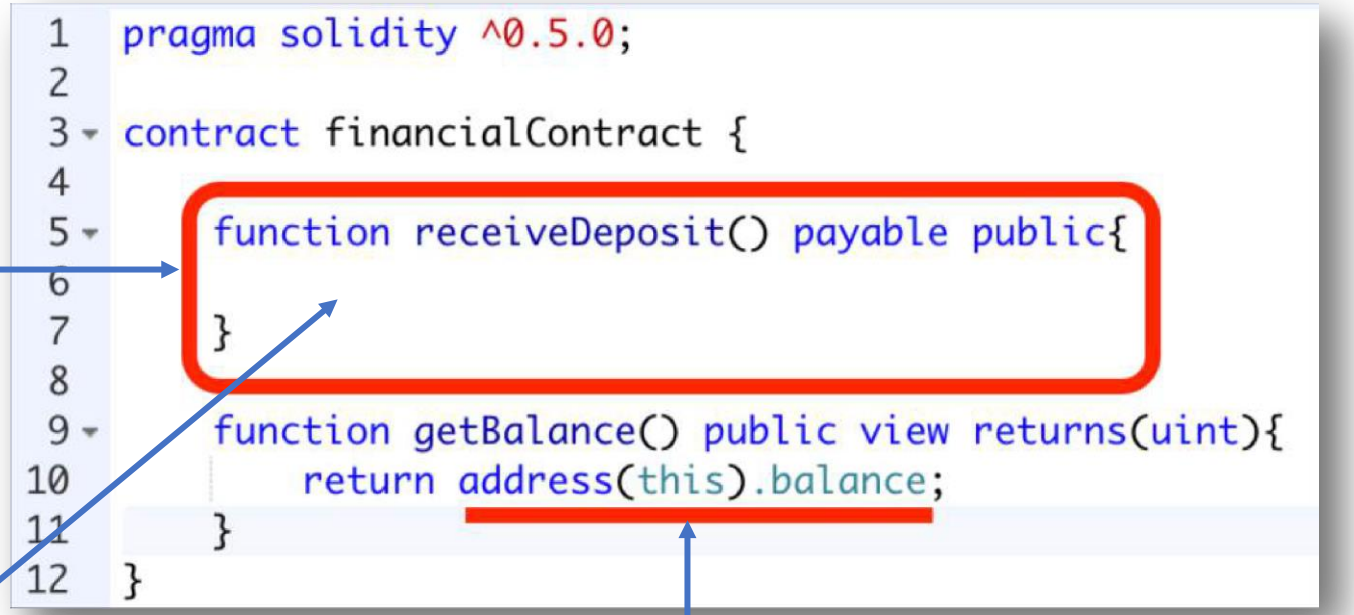
Press getBalance again to see the result 3

Additional features

- Transferring funds from an account to the contract
- Saving the address of the contract creator
- Limiting the users' access to functions
- Withdrawing funds from the contract to an account

Receive ether (1/2)

- Transfer money to the contract



```
1  pragma solidity ^0.5.0;
2
3  contract financialContract {
4
5      function receiveDeposit() payable public{
6
7      }
8
9      function getBalance() public view returns(uint){
10         return address(this).balance;
11     }
12 }
```

Payable keyword allows receiving ether

Hidden Code:

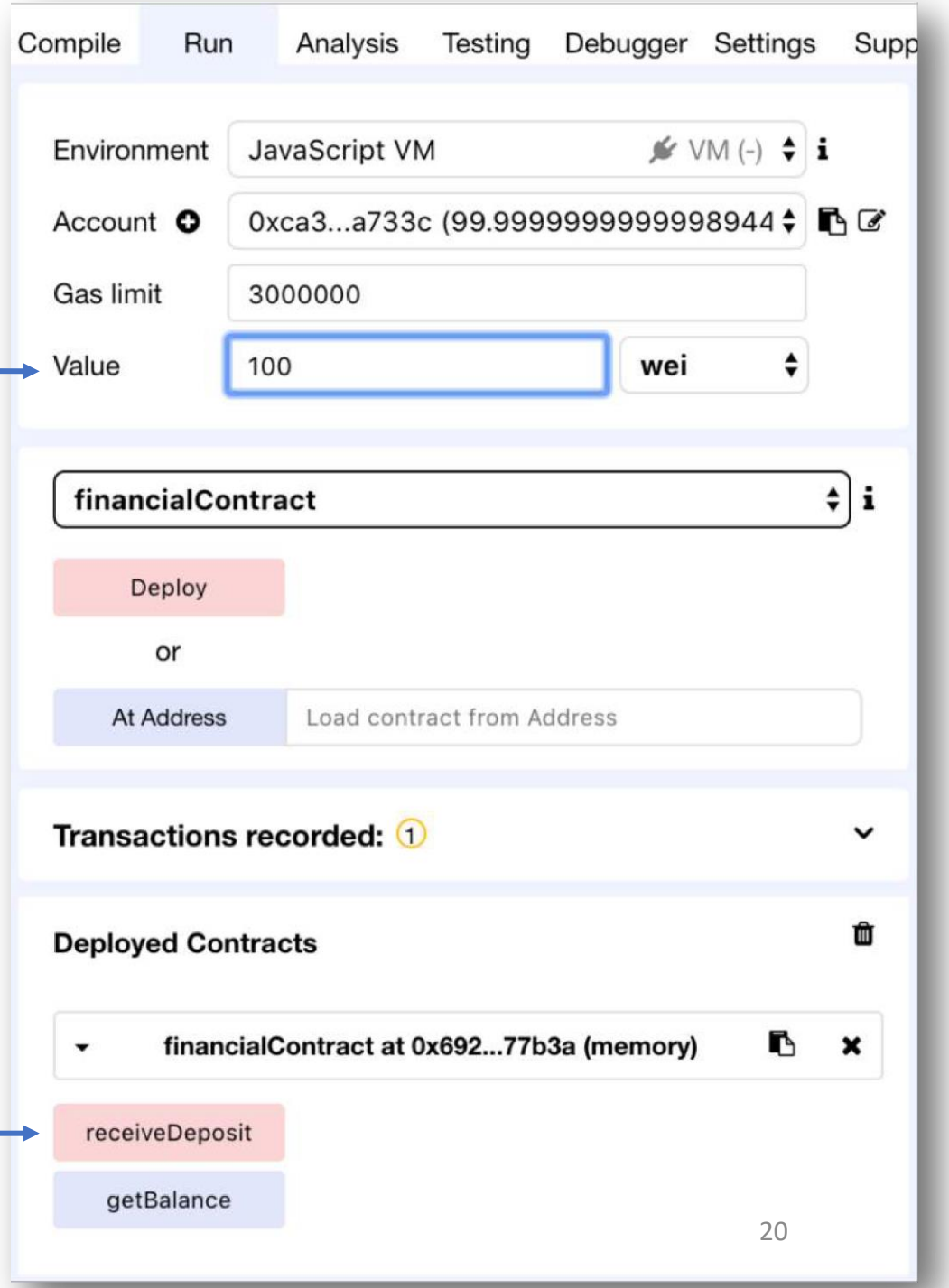
Address(this) balance += msg value;

We can get the balance of the contract

Receive ether (2/2)

1. Input the value as wei (10^{-18} of ether)

2. Click the receiveDeposit button to transfer the money to the contract



Constructor

- Will be called at the creation of the instance of the contract

```
1  pragma solidity ^0.5.0;
2
3  contract financialContract {
4
5      address owner;
6
7      constructor() public{
8          owner = msg.sender;
9      }
10
11     function receiveDeposit() payable public{
12
13     }
14
15     function getBalance() public view returns(uint){
16         return address(this).balance;
17     }
18 }
```

We want to save the address of the contract creator

Withdraw funds

- Modifier: Conditions you want to test in other functions
- First the modifier will execute, then the invoked function

```
1  pragma solidity ^0.5.0;
2
3  contract financialContract {
4
5      address owner;
6
7      constructor() public{
8          owner = msg.sender;
9      }
10
11     modifier ifOwner(){
12         if(owner != msg.sender){
13             revert();
14         }else{
15             _;
16         }
17     }
18
19
20     function receiveDeposit() payable public{
21
22     }
23
24     function getBalance() public view returns(uint){
25         return address(this).balance;
26     }
27
28     function withdraw(uint funds) public ifOwner{
29         msg.sender.transfer(funds);
30     }
31 }
```

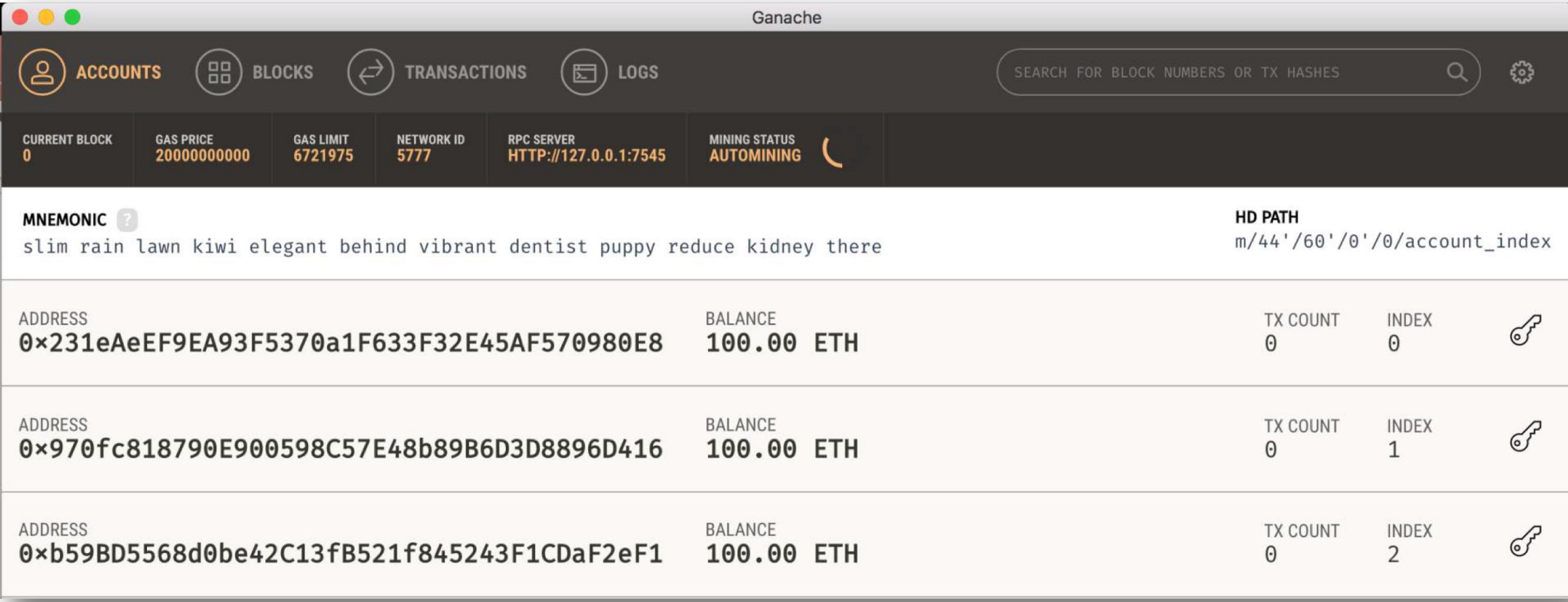
Only the contract's creator is permitted to withdraw

Transfer some money from the contract's balance to the owner

Now deploying a smart contract on an external blockchain

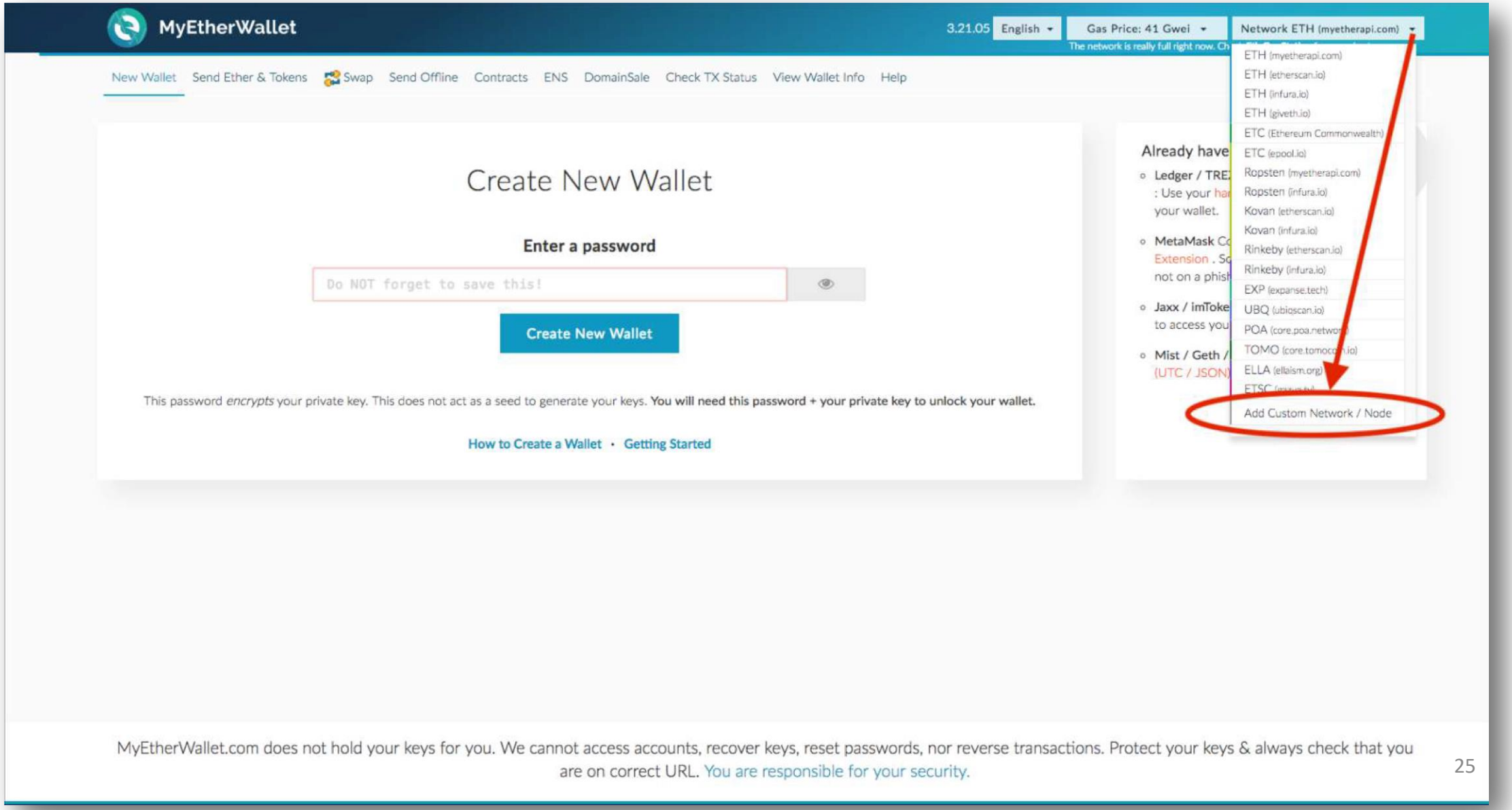
	Tools / Activities	Remix	Ganache	MyEtherWallet	Geth
1	Configuring the Blockchain	-	-	-	+
2	Deploying the Blockchain	Not Persistent	+	-	+
3	Developing the contract	+	-	-	+
4	Compiling the contract	+	-	-	+
5	Creating user account	+	+	+	+
6	Deploying the contract	+	-	+	+
7	Creating the UI for interacting	+	-	+	+
8	Run the client	+	-	+	+
9	Interact with the contract & have fun	+	-	+	+
10	Monitoring the execution	-	+	-	+

Run Ganache

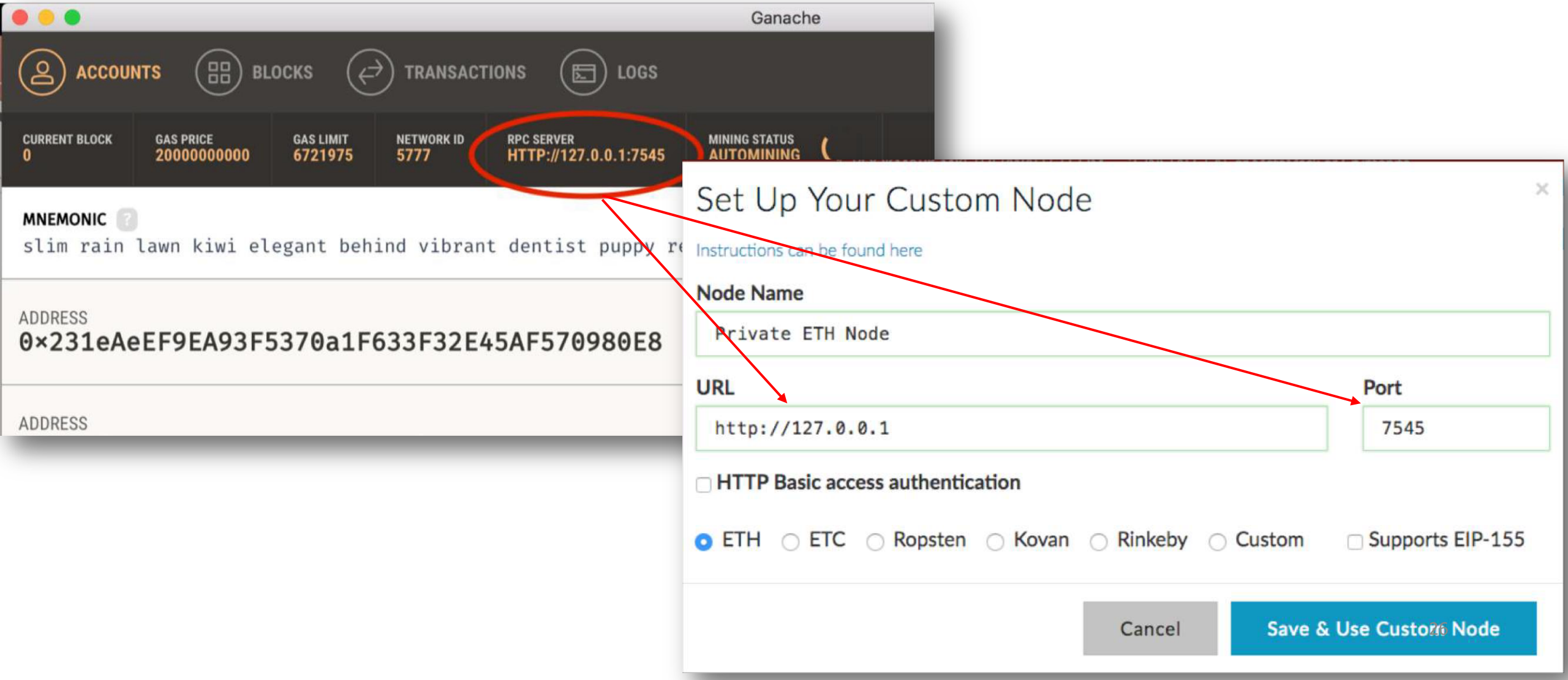

Ganache
ACCOUNTS
BLOCKS
TRANSACTIONS
LOGS
SEARCH FOR BLOCK NUMBERS OR TX HASHES
CURRENT BLOCK
0
GAS PRICE
20000000000
GAS LIMIT
6721975
NETWORK ID
5777
RPC SERVER
HTTP://127.0.0.1:7545
MINING STATUS
AUTOMINING
MNEMONIC
slim rain lawn kiwi elegant behind vibrant dentist puppy reduce kidney there
HD PATH
m/44'/60'/0'/0/account_index
ADDRESS
0×231eAeEF9EA93F5370a1F633F32E45AF570980E8
BALANCE
100.00 ETH
TX COUNT
0
INDEX
0
ADDRESS
0×970fc818790E900598C57E48b89B6D3D8896D416
BALANCE
100.00 ETH
TX COUNT
0
INDEX
1
ADDRESS
0×b59BD5568d0be42C13fB521f845243F1CDaF2eF1
BALANCE
100.00 ETH
TX COUNT
0
INDEX
2

MyEtherWallet

- add your custom network that you want to test your contracts on

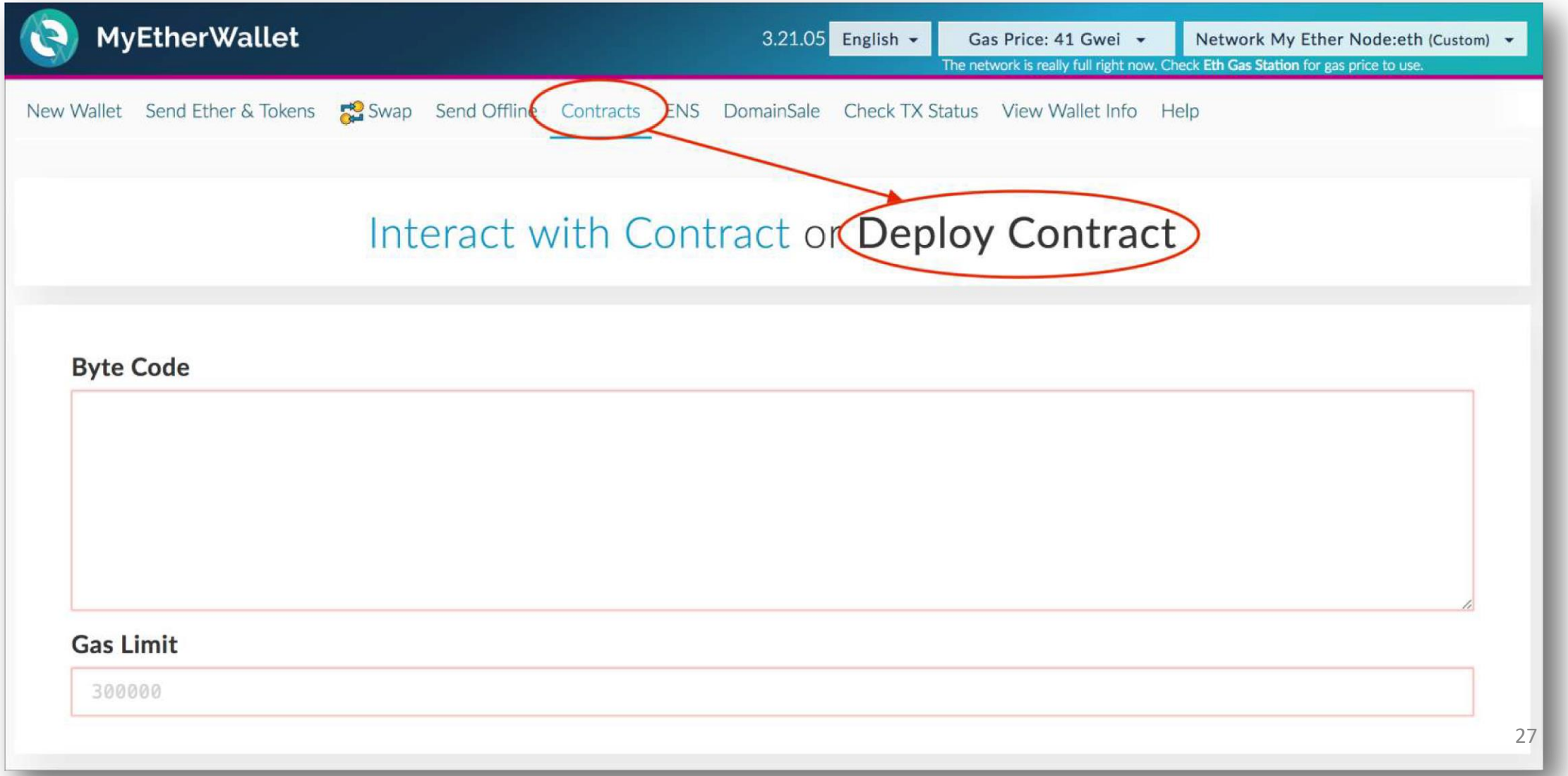


Import your RPC server address and the port number from Ganache to MyEtherWallet



MyEtherWallet

- Contracts tab: Deploy Contract

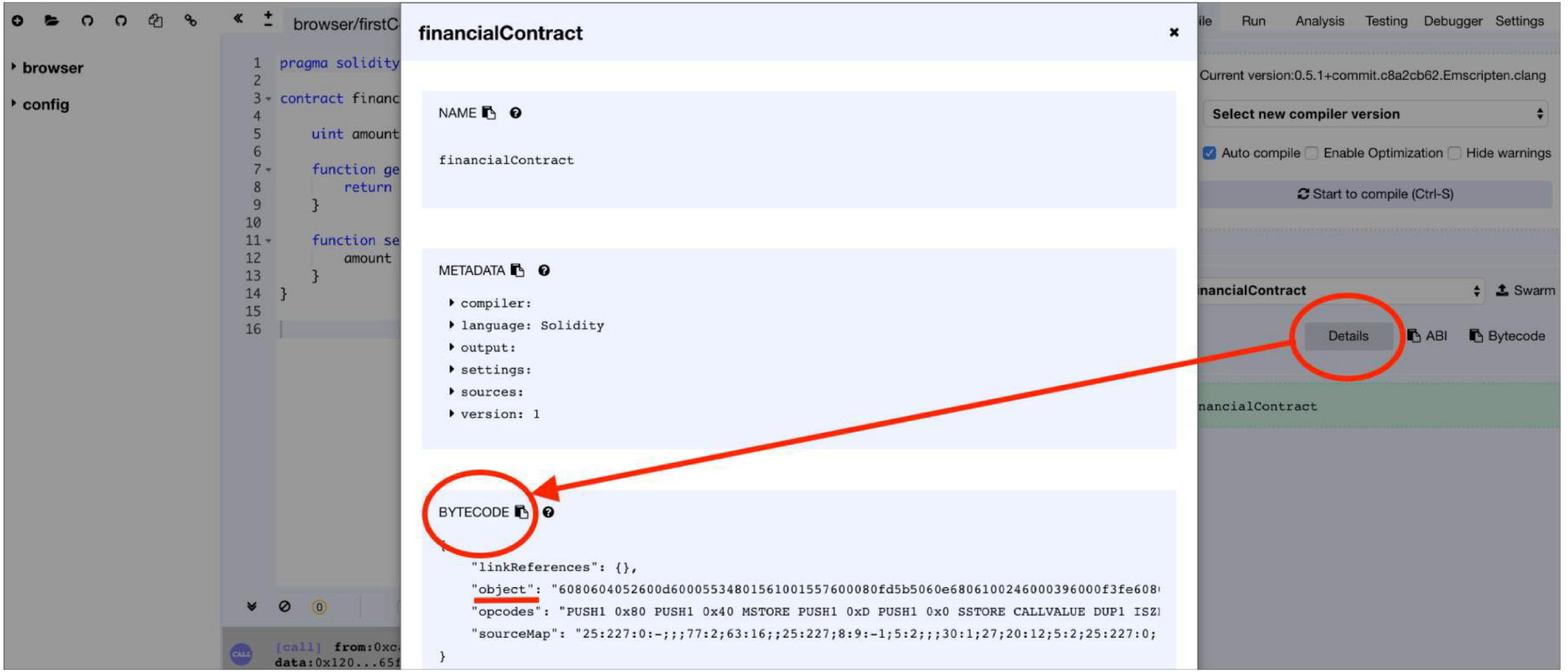


Remix

- Type your contract and compile it

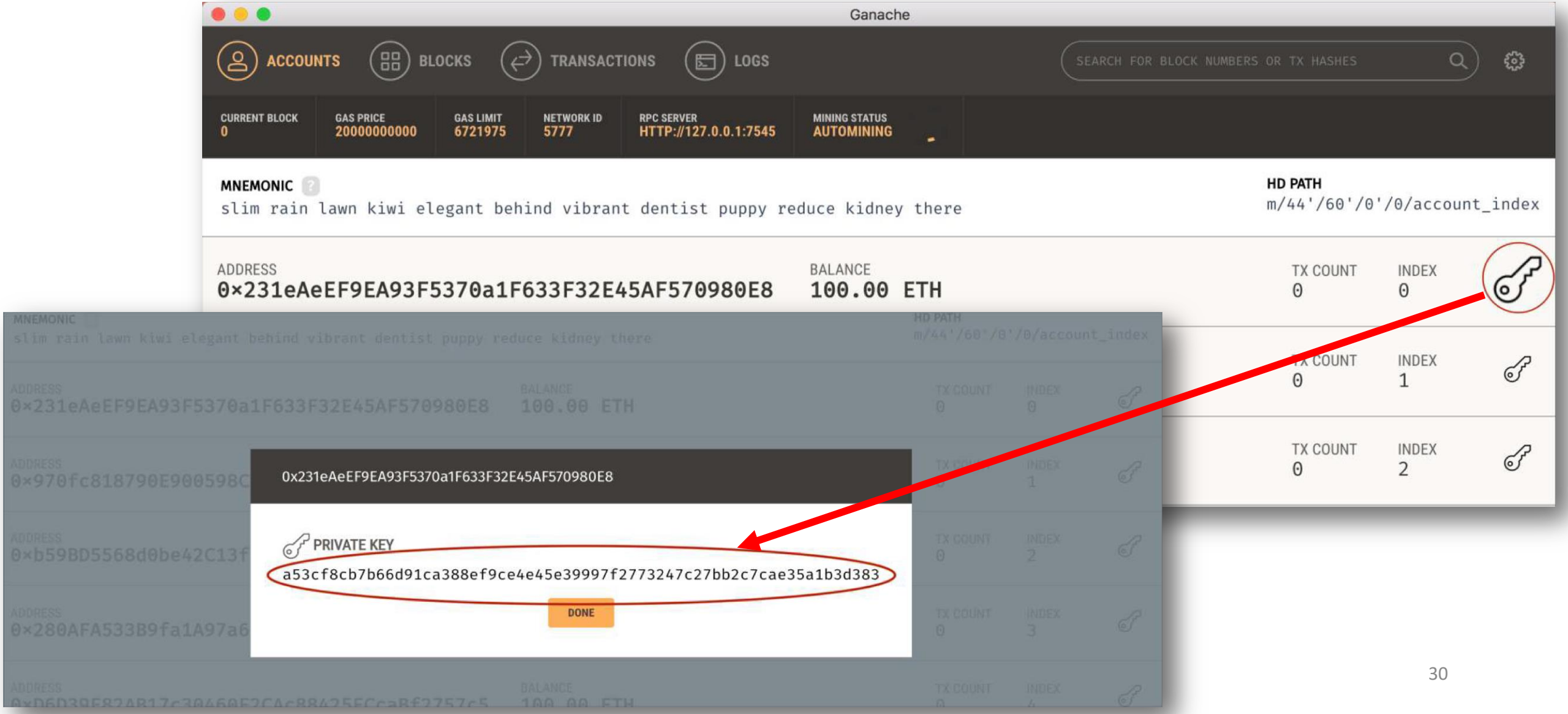
Remix

Click on Details Button: access ByteCode to import it to MyEtherWallet



Ganache

Access your private key for signing your contract in MyEtherWallet.



MyEtherWallet

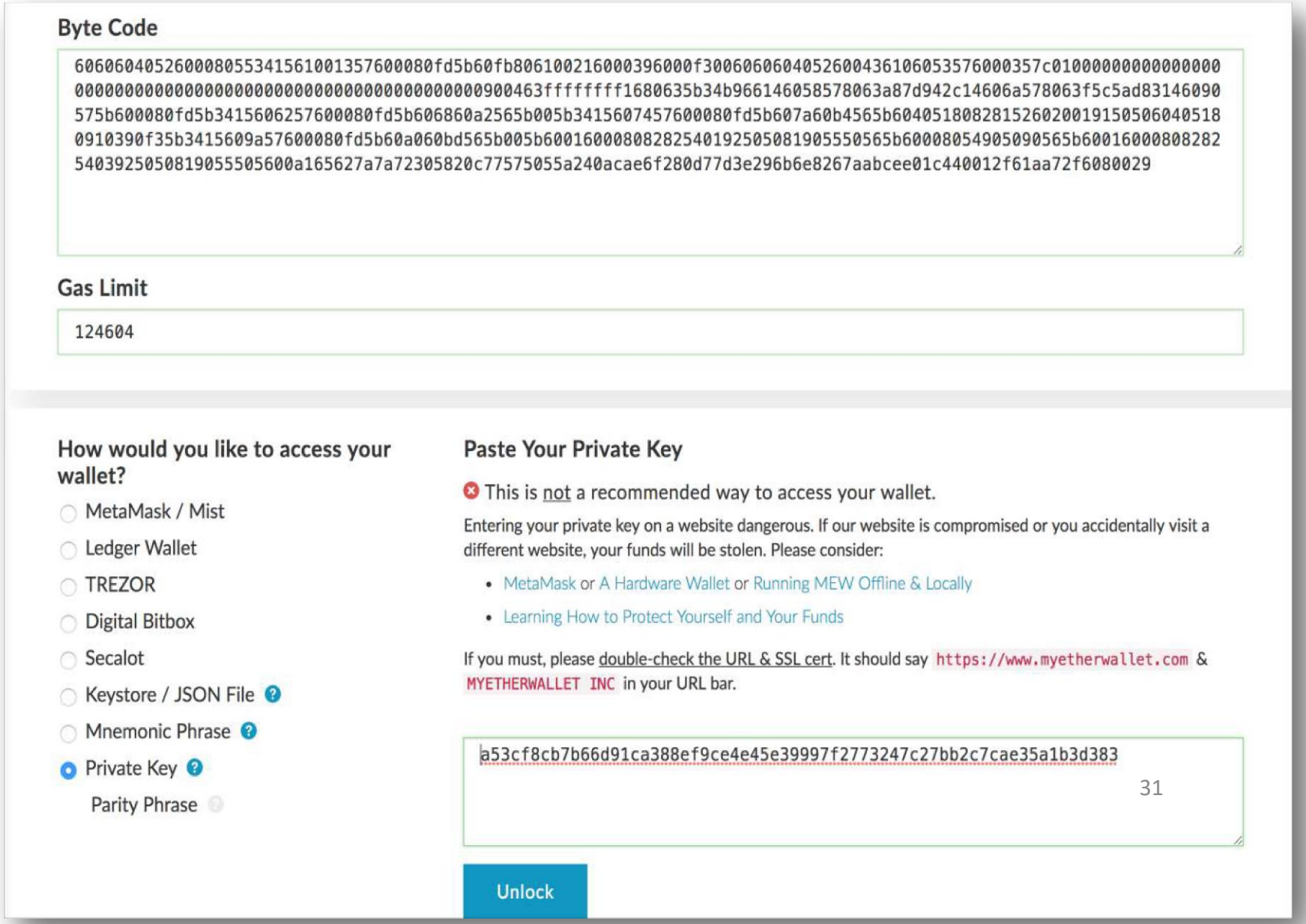
1. Paste the contract's ByteCode from Remix

2. Gas Limit will automatically be calculated

3. Paste your private key from Ganache

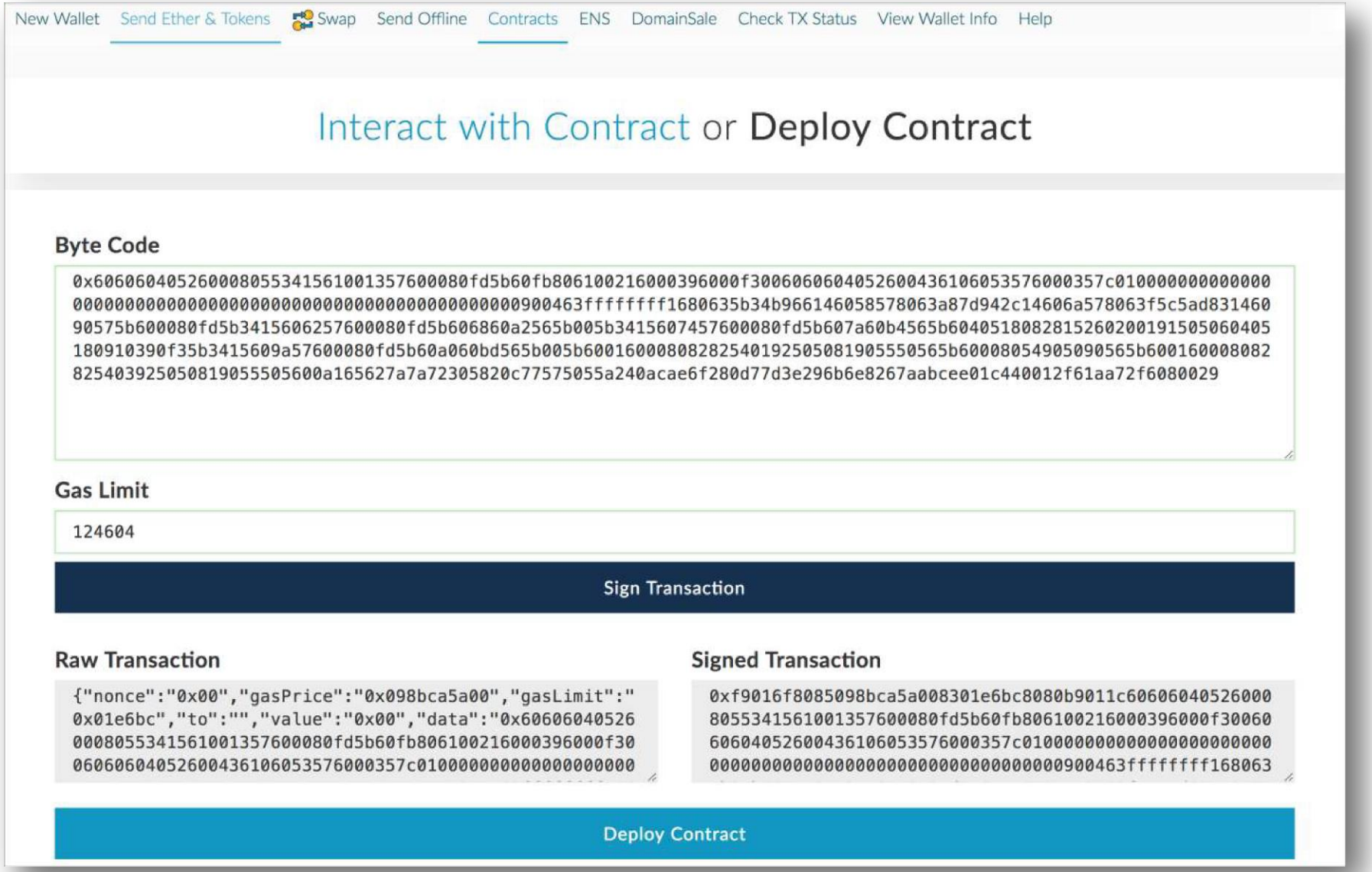
4. Click Unlock

5. Now you have access to your wallet



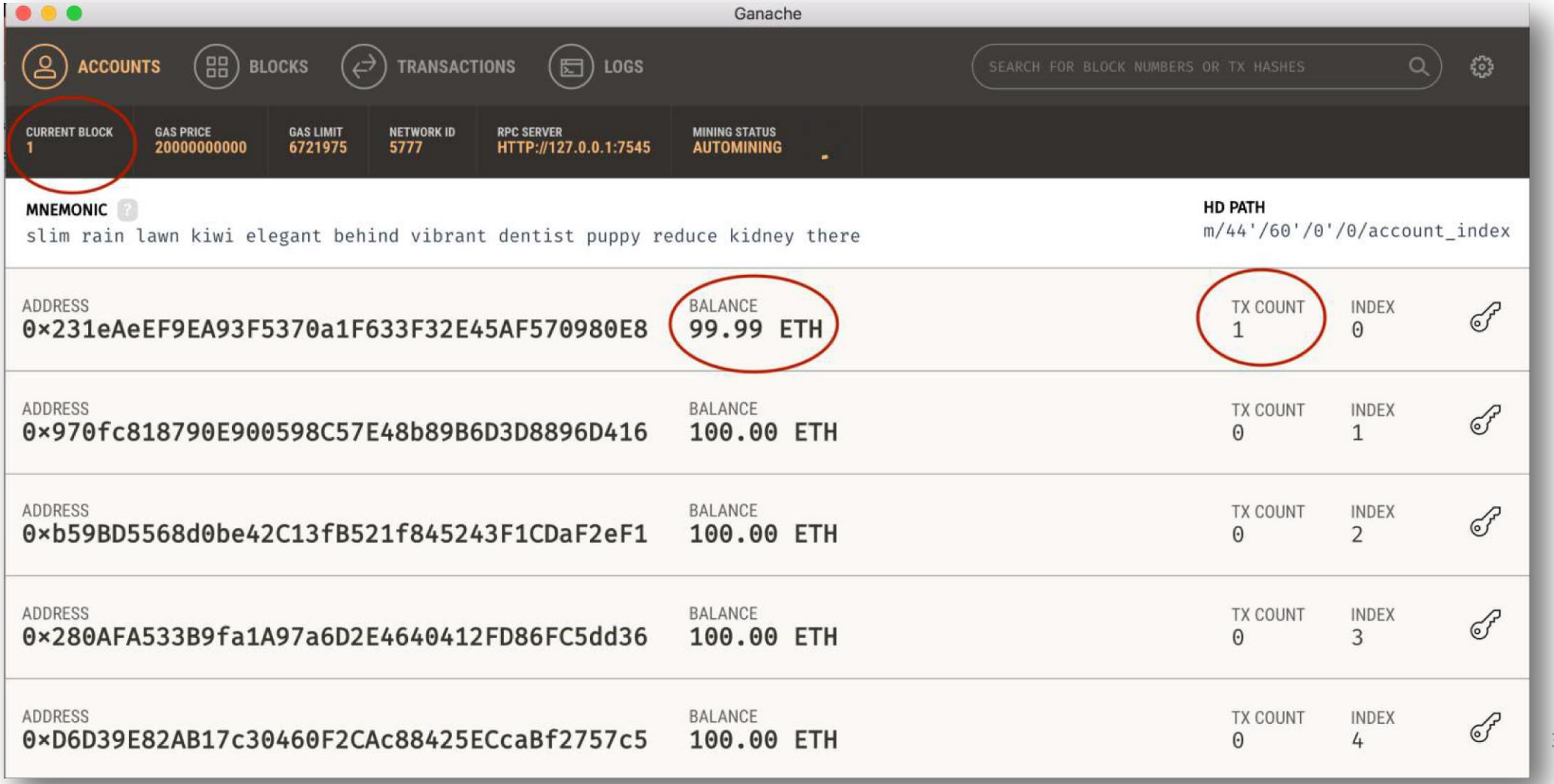
MyEtherWallet

Click on *Sign Transaction* button to deploy your contract

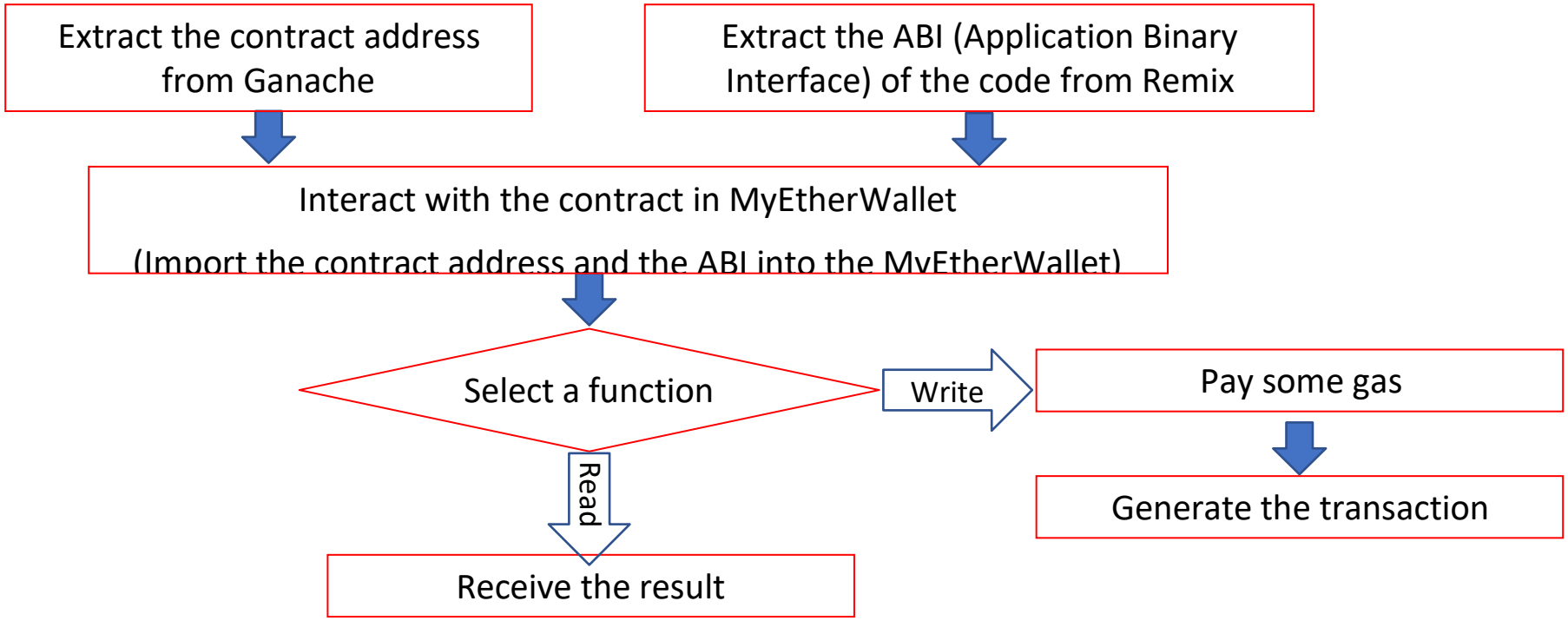


Ganache

You can see now you have one transaction for your address and your balance has been changed because of the amount of gas you paid for creating the contract.

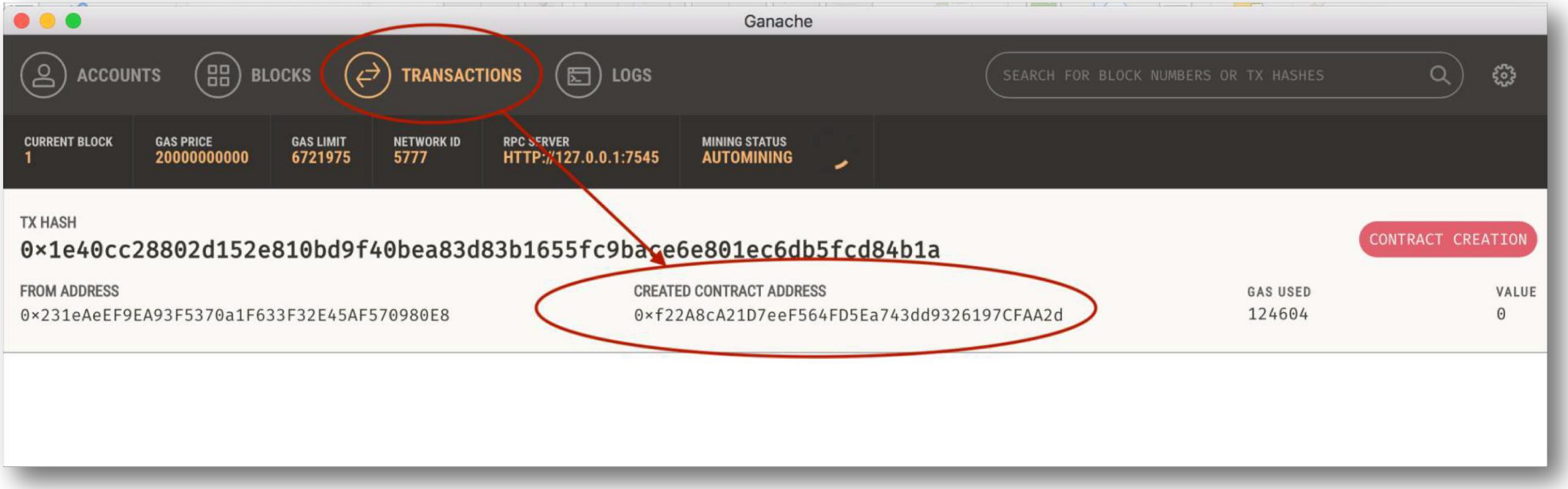


Interacting with the smart contract



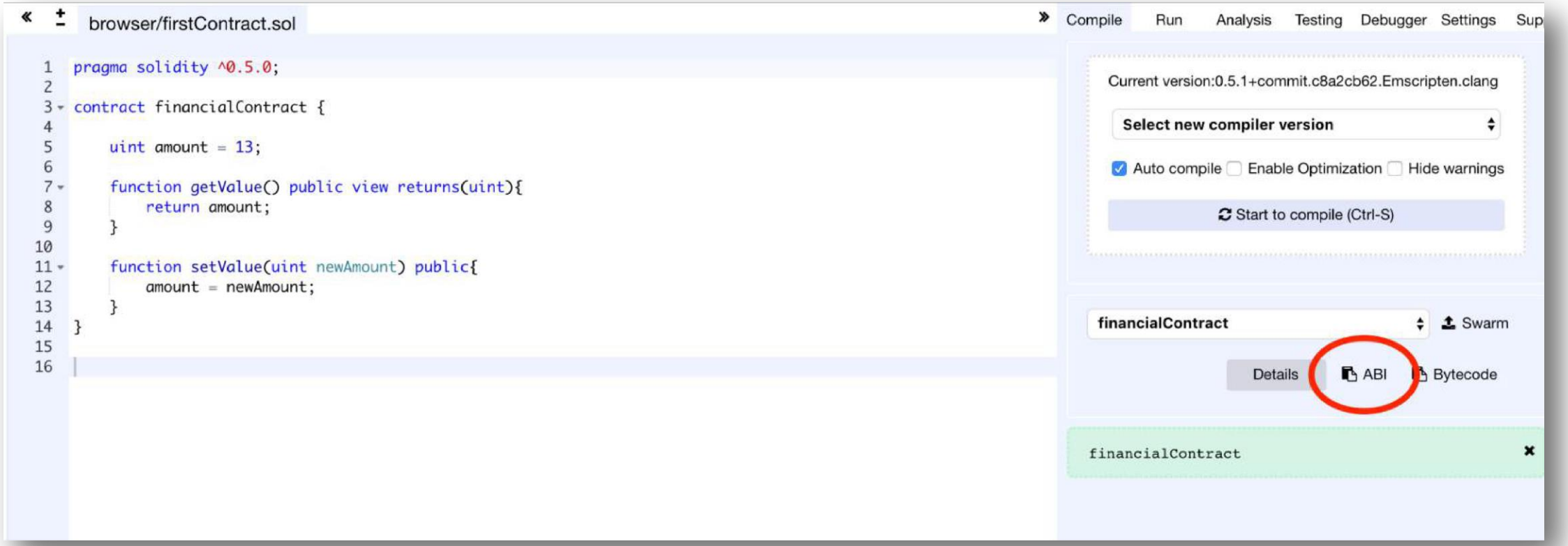
Ganache

Transactions tab: Copy the created contract address



Remix

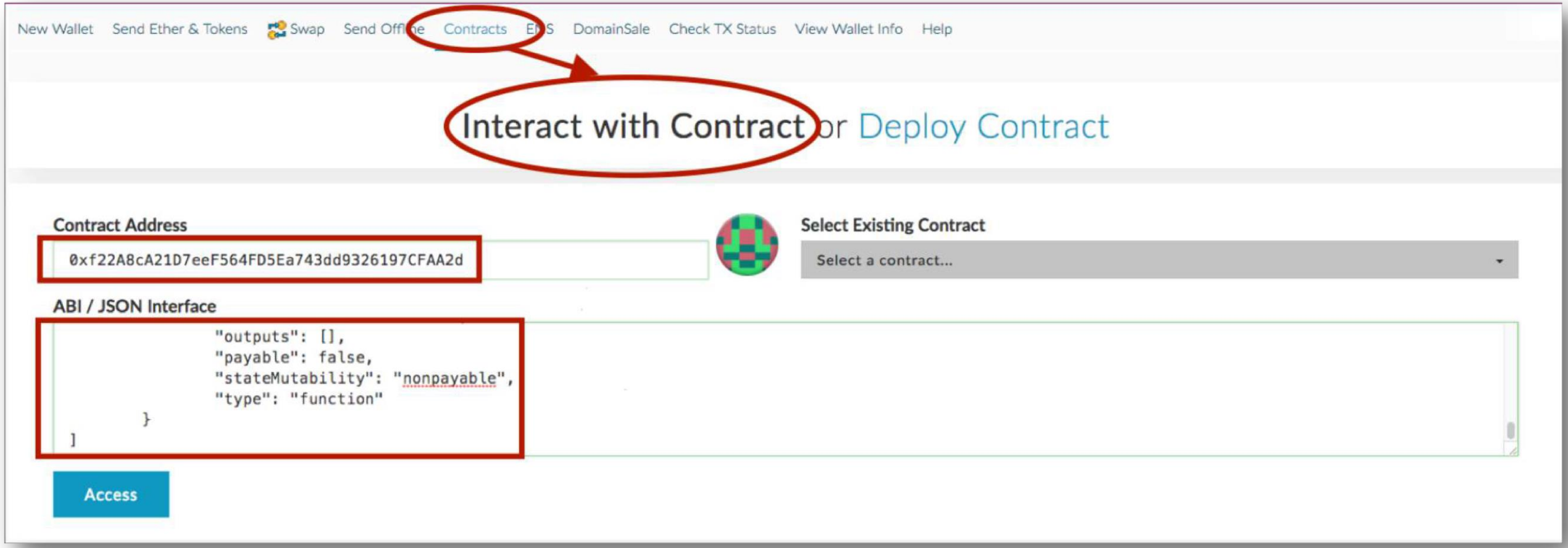
Copy the ABI
(ABI is the interface that tells MyEtherWallet how to interact with the contract)



MyEtherWallet

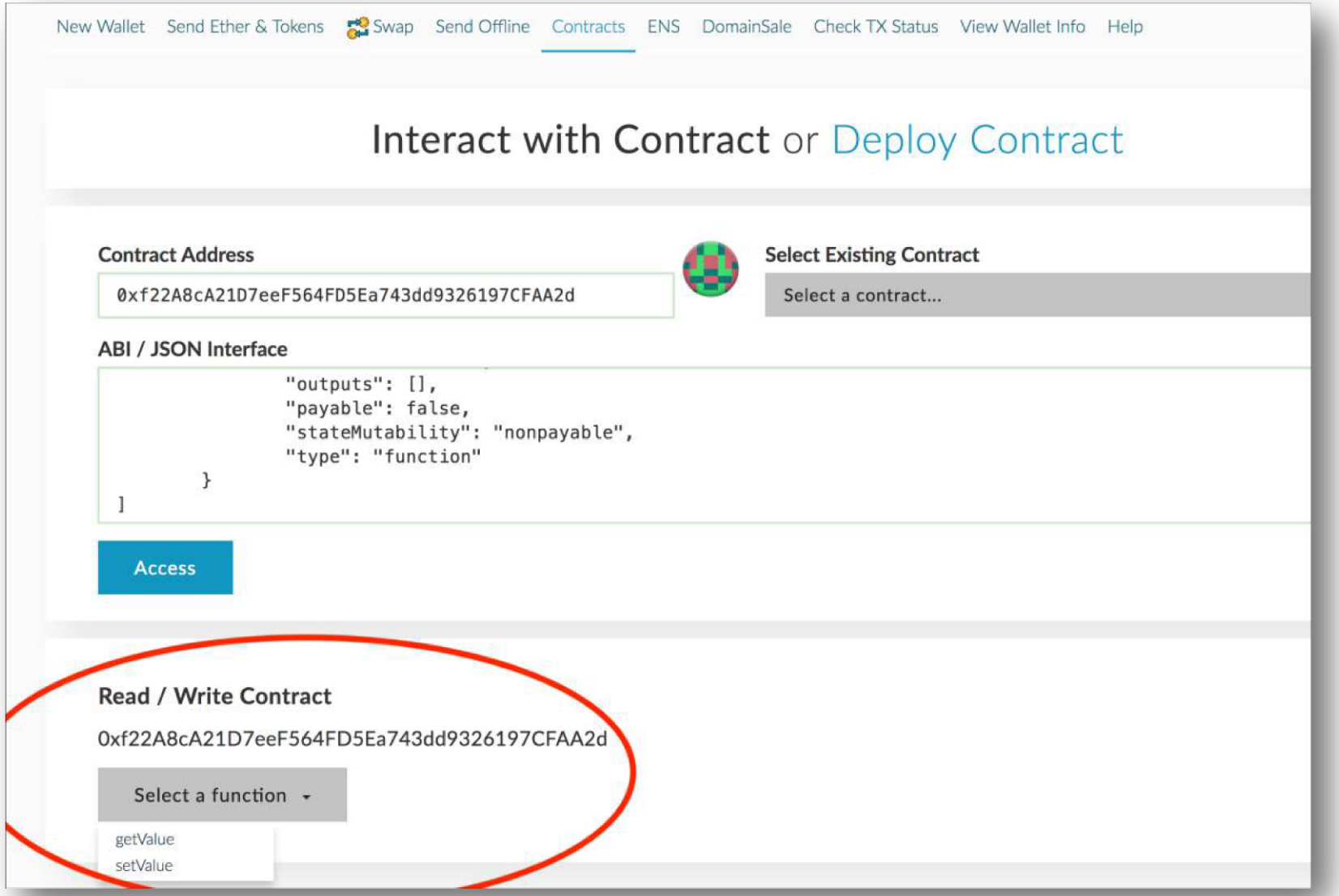
Contracts tab:

Interact with Contract = Paste the contract address from Ganache and the ABI from Remix



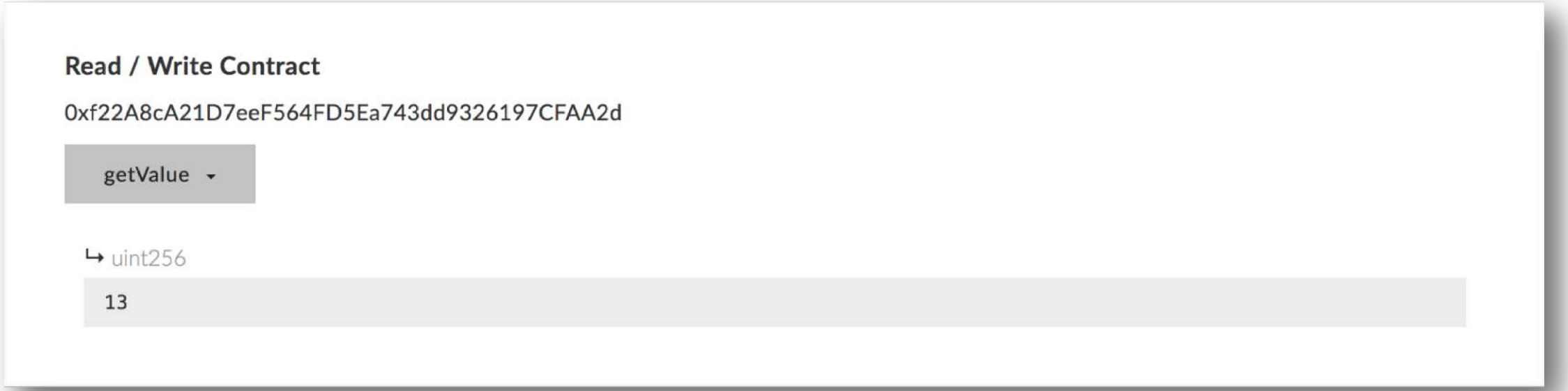
MyEtherWallet

You now can interact with the contract by selecting a function and invoking it



MyEtherWallet

If you select the getValue function you will receive the value without paying any gas
(There is no operation cost for getting information)



MyEtherWallet

If you choose a function that updates the state of the contract,

you will need to pay gas for it in a transaction.