# Lab 8: Bitcoin and Blockchain

## 1 Details

Aim: To provide a foundation in understanding in Bitcoin and Blockchain.

**At the end of this lab, remember to stop your Blockchain (Control-C from the console that is running Geth), and shut down your VM. You may also want to use “rm -r mynapier” in order to delete your blockchain.**

**Demo of setting up Geth:** https://youtu.be/Gl3Suylr-7E

## Activities

**L1.1** Using blockchain.info, find the details of the genesis block:

**Date created:**

**Reward:**

**Number of transactions:**

**Size of block:**

**Which account received the mining reward for the genesis block (last four digits):**

**How many USD does the original miner have in the account they used for the first genesis record:**

**When did the genesis block creator stop trading?**

**L1.2** Using blockchain.info, determine the following

**Total bitcoins in circulation:**

**Most recent hash block (last four hex digits):**

**Block reward per block:**

**Difficulty:**

**Average time between blocks:**

**Market capitalisation (USD):**

**24 hr price (USD):**

**24hr transactions (USD):**

**Hash rate:**

**Last successful miner:**

**Maximum block size:**

**Balance for 1GbVUSW5WJmRCpaCJ4hanUny77oDaWW4to:**

**L1.3** Download and create the Python file defined on this page:

<https://asecuritysite.com/encryption/bit>

Now run the Python file, and compare the results in L.1.2.

**Total bitcoins in circulation:**

**Most recent hash block (last four hex digits):**

**Block reward per block:**

**Difficulty:**

**Average time between blocks:**

**Market capitalisation (USD):**

**24 hr price (USD):**

**24hr transactions (USD):**

**Hash rate:**

**Balance for 1GbVUSW5WJmRCpaCJ4hanUny77oDaWW4to:**

## C Ethereum

In this tutorial, we will run an Ethereum blockchain on your Ubuntu host:

Demo: <https://www.youtube.com/watch?v=Gl3Suylr-7E>

Outline: <https://asecuritysite.com/subjects/chapter91>

On your Ubuntu computer, install Geth:

sudo apt-get install software-properties-common

sudo add-apt-repository -y ppa:ethereum/Ethereum

sudu apt-get update

sudo apt-get install ethereum

We are going to create the blockchain in the **mynapier** folder. First create **three new accounts**:

napier@napier-virtual-machine:~$ **sudo geth --datadir=mynapier account new**

WARN [03-20|22:24:56.282] Sanitizing cache to Go's GC limits provided=1024 updated=666

INFO [03-20|22:24:56.284] Maximum peer count ETH=25 LES=0 total=25

Passphrase: **Qwerty1**

Address: {**39a18a459b2475925e3014679707e4970a6a836d**}

napier@napier-virtual-machine:~$ **sudo geth --datadir=mynapier account new**

WARN [03-20|22:25:12.291] Sanitizing cache to Go's GC limits provided=1024 updated=666

INFO [03-20|22:25:12.293] Maximum peer count ETH=25 LES=0 total=25

Passphrase: **Qwerty1**

Address: {**3a5b61aeb069dc7df1b8f1b58e883118ea8bef3f**}

napier@napier-virtual-machine:~$ sudo geth --datadir=mynapier account new

WARN [03-20|22:25:46.518] Sanitizing cache to Go's GC limits provided=1024 updated=666

INFO [03-20|22:25:46.521] Maximum peer count ETH=25 LES=0 total=25

Passphrase: **Qwerty1**

Address: {**a2cda8c68259cc314bd12b67873ce7380b3dc496**}

Open custom.json, and copy and paste the following details for your genesis block, but **replace the hex IDs with the three accounts that you have created**:

{

"config": {

"chainId": 15,

"homesteadBlock": 0,

"eip150Block": 0,

"eip158Block": 0

},

"difficulty": "1",

"gasLimit": "0x3d0900",

"alloc": {

"**39a18a459b2475925e3014679707e4970a6a836d**": { "balance": "30000000" },

"**3a5b61aeb069dc7df1b8f1b58e883118ea8bef3f**": { "balance": "40000000" },

"**a2cda8c68259cc314bd12b67873ce7380b3dc496**": { "balance": "0x400000000000000" }

}

}

Next run **geth** and create the genesis block details:

napier@napier-virtual-machine:~$ **geth –-nousb --datadir=mynapier init custom.json**

WARN [03-20|20:53:53.824] Sanitizing cache to Go's GC limits provided=1024 updated=666

INFO [03-20|20:53:53.832] Maximum peer count ETH=25 LES=0 total=25

INFO [03-20|20:53:53.834] Allocated cache and file handles database=/home/napier/mynapier/geth/chaindata cache=16 handles=16

INFO [03-20|20:53:53.868] Writing custom genesis block

INFO [03-20|20:53:53.869] Persisted trie from memory database nodes=4 size=580.00B time=289.527µs gcnodes=0 gcsize=0.00B gctime=0s livenodes=1 livesize=0.00B

INFO [03-20|20:53:53.870] Successfully wrote genesis state database=chaindata hash=6061cd…6972ac

INFO [03-20|20:53:53.870] Allocated cache and file handles database=/home/napier/mynapier/geth/lightchaindata cache=16 handles=16

INFO [03-20|20:53:53.915] Writing custom genesis block

INFO [03-20|20:53:53.916] Persisted trie from memory database nodes=4 size=580.00B time=161.337µs gcnodes=0 gcsize=0.00B gctime=0s livenodes=1 livesize=0.00B

INFO [03-20|20:53:53.916] Successfully wrote genesis state database=lightchaindata hash=6061cd…6972ac

We have now created wallets and the genesis block in the mynapier folder. Examine the **mynapier** folder.

What are the contents of this folder:

How are the keys stored:

Note: You may have to use “chmod 777 mynapier” to allow access to the folder.

Next we will start our blockchain:

napier@napier-virtual-machine:~$ **geth --datadir=mynapier –-networkid=15**

WARN [03-20|20:54:31.161] Sanitizing cache to Go's GC limits provided=1024 updated=666

INFO [03-20|20:54:31.168] Maximum peer count ETH=25 LES=0 total=25

INFO [03-20|20:54:31.195] Starting peer-to-peer node instance=Geth/v1.8.23-stable-c9427004/linux-amd64/go1.10.4

INFO [03-20|20:54:31.195] Allocated cache and file handles database=/home/napier/mynapier/geth/chaindata cache=333 handles=524288

INFO [03-20|20:54:31.241] Initialised chain configuration config="{ChainID: 15 Homestead: 0 DAO: <nil> DAOSupport: false EIP150: <nil> EIP155: 0 EIP158: 0 Byzantium: <nil> Constantinople: <nil> ConstantinopleFix: <nil> Engine: unknown}"

INFO [03-20|20:54:31.241] Disk storage enabled for ethash caches dir**=/home/napier/mynapier/geth/ethash** count=3

INFO [03-20|20:54:31.241] Disk storage enabled for ethash DAGs dir=/home/napier/.ethash count=2

INFO [03-20|20:54:31.242] Initialising Ethereum protocol versions="[63 62]" network=1

INFO [03-20|20:54:31.497] Loaded most recent local header

Next open up another console, and we will connect to geth and create a new account:

napier@napier-virtual-machine:~$ **geth attach /home/napier/mynapier/geth.ipc**

WARN [03-20|20:54:56.172] Sanitizing cache to Go's GC limits provided=1024 updated=666

Welcome to the Geth JavaScript console!

instance: Geth/v1.8.23-stable-c9427004/linux-amd64/go1.10.4

coinbase: 0xa09243e009a8e6b7e13edaf876ebb138656d9b9d

at block: 0 (Thu, 01 Jan 1970 01:00:00 BST)

datadir: **/home/napier/mynapier**

modules: admin:1.0 debug:1.0 eth:1.0 ethash:1.0 miner:1.0 net:1.0 personal:1.0 rpc:1.0 txpool:1.0 web3:1.0

> **personal.newAccount("Qwerty1")**

" 0xd739a090f842be4f178c6727a68324d6c7608d71"

> **web3.eth.accounts**

["0x39a18a459b2475925e3014679707e4970a6a836d",

"0x3a5b61aeb069dc7df1b8f1b58e883118ea8bef3f”, ",   
"0x617fc4cd56a938f28b02417088f587c1fb4e7ae4",   
"0xd739a090f842be4f178c6727a68324d6c7608d71"]

We can see we now have four account (three created from the genesis block, and which have some cryptocurrency, and a new one). Take a note of your new account ID (just first four hex characters):

We can look at the initial balances in the accounts (use the hex values contained in the accounts). For the following, view of all the account balances (replace the hex IDs with the ones on your system):

> **eth.getBalance("0xd739a090f842be4f178c6727a68324d6c7608d71")**

0

**> eth.getBalance("**0x617fc4cd56a938f28b02417088f587c1fb4e7ae4**")**

30000000

What are the balances in each account:

Next unlock the account with the most Ether:

> **personal.unlockAccount("**0x617fc4cd56a938f28b02417088f587c1fb4e7ae4**")**

Unlock account 0xd739a090f842be4f178c6727a68324d6c7608d71

Passphrase: **Qwerty1**

true

Note you can also use:

**personal.unlockAccount("**0x617fc4cd56a938f28b02417088f587c1fb4e7ae4**","Qwerty1")**

Next we can transfer some cryptocurrency from one account to another. For this, transfer Ether from the account with most funds into your newly created account, and then view the transaction:

> **eth.sendTransaction({from: '0x617fc4cd5602417088f587c1fb4e7ae4a938f28b', to:' 0xd739a090f842be4f178c6727a68324d6c7608d71,value:1000})**

"0x7b37132db152ab7382eb3e580195c1f1b961fee3e1ffbc64bf7a033336b9e2af"

> **eth.getTransaction('0x7b37132db152ab7382eb3e580195c1f1b961fee3e1ffbc64bf7a033336b9e2af')**

{

blockHash: "0x0000000000000000000000000000000000000000000000000000000000000000",

blockNumber: null,

from: "0x617fc4cd56a938f28b02417088f587c1fb4e7ae4",

gas: 90000,

gasPrice: 1000000000,

hash: "0x7b37132db152ab7382eb3e580195c1f1b961fee3e1ffbc64bf7a033336b9e2af",

input: "0x",

nonce: 0,

r: "0xc9c1cece4aff8143c09be07dfcff600f657bb561e5d8034dbec692ec5554894e",

s: "0x721f63984441c4eea870383ed8784d3475f32b740e84ad07ba0e795d5d2aead5",

to: "0xd4499406c13f0c8601927cfaecb325c5ae2cac6a",

transactionIndex: 0,

v: "0x41",

value: 1000

}

What are *r*, *s*, *gas*, and *gasprice*:

If we look at the balances there has not been any transfers:

> **eth.getBalance("0x617fc4cd5602417088f587c1fb4e7ae4a938f28b ")**

288230376151711744

> **eth.getBalance("0xd739a090f842be4f178c6727a68324d6c7608d71")**

0

This is because the miners have not started yet. We can now start the miner and view the balances:

> **miner.start()**

null

> **eth.getBalance("0x617fc4cd5602417088f587c1fb4e7ae4a938f28b")**

288230376151711744

> **eth.getBalance("0xd739a090f842be4f178c6727a68324d6c7608d71")**

0

We can transfer again:

> **eth.sendTransaction({from: 0x617fc4cd5602417088f587c1fb4e7ae4a938f28b, to: '0xce1373ddfa2232dc9ca82d98420be7a2e11962b5',value:100000})**

"0x2e25093e25cbf511c2892cb38b45a5c9f6f9b2785774cd5830cf5bd978839165"

> **eth.getBalance("0xce1373ddfa2232dc9ca82d98420be7a2e11962b5")**

0

> **eth.getBalance("0x617fc4cd5602417088f587c1fb4e7ae4a938f28b")**

288230376151711744

The mining process adds some credits to the initial account:

> **eth.getBalance("0x617fc4cd5602417088f587c1fb4e7ae4a938f28b")**

5288230376151711744

> **eth.getBalance("0xce1373ddfa2232dc9ca82d98420be7a2e11962b5")**

0

After the mining process we see:

> eth.getBalance("**0xce1373ddfa2232dc9ca82d98420be7a2e11962b5**")

200000

If we look at the blockchain we see there are two blocks have been created:

> eth.blockNumber

2

What are the balances in the accounts:

What are the balances on the accounts?

How many blocks have been mined?

## D Creating a contract

Now let’s create a contract. First open up:

http://remix.ethereum.org/

and paste the following code:

pragma solidity >0.4.0;

contract test2{

uint a;

constructor () public {

a = 1;

}

function val() public returns(uint){

return a;

}

}

contract test3 is test2{

uint b = a++;

function show() public returns(uint){

return b;

}

}

We can compile the code (use the 0.5.0 compiler) and then click on Details, and get the Web3Deploy version (by clicking on Bytecode):



A sample is:

var test2Contract = web3.eth.contract([{"constant":false,"inputs":[],"name":"val","outputs":[{"name":"","type":"uint256"}],"payable":false,"stateMutability":"nonpayable","type":"function"},{"inputs":[],"payable":false,"stateMutability":"nonpayable","type":"constructor"}]);

var test2 = test2Contract.new(

{

from: web3.eth.accounts[0],

data: '0x60606040523415600e57600080fd5b6001600081905550609f806100246000396000f300606060405260043610603f576000357c0100000000000000000000000000000000000000000000000000000000900463ffffffff1680633c6bb436146044575b600080fd5b3415604e57600080fd5b6054606a565b6040518082815260200191505060405180910390f35b600080549050905600a165627a7a7230582062175dc4e9fcfe956cc06a92ee74103af0feae371ddeb5bb46c65f3f74140a0f0029',

gas: '4700000'

}, function (e, contract){

console.log(e, contract);

if (typeof contract.address !== 'undefined') {

console.log('Contract mined! address: ' + contract.address + ' transactionHash: ' + contract.transactionHash);

}

})

Now we copy from **Web Deploy** and place in a JavaScript file (sayhello.js), and then load it onto our blockchain:

> **loadScript(‘sayhello2.js’)**

and next define the account to run the script (replace with one of your IDs):

> **web3.eth.defaultAccount = '0x821eacc2a570c1aeb9b5aa64b5b915d4c1e1f3ee'**

We can now start our miners:

> miner.start()

null

> null [object Object]

Contract mined! address: 0x8d487f4a719b5a1cf47c61cc83e757b8d269f877 transactionH

ash: 0xf4bb0fa6ddc1d9e1921a55d576d68acf5b715d00cd89cc7268ece3653c50de50

null [object Object]

Contract mined! address: 0xf3872dc9ced78283ad3a511e970891807dd38590 transactionH

ash: 0xab90aa5169f4ebfcbc139874208cabb29416feb3f12c296c93466d7d8090f805

null [object Object]

Contract mined! address: 0x7a74b5da4168f0a06a752301a3711c8991acaf88 transactionH

ash: 0x6ce2a63c59d124d5ecd4681a368243ba7de8aeacc735d41583f834789cba0b16

Finally we can view:

> **test2**

{

abi: [{

constant: false,

inputs: [],

name: "val",

outputs: [{...}],

payable: false,

type: "function"

}, {

inputs: [],

payable: false,

type: "constructor"

}],

address: "0x7a74b5da4168f0a06a752301a3711c8991acaf88",

transactionHash: "0x6ce2a63c59d124d5ecd4681a368243ba7de8aeacc735d41583f834789c

ba0b16",

allEvents: function(),

val: function()

}

> **test3**

{

abi: [{

constant: false,

inputs: [],

name: "val",

outputs: [{...}],

payable: false,

type: "function"

}, {

constant: false,

inputs: [],

name: "show",

outputs: [{...}],

payable: false,

type: "function"

}],

address: "0xbd570c2f87b8af945146177377276901fd82b12d",

transactionHash: "0xc028384b4d8ea0e283c9cd3a6a747ab3efff859bb591d55f710ca20b09

665808",

allEvents: function(),

show: function(),

val: function()

}

And then test:

> **test2.val()**

"1"

> **test3.val()**

"2"

## E A bit of maths

Now we will create a contract to do a bit of maths. Let's say we want to calculate the square root of a value:

pragma solidity >0.4.0;

contract mymath {

function sqrt(uint x) public view returns (uint y) {

uint z = (x + 1) / 2;

y = x;

while (z < y) {

y = z;

z = (x / z + z) / 2;

}

}

}

When we create the JavaScript for the compiled version, and we load and run we get:

> personal.unlockAccount('0xc7552f45deb093cafb47286a0bc9415845ca3735','Qwerty')

true

> **loadScript('mycontract.js')**

null [object Object]

true

Contract mined! address: 0xc706a04b759a32dbec85702dd3864584e737aa77 transactionH

ash: 0xece670dcb578a78dec4d2338755ecade084a517310daacf37fd46fe336341563

null [object Object]

Contract mined! address: 0xfafb5f4d0db2c545592ac9134292162b03088295 transactionH

ash: 0x46204af57db69df078e1ae637b50fa76d8415ee1c1e3bd7e1c2990f328dc85ce

null [object Object]

Contract mined! address: 0x83e0bbb8abe2f0976fde9cf5db05333de067b0df transactionH

ash: 0xabea9606989bcc1bf93513213d298c84d47c7e8e1b397eaf536ebffb793d9304

> **test\_sol\_mymath.sqrt(9)**

3

> **test\_sol\_mymath.sqrt(12)**

3

> **test\_sol\_mymath.sqrt(81)**

9

Now, we will install the Solidity compiler on your Ubuntu host:

sudo add-apt-repository ppa:ethereum/ethereum

sudo apt-get install solc

Create your Solidity program on Ubuntu (1.sol), and then compile it to a binary format:

napier@napier-virtual-machine:~$ **solc --bin 1.sol**

1.sol:4:4: Warning: Function state mutability can be restricted to pure

function sqrt(uint x) public view returns (uint y) {

^ (Relevant source part starts here and spans across multiple lines).

======= 1.sol:mymath =======

Binary:



What can you observe from the code produced? How could you deploy this?

Now compile with the ABI option. What information does the output give?

How does this relate to the code your previously created from the Web site?

## Commands

sudo apt-get install software-properties-common

sudo add-apt-repository -y ppa:ethereum/ethereum

sudo apt-get install ethereum

**sudo geth --datadir=mynapier init custom.json**

**sudo geth --datadir=mynapier account new**

**sudo geth --datadir=mynapier –-networkid=15**

**sudo geth --datadir=mynapier account new**

**personal.newAccount("Qwerty1")**

**web3.eth.accounts**

**personal.unlockAccount("0x39a18a459b2475925e3014679707e4970a6a836d", “Qwerty1”)**

**seth.sendTransaction({from: "0x39a18a459b2475925e3014679707e4970a6a836d ", to: "0xa2cda8c68259cc314bd12b67873ce7380b3dc496",value:1000000})**

**eth.getBalance("0x39a18a459b2475925e3014679707e4970a6a836d")**

**eth.getBalance("0xa2cda8c68259cc314bd12b67873ce7380b3dc496")**

**eth.blockNumber**

**web3.eth.defaultAccount = '0x821eacc2a570c1aeb9b5aa64b5b915d4c1e1f3ee'**

**loadScript('mycontract.js')**

**sudo add-apt-repository ppa:ethereum/ethereum**

**sudo apt-get install solc**

**solc --bin 1.sol**