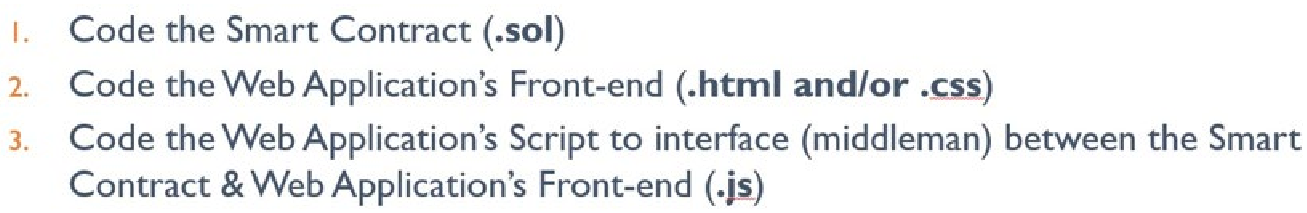
Practical 05: House Registration dApp – Introduction to Remix and MetaMask

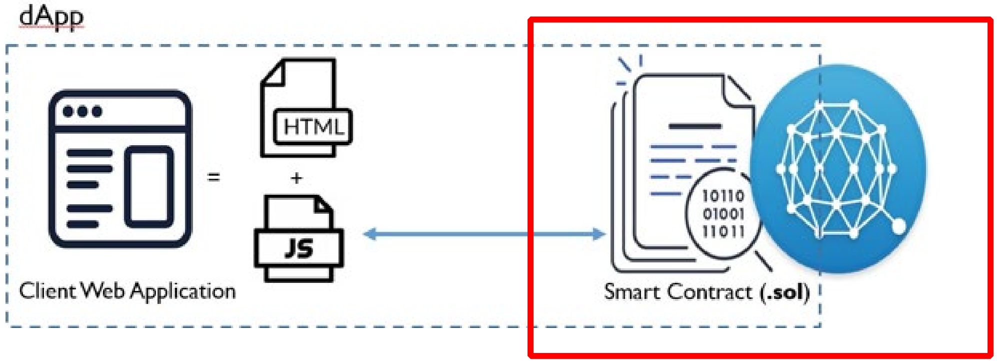
For Practical 5 to Practical 9, we will be developing an Ethereum dApp, named House Registration dApp. This House Registration dApp will have the following functions that will be covered over the next few practical:

- Display List of House Registrations (Practical 6)
- Add New House Registration (Practical 7)
- Transfer House Registration (Practical 8)
- Transfer Payment (Practical 9)

Steps to code the dApp



1. Code the Smart Contract (**.sol**)
2. Code the Web Application's Front-end (**.html and/or .css**)
3. Code the Web Application's Script to interface (middleman) between the Smart Contract & Web Application's Front-end (**.js**)



For this practical we will only be doing the 1st step which is to code the Smart Contract and deploying Smart Contract to the Ethereum Test Blockchain via MetaMask.

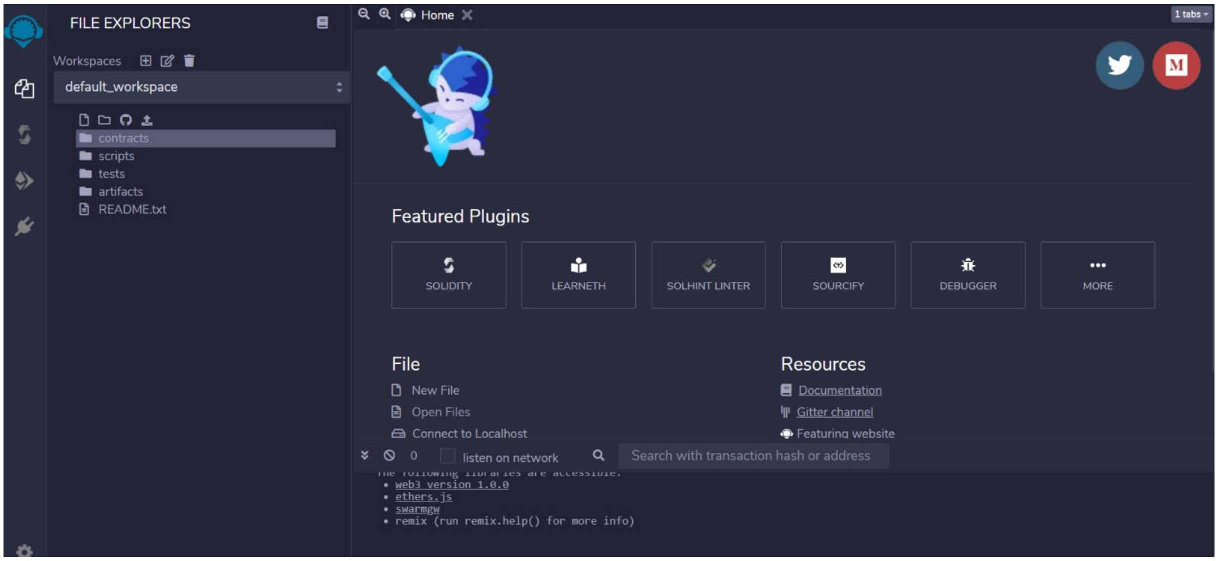
This practical consists of the following part:

Part 1: Coding and Testing the smart contract using Remix IDE.
Part 2: Installation of MetaMask
Part 3: Deploying the smart contract to the Ethereum Test Blockchain via MetaMask

Part 1: Coding and Testing the smart contract using Remix IDE

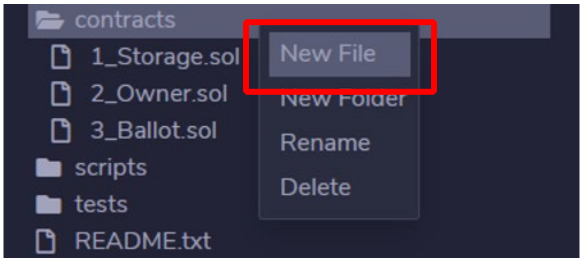
Remix is a web-based Integrated Development Environment (IDE) where you can create and test smart contracts and build a front-end web application for them.

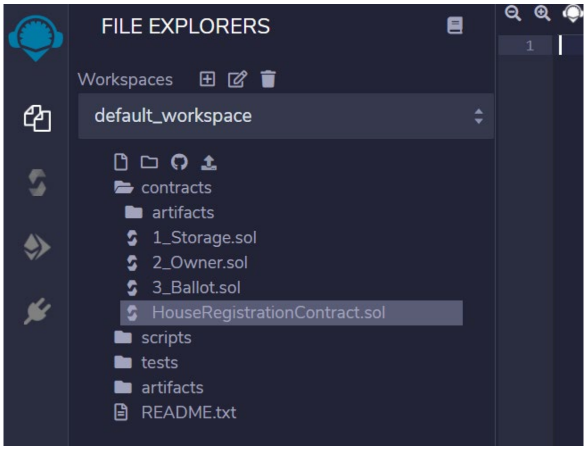
1. Go to https://remix.ethereum.org/



```
The following libraries are accessible:
• web3 version 1.0.0
• ethers.js
• swarmgw
• remix (run remix.help() for more info)
```

2. Right click on contracts and select “New File”. Name the file as **HouseRegistrationContract.sol**





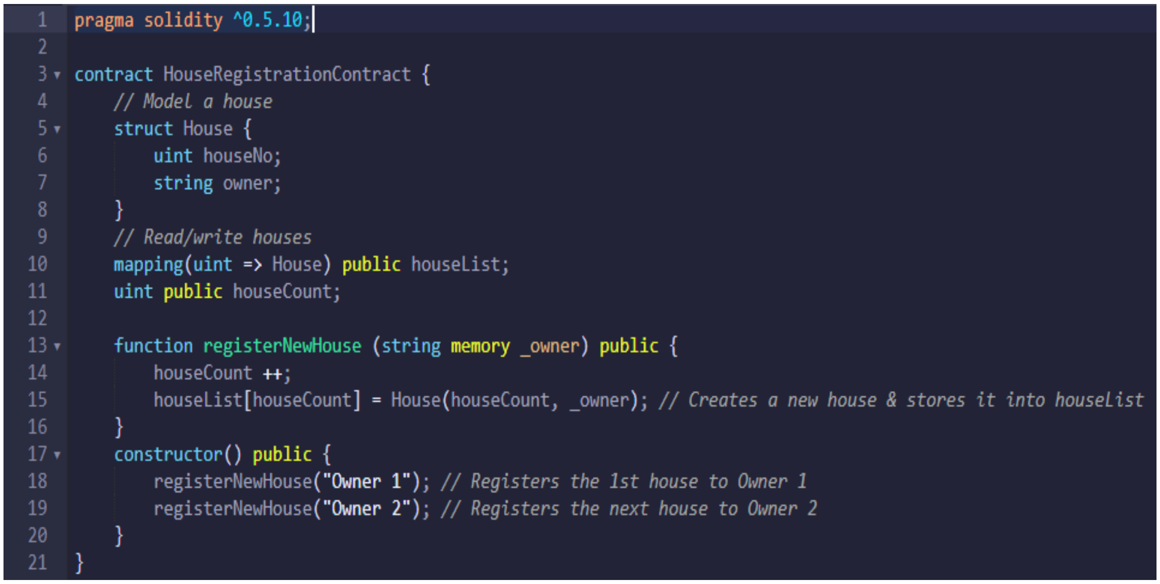
3. Copy the following code into “**HouseRegistrationContract.sol**” to register a new house.

```
    pragma solidity ^0.5.10;

contract HouseRegistrationContract {
    // Model a house
    struct House {
        uint houseNo;
        string owner;
    }
    // Read/write houses
    mapping(uint => House) public houseList;
    uint public houseCount;

    function registerNewHouse (string memory _owner) public {
        houseCount ++;
        houseList[houseCount] = House(houseCount, _owner); // Creates a new house & stores it into houseList
    }
    constructor() public {
        registerNewHouse("Owner 1"); // Registers the 1st house to Owner 1
        registerNewHouse("Owner 2"); // Registers the next house to Owner 2
    }
}
```

Your codes in **HouseRegistrationContract.sol** should look like this



```
pragma solidity ^0.5.10;

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    constructor() public {
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    }
}
```
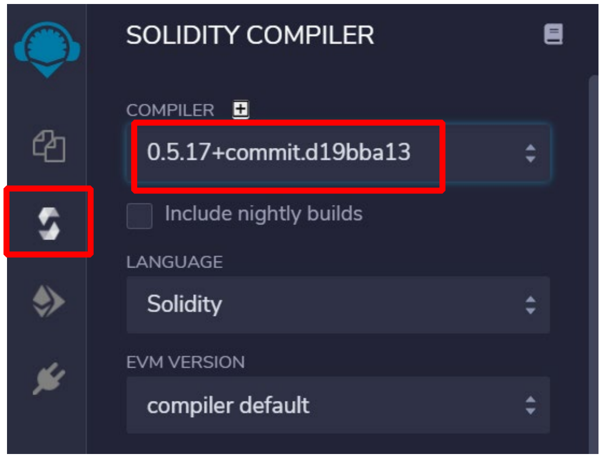

4. Click on the **compiler** **icon** and change the compiler to **0.5.17**. Click on the **blue button** to compile the smart contract.



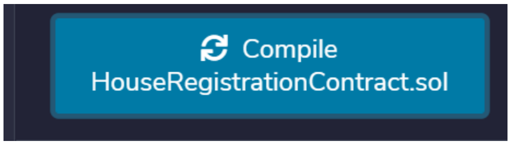
SOLIDITY COMPILER

COMPILER: 0.5.17+commit.d19bba13

☐ Include nightly builds

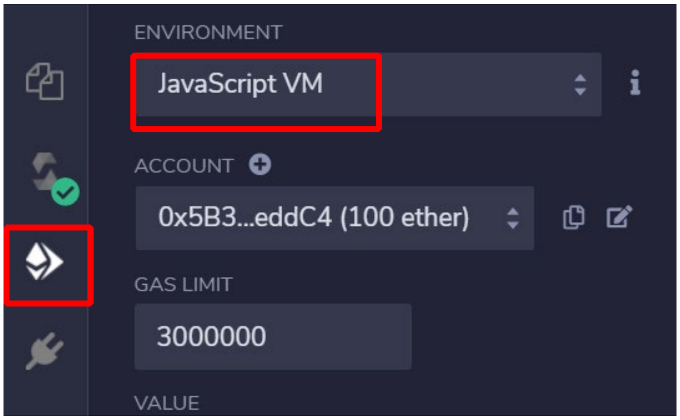
LANGUAGE: Solidity

EVM VERSION: compiler default



5. Make sure there is a green tick on the compiler icon

6. To test the smart contract, click on the **diamond** icon to go to the **Deploy & Run Transactions** panel. Make sure the environment is set to the local environment **JavaScript VM.** By selecting “JavaScript VM”, you are deploying and running your smart contract in the **local environment, i.e. your local machine/ laptop**.



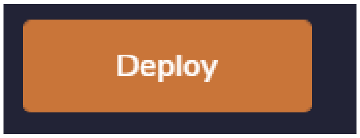
ENVIRONMENT: JavaScript VM

ACCOUNT: 0x5B3...eddC4 (100 ether)

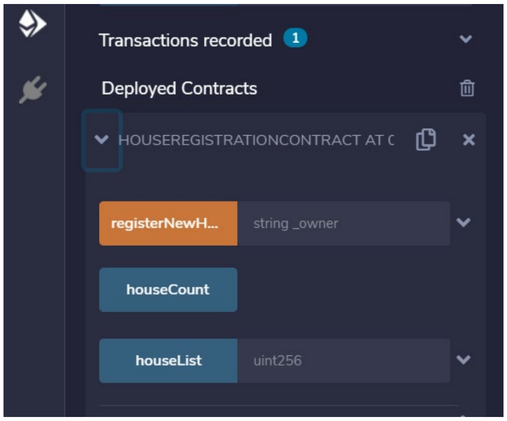
GAS LIMIT: 3000000

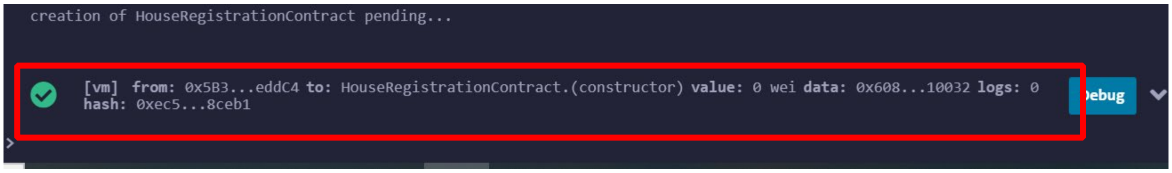
VALUE

7. Click the orange button to **Deploy**



8. Once deployed, you will be able to see the deployed contract at the **Deploy & Run Transaction panel** and the details of the transaction at the bottom toolbar.

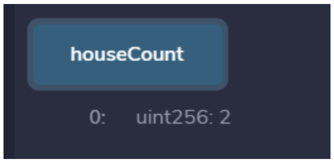




```
creation of HouseRegistrationContract pending...

[vm] from: 0x5B3...eddC4 to: HouseRegistrationContract.(constructor) value: 0 wei data: 0x608...10032 logs: 0
hash: 0xec5...8ceb1
```

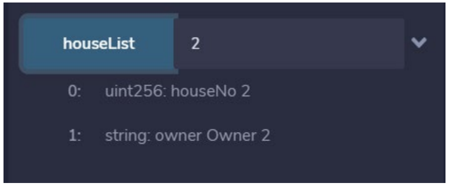
9. Test the smart contract

(i) Click on the blue "houseCount" button – you should see that there are 2 houses



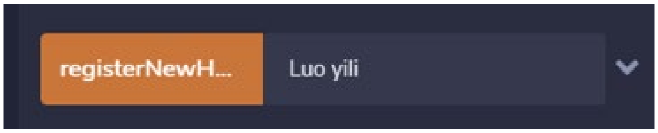
```
0:    uint256: 2
```

(ii) Enter "2" into the field beside the blue "houseList" button and click on the blue "houseList" button – you should see that house #2 is registered to "Owner 2"



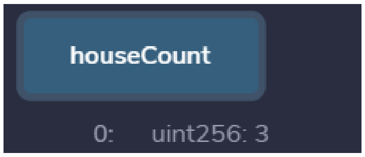
```
0:    uint256: houseNo 2
1:    string: owner Owner 2
```

(iii) Enter <your name> into the field beside the orange “registerNewHouse” button and click on the orange “registerNewHouse” button - a new house will be registered to your name.



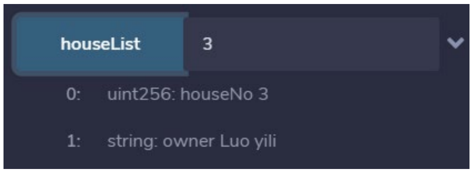
Luo yili

(iv) Click on the blue “houseCount” button – you should see that there are 3 houses registered in the blockchain now



```
0:    uint256: 3
```

(v) Enter “3” into the field beside the blue “houseList” button and click on the blue “houseList” button – you should see that house #3 is registered to your name



3

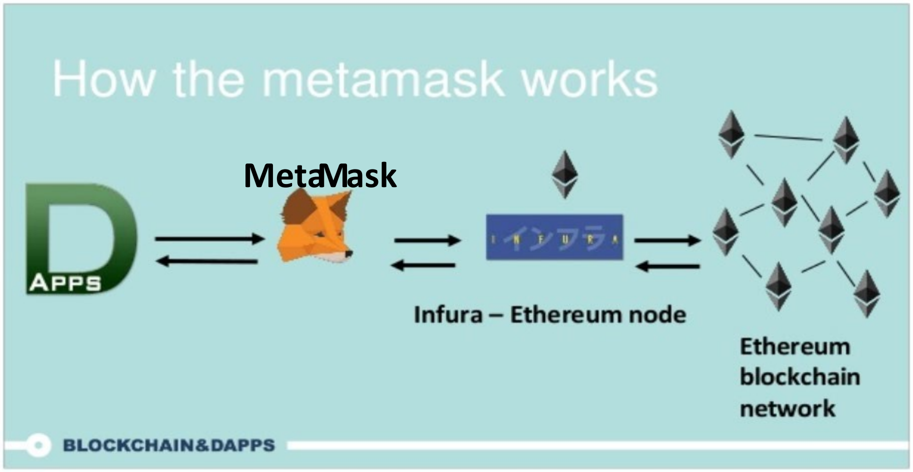
```
0:    uint256: houseNo 3
1:    string: owner Luo yili
```

Part 2: Installation of MetaMask

MetaMask is an Ether cryptocurrency wallet.

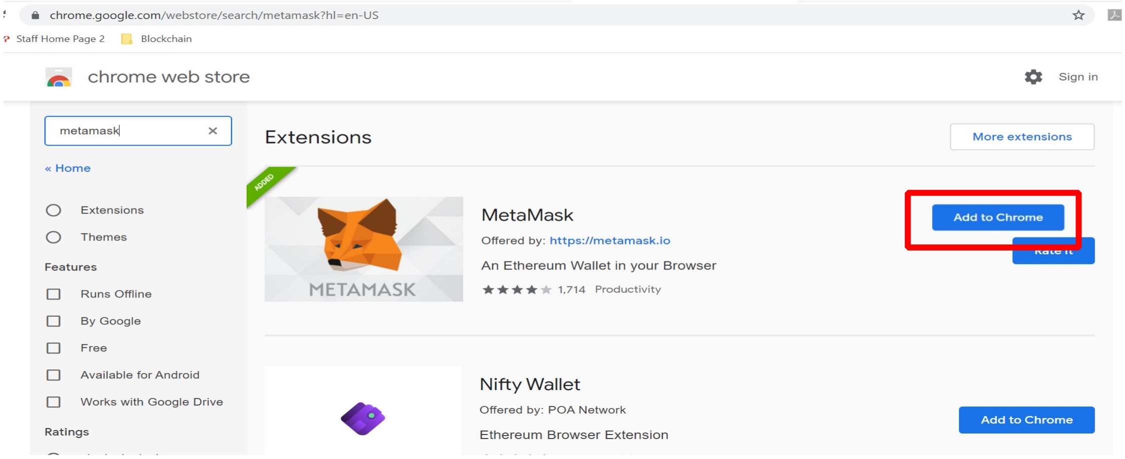
It is available as a browser extension (for Chrome, Firefox & Opera), allowing web applications to interact with the Ethereum blockchain without the need to run an Ethereum node. MetaMask talks to the Ethereum blockchain for your web application.

We will be using MetaMask to help deploy our smart contract onto the Ethereum (test) blockchain and to communicate between our web application and smart contract.



How the metamask works

1. Look for the **MetaMask** extension in the Chrome web store & click on **Add to Chrome**.



chrome.google.com/webstore/search/metamask?hl=en-US

Staff Home Page 2 Blockchain

chrome web store Sign in

metamask

« Home

○ Extensions
○ Themes

Features

□ Runs Offline
□ By Google
□ Free
□ Available for Android
□ Works with Google Drive

Ratings

Extensions More extensions

ADDED

METAMASK

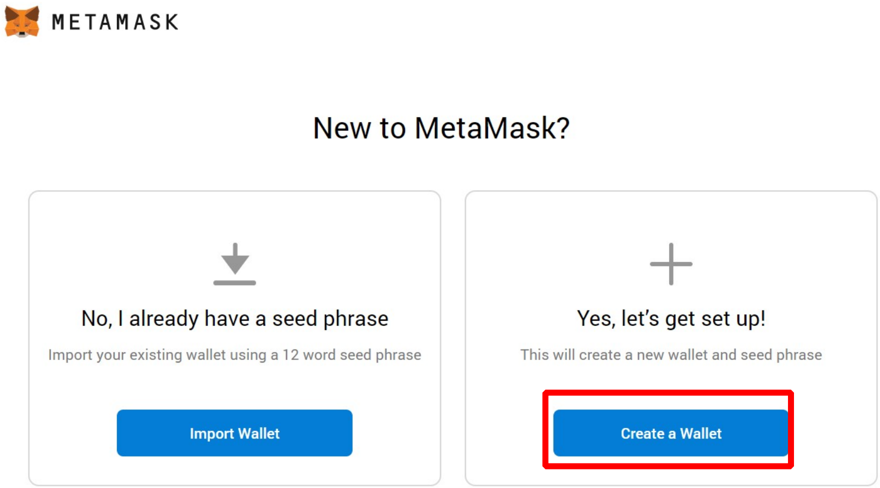
MetaMask
Offered by: https://metamask.io
An Ethereum Wallet in your Browser
★★★★★ 1,714 Productivity

Add to Chrome
Rate It

Nifty Wallet
Offered by: POA Network
Ethereum Browser Extension

Add to Chrome

2. Select **Create a Wallet**.



New to MetaMask?

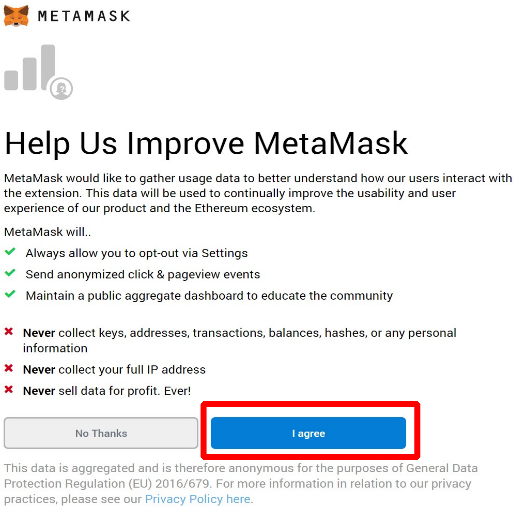
No, I already have a seed phrase

Import your existing wallet using a 12 word seed phrase

Yes, let's get set up!

This will create a new wallet and seed phrase

3. Click on **I agree**



Help Us Improve MetaMask

MetaMask would like to gather usage data to better understand how our users interact with the extension. This data will be used to continually improve the usability and user experience of our product and the Ethereum ecosystem.

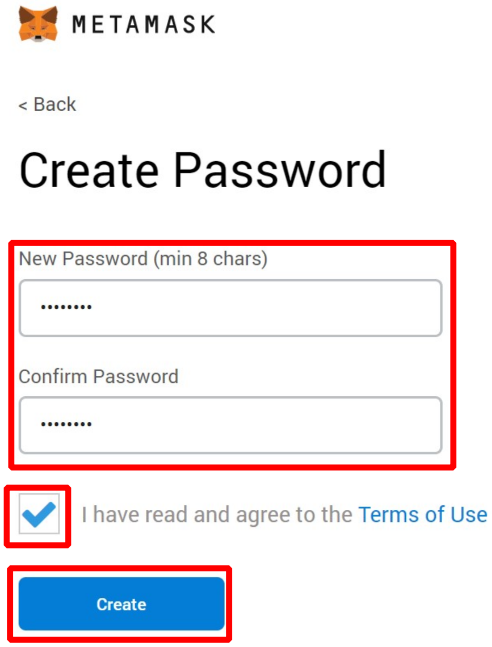
MetaMask will..

- ✓ Always allow you to opt-out via Settings
- ✓ Send anonymized click & pageview events
- ✓ Maintain a public aggregate dashboard to educate the community

- ✗ **Never** collect keys, addresses, transactions, balances, hashes, or any personal information
- ✗ **Never** collect your full IP address
- ✗ **Never** sell data for profit. Ever!

This data is aggregated and is therefore anonymous for the purposes of General Data Protection Regulation (EU) 2016/679. For more information in relation to our privacy practices, please see our Privacy Policy here.

4. Enter your own password, check the Terms of Use checkbox, and click on **Create**. Please DO NOT forget your password.



METAMASK

< Back

Create Password

New Password (min 8 chars)

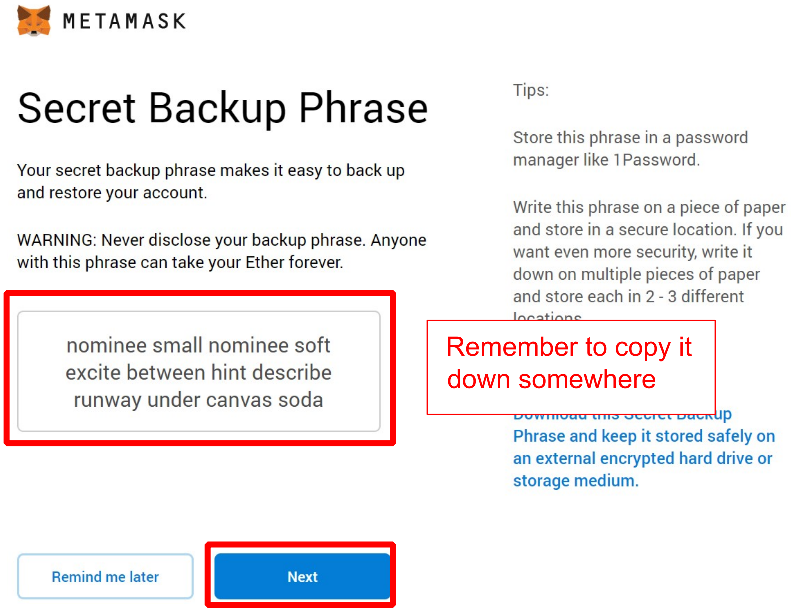
••••••••

Confirm Password

••••••••

☑ I have read and agree to the Terms of Use

5. You will be given a random secret backup phrase. **Make sure to copy the backup phrase in a place where you can remember** as it is the only way which you can restore your account back if you forget your password. Then clicking **Next.**



METAMASK

Secret Backup Phrase

Your secret backup phrase makes it easy to back up and restore your account.

WARNING: Never disclose your backup phrase. Anyone with this phrase can take your Ether forever.

nominee small nominee soft excite between hint describe runway under canvas soda

Tips:

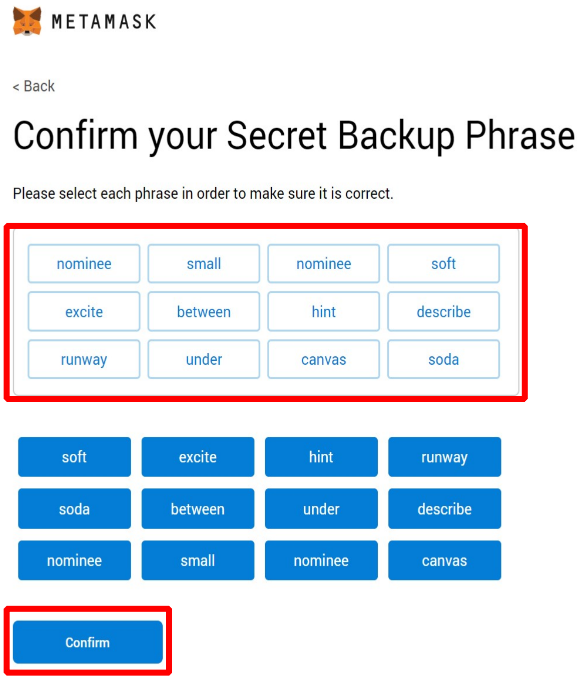
Store this phrase in a password manager like 1Password.

Write this phrase on a piece of paper and store in a secure location. If you want even more security, write it down on multiple pieces of paper and store each in 2 - 3 different locations.

Remember to copy it down somewhere

Download this Secret Backup Phrase and keep it stored safely on an external encrypted hard drive or storage medium.

6. Enter your secret backup phrase and click **Confirm**.



METAMASK

< Back

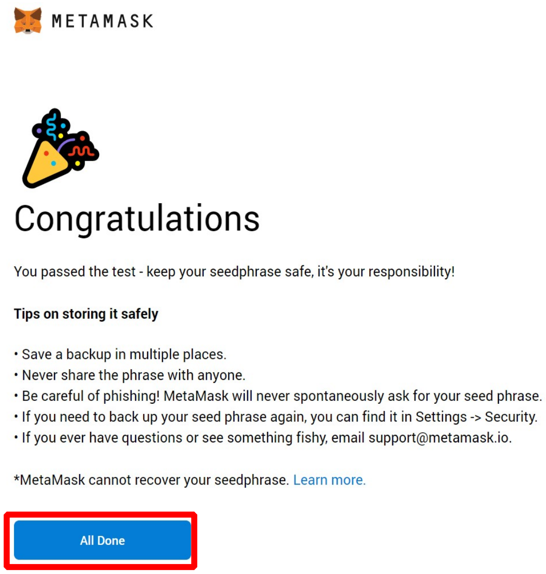
Confirm your Secret Backup Phrase

Please select each phrase in order to make sure it is correct.

nominee	small	nominee	soft
excite	between	hint	describe
runway	under	canvas	soda

soft	excite	hint	runway
soda	between	under	describe
nominee	small	nominee	canvas

7. Click **All Done**



METAMASK

Congratulations

You passed the test - keep your seedphrase safe, it's your responsibility!

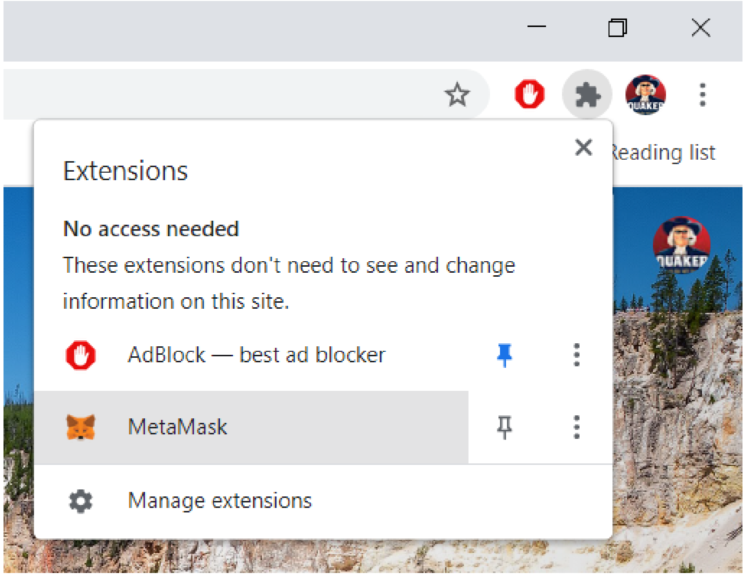
Tips on storing it safely

- Save a backup in multiple places.
- Never share the phrase with anyone.
- Be careful of phishing! MetaMask will never spontaneously ask for your seed phrase.
- If you need to back up your seed phrase again, you can find it in Settings -> Security.
- If you ever have questions or see something fishy, email support@metamask.io.

*MetaMask cannot recover your seedphrase. Learn more.

8. You should see a **fox** icon at the top of your chrome browser when the MetaMask extension has been successfully installed and account has been successfully created.

   If not, click on the **jigsaw** icon at the top-right hand corner of the window. MetaMask should appear on the dropdown menu.

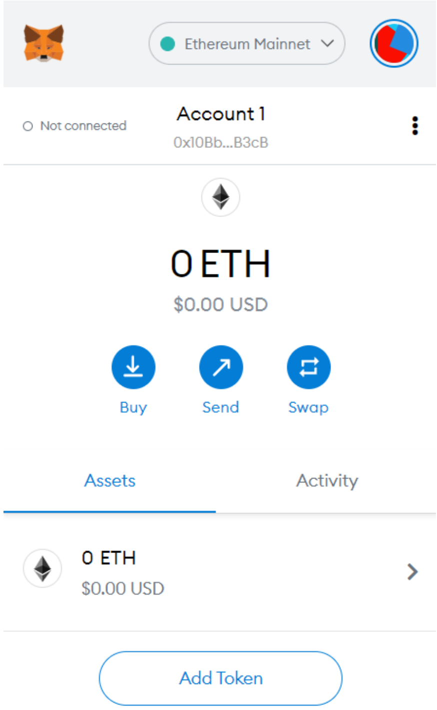


Extensions

No access needed

These extensions don't need to see and change information on this site.

   The MetaMask window should popup.



Not connected

Account 1

0x10Bb...B3cB

0 ETH

$0.00 USD

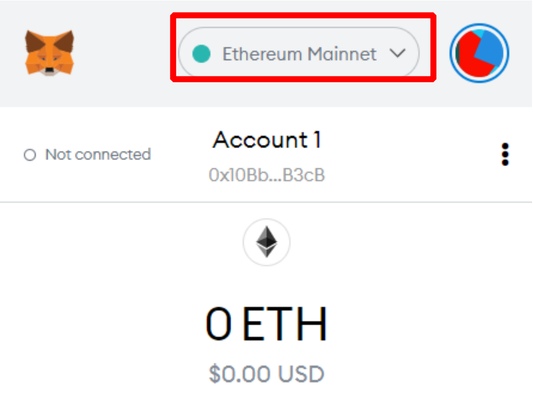
0 ETH

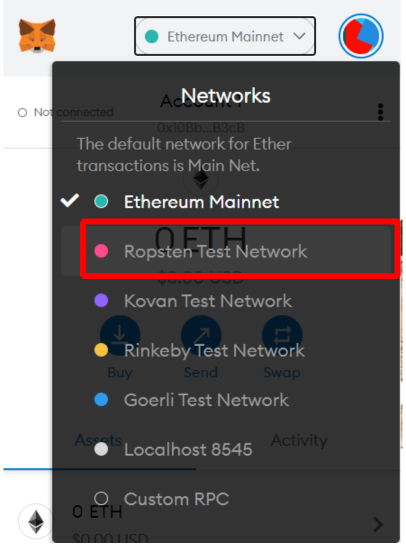
$0.00 USD

9. Click on the Main Ethereum Network dropdown.

   You should see the following networks available in your MetaMask wallet:
   - Ethereum Mainnet
   - Ropsten Test Network
   - Kovan Test Network
   - Rinkeby Test Network
   - Goerli Test Network

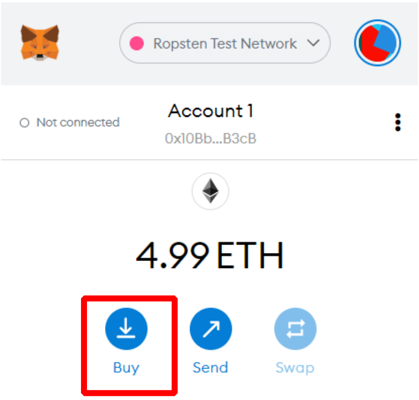
   Select **Ropsten Test Network**.

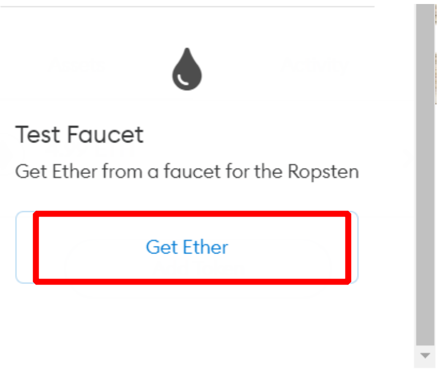




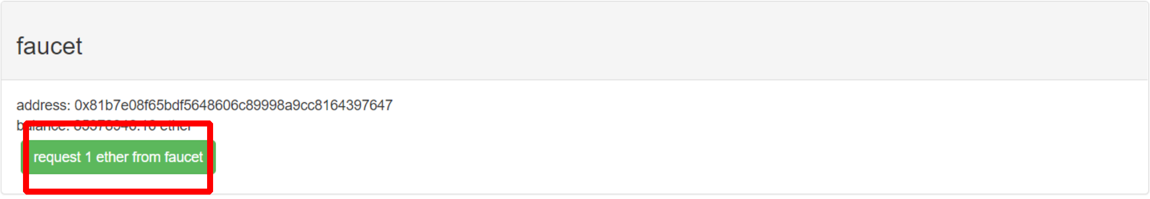
   The Main Ethereum Network, also known as Main Net, is the real Ethereum blockchain network. You will need real ether to deploy your smart contract and execute transactions on the Main Net. The rest are **Test** networks for testing purpose only, and the ethers of these networks have no real value

10. We will need to get some ETH to deploy our smart contract and execute transactions on the **Ropsten Test Network**. Click on **Buy**. Then at the bottom of the window, select **Get Ether**. (Note: If you face connection error getting the ether, you may look for other links at the bottom of this practical.)





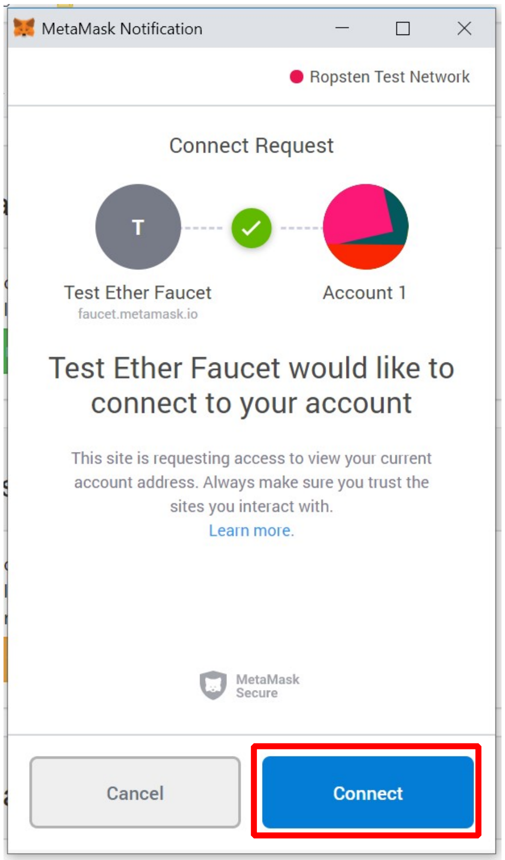
11. Select **request 1 ether from faucet**. (Note: If you face some issues trying to get the ether, you may look for other links at the bottom of this practical. This is just one of the links)



faucet

address: 0x81b7e08f65bdf5648606c89998a9cc8164397647
balance: 85376946.16 ether

12. Click on **Connect** (Note: Skip this step if you have problem doing step 10-11)



MetaMask Notification

Ropsten Test Network

Connect Request

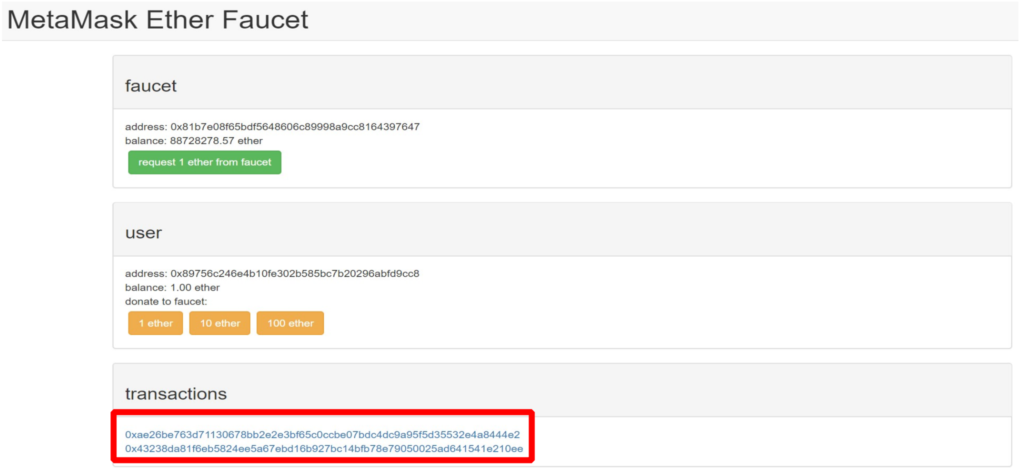
Test Ether Faucet
faucet.metamask.io

Account 1

Test Ether Faucet would like to connect to your account

This site is requesting access to view your current account address. Always make sure you trust the sites you interact with.
Learn more.

13. You should see transactions at the bottom of the page once the faucet has sent you the ether. (Note: If you receive errors, connect your laptop to a hotspot or any other Wi-Fi network other than the NYP's.)



MetaMask Ether Faucet

faucet

address: 0x81b7e08f65bdf5648606c89998a9cc8164397647
balance: 88728278.57 ether

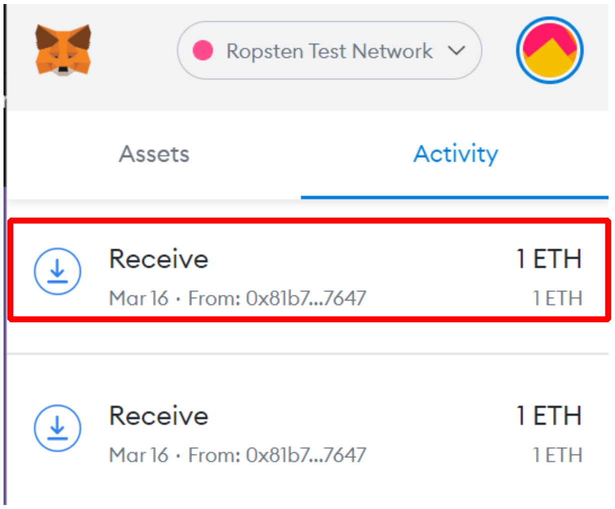
user

address: 0x89756c246e4b10fe302b585bc7b20296abfd9cc8
balance: 1.00 ether
donate to faucet:

transactions

0xae26be763d71130678bb2e2e3bf65c0ccbe07bdc4dc9a95f5d35532e4a8444e2
0x43238da81f6eb5824ee5a67ebd16b927bc14bfb78e79050025ad641541e210ee

Check your MetaMask Wallet to see if you have received the ETH.



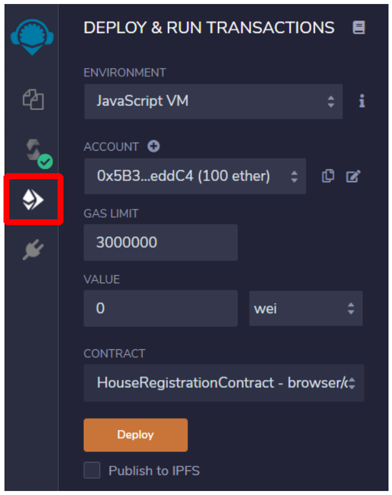
Receive 1 ETH
Mar 16 · From: 0x81b7...7647 1 ETH

Receive 1 ETH
Mar 16 · From: 0x81b7...7647 1 ETH

Part 3: Deploying the Smart Contract to Ethereum Test Blockchain via MetaMask

1. Click on the **diamond** icon to go to the **Deploy & Run Transactions** panel.

2. Change the environment **JavaScript VM to Injected Web3** from the dropdown menu. By selecting “Injected Web3”, you are deploying and running your smart contract in the real **Ethereum Test Blockchain**, hence you will need MetaMask and test Ethers to execute your transactions.



DEPLOY & RUN TRANSACTIONS

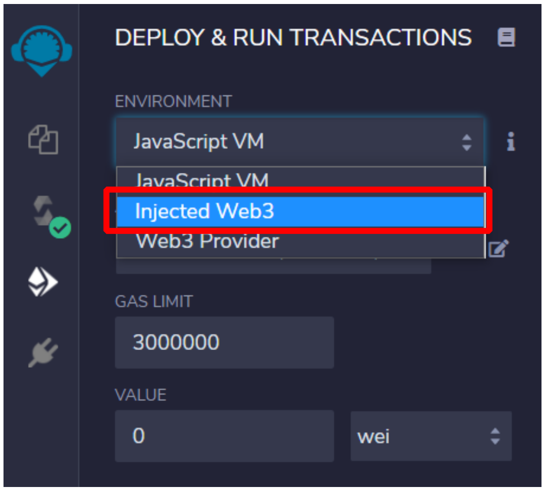
ENVIRONMENT: JavaScript VM

ACCOUNT: 0x5B3...eddC4 (100 ether)

GAS LIMIT: 3000000

VALUE: 0 wei

CONTRACT: HouseRegistrationContract - browser/c



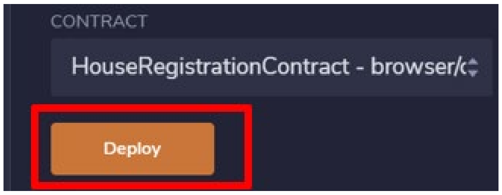
DEPLOY & RUN TRANSACTIONS

ENVIRONMENT: JavaScript VM

GAS LIMIT: 3000000

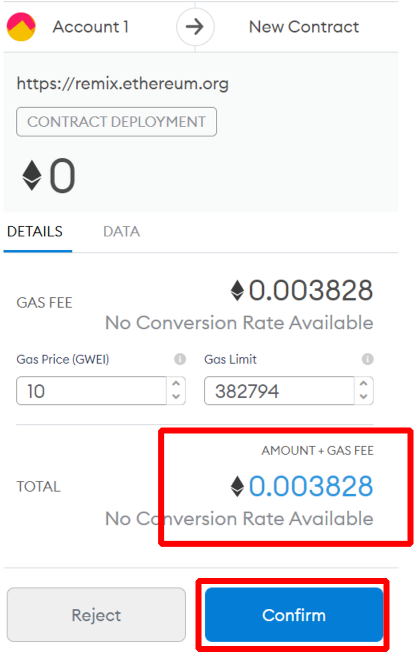
VALUE: 0 wei

3. Click on deploy



CONTRACT: HouseRegistrationContract - browser/c

4. Click on **confirm** once MetaMask has pop-up**.** (If you do not have enough Ether, request more from the faucet.)



Account 1 → New Contract

https://remix.ethereum.org

CONTRACT DEPLOYMENT

0

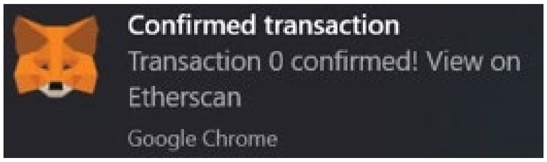
GAS FEE 0.003828
No Conversion Rate Available

Gas Price (GWEI): 10
Gas Limit: 382794

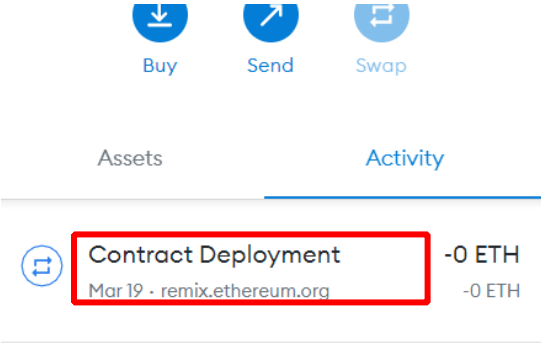
TOTAL
AMOUNT + GAS FEE
0.003828
No Conversion Rate Available

MetaMask will deploy the smart contract into the Ropsten for this amount of ETH/gas fee

5. MetaMask should soon prompt you on the confirmation of the transaction. Go to MetaMask wallet and you will be able to see the **Contract Deployment** under the **Activity** tab.

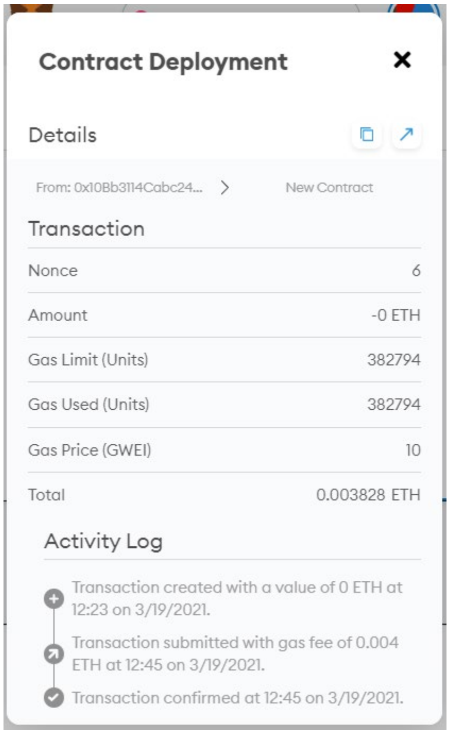


Confirmed transaction
Transaction 0 confirmed! View on Etherscan
Google Chrome



Contract Deployment -0 ETH
Mar 19 · remix.ethereum.org -0 ETH

6. Click on the **Contract Deployment** and it will show you that the smart contract has been deployed.



Contract Deployment

Details

From: 0x10Bb3114Cabc24... > New Contract

Transaction

Nonce	6
Amount	-0 ETH
Gas Limit (Units)	382794
Gas Used (Units)	382794
Gas Price (GWEI)	10
Total	0.003828 ETH

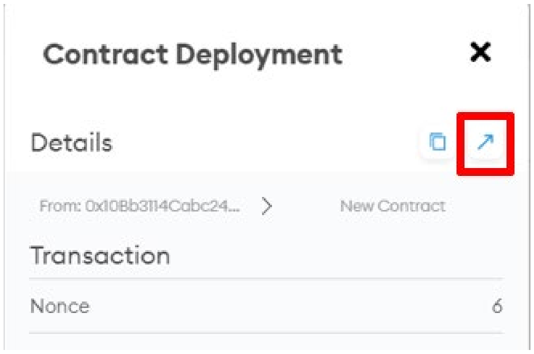
Activity Log

Transaction created with a value of 0 ETH at 12:23 on 3/19/2021.

Transaction submitted with gas fee of 0.004 ETH at 12:45 on 3/19/2021.

Transaction confirmed at 12:45 on 3/19/2021.

7. Click on the **arrow** in the contract Deployment which will direct you to **Etherscan** for more information on the transaction.



Contract Deployment

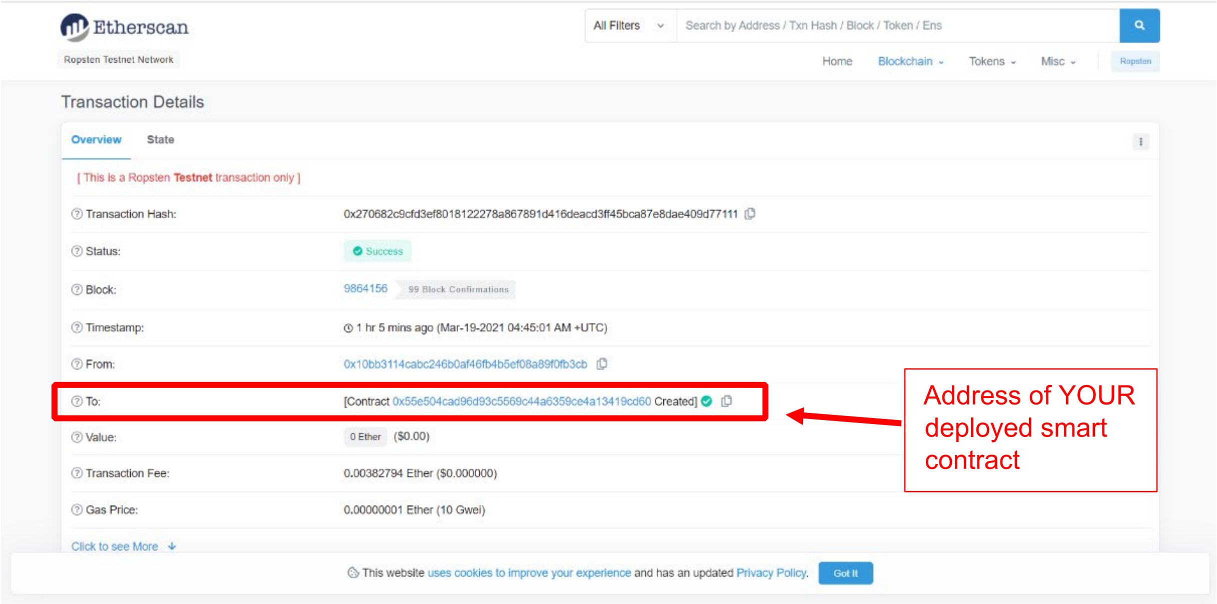
Details

From: 0x10Bb3114Cabc24... > New Contract

Transaction

Nonce	6

Highlighted below is the address of your **deployed smart contract**. (note: The address may take a while to show. Please be patient)



Transaction Details

[This is a Ropsten **Testnet** transaction only]

Transaction Hash:	0x270682c9cfd3ef8018122278a867891d416deacd3ff45bca87e8dae409d77111
Status:	Success
Block:	9864156 99 Block Confirmations
Timestamp:	1 hr 5 mins ago (Mar-19-2021 04:45:01 AM +UTC)
From:	0x10bb3114cabc246b0af46fb4b5ef08a89f0fb3cb
To:	[Contract 0x55e504cad96d93c5569c44a6359ce4a13419cd60 Created]
Value:	0 Ether ($0.00)
Transaction Fee:	0.00382794 Ether ($0.000000)
Gas Price:	0.00000001 Ether (10 Gwei)

Address of YOUR deployed smart contract

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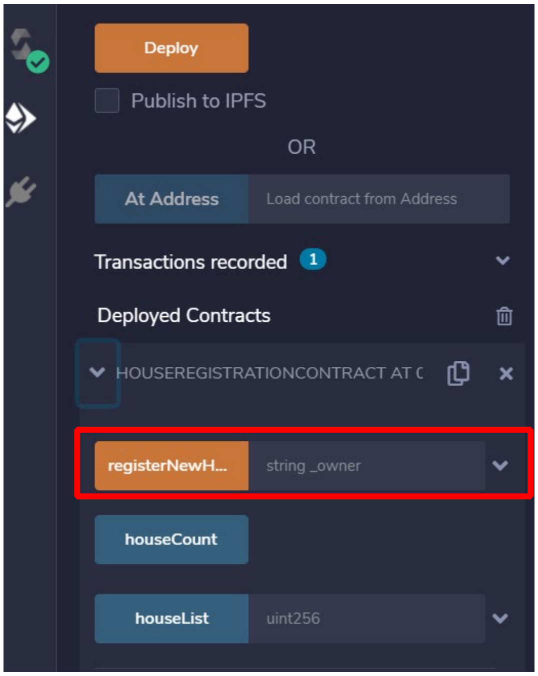
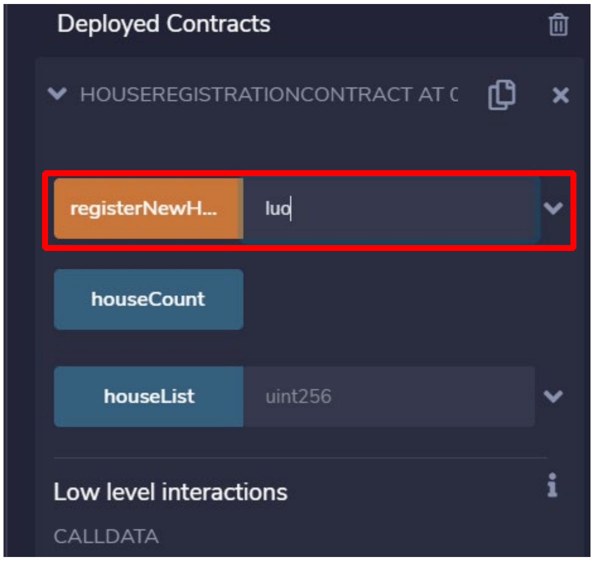
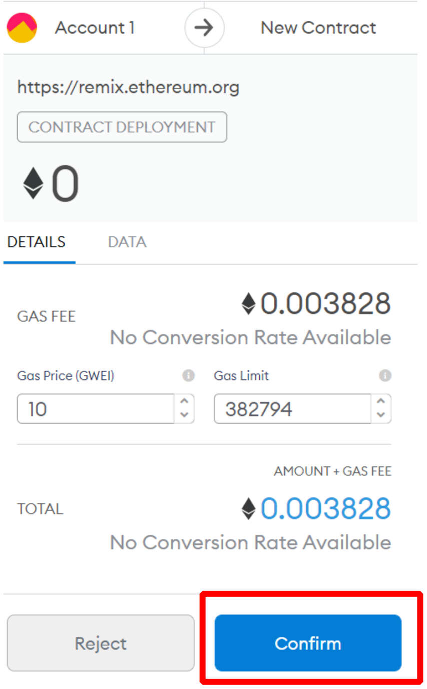
8. Under the **Deploy & Run Transaction** icon, you will be able to see the deployed contract. Click on the contract and you will be able to see the registerNewHouse function.



9. Enter your name next to the orange **registerNewHouse** button & click on orange registerNewHouse button.



10. Notice that MetaMask has popped up, click on confirm and wait for the transaction confirmation. (Note: transaction confirmation popup notification might take a while to show, please wait patiently).



Account 1 → New Contract

https://remix.ethereum.org

CONTRACT DEPLOYMENT

0

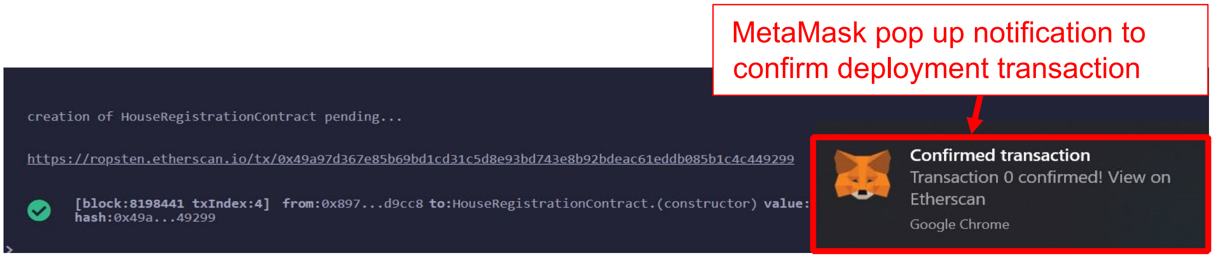
DETAILS DATA

GAS FEE 0.003828
No Conversion Rate Available

Gas Price (GWEI): 10
Gas Limit: 382794

AMOUNT + GAS FEE
TOTAL 0.003828
No Conversion Rate Available

MetaMask pop up notification to confirm deployment transaction



MetaMask pop up notification to confirm deployment transaction

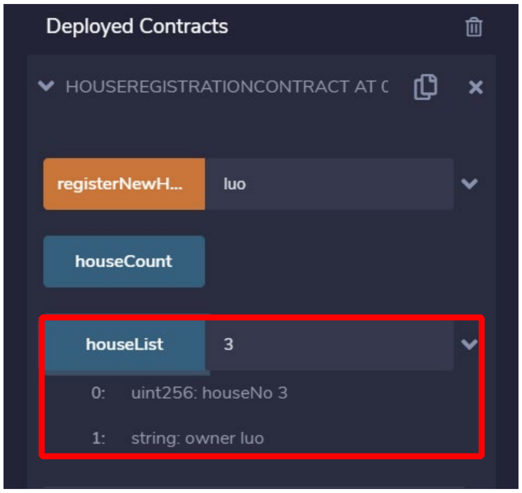
```
creation of HouseRegistrationContract pending...

https://ropsten.etherscan.io/tx/0x49a97d367e85b69bd1cd31c5d8e93bd743e8b92bdeac61eddb085b1c4c449299

✓  [block:8198441 txIndex:4]  from:0x897...d9cc8 to:HouseRegistrationContract.(constructor) value:
   hash:0x49a...49299
```

Confirmed transaction
Transaction 0 confirmed! View on Etherscan
Google Chrome

11. In the **Deploy & run transaction** panel, enter the number **3** next to the blue **houseList** button & click on it. Your name should appear as the house owner. Notice that MetaMask did not popup this time? This is because Ether is only required to execute "Write" transactions (i.e. the orange buttons) and not required for "Read" transactions (i.e. the blue buttons).

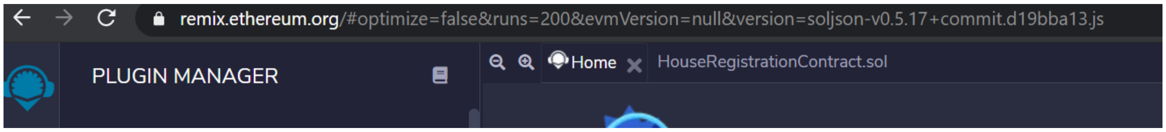


registerNewH... luo

houseList 3

```
0:   uint256: houseNo 3
1:   string: owner luo
```

12. **Bookmark/ copy & save the link** of your project to continue to work on it in the next practical.

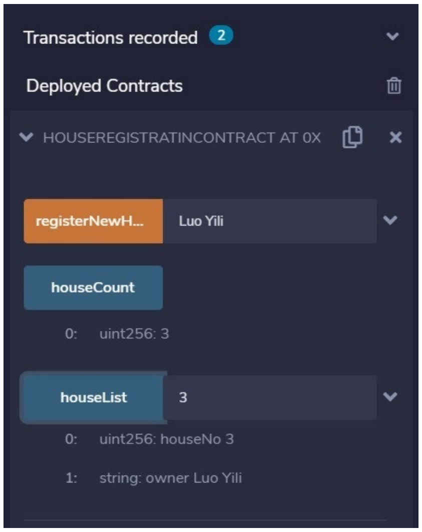


remix.ethereum.org/#optimize=false&runs=200&evmVersion=null&version=soljson-v0.5.17+commit.d19bba13.js

13. **Backup your codes**.

Create a folder **P05 Smart Contract** and create a text file using notepad inside the folder & name it **HouseRegistrationContract.txt**. Copy your HouseRegistrationContract.sol codes from Remix Ethereum and paste it into the notepad.

Capture a **screenshot of your transaction** in the Remix and save it into the "P05 Smart Contract" folder.



Transactions recorded 2

Deployed Contracts

HOUSEREGISTRATINCONTRACT AT 0X

registerNewH... Luo Yili

houseCount

0: uint256: 3

houseList 3

0: uint256: houseNo 3

1: string: owner Luo Yili

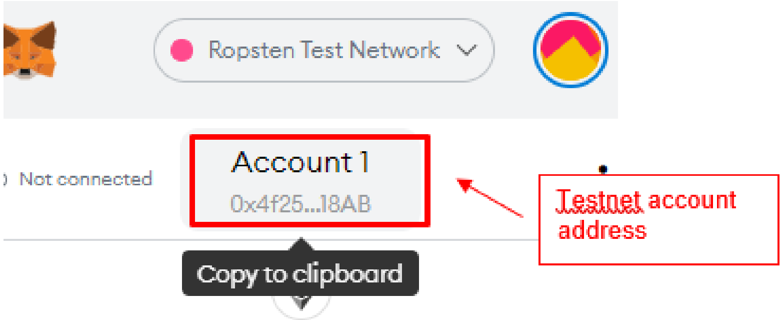
14. Zip up the **"P05 Smart Contract"** folder and **submit your zip folder to Blackboard.**

Additional Tips:

The following 2 links are another alternative Ropsten Ether Faucets links for you to request for ether: (Note: It may take some time for the ether to be added to your MetaMask account please be patient.)

- https://faucet.ropsten.be/
- https://faucet.dimensions.network/

To get the Ether from these 2 links you will need to enter **your MetaMask testnet account address,** which can be found in your MetaMask wallet app.



Testnet account address

~ End of Practical ~