2019 Workshop: Blockchain Programming: A Hands-on Tutorial
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Instructions for hands-on components: You can get the best out of this workshop if you prepare ahead and follow along as instructed in this document.

Introduction:

Blockchain is an emerging area with extraordinary interest from a wide variety of people and industries. There is a lot to learn. In this hands-on tutorial, we will cover enough to get you started on programming for the blockchain.

Learning outcomes:

On Completion of this workshop, you will be able to

(i) Design, code a Solidity smart contract for Ethereum blockchain and test the smart contract on Remix Web IDE (Integrated Development Environment)

(ii) Design and develop a Dapp (decentralized app) on Truffle IDE, deploy it on an Ethereum test chain and test it using a web interface and Metamask wallet.

******Preparation before the workshop:******

1. Copy the two Solidity code files from: https://buffalo.box.com/s/yl1ad5yqml-gugl0jfnlqhpvmwmt3vytu

   (Greeter.sol, Coin.sol) into your laptop. Save it in a location/directory where you can access it during the workshop.

2. Make sure you are able to access the Remix IDE: https://remix.ethereum.org

3. Download and install Virtual box on your laptop. https://www.virtualbox.org/wiki/Downloads

4. Download Virtual Machine image from this location: https://buf-falo.box.com/s/yl1ad5yqmlgugl0jfnlqhpvmwmt3vytu

5. Start the virtual box by double clicking on it. Import the virtual image you downloaded in Step 3. File→ import appliance…. If a pop-up appears with a request to update version of Virtual Box simply close X it. DO NOT update version.

We will work on the following steps during the workshop. Do NOT try them now.

Now we are all set to develop and deploy an Ethereum Blockchain based application using Truffle IDE. We will use “digital democracy” based ballot application. We will choose among 4 pet dogs --- whichever one is your choice.

Ballot Demo Instructions

1. Pre-requisite: You should have a Virtual box installed. Download the VM for the Ballot demo according to the instructions in the last page.
2. Double click on the VM image to import the image into virtual box.
3. Log in to the Ubuntu OS(**Password: Ubuntu**) and setup the Ganache server.
   a. Click the Ganache Icon in the quick launch bar. This will launch the Ganache test blockchain server. It will take few minutes. Be patient.
   b. Now in the Ganache application, select Quickstart option. This will start a local blockchain node.
4. Now we will work with truffle for compiling the smart contract for the ballot.sol and migrating it to the Ganache blockchain.
   a. Open a terminal and go to ballot directory in home directory.
   ```
   $cd ballot
   ```
   b. Navigate to ballot-contract
   ```
   $cd ballot-contract
   ```
   c. Compile the smart contract
   ```
   $truffle compile
   ```
   d. Deploy the compiled smart contract to Ganache
   ```
   $truffle migrate --reset
   ```
5. Now, we are ready to run the web application component of the Dapp. Navigate to ballot-app
   ```
   $cd ../ballot-app
   ```
6. Run the node server; We will use a Node.js server to host the web part of the Dapp.
   ```
   $npm start
   ```
7. Now open Chrome browser and do the following steps:

1) Select the metamask extension icon and select the network to be **http://127.0.0.1:7545** or if not available create a custom RPC with that URL.

   a. If not available follow these steps to create a custom RPC:

   b. In the interface, at the top right, you will see Main Network. Click the drop down arrow and select custom RPC.

   c. In the next interface that appears, enter http://localhost:7545 into the New RPC URL text field, click save.

2) Now, Select Import using account seed phrase and copy-paste the **mnemonic that you see at the top of the Ganache interface**. Set your password and create the account. See figure 1 and 2 for help.

3) (Be patient) Now you will see the Metamask interface for setting up the connection. Click on Import Existing Den at the bottom of the interface.

4) In the next screen, paste the seed words you copied, enter a new password, repeat the password. Then click OK button.

5) Click on left arrow to return to your Metamask wallet interface.

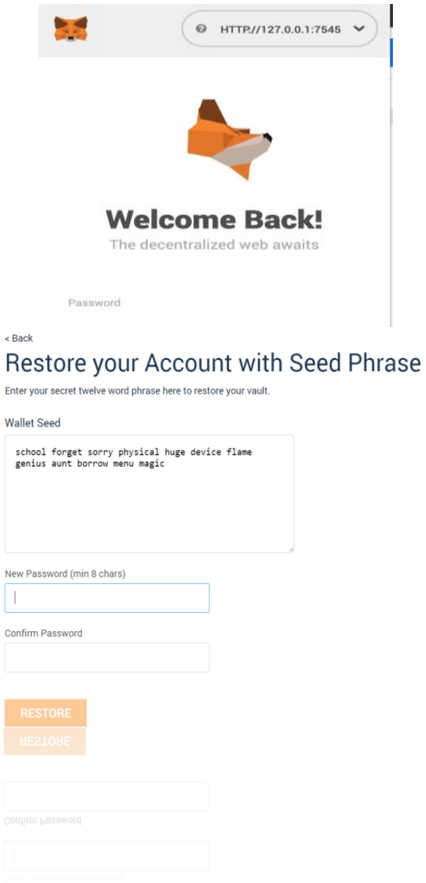
6) You will see Account 1, with 99.690 Ethers. Every account was given 100 Ethers, but part of account 1's was used up when deploying our smart contract.

7) Reset all accounts before you start so that they don't have any remnants from last run of the Metamask.

8) Now you are ready to test the complete Dapp. Type localhost:3000 to access the Ballot Dapp for the dogs.

9) Explore the various controls and displays on Metamask before you proceed. Interact and understand the working of a Dapp and the Dapp stack.

Figure 1 and 2: Metamask setup:



HTTP//127.0.0.1:7545

Welcome Back!

The decentralized web awaits

Password

< Back

Restore your Account with Seed Phrase

Enter your secret twelve word phrase here to restore your vault.

Wallet Seed

```
school forget sorry physical huge device flame
genius aunt borrow menu magic
```

New Password (min 8 chars)

Confirm Password