FINOLEX ACADEMY OF MANAGEMENT AND TECHNOLOGY, RATNAGIRI

DEPARTMENT OF MCA

PRACTICAL NO. 04

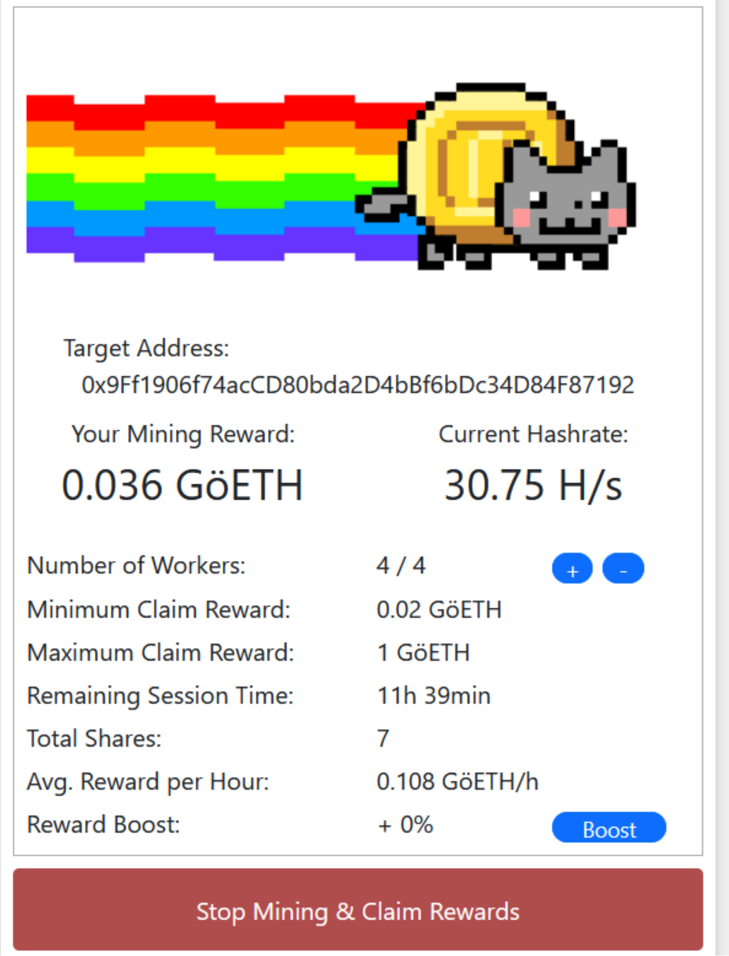
Ethereum

1. Install the metamask in browser. Setup the metamask digital cryptocurrency wallet. Create multiple accounts in metamask and connect with one of the etherum blockchain test network. Perform the task buy ethers and send ethers from one account to another. Take the screenshots of created accounts, account assets and account transactions which showing the details of transaction.

(Use following url to get free ether for Goerli Test Network: https://goerli-faucet.pk910.de/)

Ans :

Output :

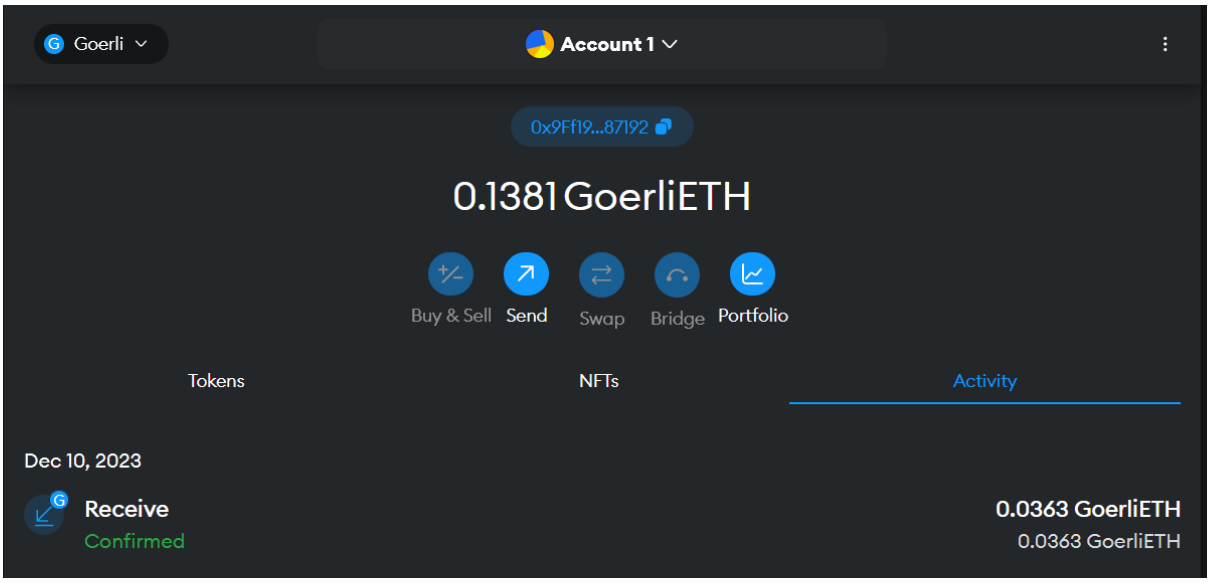


Target Address:
0x9Ff1906f74acCD80bda2D4bBf6bDc34D84F87192

Your Mining Reward: 0.036 GöETH

Current Hashrate: 30.75 H/s

Number of Workers:	4 / 4
Minimum Claim Reward:	0.02 GöETH
Maximum Claim Reward:	1 GöETH
Remaining Session Time:	11h 39min
Total Shares:	7
Avg. Reward per Hour:	0.108 GöETH/h
Reward Boost:	+ 0%

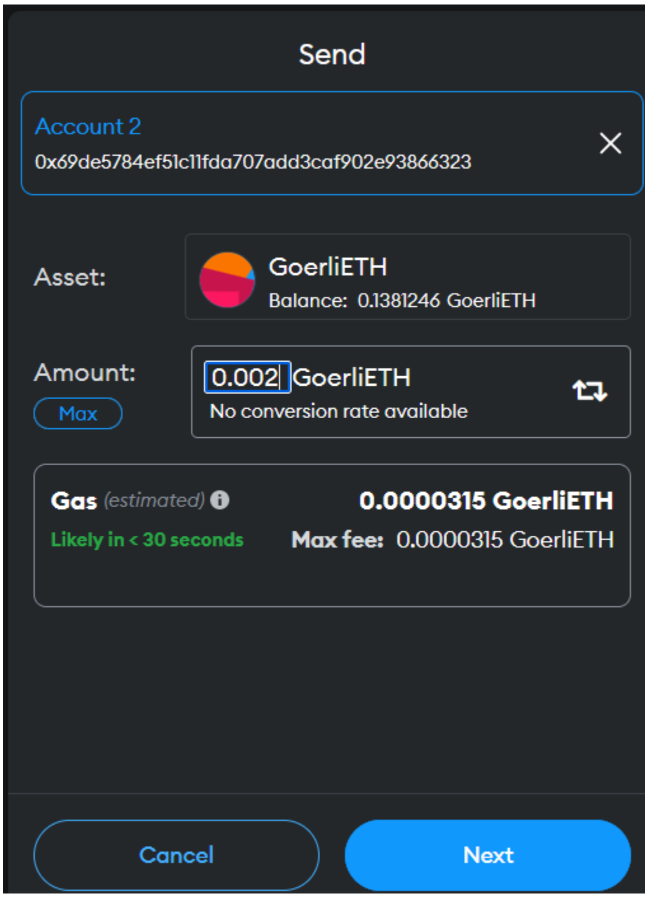


0x9Ff19...87192

0.1381 GoerliETH

Dec 10, 2023

Receive 0.0363 GoerliETH
Confirmed 0.0363 GoerliETH

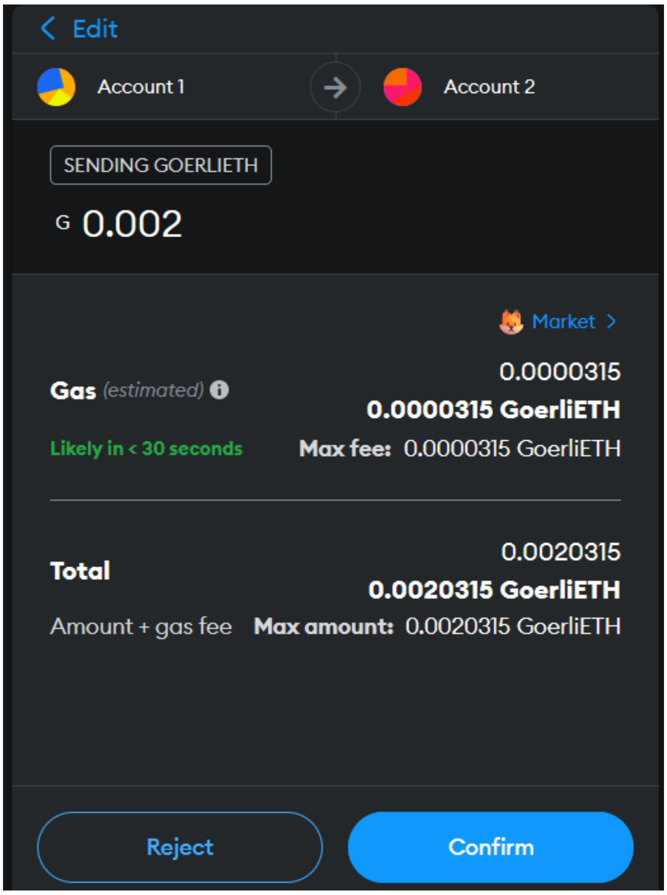


Account 2
0x69de5784ef51c11fda707add3caf902e93866323

Asset: GoerliETH
Balance: 0.1381246 GoerliETH

Amount: 0.002 GoerliETH
No conversion rate available

Gas *(estimated)* **0.0000315 GoerliETH**
Likely in < 30 seconds **Max fee:** 0.0000315 GoerliETH

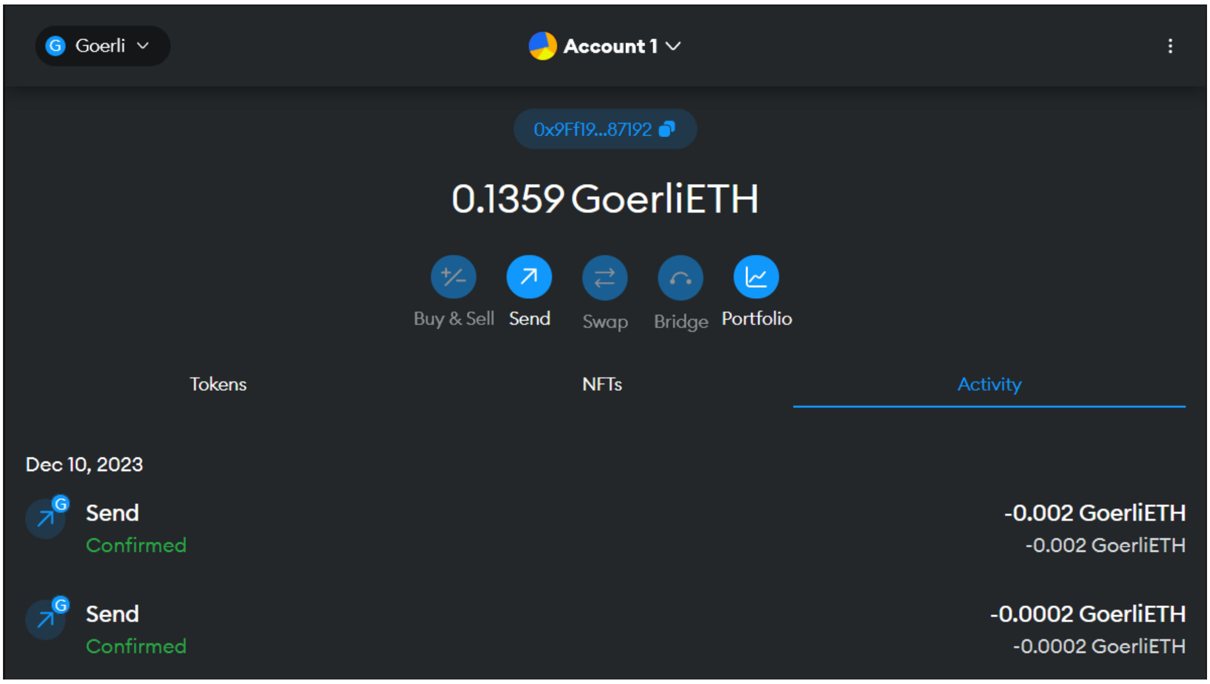


SENDING GOERLIETH

G 0.002

Gas *(estimated)* 0.0000315
0.0000315 GoerliETH
Likely in < 30 seconds **Max fee:** 0.0000315 GoerliETH

Total 0.0020315
0.0020315 GoerliETH
Amount + gas fee **Max amount:** 0.0020315 GoerliETH



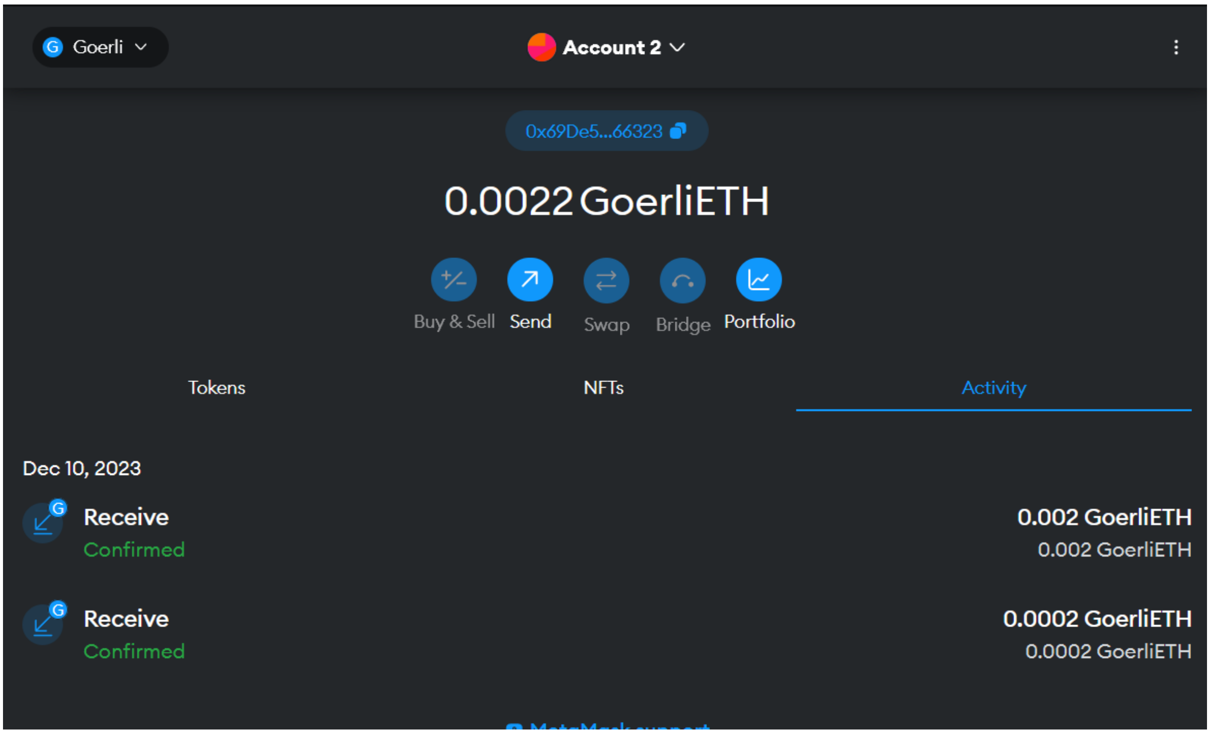
0x9Ff19...87192

0.1359 GoerliETH

Dec 10, 2023

Send
Confirmed
-0.002 GoerliETH
-0.002 GoerliETH

Send
Confirmed
-0.0002 GoerliETH
-0.0002 GoerliETH



0x69De5...66323

0.0022 GoerliETH

Dec 10, 2023

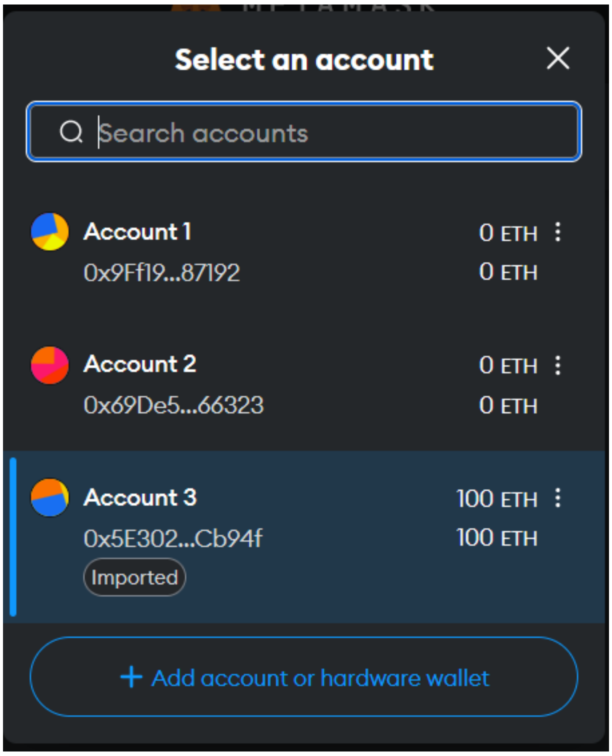
Receive
Confirmed
0.002 GoerliETH
0.002 GoerliETH

Receive
Confirmed
0.0002 GoerliETH
0.0002 GoerliETH

2. Start Ganache (your personal private blockchain network). Connect Ganache with MetaMask and import the account from Ganache to MetaMask. Transfer funds from imported account to other account of MetaMask. Take the screenshots of created accounts, account assets and account transactions which showing the details of transaction from MetaMask and Ganache interface. GoEthereum(Geth)

Ans :

- **Output :**



Select an account

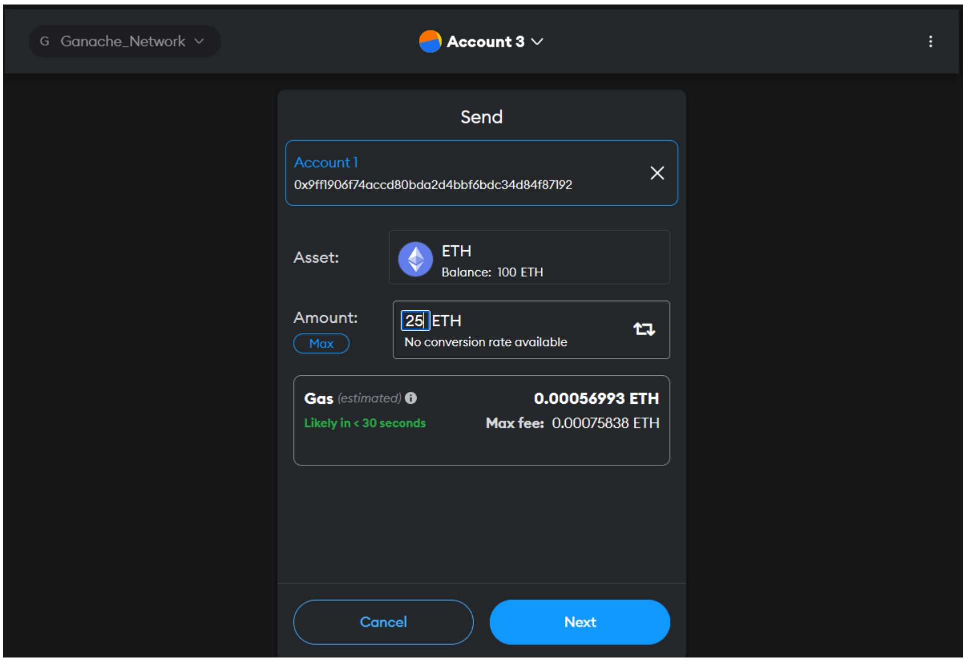
Search accounts

Account 1 0 ETH
0x9Ff19...87192 0 ETH

Account 2 0 ETH
0x69De5...66323 0 ETH

Account 3 100 ETH
0x5E302...Cb94f 100 ETH
Imported

+ Add account or hardware wallet



Ganache_Network

Account 3

Send

Account 1
0x9ff1906f74accd80bda2d4bbf6bdc34d84f87192

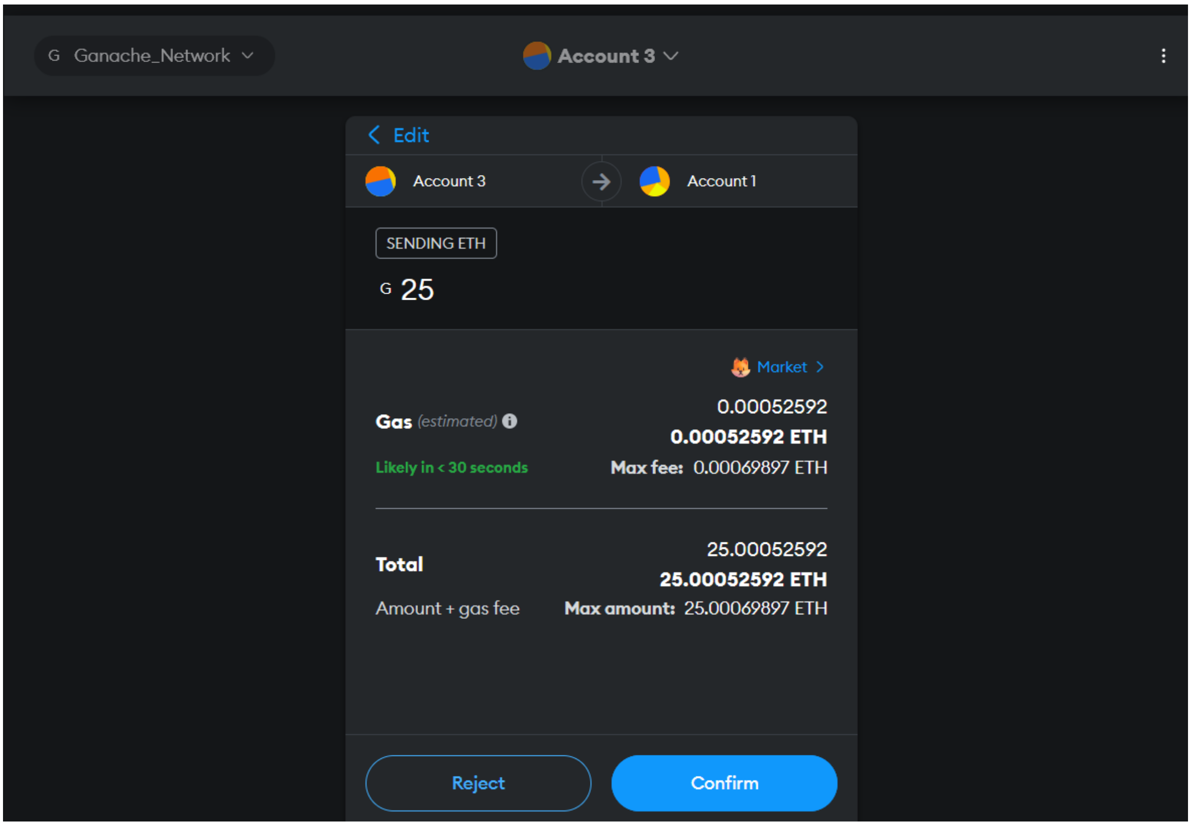
Asset: ETH
Balance: 100 ETH

Amount: 25 ETH
No conversion rate available

Max

Gas (estimated) 0.00056993 ETH
Likely in < 30 seconds Max fee: 0.00075838 ETH

Cancel Next



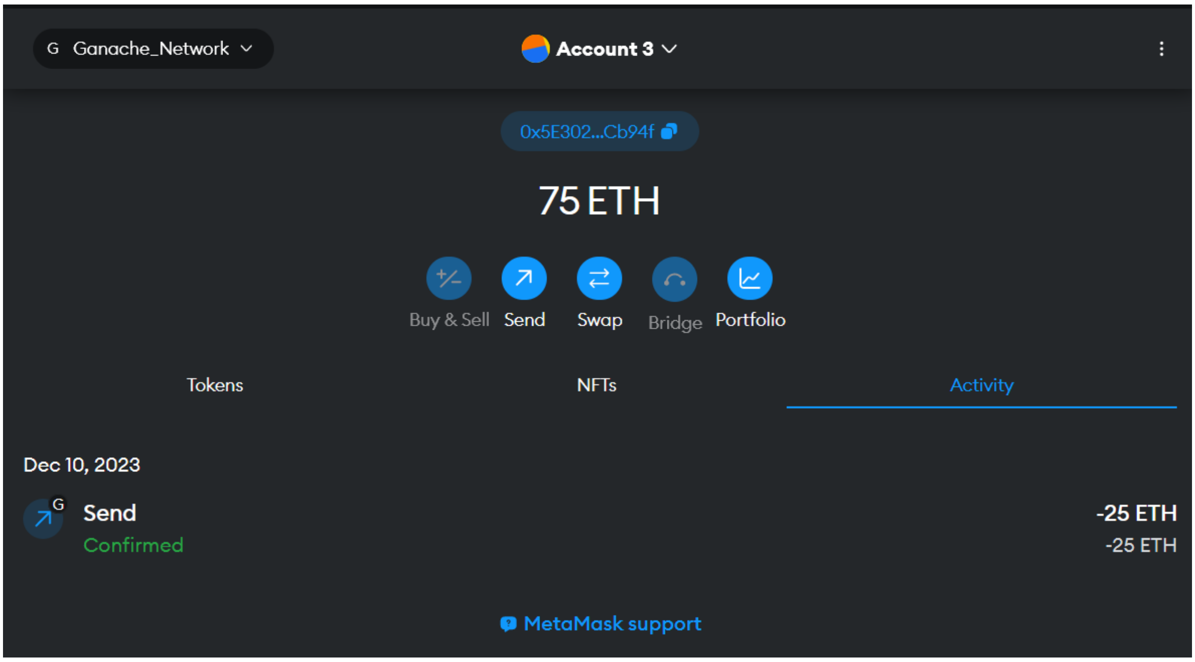
Account 3 → Account 1

SENDING ETH

G 25

Gas *(estimated)* 0.00052592
0.00052592 ETH
Likely in < 30 seconds **Max fee:** 0.00069897 ETH

Total 25.00052592
25.00052592 ETH
Amount + gas fee **Max amount:** 25.00069897 ETH

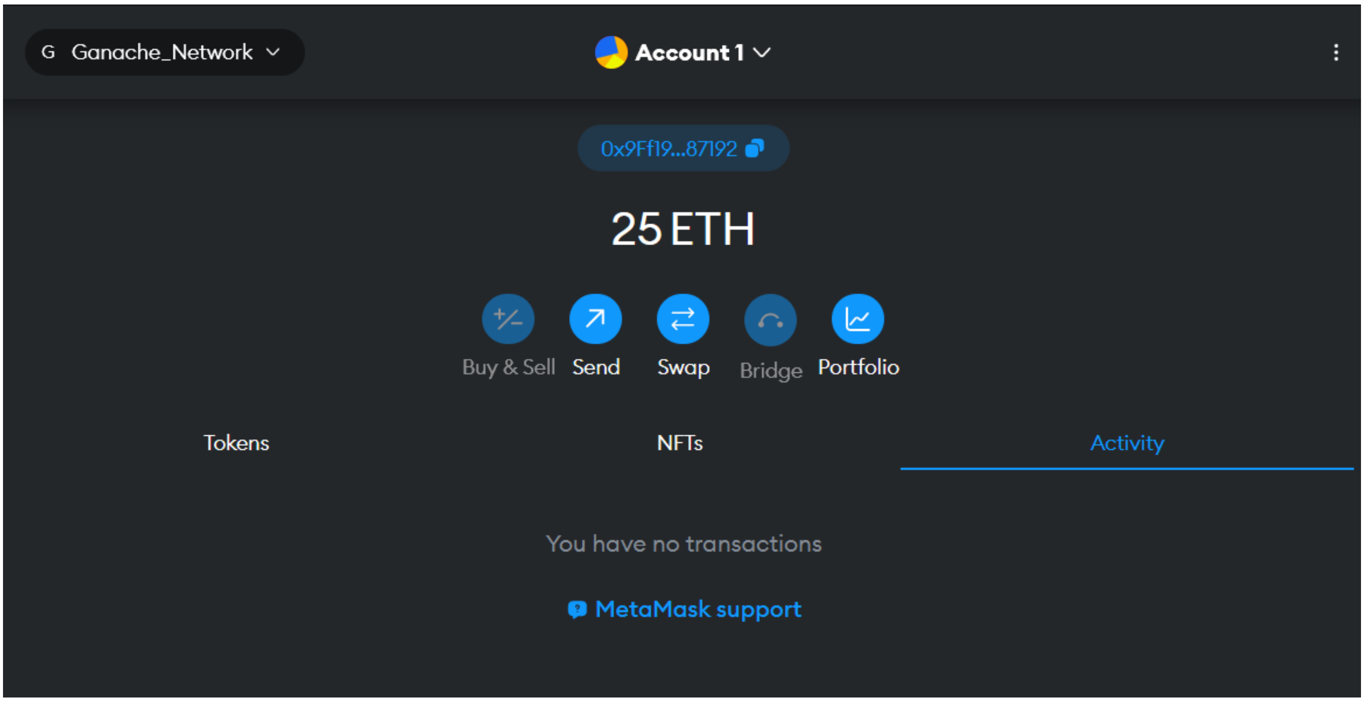


0x5E302...Cb94f

75 ETH

Dec 10, 2023

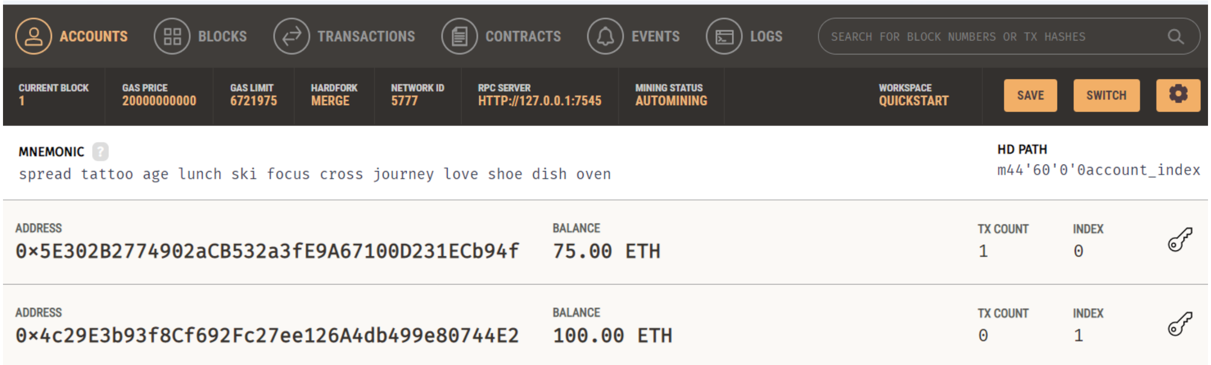
Send -25 ETH
Confirmed -25 ETH



0x9Ff19...87192

25 ETH

You have no transactions



CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
1	20000000000	6721975	MERGE	5777	HTTP://127.0.0.1:7545	AUTOMINING	QUICKSTART

MNEMONIC
spread tattoo age lunch ski focus cross journey love shoe dish oven

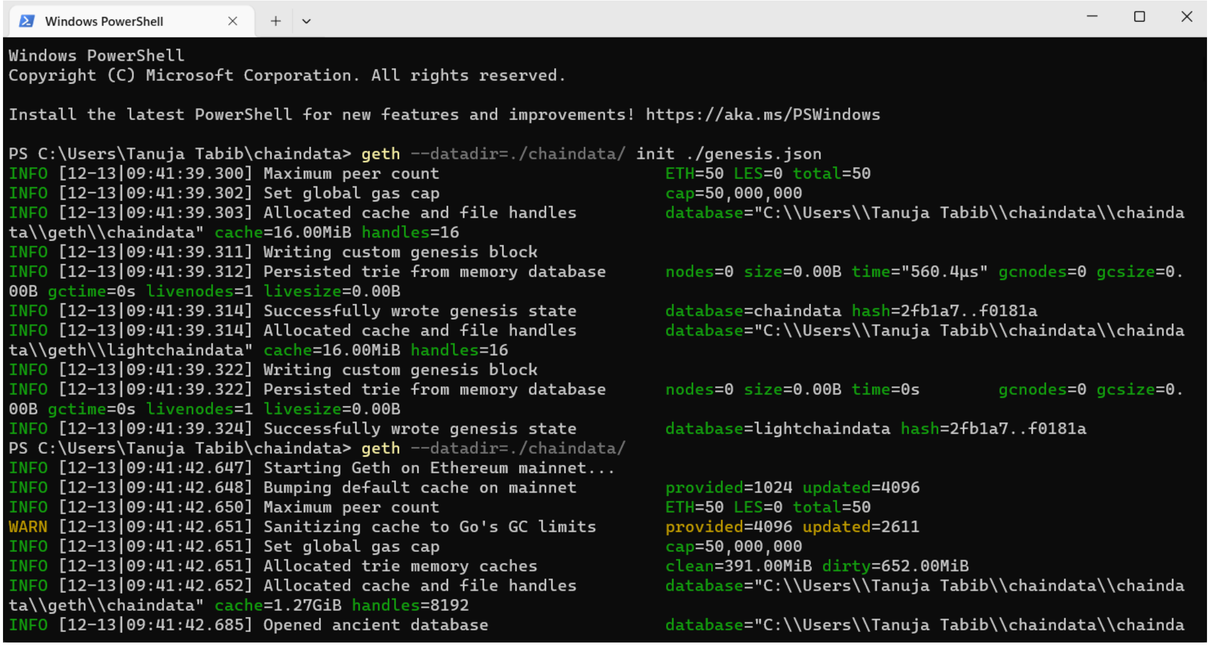
HD PATH
m44'60'0'0account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×5E302B2774902aCB532a3fE9A67100D231ECb94f	75.00 ETH	1	0
0×4c29E3b93f8Cf692Fc27ee126A4db499e80744E2	100.00 ETH	0	1

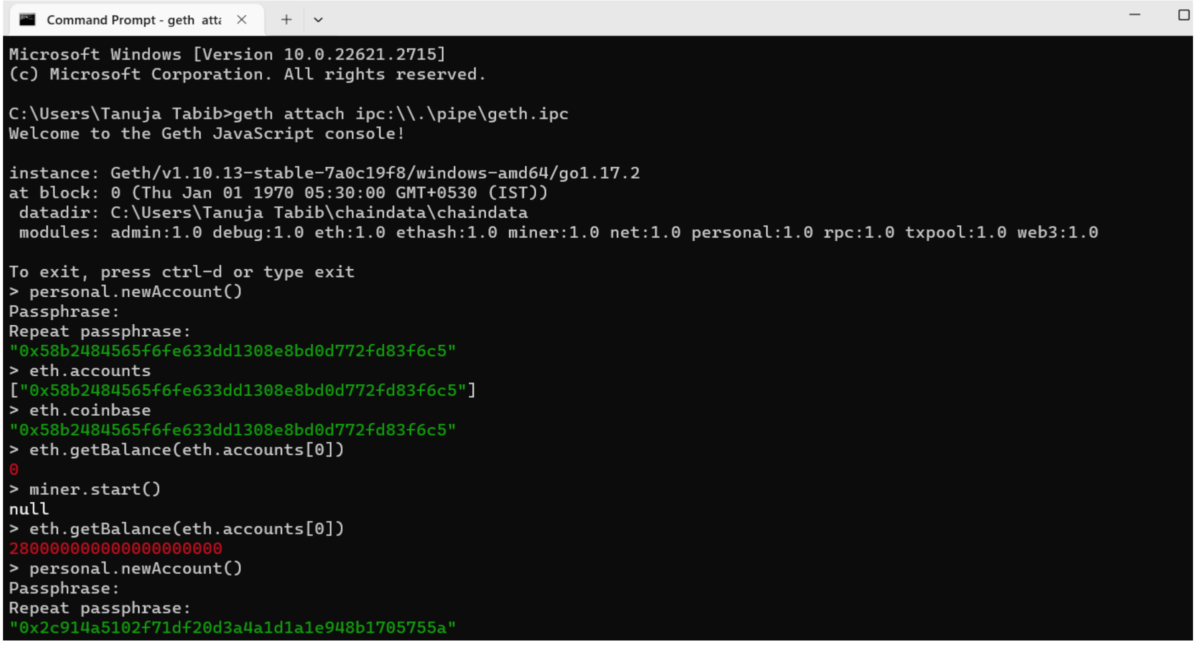
3. Create Ethereum node using Geth (GoEthereum) and create genesis block and create your personal private Ethereum blockchain. And use IPC to interact with Geth node to perform following task: create account, transfer funds using send transaction, mine the block, show the account balance before and after the mining the block, show the specific block details and access chain details. Remix IDE – Injected Provider - Public Test Network (Goerli, Sepolia) or Ganache

Ans :

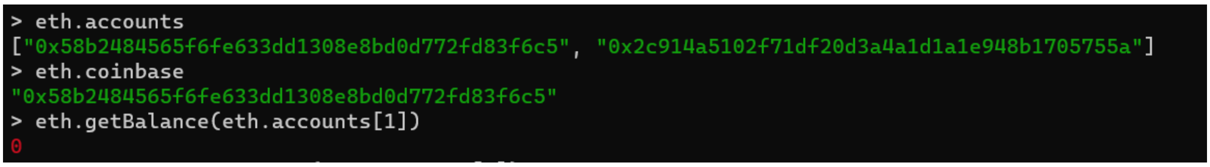
- **Output :**



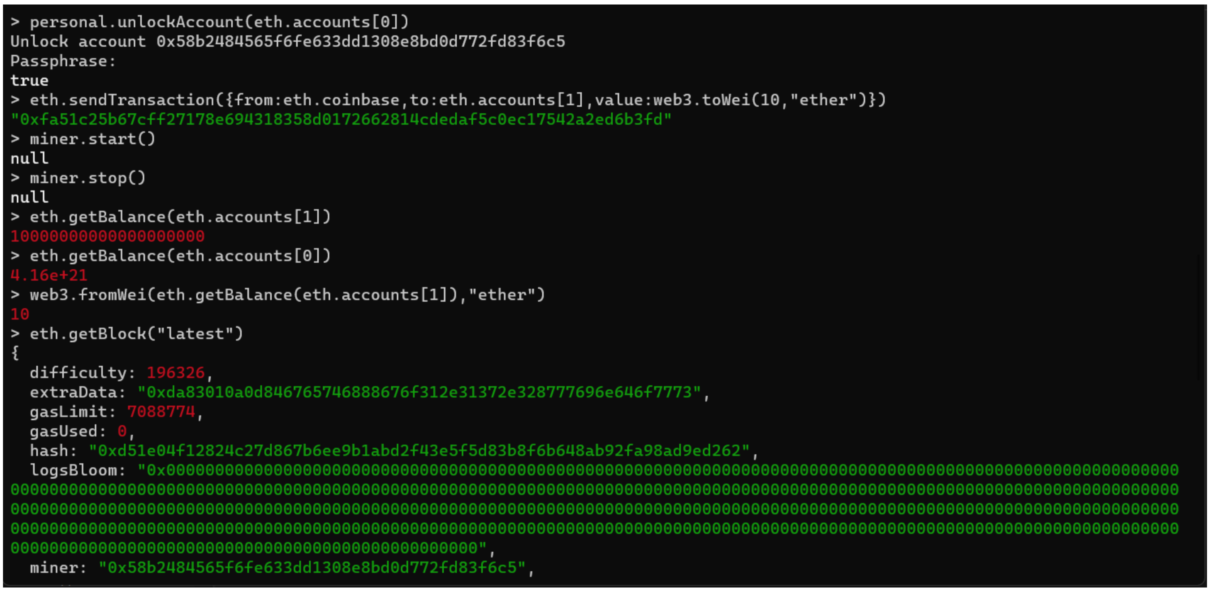
```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Tanuja Tabib\chaindata> geth --datadir=./chaindata/ init ./genesis.json
INFO [12-13|09:41:39.300] Maximum peer count                       ETH=50 LES=0 total=50
INFO [12-13|09:41:39.302] Set global gas cap                       cap=50,000,000
INFO [12-13|09:41:39.303] Allocated cache and file handles         database="C:\\Users\\Tanuja Tabib\\chaindata\\chainda
ta\\geth\\chaindata" cache=16.00MiB handles=16
INFO [12-13|09:41:39.311] Writing custom genesis block
INFO [12-13|09:41:39.312] Persisted trie from memory database      nodes=0 size=0.00B time="560.4µs" gcnodes=0 gcsize=0.
00B gctime=0s livenodes=1 livesize=0.00B
INFO [12-13|09:41:39.314] Successfully wrote genesis state         database=chaindata hash=2fb1a7..f0181a
INFO [12-13|09:41:39.314] Allocated cache and file handles         database="C:\\Users\\Tanuja Tabib\\chaindata\\chainda
ta\\geth\\lightchaindata" cache=16.00MiB handles=16
INFO [12-13|09:41:39.322] Writing custom genesis block
INFO [12-13|09:41:39.322] Persisted trie from memory database      nodes=0 size=0.00B time=0s       gcnodes=0 gcsize=0.
00B gctime=0s livenodes=1 livesize=0.00B
INFO [12-13|09:41:39.324] Successfully wrote genesis state         database=lightchaindata hash=2fb1a7..f0181a
PS C:\Users\Tanuja Tabib\chaindata> geth --datadir=./chaindata/
INFO [12-13|09:41:42.647] Starting Geth on Ethereum mainnet...
INFO [12-13|09:41:42.648] Bumping default cache on mainnet         provided=1024 updated=4096
INFO [12-13|09:41:42.650] Maximum peer count                       ETH=50 LES=0 total=50
WARN [12-13|09:41:42.651] Sanitizing cache to Go's GC limits       provided=4096 updated=2611
INFO [12-13|09:41:42.651] Set global gas cap                       cap=50,000,000
INFO [12-13|09:41:42.651] Allocated trie memory caches             clean=391.00MiB dirty=652.00MiB
INFO [12-13|09:41:42.652] Allocated cache and file handles         database="C:\\Users\\Tanuja Tabib\\chaindata\\chainda
ta\\geth\\chaindata" cache=1.27GiB handles=8192
INFO [12-13|09:41:42.685] Opened ancient database                  database="C:\\Users\\Tanuja Tabib\\chaindata\\chainda
```



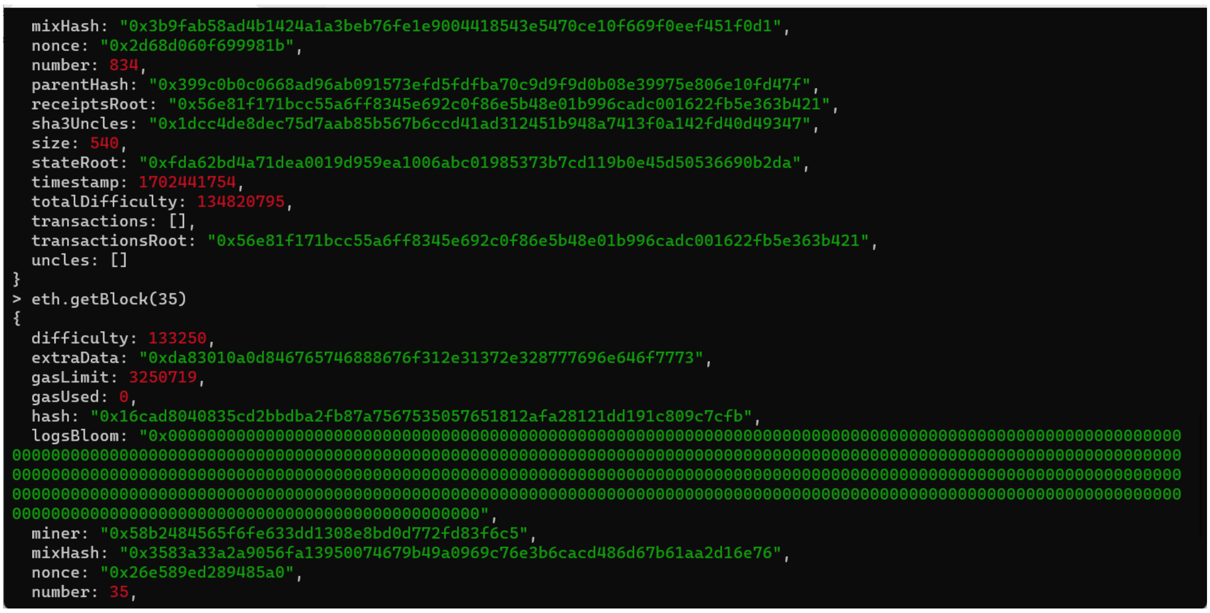
```
Microsoft Windows [Version 10.0.22621.2715]
(c) Microsoft Corporation. All rights reserved.

C:\Users\Tanuja Tabib>geth attach ipc:\\.\pipe\geth.ipc
Welcome to the Geth JavaScript console!

instance: Geth/v1.10.13-stable-7a0c19f8/windows-amd64/go1.17.2
at block: 0 (Thu Jan 01 1970 05:30:00 GMT+0530 (IST))
 datadir: C:\Users\Tanuja Tabib\chaindata\chaindata
 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

To exit, press ctrl-d or type exit
> personal.newAccount()
Passphrase:
Repeat passphrase:
"0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5"
> eth.accounts
["0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5"]
> eth.coinbase
"0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5"
> eth.getBalance(eth.accounts[0])
0
> miner.start()
null
> eth.getBalance(eth.accounts[0])
280000000000000000000
> personal.newAccount()
Passphrase:
Repeat passphrase:
"0x2c914a5102f71df20d3a4a1d1a1e948b1705755a"
```



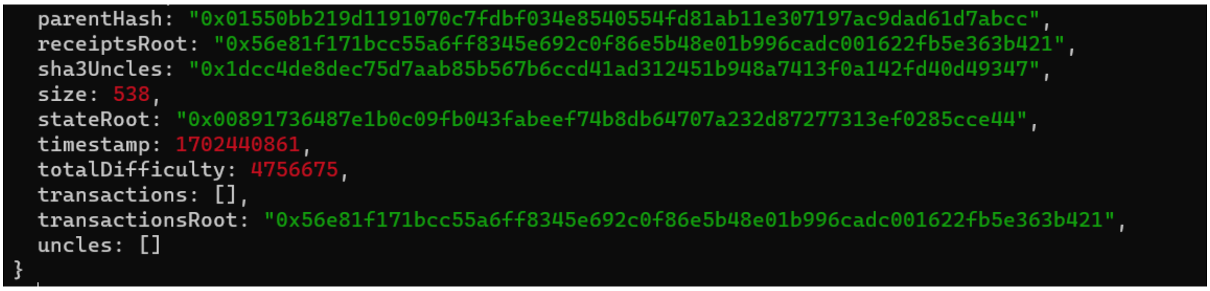
```
> eth.accounts
["0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5", "0x2c914a5102f71df20d3a4a1d1a1e948b1705755a"]
> eth.coinbase
"0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5"
> eth.getBalance(eth.accounts[1])
0
```



```
> personal.unlockAccount(eth.accounts[0])
Unlock account 0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5
Passphrase:
true
> eth.sendTransaction({from:eth.coinbase,to:eth.accounts[1],value:web3.toWei(10,"ether")})
"0xfa51c25b67cff27178e694318358d0172662814cdedaf5c0ec17542a2ed6b3fd"
> miner.start()
null
> miner.stop()
null
> eth.getBalance(eth.accounts[1])
10000000000000000000
> eth.getBalance(eth.accounts[0])
4.16e+21
> web3.fromWei(eth.getBalance(eth.accounts[1]),"ether")
10
> eth.getBlock("latest")
{
  difficulty: 196326,
  extraData: "0xda83010a0d846765746888676f312e31372e328777696e646f7773",
  gasLimit: 7088774,
  gasUsed: 0,
  hash: "0xd51e04f12824c27d867b6ee9b1abd2f43e5f5d83b8f6b648ab92fa98ad9ed262",
  logsBloom: "0x00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000",
  miner: "0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5",
```



```
  mixHash: "0x3b9fab58ad4b1424a1a3beb76fe1e9004418543e5470ce10f669f0eef451f0d1",
  nonce: "0x2d68d060f699981b",
  number: 834,
  parentHash: "0x399c0b0c0668ad96ab091573efd5fdfba70c9d9f9d0b08e39975e806e10fd47f",
  receiptsRoot: "0x56e81f171bcc55a6ff8345e692c0f86e5b48e01b996cadc001622fb5e363b421",
  sha3Uncles: "0x1dcc4de8dec75d7aab85b567b6ccd41ad312451b948a7413f0a142fd40d49347",
  size: 540,
  stateRoot: "0xfda62bd4a71dea0019d959ea1006abc01985373b7cd119b0e45d50536690b2da",
  timestamp: 1702441754,
  totalDifficulty: 134820795,
  transactions: [],
  transactionsRoot: "0x56e81f171bcc55a6ff8345e692c0f86e5b48e01b996cadc001622fb5e363b421",
  uncles: []
}
> eth.getBlock(35)
{
  difficulty: 133250,
  extraData: "0xda83010a0d846765746888676f312e31372e328777696e646f7773",
  gasLimit: 3250719,
  gasUsed: 0,
  hash: "0x16cad8040835cd2bbdba2fb87a7567535057651812afa28121dd191c809c7cfb",
  logsBloom: "0x00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000",
  miner: "0x58b2484565f6fe633dd1308e8bd0d772fd83f6c5",
  mixHash: "0x3583a33a2a9056fa13950074679b49a0969c76e3b6cacd486d67b61aa2d16e76",
  nonce: "0x26e589ed289485a0",
  number: 35,
```



```
  parentHash: "0x01550bb219d1191070c7fdbf034e8540554fd81ab11e307197ac9dad61d7abcc",
  receiptsRoot: "0x56e81f171bcc55a6ff8345e692c0f86e5b48e01b996cadc001622fb5e363b421",
  sha3Uncles: "0x1dcc4de8dec75d7aab85b567b6ccd41ad312451b948a7413f0a142fd40d49347",
  size: 538,
  stateRoot: "0x00891736487e1b0c09fb043fabeef74b8db64707a232d87277313ef0285cce44",
  timestamp: 1702440861,
  totalDifficulty: 4756675,
  transactions: [],
  transactionsRoot: "0x56e81f171bcc55a6ff8345e692c0f86e5b48e01b996cadc001622fb5e363b421",
  uncles: []
}
```

4. Write a solidity smart contract for performing following task using remixIDE and deployed it on public test network – Goerli / Sapolia using Injected provider environment.

a. To transfer funds (ethers) from user account to contract account.

b. To withdraw funds (ethers) from contract account to user account.

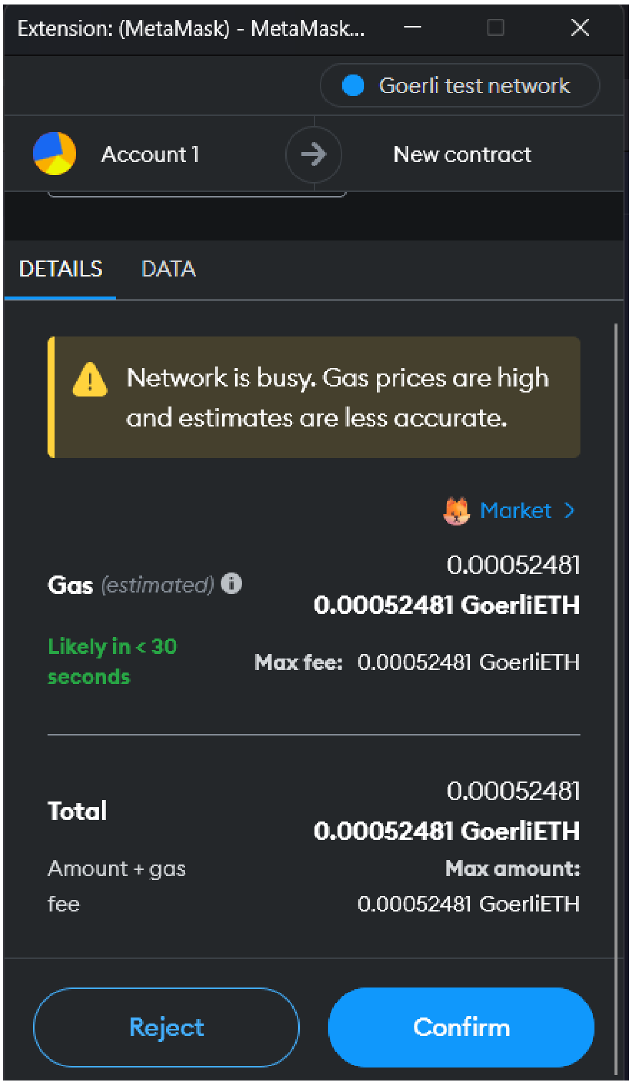
c. To apply restriction that only owner of the contract can withdraw funds (ethers) from contract account to his/her user account.

Ans :

- **Program :**
  FundManager.sol

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;
contract FundManager {
   address public owner;
   modifier onlyOwner() {
      require(msg.sender == owner, "Only owner can call this function");
      _;
   }
   constructor() {
      owner = msg.sender;
   }
   // Function to transfer funds from user account to contract account
   function transferToContract() external payable {
      // No logic needed, funds are transferred with the transaction
   }
   // Function to withdraw funds from contract account to user account
   function withdrawToUser(uint256 amount) external onlyOwner {
      require(amount > 0, "Amount must be greater than 0");
      require(address(this).balance >= amount, "Insufficient funds in the
contract");
      payable(msg.sender).transfer(amount);
   }
   // Function to get the contract's balance
   function getContractBalance() external view returns (uint256) {
      return address(this).balance;
   }
}
```

- **Output :**



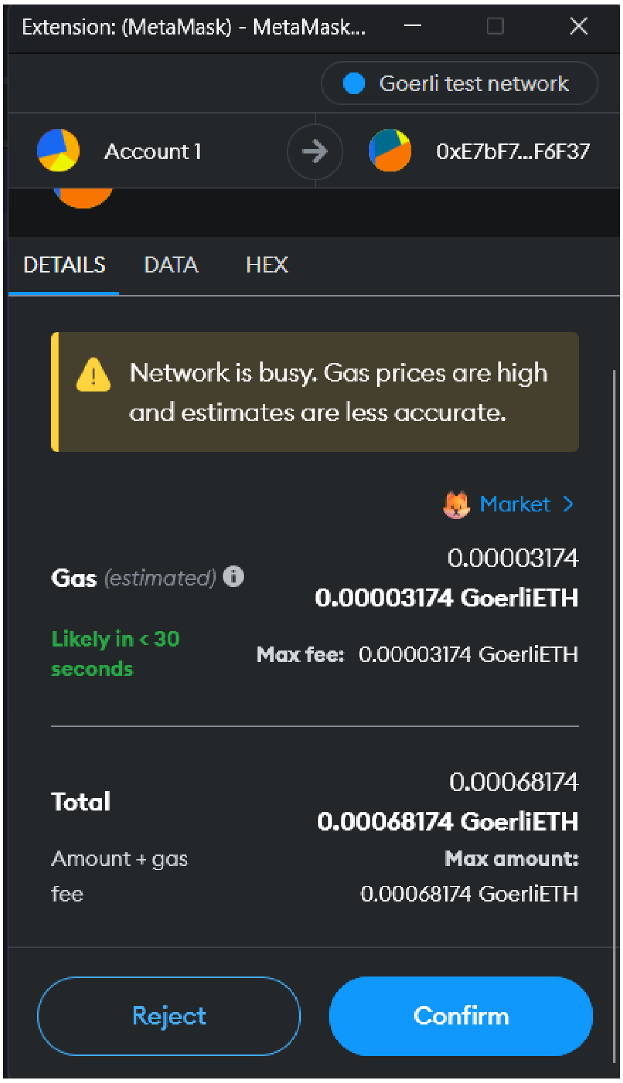
Network is busy. Gas prices are high and estimates are less accurate.

Gas *(estimated)* 0.00052481
0.00052481 GoerliETH

Likely in < 30 seconds
Max fee: 0.00052481 GoerliETH

Total 0.00052481
0.00052481 GoerliETH

Amount + gas fee
Max amount: 0.00052481 GoerliETH



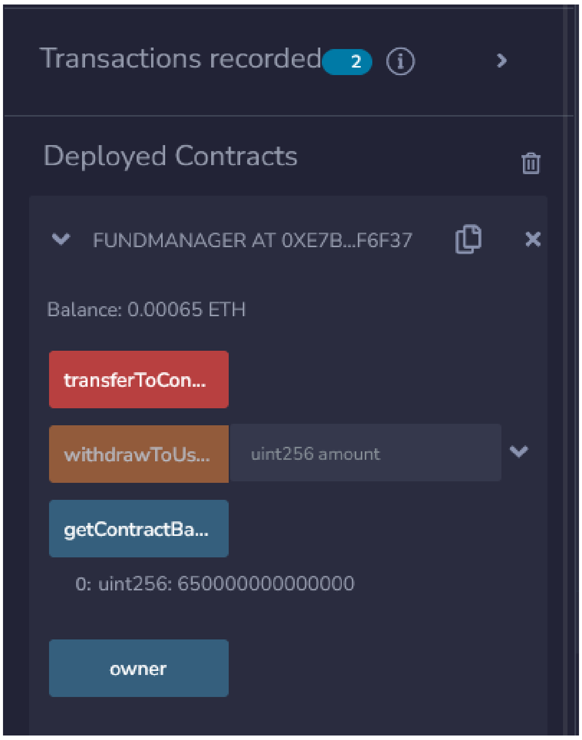
Network is busy. Gas prices are high and estimates are less accurate.

Gas *(estimated)* 0.00003174
0.00003174 GoerliETH

Likely in < 30 seconds
Max fee: 0.00003174 GoerliETH

Total 0.00068174
0.00068174 GoerliETH

Amount + gas fee
Max amount: 0.00068174 GoerliETH



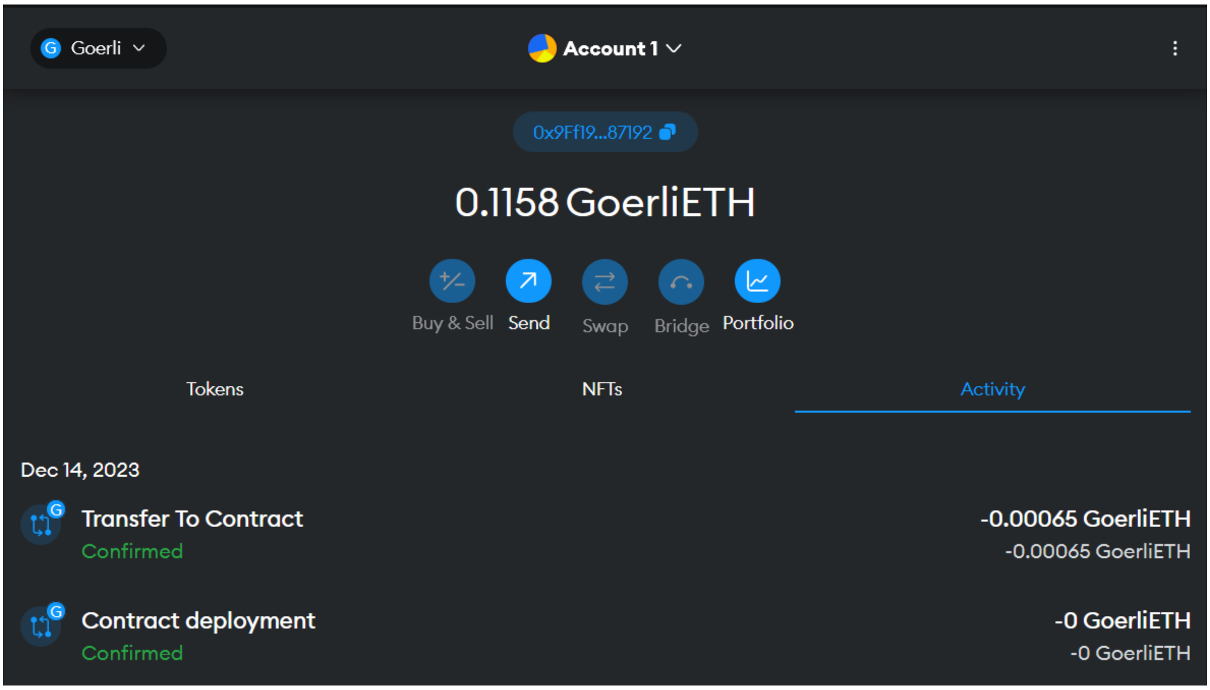
Transactions recorded 2

Deployed Contracts

FUNDMANAGER AT 0XE7B...F6F37

Balance: 0.00065 ETH

0: uint256: 650000000000000



0.1158 GoerliETH

Dec 14, 2023

Transfer To Contract — Confirmed — -0.00065 GoerliETH — -0.00065 GoerliETH

Contract deployment — Confirmed — -0 GoerliETH — -0 GoerliETH

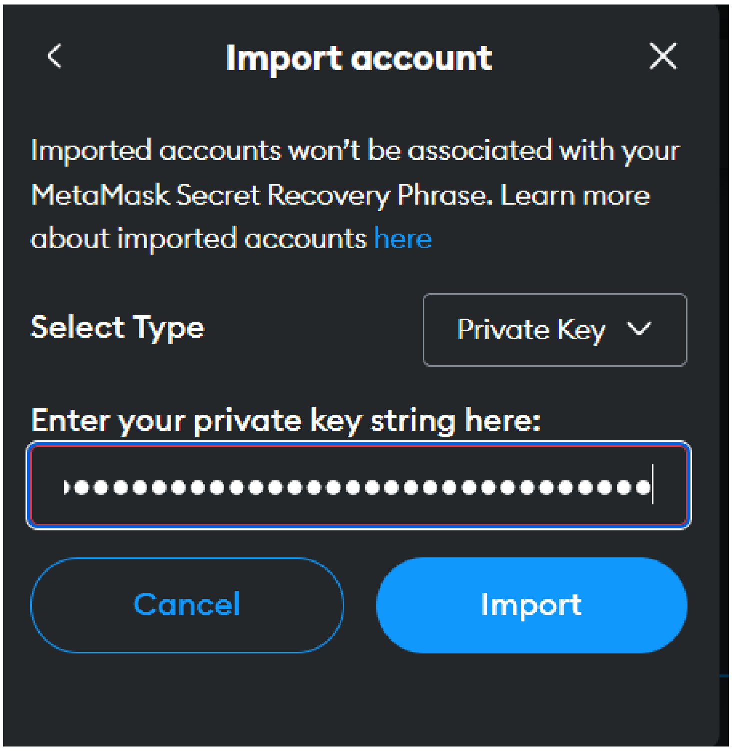
5. Write a smart contract to calculate the compound interest and deploy it on Ganache using injected provider. Truffle – Ganache

Ans :

- **Program :**
  Orange.sol

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.8.9;

contract Orange {
    function compoundInterest(uint _principal, uint _periods, uint _rate) external
pure returns(uint) {
        uint yield;
        for(uint i=0; i< _periods; i++){
            yield = _principal * _rate / 100;
            _principal += yield;
        }
        return  yield;
    }
}
```

- **Output :**

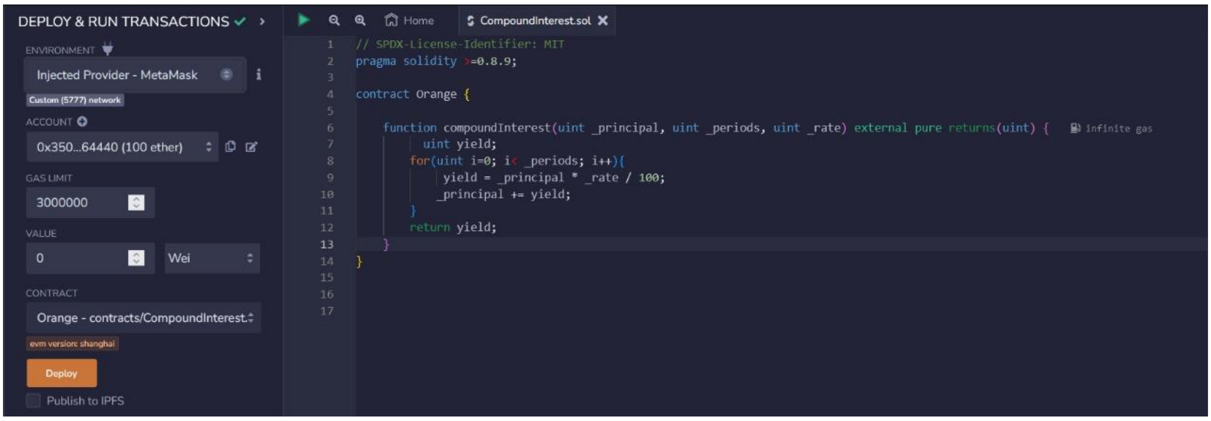


Import account

Imported accounts won't be associated with your MetaMask Secret Recovery Phrase. Learn more about imported accounts here

Select Type: Private Key

Enter your private key string here: ••••••••••••••••••••••••••••••••



ENVIRONMENT: Injected Provider - MetaMask

Custom (5777) network

ACCOUNT: 0x350...64440 (100 ether)

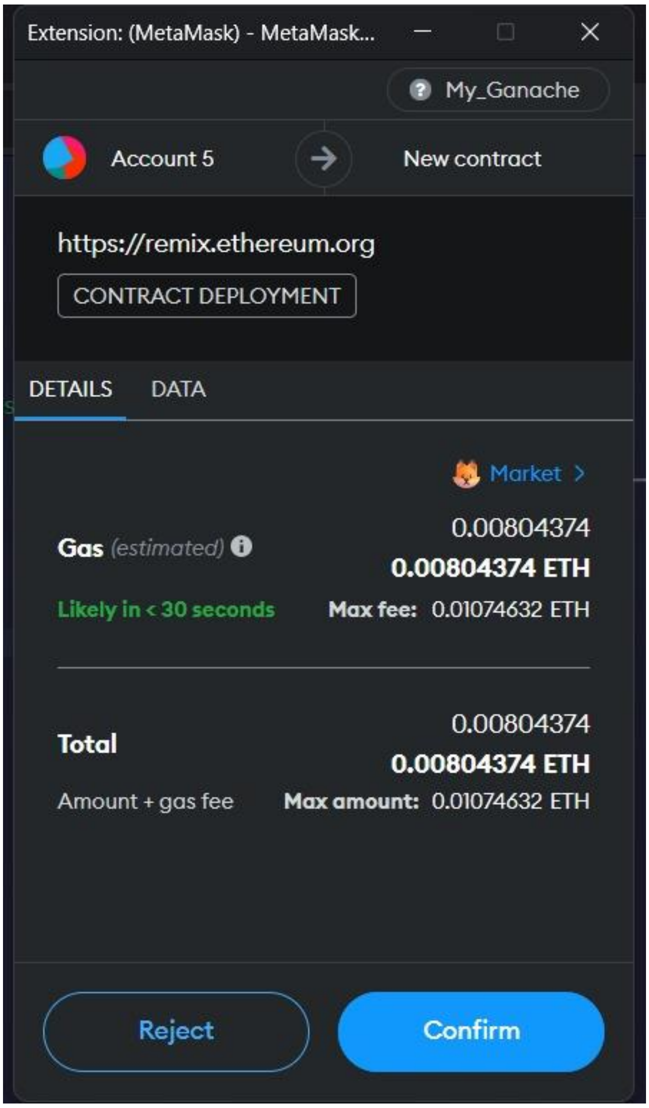
GAS LIMIT: 3000000

VALUE: 0 Wei

CONTRACT: Orange - contracts/CompoundInterest.

evm version: shanghai

```solidity
// SPDX-License-Identifier: MIT
pragma solidity >=0.8.9;

contract Orange {

    function compoundInterest(uint _principal, uint _periods, uint _rate) external pure returns(uint) {
        uint yield;
        for(uint i=0; i< _periods; i++){
            yield = _principal * _rate / 100;
            _principal += yield;
        }
        return yield;
    }
}
```



Account 5 → New contract

https://remix.ethereum.org

CONTRACT DEPLOYMENT

Gas (estimated) 0.00804374

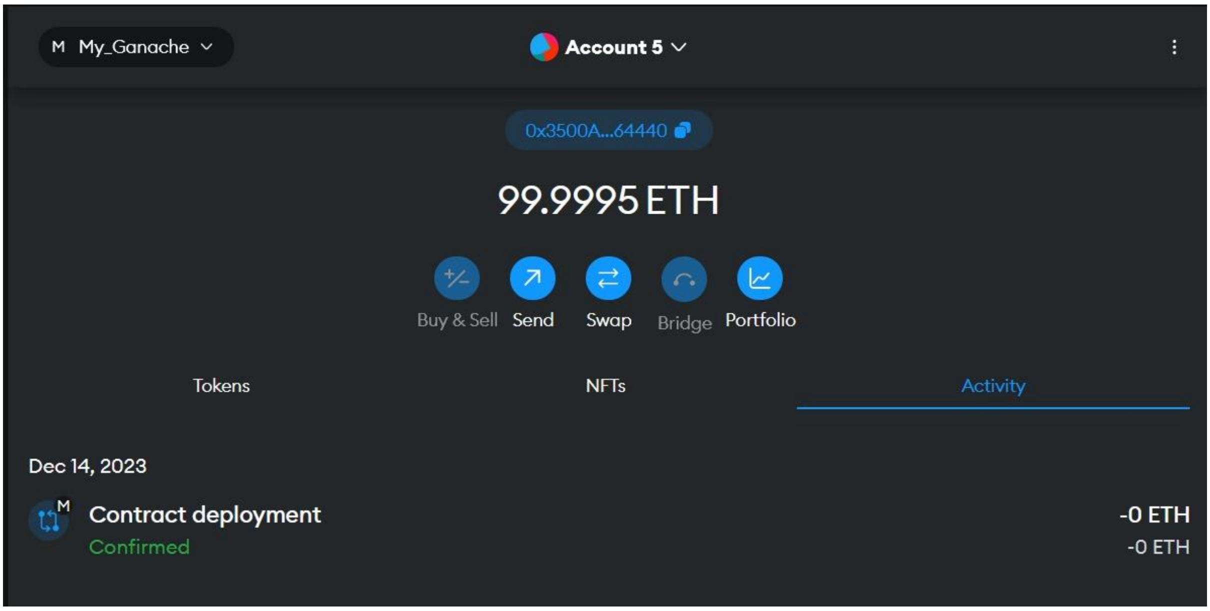
0.00804374 ETH

Likely in < 30 seconds Max fee: 0.01074632 ETH

Total 0.00804374

0.00804374 ETH

Amount + gas fee Max amount: 0.01074632 ETH



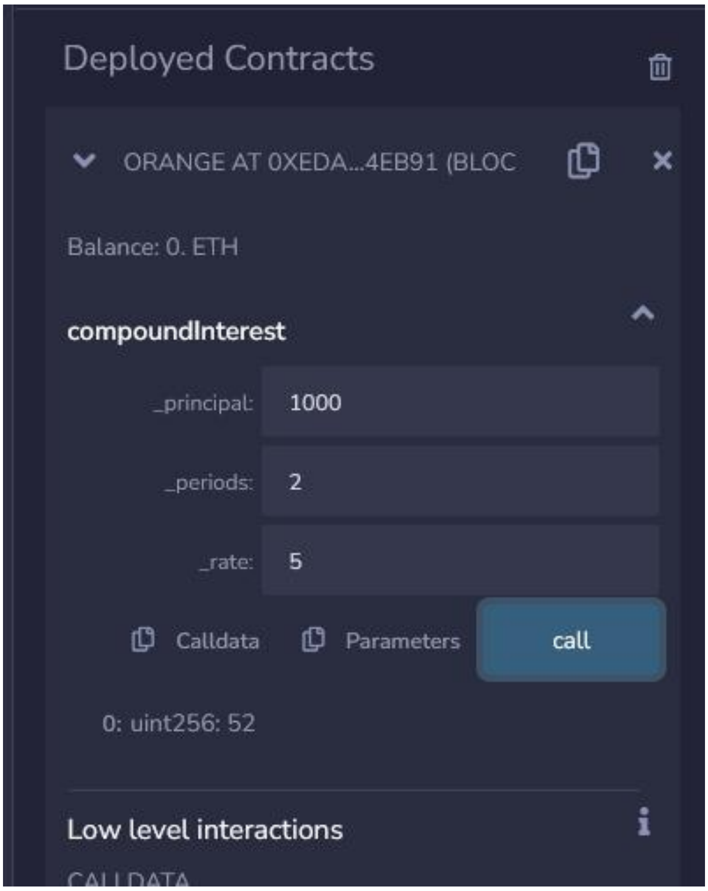
0x3500A...64440

99.9995 ETH

Dec 14, 2023

Contract deployment -0 ETH

Confirmed -0 ETH



Deployed Contracts

ORANGE AT 0XEDA...4EB91 (BLOC

Balance: 0. ETH

compoundInterest

_principal: 1000

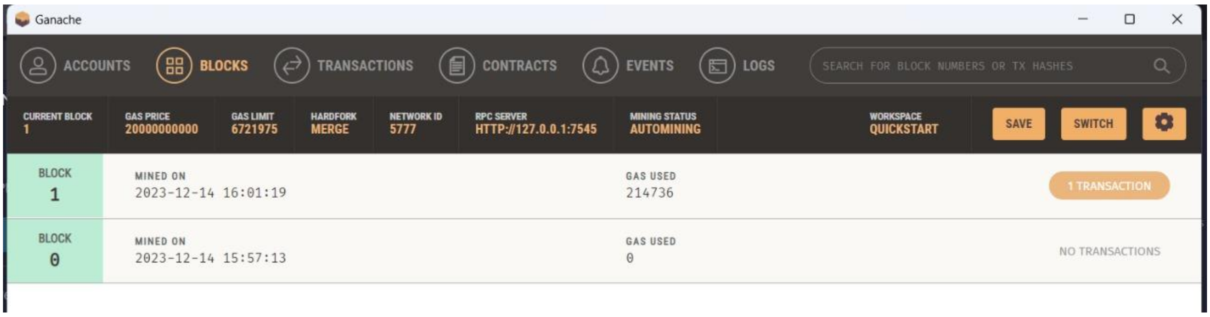
_periods: 2

_rate: 5

0: uint256: 52

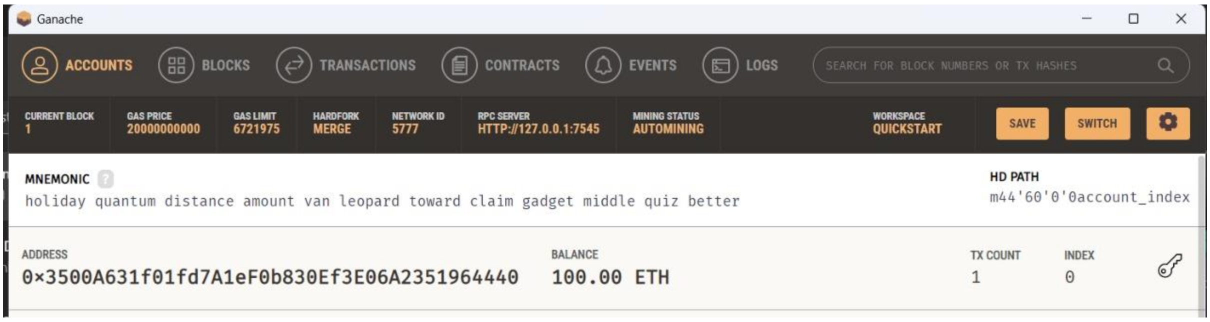
Low level interactions

CALLDATA



CURRENT BLOCK 1 | GAS PRICE 20000000000 | GAS LIMIT 6721975 | HARDFORK MERGE | NETWORK ID 5777 | RPC SERVER HTTP://127.0.0.1:7545 | MINING STATUS AUTOMINING | WORKSPACE QUICKSTART

BLOCK	MINED ON	GAS USED	
1	2023-12-14 16:01:19	214736	1 TRANSACTION
0	2023-12-14 15:57:13	0	NO TRANSACTIONS



CURRENT BLOCK 1 | GAS PRICE 20000000000 | GAS LIMIT 6721975 | HARDFORK MERGE | NETWORK ID 5777 | RPC SERVER HTTP://127.0.0.1:7545 | MINING STATUS AUTOMINING | WORKSPACE QUICKSTART

MNEMONIC
holiday quantum distance amount van leopard toward claim gadget middle quiz better

HD PATH
m44'60'0'0account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×3500A631f01fd7A1eF0b830Ef3E06A2351964440	100.00 ETH	1	0

6. Build and test decentralized application (Dapp) for Election Voting System on the local Ethereum Blockchain Network Ganache using truffle suite.

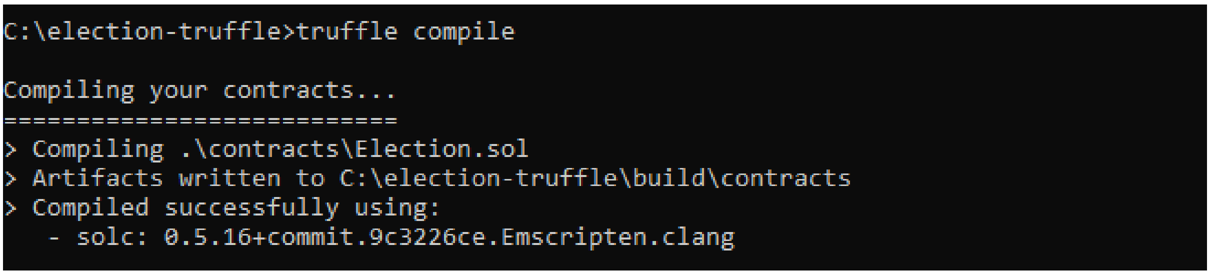
Ans :

- **Program :**

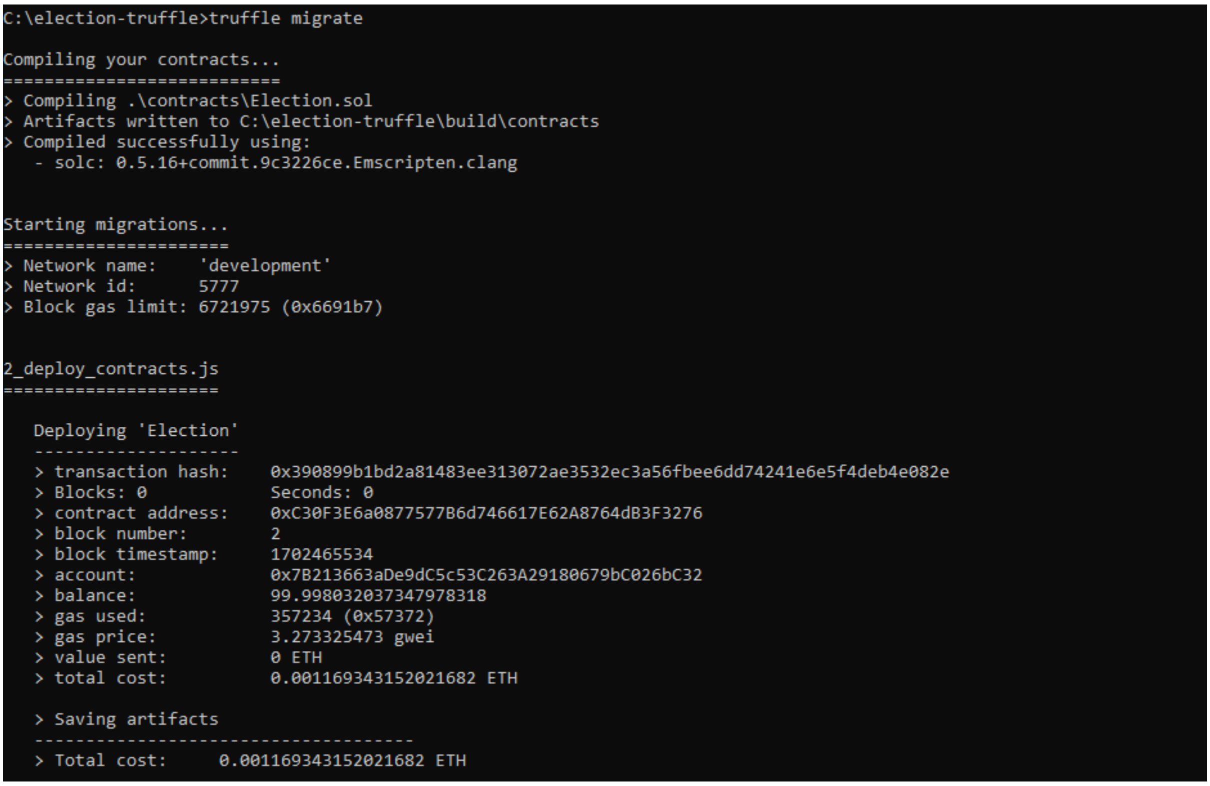
Election.sol

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.5.16;
contract Election {
struct Candidate {
uint id;
string name;
uint voteCount;
}
mapping(uint => Candidate) public candidates;
mapping(address => bool) public voters;
uint public candidatesCount;
constructor() {
addCandidate("Candidate 1");
addCandidate("Candidate 2");
}
function addCandidate(string memory _name) private {
candidatesCount++;
candidates[candidatesCount] = Candidate(candidatesCount, _name, 0);
}
function vote(uint _candidateId) public {
require(_candidateId > 0 && _candidateId <= candidatesCount, "Invalid candidate ID");
require(!voters[msg.sender], "You have already voted");
voters[msg.sender] = true;
candidates[_candidateId].voteCount++;
}
}
```

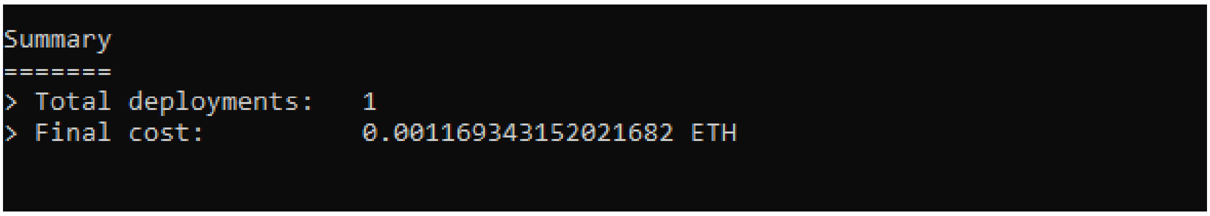
- **Output :**



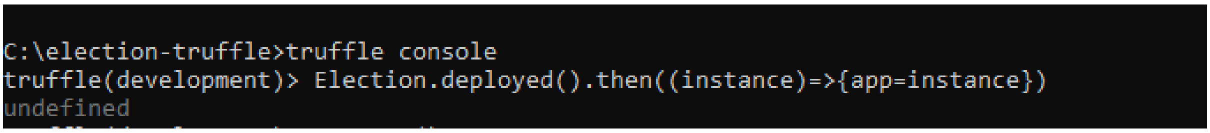
```
C:\election-truffle>truffle compile

Compiling your contracts...
===========================
> Compiling .\contracts\Election.sol
> Artifacts written to C:\election-truffle\build\contracts
> Compiled successfully using:
   - solc: 0.5.16+commit.9c3226ce.Emscripten.clang
```



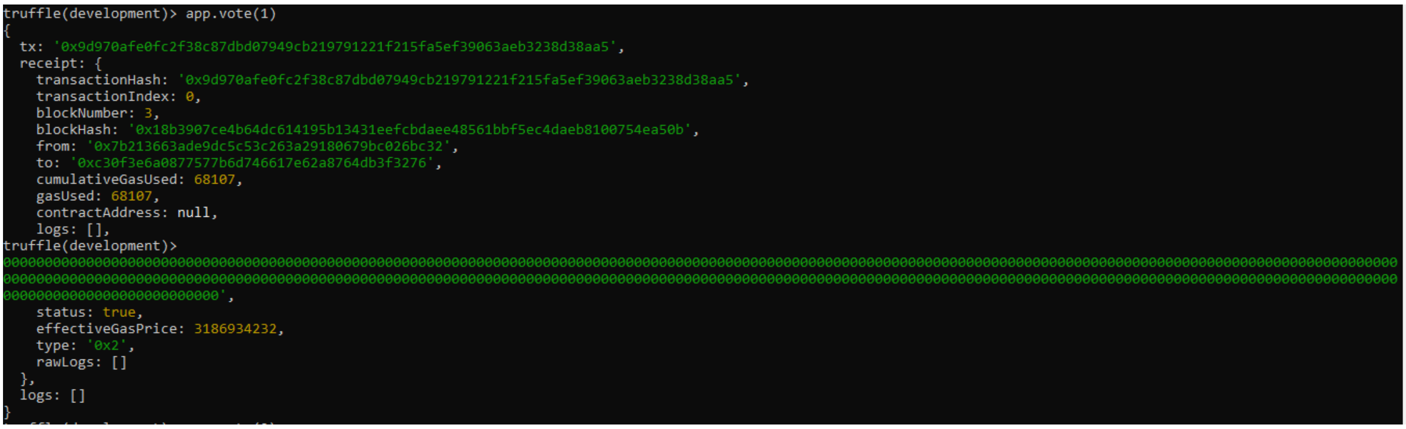
```
C:\election-truffle>truffle migrate

Compiling your contracts...
===========================
> Compiling .\contracts\Election.sol
> Artifacts written to C:\election-truffle\build\contracts
> Compiled successfully using:
   - solc: 0.5.16+commit.9c3226ce.Emscripten.clang


Starting migrations...
======================
> Network name:    'development'
> Network id:      5777
> Block gas limit: 6721975 (0x6691b7)


2_deploy_contracts.js
=====================

   Deploying 'Election'
   --------------------
   > transaction hash:    0x390899b1bd2a81483ee313072ae3532ec3a56fbee6dd74241e6e5f4deb4e082e
   > Blocks: 0            Seconds: 0
   > contract address:    0xC30F3E6a0877577B6d746617E62A8764dB3F3276
   > block number:        2
   > block timestamp:     1702465534
   > account:             0x7B213663aDe9dC5c53C263A29180679bC026bC32
   > balance:             99.998032037347978318
   > gas used:            357234 (0x57372)
   > gas price:           3.273325473 gwei
   > value sent:          0 ETH
   > total cost:          0.001169343152021682 ETH

   > Saving artifacts
   -------------------------------------
   > Total cost:     0.001169343152021682 ETH
```



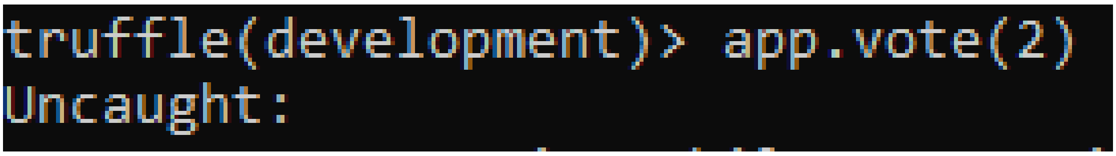
```
Summary
=======
> Total deployments:   1
> Final cost:          0.001169343152021682 ETH
```



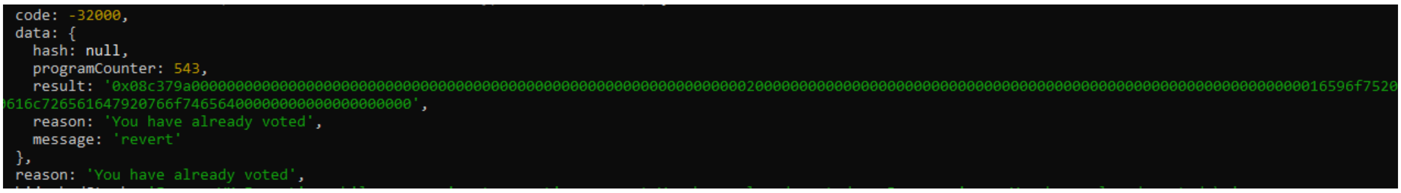
```
C:\election-truffle>truffle console
truffle(development)> Election.deployed().then((instance)=>{app=instance})
undefined
```



```
truffle(development)> app.vote(1)
{
  tx: '0x9d970afe0fc2f38c87dbd07949cb219791221f215fa5ef39063aeb3238d38aa5',
  receipt: {
    transactionHash: '0x9d970afe0fc2f38c87dbd07949cb219791221f215fa5ef39063aeb3238d38aa5',
    transactionIndex: 0,
    blockNumber: 3,
    blockHash: '0x18b3907ce4b64dc614195b13431eefcbdaee48561bbf5ec4daeb8100754ea50b',
    from: '0x7b213663ade9dc5c53c263a29180679bc026bc32',
    to: '0xc30f3e6a0877577b6d746617e62a8764db3f3276',
    cumulativeGasUsed: 68107,
    gasUsed: 68107,
    contractAddress: null,
    logs: [],
truffle(development)>
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000',
    status: true,
    effectiveGasPrice: 3186934232,
    type: '0x2',
    rawLogs: []
  },
  logs: []
}
```



```
truffle(development)> app.vote(2)
Uncaught:
```



```
  code: -32000,
  data: {
    hash: null,
    programCounter: 543,
    result: '0x08c379a000000000000000000000000000000000000000000000000000000000000000200000000000000000000000000000000000000000000000000000000000000016596f7520
616c726561647920766f7465640000000000000000000000',
    reason: 'You have already voted',
    message: 'revert'
  },
  reason: 'You have already voted',
```

7. Build and test decentralized application, (Dapp) for Banking System on the local Ethereum Blockchain Network Ganache using truffle suite.

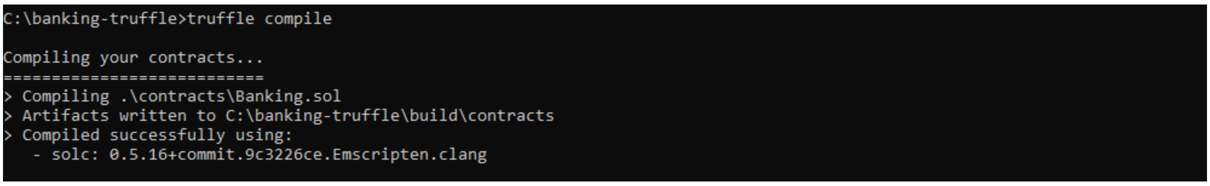
Ans :

- **Program :**

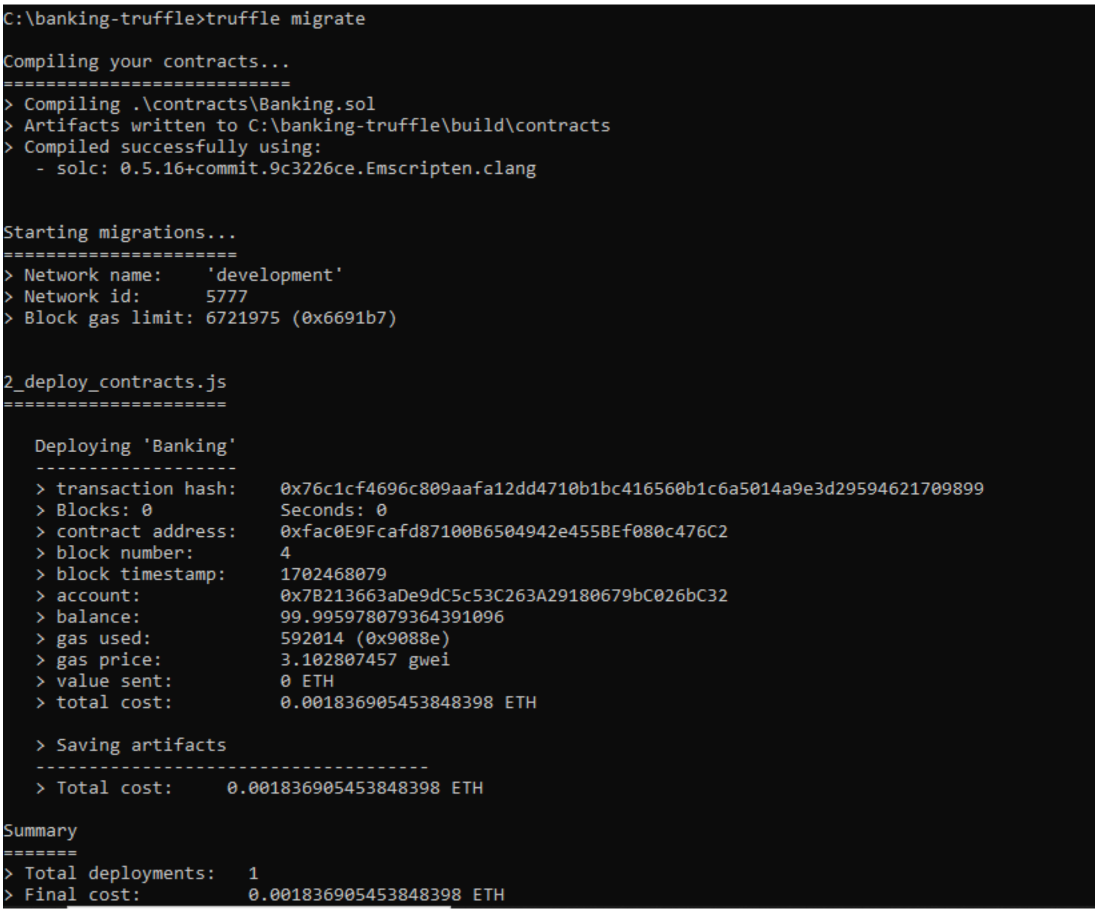
Banking.sol

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.6<0.9;
contract Banking {
    mapping (address => uint) public userAccount; // Balance
    mapping (address => bool) public userExists;
    function createAcc() public payable returns (string memory) {
        require(!userExists[msg.sender], 'Account already created');
        if (msg.value == 0) {
            userAccount[msg.sender] = 0;
        } else {
            userAccount[msg.sender] = msg.value;
        }
        userExists[msg.sender] = true;
        return 'Account created!';
    }
    function deposit() public payable returns (string memory) {
        require(userExists[msg.sender], 'Account is not created');
        require(msg.value > 0, 'Value for deposit is not zero');
        userAccount[msg.sender] += msg.value;
        return 'Deposited successfully';
    }
    function withdraw(uint amount) public returns(string memory) {
        require(userExists[msg.sender], 'Account is not created');
        require(userAccount[msg.sender] >= amount, 'Insufficient balance in bank account');
        require(amount > 0, 'Enter a non-zero value for withdrawal');
        userAccount[msg.sender] -= amount;
        payable(msg.sender).transfer(amount);
        return 'Withdrawal successful';
    }
    function transferAmount(address payable userAddress, uint amount) public returns (string memory) {
        require(userExists[msg.sender], 'Account is not created');
        require(userAccount[msg.sender] >= amount, 'Insufficient balance in bank account');
        require(userExists[userAddress], 'Recipient account does not exist in bank accounts');
        require(amount > 0, 'Enter a non-zero value for sending');
        userAccount[msg.sender] -= amount;
        userAccount[userAddress] += amount;
        return 'Transfer successful';
    }
    function sendAmount(address payable toAddress, uint256 amount) public returns (string memory) {
        require(userExists[msg.sender], 'Account is not created');
        require(userAccount[msg.sender] >= amount, 'Insufficient balance in bank account');
        require(amount > 0, 'Enter a non-zero value for withdrawal');
        userAccount[msg.sender] -= amount;
        toAddress.transfer(amount);
        return 'Transfer successful';
    }
    function userAccountBalance() public view returns (uint) {
        return userAccount[msg.sender];
    }
    function accountExists() public view returns(bool) {
        return userExists[msg.sender];
    }
}
```

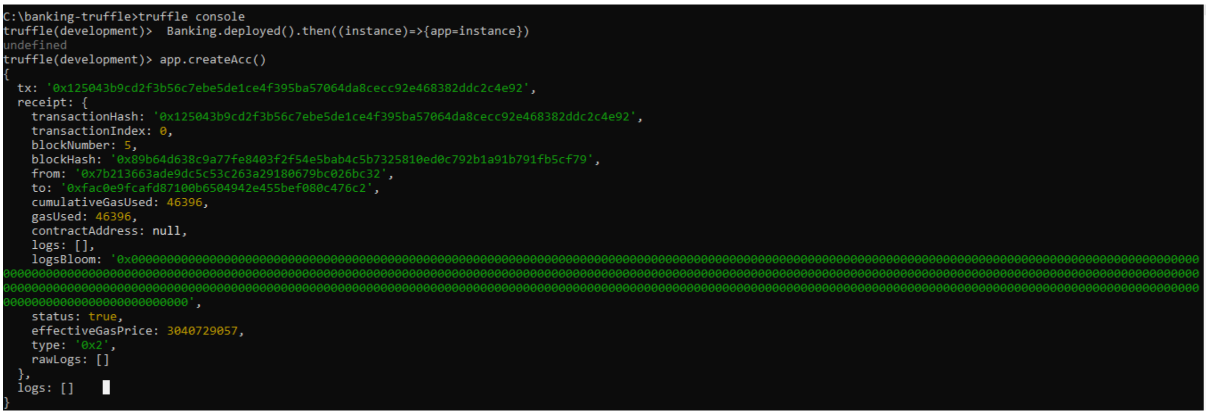
- **Output :**



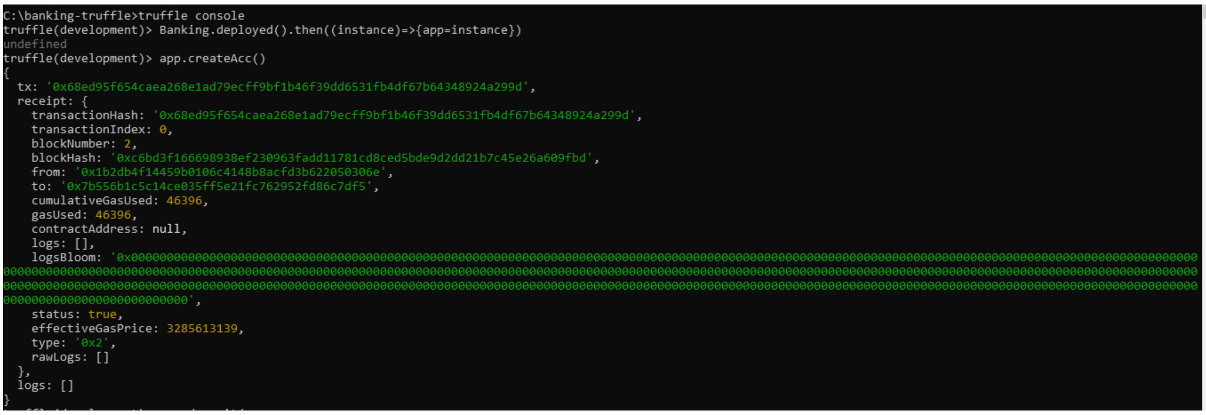
```
C:\banking-truffle>truffle compile

Compiling your contracts...
===========================
> Compiling .\contracts\Banking.sol
> Artifacts written to C:\banking-truffle\build\contracts
> Compiled successfully using:
   - solc: 0.5.16+commit.9c3226ce.Emscripten.clang
```



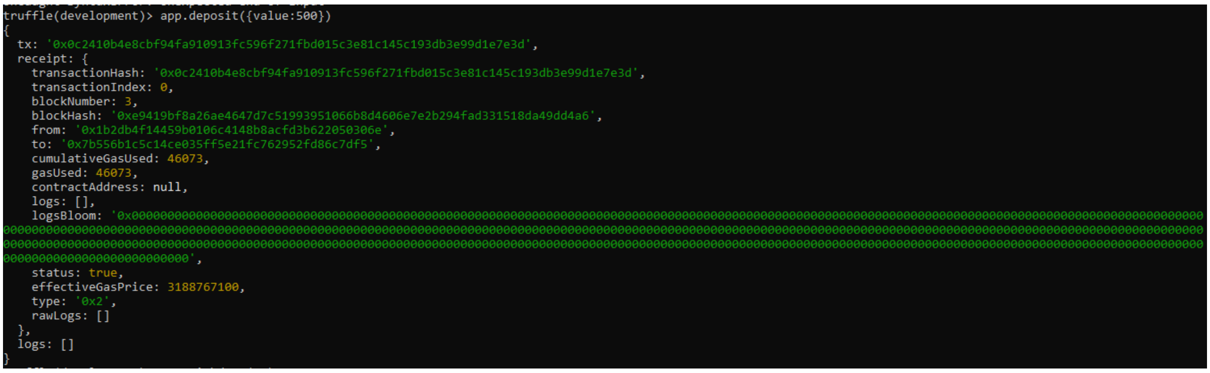
```
C:\banking-truffle>truffle migrate

Compiling your contracts...
===========================
> Compiling .\contracts\Banking.sol
> Artifacts written to C:\banking-truffle\build\contracts
> Compiled successfully using:
   - solc: 0.5.16+commit.9c3226ce.Emscripten.clang


Starting migrations...
======================
> Network name:    'development'
> Network id:      5777
> Block gas limit: 6721975 (0x6691b7)


2_deploy_contracts.js
=====================

   Deploying 'Banking'
   -------------------
   > transaction hash:    0x76c1cf4696c809aafa12dd4710b1bc416560b1c6a5014a9e3d29594621709899
   > Blocks: 0            Seconds: 0
   > contract address:    0xfac0E9Fcafd87100B6504942e455BEf080c476C2
   > block number:        4
   > block timestamp:     1702468079
   > account:             0x7B213663aDe9dC5c53C263A29180679bC026bC32
   > balance:             99.995978079364391096
   > gas used:            592014 (0x9088e)
   > gas price:           3.102807457 gwei
   > value sent:          0 ETH
   > total cost:          0.001836905453848398 ETH

   > Saving artifacts
   -------------------------------------
   > Total cost:     0.001836905453848398 ETH

Summary
=======
> Total deployments:   1
> Final cost:          0.001836905453848398 ETH
```



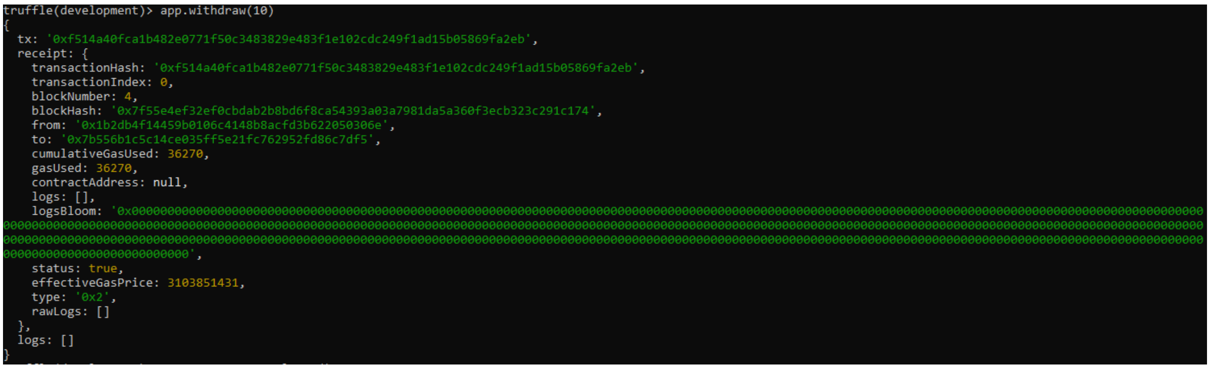
```
C:\banking-truffle>truffle console
truffle(development)>  Banking.deployed().then((instance)=>{app=instance})
undefined
truffle(development)> app.createAcc()
{
  tx: '0x125043b9cd2f3b56c7ebe5de1ce4f395ba57064da8cecc92e468382ddc2c4e92',
  receipt: {
    transactionHash: '0x125043b9cd2f3b56c7ebe5de1ce4f395ba57064da8cecc92e468382ddc2c4e92',
    transactionIndex: 0,
    blockNumber: 5,
    blockHash: '0x89b64d638c9a77fe8403f2f54e5bab4c5b7325810ed0c792b1a91b791fb5cf79',
    from: '0x7b213663ade9dc5c53c263a29180679bc026bc32',
    to: '0xfac0e9fcafd87100b6504942e455bef080c476c2',
    cumulativeGasUsed: 46396,
    gasUsed: 46396,
    contractAddress: null,
    logs: [],
    logsBloom: '0x000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000',
    status: true,
    effectiveGasPrice: 3040729057,
    type: '0x2',
    rawLogs: []
  },
  logs: []
}
```



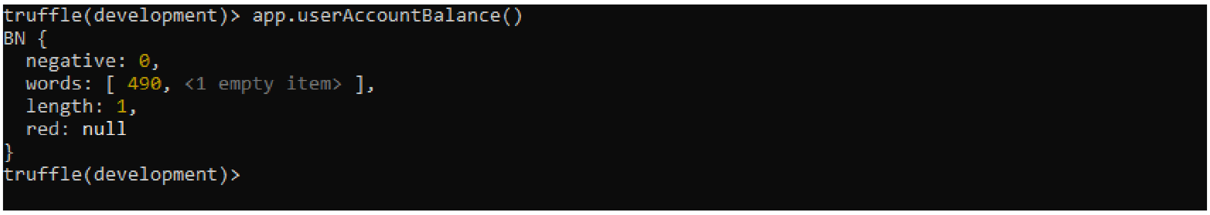
```
C:\banking-truffle>truffle console
truffle(development)> Banking.deployed().then((instance)=>{app=instance})
undefined
truffle(development)> app.createAcc()
{
  tx: '0x68ed95f654caea268e1ad79ecff9bf1b46f39dd6531fb4df67b64348924a299d',
  receipt: {
    transactionHash: '0x68ed95f654caea268e1ad79ecff9bf1b46f39dd6531fb4df67b64348924a299d',
    transactionIndex: 0,
    blockNumber: 2,
    blockHash: '0xc6bd3f166698938ef230963fadd11781cd8ced5bde9d2dd21b7c45e26a609fbd',
    from: '0x1b2db4f14459b0106c4148b8acfd3b622050306e',
    to: '0x7b556b1c5c14ce035ff5e21fc762952fd86c7df5',
    cumulativeGasUsed: 46396,
    gasUsed: 46396,
    contractAddress: null,
    logs: [],
    logsBloom: '0x000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000',
    status: true,
    effectiveGasPrice: 3285613139,
    type: '0x2',
    rawLogs: []
  },
  logs: []
}
```



```
truffle(development)> app.deposit({value:500})
{
  tx: '0x0c2410b4e8cbf94fa910913fc596f271fbd015c3e81c145c193db3e99d1e7e3d',
  receipt: {
    transactionHash: '0x0c2410b4e8cbf94fa910913fc596f271fbd015c3e81c145c193db3e99d1e7e3d',
    transactionIndex: 0,
    blockNumber: 3,
    blockHash: '0xe9419bf8a26ae4647d7c51993951066b8d4606e7e2b294fad331518da49dd4a6',
    from: '0x1b2db4f14459b0106c4148b8acfd3b622050306e',
    to: '0x7b556b1c5c14ce035ff5e21fc762952fd86c7df5',
    cumulativeGasUsed: 46073,
    gasUsed: 46073,
    contractAddress: null,
    logs: [],
    logsBloom: '0x000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000',
    status: true,
    effectiveGasPrice: 3188767100,
    type: '0x2',
    rawLogs: []
  },
  logs: []
}
```



```
truffle(development)> app.withdraw(10)
{
  tx: '0xf514a40fca1b482e0771f50c3483829e483f1e102cdc249f1ad15b05869fa2eb',
  receipt: {
    transactionHash: '0xf514a40fca1b482e0771f50c3483829e483f1e102cdc249f1ad15b05869fa2eb',
    transactionIndex: 0,
    blockNumber: 4,
    blockHash: '0x7f55e4ef32ef0cbdab2b8bd6f8ca54393a03a7981da5a360f3ecb323c291c174',
    from: '0x1b2db4f14459b0106c4148b8acfd3b622050306e',
    to: '0x7b556b1c5c14ce035ff5e21fc762952fd86c7df5',
    cumulativeGasUsed: 36270,
    gasUsed: 36270,
    contractAddress: null,
    logs: [],
    logsBloom: '0x000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000',
    status: true,
    effectiveGasPrice: 3103851431,
    type: '0x2',
    rawLogs: []
  },
  logs: []
}
```



```
truffle(development)> app.userAccountBalance()
BN {
  negative: 0,
  words: [ 490, <1 empty item> ],
  length: 1,
  red: null
}
truffle(development)>
```