Course 1 Project

Create and Transact on Ethereum Private Blockchain

Introduction

Course 1 covered the basic blockchain concepts, structure, operational details, algorithms and techniques. We explored some of the blockchain concepts such as hashing and public-key cryptography in the quizzes associated with the module1, 2 and 3. In this course project, we will explore the following operations on a blockchain: create nodes on a private Ethereum blockchain, create accounts, unlock accounts, mine, transact, transfer Ethers, and check balances.

Approach

We have provided a virtual image (VM) that has a preinstalled Ethereum client (Go Language Ethereum – geth) and graphical user interface (GUI) to invoke the commands to accomplish project tasks. Please understand that this is not a simulation. You are actually working on local Ethereum nodes on your laptop/computing device. We have used a virtual image so that the project provides the same instructions irrespective of the computing systems that our diverse learners are working on. It does not require you to use command line interface (CLI) commands, since the commands are encoded as buttons. This lab provides quick and easy accessibility to the commands. If you are curious about the list of commands we used for this lab, it is provided at the end of this lab description.

Learning outcomes

Demonstrate that you can follow the steps to transact on a blockchain, with the concepts learned in the course such as:

- Account
- Account balance
- Node
- Peers
- Peer-to-peer transaction
- Genesis block
- Ethers
- Mining
- Interacting with a private blockchain

Project Implementation details: What to do?

In this project, you will deploy an Ethereum test blockchain with two nodes and transact between them. We will do it in two steps, (1) setting up the environment and (2) working with the blockchain provided in Part 1 and Part 2. **Read all instructions below before you begin the project.**

1. **Part 1 – Setting Up the Environment**
   Please refer to environment setup file provided in Step 1 of the Instructions tab. Follow the instructions to setup and get started. DO NOT miss this step. This document also has troubleshooting tips in case you run into problems.

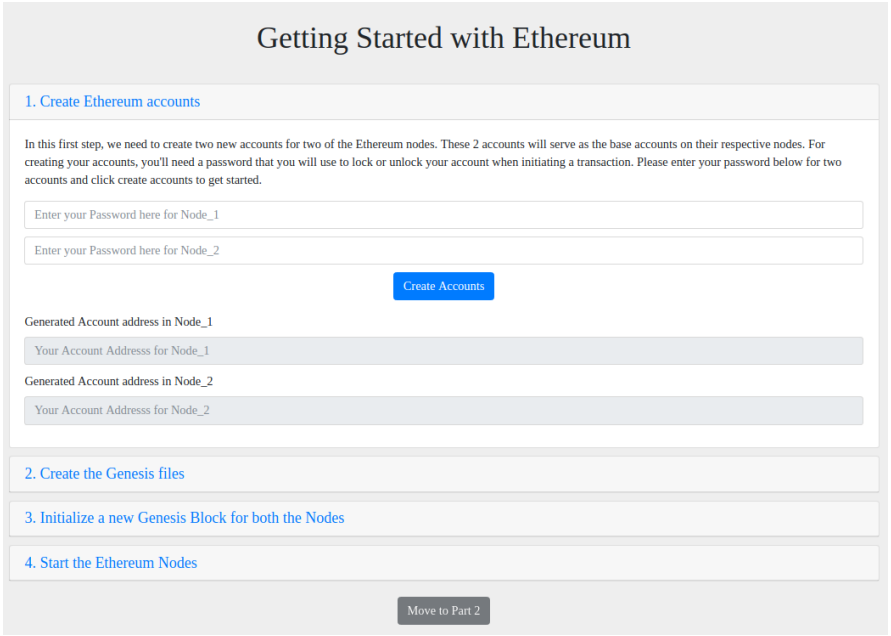
   (You might have already done this before reading this document)

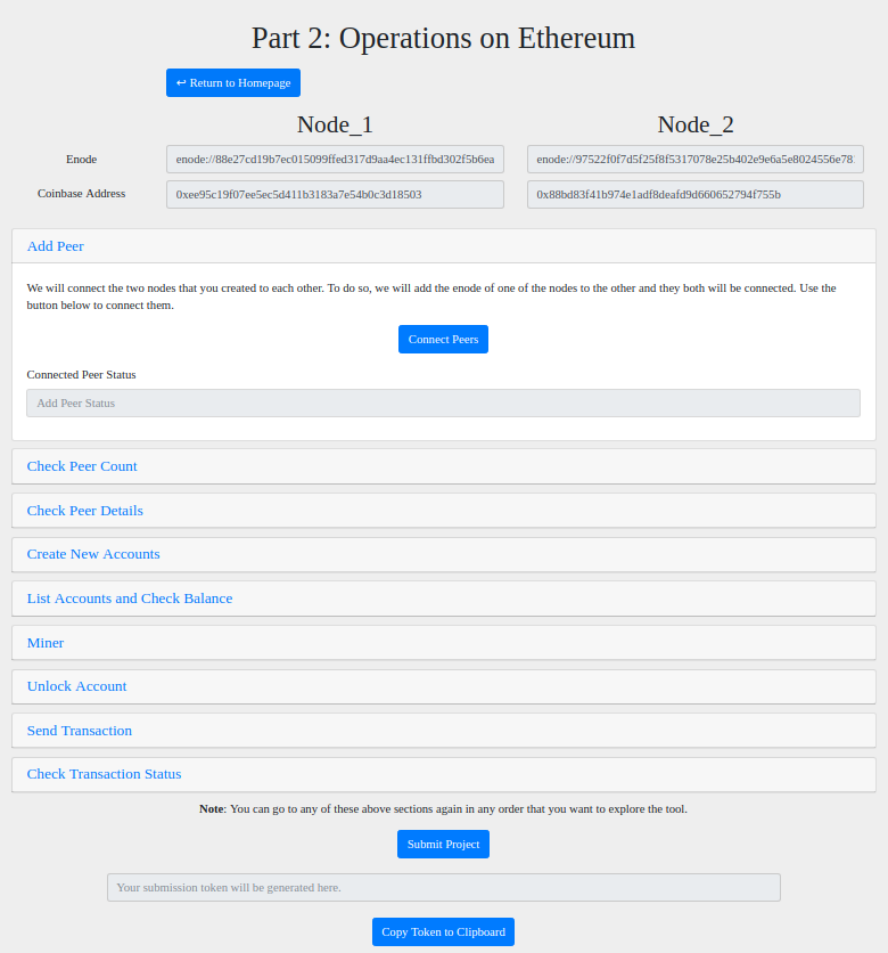
2. **Part 2 – Initializing and Starting the Ethereum Nodes**
   If you successfully completed the previous step, you will see a web interface with brief instructions in each step. You can complete the exercise by reading through the instructions provided on the web interface. **After reading the notes below, complete all the steps indicated.**

   Notes:

   - **What are we doing in Part 2?**
     - Creating two nodes
     - Connecting them as peers
     - Checking peer details
     - Creating multiple accounts
     - Checking their starting balances to be 0
     - Starting a miner adds (miner fees/rewards) to the balance of the coinbase account of the miner node
     - Transacting between the account with the balance (first node) to ANY other account in the first or second node.
     - You also learn the need to unlock the accounts before transactions and the ability to examine the status of the transaction (pending, completed, etc.)

     These steps are shown in the screenshots below:





- **Passwords for the nodes**
  Use simple passwords! (ex. “b” for Node1 and “c” for Node2) so you’ll remember them when you need to unlock the accounts.
  If you forget the passwords, you will have to redo the steps to create the accounts all over again.
  Of course, in a production blockchain, you will have to use strong passwords that others will not be able to guess.

- **Read the instructions and explanations at each step of the interface**
  - You need to click on the buttons in each of the steps to execute the operations. Learn as you go.
  - Associate the steps you are executing with lessons in the videos. Execution of each operation takes some time depending on the resources (such as RAM memory) on your computer.
  - Be patient. **Pay attention to the notifications requesting you to wait until each operation is completed.**

- We have allocated an arbitrarily long/generous duration of time for each operation to complete. This is to accommodate any computation power variances of learners.

- **If your interaction stalls for some reason, do not hesitate to go back and restart!** There are many options for restarting (partial or full from the beginning). Grading is based on the steps you complete, and NOT how many times you restarted. (Refer to the troubleshooting tips in case you run into any issues).

- **Observations:**
  - Enode values,
  - Address[0] or coinbase addresses of accounts
  - Peer details in JSON format
  - Creation of accounts in a single node
  - Miner operations
  - The genesis block is the first block of a blockchain
  - DAG (directed acyclic graph) generation when a miner is started
    - Process is need for memory based on Proof of Work consensus in Ethereum.

- **Starting and Stopping the Miner**
  In this project, there is only one miner started on the first node. Do not stop the miner until you complete the transactions. Recall from the lesson a miner is needed to confirm your transactions. The transactions will never be confirmed if you do not have a miner running.

- **Grading and Submission**
  - We are using auto-grading for your project.
  - You are assessed for the steps you completed.
  - The grade does NOT depend on the number of attempts.
  - The grade does NOT depend on the time you took to complete the project.
  - When you complete the project, you will get a unique hash based on the steps you completed. Please submit that to the Coursera learning system as directed to get a grade.
  - **Save the hash generated into a text (.txt) file and submit this file**.
  - You will get an error if you simply submit the hash.
  - See this link if you need help: https://learner.coursera.help/hc/en-us/articles/209818753

- **Exploring Beyond**
  This project is always available for you to explore and learn. Do not hesitate to explore further and try different transactions. We have provided only one miner. You can always restart the VM and try out various operations including CLI (command line interface) commands given at the end of this document. The same VM will be used in Course 3 for the development of a Decentralized Application or Dapp.

- **Summary**
  In this exercise, you got a feel for setting up your own Ethereum client and working on some basic operations.
  We strongly encourage using the Online Discussions to discuss the project with other students and to resolve any problems you may face.
  In the next two courses, you will get to design and develop applications for the Ethereum blockchain.

Extra Material

*In this project, we have already installed **geth** in the virtual appliance provided to you.* To make things easier, we have provided a web interface to help you out in interacting with the geth instance running in the backend. If you are curious here are commands behind those buttons you clicked. We will learn more details about geth commands and the supporting APIs in Course 3.

1. **Create new Accounts:**
   geth account new --datadir ~/Node_1 and geth account new --datadir ~/Node_2
2. **Initialize Genesis File:**
   geth init customGenesis.json --datadir ~/Node_1 and geth init customGenesis.json --datadir ~/Node_2
3. **Start Geth**:
   a. NODE_1:
      geth --datadir ~/Node_1 --maxpeers 95 --networkid 13 --nodiscover --rpc --rpccorsdomain "*" --port 30301 --rpcport 8544 --rpcapi="txpool,db,eth,net,web3,personal,admin,miner"
   b. NODE_2:
      geth --datadir ~/Node_2 --maxpeers 95 --networkid 13 --nodiscover --rpc --rpccorsdomain "*" --port 30302 --rpcport 8545 --rpcapi="txpool,db,eth,net,web3,personal,admin,miner"

4. **Connect Peers:** admin.addPeer(<eNode of the other node>);
5. **Peer Count:** net.peerCount
6. **Peer Details:** admin.peers
7. **Create New Accounts:** personal.newAccount(<password>)
8. **List accounts:** eth.accounts
9. **Check Balance:** eth.getBalance(<account>)
10. **Start Miner:** miner.start(4)
11. **Stop Miner:** miner.stop()
12. **Unlock Accounts:** personal.unlockAccount(<address>,<password>,<duration in sec>)
13. **Send Transaction:** eth.sendTransaction({from:<address>, to:<address> , value: <value>})
14. **Check Transaction Status:** txpool.status