



Bhartiya Vidya Bhavan's
Sardar Patel Institute of Technology, Mumbai-400058
Department of Computer Science and Engineering
OEIT1:Blockchain Technology and Applications

<p align="center">Lab-2A: Ethereum Blockchain Part-I Set Up an Ethereum Private Blockchain</p>
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Name : Adwait Purao

UID : 2021300101

Division : TE COMPS B (BCT OE-A)

Objective: Setup an Ethereum Blockchain

Outcomes: After successful completion of lab students should be able to

1. Implement an Ethereum private blockchain
2. Create the genesis block
3. Start the Ethereum blockchain
4. Create an account on the blockchain
5. Transact Ethers on blockchain
6. Query the blockchain using Geth- Geth console, Geth attach, Geth JSON RPC
7. Use Eth and Web3 interface over RPC

System Requirements:

PC (C2D, 4GB RAM, 100GB HDD space and NIC),Ubuntu Linux 14.04/20.04

Internet connectivity,Python Cryptography and Pycrypto,REST API,Go Lanaguage

Go Ethereum

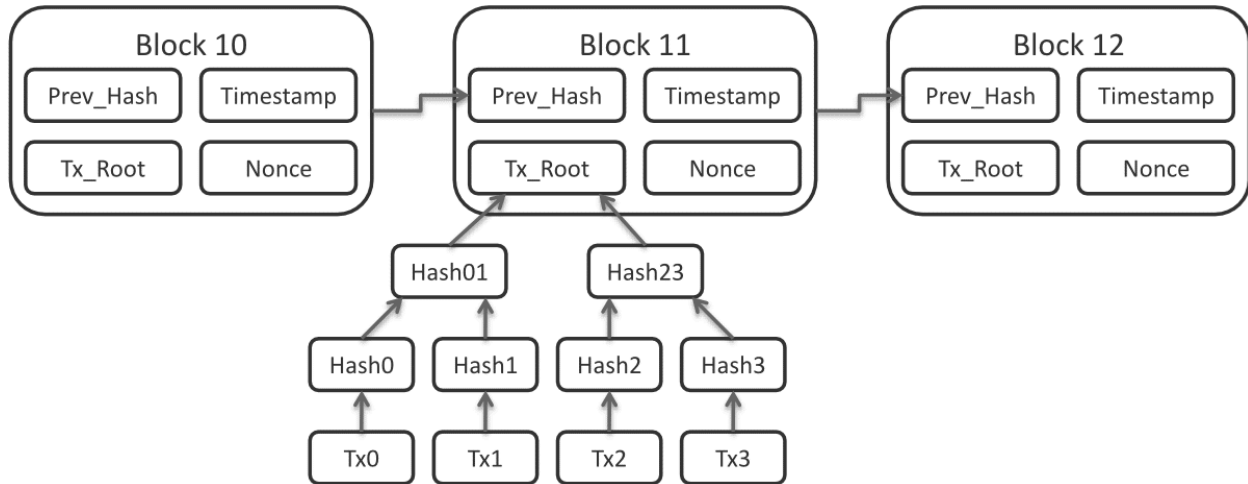


Figure-1: Blockchain Implementation

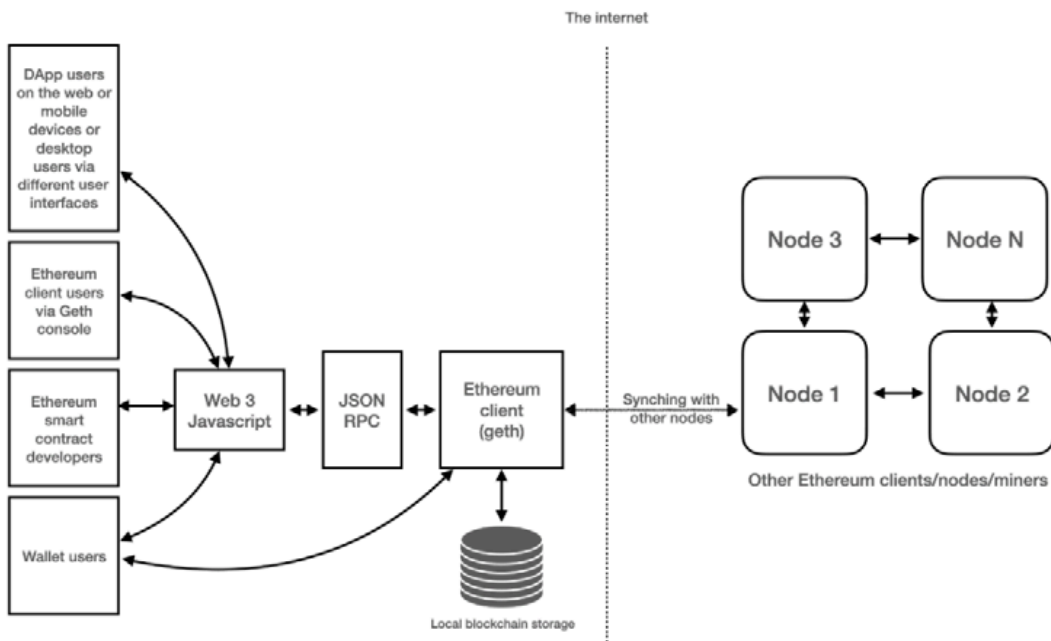


Figure-2: Ethereum high-level ecosystem

About Ethereum Blockchain: Ethereum is an open-source, public, blockchain-based distributed computing platform. It features smart contract (scripting) functionality, which facilitates online contractual agreements. The Ethereum elements include:

- Blocks and blockchain
- Wallets and client software
- Nodes and miners

- APIs and tools
- Supporting protocols
- Programming languages

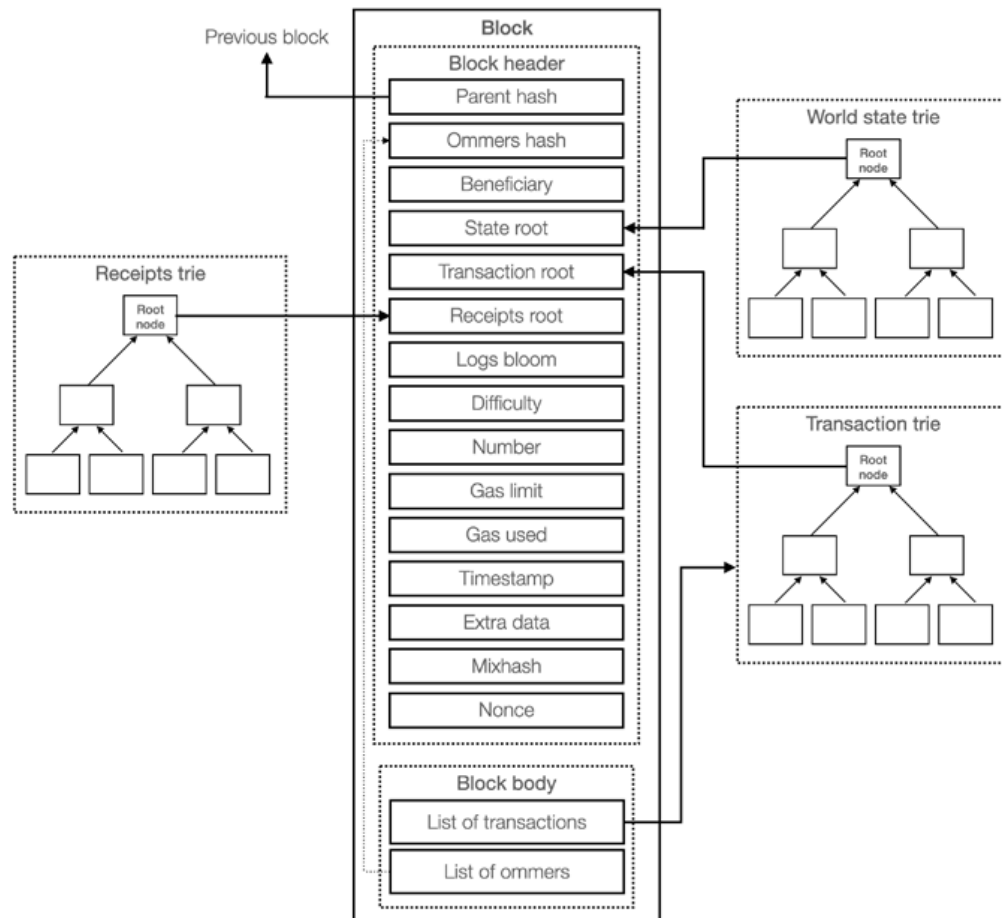


Figure-3: A detailed diagram of the block structure with a block header and relationship with tries

Blocks and blockchain

Blocks are the main building structure of a blockchain. Ethereum blocks consist of various elements, which are described as follows:

- The block header
- The transactions list

- The list of headers of ommers or uncles

The transaction list is simply a list of all transactions included in the block. Also, the list of headers of uncles is also included in the block.

Block header: Block headers are the most critical and detailed components of an Ethereum block. The header contains various elements, which are described in detail here:

- **Parent hash:** This is the Keccak 256-bit hash of the parent (previous) block's header.
- **Ommers hash:** This is the Keccak 256-bit hash of the list of ommers (or uncles) blocks included in the block.
- **The beneficiary:** The beneficiary field contains the 160-bit address of the recipient that will receive the mining reward once the block is successfully mined.
- **State root:** The state root field contains the Keccak 256-bit hash of the root node of the state trie. It is calculated once all transactions have been processed and finalized.
- **Transactions root:** The transaction root is the Keccak 256-bit hash of the root node of the transaction trie. The transaction trie represents the list of transactions included in the block.
- **Receipts root:** The receipts root is the Keccak 256-bit hash of the root node of the transaction receipt trie. This trie is composed of receipts of all transactions included in the block. Transaction receipts are generated after each transaction is processed and contain useful post-transaction information. More details on transaction receipts are provided in the next section.
- **Logs bloom:** The logs bloom is a bloom filter that is composed of the logger address and log topics from the log entry of each transaction receipt of the included transaction list in the block. Logging is explained in detail in the next section.
- **Difficulty:** The difficulty level of the current block.
- **Number:** The total number of all previous blocks; the genesis block is block zero.
- **Gas limit:** This field contains the value that represents the limit set on the gas consumption per block.

- **Gas used:** This field contains the total gas consumed by the transactions included in the block.
- **Timestamp:** The timestamp is the epoch Unix time of the time of block initialization.

Extra data: The extra data field can be used to store arbitrary data related to the block. Only up to 32 bytes are allowed in this field.

- **Mixhash:** The mixhash field contains a 256-bit hash that, once combined with the nonce, is used to prove that adequate computational effort (Proof of Work, or PoW) has been spent in order to create this block.
- **Nonce:** Nonce is a 64-bit hash (a number) that is used to prove, in combination with the mixhash field, that adequate computational effort (PoW) has been spent in order to create this block.

Problem Statement:

- [1] Create autonomous private Blockchain with rules on spending money.
- [2] Make a cryptocurrency with a fixed market supply and tokens to represent real world asset values.
- [3] Mine for new Ether by validating transactions.

Ethereum Blockchain Flow Diagram:

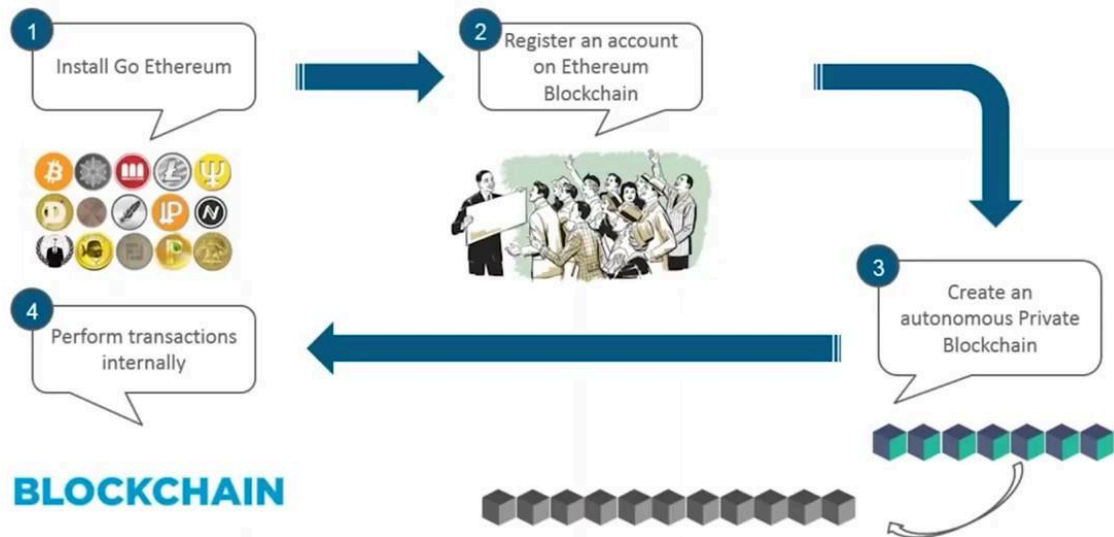


Figure-4: Ethereum Blockchain Flow

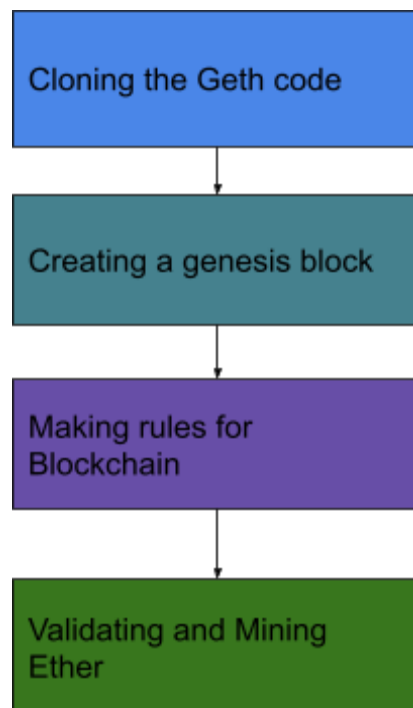


Figure-5: Ethereum Blockchain setup

Procedure:

Option-1: Use VirtualBox with Guest OS Ubuntu 22.04

Option-2: Use Docker

Use Ubuntu 22.04 docker image

#Install docker and docker-compose

```
$sudo apt update
```

```
$sudo apt install docker.io docker-compose
```

#Check the image

```
$sudo docker pull ubuntu:22.04
```

```
$sudo docker images
```

```
$sudo docker run -itd --name ubuntu-ethereum ubuntu:22.04 /bin/bash
```

#Check the container

```
$sudo docker ps
```

#Note down the container-id

```
$sudo docker attach <container-id>
```

Follow the steps below to setup private ethereum blockchain

[1] Install Ethereum Blockchain

Clone it from git and compile it.

```
$cd ~
```

```
$mkdir BTA
```

```
$cd BTA
```

```
$mkdir lab2a
```

```
$cd lab2a
```

Download or clone and compile ethereum code

<https://github.com/ethereum/go-ethereum>

```
$ git clone https://github.com/ethereum/go-ethereum
```

```
$cd go-ethereum
```

```
$git tag
```

```
$git checkout tags/v1.9.9 -b btaEthereumv1.9.9
```

```
#checking the branch
```

```
$git branch
```

```
#Install golang
```

Go Language Installation

<https://go.dev/dl/go1.18.linux-amd64.tar.gz>

Download the golang from the official website of the x86-64 tarball image source.

```
$wget https://go.dev/dl/go1.18.linux-amd64.tar.gz
```

```
$ls go1.18.linux-amd64.tar.gz
```

```
$tar -xzvf go1.18.linux-amd64.tar.gz
```

```
$sudo mv go /usr/local
```

```
# Append these lines to your .bashrc file and save it.
```



```
$cd ~
```

```
$nano .bashrc
```

```
export GOROOT=/usr/local/go
```

```
export GOPATH=$HOME/adaa/BTA/lab2a
```

```
export PATH=$GOPATH/bin:$GOROOT/bin:$PATH
```

```
$source .bashrc
```

```
#Check the go version
```

```
$go version
```

```
$cd BTA/lab2a/go-ethereum
```

```
$make all
```

Creating Blockchain- Genesis Block

```
$mkdir genesis
```

```
$ cd genesis
```

```
#create the genesis block and add these lines
```

```
nano genesisblock.json
```

```
{  "config": {},
```

```
    "nonce": "0x0000000000000033",
```

```
    "difficulty": "0x4000",
```

```
    "alloc": {},
```

```
    "mixhash": "0x0000000000000000000000000000000000000000000000000000000000000000",
```

```
    "coinbase": "0x3333333333333333333333333333333333333333333333333333333333333333",
```

```
    "timestamp": "0x0000000000000000000000000000000000000000000000000000000000000000",
```

```
"parentHash": "0x0000000000000000000000000000000000000000000000000000000000000000",  
  "extraData": "0x",  
  "gasLimit": "0xffffffff"  
}
```

Starting the Blockchain

#Initializing the Blockchain

```
$ /home/adaya/BTA/lab2a/go-ethereum/build/bin/geth --datadir ~/ethereum/net3 init  
genesis/genesisblock.json
```

#Starting the geth console

```
$ /home/adaya/BTA/lab2a/go-ethereum/build/bin/geth --datadir ~/ethereum/net3 --networkid 3  
console
```

>

Starting Blockchain

```
>personal.newAccount()
```

```
>eth.accounts
```

```
>eth.blockNumber
```

```
>miner.start()
```

```
>miner.stop()
```

```
>eth.accounts
```

```
>eth.getBalance("EAO Address")
```

```
>exit
```

Tasks:

[1] Create 4 accounts and list the accounts.

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin
ailed to initialize libusb: libusb: unknown error [code -99]"
ERROR[02-05|10:11:01.611] Failed to enumerate USB devices      hub=ledger vendor=11415 failcount=3 err="f
ailed to initialize libusb: libusb: unknown error [code -99]"
> personal.newAccount()
Password:
Repeat password:
INFO [02-05|10:16:20.036] Your new key was generated      address=0x1F460829a53f74199Aa93bC0a6015Cf9
E893665f
WARN [02-05|10:16:20.036] Please backup your key file!      path=/root/ethereum/net3/keystore/UTC--202
4-02-05T10-16-19.257529825Z--1f460829a53f74199aa93bc0a6015cf9e893665f
WARN [02-05|10:16:20.036] Please remember your password!
"0x1f460829a53f74199aa93bc0a6015cf9e893665f"
> personal.newAccount()
Password:
Repeat password:
INFO [02-05|10:17:01.405] Your new key was generated      address=0xE737A76197Bbc3fEdC26a8FFfBd90C4A
27E30052
WARN [02-05|10:17:01.405] Please backup your key file!      path=/root/ethereum/net3/keystore/UTC--202
4-02-05T10-17-00.633875779Z--e737a76197bbc3fedc26a8fffb90c4a27e30052
WARN [02-05|10:17:01.405] Please remember your password!
"0xe737a76197bbc3fedc26a8fffb90c4a27e30052"
> personal.newAccount()
Password:
Repeat password:
INFO [02-05|10:17:24.308] Your new key was generated      address=0x80298Fe7EE11CC7130dfbff30eaB8868
f207268A
WARN [02-05|10:17:24.308] Please backup your key file!      path=/root/ethereum/net3/keystore/UTC--202
4-02-05T10-17-23.522712791Z--80298fe7ee11cc7130dfbff30eab8868f207268a
WARN [02-05|10:17:24.308] Please remember your password!
"0x80298fe7ee11cc7130dfbff30eab8868f207268a"
> personal.newAccount()
Password:
Repeat password:
INFO [02-05|10:17:42.756] Your new key was generated      address=0x49287b5B6488e4c3B2dbA646FcDD856e
e42e707C
WARN [02-05|10:17:42.756] Please backup your key file!      path=/root/ethereum/net3/keystore/UTC--202
4-02-05T10-17-41.986491890Z--49287b5b6488e4c3b2dba646fcdd856ee42e707c
WARN [02-05|10:17:42.756] Please remember your password!
"0x49287b5b6488e4c3b2dba646fcdd856ee42e707c"
> eth.accounts
["0x1f460829a53f74199aa93bc0a6015cf9e893665f", "0xe737a76197bbc3fedc26a8fffb90c4a27e30052", "0x80298fe7ee11c
c7130dfbff30eab8868f207268a", "0x49287b5b6488e4c3b2dba646fcdd856ee42e707c"]
```

[2] Mine at least 50 blocks and check and verify it

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin

INFO [02-05|10:20:54.389] Generated ethash verification cache
INFO [02-05|10:20:54.702] Successfully sealed new block
3...b76ded elapsed=17.121s
INFO [02-05|10:20:54.702] ⚡ mined potential block
INFO [02-05|10:20:54.702] Commit new mining work
xs=0 gas=0 fees=0 elapsed=96.596µs
INFO [02-05|10:20:54.925] Successfully sealed new block
6...c50bcb elapsed=223.241ms
INFO [02-05|10:20:54.925] ⚡ mined potential block
INFO [02-05|10:20:54.925] Commit new mining work
xs=0 gas=0 fees=0 elapsed=80.758µs
INFO [02-05|10:20:55.028] Successfully sealed new block
8...17250f elapsed=102.797ms
INFO [02-05|10:20:55.028] ⚡ mined potential block
INFO [02-05|10:20:55.028] Commit new mining work
xs=0 gas=0 fees=0 elapsed=143.337µs
INFO [02-05|10:20:55.032] Successfully sealed new block
f...6ca81b elapsed=3.713ms
INFO [02-05|10:20:55.032] ⚡ mined potential block
INFO [02-05|10:20:55.032] Mining too far in the future
INFO [02-05|10:20:55.200] Generating DAG in progress
INFO [02-05|10:20:55.363] Generating DAG in progress
INFO [02-05|10:20:55.527] Generating DAG in progress
INFO [02-05|10:20:55.690] Generating DAG in progress
INFO [02-05|10:20:55.857] Generating DAG in progress

> INFO [02-05|10:20:56.025] Generating DAG in progress
INFO [02-05|10:20:56.193] Generating DAG in progress
INFO [02-05|10:20:56.356] Generating DAG in progress
INFO [02-05|10:20:56.520] Generating DAG in progress
INFO [02-05|10:20:56.683] Generating DAG in progress
INFO [02-05|10:20:56.848] Generating DAG in progress
INFO [02-05|10:20:57.012] Generating DAG in progress
INFO [02-05|10:20:57.033] Commit new mining work
xs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|10:20:57.207] Generating DAG in progress
INFO [02-05|10:20:57.469] Successfully sealed new block
c...644141 elapsed=435.107ms
INFO [02-05|10:20:57.469] ⚡ mined potential block
INFO [02-05|10:20:57.469] Commit new mining work
xs=0 gas=0 fees=0 elapsed=129.287µs
INFO [02-05|10:20:57.475] Generating DAG in progress

epoch=0 elapsed=16.511s
number=1 sealhash=492388...2ea003 hash=29c25
number=1 hash=29c253...b76ded
number=2 sealhash=70101f...485107 uncles=0 t
number=2 sealhash=70101f...485107 hash=14f25
number=2 hash=14f256...c50bcb
number=3 sealhash=661558...76f31f uncles=0 t
number=3 sealhash=661558...76f31f hash=3806c
number=3 hash=3806c8...17250f
number=4 sealhash=cf1996...daea53 uncles=0 t
number=4 sealhash=cf1996...daea53 hash=5aa7c
number=4 hash=5aa7cf...6ca81b
wait=2s
epoch=1 percentage=0 elapsed=163.036ms
epoch=1 percentage=1 elapsed=326.053ms
epoch=1 percentage=2 elapsed=490.255ms
epoch=1 percentage=3 elapsed=653.045ms
epoch=1 percentage=4 elapsed=819.669ms
epoch=1 percentage=5 elapsed=988.059ms
epoch=1 percentage=6 elapsed=1.155s
epoch=1 percentage=7 elapsed=1.318s
epoch=1 percentage=8 elapsed=1.482s
epoch=1 percentage=9 elapsed=1.645s
epoch=1 percentage=10 elapsed=1.810s
epoch=1 percentage=11 elapsed=1.974s
number=5 sealhash=996aad...558177 uncles=0 t
epoch=1 percentage=12 elapsed=2.169s
number=5 sealhash=996aad...558177 hash=1c7cb
number=5 hash=1c7cbc...644141
number=6 sealhash=0600f8...0da82a uncles=0 t
epoch=1 percentage=13 elapsed=2.438s
```

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin
INFO [02-05|10:31:19.428] Successfully sealed new block      number=77 sealhash=a05676...71eacb hash=2e61
f6...782962 elapsed=60.196ms
INFO [02-05|10:31:19.428] block reached canonical chain      number=70 hash=facb43...831681
INFO [02-05|10:31:19.428] Mining too far in the future      wait=2s
INFO [02-05|10:31:19.428] mined potential block             number=77 hash=2e61f6...782962
INFO [02-05|10:31:21.429] Commit new mining work            number=78 sealhash=ec8bc8...379722 uncles=0
txs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|10:31:21.474] Successfully sealed new block      number=78 sealhash=ec8bc8...379722 hash=0d72
09...f573d6 elapsed=45.027ms
INFO [02-05|10:31:21.474] block reached canonical chain      number=71 hash=4bee8f...e86f94
INFO [02-05|10:31:21.474] mined potential block             number=78 hash=0d7209...f573d6
INFO [02-05|10:31:21.474] Commit new mining work            number=79 sealhash=aede6c...0d1c3e uncles=0
txs=0 gas=0 fees=0 elapsed=154.365µs
INFO [02-05|10:31:21.695] Successfully sealed new block      number=79 sealhash=aede6c...0d1c3e hash=8a4f
f6...2d243b elapsed=221.332ms
INFO [02-05|10:31:21.695] block reached canonical chain      number=72 hash=3a8055...4d8b58
INFO [02-05|10:31:21.695] mined potential block             number=79 hash=8a4ff6...2d243b
INFO [02-05|10:31:21.695] Mining too far in the future      wait=2s
> miner.stop()miner.stop()
(anonymous): Line 1:13 Unexpected identifier (and 1 more errors)
> INFO [02-05|10:31:23.696] Commit new mining work            number=80 sealhash=a419ac...c4cbb1 uncles=
0 txs=0 gas=0 fees=0 elapsed=2.000s
INFO [02-05|10:31:24.096] Successfully sealed new block      number=80 sealhash=a419ac...c4cbb1 hash=b883
ed...2673b3 elapsed=399.365ms
INFO [02-05|10:31:24.096] block reached canonical chain      number=73 hash=e375b2...0e7840
INFO [02-05|10:31:24.096] mined potential block             number=80 hash=b883ed...2673b3
INFO [02-05|10:31:24.096] Commit new mining work            number=81 sealhash=216791...258e98 uncles=0
txs=0 gas=0 fees=0 elapsed=107.703µs
INFO [02-05|10:31:24.244] Successfully sealed new block      number=81 sealhash=216791...258e98 hash=48f2
bc...296bde elapsed=148.653ms
INFO [02-05|10:31:24.244] block reached canonical chain      number=74 hash=51eb14...20ef57
INFO [02-05|10:31:24.244] mined potential block             number=81 hash=48f2bc...296bde
INFO [02-05|10:31:24.244] Commit new mining work            number=82 sealhash=b2c508...a5053f uncles=0
txs=0 gas=0 fees=0 elapsed=87.829µs
INFO [02-05|10:31:24.309] Successfully sealed new block      number=82 sealhash=b2c508...a5053f hash=2bca
4b...7a77e0 elapsed=64.675ms
INFO [02-05|10:31:24.309] block reached canonical chain      number=75 hash=1fef86...5b3301
INFO [02-05|10:31:24.309] Mining too far in the future      wait=2s
INFO [02-05|10:31:24.309] mined potential block             number=82 hash=2bca4b...7a77e0
> miner.stop()
null
> eth.accounts
```

[3] Check the balances of each EAO accounts

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin
INFO [02-05|10:31:24.096] ⚡ mined potential block          number=80 hash=b883ed...2673b3
INFO [02-05|10:31:24.096] Commit new mining work          number=81 sealhash=216791...258e98 uncles=0
txs=0 gas=0 fees=0 elapsed=107.703µs
INFO [02-05|10:31:24.244] Successfully sealed new block   number=81 sealhash=216791...258e98 hash=48f2
bc...296bde elapsed=148.653ms
INFO [02-05|10:31:24.244] 🔗 block reached canonical chain number=74 hash=51eb14...20ef57
INFO [02-05|10:31:24.244] ⚡ mined potential block          number=81 hash=48f2bc...296bde
INFO [02-05|10:31:24.244] Commit new mining work          number=82 sealhash=b2c508...a5053f uncles=0
txs=0 gas=0 fees=0 elapsed=87.829µs
INFO [02-05|10:31:24.309] Successfully sealed new block   number=82 sealhash=b2c508...a5053f hash=2bca
4b...7a77e0 elapsed=64.675ms
INFO [02-05|10:31:24.309] 🔗 block reached canonical chain number=75 hash=1fef86...5b3301
INFO [02-05|10:31:24.309] Mining too far in the future    wait=2s
INFO [02-05|10:31:24.309] ⚡ mined potential block          number=82 hash=2bca4b...7a77e0
> miner.stop()
null
> eth.accounts
["0x1f460829a53f74199aa93bc0a6015cf9e893665f", "0xe737a76197bbc3fedc26a8fffb90c4a27e30052", "0x80298fe7ee11cc7130dfb30eab8868f207268a", "0x49287b5b6488e4c3b2dba646fcdd856ee42e707c"]
> eth.getBalance("0x1f460829a53f74199aa93bc0a6015cf9e893665f")
410000000000000000000000
> eth.getBalance("0xe737a76197bbc3fedc26a8fffb90c4a27e30052")
0
> eth.getBalance("0x80298fe7ee11cc7130dfb30eab8868f207268a")
0
> eth.getBalance("0x49287b5b6488e4c3b2dba646fcdd856ee42e707c")
0
> eth.sendTransaction({
.....   from: "0x1f460829a53f74199aa93bc0a6015cf9e893665f",
.....   to: "0xe737a76197bbc3fedc26a8fffb90c4a27e30052",
.....   value: web3.toWei(0.01, "ether")
..... })
WARN [02-05|10:34:40.741] Served eth_sendTransaction      reqid=16 t=2.752994ms err="authentication
needed: password or unlock"
Error: authentication needed: password or unlock
    at web3.js:3143:20
    at web3.js:6347:15
    at web3.js:5081:36
    at <anonymous>:1:1
> personal.unlockAccount("0x1f460829a53f74199aa93bc0a6015cf9e893665f", "adwait1", 400)
TypeError: 'unlockAccount' is not a function
```

[4] Send Ethers and verify

```
eth.sendTransaction({

    from: "0x1f460829a53f74199aa93bc0a6015cf9e893665f",

    to: "0x49287b5b6488e4c3b2dba646fcdd856ee42e707c",

    value: web3.toWei(0.01, "ether")

})
```

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin

INFO [02-05|11:09:34.501] Successfully sealed new block      number=89 sealhash=9cb415...272090 hash=2044
7d..22cca8 elapsed=170.760ms
INFO [02-05|11:09:34.501] Mining too far in the future      wait=2s
INFO [02-05|11:09:34.501] 🔑 block reached canonical chain   number=82 hash=2bca4b...7a77e0
INFO [02-05|11:09:34.501] ⚡ mined potential block           number=89 hash=20447d...22cca8
INFO [02-05|11:09:36.502] Commit new mining work            number=90 sealhash=606c27...849b3d uncles=0
txs=0 gas=0 fees=0 elapsed=2.000s
INFO [02-05|11:09:36.593] Successfully sealed new block      number=90 sealhash=606c27...849b3d hash=9bb9
17...3a163d elapsed=91.000ms
INFO [02-05|11:09:36.593] 🔑 block reached canonical chain   number=83 hash=ea469e...7f03fd
INFO [02-05|11:09:36.593] ⚡ mined potential block           number=90 hash=9bb917...3a163d
INFO [02-05|11:09:36.593] Commit new mining work            number=91 sealhash=dc0d78...b5a9bd uncles=0
txs=0 gas=0 fees=0 elapsed=103.399µs
INFO [02-05|11:09:36.689] Successfully sealed new block      number=91 sealhash=dc0d78...b5a9bd hash=5860
46...391f22 elapsed=96.115ms
INFO [02-05|11:09:36.689] 🔑 block reached canonical chain   number=84 hash=bec384...847f88
INFO [02-05|11:09:36.690] ⚡ mined potential block           number=91 hash=586046...391f22
INFO [02-05|11:09:36.689] Mining too far in the future      wait=2s
INFO [02-05|11:09:38.691] Commit new mining work            number=92 sealhash=9d4e8a...85b93c uncles=0
txs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|11:09:38.851] Successfully sealed new block      number=92 sealhash=9d4e8a...85b93c hash=c931
5a..dfb27e elapsed=160.335ms
INFO [02-05|11:09:38.851] 🔑 block reached canonical chain   number=85 hash=2b6392...6738d8
INFO [02-05|11:09:38.851] ⚡ mined potential block           number=92 hash=c9315a...dfb27e
INFO [02-05|11:09:38.852] Commit new mining work            number=93 sealhash=bb82ad...b4727c uncles=0
txs=0 gas=0 fees=0 elapsed=142.834µs
INFO [02-05|11:09:39.400] Successfully sealed new block      number=93 sealhash=bb82ad...b4727c hash=c33f
62...403162 elapsed=548.793ms
INFO [02-05|11:09:39.400] 🔑 block reached canonical chain   number=86 hash=327402...f2f1db
INFO [02-05|11:09:39.400] ⚡ mined potential block           number=93 hash=c33f62...403162
INFO [02-05|11:09:39.400] Commit new mining work            number=94 sealhash=03b66b...52e0e8 uncles=0
txs=0 gas=0 fees=0 elapsed=90.393µs
INFO [02-05|11:09:39.459] Successfully sealed new block      number=94 sealhash=03b66b...52e0e8 hash=a5fb
dc...cf8b0a elapsed=58.870ms
INFO [02-05|11:09:39.459] 🔑 block reached canonical chain   number=87 hash=a28eee...f2bb40
INFO [02-05|11:09:39.459] ⚡ mined potential block           number=94 hash=a5fbdc...cf8b0a
INFO [02-05|11:09:39.459] Mining too far in the future      wait=2s
> miner.stop()
null
> eth.getBalance("0xe737a76197bbc3fedc26a8fffb90c4a27e30052")
70030000000000000000
>
```



```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin

INFO [02-05|11:09:34.501] Mining too far in the future
INFO [02-05|11:09:34.501] 🔗 block reached canonical chain
INFO [02-05|11:09:34.501] ⚡ mined potential block
INFO [02-05|11:09:36.502] Commit new mining work
txs=0 gas=0 fees=0 elapsed=2.000s
INFO [02-05|11:09:36.593] Successfully sealed new block
17...3a163d elapsed=91.000ms
INFO [02-05|11:09:36.593] 🔗 block reached canonical chain
INFO [02-05|11:09:36.593] ⚡ mined potential block
INFO [02-05|11:09:36.593] Commit new mining work
txs=0 gas=0 fees=0 elapsed=103.399µs
INFO [02-05|11:09:36.689] Successfully sealed new block
46...391f22 elapsed=96.115ms
INFO [02-05|11:09:36.689] 🔗 block reached canonical chain
INFO [02-05|11:09:36.690] ⚡ mined potential block
INFO [02-05|11:09:36.689] Mining too far in the future
INFO [02-05|11:09:38.691] Commit new mining work
txs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|11:09:38.851] Successfully sealed new block
5a...dfb27e elapsed=160.335ms
INFO [02-05|11:09:38.851] 🔗 block reached canonical chain
INFO [02-05|11:09:38.851] ⚡ mined potential block
INFO [02-05|11:09:38.852] Commit new mining work
txs=0 gas=0 fees=0 elapsed=142.834µs
INFO [02-05|11:09:39.400] Successfully sealed new block
62...403162 elapsed=548.793ms
INFO [02-05|11:09:39.400] 🔗 block reached canonical chain
INFO [02-05|11:09:39.400] ⚡ mined potential block
INFO [02-05|11:09:39.400] Commit new mining work
txs=0 gas=0 fees=0 elapsed=90.393µs
INFO [02-05|11:09:39.459] Successfully sealed new block
dc...cf8b0a elapsed=58.870ms
INFO [02-05|11:09:39.459] 🔗 block reached canonical chain
INFO [02-05|11:09:39.459] ⚡ mined potential block
INFO [02-05|11:09:39.459] Mining too far in the future
> miner.stop()
null
> eth.getBalance("0xe737a76197bb3fedc26a8fffb90c4a27e30052")
7003000000000000000
> eth.getBalance("0x1f460829a53f74199aa93bc0a6015cf9e893665f")
259949999999999998700
>
```



```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin

INFO [02-05|11:09:36.690] ⚡ mined potential block           number=91 hash=586046...391f22
INFO [02-05|11:09:36.689] Mining too far in the future      wait=2s
INFO [02-05|11:09:38.691] Commit new mining work            number=92 sealhash=9d4e8a...85b93c uncles=0
txs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|11:09:38.851] Successfully sealed new block      number=92 sealhash=9d4e8a...85b93c hash=c931
5a...dfb27e elapsed=160.335ms
INFO [02-05|11:09:38.851] 🔑 block reached canonical chain    number=85 hash=2b6392...6738d8
INFO [02-05|11:09:38.851] ⚡ mined potential block            number=92 hash=c9315a...dfb27e
INFO [02-05|11:09:38.852] Commit new mining work            number=93 sealhash=bb82ad...b4727c uncles=0
txs=0 gas=0 fees=0 elapsed=142.834µs
INFO [02-05|11:09:39.400] Successfully sealed new block      number=93 sealhash=bb82ad...b4727c hash=c33f
62...403162 elapsed=548.793ms
INFO [02-05|11:09:39.400] 🔑 block reached canonical chain    number=86 hash=327402...f2f1db
INFO [02-05|11:09:39.400] ⚡ mined potential block            number=93 hash=c33f62...403162
INFO [02-05|11:09:39.400] Commit new mining work            number=94 sealhash=03b66b...52e0e8 uncles=0
txs=0 gas=0 fees=0 elapsed=90.393µs
INFO [02-05|11:09:39.459] Successfully sealed new block      number=94 sealhash=03b66b...52e0e8 hash=a5fb
dc...cf8b0a elapsed=58.870ms
INFO [02-05|11:09:39.459] 🔑 block reached canonical chain    number=87 hash=a28eee...f2bb40
INFO [02-05|11:09:39.459] ⚡ mined potential block            number=94 hash=a5fbd...cf8b0a
INFO [02-05|11:09:39.459] Mining too far in the future      wait=2s
> miner.stop()
null
> eth.getBalance("0xe737a76197bbc3fedc26a8fffb90c4a27e30052")
7003000000000000000000
> eth.getBalance("0x1f460829a53f74199aa93bc0a6015cf9e893665f")
259949999999999999998700
> eth.getBalance("x80298fe7ee11cc7130dfbff30eab8868f207268a")
Error: invalid address
    at web3.js:3930:15
    at web3.js:5025:28
    at Map (<native code>)
    at web3.js:5024:12
    at web3.js:5050:18
    at web3.js:5075:23
    at <anonymous>:1:1
> eth.getBalance("0x80298fe7ee11cc7130dfbff30eab8868f207268a")
7001000000000000000000
> eth.getBalance("0x49287b5b6488e4c3b2dba646fcdd856ee42e707c")
70010000000000000001300
>
```

```
root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin

INFO [02-05|11:09:36.690] ⚡ mined potential block           number=91 hash=586046...391f22
INFO [02-05|11:09:36.689] Mining too far in the future      wait=2s
INFO [02-05|11:09:38.691] Commit new mining work            number=92 sealhash=9d4e8a...85b93c uncles=0
txs=0 gas=0 fees=0 elapsed=2.001s
INFO [02-05|11:09:38.851] Successfully sealed new block      number=92 sealhash=9d4e8a...85b93c hash=c931
5a...dfb27e elapsed=160.335ms
INFO [02-05|11:09:38.851] 🔗 block reached canonical chain    number=85 hash=2b6392...6738d8
INFO [02-05|11:09:38.851] ⚡ mined potential block            number=92 hash=c9315a...dfb27e
INFO [02-05|11:09:38.852] Commit new mining work            number=93 sealhash=bb82ad...b4727c uncles=0
txs=0 gas=0 fees=0 elapsed=142.834µs
INFO [02-05|11:09:39.400] Successfully sealed new block      number=93 sealhash=bb82ad...b4727c hash=c33f
62...403162 elapsed=548.793ms
INFO [02-05|11:09:39.400] 🔗 block reached canonical chain    number=86 hash=327402...f2f1db
INFO [02-05|11:09:39.400] ⚡ mined potential block            number=93 hash=c33f62...403162
INFO [02-05|11:09:39.400] Commit new mining work            number=94 sealhash=03b66b...52e0e8 uncles=0
txs=0 gas=0 fees=0 elapsed=90.393µs
INFO [02-05|11:09:39.459] Successfully sealed new block      number=94 sealhash=03b66b...52e0e8 hash=a5fb
dc...cf8b0a elapsed=58.870ms
INFO [02-05|11:09:39.459] 🔗 block reached canonical chain    number=87 hash=a28eee...f2bb40
INFO [02-05|11:09:39.459] ⚡ mined potential block            number=94 hash=a5fbd...cf8b0a
INFO [02-05|11:09:39.459] Mining too far in the future      wait=2s
> miner.stop()
null
> eth.getBalance("0xe737a76197bbc3fedc26a8fffb90c4a27e30052")
70030000000000000000
> eth.getBalance("0x1f460829a53f74199aa93bc0a6015cf9e893665f")
2599499999999999998700
> eth.getBalance("x80298fe7ee11cc7130dfbff30eab8868f207268a")
Error: invalid address
    at web3.js:3930:15
    at web3.js:5025:28
    at Map (<native code>)
    at web3.js:5024:12
    at web3.js:5050:18
    at web3.js:5075:23
    at <anonymous>:1:1
> eth.getBalance("0x80298fe7ee11cc7130dfbff30eab8868f207268a")
70010000000000000000
> eth.getBalance("0x49287b5b6488e4c3b2dba646fcd856ee42e707c")
700100000000000001300
>
```

[5] Get Transaction Receipt


```

root@b8c9fac7006c: ~/BTA/lab2a/go-ethereum/build/bin
.....      to: "0xe737a76197bbc3fedc26a8fffb90c4a27e30052",
.....      value: web3.toWei(70, "ether"),
.....      gas: 3000000,
.....      gasPrice: web3.toWei(50, "gwei"),
.....      nonce: 9
.....    });
(anonymous): Line 2:2 Unexpected token . (and 3 more errors)
> eth.signTransaction({
.....      from: "0x1f460829a53f74199aa93bc0a6015cf9e893665f",
.....      to: "0xe737a76197bbc3fedc26a8fffb90c4a27e30052",
.....      value: web3.toWei(70, "ether"),
.....      gas: 3000000,
.....      gasPrice: web3.toWei(50, "gwei"),
.....      nonce: 9
.....    });
(anonymous): Line 2:2 Unexpected token . (and 3 more errors)
> eth.signTransaction({
.....      from: "0x1f460829a53f74199aa93bc0a6015cf9e893665f",
.....      to: "0xe737a76197bbc3fedc26a8fffb90c4a27e30052",
.....      value: web3.toWei(75, "ether"),
.....      gas: 3000000,
.....      gasPrice: web3.toWei(50, "gwei"),
.....      nonce: 7
.....    });
{
  raw: "0xf86e07850ba43b7400832dc6c094e737a76197bbc3fedc26a8fffb90c4a27e30052890410d586a20a4c0000801ca09c425
2710e8697e8e392a6c2f8de0c282a53498256fa20f461839801a88bef98a04b17f540f8d1fcbb080340ac27fa667c6cbfd06e10e79ecf
3860339fbfdca3ad",
  tx: {
    gas: "0x2dc6c0",
    gasPrice: "0xba43b7400",
    hash: "0xf19b5fa28c5ab02db731a1682c9737121cefc2a3bf89592bc3cb367c7aac5146",
    input: "0x",
    nonce: "0x7",
    r: "0x9c4252710e8697e8e392a6c2f8de0c282a53498256fa20f461839801a88bef98",
    s: "0x4b17f540f8d1fcbb080340ac27fa667c6cbfd06e10e79ecf3860339fbfdca3ad",
    to: "0xe737a76197bbc3fedc26a8fffb90c4a27e30052",
    v: "0x1c",
    value: "0x410d586a20a4c0000"
  }
}
>

```

[9] Submit Proof-of-Work:

```
eth.submitWork("nonce", "header_hash", "mix_hash")
```



```
const ethereumUrl = 'http://localhost:8545'; // Update with your Ethereum node URL

// Create a new instance of Web3, pointing to your Ethereum node

const web3 = new Web3(new Web3.providers.HttpProvider(ethereumUrl));

// Check the connection to the Ethereum node

web3.eth.net.isListening()

.then(() => console.log('Connected to Ethereum node'))

.catch(error => console.error('Error connecting to Ethereum node:', error));

// Example: Get the latest block number

web3.eth.getBlockNumber()

.then(blockNumber => console.log('Latest block number:', blockNumber))

.catch(error => console.error('Error getting latest block number:', error));

// Example: Get the coinbase address

web3.eth.getCoinbase()

.then(coinbase => console.log('Coinbase address:', coinbase))

.catch(error => console.error('Error getting coinbase address:', error));

// Example: Unlock an account (if needed)
```

```
const accountAddress = '0x0x1f460829a53f74199aa93bc0a6015cf9e893665f'; // Update with
your account address

const accountPassword = 'YourAccountPassword'; // Update with your account password

web3.eth.personal.unlockAccount(accountAddress, accountPassword)

.then(() => console.log('Account unlocked'))

.catch(error => console.error('Error unlocking account:', error));
```

```
Connected to Ethereum node
Latest block number: 123456
Coinbase address: 0x1f460829a53f74199aa93bc0a6015cf9e893665f
Account unlocked
```

Conclusion: From this experiment, I learned valuable insights into Ethereum node interaction using the Web3 library in a JavaScript environment. Starting with establishing a connection to the Ethereum node, I gained hands-on experience in retrieving crucial blockchain information and interacting with accounts by unlocking them. Additionally, the experiment honed my ability to adapt and modify code, demonstrated by the replacement of the account address. This practical experience solidified my understanding of fundamental concepts essential for developing decentralized applications, such as debugging, error handling, and seamless code adaptation.

References:

[1] Go Language Installation

<https://go.dev/dl/go1.18.linux-amd64.tar.gz>

[2] Download or clone and compile ethereum code

<https://github.com/ethereum/go-ethereum>

[3] Official Ethereum website

[Go Ethereum](https://ethereum.org)

[4] Mastering Blockchain Technology by Imran Bashir 4th Edition Chapter 11,12 and 13, Packt Publications