PRACTICAL 1

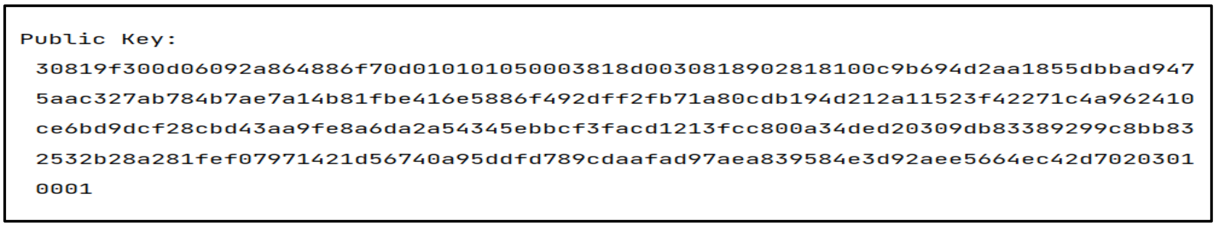
AIM: Write the following programs for Blockchain in Python:

[A] A simple client class that generates the private and public keys by using the builtin Python RSA algorithm and test it.

CODE:

```
import binascii
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5
from Crypto import Random

class Client:
    def __init__(self):
        random = Random.new().read
        self._private_key = RSA.generate(1024, random)
        self._public_key = self._private_key.publickey()
        self._signer = PKCS1_v1_5.new(self._private_key)

    @property
    def identity(self):
        return binascii.hexlify(self._public_key.exportKey(format="DER")).decode("ascii")

# Create an instance of the Client class
UDIT = Client()

# Print the public key (identity) of the client
print("\nPublic Key:", UDIT.identity)
```

OUTPUT:



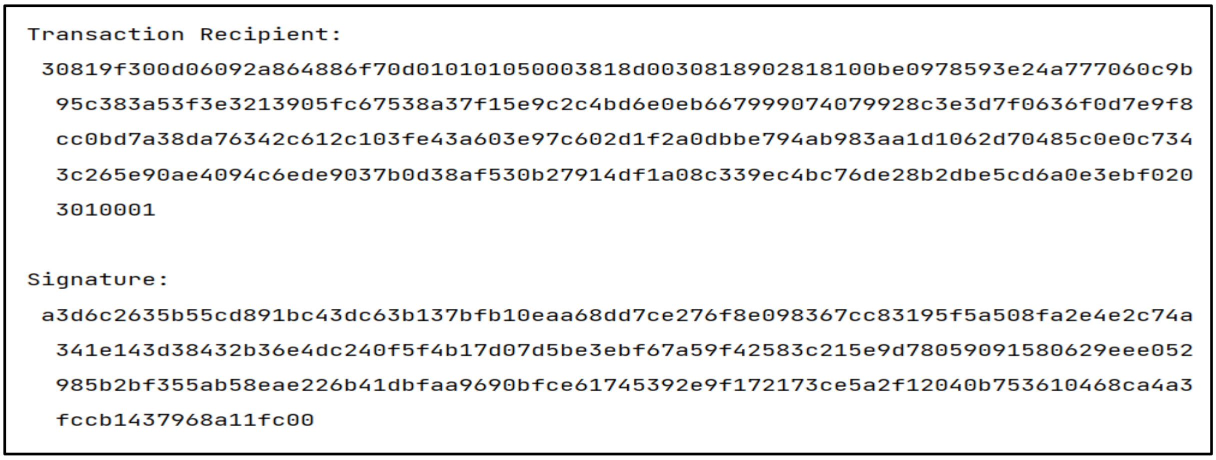
```
Public Key:
 30819f300d06092a864886f70d010101050003818d0030818902818100c9b694d2aa1855dbbad947
 5aac327ab784b7ae7a14b81fbe416e5886f492dff2fb71a80cdb194d212a11523f42271c4a962410
 ce6bd9dcf28cbd43aa9fe8a6da2a54345ebbcf3facd1213fcc800a34ded20309db83389299c8bb83
 2532b28a281fef07971421d56740a95ddfd789cdaafad97aea839584e3d92aee5664ec42d7020301
 0001
```

[B] A transaction class to send and receive money and test it.

CODE:

```
import binascii
import collections
import datetime
from Crypto.Hash import SHA
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5
from Crypto import Random

class Client:
    def __init__(self):
        random = Random.new().read
        self._private_key = RSA.generate(1024, random)
        self._public_key = self._private_key.publickey()
        self._signer = PKCS1_v1_5.new(self._private_key)

    @property
    def identity(self):
        return binascii.hexlify(self._public_key.exportKey(format="DER")).decode("ascii")



class Transaction:
    def __init__(self, sender, recipient, value):
        self.sender = sender
        self.recipient = recipient
        self.value = value
        self.time = datetime.datetime.now()

    def to_dict(self):
        identity = "Genesis" if self.sender == "Genesis" else self.sender.identity
        return collections.OrderedDict(
            {
                "sender": identity,
                "recipient": self.recipient,
                "value": self.value,
                "time": self.time,
            }
        )

    def sign_transaction(self):
        private_key = self.sender._private_key
        signer = PKCS1_v1_5.new(private_key)
        h = SHA.new(str(self.to_dict()).encode("utf8"))
        return binascii.hexlify(signer.sign(h)).decode("ascii")

UDIT = Client()
UGC = Client()

t = Transaction(UDIT, UGC.identity, 5.0)

print("\nTransaction Recipient:\n", t.recipient)    # print("\nTransaction Sender:\n", t.sender)
print("\nTransaction Value:\n", t.value)
signature = t.sign_transaction()
print("\nSignature:\n", signature)
```

OUTPUT:



```
Transaction Recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100be0978593e24a777060c9b
  95c383a53f3e3213905fc67538a37f15e9c2c4bd6e0eb667999074079928c3e3d7f0636f0d7e9f8
  cc0bd7a38da76342c612c103fe43a603e97c602d1f2a0dbbe794ab983aa1d1062d70485c0e0c734
  3c265e90ae4094c6ede9037b0d38af530b27914df1a08c339ec4bc76de28b2dbe5cd6a0e3ebf020
  3010001

Signature:
 a3d6c2635b55cd891bc43dc63b137bfb10eaa68dd7ce276f8e098367cc83195f5a508fa2e4e2c74a
  341e143d38432b36e4dc240f5f4b17d07d5be3ebf67a59f42583c215e9d78059091580629eee052
  985b2bf355ab58eae226b41dbfaa9690bfce61745392e9f172173ce5a2f12040b753610468ca4a3
  fccb1437968a11fc00
```

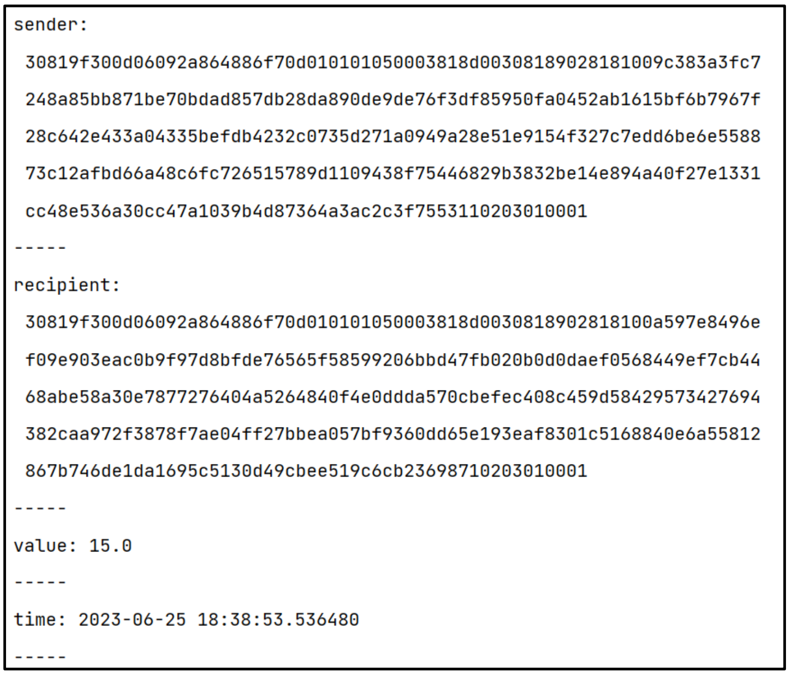
[C] Create multiple transactions and display them.

CODE:

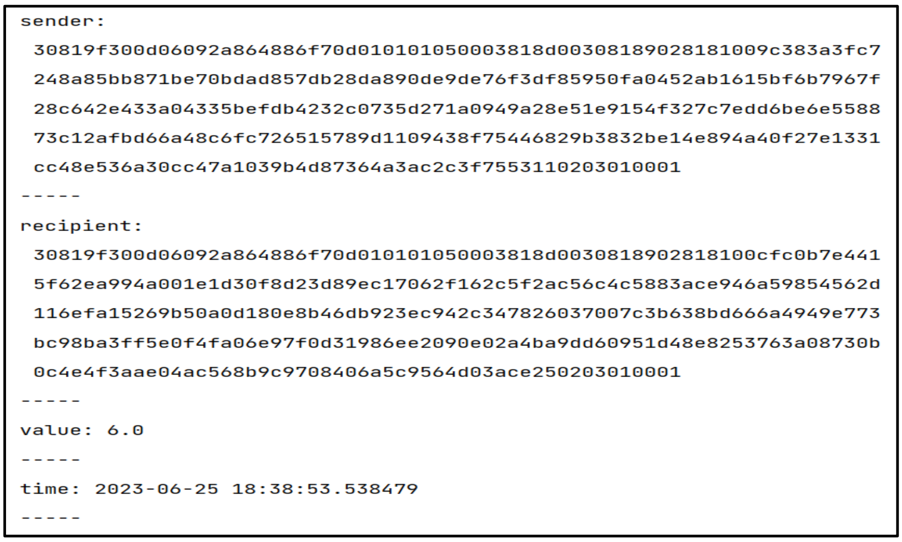
```
import binascii
import collections
import datetime
from Crypto.Hash import SHA
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5
from Crypto import Random


class Client:
    def __init__(self):
        random = Random.new().read
        self._private_key = RSA.generate(1024, random)
        self._public_key = self._private_key.publickey()
        self._signer = PKCS1_v1_5.new(self._private_key)

    @property
    def identity(self):
        return binascii.hexlify(self._public_key.exportKey(format="DER")).decode("ascii")


class Transaction:
    def __init__(self, sender, recipient, value):
        self.sender = sender
        self.recipient = recipient
        self.value = value
        self.time = datetime.datetime.now()

    def to_dict(self):
        identity = "Genesis" if self.sender == "Genesis" else self.sender.identity
        return collections.OrderedDict(
            {
                "sender": identity,
                "recipient": self.recipient,
                "value": self.value,
                "time": self.time,
            }
        )

    def sign_transaction(self):
        private_key = self.sender._private_key
        signer = PKCS1_v1_5.new(private_key)
        h = SHA.new(str(self.to_dict()).encode("utf8"))
        return binascii.hexlify(signer.sign(h)).decode("ascii")

    def display_transaction(transaction):
        # for transaction in transactions:
        dict = transaction.to_dict()
        print("sender: " + dict['sender'])
        print('-----')
        print("recipient: " + dict['recipient'])
        print('-----')
        print("value: " + str(dict['value']))
        print('-----')
        print("time: " + str(dict['time']))
        print('-----')



UDIT = Client()
UGC = Client()
AICTE = Client()
MU = Client()

t1 = Transaction(UDIT, UGC.identity, 15.0)
t1.sign_transaction()
transactions = [t1]
t2 = Transaction(UDIT, AICTE.identity, 6.0)
t2.sign_transaction()
transactions.append(t2)
t3 = Transaction(UGC, MU.identity, 2.0)
t3.sign_transaction()
```

```
transactions.append(t3)
t4 = Transaction(AICTE, UGC.identity, 4.0)
t4.sign_transaction()
transactions.append(t4)
for transaction in transactions:
    Transaction.display_transaction(transaction)
    print("           ")
```

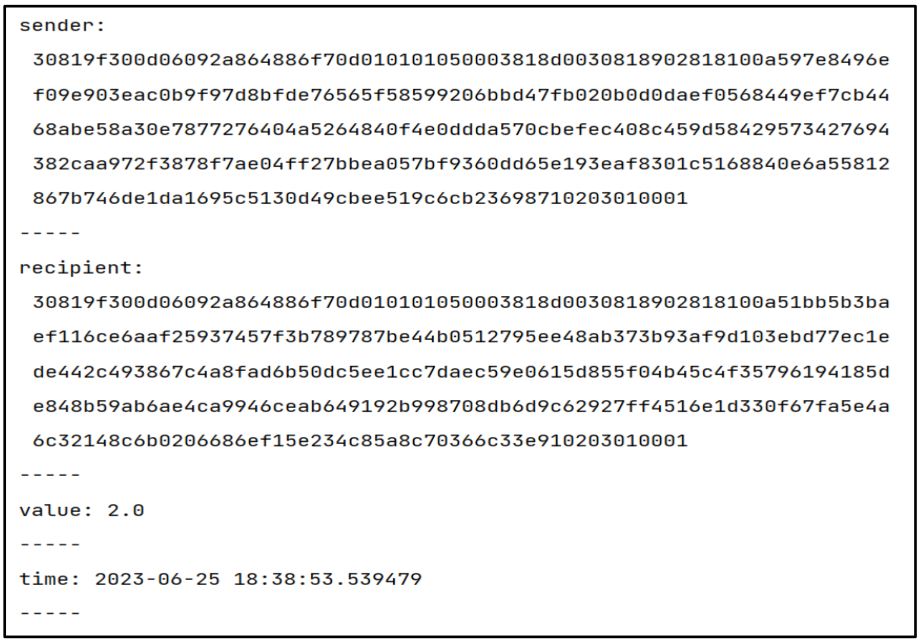
OUTPUT:



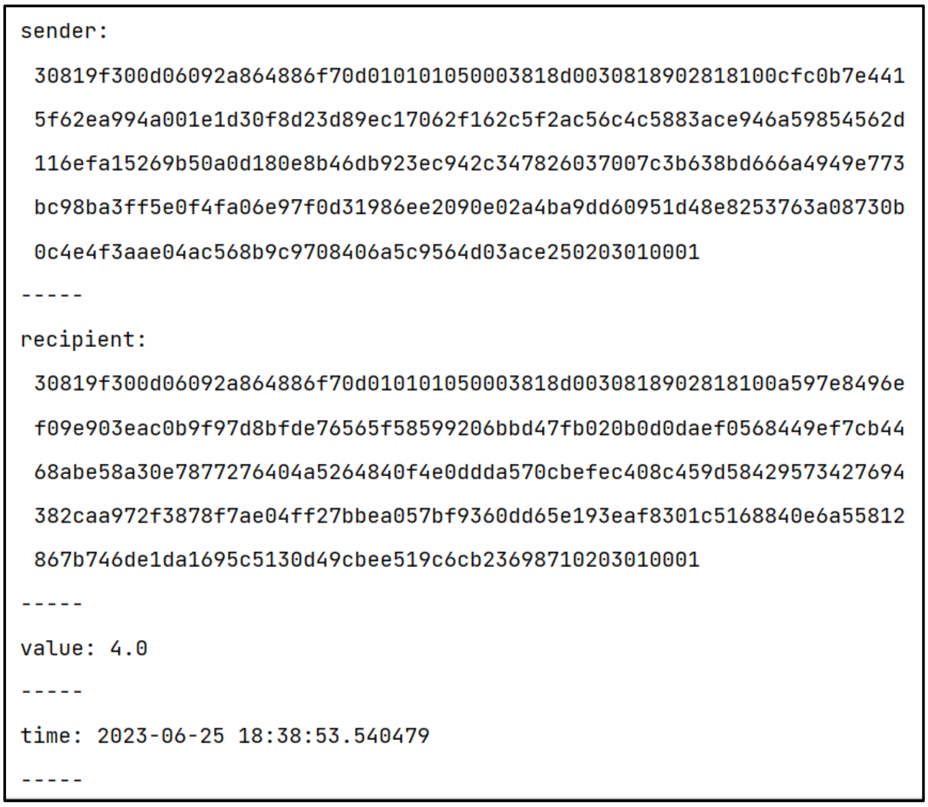
```
sender:
 30819f300d06092a864886f70d010101050003818d00308189028181009c383a3fc7
 248a85bb871be70bdad857db28da890de9de76f3df85950fa0452ab1615bf6b7967f
 28c642e433a04335befdb4232c0735d271a0949a28e51e9154f327c7edd6be6e5588
 73c12afbd66a48c6fc726515789d1109438f75446829b3832be14e894a40f27e1331
 cc48e536a30cc47a1039b4d87364a3ac2c3f7553110203010001
-----
recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100a597e8496e
 f09e903eac0b9f97d8bfde76565f58599206bbd47fb020b0d0daef0568449ef7cb44
 68abe58a30e7877276404a5264840f4e0ddda570cbefec408c459d58429573427694
 382caa972f3878f7ae04ff27bbea057bf9360dd65e193eaf8301c5168840e6a55812
 867b746de1da1695c5130d49cbee519c6cb23698710203010001
-----
value: 15.0
-----
time: 2023-06-25 18:38:53.536480
-----
```



```
sender:
 30819f300d06092a864886f70d010101050003818d00308189028181009c383a3fc7
 248a85bb871be70bdad857db28da890de9de76f3df85950fa0452ab1615bf6b7967f
 28c642e433a04335befdb4232c0735d271a0949a28e51e9154f327c7edd6be6e5588
 73c12afbd66a48c6fc726515789d1109438f75446829b3832be14e894a40f27e1331
 cc48e536a30cc47a1039b4d87364a3ac2c3f7553110203010001
-----
recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100cfc0b7e441
 5f62ea994a001e1d30f8d23d89ec17062f162c5f2ac56c4c5883ace946a59854562d
 116efa15269b50a0d180e8b46db923ec942c347826037007c3b638bd666a4949e773
 bc98ba3ff5e0f4fa06e97f0d31986ee2090e02a4ba9dd60951d48e8253763a08730b
 0c4e4f3aae04ac568b9c9708406a5c9564d03ace250203010001
-----
value: 6.0
-----
time: 2023-06-25 18:38:53.538479
-----
```



```
sender:
 30819f300d06092a864886f70d010101050003818d0030818902818100a597e8496e
 f09e903eac0b9f97d8bfde76565f58599206bbd47fb020b0d0daef0568449ef7cb44
 68abe58a30e7877276404a5264840f4e0ddda570cbefec408c459d58429573427694
 382caa972f3878f7ae04ff27bbea057bf9360dd65e193eaf8301c5168840e6a55812
 867b746de1da1695c5130d49cbee519c6cb23698710203010001
-----
recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100a51bb5b3ba
 ef116ce6aaf25937457f3b789787be44b0512795ee48ab373b93af9d103ebd77ec1e
 de442c493867c4a8fad6b50dc5ee1cc7daec59e0615d855f04b45c4f35796194185d
 e848b59ab6ae4ca9946ceab649192b998708db6d9c62927ff4516e1d330f67fa5e4a
 6c32148c6b0206686ef15e234c85a8c70366c33e910203010001
-----
value: 2.0
-----
time: 2023-06-25 18:38:53.539479
-----
```



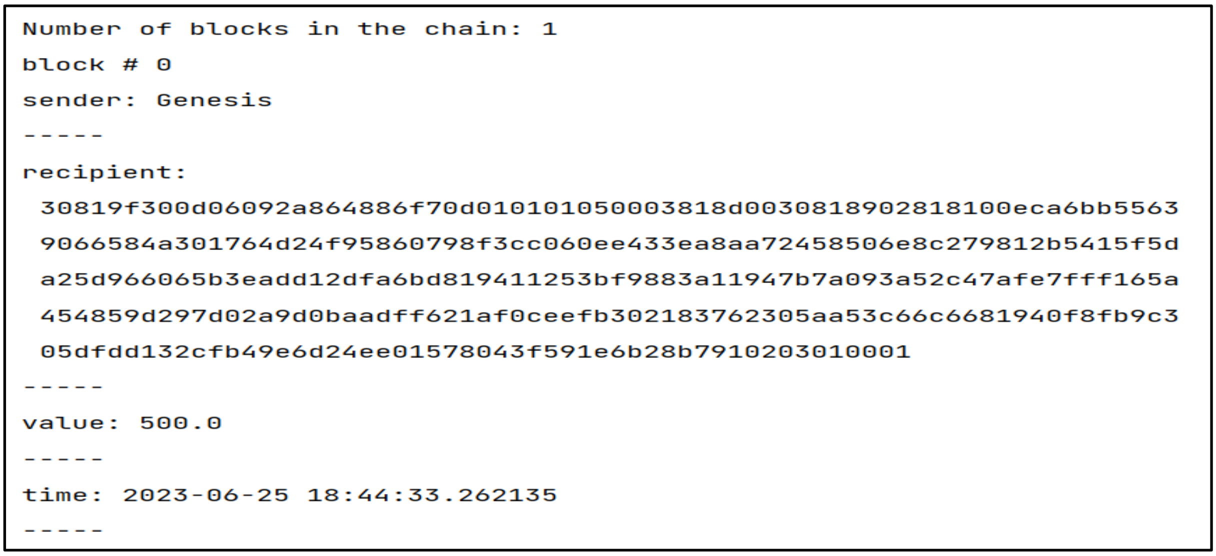
```
sender:
 30819f300d06092a864886f70d010101050003818d0030818902818100cfc0b7e441
 5f62ea994a001e1d30f8d23d89ec17062f162c5f2ac56c4c5883ace946a59854562d
 116efa15269b50a0d180e8b46db923ec942c347826037007c3b638bd666a4949e773
 bc98ba3ff5e0f4fa06e97f0d31986ee2090e02a4ba9dd60951d48e8253763a08730b
 0c4e4f3aae04ac568b9c9708406a5c9564d03ace250203010001
-----
recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100a597e8496e
 f09e903eac0b9f97d8bfde76565f58599206bbd47fb020b0d0daef0568449ef7cb44
 68abe58a30e7877276404a5264840f4e0ddda570cbefec408c459d58429573427694
 382caa972f3878f7ae04ff27bbea057bf9360dd65e193eaf8301c5168840e6a55812
 867b746de1da1695c5130d49cbee519c6cb23698710203010001
-----
value: 4.0
-----
time: 2023-06-25 18:38:53.540479
-----
```

[D] Create a blockchain, a genesis block and execute it.

CODE:

```
import binascii
import collections
import datetime
from Crypto.Hash import SHA
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5
from Crypto import Random



class Client:
    def __init__(self):
        random = Random.new().read
        self._private_key = RSA.generate(1024, random)
        self._public_key = self._private_key.publickey()
        self._signer = PKCS1_v1_5.new(self._private_key)

    @property
    def identity(self):
        return binascii.hexlify(self._public_key.exportKey(format="DER")).decode("ascii")



class Transaction:
    def __init__(self, sender, recipient, value):
        self.sender = sender
        self.recipient = recipient
        self.value = value
        self.time = datetime.datetime.now()

    def to_dict(self):
        identity = "Genesis" if self.sender == "Genesis" else self.sender.identity
        return collections.OrderedDict(
            {
                "sender": identity,
                "recipient": self.recipient,
                "value": self.value,
                "time": self.time,
            }
        )

    def sign_transaction(self):
        private_key = self.sender._private_key
        signer = PKCS1_v1_5.new(private_key)
        h = SHA.new(str(self.to_dict()).encode("utf8"))
        return binascii.hexlify(signer.sign(h)).decode("ascii")

    def display_transaction(transaction):
        # for transaction in transactions:
        dict = transaction.to_dict()
        print("sender: " + dict['sender'])
        print('-----')
        print("recipient: " + dict['recipient'])
        print('-----')
        print("value: " + str(dict['value']))
        print('-----')
        print("time: " + str(dict['time']))
        print('-----')



class Block:
    def __init__(self, client):
        self.verified_transactions = []
        self.previous_block_hash = ""
        self.Nonce = ""
        self.client = client



def dump_blockchain(blocks):
    print(f"\nNumber of blocks in the chain: {len(blocks)}")
    for i, block in enumerate(blocks):
        print(f"block # {i}")
        for transaction in block.verified_transactions:
            Transaction.display_transaction(transaction)
            print("    ")
    print("           ")



UDIT = Client()
t0 = Transaction("Genesis", UDIT.identity, 500.0)
block0 = Block(UDIT)
block0.previous_block_hash = ""
NONCE = None
block0.verified_transactions.append(t0)
digest = hash(block0)
last_block_hash = digest
TPCoins = [block0]
dump_blockchain(TPCoins)
```

OUTPUT:



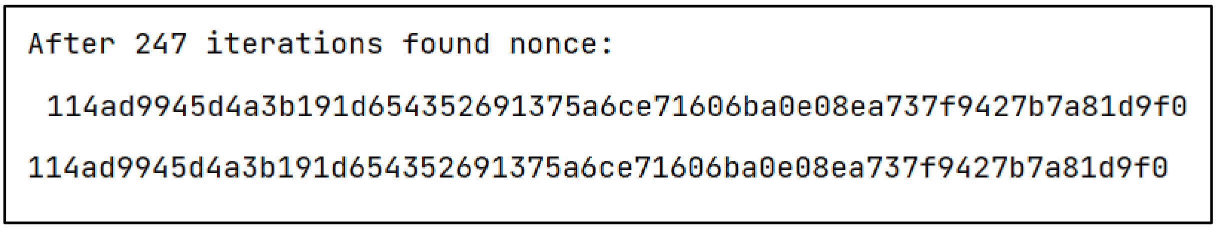
```
Number of blocks in the chain: 1
block # 0
sender: Genesis
-----
recipient:
 30819f300d06092a864886f70d010101050003818d0030818902818100eca6bb5563
 9066584a301764d24f95860798f3cc060ee433ea8aa72458506e8c279812b5415f5d
 a25d966065b3eadd12dfa6bd819411253bf9883a11947b7a093a52c47afe7fff165a
 454859d297d02a9d0baadff621af0ceefb302183762305aa53c66c6681940f8fb9c3
 05dfdd132cfb49e6d24ee01578043f591e6b28b7910203010001
-----
value: 500.0
-----
time: 2023-06-25 18:44:33.262135
-----
```

[E] Create a mining function and test it.

CODE:

```
import hashlib



def sha256(message):
    return hashlib.sha256(message.encode("ascii")).hexdigest()



def mine(message, difficulty=1):
    assert difficulty >= 1
    prefix = "1" * difficulty
    for i in range(1000):
        digest = sha256(str(hash(message)) + str(i))
        if digest.startswith(prefix):
            print(f"After {str(i)} iterations found nonce: {digest}")
            return digest

print(mine("test message", 2))
```

OUTPUT:



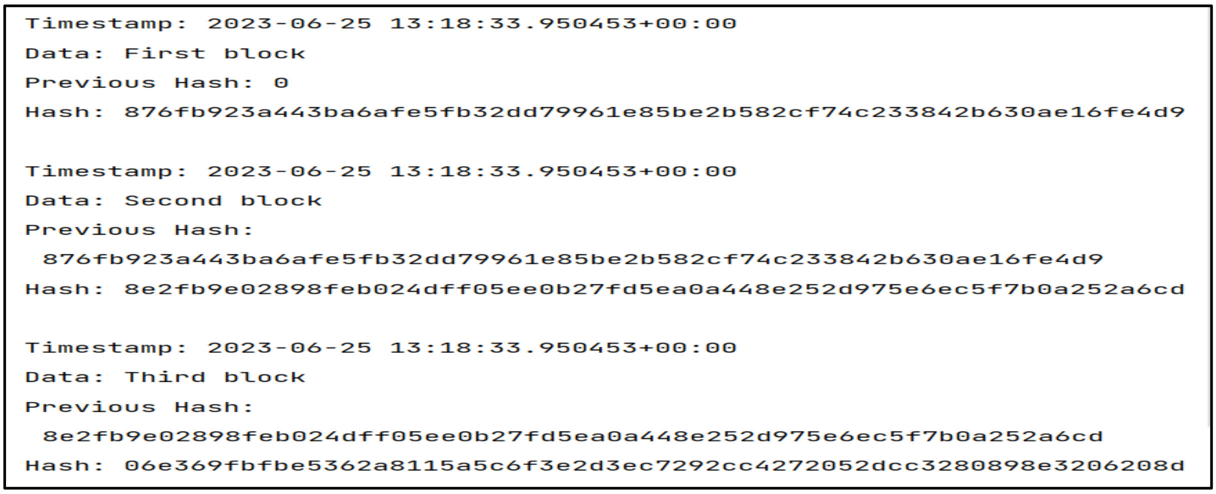
```
After 247 iterations found nonce:
 114ad9945d4a3b191d654352691375a6ce71606ba0e08ea737f9427b7a81d9f0
114ad9945d4a3b191d654352691375a6ce71606ba0e08ea737f9427b7a81d9f0
```

[F] Add blocks to the miner and dump the blockchain.

CODE:

```
import datetime
import hashlib
class Block:
  def __init__(self, data, previous_hash):
    self.timestamp = datetime.datetime.now(datetime.timezone.utc)
    self.data = data
    self.previous_hash = previous_hash
    self.hash = self.calc_hash()
  def calc_hash(self):
    sha = hashlib.sha256()
    hash_str = self.data.encode("utf-8")
    sha.update(hash_str)
    return sha.hexdigest()
blockchain = [Block("First block", "0")]
blockchain.append(Block("Second block", blockchain[0].hash))
blockchain.append(Block("Third block", blockchain[1].hash))
# Dumping the blockchain
for block in blockchain:
  print(
f"Timestamp: {block.timestamp}\nData: {block.data}\nPrevious Hash: {block.previous_hash}\nHash:
{block.hash}\n"
  )
```

OUTPUT:



```
Timestamp: 2023-06-25 13:18:33.950453+00:00
Data: First block
Previous Hash: 0
Hash: 876fb923a443ba6afe5fb32dd79961e85be2b582cf74c233842b630ae16fe4d9

Timestamp: 2023-06-25 13:18:33.950453+00:00
Data: Second block
Previous Hash:
 876fb923a443ba6afe5fb32dd79961e85be2b582cf74c233842b630ae16fe4d9
Hash: 8e2fb9e02898feb024dff05ee0b27fd5ea0a448e252d975e6ec5f7b0a252a6cd

Timestamp: 2023-06-25 13:18:33.950453+00:00
Data: Third block
Previous Hash:
 8e2fb9e02898feb024dff05ee0b27fd5ea0a448e252d975e6ec5f7b0a252a6cd
Hash: 06e369fbfbe5362a8115a5c6f3e2d3ec7292cc4272052dcc3280898e3206208d
```

PRACTICAL 2

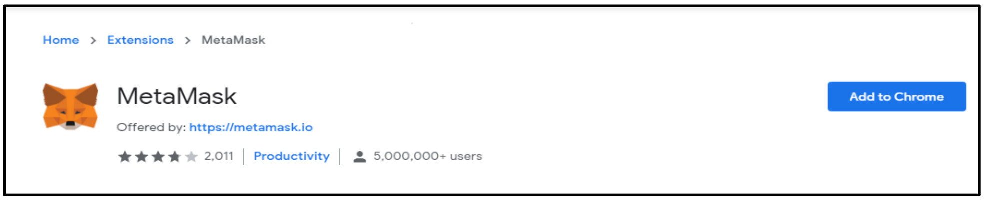
AIM: Install and configure Go Ethereum and the Mist browser. Develop and test a sample application.

Step 1: Go to Chrome Web Store Extensions Section.

Step 2: Search MetaMask.

Step 3: Check the number of downloads to make sure that the legitimate MetaMask is being installed, as hackers might try to make clones of it.

Step 4: Click the Add to Chrome button.

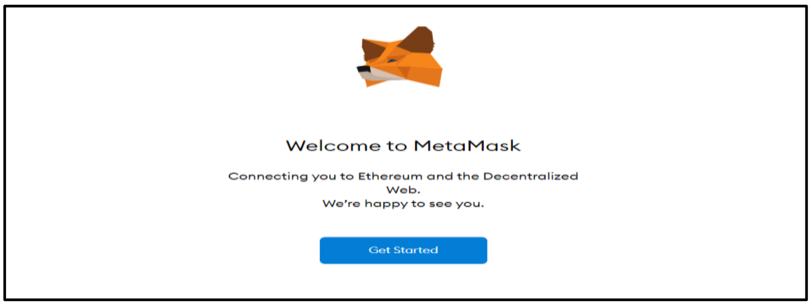


MetaMask

Offered by: https://metamask.io

★★★★☆ 2,011 | Productivity | 5,000,000+ users

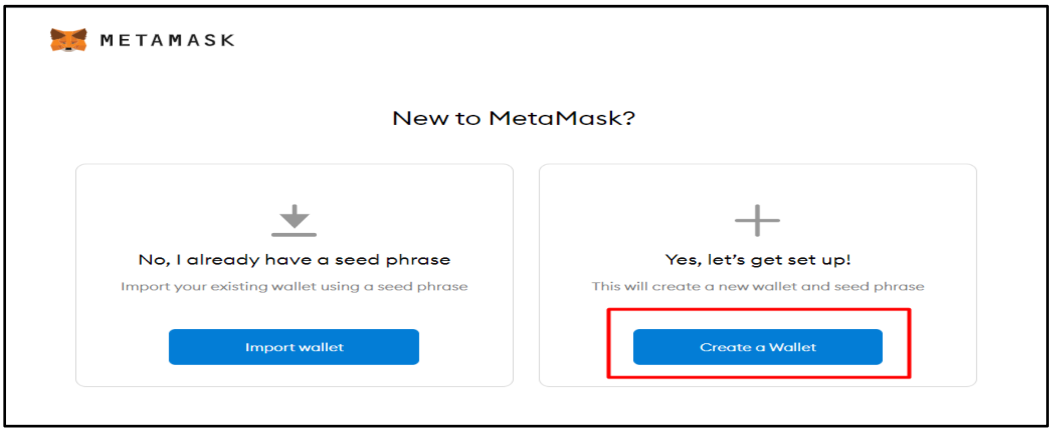
Step 5: Once installation is complete this page will be displayed. Click on the Get Started button.



Welcome to MetaMask

Connecting you to Ethereum and the Decentralized Web.
We're happy to see you.

Step 6: This is the first time creating a wallet, so click the Create a Wallet button. If there is already a wallet then import the already created using the Import Wallet button.



METAMASK

New to MetaMask?

No, I already have a seed phrase

Import your existing wallet using a seed phrase

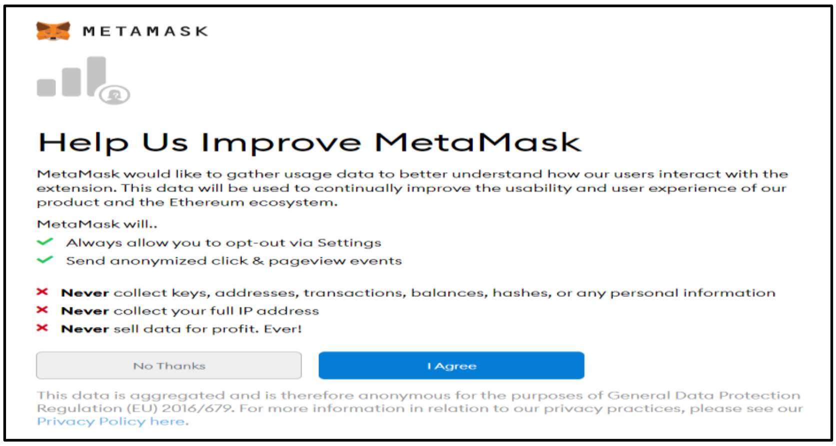
Import wallet

Yes, let's get set up!

This will create a new wallet and seed phrase

Create a Wallet

Step 7: Click I Agree button to allow data to be collected to help improve MetaMask or else click the No Thanks button. The wallet can still be created even if the user will click on the No thanks Button.



METAMASK

Help Us Improve MetaMask

MetaMask would like to gather usage data to better understand how our users interact with the extension. This data will be used to continually improve the usability and user experience of our product and the Ethereum ecosystem.

MetaMask will..

✓ Always allow you to opt-out via Settings

✓ Send anonymized click & pageview events

✗ **Never** collect keys, addresses, transactions, balances, hashes, or any personal information

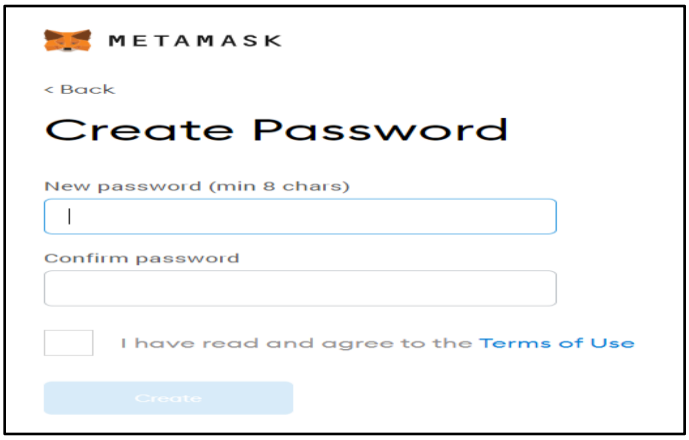
✗ **Never** collect your full IP address

✗ **Never** sell data for profit. Ever!

No Thanks I Agree

This data is aggregated and is therefore anonymous for the purposes of General Data Protection Regulation (EU) 2016/679. For more information in relation to our privacy practices, please see our Privacy Policy here.

Step 8: Create a password for your wallet. This password is to be entered every time the browser is launched and wants to use MetaMask. A new password needs to be created if chrome is uninstalled or if there is a switching of browsers. In that case, go through the Import Wallet button. This is because MetaMask stores the keys in the browser. Agree to Terms of Use.



METAMASK

< Back

Create Password

New password (min 8 chars)

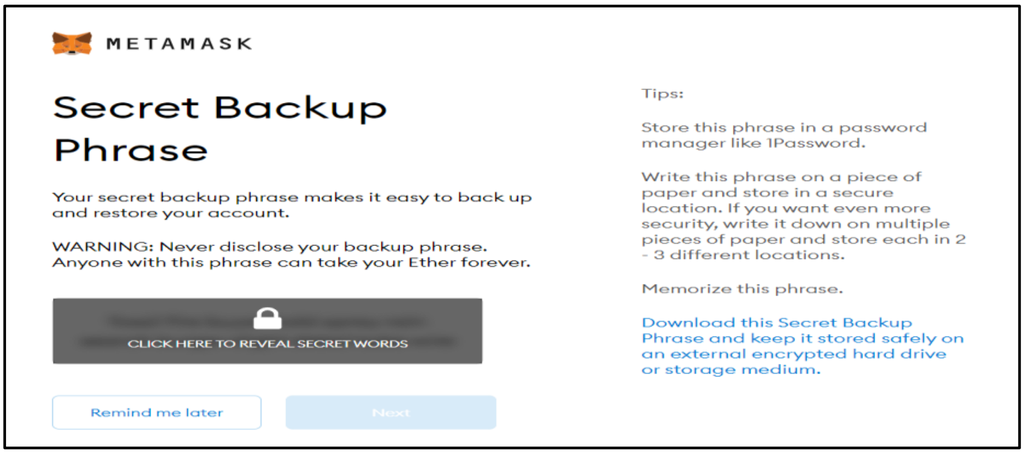
Confirm password

□ I have read and agree to the Terms of Use

Create

Step 9: Click on the dark area which says Click here to reveal secret words to get your secret phrase.

Step 10: This is the most important step. Back up your secret phrase properly. Do not store your secret phrase on your computer. Please read everything on this screen until you understand it completely before proceeding. The secret phrase is the only way to access your wallet if you forget your password. Once done click the Next button.



METAMASK

Secret Backup Phrase

Your secret backup phrase makes it easy to back up and restore your account.

WARNING: Never disclose your backup phrase. Anyone with this phrase can take your Ether forever.

Tips:

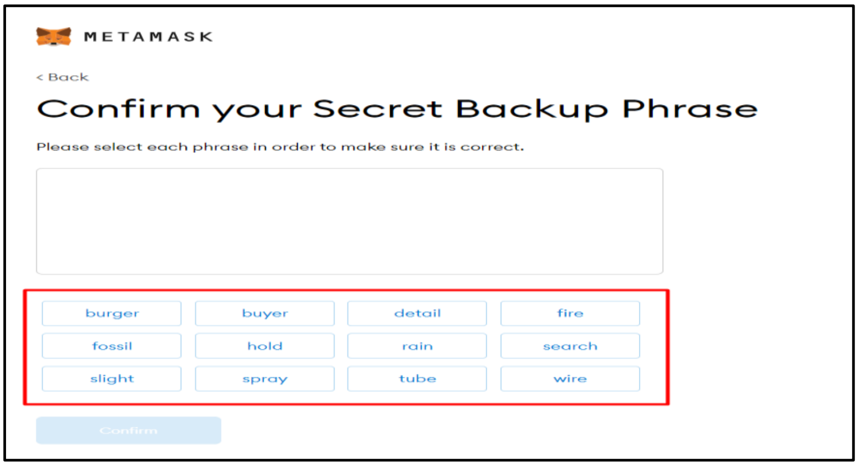
Store this phrase in a password manager like 1Password.

Write this phrase on a piece of paper and store in a secure location. If you want even more security, write it down on multiple pieces of paper and store each in 2 - 3 different locations.

Memorize this phrase.

Download this Secret Backup Phrase and keep it stored safely on an external encrypted hard drive or storage medium.

Step 11: Click the buttons respective to the order of the words in your seed phrase. In other words, type the seed phrase using the button on the screen. If done correctly the Confirm button should turn blue.



METAMASK

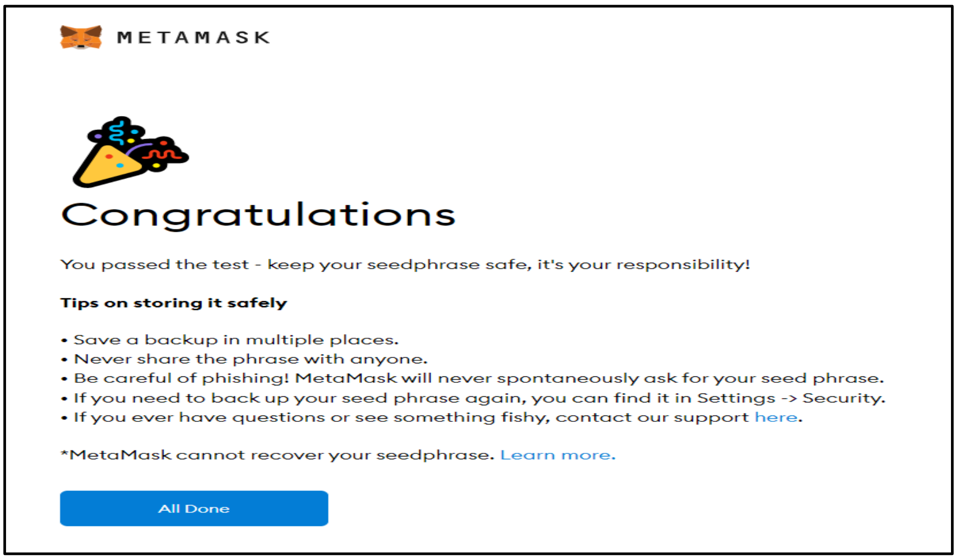
< Back

Confirm your Secret Backup Phrase

Please select each phrase in order to make sure it is correct.

burger	buyer	detail	fire
fossil	hold	rain	search
slight	spray	tube	wire

Step 12: Click the Confirm button. Please follow the tips mentioned.



Congratulations

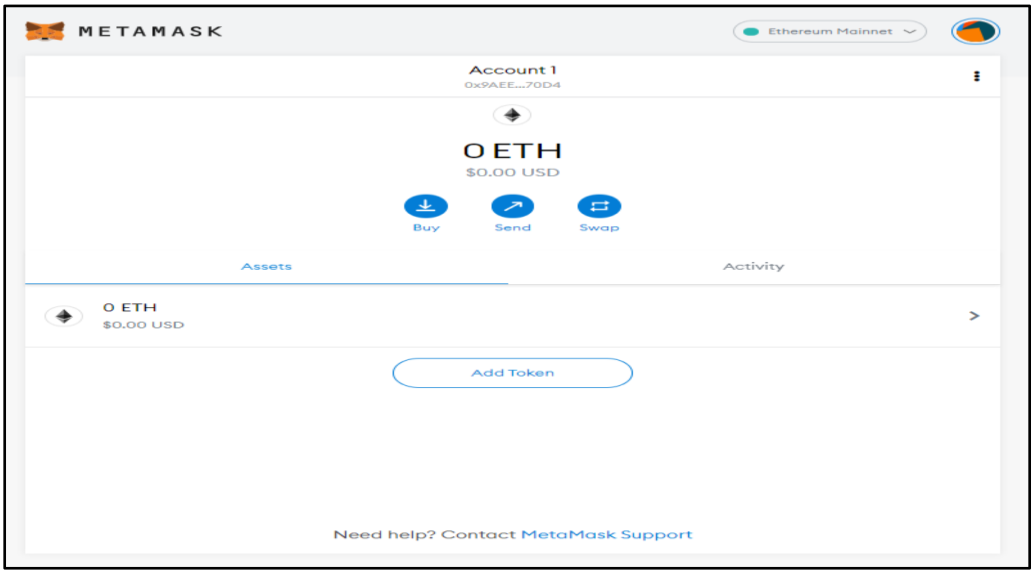
You passed the test - keep your seedphrase safe, it's your responsibility!

Tips on storing it safely

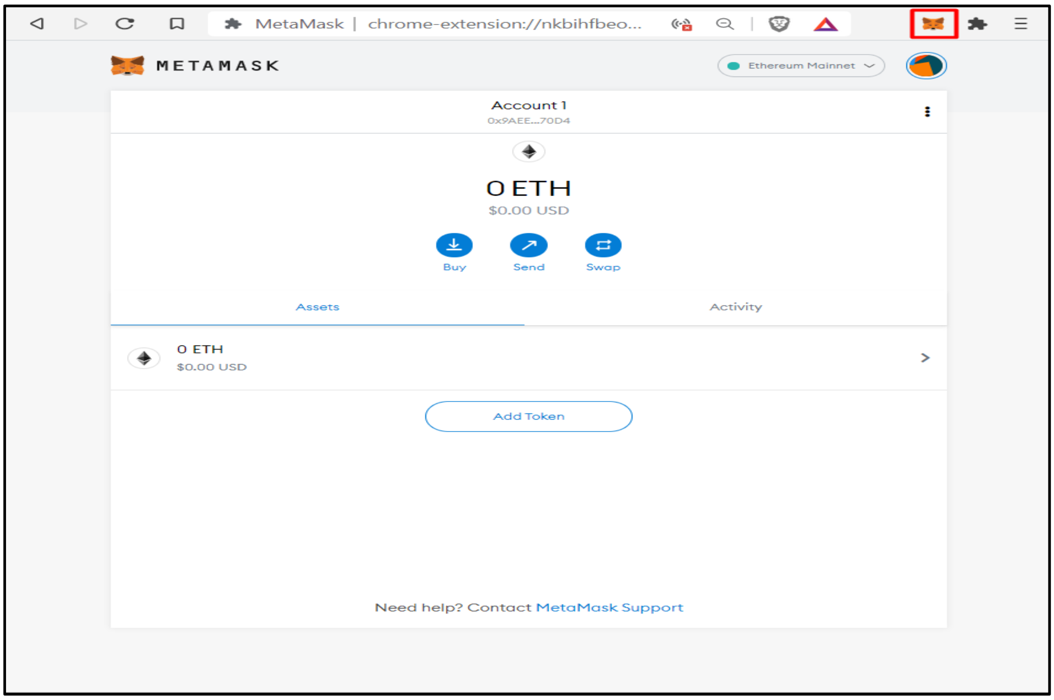
- Save a backup in multiple places.
- Never share the phrase with anyone.
- Be careful of phishing! MetaMask will never spontaneously ask for your seed phrase.
- If you need to back up your seed phrase again, you can find it in Settings -> Security.
- If you ever have questions or see something fishy, contact our support here.

*MetaMask cannot recover your seedphrase. Learn more.

Step 13: One can see the balance and copy the address of the account by clicking on the Account 1 area.



Step 14: One can access MetaMask in the browser by clicking the Foxface icon on the top right. If the Foxface icon is not visible, then click on the puzzle piece icon right next to it.



PRACTICAL 3

AIM: Implement and demonstrate the use of the following in Solidity:

[A] Variable, Operators, Loops, Decision Making, Strings, Arrays, Enums, Structs, Mappings, Conversions, Ether Units, Special Variables.

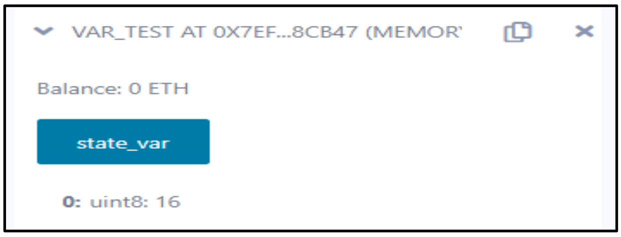
[I] Variable

[i] State Variable

CODE:

```
//Solidity program to demonstrate state variables
pragma solidity ^0.5.0;
// Creating a contract
contract var_Test
{
   // Declaring a state variable
   uint8 public state_var;

   // Defining a constructor
   constructor() public {
      state_var = 16;
   }
}
```

OUTPUT:



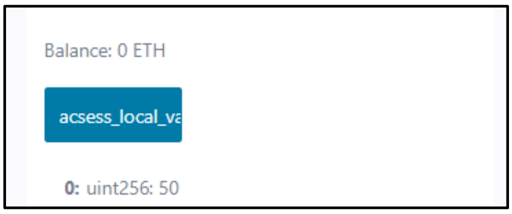
```
VAR_TEST AT 0X7EF...8CB47 (MEMOR'
Balance: 0 ETH
state_var
0: uint8: 16
```

[ii] Local Variable

CODE:

```
//Solidity program to demonstrate Local variables
pragma solidity ^0.5.0;
// Creating a contract
contract local_var_Test
{
    // Defining function to show the declaration and
    // scope of Local variables
    function acsess_local_variable() public pure returns(uint) {
        // Initializing Local variables
        uint a = 10;
        uint b = 40;
        uint sum = a + b;
        // Access the Local variable
        return sum;
    }
}
```

OUTPUT:



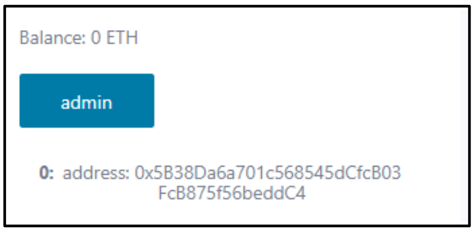
```
Balance: 0 ETH
acsess_local_va
0: uint256: 50
```

[iii] Global Variable

CODE:

```
//Solidity program to show Global variables
pragma solidity ^0.5.0;
// Creating a contract
contract globalTest
{
    // Defining a variable
    address public admin;
    // Creating a constructor to
    // use Global variable
    constructor() public
    {
        admin = msg.sender;
    }
}
```

OUTPUT:



Balance: 0 ETH

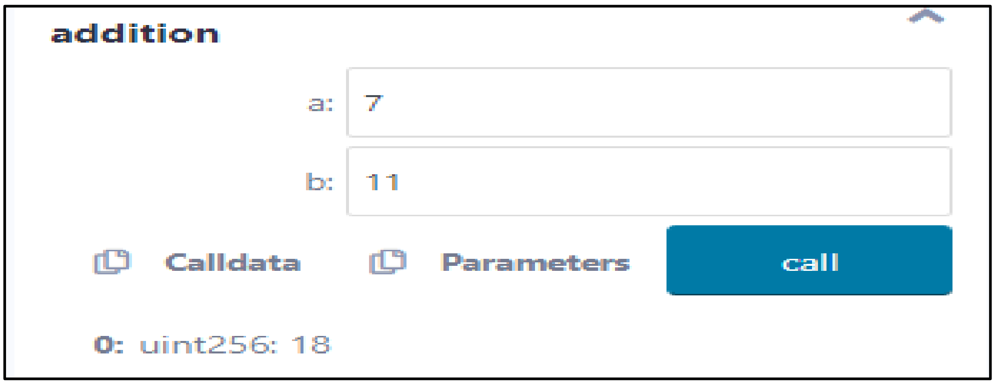
0: address: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4

[II] Operators

CODE:

```
pragma solidity ^0.4.0;

contract Operators {

    uint256 result = 0;

    function addition(uint256 a, uint256 b) public pure returns (uint256) {
        return a + b;
    }

    function subtraction(uint256 a, uint256 b) public pure returns (uint256) {
        return a - b;
    }

    function division(uint256 a, uint256 b) public pure returns (uint256) {
        return a / b;
    }

    function multiply(uint256 a, uint256 b) public pure returns (uint256) {
        return a * b;
    }
}
```

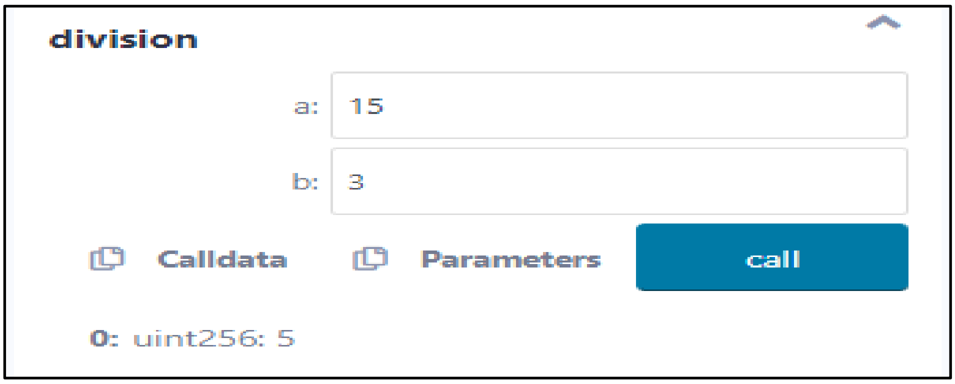
OUTPUT:



a: 7

b: 11

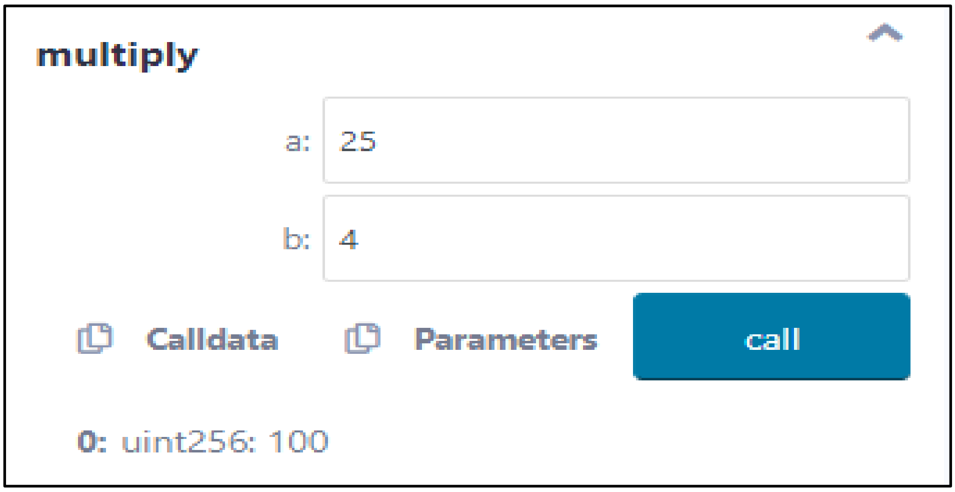
0: uint256: 18


division

a: 15

b: 3

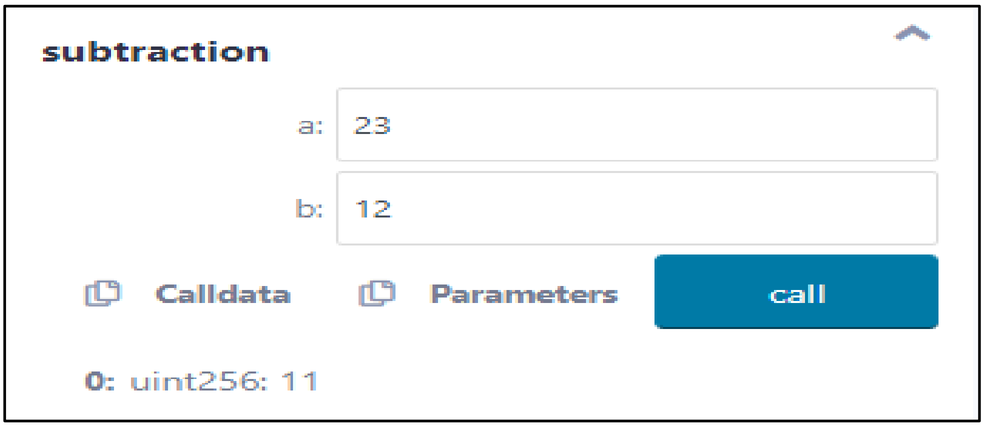
0: uint256: 5


multiply

a: 25

b: 4

0: uint256: 100


subtraction

a: 23

b: 12

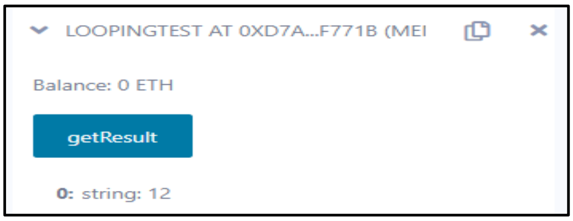
0: uint256: 11

[III] Loops

CODE:

```
pragma solidity ^0.5.0;
contract LoopingTest {
   uint256 storedData;
   constructor() public {
      storedData = 10;
   }
   function getResult() public pure returns (string memory) {
      uint256 a = 10;
      uint256 b = 2;
      uint256 result = a + b;
      return integerToString(result);
   }
   function integerToString(uint256 _i) internal pure returns (string memory) {
      if (_i == 0) {
         return "0";
      }
      uint256 j = 0;
      uint256 len;
      for (j = _i; j != 0; j /= 10) {
         //for loop example
         len++;
      }
      bytes memory bstr = new bytes(len);
      uint256 k = len - 1;
      while (_i != 0) {
         bstr[k--] = bytes1(uint8(48 + (_i % 10)));
         _i /= 10;
      }
      return string(bstr); //access local variable
   }
}
```

OUTPUT:



Balance: 0 ETH

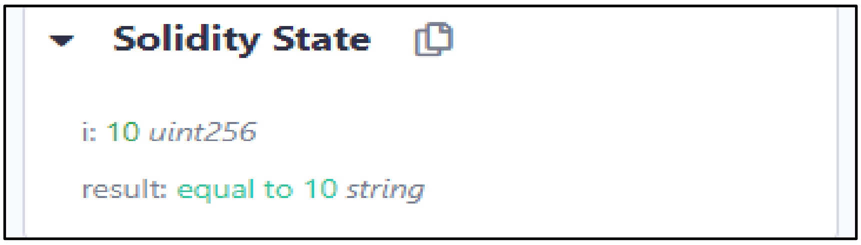
```
0: string: 12
```

[IV] Decision Making

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.1;

// Creating a contract
contract Types {

    // Declaring state variables
    uint256 i = 10;
    string result;

    function decision_making() public payable returns (string memory) {
        if (i < 10) {
            result = "less than 10";
        }
        else if (i == 10) {
            result = "equal to 10";
        }
        else {
            result = "greater than 10";
        }
        return result;
    }
}
```

OUTPUT:



```
Solidity State

i: 10 uint256

result: equal to 10 string
```

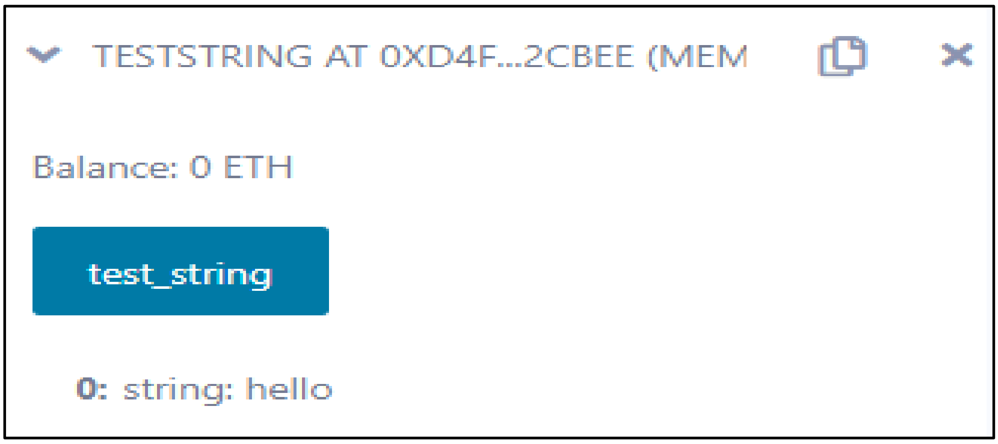
[V] Strings

[i] Double Quotes

CODE:

```
pragma solidity ^0.5.0;

contract testString
{
    function test_string() public pure returns (string memory)
    {
        string memory a = "hello";
        return a;
    }
}
```

OUTPUT:



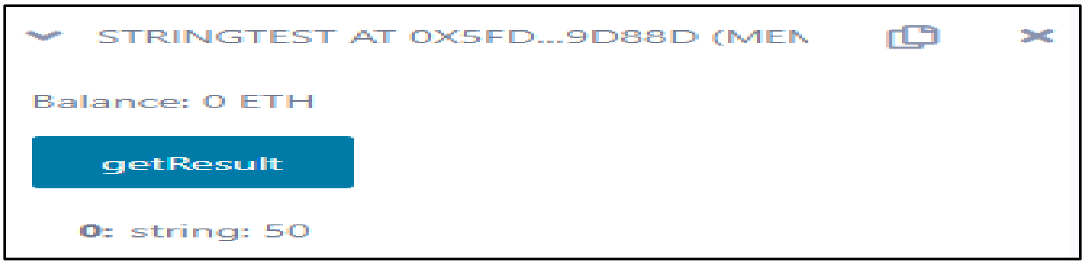
```
TESTSTRING AT 0XD4F...2CBEE (MEM
Balance: 0 ETH
test_string
0: string: hello
```

[ii] Single Quotes

CODE:

```
pragma solidity ^0.5.2;
contract stringTest
{
    function getResult() public pure returns(string memory) {
        uint a = 25;
        uint b = 25;
        uint result = a + b;
        return integerToString(result);
    }
    function integerToString(uint _i) internal pure returns (string memory){
        if (_i == 0)
        {
          return "0";
        }
        uint j = _i;
        uint len;
        while (j != 0)
        {
          len++;
          j/= 10;
        }
        bytes memory bstr = new bytes(len);
        uint k = len - 1;
        while (_i != 0)
        {
          bstr[k-- ] = byte(uint8(48 + _i % 10));
          _i /= 10;
        }
    return string(bstr);
    }
}
```

OUTPUT:



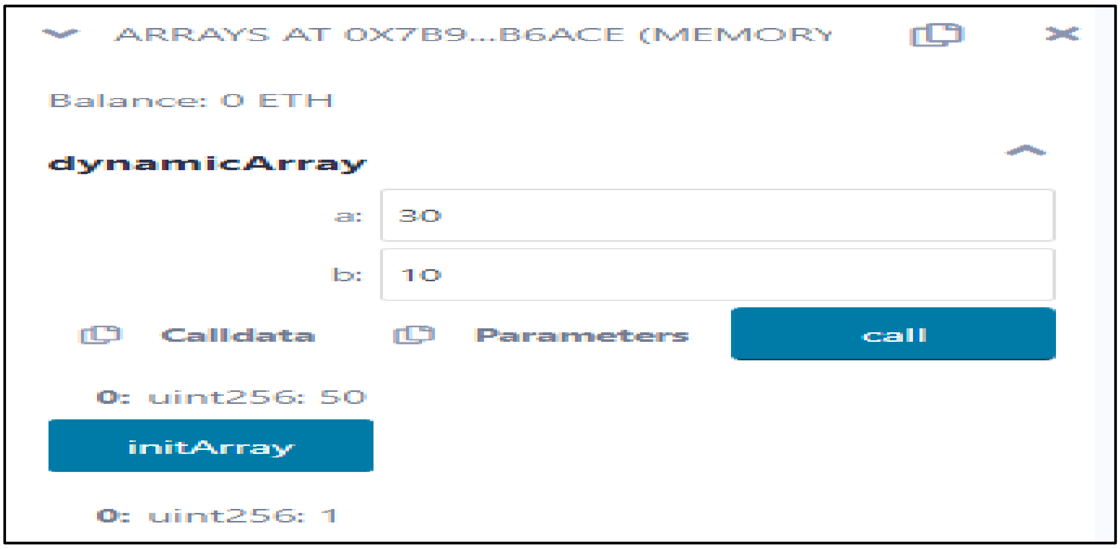
```
0: string: 50
```

[VI] Arrays

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity 0.7.0;

contract Arrays {

    function initArray() public pure returns (uint256) {
        uint128[3] memory array = [1, 2, uint128(3)];
        return array[0];
    }

    function dynamicArray(uint256 a, uint256 b) public pure returns (uint256) {

        uint128[] memory array = new uint128[](a);
        uint128 val = 5;

        for (uint128 j = 0; j < a; j++) {
            array[j] = j * val;
        }

        return array[b];
    }
}
```

OUTPUT:



ARRAYS AT 0X7B9...B6ACE (MEMORY

Balance: 0 ETH

dynamicArray

a: 30

b: 10

0: uint256: 50

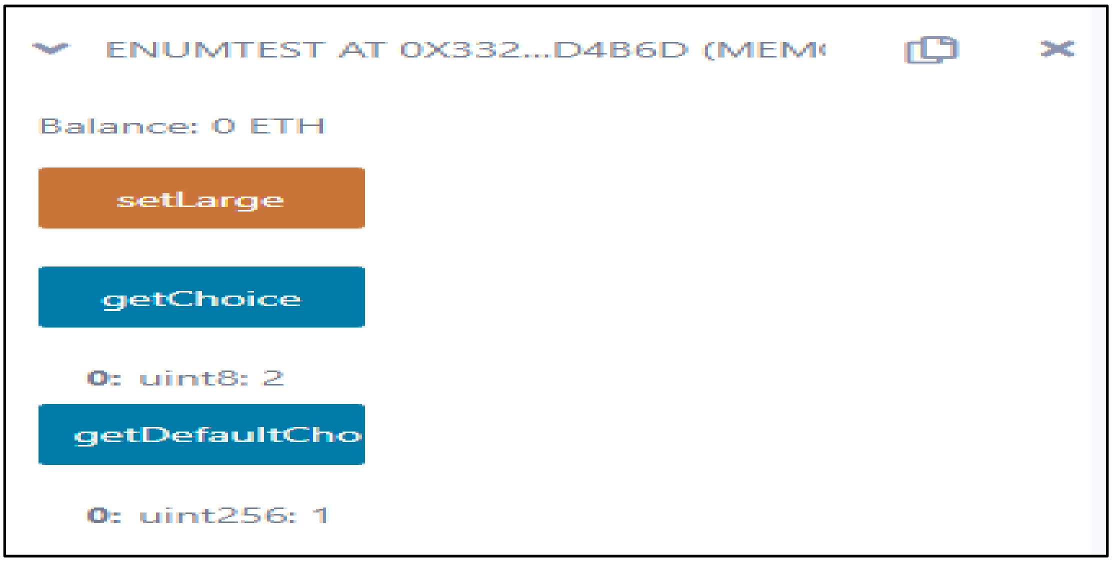
0: uint256: 1

[VII] Enums

CODE:

```
pragma solidity ^0.5.0;

contract enumTest {
    enum FreshJuiceSize {
        SMALL,
        MEDIUM,
        LARGE
    }
    FreshJuiceSize choice;
    FreshJuiceSize constant defaultChoice = FreshJuiceSize.MEDIUM;

    function setLarge() public {
        choice = FreshJuiceSize.LARGE;
    }

    function getChoice() public view returns (FreshJuiceSize) {
        return choice;
    }

    function getDefaultChoice() public pure returns (uint256) {
        return uint256(defaultChoice);
    }
}
```

OUTPUT:



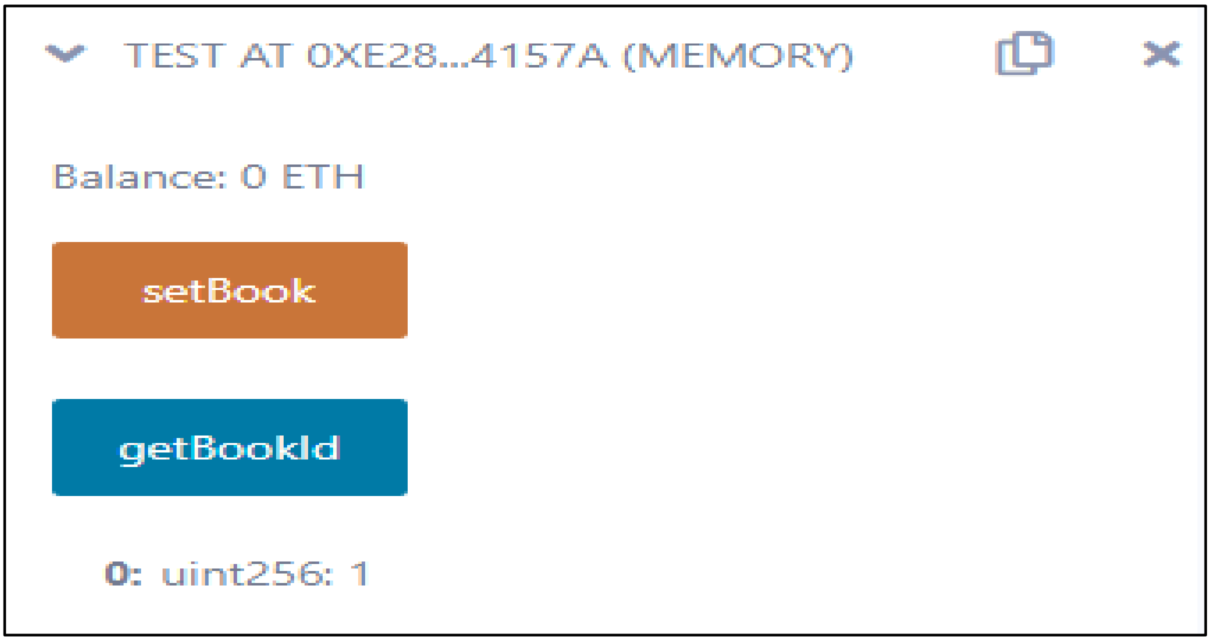
```
ENUMTEST AT 0X332...D4B6D (MEM
Balance: 0 ETH
0: uint8: 2
0: uint256: 1
```

[VIII] Structs

STEPS:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.1;

contract test {
   struct Book {
      string title;
      string author;
      uint book_id;
   }

   Book book;

   function setBook() public {
      book = Book('Learn Java', 'TP', 1);
   }

   function getBookId() public view returns (uint) {
      return book.book_id;
   }
}
```

OUTPUT:



```
Balance: 0 ETH
0: uint256: 1
```

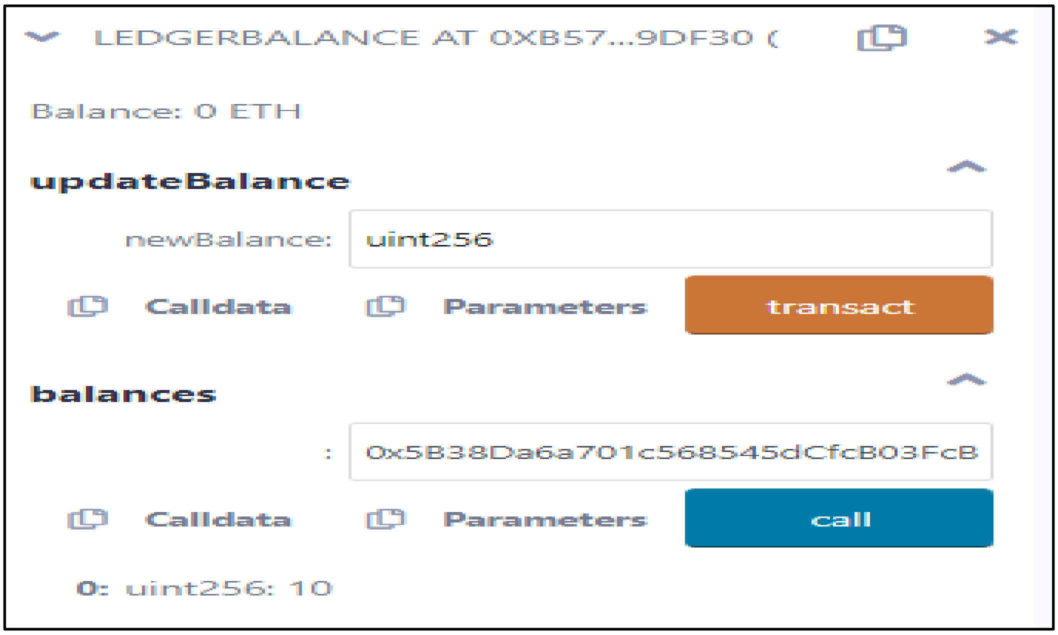
[IX] Mappings

CODE:

```
pragma solidity ^0.5.0;

contract LedgerBalance
{
    mapping(address => uint) public balances;

    function updateBalance(uint newBalance) public
    {
    balances[msg.sender] = newBalance;
    }
}
contract Updater
{
    function updateBalance() public returns (uint)
    {
        LedgerBalance ledgerBalance = new LedgerBalance();
        ledgerBalance.updateBalance(10);
        return ledgerBalance.balances(address(this));
    }
}
```

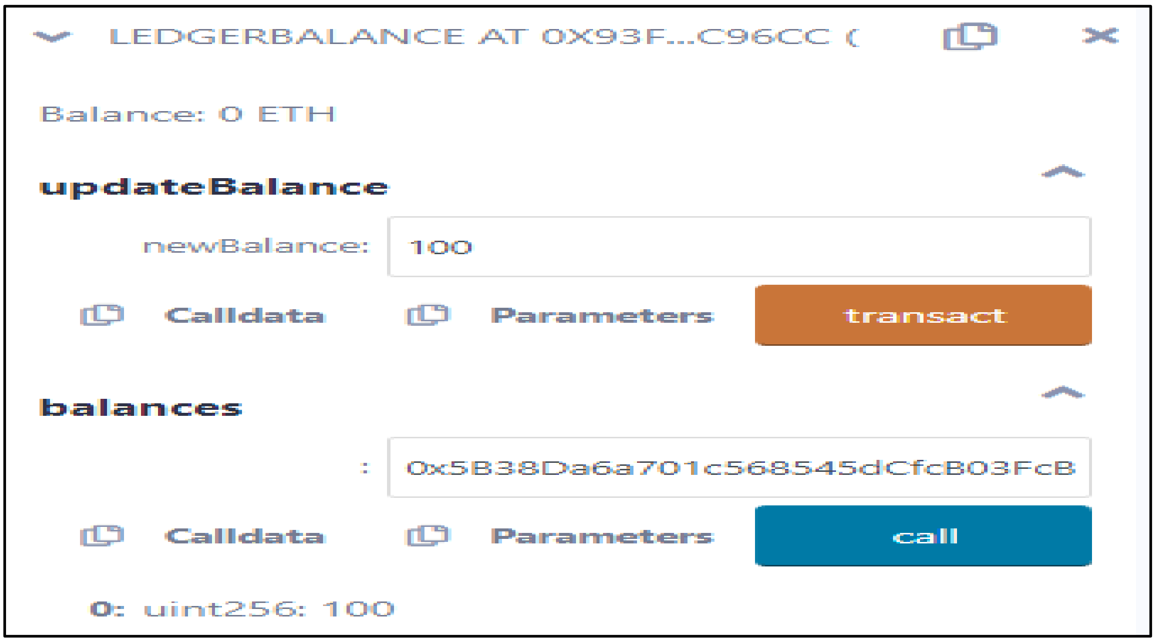
OUTPUT:

With Original Balance: 10



```
LEDGERBALANCE AT 0XB57...9DF30 (
Balance: 0 ETH
updateBalance
newBalance: uint256
balances
: 0x5B38Da6a701c568545dCfcB03FcB
0: uint256: 10
```

With Updated Balance: 100



Balance: 0 ETH

updateBalance

newBalance: 100

balances

: 0x5B38Da6a701c568545dCfcB03FcB

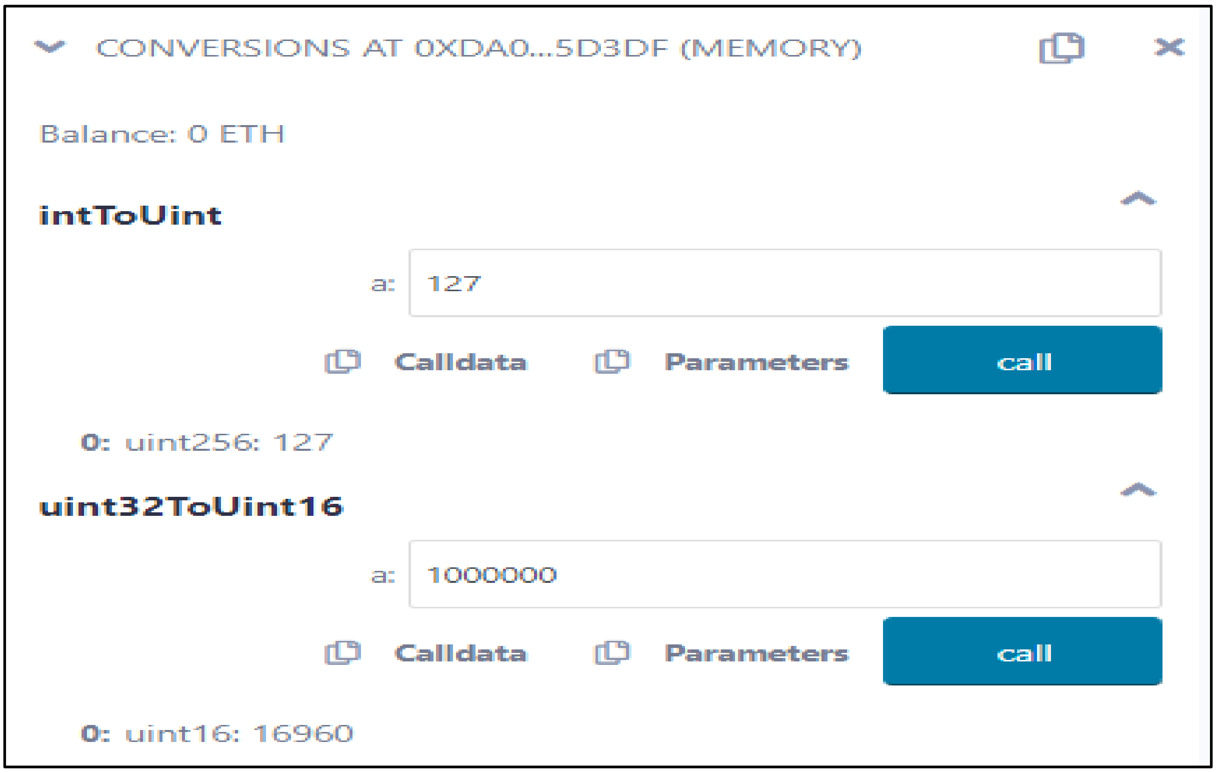
0: uint256: 100

[X] Conversions

CODE:

```
pragma solidity ^0.4.0;

contract Conversions {
   function intToUint(int8 a) public pure returns (uint256) {
      uint256 b = uint256(a);
      return b;
   }

   function uint32ToUint16(uint32 a) public pure returns (uint16) {
      uint16 b = uint16(a);
      return b;
   }
}
```

OUTPUT:



```
a: 127
0: uint256: 127
a: 1000000
0: uint16: 16960
```

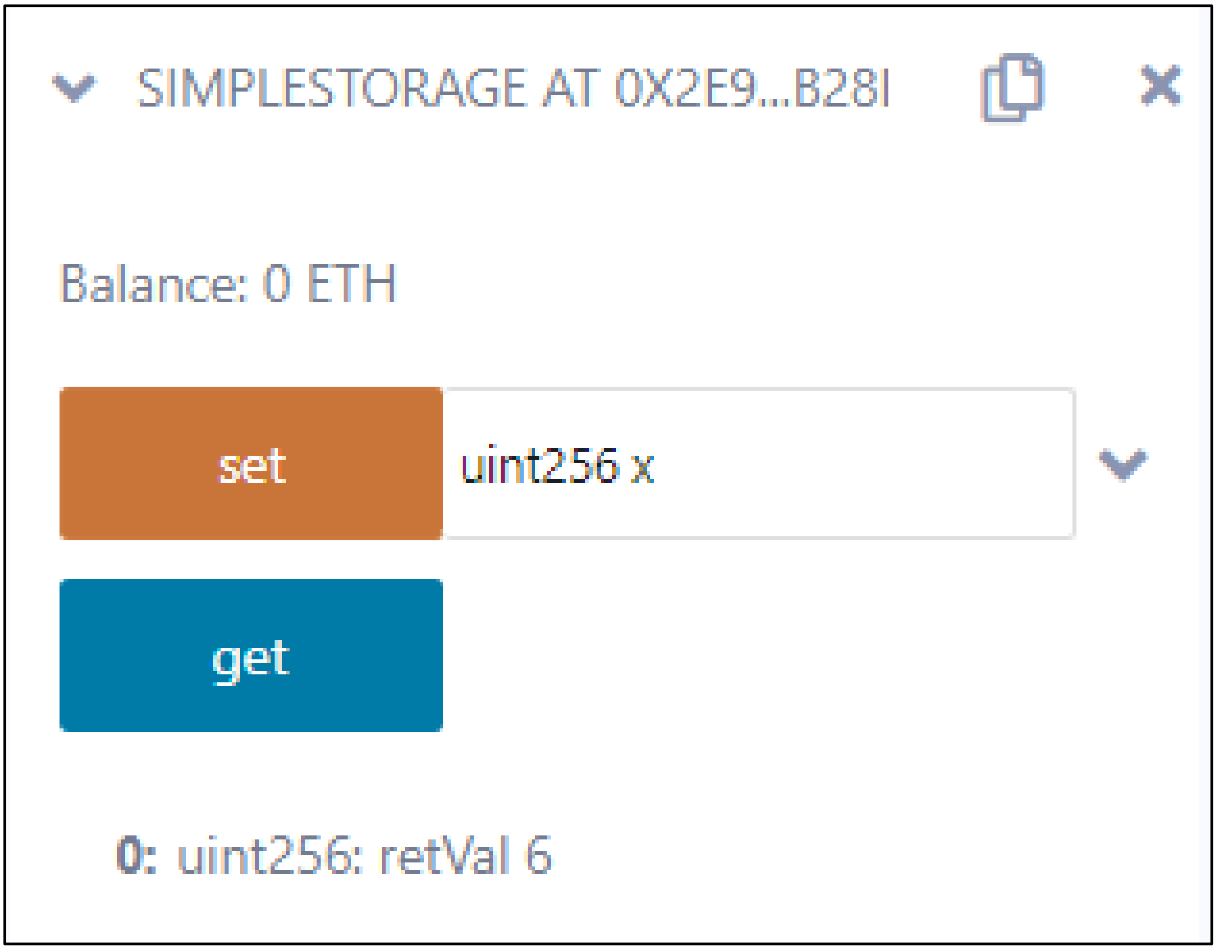
[XI] Ether Units

CODE:

```
pragma solidity ^0.4.6;

contract SimpleStorage {
  uint256 storedData = 2;

  function set(uint256 x) public {
    storedData = x;
    /*
    Ether Units
    Wei
    Finney
    Szabo
    Ether
    */
    if (2000000000000000000 == 2 ether) {
      storedData = 2;
    }
    else {
      storedData = 3;
    }
    /*
    Time Units
    seconds
    minutes
    hours
    days
    weeks
    month
    years
    */
    if (120 seconds == 2 minutes) {
      storedData = 6;
    }
    else {
      storedData = 9;
    }
  }
```

```
    function get() constant public returns (uint256 retVal)
    {
        return storedData;
    }
}
```

OUTPUT:



Balance: 0 ETH

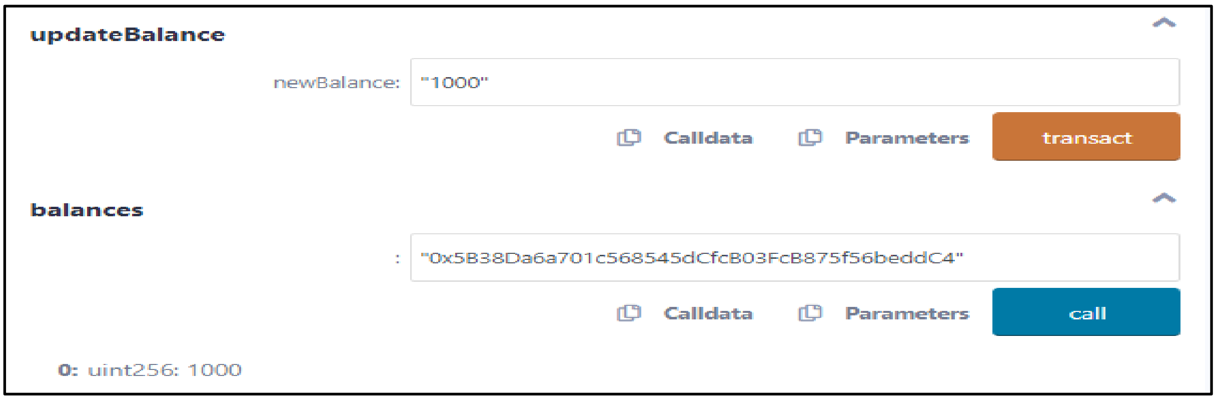
0: uint256: retVal 6

[XII] Special Variables

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.1;

contract LedgerBalance {
   mapping(address => uint256) public balances;

   function updateBalance(uint256 newBalance) public {
      balances[msg.sender] = newBalance;
   }
}
contract Updater {
   function updateBalance() public returns (uint256) {
      LedgerBalance ledgerBalance = new LedgerBalance();
      ledgerBalance.updateBalance(10);
      return ledgerBalance.balances(address(this));
   }
}
```

OUTPUT:



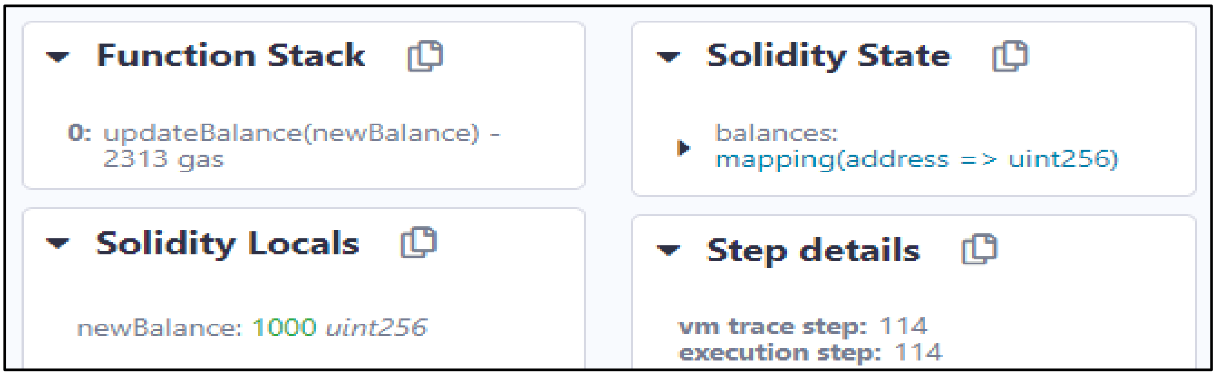
updateBalance

newBalance: "1000"

balances

: "0x5B38Da6a701c568545dCfcB03FcB875f56beddC4"

```
0: uint256: 1000
```



Function Stack

```
0: updateBalance(newBalance) -
   2313 gas
```

Solidity State

```
balances:
mapping(address => uint256)
```

Solidity Locals

```
newBalance: 1000 uint256
```

Step details

```
vm trace step: 114
execution step: 114
```

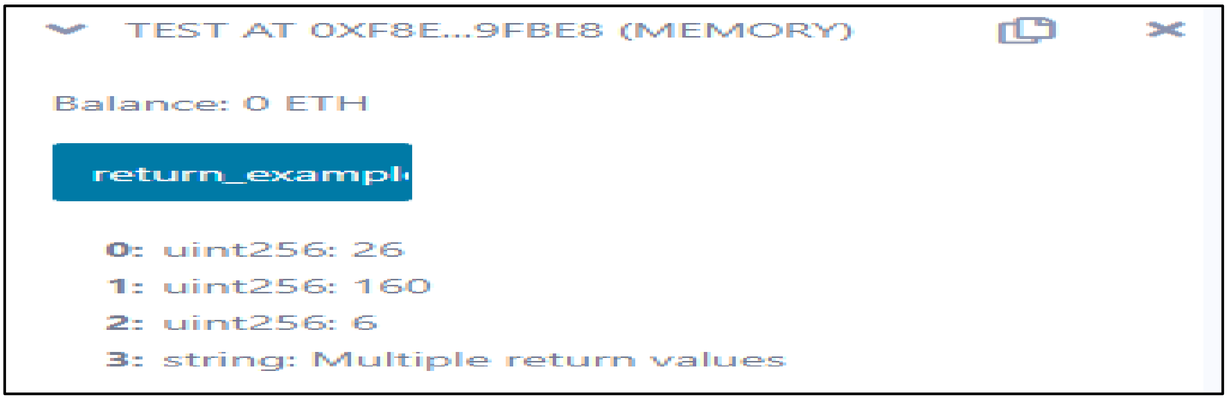
[B] Functions, Function Modifiers, View Functions, Pure Functions, Fallback Function, Function Overloading, Mathematical functions, Cryptographic functions.

[I] Functions

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Test {
  function return_example()
    public
    pure
    returns (
      uint256,
      uint256,
      uint256,
      string memory
    )
  {
    uint256 num1 = 10;
    uint256 num2 = 16;
    uint256 sum = num1 + num2;
    uint256 prod = num1 * num2;
    uint256 diff = num2 - num1;
    string memory message = "Multiple return values";
    return (sum, prod, diff, message);
  }
}
```

OUTPUT:



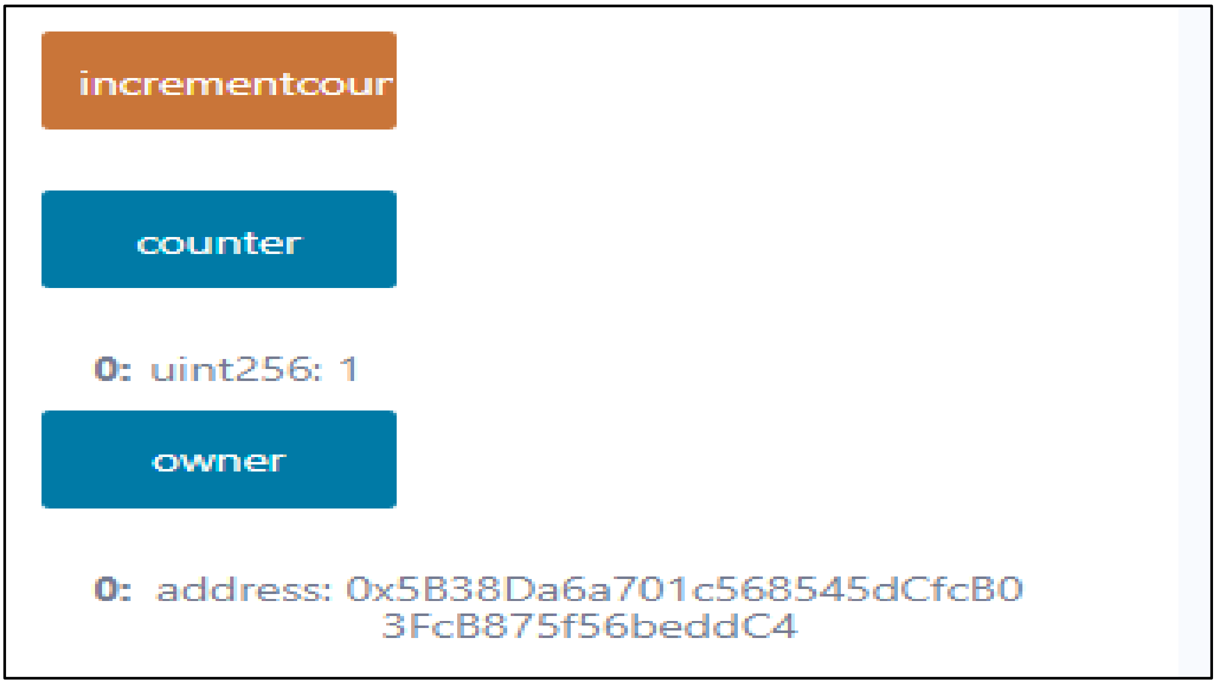
```
TEST AT 0XF8E...9FBE8 (MEMORY)

Balance: 0 ETH

return_exampl

0: uint256: 26
1: uint256: 160
2: uint256: 6
3: string: Multiple return values
```

[II] Function Modifiers

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract ExampleContract {
  address public owner = 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4;
  uint256 public counter;

  modifier onlyowner() {
    require(msg.sender == owner, "Only the contract owner can call");
    _;
  }

  function incrementcounter() public onlyowner {
    counter++;
  }
}
```

OUTPUT:



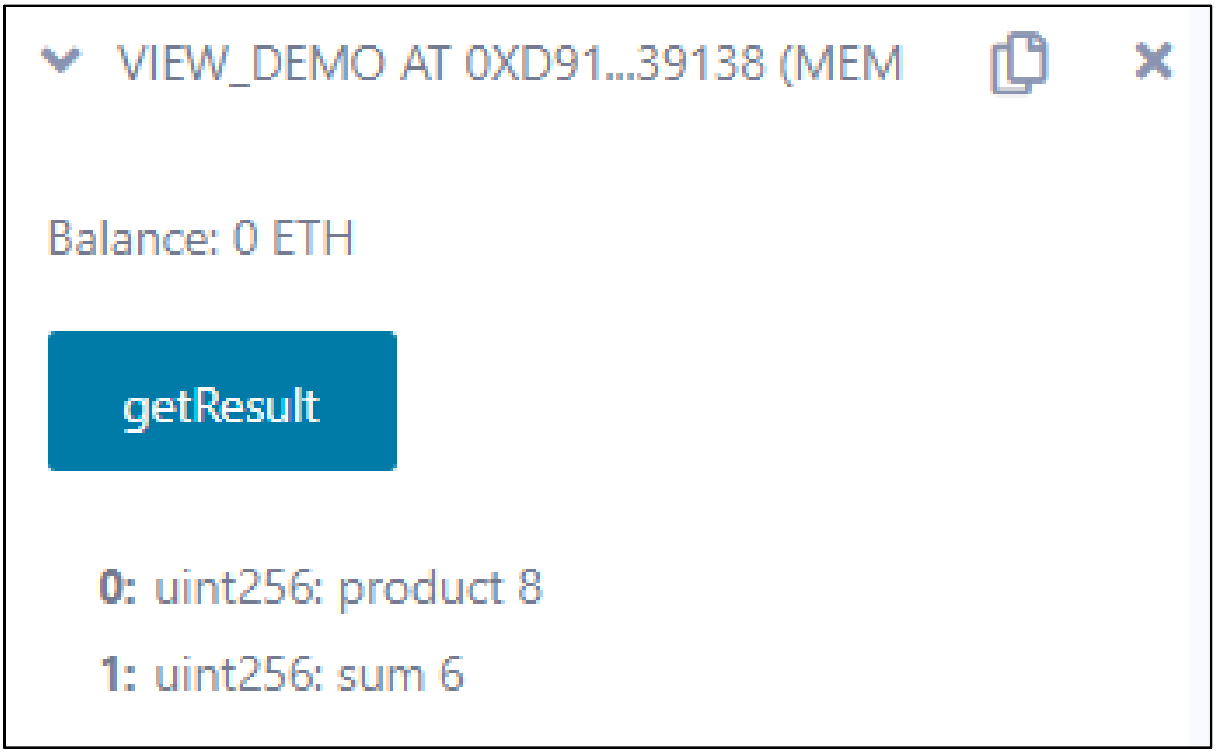
```
0: uint256: 1
0: address: 0x5B38Da6a701c568545dCfcB0
            3FcB875f56beddC4
```

[III] View Functions

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract view_demo {
  uint256 num1 = 2;
  uint256 num2 = 4;

  function getResult() public view returns (uint256 product, uint256 sum) {
    product = num1 * num2;
    sum = num1 + num2;
  }
}
```

OUTPUT:



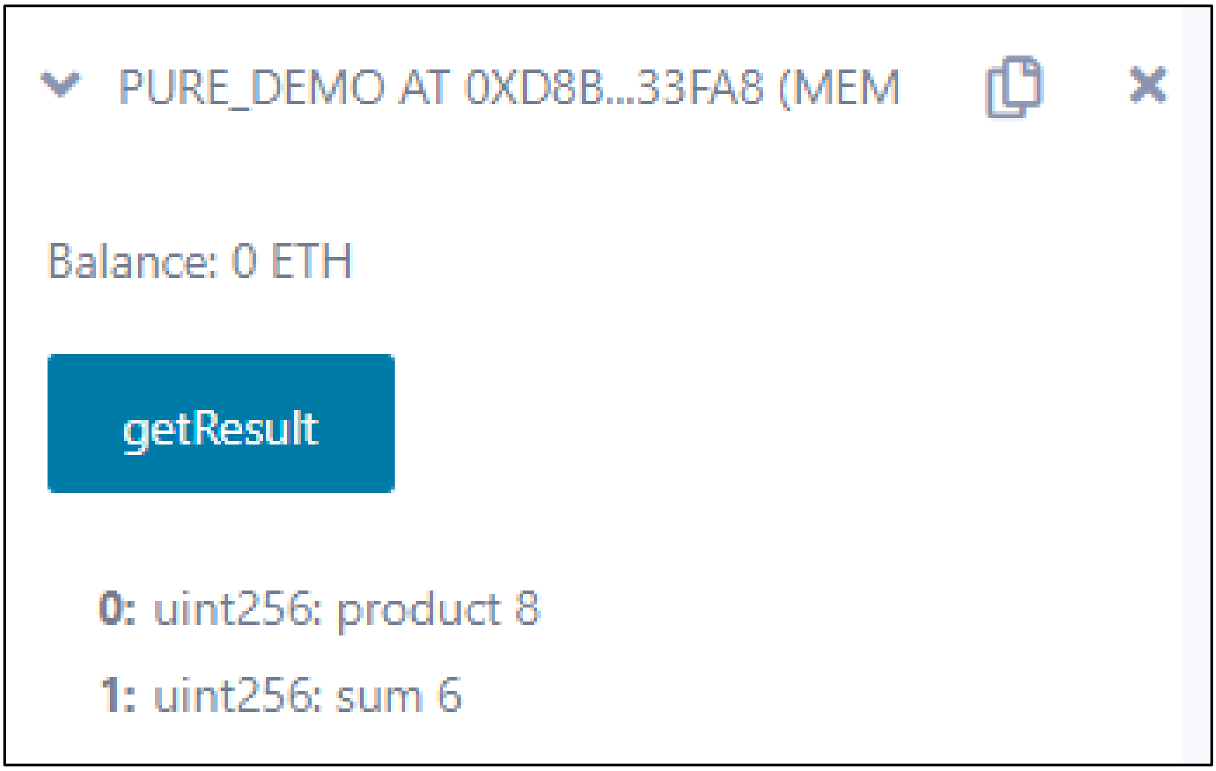
```
Balance: 0 ETH

0: uint256: product 8
1: uint256: sum 6
```

[IV] Pure Functions

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract pure_demo {
  function getResult() public pure returns (uint256 product, uint256 sum) {
    uint256 num1 = 2;
    uint256 num2 = 4;
    product = num1 * num2;
    sum = num1 + num2;
  }
}
```

OUTPUT:



Balance: 0 ETH

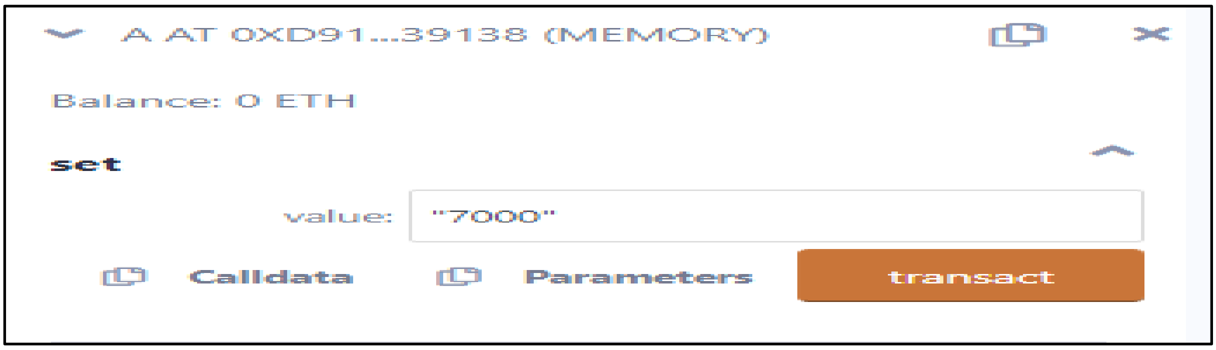
```
0: uint256: product 8
1: uint256: sum 6
```

[V] Fallback Function

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;
contract A {
  uint256 n;

  function set(uint256 value) external {
    n = value;
  }
function() external payable {
    n = 0;
  }
}
contract example {
  function callA(A a) public returns (bool) {
    (bool success, ) = address(a).call(abi.encodeWithSignature("setter()"));
    require(success);
    address payable payableA = address(uint160(address(a)));
    return (payableA.send(2 ether));
  }
}
```

OUTPUT:

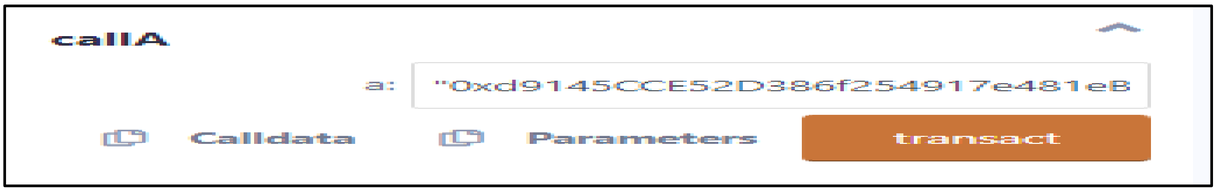


A AT 0XD91...39138 (MEMORY)

Balance: 0 ETH

set

value: "7000"



callA

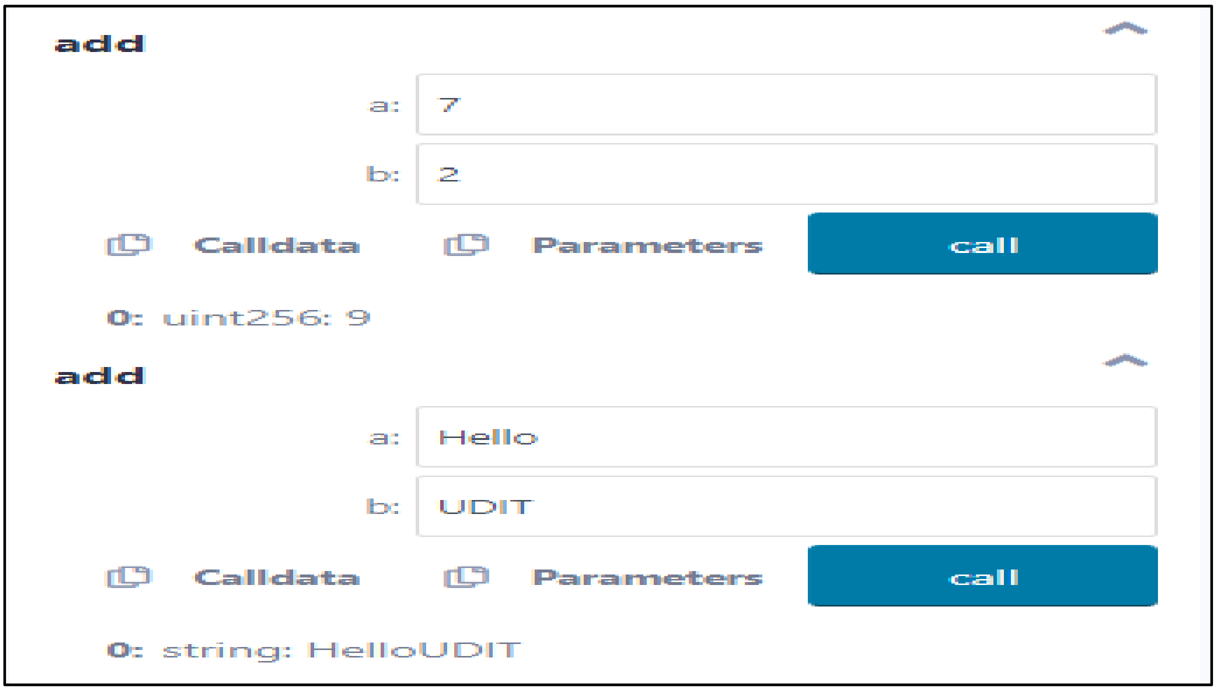
a: "0xd9145CCE52D386f254917e481eB

[VI] Function Overloading

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract OverloadingExample {
  function add(uint256 a, uint256 b) public pure returns (uint256) {
    return a + b;
  }

  function add(string memory a, string memory b)
    public
    pure
    returns (string memory)
  {
    return string(abi.encodePacked(a, b));
  }
}
```

OUTPUT:



add

a: 7

b: 2

0: uint256: 9

add

a: Hello

b: UDIT

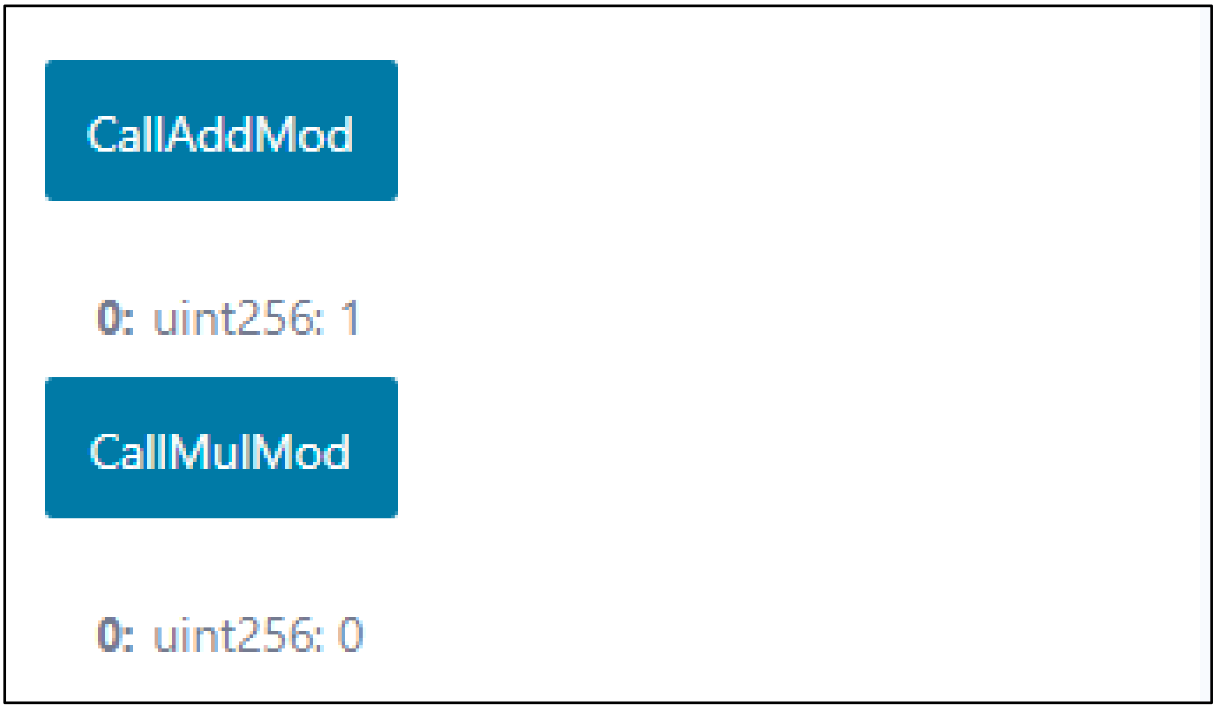
0: string: HelloUDIT

[VII] Mathematical Functions

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Test{ function CallAddMod() public pure returns(uint){

   return addmod(7,3,3);

}

function CallMulMod() public pure returns(uint){

   return mulmod(7,3,3);

   }
}
```

OUTPUT:



```
0: uint256: 1
```

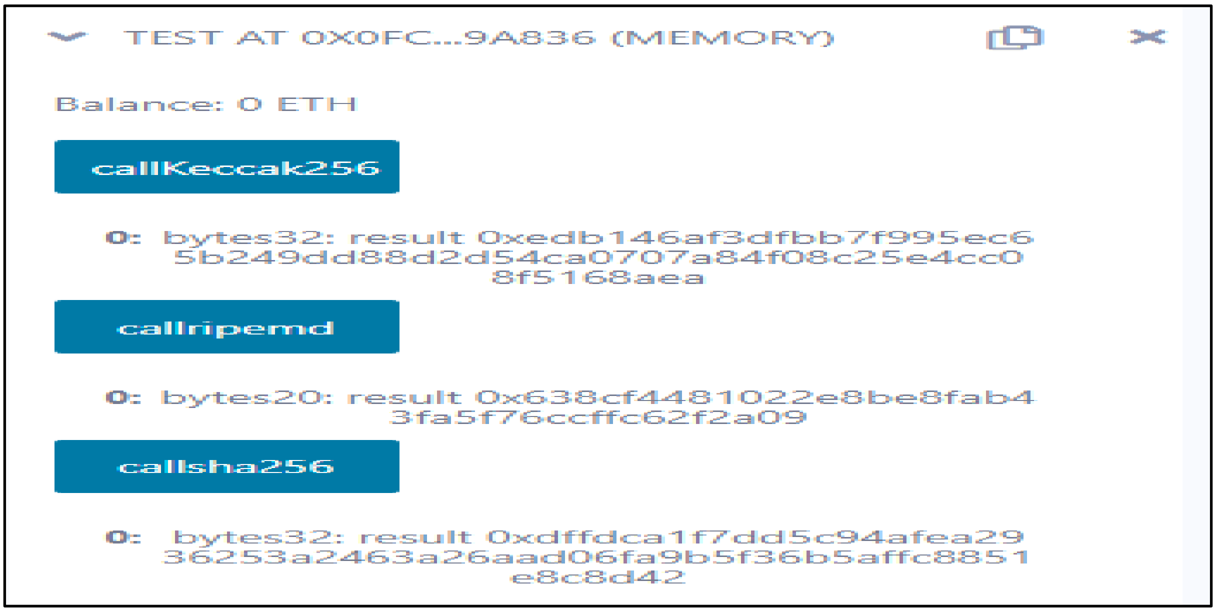
```
0: uint256: 0
```

[VIII] Cryptographic Functions

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Test{ function callKeccak256() public pure returns(bytes32 result){

  return keccak256("BLOCKCHAIN");

}

function callsha256() public pure returns(bytes32 result){

  return sha256("BLOCKCHAIN");

}

function callripemd() public pure returns (bytes20 result){

  return ripemd160("BLOCKCHAIN");
  }
}
```

OUTPUT:



```
Balance: 0 ETH

0: bytes32: result 0xedb146af3dfbb7f995ec6
   5b249dd88d2d54ca0707a84f08c25e4cc0
   8f5168aea

0: bytes20: result 0x638cf4481022e8be8fab4
   3fa5f76ccffc62f2a09

0: bytes32: result 0xdffdca1f7dd5c94afea29
   36253a2463a26aad06fa9b5f36b5affc8851
   e8c8d42
```

PRACTICAL 4

AIM: Implement and demonstrate the use of the following in Solidity:

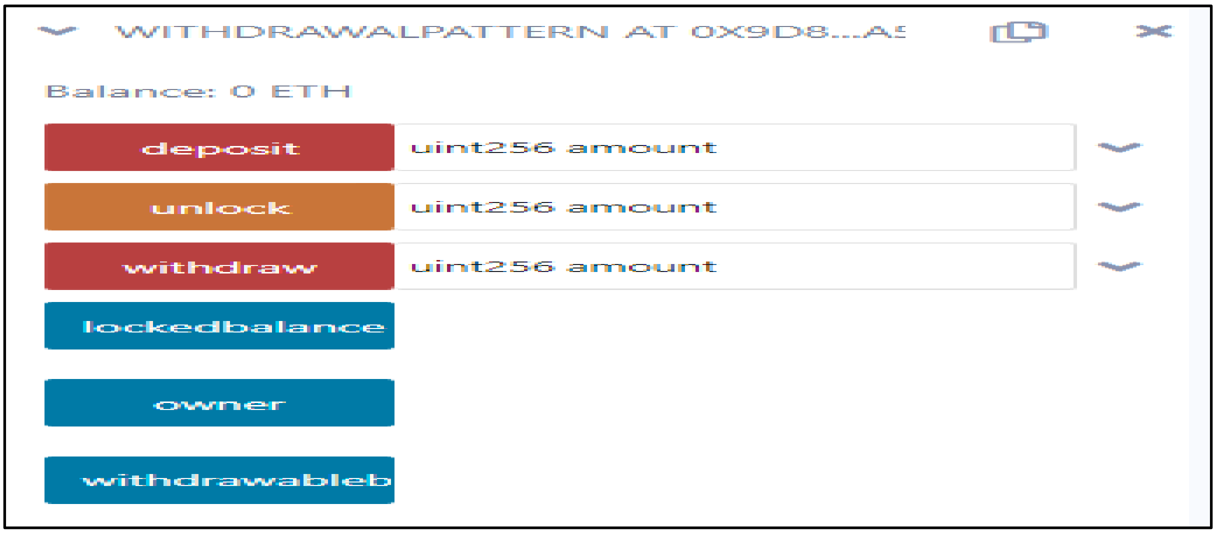
[A] Withdrawal Pattern, Restricted Access.

[I] Withdrawal Pattern

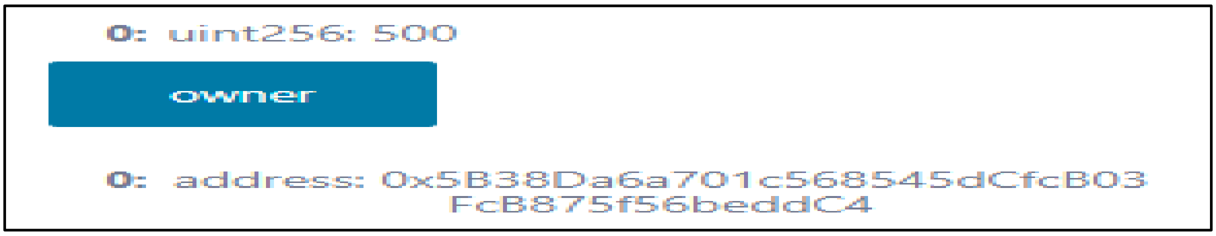
CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract WithdrawalPattern {
  address public owner;
  uint256 public lockedbalance;
  uint256 public withdrawablebalance;

  constructor() {
    owner = msg.sender;
  }

  modifier onlyowner() {
    require(msg.sender == owner, "Only the owner can call this function");
    _;
  }

  function deposit(uint256 amount) public payable {
    require(amount > 0, "Amount must be greater than zero");
    lockedbalance += amount;
  }

  function withdraw(uint256 amount) public payable onlyowner {
    require(
      amount <= withdrawablebalance,
      "Insufficient withdrawable balance"
    );
    withdrawablebalance -= amount;
    payable(msg.sender).transfer(amount);
  }
  function unlock(uint256 amount) public onlyowner {
    require(amount <= lockedbalance, "Insufficient locked balance");
    lockedbalance -= amount;
    withdrawablebalance += amount;
  }
}
```

OUTPUT:



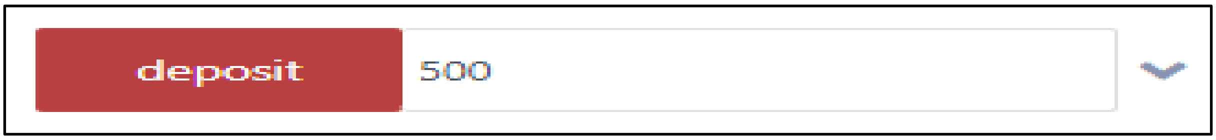
Step 1: Click on owner to create the owner object.



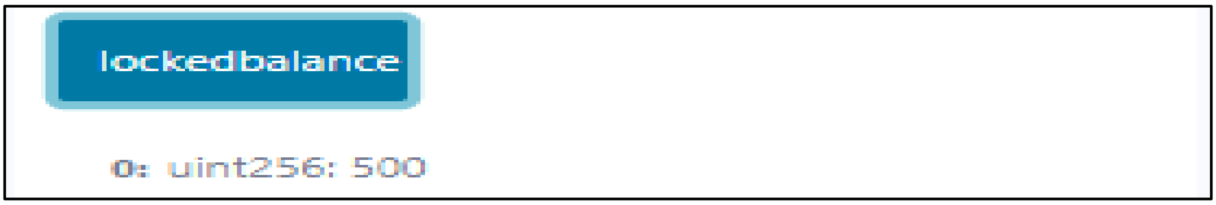
```
0: uint256: 500
```

```
0: address: 0x5B38Da6a701c568545dCfcB03
FcB875f56beddC4
```

Step 2: Enter an amount and click on deposit.

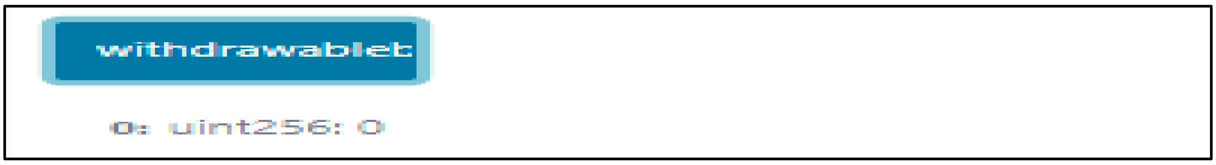


Step 3: Click on locked balance button to display the locked amount in the account.



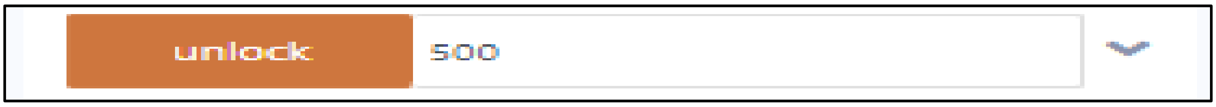
```
0: uint256: 500
```

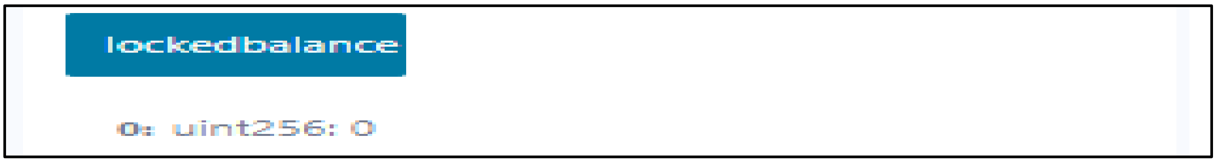
Step 4: Click on withdrawable balance button.



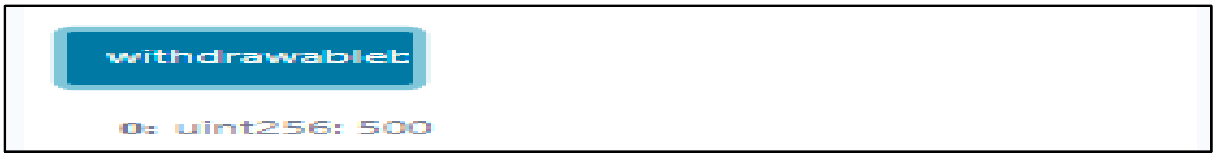
```
0: uint256: 0
```

Step 5: Click on unlock button and enter any amount to transfer amount to withdrawable balance. Check locked balance and withdrawable balance.



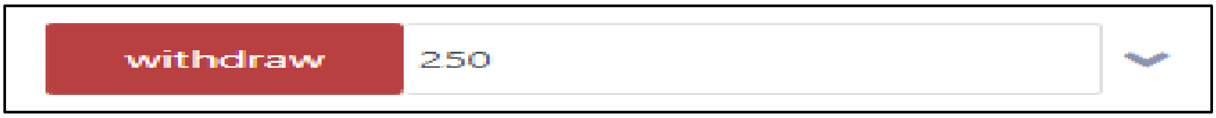


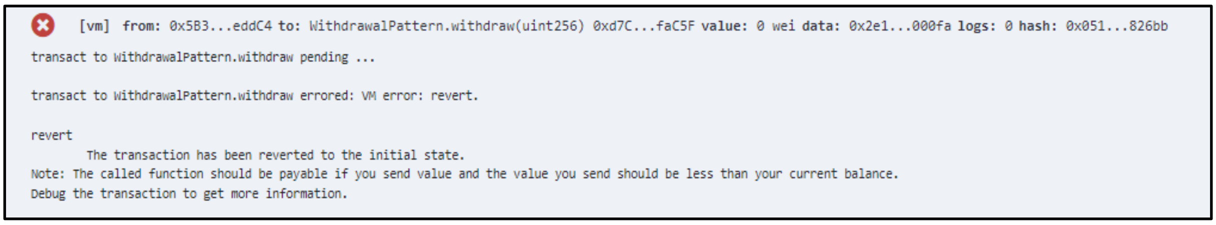
```
0: uint256: 0
```



```
0: uint256: 500
```

Step 6: Enter any amount you want to withdraw and click the withdraw button. You should get an error and the transaction should be reverted.





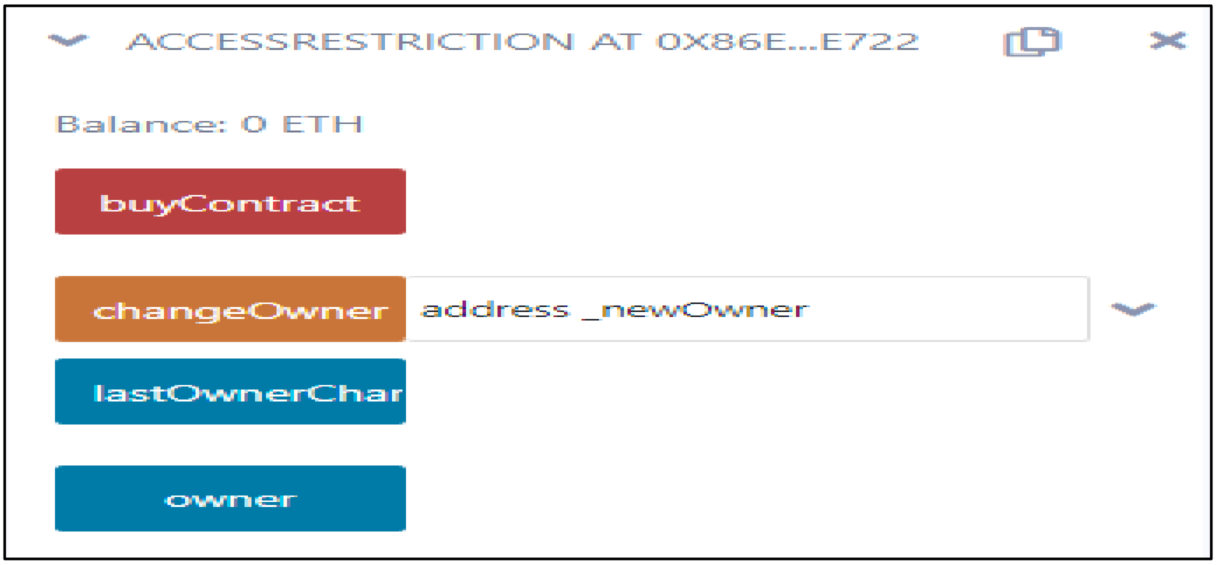
```
[vm]  from: 0x5B3...eddC4 to: WithdrawalPattern.withdraw(uint256) 0xd7C...faC5F value: 0 wei data: 0x2e1...000fa logs: 0 hash: 0x051...826bb
transact to WithdrawalPattern.withdraw pending ...

transact to WithdrawalPattern.withdraw errored: VM error: revert.

revert
	The transaction has been reverted to the initial state.
Note: The called function should be payable if you send value and the value you send should be less than your current balance.
Debug the transaction to get more information.
```

[II] Restricted Access

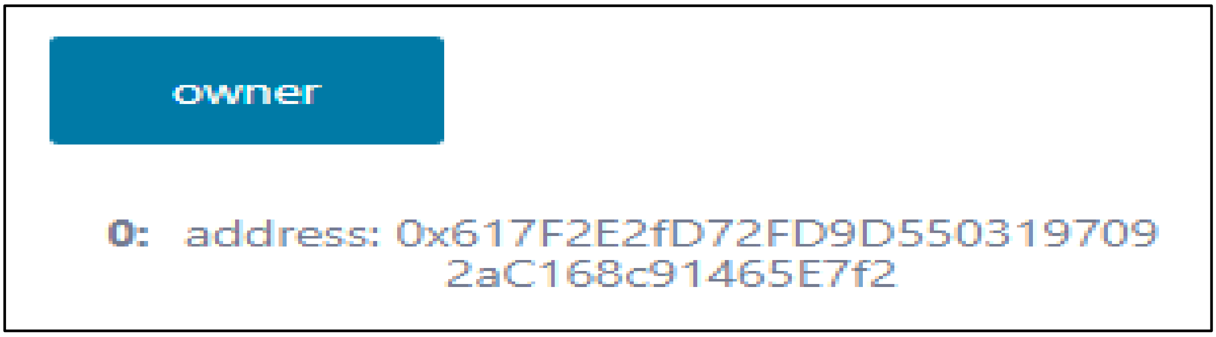
CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract AccessRestriction {

    address public owner = msg.sender;
    uint public lastOwnerChange = now;

    modifier onlyBy(address _account) {
        require(msg.sender == _account);
        _;
    }

    modifier onlyAfter(uint _time) {
        require(now >= _time);
        _;
    }

    modifier costs(uint _amount) {
        require(msg.value >= _amount);
        _;
        if (msg.value > _amount) {
            msg.sender.transfer(msg.value - _amount);
        }
    }

    function changeOwner(address _newOwner) public onlyBy(owner) {
        owner = _newOwner;
    }

    function buyContract() public payable onlyAfter(lastOwnerChange + 4 weeks) costs(1 ether) {
        owner = msg.sender;
        lastOwnerChange = now;
    }
}
```

OUTPUT:

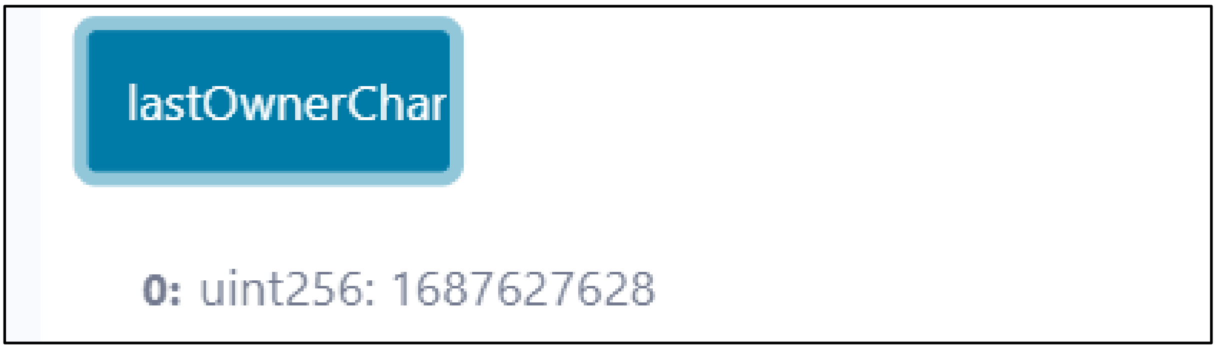


Step 1: Click on owner to create the owner object.



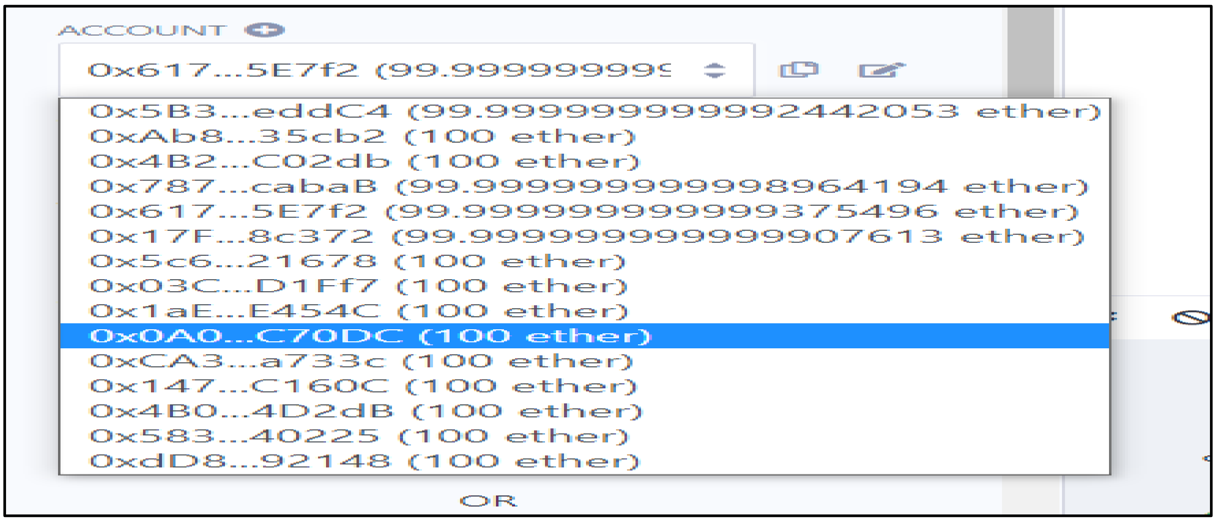
```
0:   address: 0x617F2E2fD72FD9D550319709
              2aC168c91465E7f2
```

Step 2: Click on lastOwnerChange button.



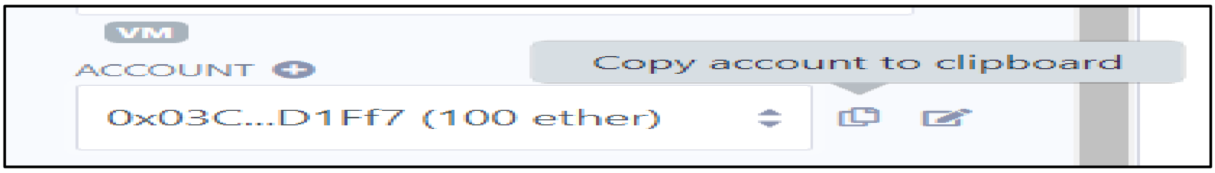
```
0: uint256: 1687627628
```

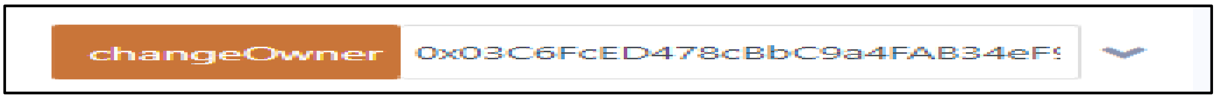
Step 3: Change the address of the account from Account dropdown in Deploy tab of Remix IDE.



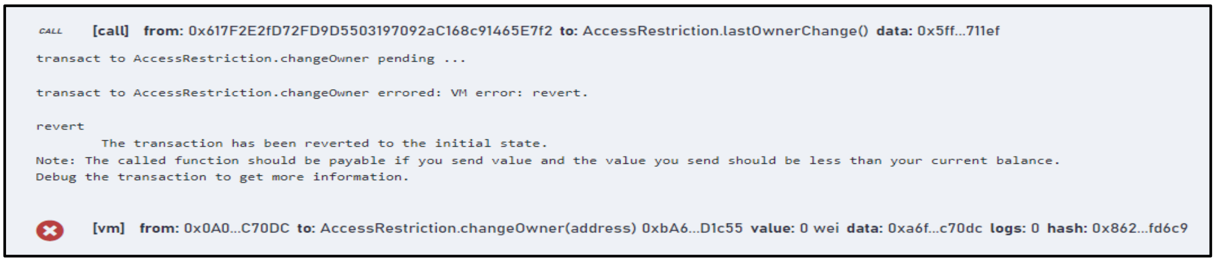
```
0x5B3...eddC4 (99.99999999999992442053 ether)
0xAb8...35cb2 (100 ether)
0x4B2...C02db (100 ether)
0x787...cabaB (99.99999999999998964194 ether)
0x617...5E7f2 (99.99999999999993375496 ether)
0x17F...8c372 (99.99999999999999907613 ether)
0x5c6...21678 (100 ether)
0x03C...D1Ff7 (100 ether)
0x1aE...E454C (100 ether)
0x0A0...C70DC (100 ether)
0xCA3...a733c (100 ether)
0x147...C160C (100 ether)
0x4B0...4D2dB (100 ether)
0x583...40225 (100 ether)
0xdD8...92148 (100 ether)
```

Step 4: Copy and paste the address in changeOwner input and click on changeOwner.



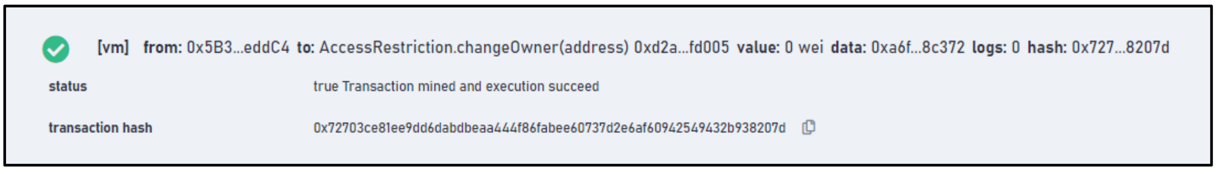


Step 5: You should get an error as following.

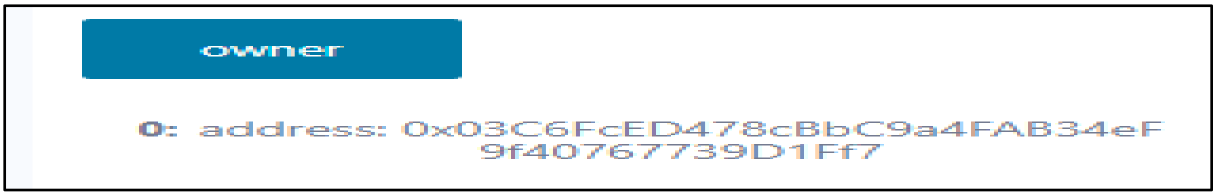


```
CALL  [call] from: 0x617F2E2fD72FD9D5503197092aC168c91465E7f2 to: AccessRestriction.lastOwnerChange() data: 0x5ff...711ef
transact to AccessRestriction.changeOwner pending ...

transact to AccessRestriction.changeOwner errored: VM error: revert.

revert
        The transaction has been reverted to the initial state.
Note: The called function should be payable if you send value and the value you send should be less than your current balance.
Debug the transaction to get more information.

[vm] from: 0x0A0...C70DC to: AccessRestriction.changeOwner(address) 0xbA6...D1c55 value: 0 wei data: 0xa6f...c70dc logs: 0 hash: 0x862...fd6c9
```

Step 6: Now, change back to the actual address of the account and click on changeOwner.



```
[vm] from: 0x5B3...eddC4 to: AccessRestriction.changeOwner(address) 0xd2a...fd005 value: 0 wei data: 0xa6f...8c372 logs: 0 hash: 0x727...8207d
status              true Transaction mined and execution succeed
transaction hash    0x72703ce81ee9dd6dabdbeaa444f86fabee60737d2e6af60942549432b938207d
```



0: address: 0x03C6FcED478cBbC9a4FAB34eF9f40767739D1Ff7

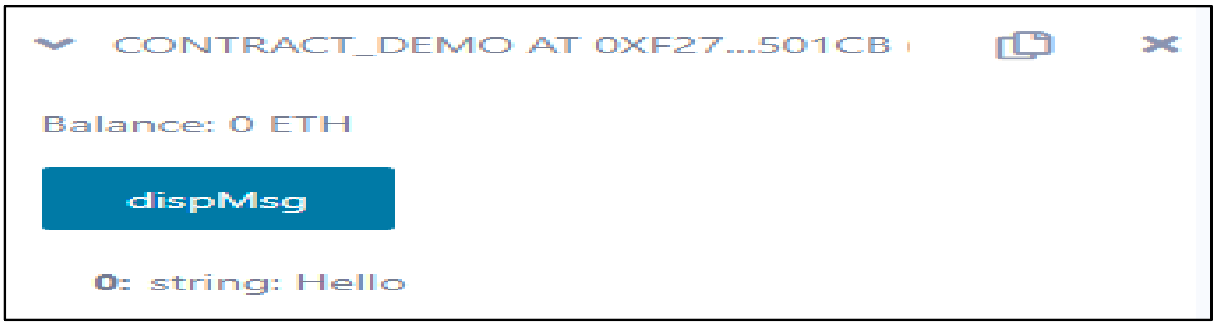
[B] Contracts, Inheritance, Constructors, Abstract Contracts, Interfaces.

[I] Contracts

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Contract_demo {
  string message = "Hello";

  function dispMsg() public view returns (string memory) {
    return message;
  }
}
```

OUTPUT:



```
CONTRACT_DEMO AT 0XF27...501CB
Balance: 0 ETH
0: string: Hello
```

[II] Inheritance

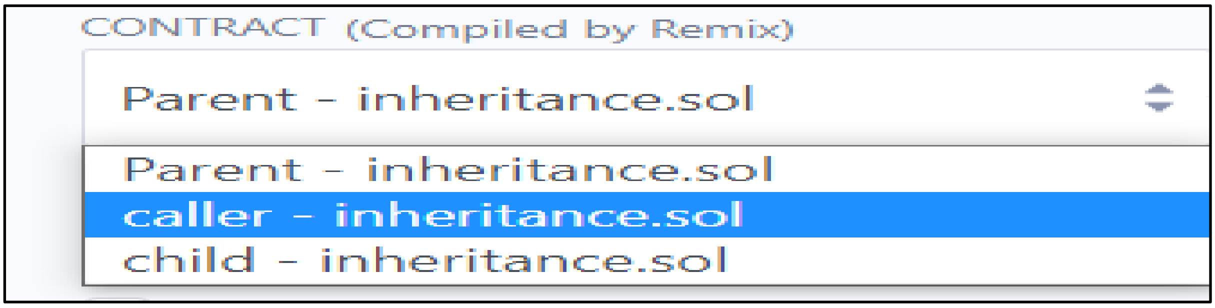
CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Parent {
  uint256 internal sum;

  function setValue() external {
    uint256 a = 10;
    uint256 b = 20;
    sum = a + b;
  }
}
```

```
contract child is Parent {
  function getValue() external view returns (uint256) {
    return sum;
  }
}

contract caller {
  child cc = new child();

  function testInheritance() public returns (uint256) {
    cc.setValue();
    return cc.getValue();
  }

  function show_value() public view returns (uint256) {
    return cc.getValue();
  }
}
```

OUTPUT:

Step 1: Select caller contract and deploy.

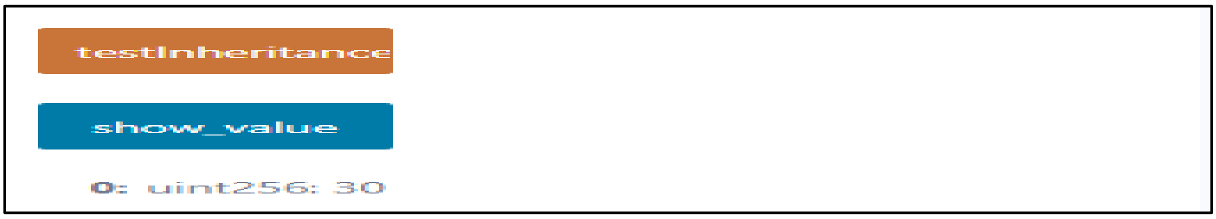


CONTRACT (Compiled by Remix)

Parent - inheritance.sol

Parent - inheritance.sol
caller - inheritance.sol
child - inheritance.sol

Step 2: Click test Inheritance and then click on show_value to view value.



0: uint256: 30

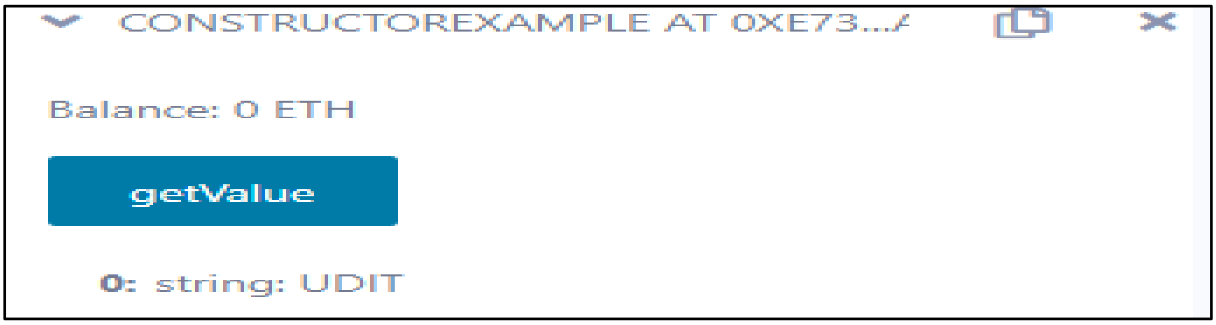
[III] Constructors

CODE:

```
// SPDX-License-Identifier: MIT
```

```
pragma solidity ^0.5.0;

// Creating a contract
contract constructorExample {
  string str;

  constructor() public {
    str = "UDIT";
  }

  function getValue() public view returns (string memory) {
    return str;
  }
}
```

OUTPUT:



```
Balance: 0 ETH
0: string: UDIT
```

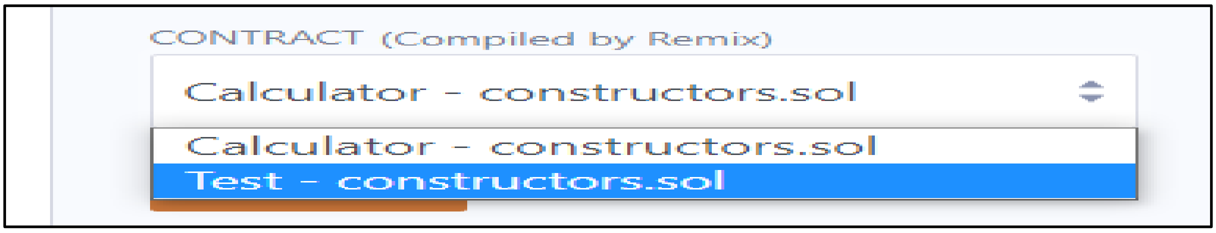
[IV] Abstract Contracts

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

contract Calculator {
  function getResult() external view returns (uint256);
}

contract Test is Calculator {
  constructor() public {}

  function getResult() external view returns (uint256) {
    uint256 a = 1;
    uint256 b = 2;
    uint256 result = a + b;
    return result;
  }
}
```

OUTPUT:

Step 1: Select Test contract and deploy.

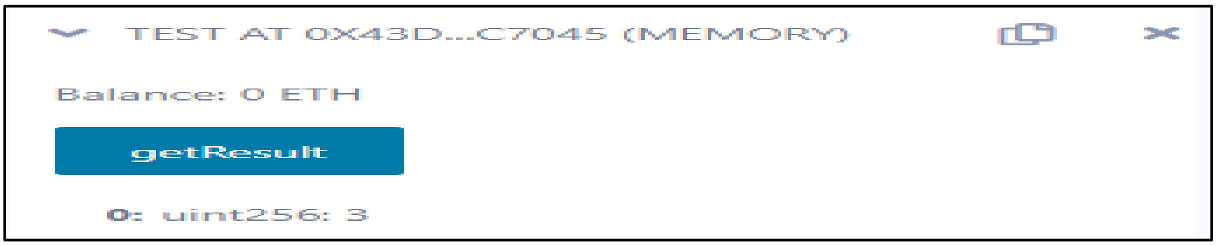


CONTRACT (Compiled by Remix)

Calculator - constructors.sol

Calculator - constructors.sol
Test - constructors.sol

Step 2: Click on getResult to get sum of a+b.



TEST AT 0X43D...C7045 (MEMORY)

Balance: 0 ETH

0: uint256: 3

[V] Interfaces

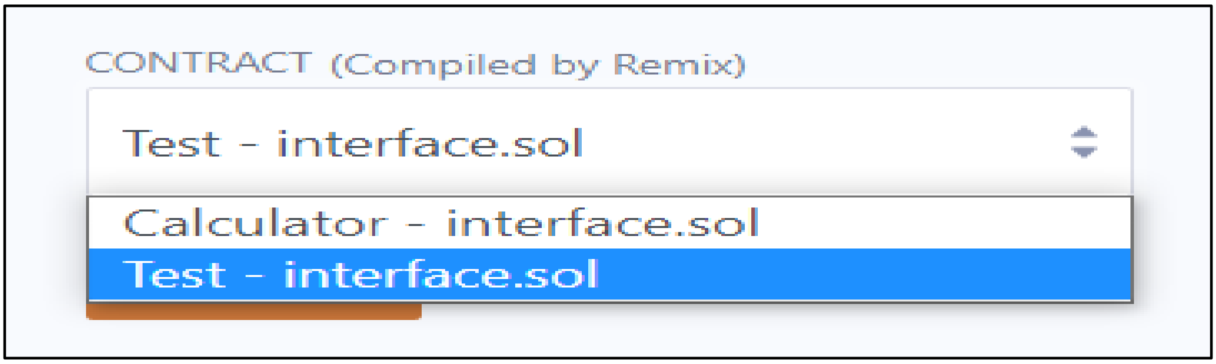
CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

interface Calculator {
  function getResult() external view returns(uint);
}
contract Test is Calculator {
  constructor() public {}
  function getResult() external view returns(uint){
   uint a = 1;
   uint b = 2;
   uint result = a + b;
   return result;
  }
```

}

OUTPUT:

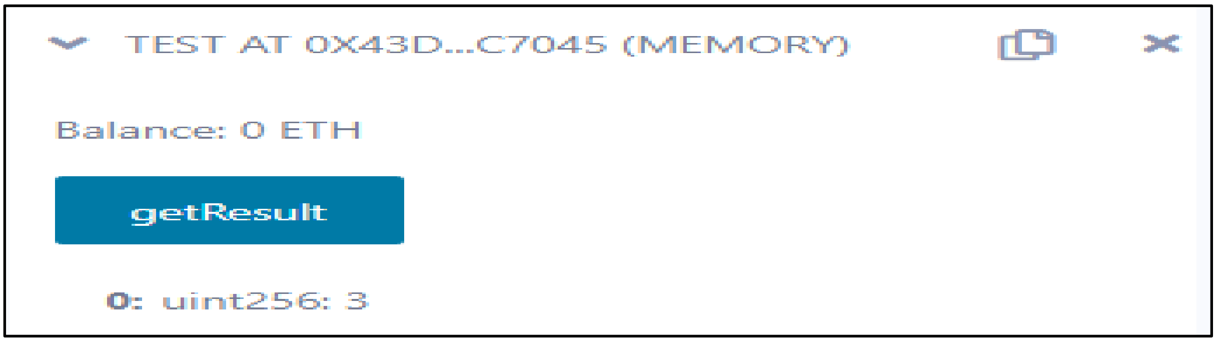
Step 1: Select Test interface contract and deploy.



CONTRACT (Compiled by Remix)

Test - interface.sol

Step 2: Click on getResult to get sum of a+b.



TEST AT 0X43D...C7045 (MEMORY)

Balance: 0 ETH

0: uint256: 3

[C] Libraries, Assembly, Events, Error handling.

[I] Libraries

CODE:

Create library myLib.sol

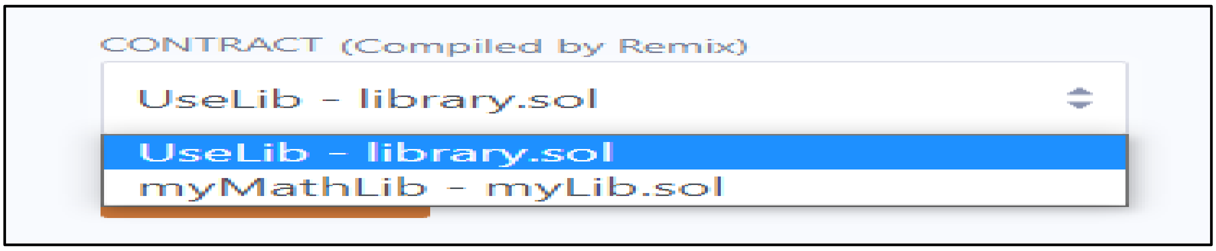
```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

library myMathLib {
  function sum(uint256 a, uint256 b) public pure returns (uint256) {
    return a + b;
  }

  function exponent(uint256 a, uint256 b) public pure returns (uint256) {
    return a**b;
  }
}
```

Using the library myLib.sol

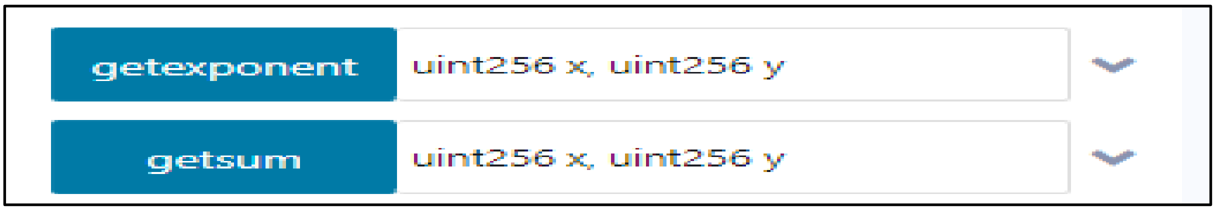
```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

import "myLib.sol";

contract UseLib {
  function getsum(uint256 x, uint256 y) public pure returns (uint256) {
    return myMathLib.sum(x, y);
  }

  function getexponent(uint256 x, uint256 y) public pure returns (uint256) {
    return myMathLib.exponent(x, y);
  }
}
```

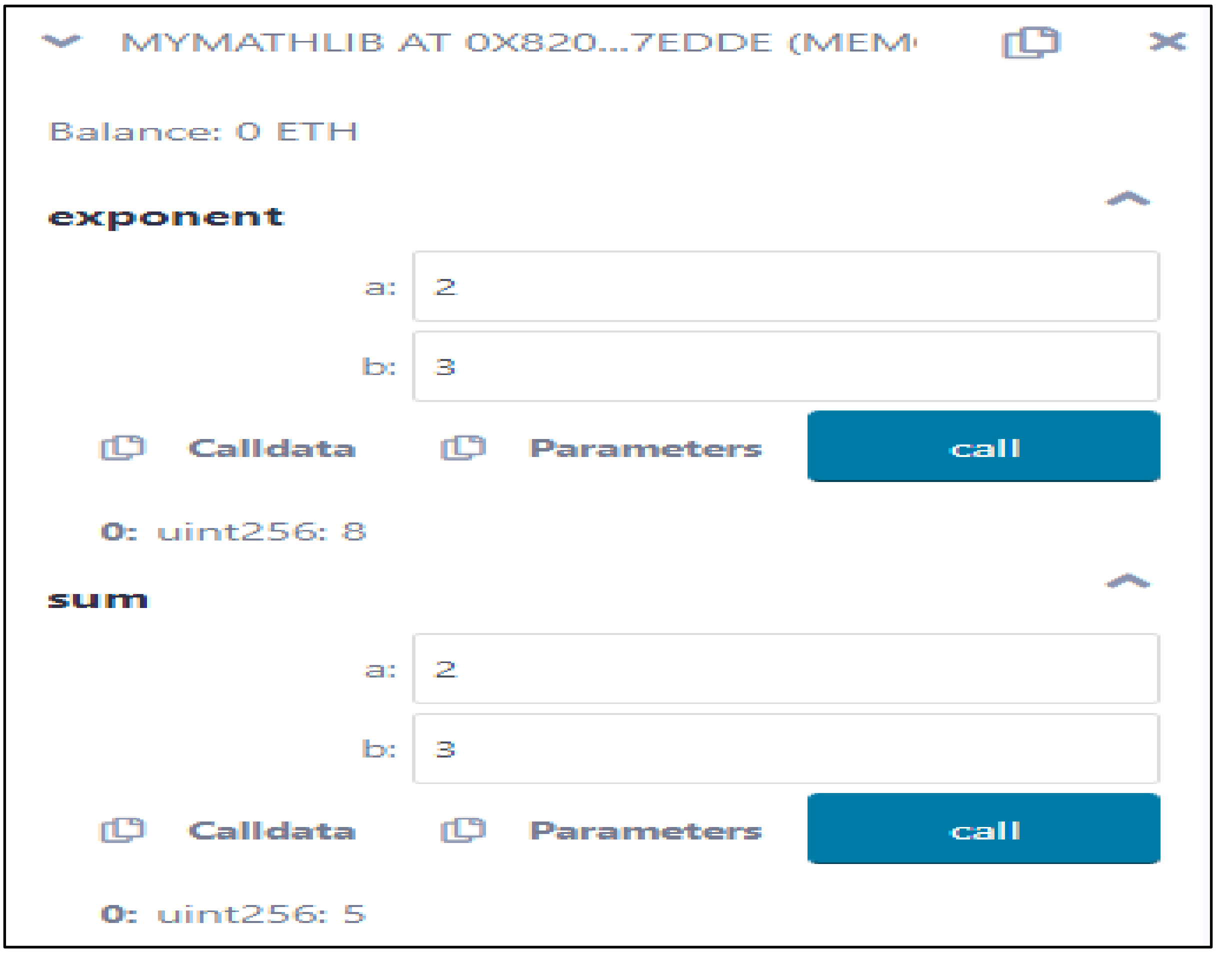
OUTPUT:

Step 1: Change contract to UseLib and deploy.



Step 2: Input values to both getexponent and getsum functions and get their values as below.





a: 2

b: 3

0: uint256: 8

a: 2

b: 3

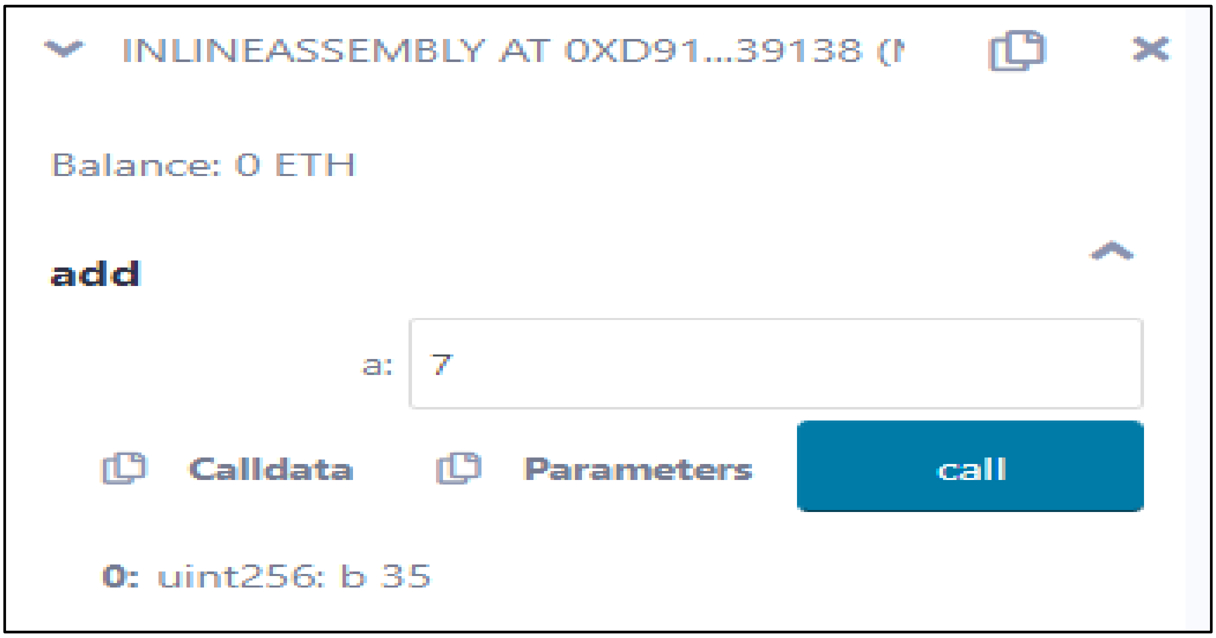
0: uint256: 5

[II] Assembly

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.4.16 <0.9.0;

contract InlineAssembly {
  // Defining function
  function add(uint256 a) public view returns (uint256 b) {
    assembly {
      let c := add(a, 16)
      mstore(0x80, c)
      {
        let d := add(sload(c), 12)
        b := d
      }

      b := add(b, c)
    }
  }
}
```

OUTPUT:



INLINEASSEMBLY AT 0XD91...39138 (M

Balance: 0 ETH

a: 7

0: uint256: b 35

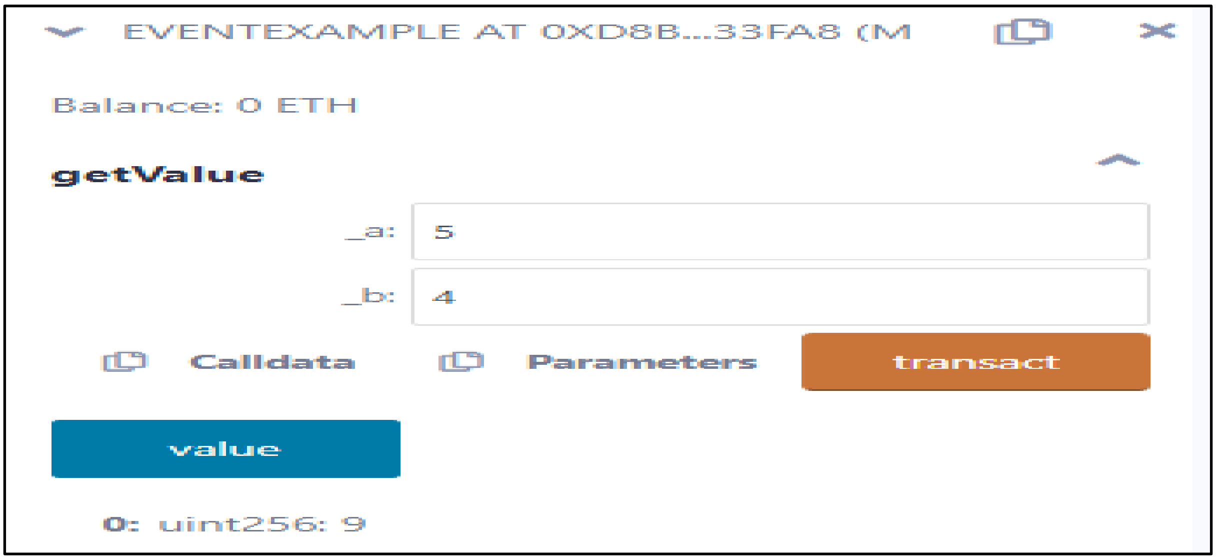
[III] Events

CODE:

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

// Creating a contract
contract eventExample {
  // Declaring state variables
  uint256 public value = 0;

  // Declaring an event
  event Increment(address owner);

  // Defining a function for logging event
  function getValue(uint256 _a, uint256 _b) public {
    emit Increment(msg.sender);
    value = _a + _b;
  }
}
```

OUTPUT:

Step 1: Input values to getValue function and get the result by clicking on the value button.



EVENTEXAMPLE AT 0XD8B...33FA8 (M

Balance: 0 ETH

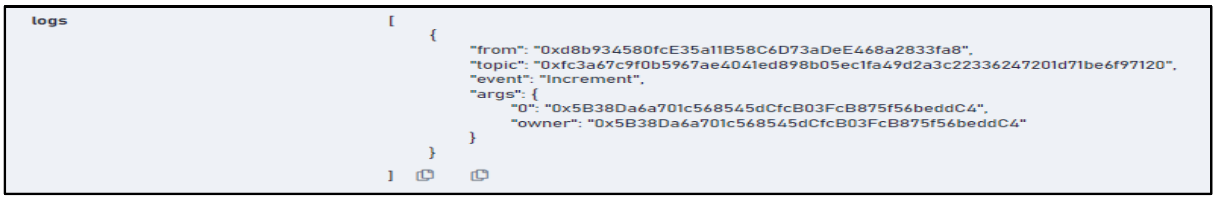
getValue

_a: 5

_b: 4

0: uint256: 9

Step 2: In the terminal, check for logs.



```
logs                                    [
                                             {
                                                  "from": "0xd8b934580fcE35a11B58C6D73aDeE468a2833fa8",
                                                  "topic": "0xfc3a67c9f0b5967ae4041ed898b05ec1fa49d2a3c22336247201d71be6f97120",
                                                  "event": "Increment",
                                                  "args": {
                                                       "0": "0x5B38Da6a701c568545dCfcB03FcB875f56beddC4",
                                                       "owner": "0x5B38Da6a701c568545dCfcB03FcB875f56beddC4"
                                                  }
                                             }
                                        ]
```

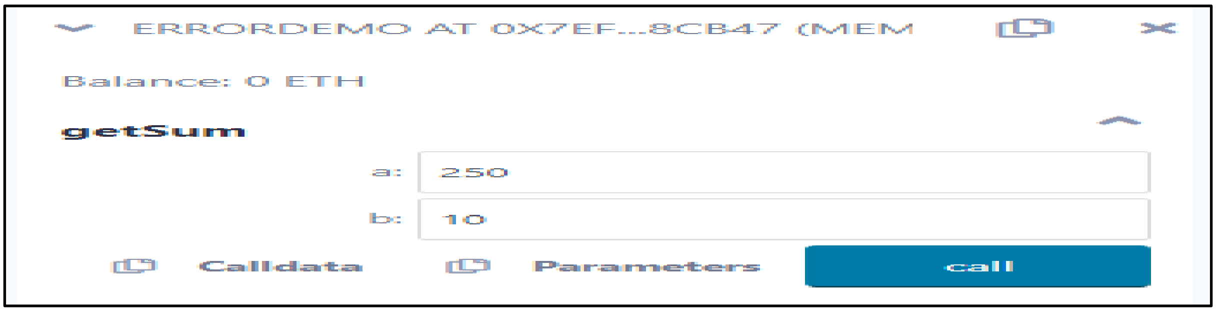
[IV] Error handling

CODE:

```
// SPDX-License-Identifier: MIT

pragma solidity ^0.5.0;
contract ErrorDemo {
  function getSum(uint256 a, uint256 b) public pure returns (uint256) {
    uint256 sum = a + b;
    require(sum < 255, "Invalid");
    assert(sum<255);
    return sum;
  }
}
```

OUTPUT:

Step 1: Input values to the getSum function.



ERRORDEMO AT 0X7EF...8CB47 (MEM

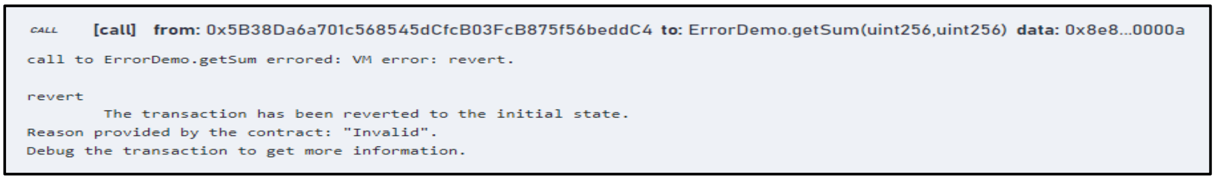
Balance: 0 ETH

getSum

a: 250

b: 10

Step 2: Check terminal panel.



```
CALL   [call]  from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: ErrorDemo.getSum(uint256,uint256) data: 0x8e8...0000a
call to ErrorDemo.getSum errored: VM error: revert.

revert
        The transaction has been reverted to the initial state.
Reason provided by the contract: "Invalid".
Debug the transaction to get more information.
```

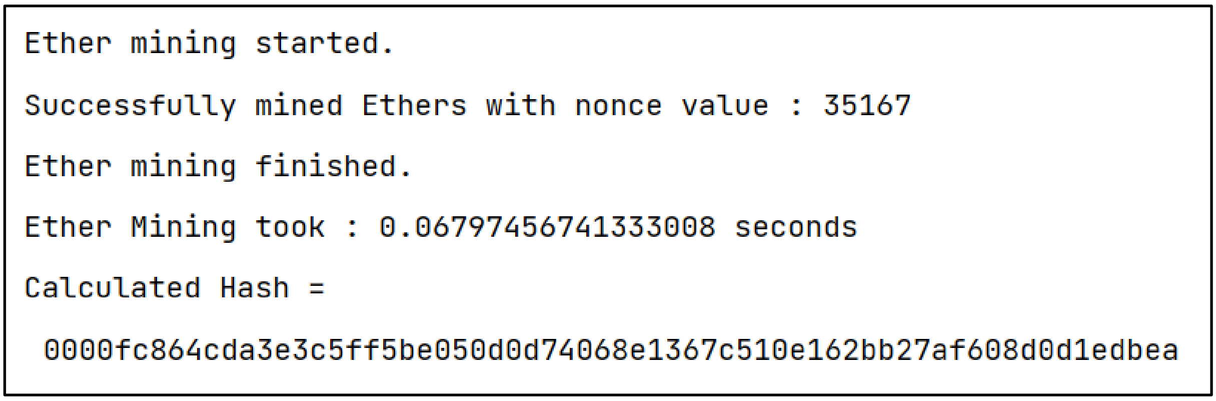
PRACTICAL 5

AIM: Write a program to demonstrate mining of Ether.

CODE:

```
from hashlib import sha256
import time

MAX_NONCE = 100000000000

def hashGenerator(text):
    return sha256(text.encode("ascii")).hexdigest()

def mine(block_number, transactions, previous_hash, prefix_zeros):
    prefix_str = '0'*prefix_zeros
    for nonce in range(MAX_NONCE):
        text = str(block_number) + transactions + previous_hash + str(nonce)
        new_hash = hashGenerator(text)
        if new_hash.startswith(prefix_str):
            print(f"Successfully mined Ethers with nonce value : {nonce}")
            return new_hash

    raise BaseException(f"Couldn't find correct hash after trying {MAX_NONCE} times")

if __name__ == '__main__':
    transactions = '''
    Prateek->Hajra->77,
    Kunal->Soham->18
    '''
    difficulty = 4
    start = time.time()
    print("Ether mining started.")
    new_hash                                                                    =
mine(5,transactions,'0000000xa036944e29568d0cff17edbe038f81208fecf9a66be9a2b8321c6ec7',
difficulty)
    total_time = str((time.time() - start))
    print(f"Ether mining finished.")
    print(f"Ether Mining took : {total_time} seconds")
    print(f"Calculated Hash = {new_hash}")
```

OUTPUT:



```
Ether mining started.
Successfully mined Ethers with nonce value : 35167
Ether mining finished.
Ether Mining took : 0.06797456741333008 seconds
Calculated Hash =
 0000fc864cda3e3c5ff5be050d0d74068e1367c510e162bb27af608d0d1edbea
```

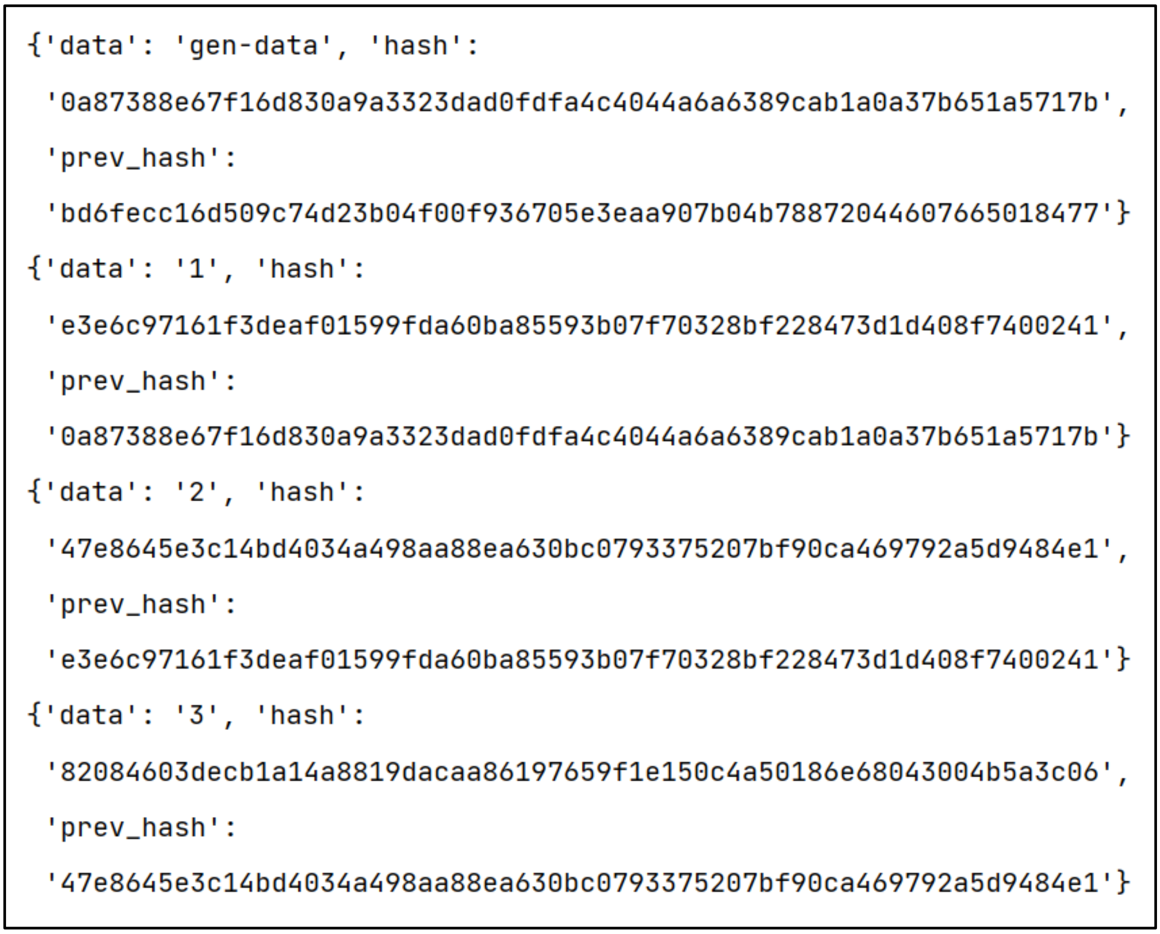
PRACTICAL 6

AIM: Create your own blockchain and demonstrate its use.

CODE:

```
from hashlib import sha256

def hashGenerator(text):
    return sha256(text.encode("ascii")).hexdigest()

class Block:
    def __init__(self,data,hash,prev_hash):
        self.data=data
        self.hash=hash
        self.prev_hash=prev_hash

class Blockchain:
    def __init__(self):
      hashLast=hashGenerator('gen_last')
      hashStart=hashGenerator('gen_hash')

      genesis=Block('gen-data',hashStart,hashLast)
      self.chain=[genesis]

    def add_block(self,data):
        prev_hash=self.chain[-1].hash
        hash=hashGenerator(data+prev_hash)
        block=Block(data,hash,prev_hash)
        self.chain.append(block)

bc=Blockchain()
bc.add_block('1')
bc.add_block('2')
bc.add_block('3')

for block in bc.chain:
    print(block.__dict__)
```

OUTPUT:



```
{'data': 'gen-data', 'hash':
 '0a87388e67f16d830a9a3323dad0fdfa4c4044a6a6389cab1a0a37b651a5717b',
 'prev_hash':
 'bd6fecc16d509c74d23b04f00f936705e3eaa907b04b78872044607665018477'}
{'data': '1', 'hash':
 'e3e6c97161f3deaf01599fda60ba85593b07f70328bf228473d1d408f7400241',
 'prev_hash':
 '0a87388e67f16d830a9a3323dad0fdfa4c4044a6a6389cab1a0a37b651a5717b'}
{'data': '2', 'hash':
 '47e8645e3c14bd4034a498aa88ea630bc0793375207bf90ca469792a5d9484e1',
 'prev_hash':
 'e3e6c97161f3deaf01599fda60ba85593b07f70328bf228473d1d408f7400241'}
{'data': '3', 'hash':
 '82084603decb1a14a8819dacaa86197659f1e150c4a50186e68043004b5a3c06',
 'prev_hash':
 '47e8645e3c14bd4034a498aa88ea630bc0793375207bf90ca469792a5d9484e1'}
```