Connecting our Ethereum private blockchain and interacting with it.

Tools:

1. A private blockchain: Setup and provided by the university.
2. MetaMask: Wallet.
3. Remix Ethereum: Online Solidity compiler.

Outline

- We show how to connect to our private blockchain and interact with it.
- Steps:

1. Install MetaMask. Create an account (i.e. an address and public-private key) via MetaMask.

2. Send us your account address, so we can give you some Ether.

3. Get familiar with Solidity and the Remix compiler:

   - Write smart contracts, debug and compile them online.

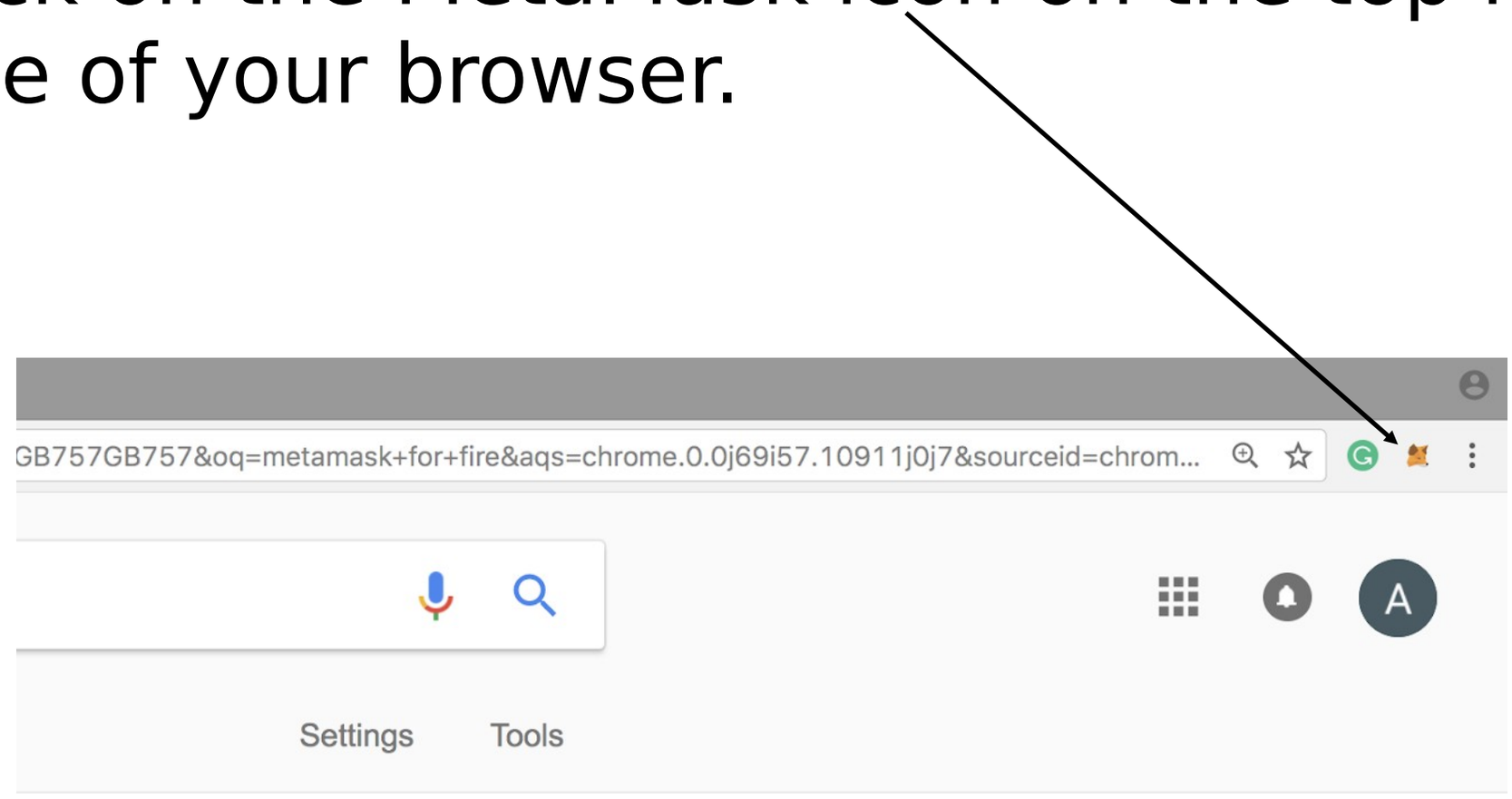
4. Send/deploy the latest version of the contract to the blockchain and interact with the deployed contract.

Step 1:
Install Metamask

- It is an extension for Firefox and Google Chrome.
- Allows us to create our public/private keys and connect to the blockchain.
- We recommend using MetaMask for Firefox or Chrome
    - Download it from: https://metamask.io/
- Follow the instructions to install it.

Step1.1:
Set Up an Account in MetaMask

- Click on the MetaMask icon on the top right side of your browser.



Step1.2: Create an Account in MetaMask

- Follow the instructions to create an account – you can choose the beta version which is more user friendly

- After you provide a password, an account (i.e. an address, public and secret keys) will be created for you – you can also create more than one accounts per wallet

- **Store your seed**: you will need it to restore your wallet in case you delete Metamask

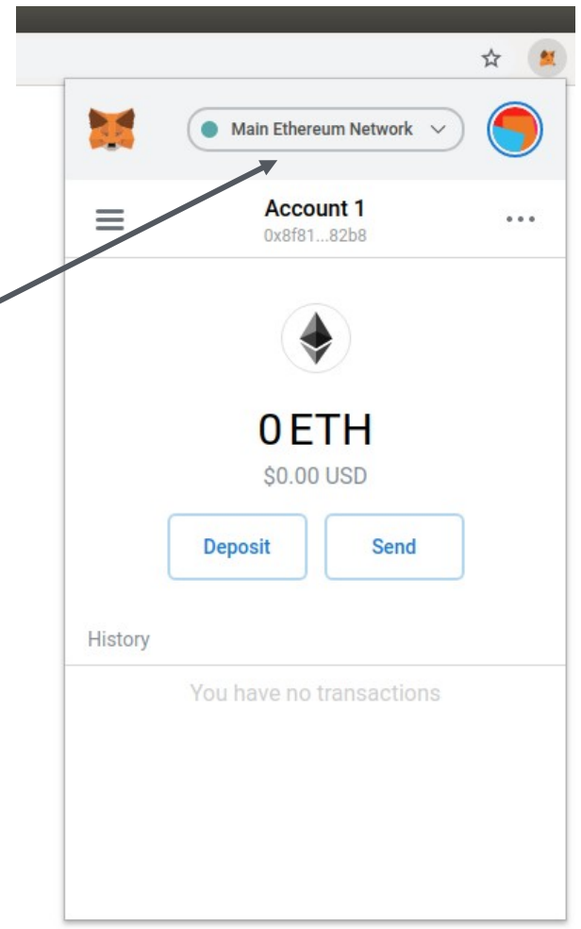
Step1.3:

Connect MetaMask to the Private Blockchain

3.1. Click the MetaMask icon.

3.2. Click on the Network option

3.3. Click on “Custom RPC”



Step1.3:

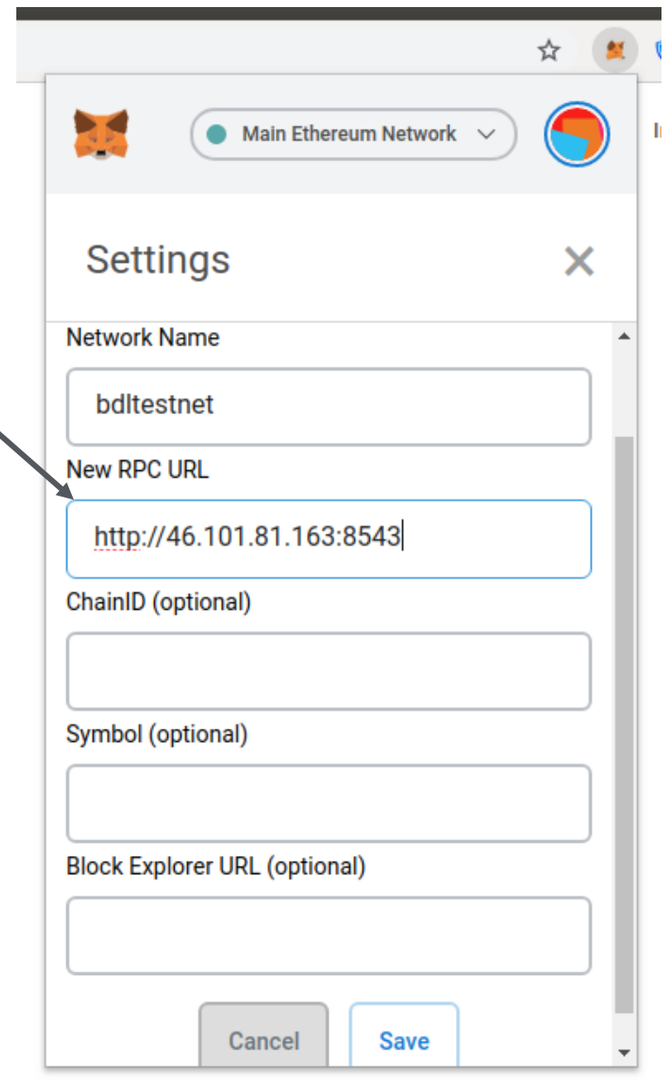
Connect MetaMask to the Private Blockchain

3.1. In the “New RPC URL” box, insert the following link:

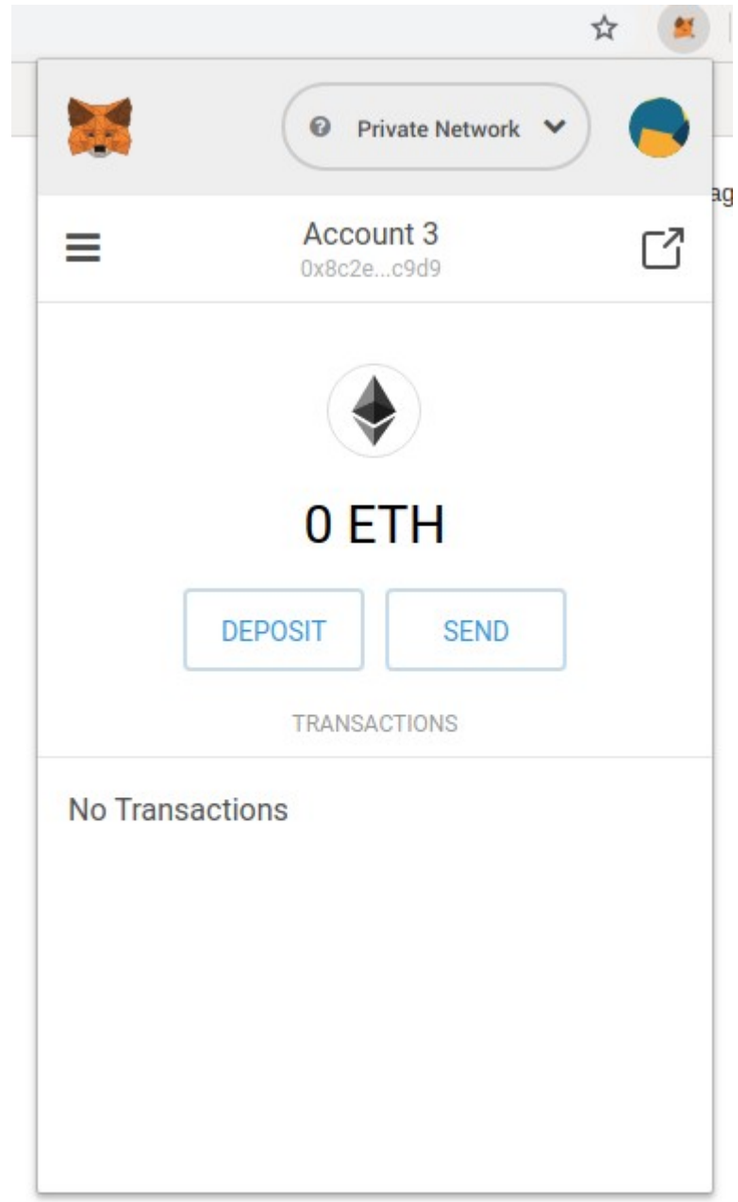
http://129.215.199.19:8545

3.2. Click on Save

3.3. Press X to go to the main page



Step1.3: Your Address



- When you've successfully connected to the chain, this page will appear

- Your address is under the account's name – here it starts with "0x8c" and ends with "c9d9"

- Click on it to copy it and then send it to those who want to pay you

Step 2:
Send us Your Account Address

- You need some Ether to send a transaction and interact with a smart contract.

- We have created a lot of Ether - you can also have some.

- Request some Ether by sending your account’s address to this email address:

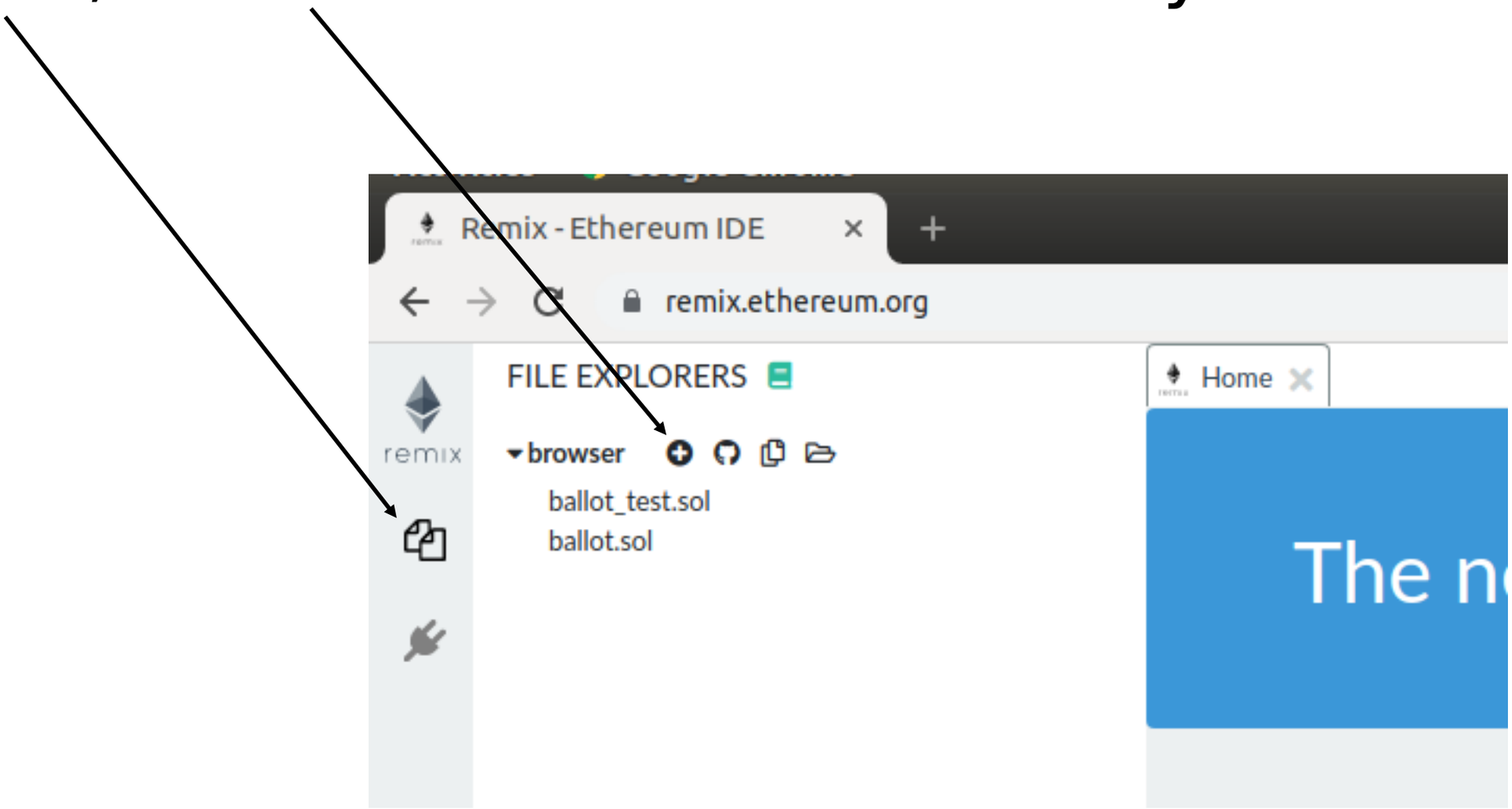
dimitris.karakostas@ed.ac.uk

Step 3:
Getting Familiar with Remix Ethereum:
Online Solidity Compiler

- You can write, debug, deploy (i.e. send to a blockchain) your smart contract via remix Ethereum: http://remix.ethereum.org
- After you deploy your contract, you can interact with it using Remix
- Before you deploy your smart contract to the private chain, run and debug it online.

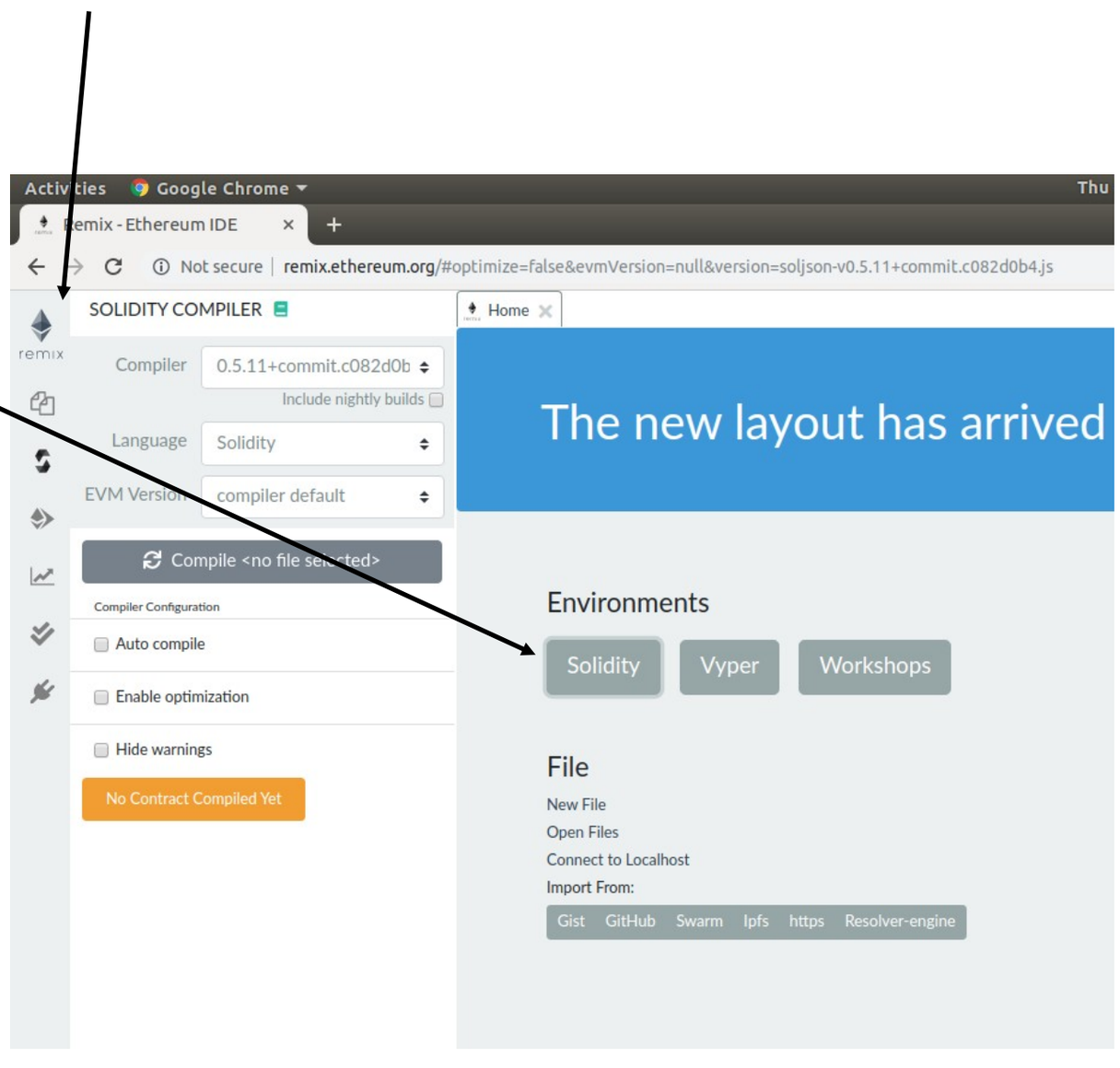
Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

- To view your files and create a new, click on the file explorer, create a new file and write your Solidity code



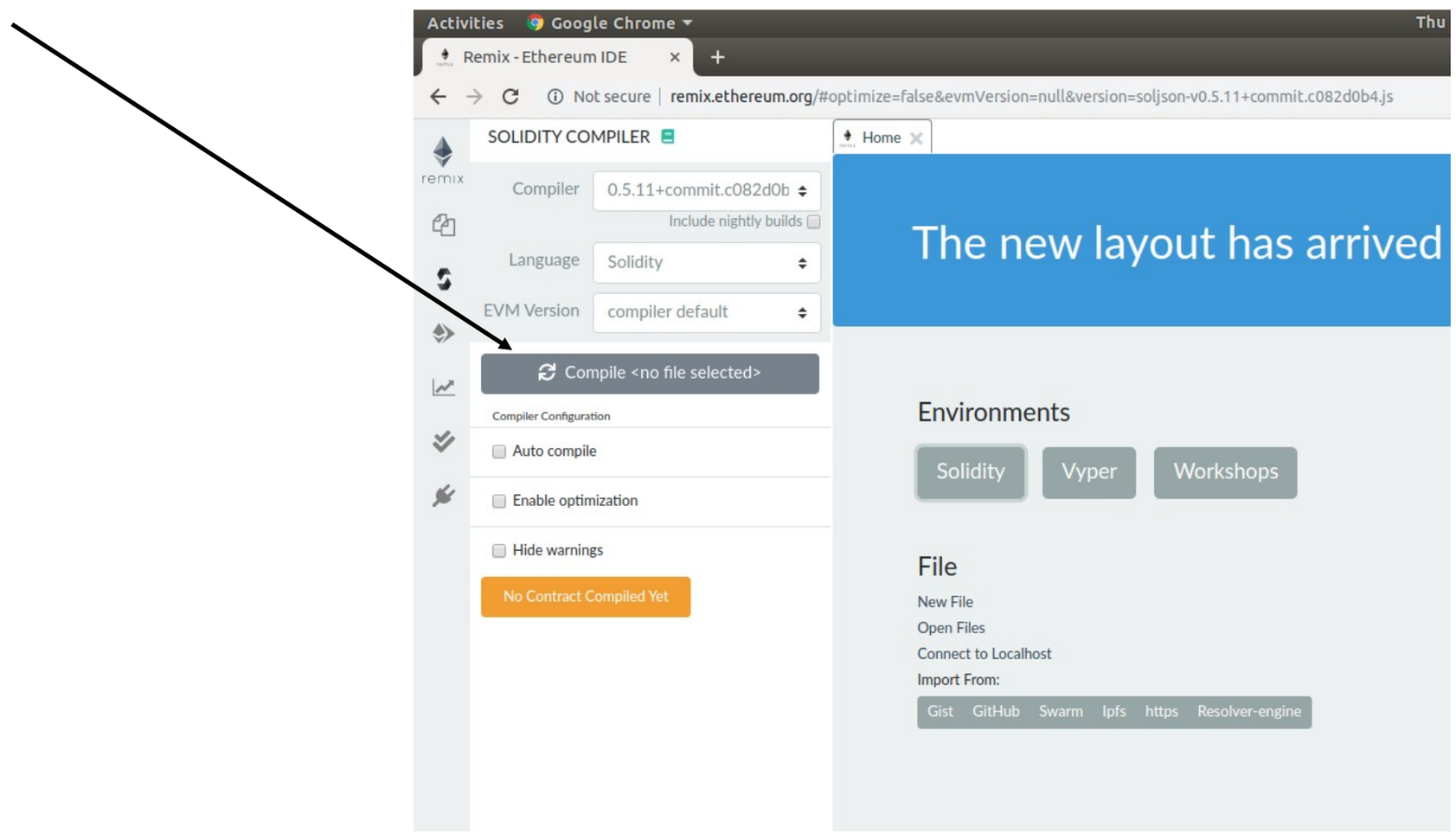
Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

- Next, click the home button and then choose the Solidity environment



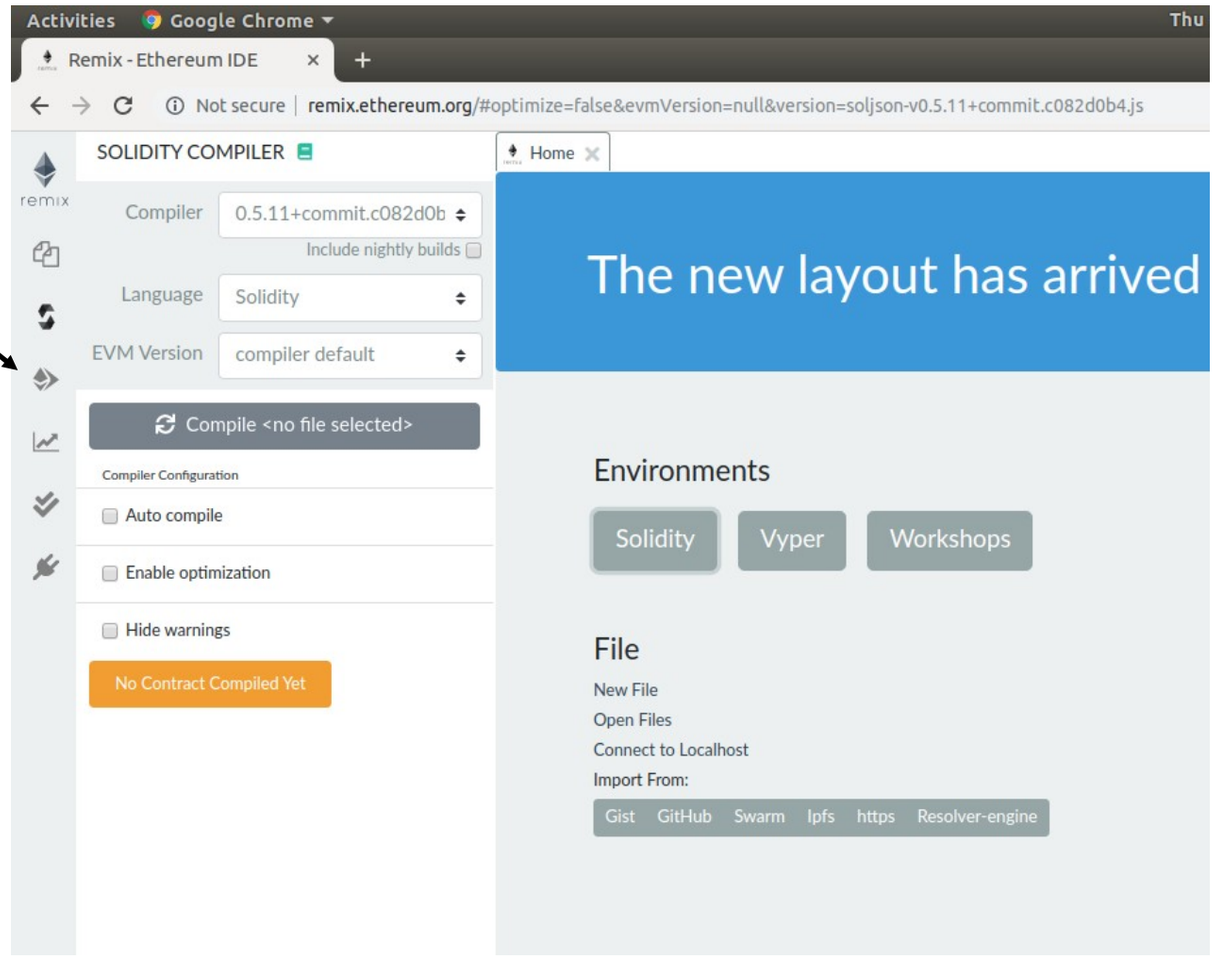
Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

- Next, compile your smart contract (every time you change your contract you need to recompile it)



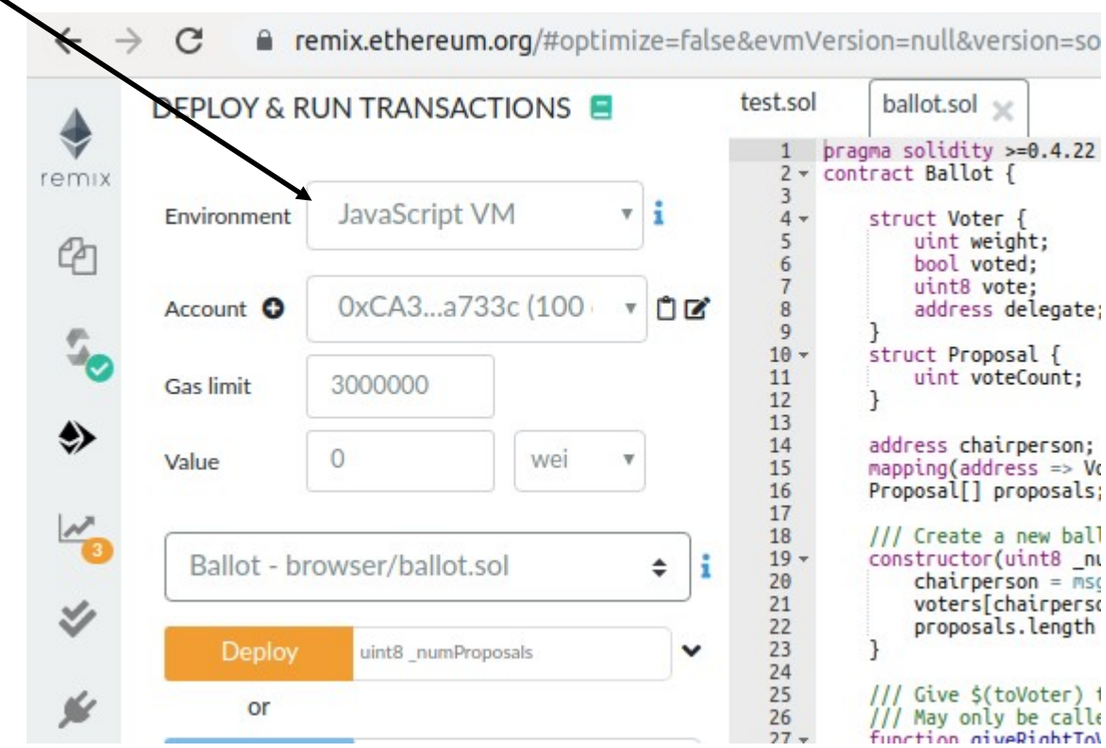
Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

- Next, to deploy and test your contract, choose the deployment explorer



Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

- You can deploy your contract in a number of environments



Step 3:
Getting familiar with Remix:
Javascript VM environment

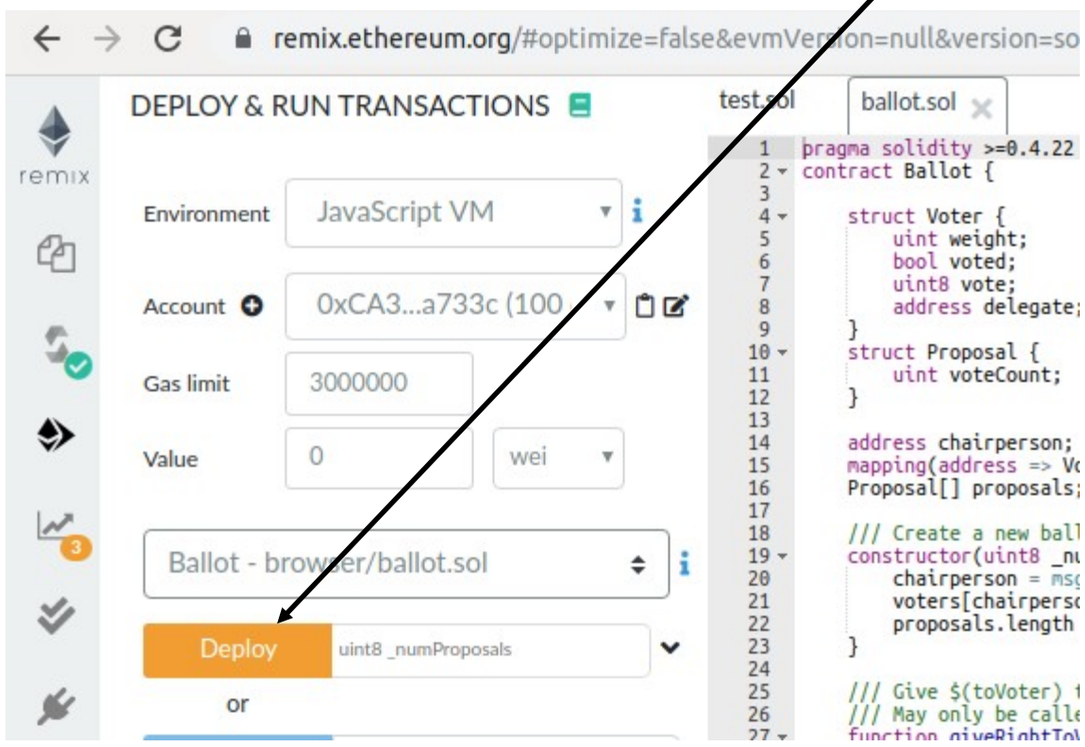
- **Javascript VM**
  - This is a testing environment
  - It is a local environment that lives on your browser’s tab
  - Whatever you do in this environment does not affect your funds, i.e. it does not have access to your wallet
  - When you close the browser it is deleted and when you open it again it is created fresh, so every time you use this environment you need to re-deploy your contracts

Step 3:
Getting familiar with Remix:
Injected Web3 environment

- **Injected Web3**
  - This environment has access to your Metamask
  - It connects to the network to which Metamask is connected and uses the funds of your wallet
  - Every time you try to use a contract, Metamask will request permission before completing the operation – this is because an actual transaction is posted and the actual funds in your wallet are used

Step 3:
Getting familiar with Remix Ethereum:
Online Solidity Compiler

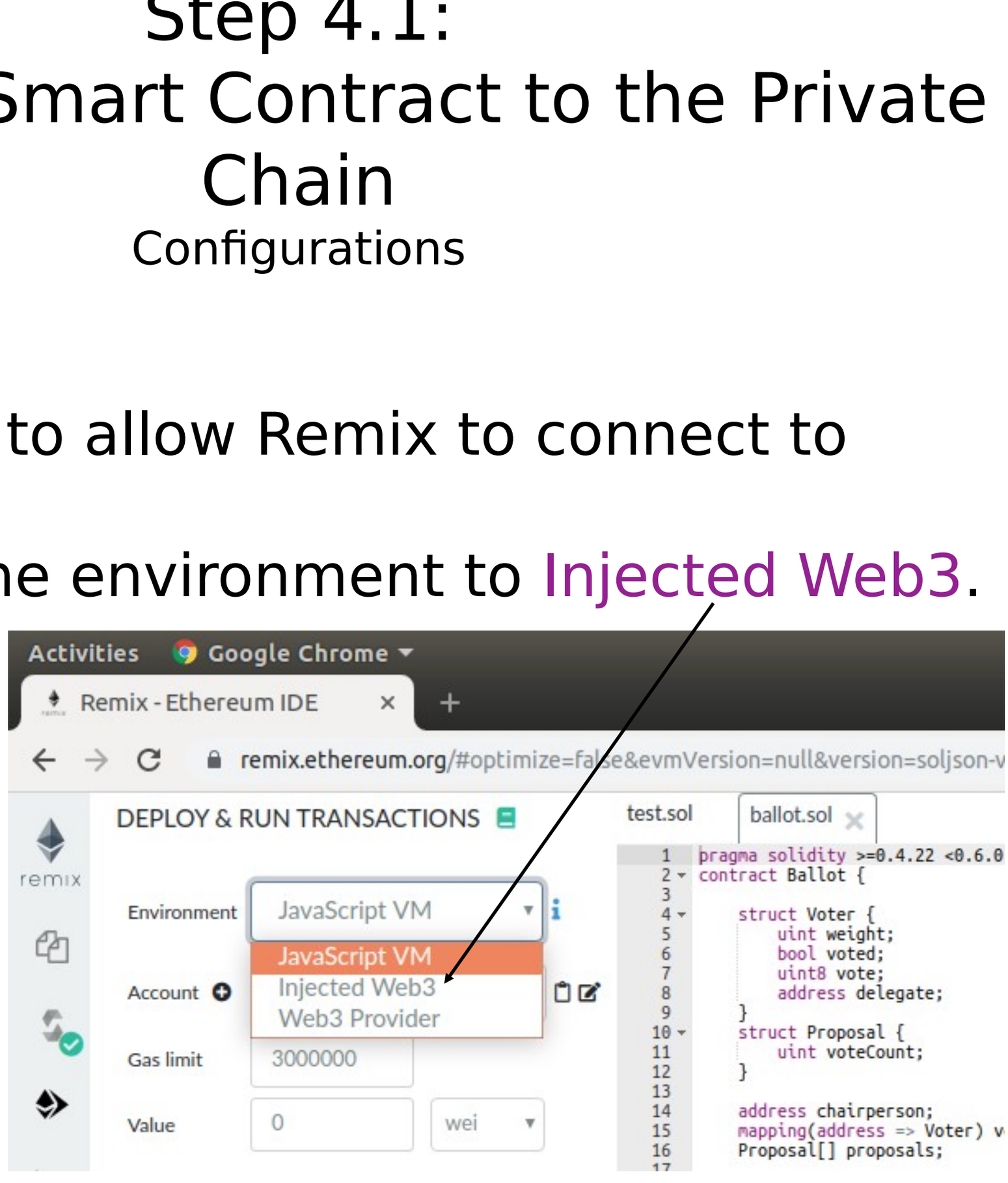
- To test your smart contract, click on Deploy
- Remix creates a user interface to interact with the contract



Step 4.1:
Deploying Smart Contract to the Private Chain

Configurations

- First, you need to allow Remix to connect to Metamask
- In Remix, set the environment to Injected Web3.

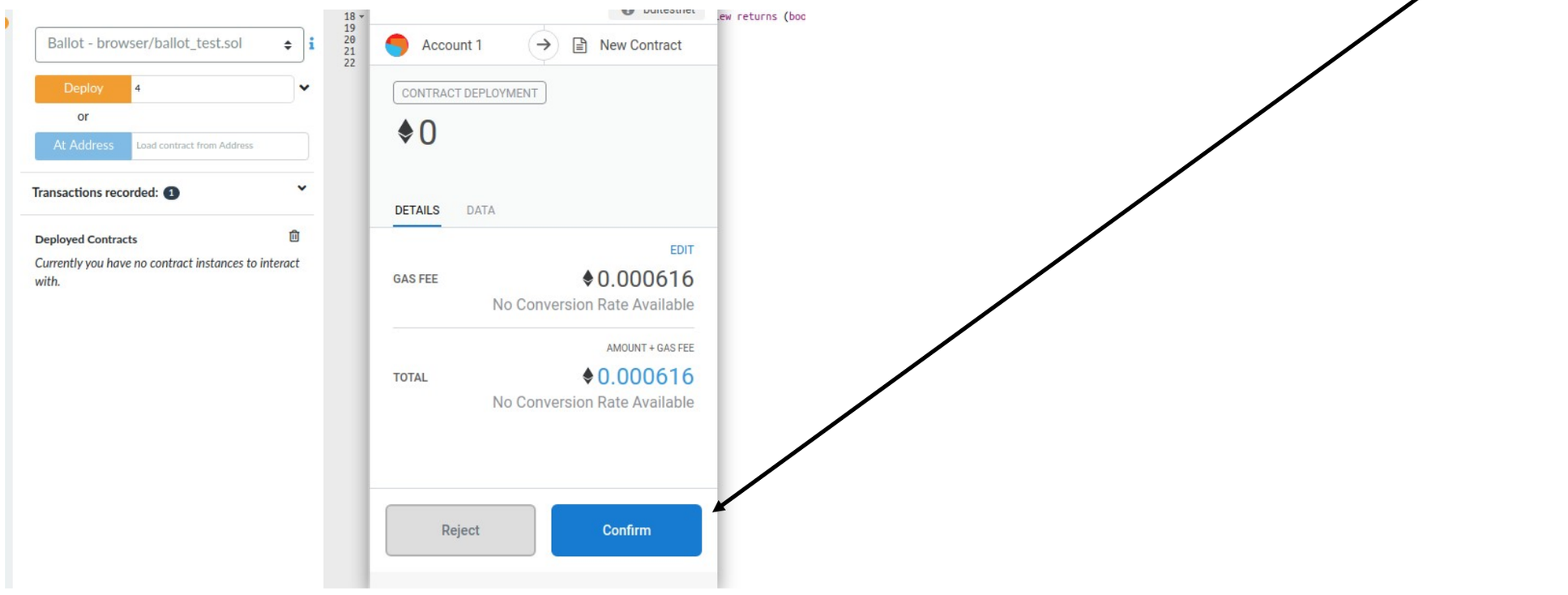


Step 4.2: Deploying Smart Contract to the Private Chain

Deploying a Contract to the Blockchain

- Click on Deploy

- MetaMask will request your permission to send your contract to the blockchain - by clicking on confirm, you publish your contract (and pay the fee)

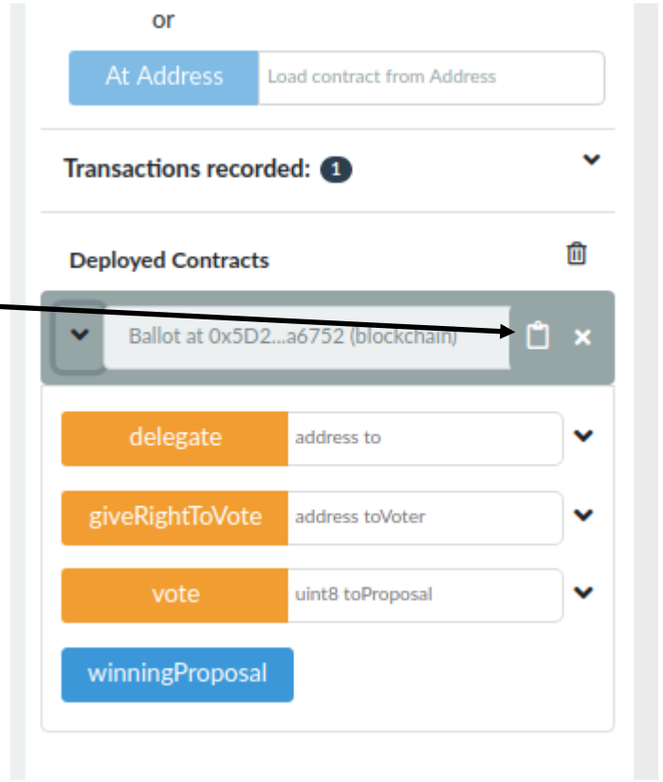


Step 4.3:
Deploying Smart Contract to the Private Chain

Saving the Deployed Contract's Address

- When, your contract is successfully submitted & deployed, Remix provides the contract’s address

- You need the contract’s code and the address next time you want to interact with your deployed contract.

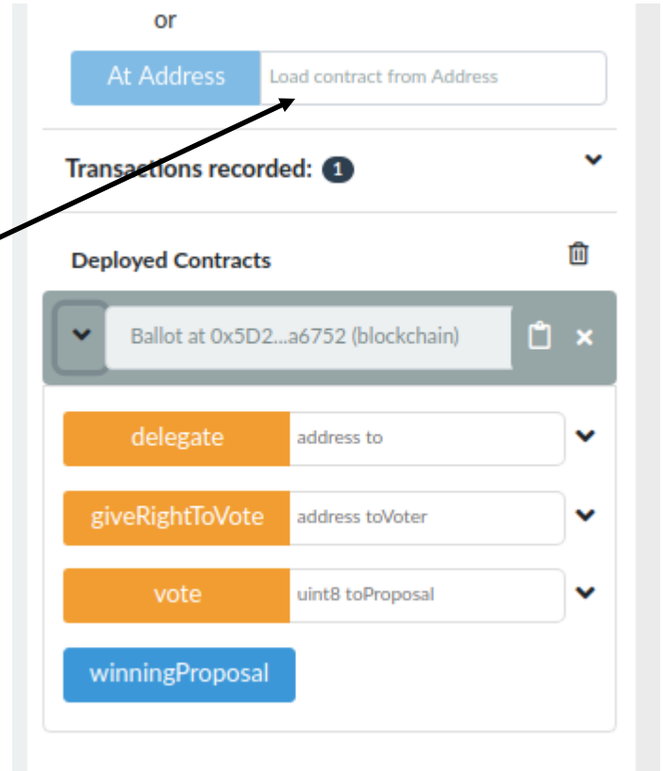


Step 4.3:
Deploying Smart Contract to the Private Chain

Interacting with a Deployed Contract

1. Log in to MetaMask, connect to the blockchain (as previously explained)
2. In Remix, write and compile your contract, and set the environment to Injected Web3.

3. Insert the deployed contract's address and click on: At Address.

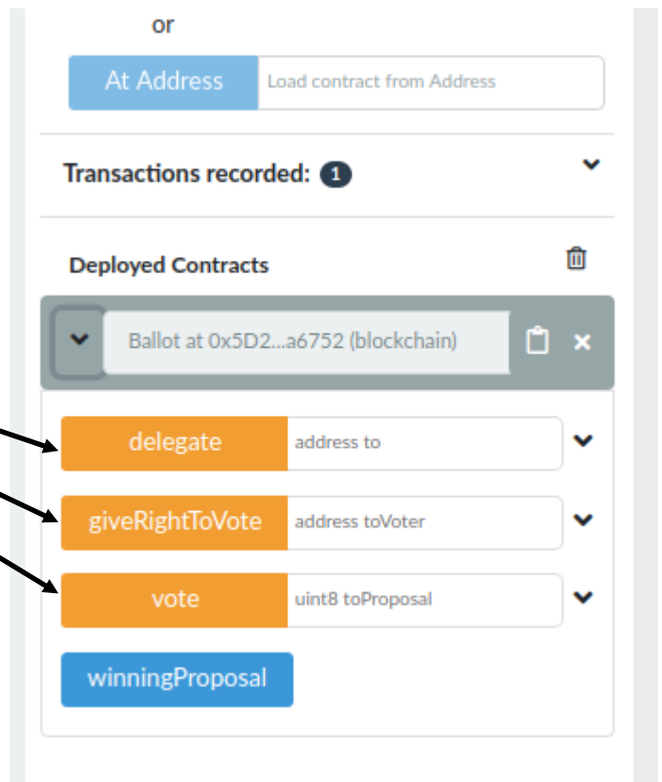


Step 4.3:
Deploying Smart Contract to the Private Chain

Interacting with a Deployed Contract

4- All the public/external functions in the contract are provided and you can pass arguments on them and invoke them

- Orange fields change the contract's state, so you create a transaction and spend funds - at minimum you pay the fees, if your transaction does not send funds to the contract
- Blue fields just show you the contract's state and are free



Debugging

- <u>If you don’t see your funds in Metamask</u>
  - Double check that you are connected to the correct network, i.e. the private network and not e.g. the Ethereum mainnet
  - If you are connected to the private network, try connecting to a different network (e.g. the Ethereum mainnet) and then reconnecting back to the private network – sometimes Metamask’s connection breaks down, so this will reset the network
  - If you still don’t see your funds, try deleting Metamask from your browser (remember to **store your seed** first), and then re-install it, recreate your wallet using your seed (if you have more than one accounts in your wallet, you have to create them all manually again) and connect to the private network – sometimes Metamask’s internal transaction generator breaks down (due to temporary network issues), so this will reset your wallet from scratch
  - If you still don’t see your funds contact the course’s TA

Debugging

- If you want to find past transactions' IDs
  - Metamask keeps a list of all transactions that you have made
  - Click on a transaction and it will redirect you to Etherscan – the public Ethereum network's explorer
  - Etherscan will not show you anything, because it does not track the private network but the public Ethereum, but
  - Either in the URL or in Etherscan's page you will find the transaction ID

- If you interact with a contract but don't see your changes published
  - Make sure that you have set the environment to *Injected Web3*
  - Double check that the address of the contract to which you connect is the correct one and the contract's code is exactly the same as the deployed contract