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Department of Electronics and Telecommunication Engineering
IT424:Blockchain Technology and Applications

Lab-6: Ethereum Blockchain Part-I
Setup an Ethereum Private Blockchain

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 Language
Go Ethereum

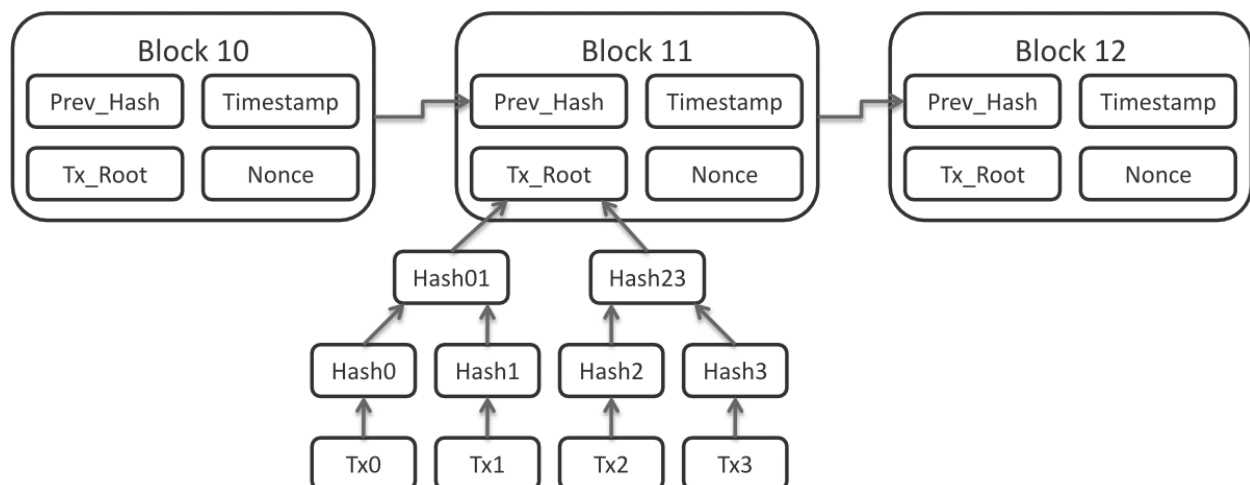


Figure-1: Blockchain Implementation

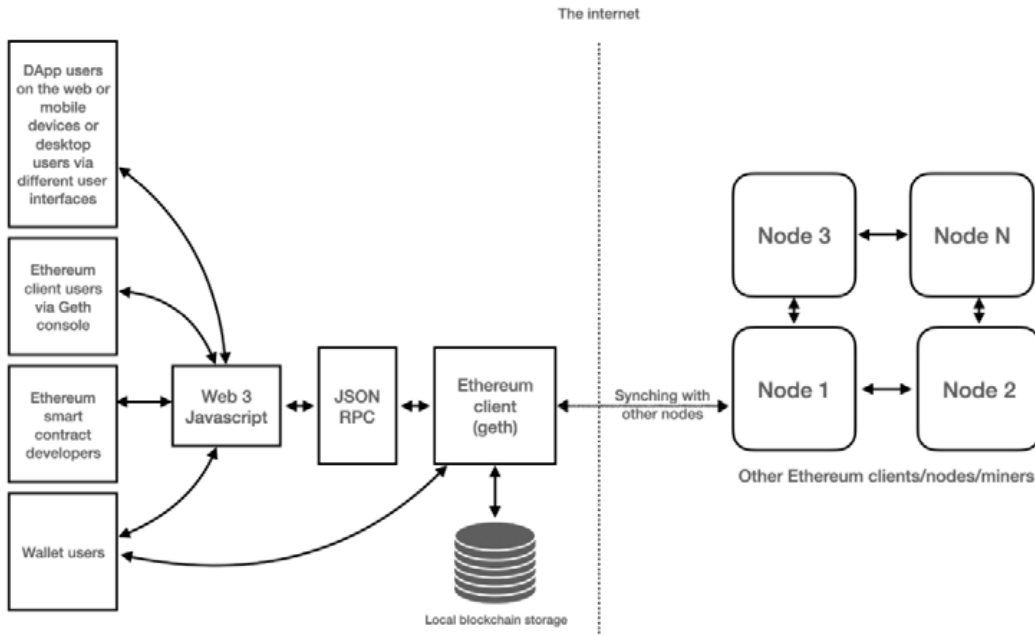


Figure-2: Ethereum high-level ecosystem

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

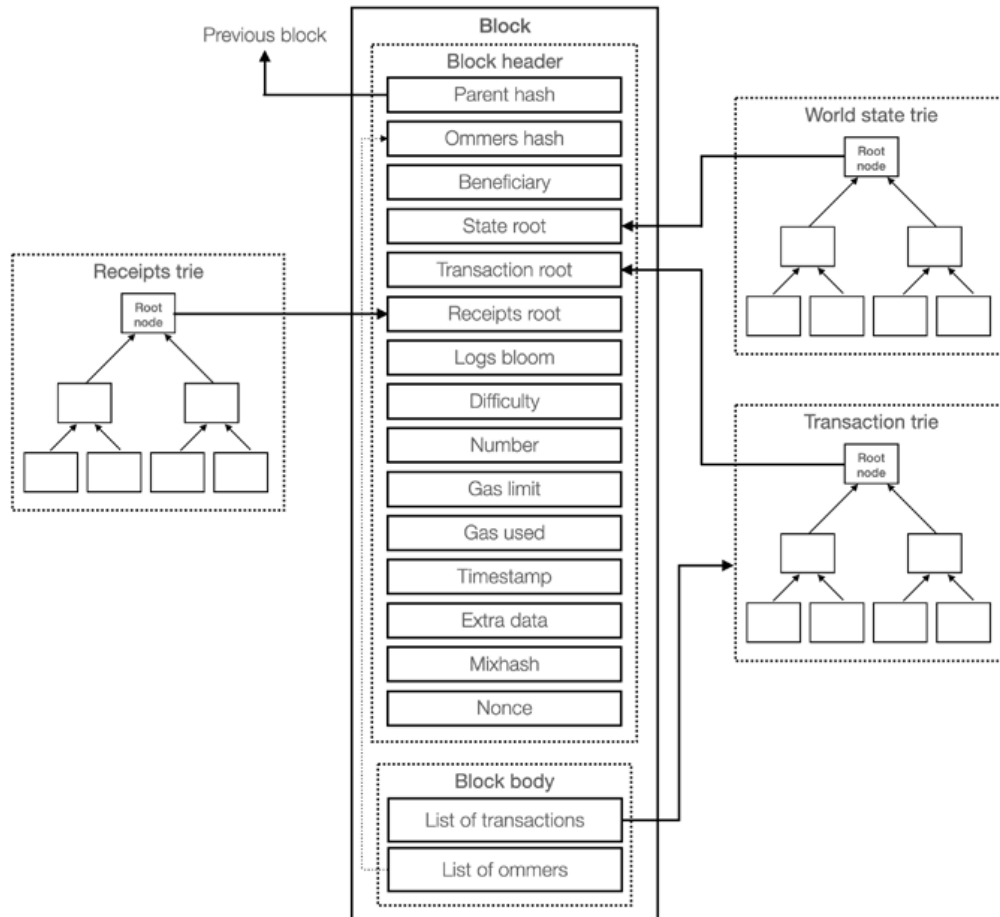


Figure-3: A detailed diagram of the block structure with a block header and relationship with tries

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 market supply and tokens to represent real world asset values.

[3] Mine for new Ether by validating transactions.

Ethereum Blockchain Flow Diagram:

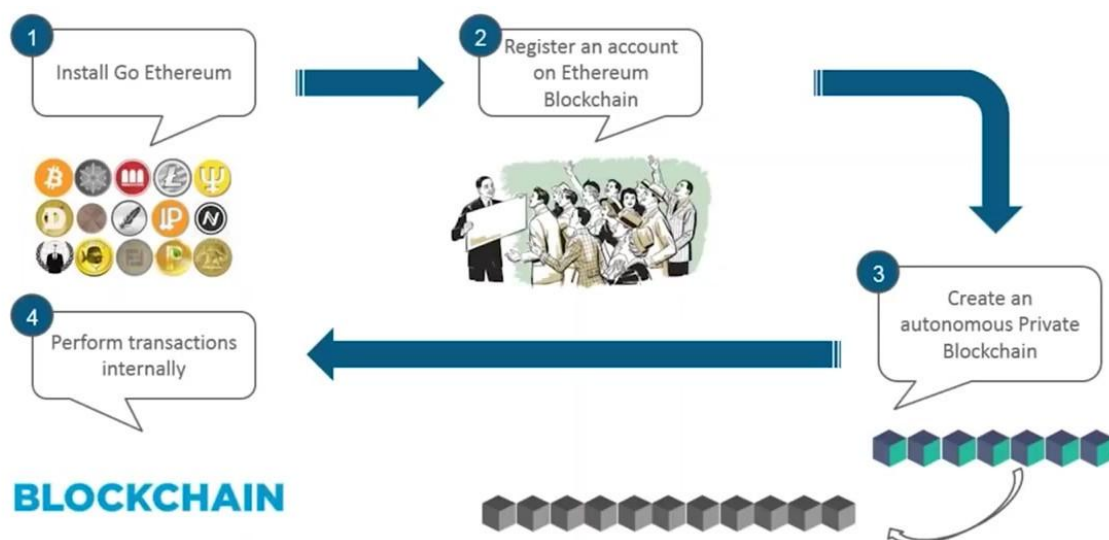


Figure-4: Ethereum Blockchain Flow

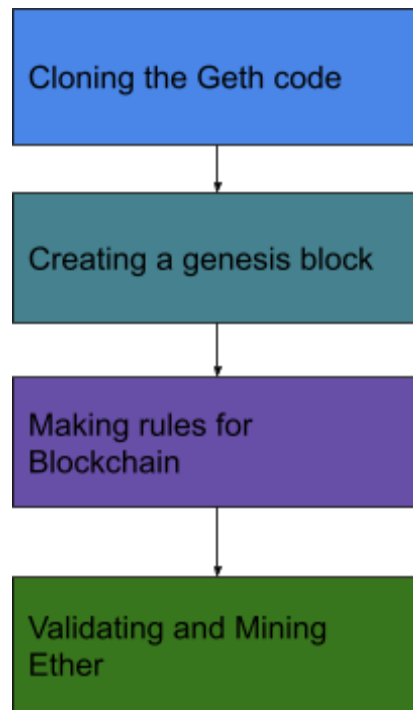


Figure-5: Ethereum Blockchain setup

Procedure:

[1] Install Ethereum Blockchain

Clone it from git and compile it.

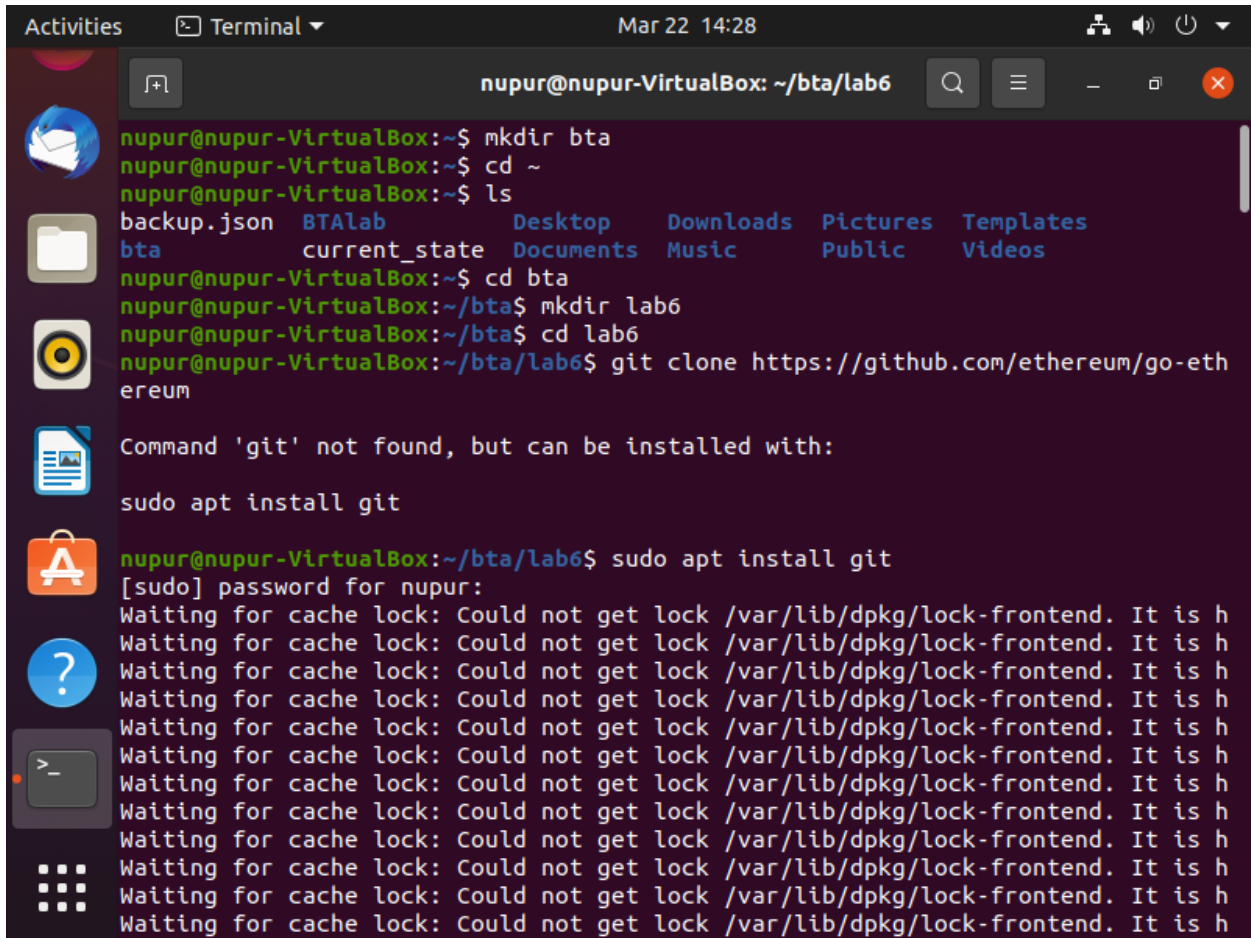
```
$cd ~
```

```
$mkdir BTA
```

```
$cd BTA
```

\$mkdir lab6

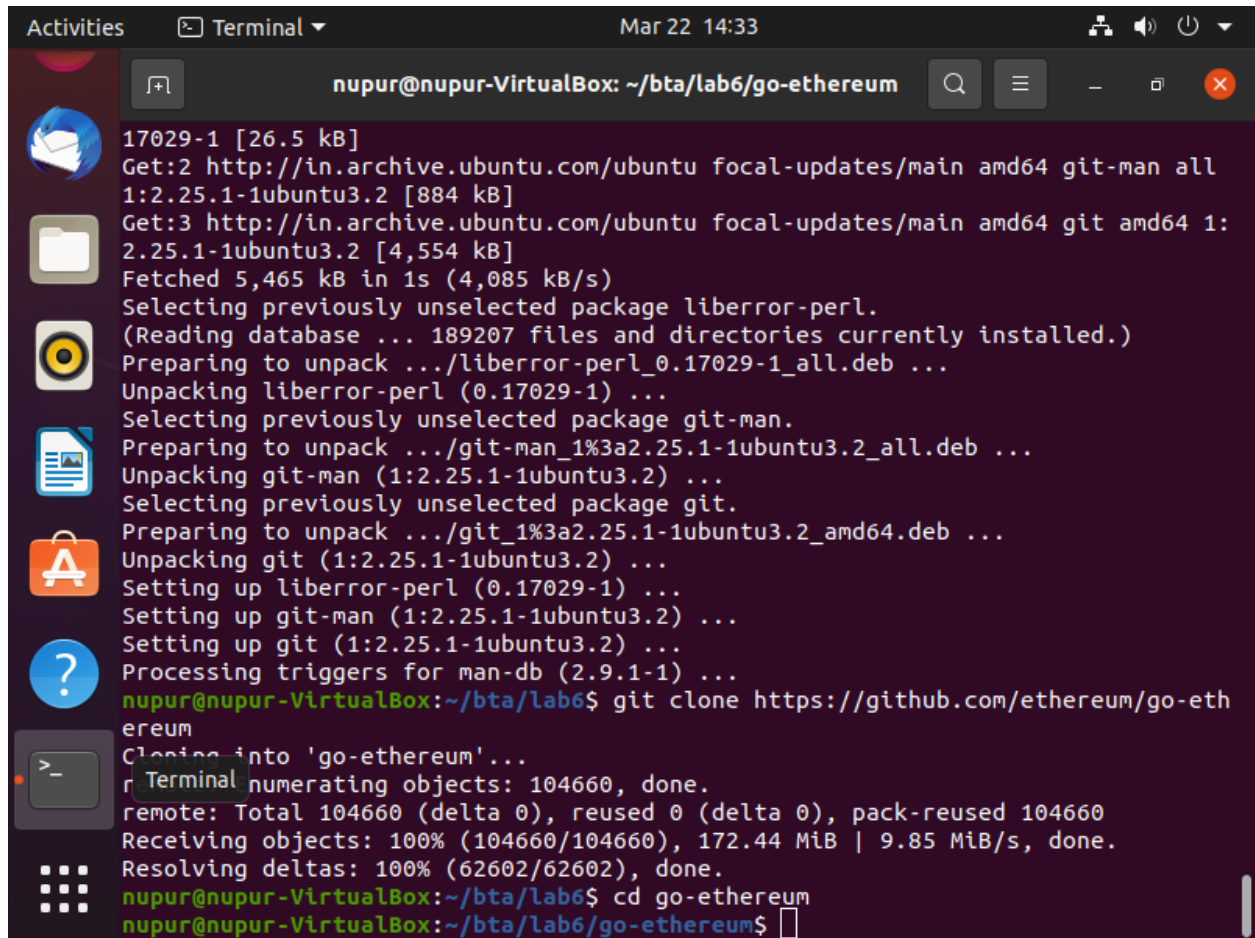
\$cd lab6



```
Activities Terminal Mar 22 14:28
nupur@nupur-VirtualBox: ~/bta/lab6

nupur@nupur-VirtualBox:~$ mkdir bta
nupur@nupur-VirtualBox:~$ cd ~
nupur@nupur-VirtualBox:~$ ls
backup.json  BTALab  Desktop  Downloads  Pictures  Templates
bta          current_state  Documents  Music  Public  Videos
nupur@nupur-VirtualBox:~$ cd bta
nupur@nupur-VirtualBox:~/bta$ mkdir lab6
nupur@nupur-VirtualBox:~/bta$ cd lab6
nupur@nupur-VirtualBox:~/bta/lab6$ git clone https://github.com/ethereum/go-eth
ereum
Command 'git' not found, but can be installed with:
sudo apt install git
nupur@nupur-VirtualBox:~/bta/lab6$ sudo apt install git
[sudo] password for nupur:
Waiting for cache lock: Could not get lock /var/lib/dpkg/lock-frontend. It is h
Waiting for cache lock: Could not get lock /var/lib/dpkg/lock-frontend. It is h
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Waiting for cache lock: Could not get lock /var/lib/dpkg/lock-frontend. It is h
Waiting for cache lock: Could not get lock /var/lib/dpkg/lock-frontend. It is h
```

\$ git clone <https://github.com/ethereum/go-ethereum>



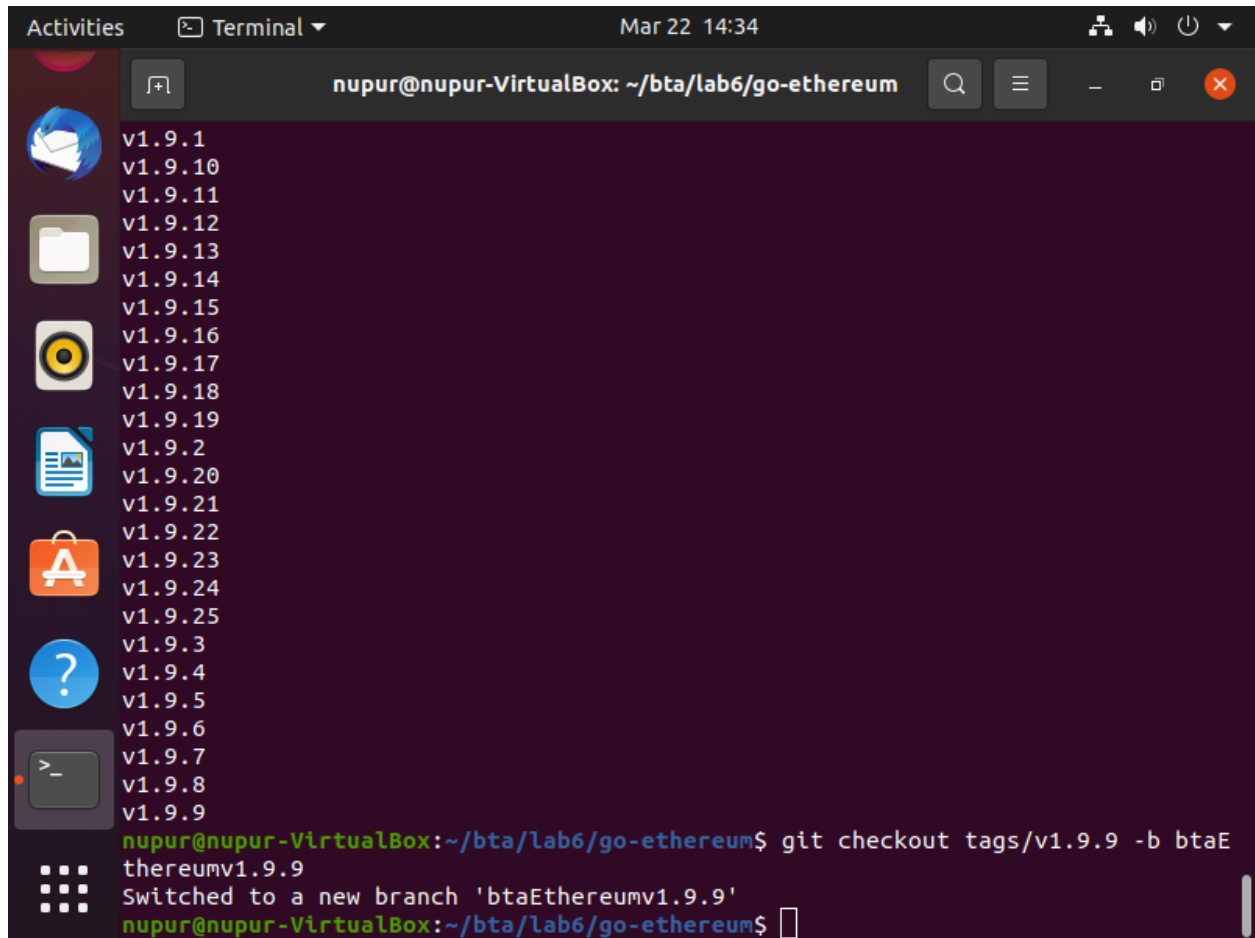
The screenshot shows a terminal window titled "Terminal" with the date and time "Mar 22 14:33". The user is logged in as "nupur" on a machine named "nupur-VirtualBox". The terminal output shows the following commands and their results:

```
17029-1 [26.5 kB]
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 git-man all
1:2.25.1-1ubuntu3.2 [884 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 git amd64 1:
2.25.1-1ubuntu3.2 [4,554 kB]
Fetched 5,465 kB in 1s (4,085 kB/s)
Selecting previously unselected package liberror-perl.
(Reading database ... 189207 files and directories currently installed.)
Preparing to unpack .../liberror-perl_0.17029-1_all.deb ...
Unpacking liberror-perl (0.17029-1) ...
Selecting previously unselected package git-man.
Preparing to unpack .../git-man_1%3a2.25.1-1ubuntu3.2_all.deb ...
Unpacking git-man (1:2.25.1-1ubuntu3.2) ...
Selecting previously unselected package git.
Preparing to unpack .../git_1%3a2.25.1-1ubuntu3.2_amd64.deb ...
Unpacking git (1:2.25.1-1ubuntu3.2) ...
Setting up liberror-perl (0.17029-1) ...
Setting up git-man (1:2.25.1-1ubuntu3.2) ...
Setting up git (1:2.25.1-1ubuntu3.2) ...
Processing triggers for man-db (2.9.1-1) ...
nupur@nupur-VirtualBox:~/bta/lab6$ git clone https://github.com/ethereum/go-eth
ereum
Cloning into 'go-ethereum'...
remote: Total 104660 (delta 0), reused 0 (delta 0), pack-reused 104660
Receiving objects: 100% (104660/104660), 172.44 MiB | 9.85 MiB/s, done.
Resolving deltas: 100% (62602/62602), done.
nupur@nupur-VirtualBox:~/bta/lab6$ cd go-ethereum
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$
```

\$cd go-ethereum

\$git tag

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



```
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum
v1.9.1
v1.9.10
v1.9.11
v1.9.12
v1.9.13
v1.9.14
v1.9.15
v1.9.16
v1.9.17
v1.9.18
v1.9.19
v1.9.2
v1.9.20
v1.9.21
v1.9.22
v1.9.23
v1.9.24
v1.9.25
v1.9.3
v1.9.4
v1.9.5
v1.9.6
v1.9.7
v1.9.8
v1.9.9
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ git checkout tags/v1.9.9 -b btaE
thereumv1.9.9
Switched to a new branch 'btaEthereumv1.9.9'
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$
```

#checking the branch

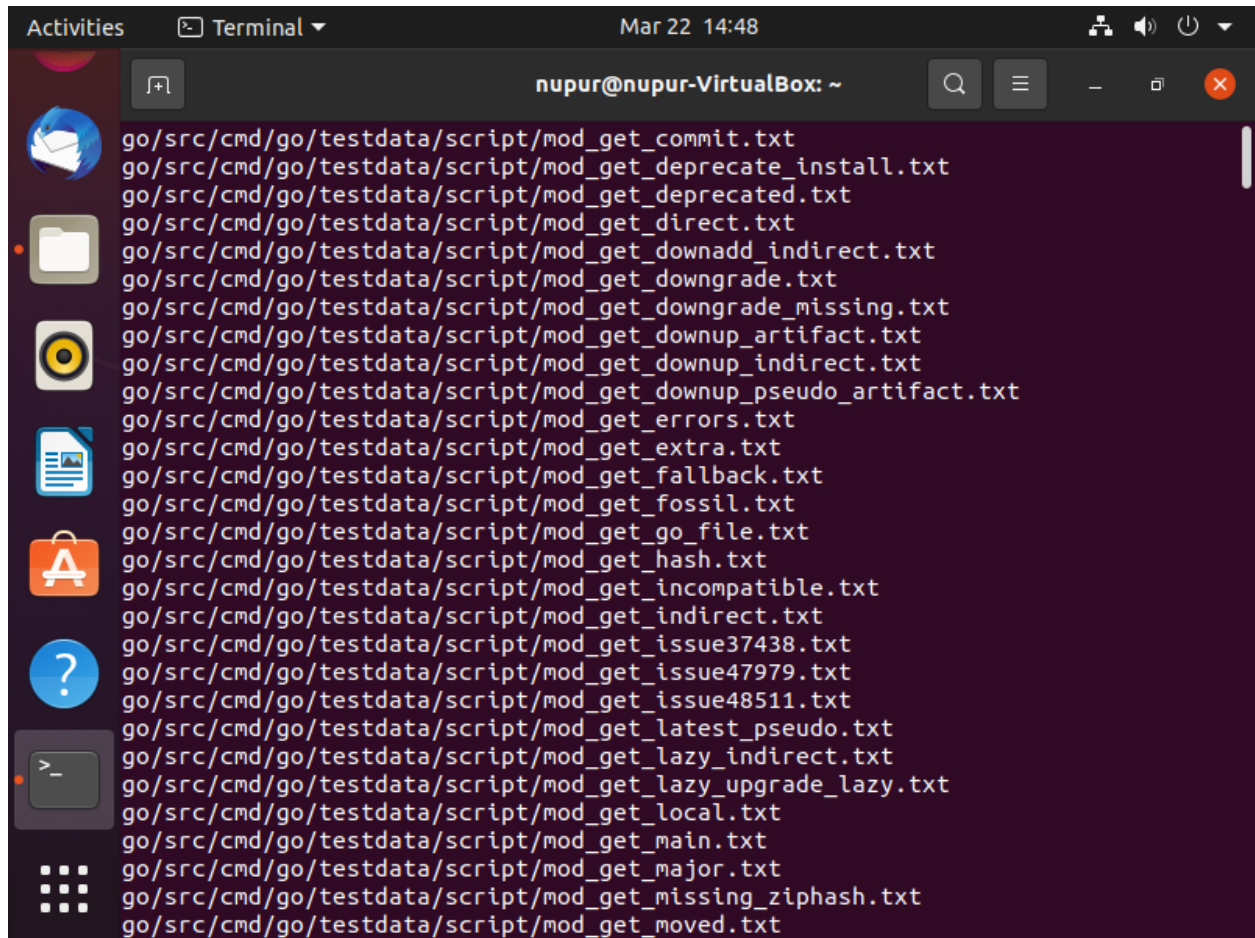
\$git branch

#Install golang

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

go1.18.linux-amd64.tar.gz

\$tar -xzf go1.18.linux-amd64.tar.gz



The screenshot shows a terminal window titled "nupur@nupur-VirtualBox: ~" with a search bar and window controls. The terminal displays a list of 28 Go module files, all located in the path `go/src/cmd/go/testdata/script/mod_get_`. The files are: `commit.txt`, `deprecate_install.txt`, `deprecated.txt`, `direct.txt`, `downadd_indirect.txt`, `downgrade.txt`, `downgrade_missing.txt`, `downup_artifact.txt`, `downup_indirect.txt`, `downup_pseudo_artifact.txt`, `errors.txt`, `extra.txt`, `fallback.txt`, `fossil.txt`, `go_file.txt`, `hash.txt`, `incompatible.txt`, `indirect.txt`, `issue37438.txt`, `issue47979.txt`, `issue48511.txt`, `latest_pseudo.txt`, `lazy_indirect.txt`, `lazy_upgrade_lazy.txt`, `local.txt`, `main.txt`, `major.txt`, `missing_ziphash.txt`, and `moved.txt`.

```
go/src/cmd/go/testdata/script/mod_get_commit.txt
go/src/cmd/go/testdata/script/mod_get_deprecate_install.txt
go/src/cmd/go/testdata/script/mod_get_deprecated.txt
go/src/cmd/go/testdata/script/mod_get_direct.txt
go/src/cmd/go/testdata/script/mod_get_downadd_indirect.txt
go/src/cmd/go/testdata/script/mod_get_downgrade.txt
go/src/cmd/go/testdata/script/mod_get_downgrade_missing.txt
go/src/cmd/go/testdata/script/mod_get_downup_artifact.txt
go/src/cmd/go/testdata/script/mod_get_downup_indirect.txt
go/src/cmd/go/testdata/script/mod_get_downup_pseudo_artifact.txt
go/src/cmd/go/testdata/script/mod_get_errors.txt
go/src/cmd/go/testdata/script/mod_get_extra.txt
go/src/cmd/go/testdata/script/mod_get_fallback.txt
go/src/cmd/go/testdata/script/mod_get_fossil.txt
go/src/cmd/go/testdata/script/mod_get_go_file.txt
go/src/cmd/go/testdata/script/mod_get_hash.txt
go/src/cmd/go/testdata/script/mod_get_incompatible.txt
go/src/cmd/go/testdata/script/mod_get_indirect.txt
go/src/cmd/go/testdata/script/mod_get_issue37438.txt
go/src/cmd/go/testdata/script/mod_get_issue47979.txt
go/src/cmd/go/testdata/script/mod_get_issue48511.txt
go/src/cmd/go/testdata/script/mod_get_latest_pseudo.txt
go/src/cmd/go/testdata/script/mod_get_lazy_indirect.txt
go/src/cmd/go/testdata/script/mod_get_lazy_upgrade_lazy.txt
go/src/cmd/go/testdata/script/mod_get_local.txt
go/src/cmd/go/testdata/script/mod_get_main.txt
go/src/cmd/go/testdata/script/mod_get_major.txt
go/src/cmd/go/testdata/script/mod_get_missing_ziphash.txt
go/src/cmd/go/testdata/script/mod_get_moved.txt
```

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

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

```
$cd ~
```

```
$nano .bashrc
```

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

```
export GOPATH=$HOME/BTA/lab6A
```

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

```
Activities Terminal Mar 22 15:36
nupur@nupur-VirtualBox: ~
nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~ x
GNU nano 4.8 .bashrc
# ~/.bash_aliases, instead of adding them here directly.
# See /usr/share/doc/bash-doc/examples in the bash-doc package.

if [ -f ~/.bash_aliases ]; then
    . ~/.bash_aliases
fi

# enable programmable completion features (you don't need to enable
# this, if it's already enabled in /etc/bash.bashrc and /etc/profile
# sources /etc/bash.bashrc).
if ! shopt -oq posix; then
    if [ -f /usr/share/bash-completion/bash_completion ]; then
        . /usr/share/bash-completion/bash_completion
    elif [ -f /etc/bash_completion ]; then
        . /etc/bash_completion
    fi
fi

export GOPATH=/usr/local/go
export GOPATH=$HOME/bta/lab6
export PATH=$GOPATH/bin:$GOPATH/bin:$PATH

```

Get Help Write Out Where Is Cut Text Justify
Exit Read File Replace Paste Text To Spell

\$source .bashrc

```
Activities Terminal Mar 22 14:51
nupur@nupur-VirtualBox: ~
go/test/undef.go
go/test/unsafebuiltins.go
go/test/used.go
go/test/utf.go
go/test/varerr.go
go/test/varinit.go
go/test/winbatch.go
go/test/writebarrier.go
go/test/zerodivide.go
nupur@nupur-VirtualBox:~/Downloads$ ls
go go1.18.linux-amd64.tar.gz
nupur@nupur-VirtualBox:~/Downloads$ sudo mv go /usr/local
[sudo] password for nupur:
nupur@nupur-VirtualBox:~/Downloads$ cd ~
nupur@nupur-VirtualBox:~$ cd /usr/local
nupur@nupur-VirtualBox:/usr/local$ ls
bin etc games go include lib man sbin share src
nupur@nupur-VirtualBox:/usr/local$ cd go
nupur@nupur-VirtualBox:/usr/local/go$ ls
api codereview.cfg doc misc README.md test
AUTHORS CONTRIBUTING.md lib PATENTS SECURITY.md VERSION
bin CONTRIBUTORS LICENSE pkg src
nupur@nupur-VirtualBox:/usr/local/go$ cd ~
nupur@nupur-VirtualBox:~$ nano .bashrc
nupur@nupur-VirtualBox:~$ nano .bashrc
nupur@nupur-VirtualBox:~$ source .bashrc
nupur@nupur-VirtualBox:~$ go version
go version go1.18 linux/amd64
nupur@nupur-VirtualBox:~$
```

#Check the go version

\$go version

\$cd BTA/lab6/go-ethereum

\$make all

```
Activities Terminal Mar 22 14:52
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

nupur@nupur-VirtualBox:~/Downloads$ sudo mv go /usr/local
[sudo] password for nupur:
nupur@nupur-VirtualBox:~/Downloads$ cd ~
nupur@nupur-VirtualBox:~$ cd /usr/local
nupur@nupur-VirtualBox:/usr/local$ ls
bin  etc  games  go  include  lib  man  sbin  share  src
nupur@nupur-VirtualBox:/usr/local$ cd go
nupur@nupur-VirtualBox:/usr/local/go$ ls
api      codereview.cfg  doc      misc      README.md  test
AUTHORS  CONTRIBUTING.md lib      PATENTS  SECURITY.md VERSION
bin      CONTRIBUTORS    LICENSE  pkg      src
nupur@nupur-VirtualBox:/usr/local/go$ cd ~
nupur@nupur-VirtualBox:~$ nano .bashrc
nupur@nupur-VirtualBox:~$ nano .bashrc
nupur@nupur-VirtualBox:~$ source .bashrc
nupur@nupur-VirtualBox:~$ go version
go version go1.18 linux/amd64
nupur@nupur-VirtualBox:~$ cd bta/lab6/go-ethereum
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ git branch
* btaEthereumv1.9.9
  master
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ make all
build/cov.sh go run build/ci.go install
g Terminal loading github.com/cespare/cp v0.1.0
go: downloading github.com/Azure/azure-storage-blob-go v0.7.0
go: downloading golang.org/x/crypto v0.0.0-20190308221718-c2843e01d9a2
go: downloading github.com/Azure/azure-pipeline-go v0.2.2
go: downloading github.com/matttn/go-ieproxy v0.0.0-20190702010315-6dee0af9227d
```

Creating Blockchain- Genesis Block

\$mkdir genesis

\$ cd genesis

#create the genesis block and add these lines

nano genesisblock.jsom

```
{  "config": {},
    "nonce": "0x00000000000000033",
    "difficulty": "0x4000",
    "alloc": {},
```

```

"mixhash": "0x0000000000000000000000000000000000000000000000000000000000000000",

"coinbase": "0x3333333333333333333333333333333333333333333333333333333333333333",

"timestamp": "0x0000000000000000000000000000000000000000000000000000000000000000",

"parentHash": "0x0000000000000000000000000000000000000000000000000000000000000000",

  "extraData": "0x",

  "gasLimit": "0xffffffff"

}

```

```

nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum/genesis
GNU nano 4.8 genesisblock.json
{
  "config": {},
  "nonce": "0x0000000000000033",
  "difficulty": "0x4000",
  "alloc": {},
  "mixhash": "0x0000000000000000000000000000000000000000000000000000000000000000",
  "coinbase": "0x3333333333333333333333333333333333333333333333333333333333333333",
  "timestamp": "0x0000000000000000000000000000000000000000000000000000000000000000",
  "parentHash": "0x0000000000000000000000000000000000000000000000000000000000000000",
  "extraData": "0x",
  "gasLimit": "0xffffffff"
}

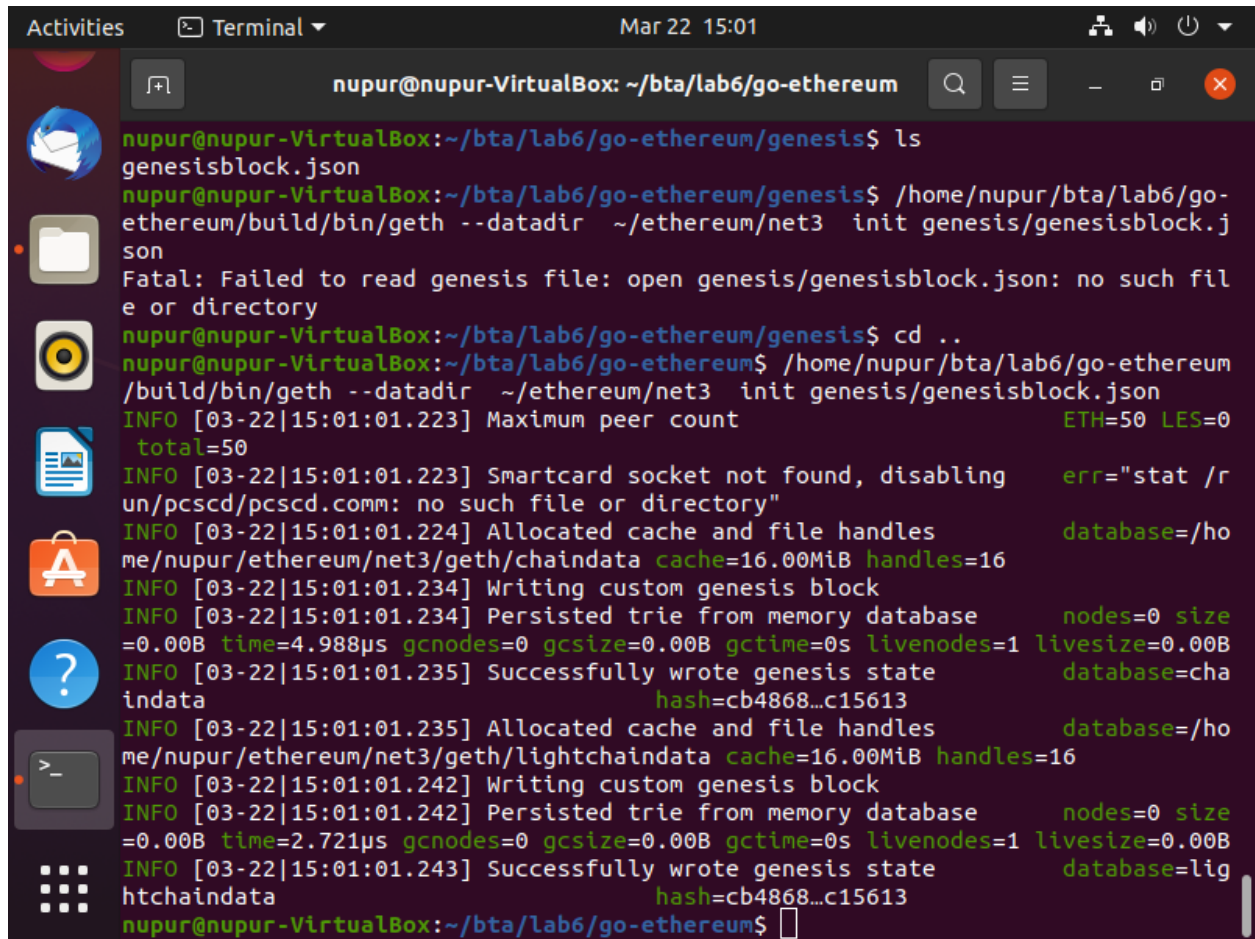
```

[^]G Get Help [^]O Write Out [^]W Where Is [^]K Cut Text [^]J Justify
[^]X Exit [^]R Read File [^]\ Replace [^]U Paste Text [^]T To Spell

Starting the Blockchain

#Initializing the Blockchain

```
$ /home/adaya/BTA/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/net3 init  
genesis/genesisblock.json
```



The screenshot shows a terminal window titled "nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum". The user runs the command `ls genesisblock.json`, which fails with the error "Fatal: Failed to read genesis file: open genesis/genesisblock.json: no such file or directory". The user then runs `cd ..` and the `geth init` command. The output shows the initialization process, including setting the maximum peer count to 50, disabling the smartcard socket, allocating cache and file handles, writing the custom genesis block, and persisting the trie from memory. The process concludes with the message "Successfully wrote genesis state" and the database path set to `lightchaindata`.

```
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum$ ls  
genesisblock.json  
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum/genesis$ /home/nupur/bta/lab6/go-  
ethereum/build/bin/geth --datadir ~/ethereum/net3 init genesis/genesisblock.j  
son  
Fatal: Failed to read genesis file: open genesis/genesisblock.json: no such fil  
e or directory  
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum/genesis$ cd ..  
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ /home/nupur/bta/lab6/go-ethereum  
/build/bin/geth --datadir ~/ethereum/net3 init genesis/genesisblock.json  
INFO [03-22|15:01:01.223] Maximum peer count                ETH=50 LES=0  
total=50  
INFO [03-22|15:01:01.223] Smartcard socket not found, disabling   err="stat /r  
un/pcscd/pcscd.comm: no such file or directory"  
INFO [03-22|15:01:01.224] Allocated cache and file handles       database=/ho  
me/nupur/ethereum/net3/geth/chaindata cache=16.00MiB handles=16  
INFO [03-22|15:01:01.234] Writing custom genesis block  
INFO [03-22|15:01:01.234] Persisted trie from memory database    nodes=0 size  
=0.00B time=4.988µs gcnodes=0 gcsize=0.00B gctime=0s livenodes=1 livesize=0.00B  
INFO [03-22|15:01:01.235] Successfully wrote genesis state       database=cha  
indata hash=cb4868...c15613  
INFO [03-22|15:01:01.235] Allocated cache and file handles       database=/ho  
me/nupur/ethereum/net3/geth/lightchaindata cache=16.00MiB handles=16  
INFO [03-22|15:01:01.242] Writing custom genesis block  
INFO [03-22|15:01:01.242] Persisted trie from memory database    nodes=0 size  
=0.00B time=2.721µs gcnodes=0 gcsize=0.00B gctime=0s livenodes=1 livesize=0.00B  
INFO [03-22|15:01:01.243] Successfully wrote genesis state       database=lig  
htchaindata hash=cb4868...c15613  
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$
```

#Starting the geth console

```
$ /home/adaya/BTA/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/net3 --networkid 3  
console
```



```
Activities Terminal Mar 22 15:02
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ /home/nupur/bta/lab6/go-ethereum
/build/bin/geth --datadir ~/ethereum/net3 --networkid 3 console
INFO [03-22|15:01:58.318] Maximum peer count ETH=50 LES=0
total=50
INFO [03-22|15:01:58.318] Smartcard socket not found, disabling err="stat /r
un/pcscd/pcscd.comm: no such file or directory"
INFO [03-22|15:01:58.319] Starting peer-to-peer node instance=Get
h/v1.9.9-stable-01744997/linux-amd64/go1.18
INFO [03-22|15:01:58.319] Allocated trie memory caches clean=256.00
MiB dirty=256.00MiB
INFO [03-22|15:01:58.319] Allocated cache and file handles database=/ho
me/nupur/ethereum/net3/geth/chaindata cache=512.00MiB handles=524288
INFO [03-22|15:01:58.342] Opened ancient database database=/ho
me/nupur/ethereum/net3/geth/chaindata/ancient
INFO [03-22|15:01:58.343] Initialised chain configuration config="{Cha
inID: <nil> Homestead: <nil> DAO: <nil> DAOsupport: false EIP150: <nil> EIP155:
<nil> EIP158: <nil> Byzantium: <nil> Constantinople: <nil> Petersburg: <nil> I
stanbul: <nil>, Muir Glacier: <nil>, Engine: unknown}"
INFO [03-22|15:01:58.343] Disk storage enabled for ethash caches dir=/home/nu
pur/ethereum/net3/geth/ethash count=3
INFO [03-22|15:01:58.343] Disk storage enabled for ethash DAGs dir=/home/nu
pur/.ethash count=2
INFO [03-22|15:01:58.343] Initialising Ethereum protocol versions="[6
4 63]" network=3 dbversion=<nil>
WARN [03-22|15:01:58.343] Upgrade blockchain database version from=<nil> t
o=7
INFO [03-22|15:01:58.343] Loaded most recent local header number=0 has
h=cb4868...c15613 td=16384 age=52y11mo3w
INFO [03-22|15:01:58.343] Loaded most recent local full block number=0 has
```

>

Starting Blockchain

>personal.newAccount()

>eth.accounts

>eth.blockNumber


```
Activities Terminal Mar 22 15:09
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

Welcome to the Geth JavaScript console!

instance: Geth/v1.9.9-stable-01744997/linux-amd64/go1.18
at block: 0 (Thu, 01 Jan 1970 05:30:00 IST)
datadir: /home/nupur/ethereum/net3
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()
Password:
Repeat password:
INFO [03-22|15:04:34.407] Your new key was generated address=0x24
6d8d2636aB4333EF60c5A2AD246D96A8131D4A
WARN [03-22|15:04:34.407] Please backup your key file! path=/home/n
upur/ethereum/net3/keystore/UTC--2022-03-22T09-34-32.848246828Z--246d8d2636ab43
33ef60c5a2ad246d96a8131d4a
WARN [03-22|15:04:34.407] Please remember your password!
"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a"
> eth.accounts
["0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a"]
> ethtBlockNumber
ReferenceError: 'ethtBlockNumber' is not defined
    at <anonymous>:1:1
> eth.BlockNumber
undefined
> eth.blockNumber
0
> 
```

>miner.start()

```
Activities Terminal Mar 22 15:12
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

INFO [03-22|15:04:34.407] Your new key was generated address=0x24
6d8d2636aB4333EF60c5A2AD246D96A8131D4A
WARN [03-22|15:04:34.407] Please backup your key file! path=/home/n
upur/ethereum/net3/keystore/UTC--2022-03-22T09-34-32.848246828Z--246d8d2636ab43
33ef60c5a2ad246d96a8131d4a
WARN [03-22|15:04:34.407] Please remember your password!
"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a"
> eth.accounts
["0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a"]
> eth.getBlockNumber
ReferenceError: 'eth.getBlockNumber' is not defined
    at <anonymous>:1:1
> eth.BlockNumber
undefined
> eth.blockNumber
0
> miner.start()
INFO [03-22|15:12:07.175] Updated mining threads threads=2
INFO [03-22|15:12:07.175] Transaction pool price threshold updated price=100000
0000
INFO [03-22|15:12:07.175] Etherbase automatically configured address=0x24
6d8d2636aB4333EF60c5A2AD246D96A8131D4A
null
> INFO [03-22|15:12:07.177] Commit new mining work number=1 s
ealhash=a5be47...f6cd81 uncles=0 txs=0 gas=0 fees=0 elapsed=226.007µs
INFO [03-22|15:12:09.242] Generating DAG in progress epoch=0 perc
entage=0 elapsed=1.559s
```

```
Activities Terminal Mar 22 15:24
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

alhash=d9068b...c401f7 hash=47ed53...a6b9c3 elapsed=1.768s
INFO [03-22|15:18:13.280] block reached canonical chain number=37 h
ash=19a7fa...bd470f
INFO [03-22|15:18:13.280] mined potential block number=44 h
ash=47ed53...a6b9c3
INFO [03-22|15:18:13.281] Commit new mining work number=45 se
alhash=b3b5a0...b0a534 uncles=0 txs=0 gas=0 fees=0 elapsed=79.588µs
INFO [03-22|15:18:15.142] Successfully sealed new block number=45 se
alhash=b3b5a0...b0a534 hash=1746dc...ff0c88 elapsed=1.861s
INFO [03-22|15:18:15.143] block reached canonical chain number=38 h
ash=263384...30a20b
INFO [03-22|15:18:15.143] mined potential block number=45 h
ash=1746dc...ff0c88
INFO [03-22|15:18:15.160] Commit new mining work number=46 se
alhash=306d45...f60cc3 uncles=0 txs=0 gas=0 fees=0 elapsed=91.823µs
INFO [03-22|15:18:16.044] Generating DAG in progress epoch=1 perc
centage=36 elapsed=2m53.288s
INFO [03-22|15:18:19.441] Successfully sealed new block number=46 se
alhash=306d45...f60cc3 hash=3c2e52...673bed elapsed=4.281s
INFO [03-22|15:18:19.441] block reached canonical chain number=39 h
ash=31ccdd...3403e3
INFO [03-22|15:18:19.441] mined potential block number=46 h
ash=3c2e52...673bed
INFO [03-22|15:18:19.457] Commit new mining work number=47 se
alhash=22d6e5...ad561e uncles=0 txs=0 gas=0 fees=0 elapsed=98.489µs
INFO [03-22|15:18:19.885] Successfully sealed new block number=47 se
alhash=22d6e5...ad561e hash=c6d106...e42896 elapsed=427.885ms
INFO [03-22|15:18:19.885] block reached canonical chain number=40 h
ash=0f4462...990b7d
```

>miner.stop()

```
Activities Terminal Mar 22 15:21
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

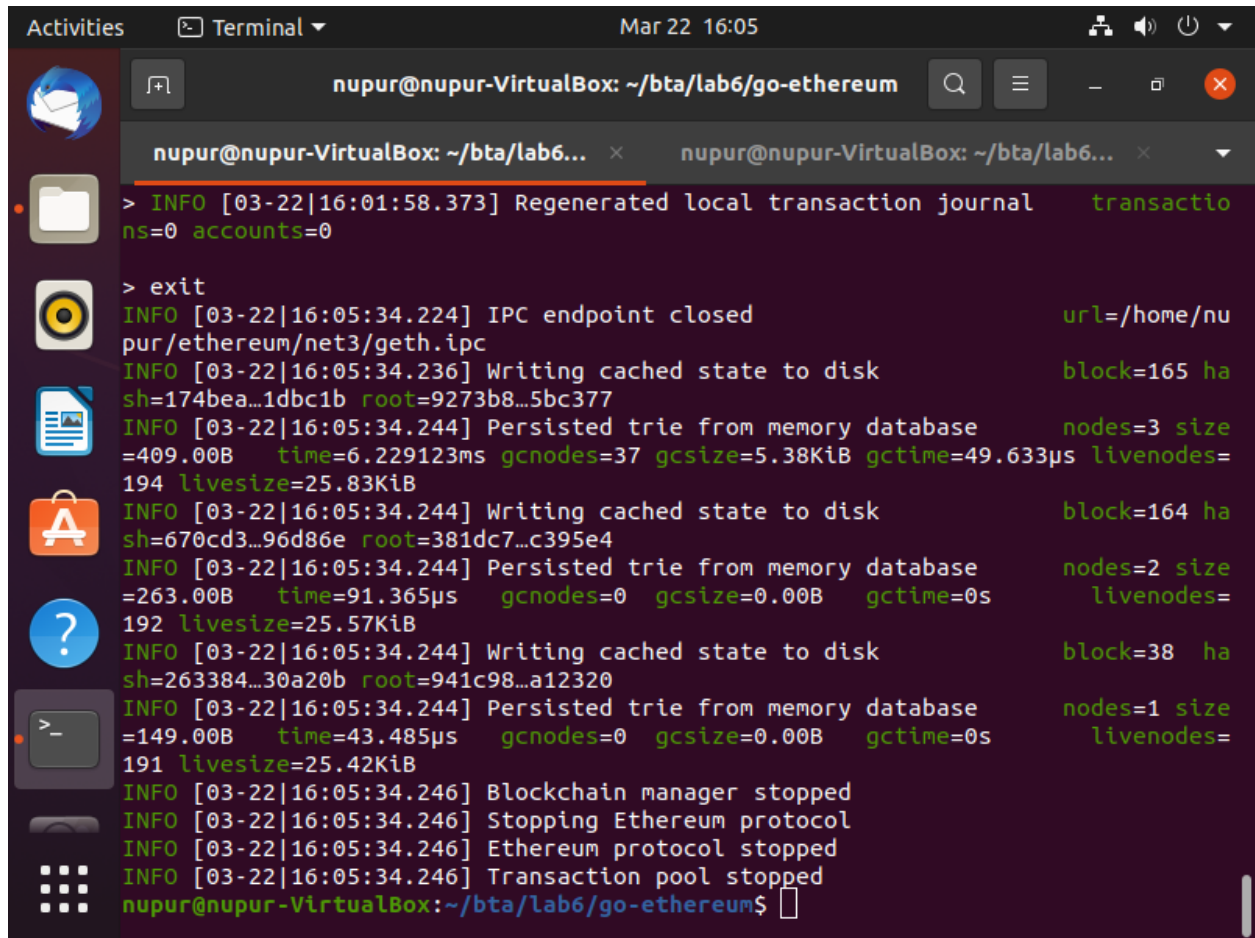
null
> INFO [03-22|15:20:53.445] Generating DAG in progress epoch=1 percentage=92 elapsed=5m30.690s
INFO [03-22|15:20:55.024] Generating DAG in progress epoch=1 percentage=93 elapsed=5m32.268s
> miner.stop()
null
> miner.stop() INFO [03-22|15:20:56.673] Generating DAG in progress epoch=1 percentage=94 elapsed=5m33.917s
null
> miner.stop()
null
> INFO [03-22|15:20:58.613] Generating DAG in progress epoch=1 percentage=95 elapsed=5m35.857s
INFO [03-22|15:21:00.273] Generating DAG in progress epoch=1 percentage=96 elapsed=5m37.517s
^C
> INFO [03-22|15:21:01.846] Generating DAG in progress epoch=1 percentage=97 elapsed=5m39.090s
> et INFO [03-22|15:21:03.433] Generating DAG in progress epoch=1 percentage=98 elapsed=5m40.677s
> eth.INFO [03-22|15:21:05.099] Generating DAG in progress epoch=1 percentage=99 elapsed=5m42.344s
INFO [03-22|15:21:05.106] Generated ethash verification cache epoch=1 elapsed=5m42.345s
> eth.blockNumber
98
>
```

>eth.accounts

```
Activities Terminal Mar 22 15:53
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x
> miner.start() INFO [03-22|15:52:08.796] Successfully sealed new block number=164 sealhash=86ea5a...ffcaa6 hash=670cd3...96d86e elapsed=994.221ms
INFO [03-22|15:52:08.796] block reached canonical chain number=157
hash=3b3e5d...3f0841
INFO [03-22|15:52:08.796] mined potential block number=164
hash=670cd3...96d86e
INFO [03-22|15:52:08.796] Commit new mining work number=165 s
ealhash=df4217...be6a4b uncles=0 txs=0 gas=0 fees=0 elapsed=82.984µs
> miner.stop() INFO [03-22|15:52:11.024] Successfully sealed new block number=165 sealhash=df4217...be6a4b hash=174bea...1dbc1b elapsed=2.227s
INFO [03-22|15:52:11.025] block reached canonical chain number=158
hash=a06ebb...1027e8
INFO [03-22|15:52:11.025] mined potential block number=165
hash=174bea...1dbc1b
INFO [03-22|15:52:11.025] Commit new mining work number=166 s
ealhash=be2593...5eaf56 uncles=0 txs=0 gas=0 fees=0 elapsed=102.594µs
null
> eth.accounts
["0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a", "0xce2a94e85709a0016fb83659b02c681ea9df34c6"]
> eth.getBalance("0xce2a94e85709a0016fb83659b02c681ea9df34c6")
1000000000000000000
> eth.getBalance("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")
82499000000000000000
> 
```

>eth.getBalance("EAO Address")



The screenshot shows a terminal window titled "nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum". The terminal output shows the following sequence of events:

```
> INFO [03-22|16:01:58.373] Regenerated local transaction journal      transactio
ns=0  accounts=0

> exit
INFO [03-22|16:05:34.224] IPC endpoint closed                      url=/home/nu
pur/ethereum/net3/eth.ipc
INFO [03-22|16:05:34.236] Writing cached state to disk            block=165 ha
sh=174bea...1dbc1b  root=9273b8...5bc377
INFO [03-22|16:05:34.244] Persisted trie from memory database     nodes=3 size
=409.00B  time=6.229123ms  gcnodes=37  gcsiz=5.38KiB  gctime=49.633µs  livenodes=
194  livesize=25.83KiB
INFO [03-22|16:05:34.244] Writing cached state to disk            block=164 ha
sh=670cd3...96d86e  root=381dc7...c395e4
INFO [03-22|16:05:34.244] Persisted trie from memory database     nodes=2 size
=263.00B  time=91.365µs   gcnodes=0   gcsiz=0.00B  gctime=0s    livenodes=
192  livesize=25.57KiB
INFO [03-22|16:05:34.244] Writing cached state to disk            block=38  ha
sh=263384...30a20b  root=941c98...a12320
INFO [03-22|16:05:34.244] Persisted trie from memory database     nodes=1 size
=149.00B  time=43.485µs   gcnodes=0   gcsiz=0.00B  gctime=0s    livenodes=
191  livesize=25.42KiB
INFO [03-22|16:05:34.246] Blockchain manager stopped
INFO [03-22|16:05:34.246] Stopping Ethereum protocol
INFO [03-22|16:05:34.246] Ethereum protocol stopped
INFO [03-22|16:05:34.246] Transaction pool stopped
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$
```

Tasks:

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


```
Activities Terminal Mar 22 15:21
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

null
> INFO [03-22|15:20:53.445] Generating DAG in progress epoch=1 percentage=92 elapsed=5m30.690s
INFO [03-22|15:20:55.024] Generating DAG in progress epoch=1 percentage=93 elapsed=5m32.268s
> miner.stop()
null
> miner.stop() INFO [03-22|15:20:56.673] Generating DAG in progress epoch=1 percentage=94 elapsed=5m33.917s
null
> miner.stop()
null
> INFO [03-22|15:20:58.613] Generating DAG in progress epoch=1 percentage=95 elapsed=5m35.857s
INFO [03-22|15:21:00.273] Generating DAG in progress epoch=1 percentage=96 elapsed=5m37.517s
^C
> INFO [03-22|15:21:01.846] Generating DAG in progress epoch=1 percentage=97 elapsed=5m39.090s
> et INFO [03-22|15:21:03.433] Generating DAG in progress epoch=1 percentage=98 elapsed=5m40.677s
> eth.INFO [03-22|15:21:05.099] Generating DAG in progress epoch=1 percentage=99 elapsed=5m42.344s
INFO [03-22|15:21:05.106] Generated ethash verification cache epoch=1 elapsed=5m42.345s
> eth.blockNumber
98
>
```



```
Activities Terminal Mar 22 15:24
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

alhash=d9068b...c401f7 hash=47ed53...a6b9c3 elapsed=1.768s
INFO [03-22|15:18:13.280] block reached canonical chain number=37 h
ash=19a7fa...bd470f
INFO [03-22|15:18:13.280] mined potential block number=44 h
ash=47ed53...a6b9c3
INFO [03-22|15:18:13.281] Commit new mining work number=45 se
alhash=b3b5a0...b0a534 uncles=0 txs=0 gas=0 fees=0 elapsed=79.588µs
INFO [03-22|15:18:15.142] Successfully sealed new block number=45 se
alhash=b3b5a0...b0a534 hash=1746dc...ff0c88 elapsed=1.861s
INFO [03-22|15:18:15.143] block reached canonical chain number=38 h
ash=263384...30a20b
INFO [03-22|15:18:15.143] mined potential block number=45 h
ash=1746dc...ff0c88
INFO [03-22|15:18:15.160] Commit new mining work number=46 se
alhash=306d45...f60cc3 uncles=0 txs=0 gas=0 fees=0 elapsed=91.823µs
INFO [03-22|15:18:16.044] Generating DAG in progress epoch=1 perc
centage=36 elapsed=2m53.288s
INFO [03-22|15:18:19.441] Successfully sealed new block number=46 se
alhash=306d45...f60cc3 hash=3c2e52...673bed elapsed=4.281s
INFO [03-22|15:18:19.441] block reached canonical chain number=39 h
ash=31ccdd...3403e3
INFO [03-22|15:18:19.441] mined potential block number=46 h
ash=3c2e52...673bed
INFO [03-22|15:18:19.457] Commit new mining work number=47 se
alhash=22d6e5...ad561e uncles=0 txs=0 gas=0 fees=0 elapsed=98.489µs
INFO [03-22|15:18:19.885] Successfully sealed new block number=47 se
alhash=22d6e5...ad561e hash=c6d106...e42896 elapsed=427.885ms
INFO [03-22|15:18:19.885] block reached canonical chain number=40 h
ash=0f4462...990b7d
```

[2] Check the balances of each EAO accounts

```
Activities Terminal Mar 22 15:24 nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

eth.getCoinbase
eth.getCompilers
eth.getGasPrice
eth.getHashrate
eth.getHeaderByHash
eth.getHeaderByNumber
> eth.getBalance
function()
> eth.getBalance()
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("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")
490000000000000000000000
> eth.sendTransaction({
.....   from: "EA01",
.....   to: "EA02",
.....   value: web3.toWei(0.01, "ether")
..... })
.....
..... ^C
>
```

[3] Send Ethers and verify

```
eth.sendTransaction({
  from: "EAO1",
  to: "EAO2",
  value: web3.toWei(0.01, "ether")
})
```

Activities Terminal Mar 22 15:46

nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x

```
> eth.sendTransaction(
{ from:"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a",
to:"0xce2a94e85709a0016fb83659b02c681ea9df34c6",
> eth.sendTransaction(
{ from:"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a",
to:"0xce2a94e85709a0016fb83659b02c681ea9df34c6",
> web3.personal.unlockAccount("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")

Unlock account 0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a
Password:
true
> eth.sendTransaction(
{ from:"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a",
to:"0xce2a94e85709a0016fb83659b02c681ea9df34c6",
> web3.personal.unlockAccount("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")

Unlock account 0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a
Password:
true
> web3.personal.unlockAccount("0xce2a94e85709a0016fb83659b02c681ea9df34c6")

Unlock account 0xce2a94e85709a0016fb83659b02c681ea9df34c6
Password:
true
> 
```

```
Activities Terminal Mar 22 15:49
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum
nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x
Password:
true
> eth.sendTransaction(
{ from:"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a",
to:"0xce2a94e85709a0016fb83659b02c681ea9df34c6",
> web3.personal.unlockAccount("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")

Unlock account 0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a
Password:
true
> web3.personal.unlockAccount("0xce2a94e85709a0016fb83659b02c681ea9df34c6")
Unlock account 0xce2a94e85709a0016fb83659b02c681ea9df34c6
Password:
true
> eth.sendTransaction({ from:"0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a", to:"
0xce2a94e85709a0016fb83659b02c681ea9df34c6",value: web3.toWei(0.01,"ether")})
INFO [03-22|15:48:49.619] Setting new local account address=0x24
6d8d2636aB4333EF60c5A2AD246D96A8131D4A
INFO [03-22|15:48:49.619] Submitted transaction fullhash=0xb
d3480712483ee41ba3be6539efd627b63a479e1a448ed3736b9c79c3f835d2c recipient=0xcE2
a94E85709a0016Fb83659b02c681ea9dF34c6
"0xbd3480712483ee41ba3be6539efd627b63a479e1a448ed3736b9c79c3f835d2c"
> eth.getBalance("0xce2a94e85709a0016fb83659b02c681ea9df34c6")
0
>
```

```
Activities Terminal Mar 22 15:50
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum
nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x
ealhash=a89c97...ef3564 uncles=0 txs=0 gas=0 fees=0 elapsed=2.001s
INFO [03-22|15:50:58.980] Successfully sealed new block number=110 s
ealhash=a89c97...ef3564 hash=5dbde7...c377bf elapsed=1.197s
INFO [03-22|15:50:58.980] block reached canonical chain number=103
hash=4c7743...eb5480
INFO [03-22|15:50:58.980] mined potential block number=110
hash=5dbde7...c377bf
INFO [03-22|15:50:58.980] Commit new mining work number=111 s
ealhash=83f2e2...9f3f0d uncles=0 txs=0 gas=0 fees=0 elapsed=96.184µs
INFO [03-22|15:50:59.369] Successfully sealed new block number=111 s
ealhash=83f2e2...9f3f0d hash=79d782...aa933a elapsed=389.352ms
INFO [03-22|15:50:59.370] block reached canonical chain number=104
hash=1e7ac1...c4b787
INFO [03-22|15:50:59.370] mined potential block number=111
hash=79d782...aa933a
INFO [03-22|15:50:59.370] Commit new mining work number=112 s
ealhash=e36825...8b120f uncles=0 txs=0 gas=0 fees=0 elapsed=224.987µs
INFO [03-22|15:50:59.392] Successfully sealed new block number=112 s
ealhash=e36825...8b120f hash=63d1da...d93d01 elapsed=22.142ms
INFO [03-22|15:50:59.392] block reached canonical chain number=105
hash=05e998...d9cd21
INFO [03-22|15:50:59.392] Commit new mining work number=113 s
ealhash=4163f7...014e9f uncles=0 txs=0 gas=0 fees=0 elapsed=620.755µs
INFO [03-22|15:50:59.393] mined potential block number=112
hash=63d1da...d93d01
```

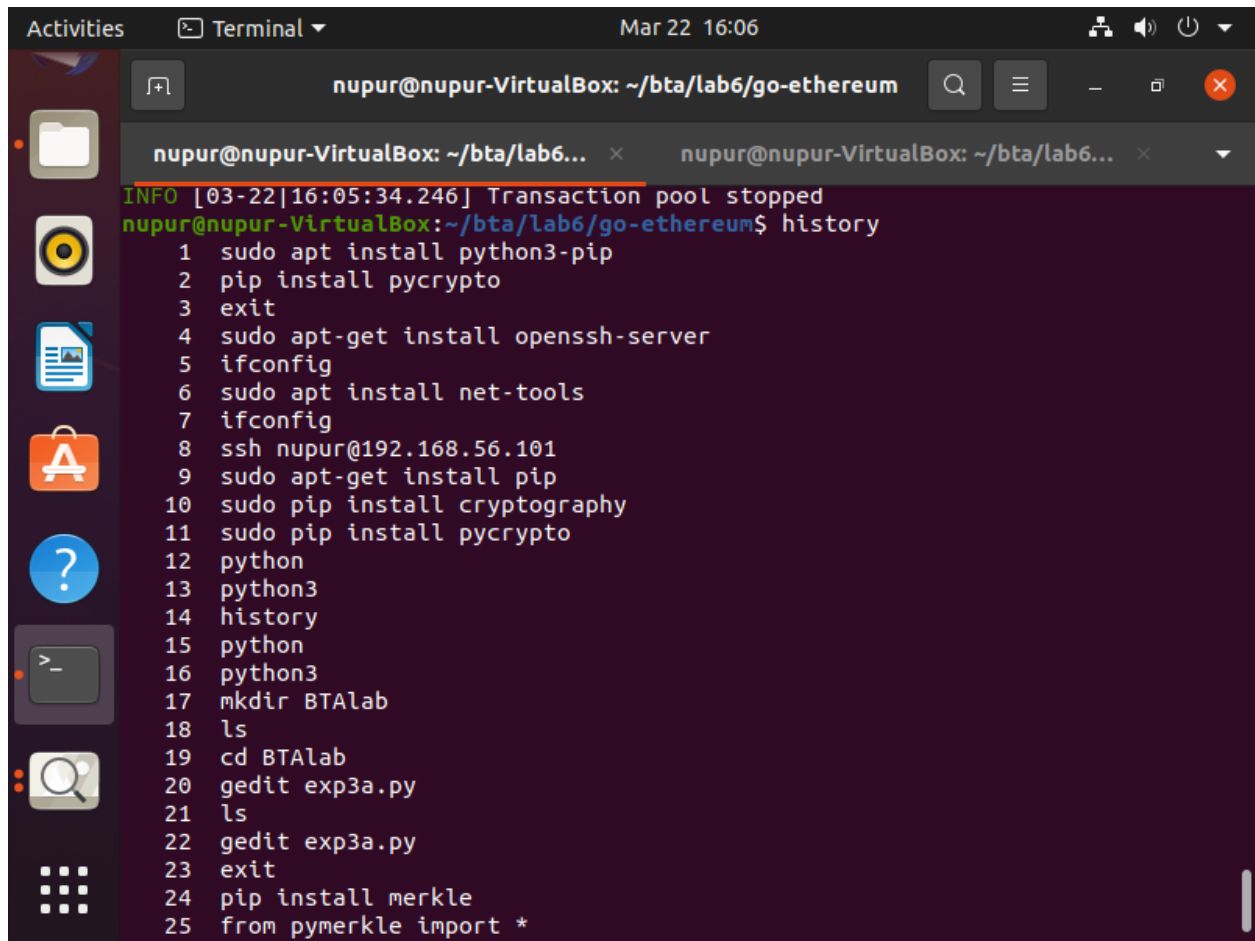
Activities Terminal Mar 22 15:53

nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum

nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x

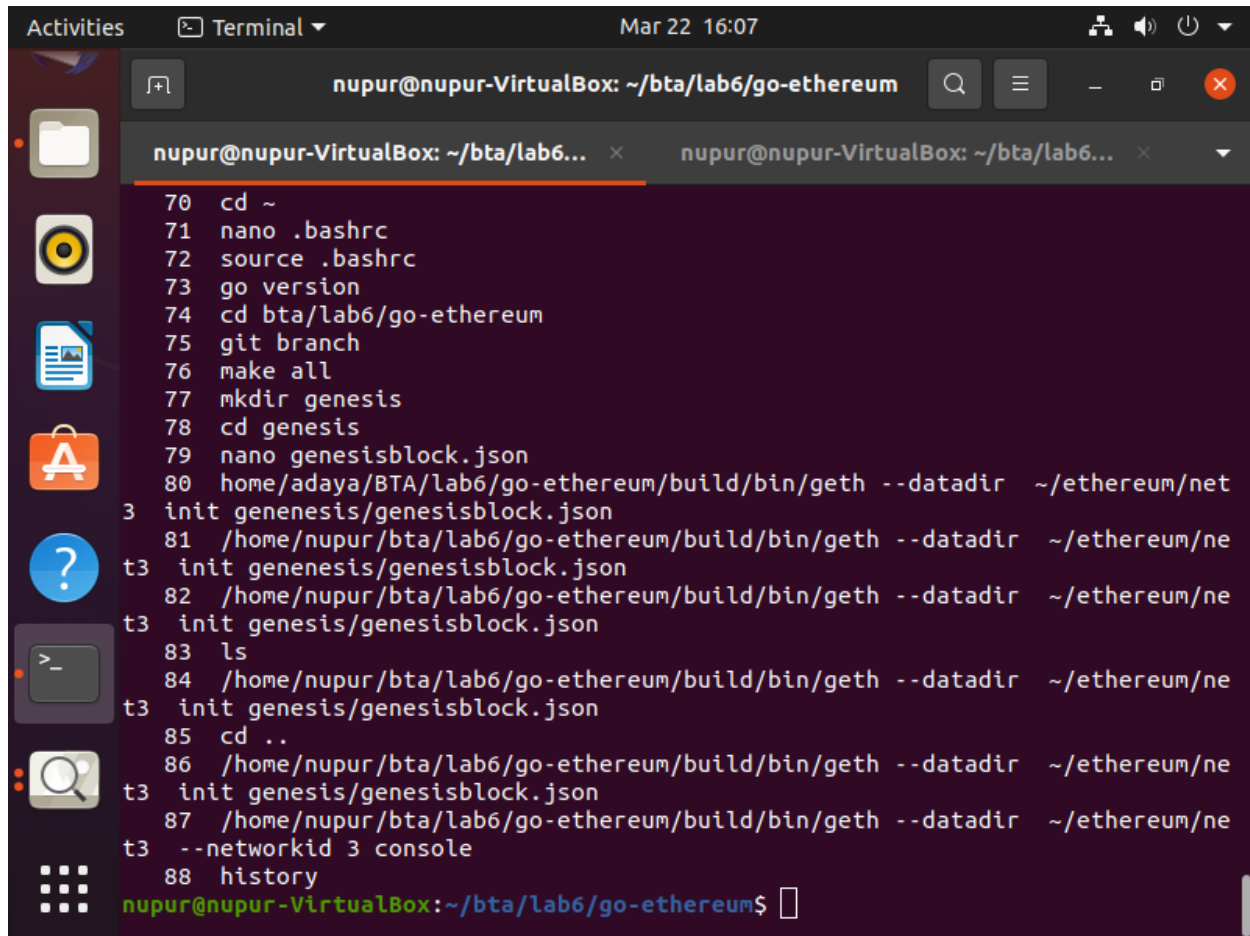
```
> miner.start()
INFO [03-22|15:52:08.796] Successfully sealed new block      number=164
sealhash=86ea5a...ffcaa6 hash=670cd3...96d86e elapsed=994.221ms
INFO [03-22|15:52:08.796] block reached canonical chain      number=157
hash=3b3e5d...3f0841
INFO [03-22|15:52:08.796] mined potential block              number=164
hash=670cd3...96d86e
INFO [03-22|15:52:08.796] Commit new mining work              number=165 s
sealhash=df4217...be6a4b uncles=0 txs=0 gas=0 fees=0 elapsed=82.984µs
> miner.stop()
INFO [03-22|15:52:11.024] Successfully sealed new block      number=165
sealhash=df4217...be6a4b hash=174bea...1dbc1b elapsed=2.227s
INFO [03-22|15:52:11.025] block reached canonical chain      number=158
hash=a06ebb...1027e8
INFO [03-22|15:52:11.025] mined potential block              number=165
hash=174bea...1dbc1b
INFO [03-22|15:52:11.025] Commit new mining work              number=166 s
sealhash=be2593...5eaf56 uncles=0 txs=0 gas=0 fees=0 elapsed=102.594µs
null
> eth.accounts
["0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a", "0xce2a94e85709a0016fb83659b02c681ea9df34c6"]
> eth.getBalance("0xce2a94e85709a0016fb83659b02c681ea9df34c6")
1000000000000000000
> eth.getBalance("0x246d8d2636ab4333ef60c5a2ad246d96a8131d4a")
82499000000000000000
>
```


History



The screenshot shows a terminal window titled "nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum". The terminal output includes a log message and a list of 25 commands from the shell history. The log message is "INFO [03-22|16:05:34.246] Transaction pool stopped". The commands are listed as follows:

```
INFO [03-22|16:05:34.246] Transaction pool stopped
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$ history
 1 sudo apt install python3-pip
 2 pip install pycrypto
 3 exit
 4 sudo apt-get install openssh-server
 5 ifconfig
 6 sudo apt install net-tools
 7 ifconfig
 8 ssh nupur@192.168.56.101
 9 sudo apt-get install pip
10 sudo pip install cryptography
11 sudo pip install pycrypto
12 python
13 python3
14 history
15 python
16 python3
17 mkdir BTALab
18 ls
19 cd BTALab
20 gedit exp3a.py
21 ls
22 gedit exp3a.py
23 exit
24 pip install merkle
25 from pymerkle import *
```

```
Activities Terminal Mar 22 16:07
nupur@nupur-VirtualBox: ~/bta/lab6/go-ethereum
nupur@nupur-VirtualBox: ~/bta/lab6... x nupur@nupur-VirtualBox: ~/bta/lab6... x
70 cd ~
71 nano .bashrc
72 source .bashrc
73 go version
74 cd bta/lab6/go-ethereum
75 git branch
76 make all
77 mkdir genesis
78 cd genesis
79 nano genesisblock.json
80 /home/adaya/BTA/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/net
3 init genesis/genesisblock.json
81 /home/nupur/bta/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/ne
t3 init genesis/genesisblock.json
82 /home/nupur/bta/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/ne
t3 init genesis/genesisblock.json
83 ls
84 /home/nupur/bta/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/ne
t3 init genesis/genesisblock.json
85 cd ..
86 /home/nupur/bta/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/ne
t3 init genesis/genesisblock.json
87 /home/nupur/bta/lab6/go-ethereum/build/bin/geth --datadir ~/ethereum/ne
t3 --networkid 3 console
88 history
nupur@nupur-VirtualBox:~/bta/lab6/go-ethereum$
```

Conclusion:

In this experiment, created a private ethereum blockchain. Installed go ethereum and created a genesis block. Created an account and then mined for ethers, which is a crypto currency. Performed transactions to transfer ethers from one account to another. After that, again mined for ethers so that the new transaction gets added to the blockchain as a new block and ethers get successfully transferred.

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](#)

[4] Mastering Blockchain Technology by Imran Bashir 3rd Edition Chapter 11,12 and 13, Packt Publications