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Practical -1 Write the following programs for Blockchain in Python

A) A simple client class that generates the private and public keys by using the built-in Python RSA algorithm and test it.

```
import binascii

import Crypto
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5


class Client:
    def __init__(self):
        random = Crypto.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"
        )


Dinesh = Client()
print("\n Public Key:",Dinesh.identity)
```

Output

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac1>C:/Users/Achsa
h/AppData/Local/Programs/Python/Python39/python.exe c:/Users/Achsah/Documents/
MScIT/sem4/blockchain_practical/prac1/prac1a.py

Public Key:  30819f300d06092a864886f70d010101050003818d0030818902818100adcc265
040fdf19988db8eabc5e73fbc2d4527f95af6f3b9305377b0182d61fc44441af11dc1c8537c06d
452718289d83e92245c1af7373bf3d45e95c78383d0a82edb026f63d4fa805366017b991bc9ac8
6391f59935bf6559f8a23d89aa915a9e2f4c3e0113f9d9b9b5e071e2c4f780fff35fb0c9506c7c
b596a0128fe5f230203010001
```

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

```
import binascii
import collections
import datetime
from client import Client
from Crypto.Hash import SHA
from Crypto.Signature import PKCS1_v1_5


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")


Dinesh = Client()
Ramesh = Client()


t = Transaction(Dinesh, Ramesh.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

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac1>C:/Users/Achsah/AppData/Local/Programs/Python/Python39/python.exe c:/Users/Achsah/Documents/MScIT/sem4/blockchain_practical/prac1/prac1b.py

Transaction Recipient:  30819f300d06092a864886f70d010101050003818d0030818902818100c308b9261d2397e09dffcf67981240735cb2e3e0f4f510d29e21a70335503f142005e5f09e9db9091b263e73b6a32cd909fdc77a616bd4a5e09d044bf63c7906a98b791021ee41dbfb83d5022fb2423185262689e31287543b0863385d7325e30bcf8bc722907bfa0b4a39495f6a2ac2d6bf5e50e77d2b52d6efcafd3a062a9f0203010001

Transaction Value:  5.0

Signature:  b3a8342acd21883671ff67dde74172f31f094935a2775765ec6e20f5ba910627eb9450b14d721933ea2ecca46d7a14e38d8b1e3e2382b9132c09ea94077b31c4f4a7cdf33b0f3ec4e0378fb6f53e8ba450b79572737b440f8584bc79c3fe3360ac75d23655d81e2c8f1dbe1435a2735100a3738d05522aeaadeee7f5bba6fff2
```

C) Create multiple transactions and display them.

```
from client import Client
from transaction_class import Transaction

Dinesh = Client()
Ramesh = Client()

t = Transaction(Dinesh, Ramesh.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)


Dinesh = Client()
Ramesh = Client()
Seema = Client()
Vijay = Client()

t1 = Transaction(Dinesh, Ramesh.identity, 15.0)
t1.sign_transaction()
transactions = [t1]
t2 = Transaction(Dinesh, Seema.identity, 6.0)
t2.sign_transaction()
transactions.append(t2)
t3 = Transaction(Ramesh, Vijay.identity, 2.0)
t3.sign_transaction()
transactions.append(t3)
t4 = Transaction(Seema, Ramesh.identity, 4.0)
t4.sign_transaction()
transactions.append(t4)


for transaction in transactions:
    Transaction.display_transaction(transaction)
    print("----------------")
```

Output

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac1>C:/Users/Achsah/AppData/Local/Programs/Python/Python39/python.exe c:/Users/Achsah/Documents/MScIT/sem4/blockchain_practical/prac1/prac1c.py
sender: 30819f300d06092a864886f70d010101050003818d0030818902818100c123f94a104b17803a5fb728b6a4e3abb26f2554e5652b5be5df08cf3f56efef5a36196fe4eebbb8fe7f299d1fbe153031bce451e3c45ef26802375c49f3474b9d23312534badccf3a8ecf4c238dc593a8a488eeaf155b347fda86b5548de80a96b3e1543eb20d486703574d6c28a67cc04797c247e457fc233a6074f5e1c0cb0203010001
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100c551eccbd6e7624223f4a517414b122ae738153aa00dd11951cf58e7f3cd436e639cc89fd84d34a93892450966378401babe918f186401a514162ede7fcab891df9023dc6604d1bfea1df2e83e9a3a985cdfcb00a9e2e55ba4364b48a1200c5ed6d163e4e7e8e39d3de67272f63b04e559872fec9719fc7870b308581761fec10203010001
-----
value: 15.0
-----
time: 2023-04-22 22:13:48.781101
```

```
--------------
sender: 30819f300d06092a864886f70d010101050003818d0030818902818100c123f94a104b17803a5fb728b6a4e3abb26f2554e5652b5be5df08cf3f56efef5a36196fe4eebbb8fe7f299d1fbe153031bce451e3c45ef26802375c49f3474b9d23312534badccf3a8ecf4c238dc593a8a488eeaf155b347fda86b5548de80a96b3e1543eb20d486703574d6c28a67cc04797c247e457fc233a6074f5e1c0cb0203010001
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100cc47acc592a9c8ec78b211ebda5ef91f40518e9c23338e0c99824892012b533656c8872d512994269e79d58a54e9fd8548141f204b26a3d89e636468c81171b2147a2ca0c5745d66822b19d826f235afa2cab4a9f4b1623895019db6fdbcd752ff6a3dbc709d76cdd64df5e12ae674a5c896c09b632ab0b6b19c731c4d9004b30203010001
-----
value: 6.0
-----
time: 2023-04-22 22:13:48.783100
```

```
--------------
sender: 30819f300d06092a864886f70d010101050003818d0030818902818100c551eccbd6e7624223f4a517414b122ae738153aa00dd11951cf58e7f3cd436e639cc89fd84d34a93892450966378401babe918f186401a514162ede7fcab891df9023dc6604d1bfea1df2e83e9a3a985cdfcb00a9e2e55ba4364b48a1200c5ed6d163e4e7e8e39d3de67272f63b04e559872fec9719fc7870b308581761fec10203010001
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100ae7406d1f27b484dc241f33a48b66df19d6e5f3b732fefda2622ee726bb49dcfea390ff1f5a11c651f7a96fd888f9e901630645da2bfe9d898769a859481a10eff8f977a40e59701f43e278992741af99bb77aed08bb6fa5297ed2116441300469e73ec347e0bb8e790c960948b7872e6a60060581caf4b78d1624b0a45848610203010001
-----
value: 2.0
-----
time: 2023-04-22 22:13:48.784604
```


sender: 30819f300d06092a864886f70d010101050003818d0030818902818100cc47acc592a9c8ec78b211ebda
5ef91f40518e9c23338e0c99824892012b533656c8872d512994269e79d58a54e9fd8548141f204b26a3d89e6364
68c81171b2147a2ca0c5745d66822b19d826f235afa2cab4a9f4b1623895019db6fdbcd752ff6a3dbc709d76cdd6
4df5e12ae674a5c896c09b632ab0b6b19c731c4d9004b30203010001
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100c551eccbd6e7624223f4a51
7414b122ae738153aa00dd11951cf58e7f3cd436e639cc89fd84d34a93892450966378401babe918f186401a5141
62ede7fcab891df9023dc6604d1bfea1df2e83e9a3a985cdfcb00a9e2e55ba4364b48a1200c5ed6d163e4e7e8e39
d3de67272f63b04e559872fec9719fc7870b308581761fec10203010001
value: 4.0
time: 2023-04-22 22:13:48.787805

D) Create a blockchain, a genesis block and execute it.

```
from client import Client
from transaction_class import Transaction


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("═══════════════════════════════════════")


Dinesh = Client()
t0 = Transaction("Genesis", Dinesh.identity(), 500.0)

block0 = Block(Dinesh)
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: 30819f300d06092a864886f70d010101050003818d0030818902818100b6dbe8af2c6f079fc7bdf8a
5f00cf97738460294c2cb1d968cd6e59961afb3a39c96e132ada370ac2802aa8a58bf2d6ef13d39c95f744b31af0
0467c883980d7e825fc83fcf6a4d925be93c50d3cd1691d58495bd07aded1ef8c05d9b5606dcef55dd85721d4804
3bd1b733f2eb7027fff0920abac3204b093247fcee235a5a90203010001
-----
value: 500.0
-----
time: 2023-04-22 22:40:58.531260
-----
-------------
==================================
```

E) Create a mining function and test it.

```
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 print(digest)


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

Output

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac1>C:/Users/Achsah/AppData/Local/Programs/Python/Python39/python.exe c:/Users/Achsah/Documents/MScIT/sem4/blockchain_practical/prac1/prac1e.py

 After 119 iterations found nonce: 11a90de765a93c9fd75b5da05644bf4ef06059ac26b95d283270b35274c50050

 After 146 iterations found nonce: 11e7b37a2c393112e7190f748400462e8fd3eec0afbbbc16c28e92faa19b19bf

 After 350 iterations found nonce: 11eeaf6cacc8cc0fb4cc8f0a32a5ad6702e74702e8c745e996945b6c49b4dae8

 After 464 iterations found nonce: 11c5bf9e6a861f4e9ac8bd60af865e19f2d7460cf46a0a79bae84ab85e47b911
```

F) Add blocks to the miner and dump the blockchain.

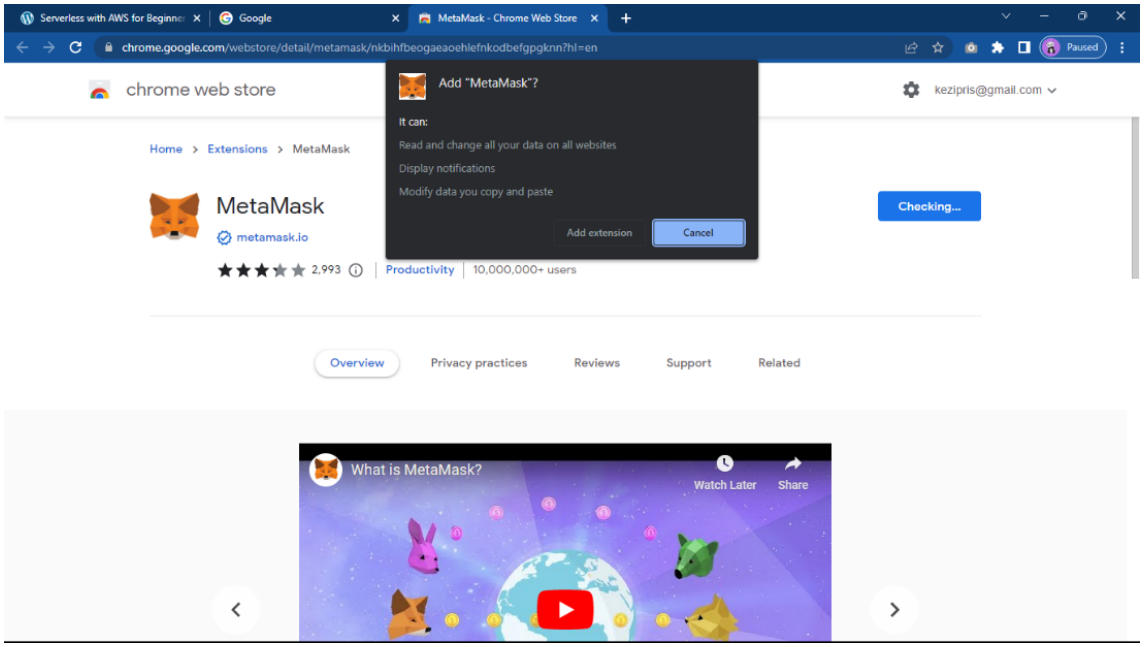
```
import datetime
import hashlib

# Create a class with two functions


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()


# Instantiate the class

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"
    )
```

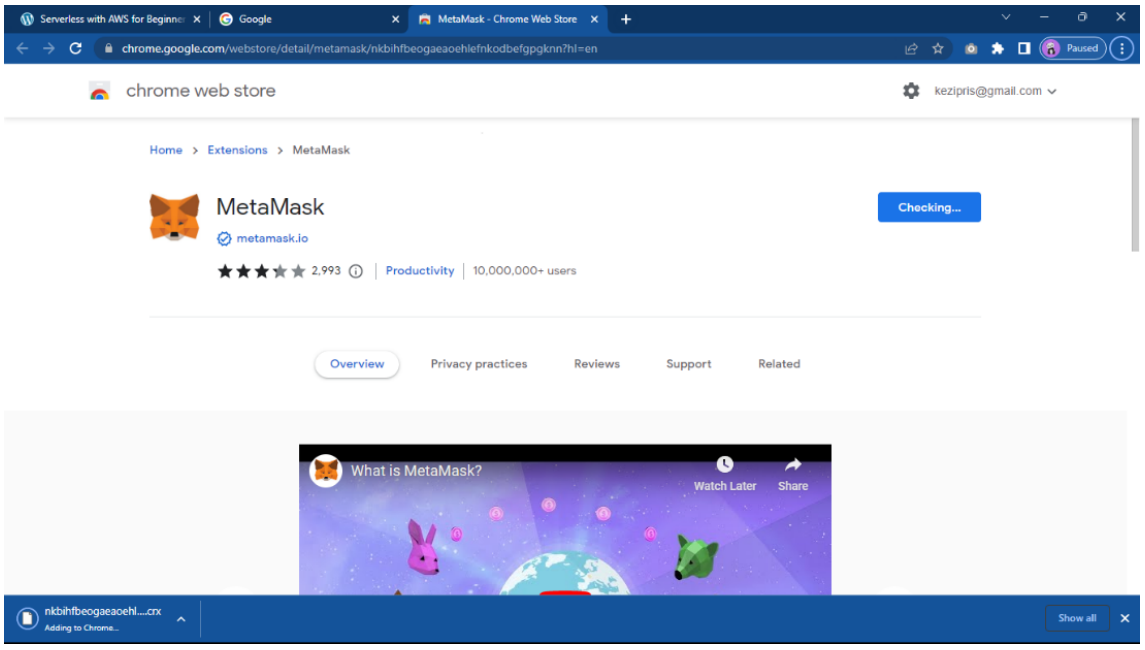
Output

```
Timestamp: 2023-04-22 17:41:07.240201+00:00
Data: First block
Previous Hash: 0
Hash: 876fb923a443ba6afe5fb32dd79961e85be2b582cf74c233842b630ae16fe4d9

Timestamp: 2023-04-22 17:41:07.240201+00:00
Data: Second block
Previous Hash: 876fb923a443ba6afe5fb32dd79961e85be2b582cf74c233842b630ae16fe4d9
Hash: 8e2fb9e02898feb024dff05ee0b27fd5ea0a448e252d975e6ec5f7b0a252a6cd

Timestamp: 2023-04-22 17:41:07.240201+00:00
Data: Third block
Previous Hash: 8e2fb9e02898feb024dff05ee0b27fd5ea0a448e252d975e6ec5f7b0a252a6cd
Hash: 06e369fbfbe5362a8115a5c6f3e2d3ec7292cc4272052dcc3280898e3206208d
```

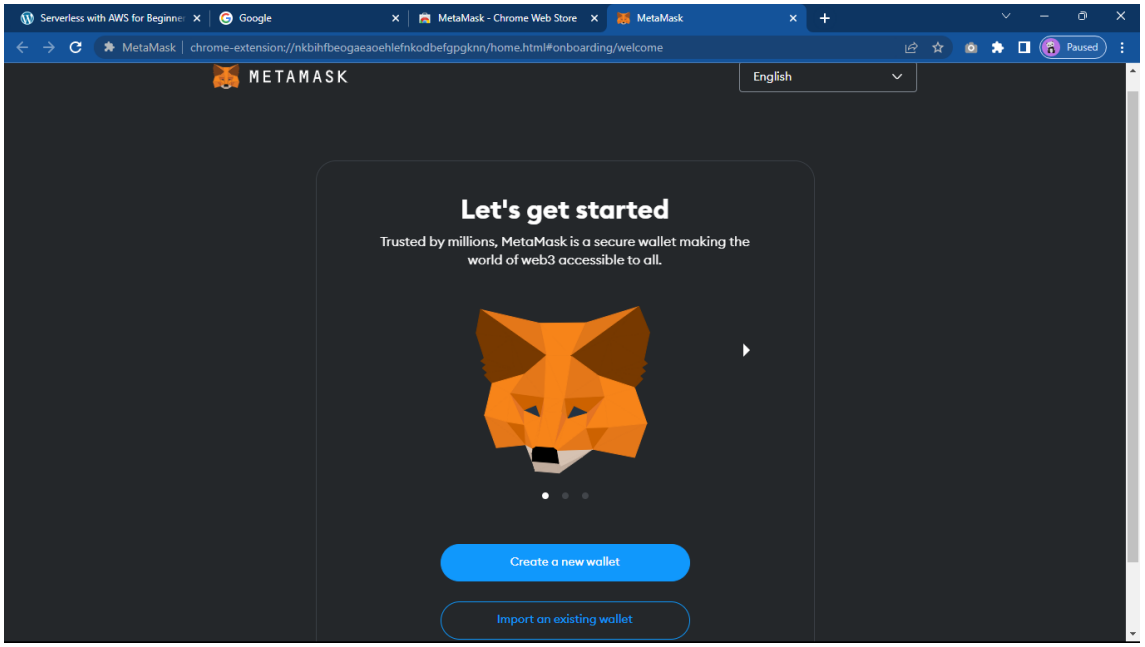
Practical-2 Install and configure Go Ethereum and the Mist browser. Develop and test a sample application(MetaMask & Remix)

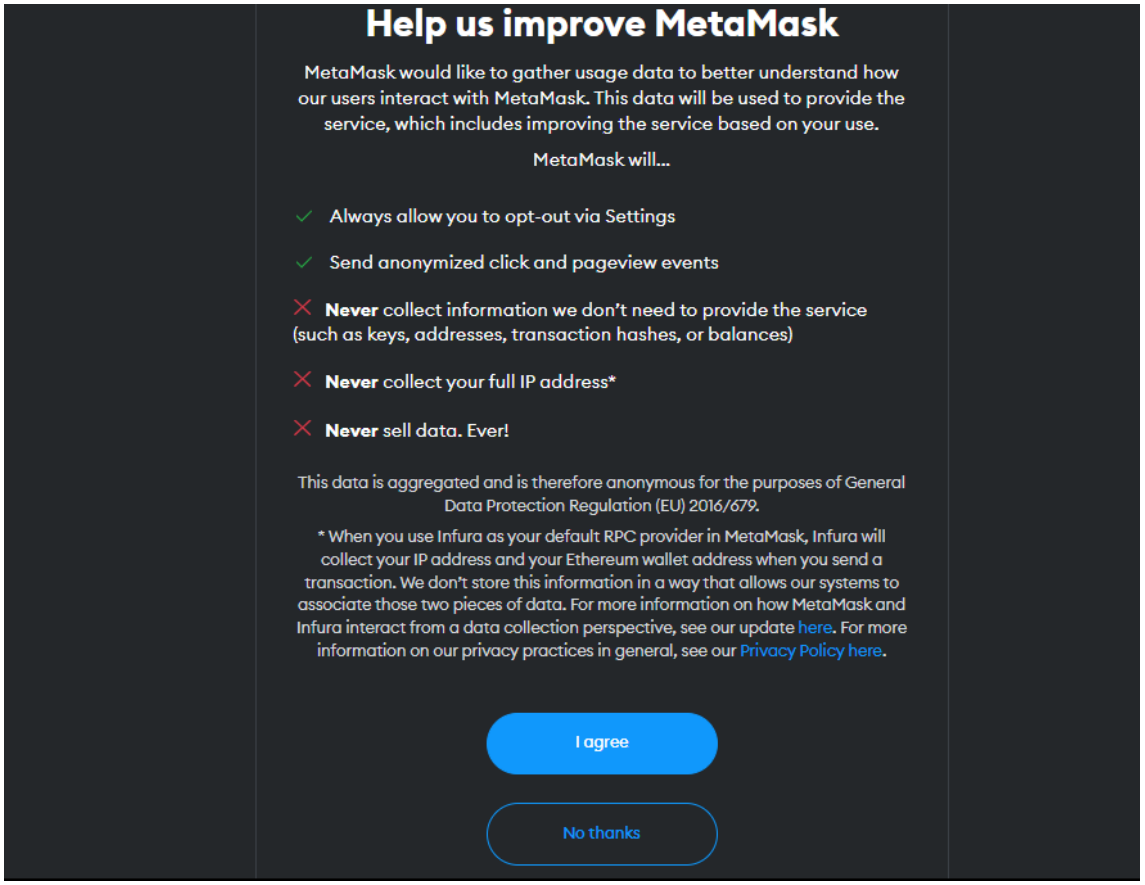
Step 1-> Install MetaMask extension for chrome from Chrome Web Store



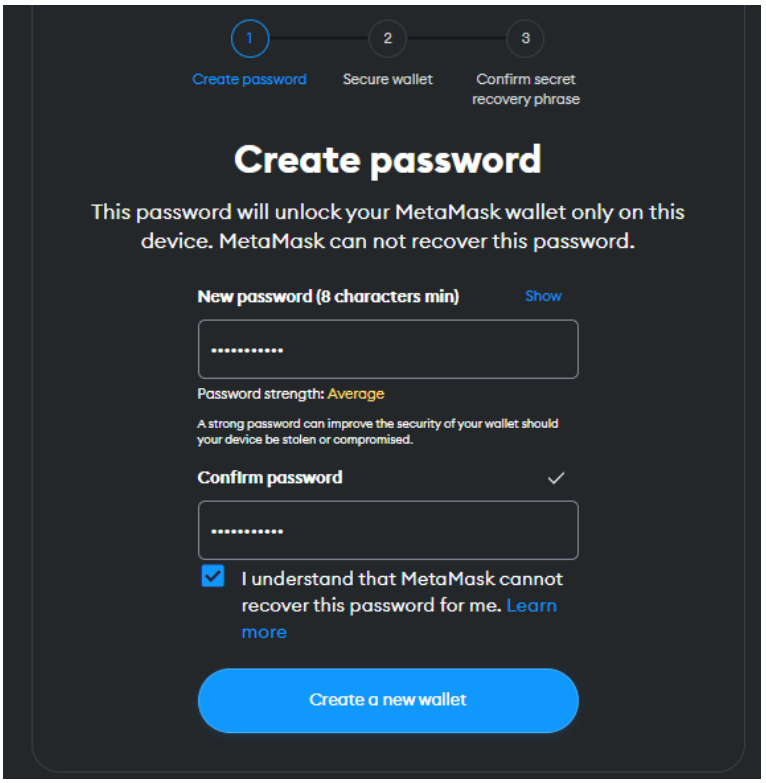


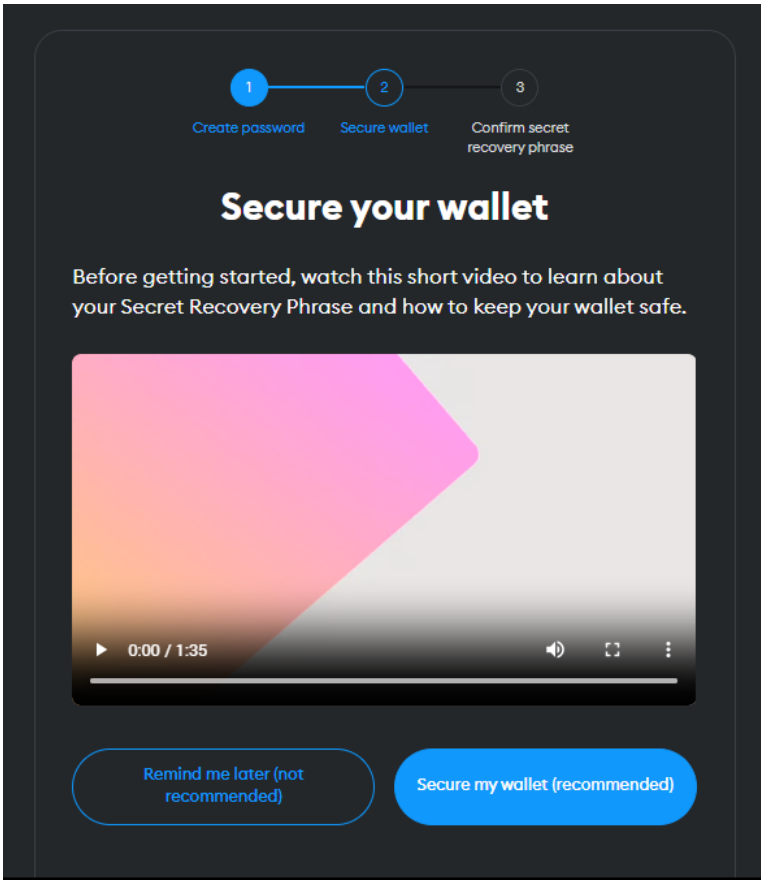
Step 2-> Click on Metamask Extension in Extensions. Below page will open in a new tab. Click on Create a New Wallet. Click on I agree.



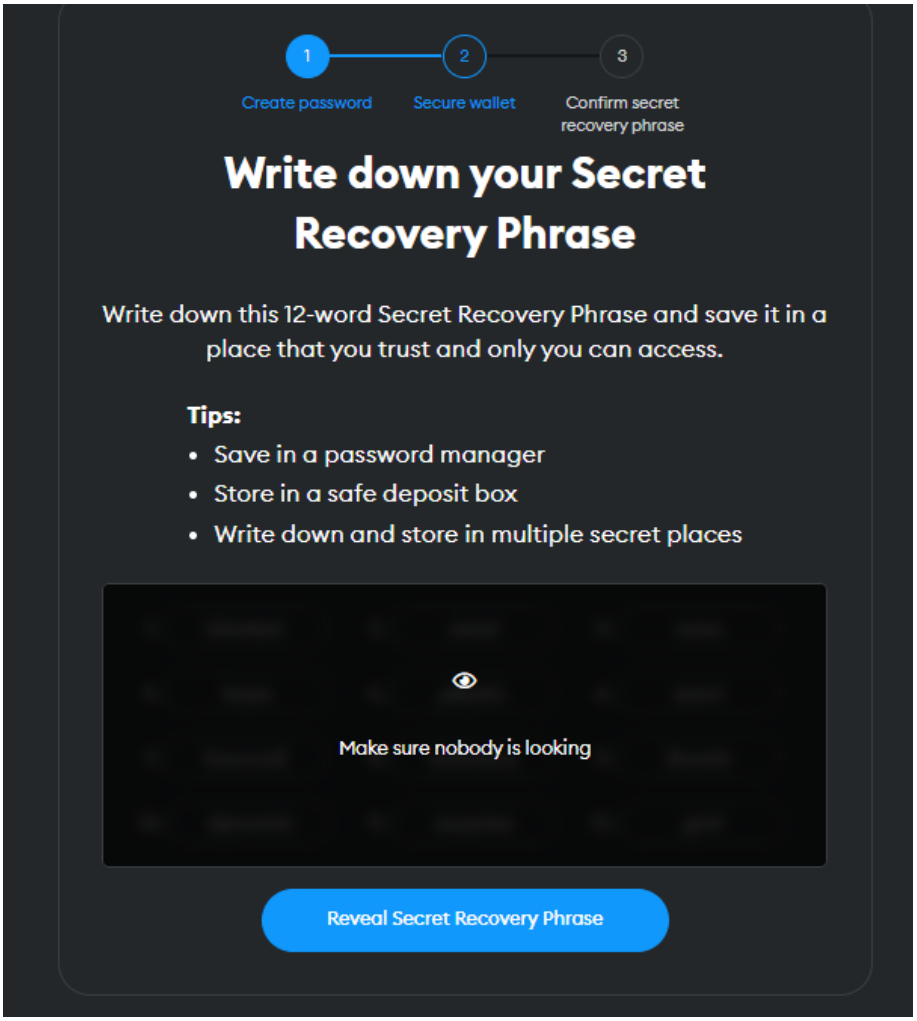


Step 3-> Create a password. This password can be used only on the device it was created on. Create a Strong password and click on Create a new Wallet button

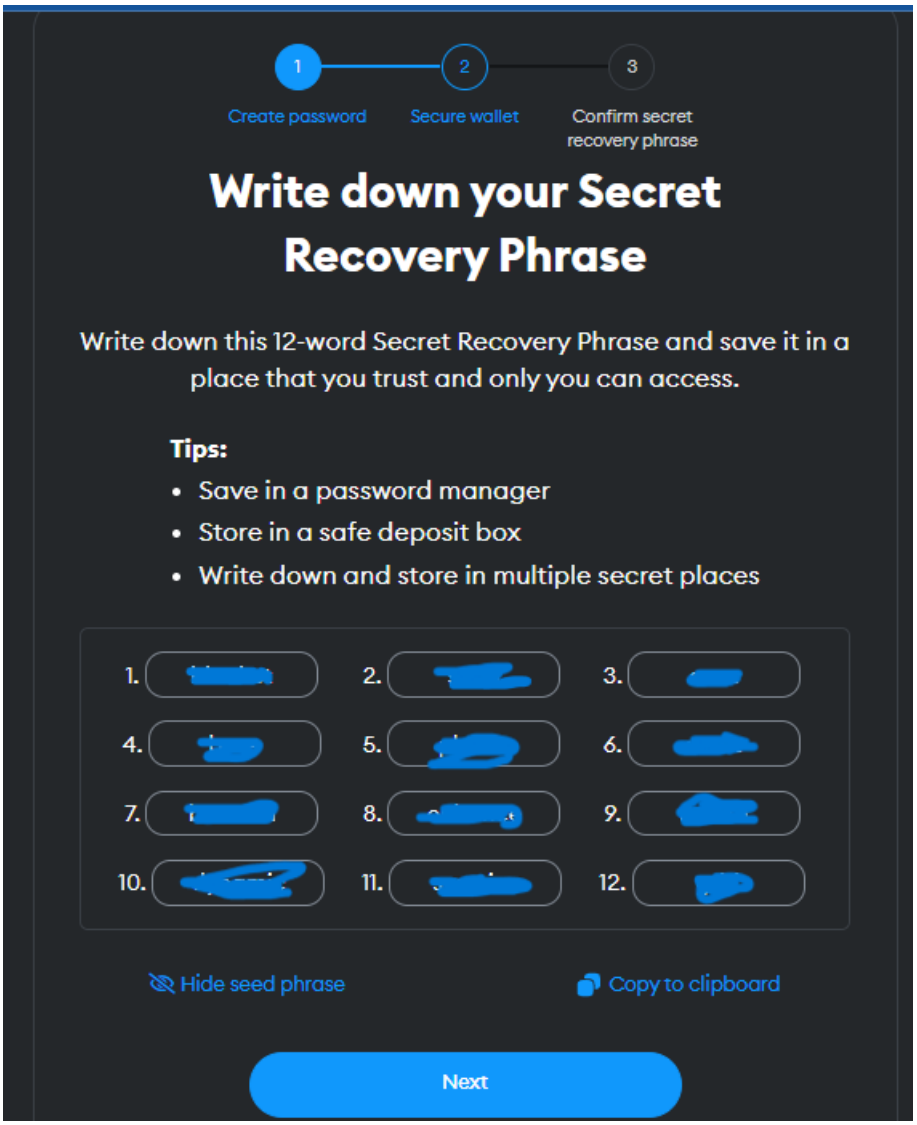



1
Create password
2
Secure wallet
3
Confirm secret recovery phrase
Secure your wallet
Before getting started, watch this short video to learn about your Secret Recovery Phrase and how to keep your wallet safe.
0:00 / 1:35
Remind me later (not recommended)
Secure my wallet (recommended)

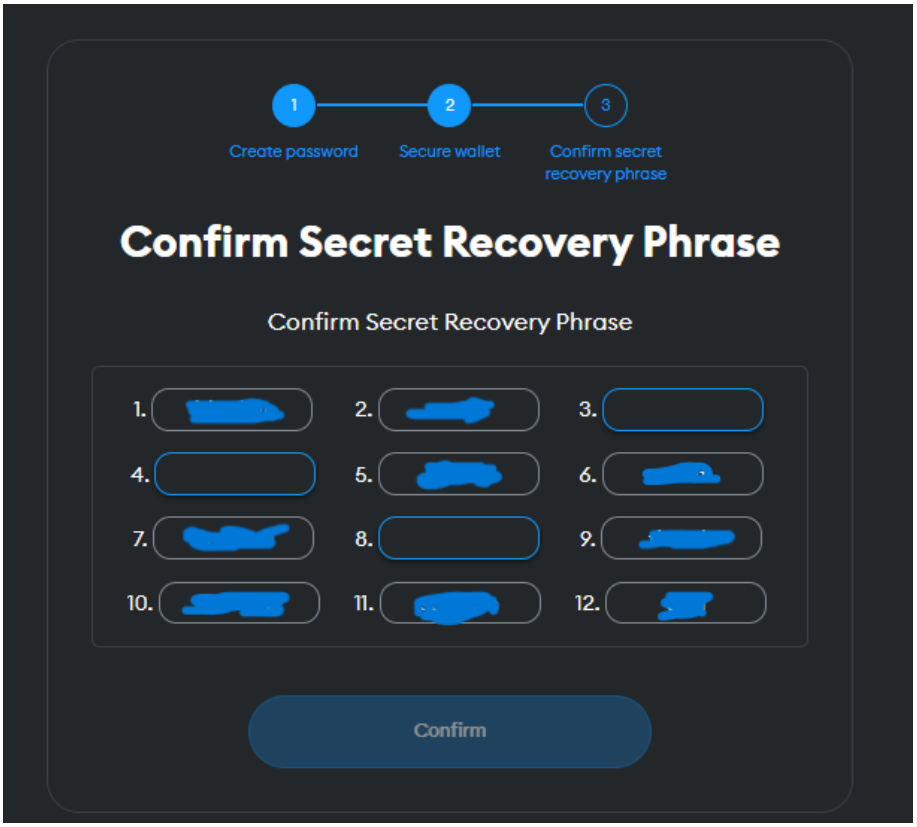
Step 4-> Click on Secure my wallet button, following window will appear



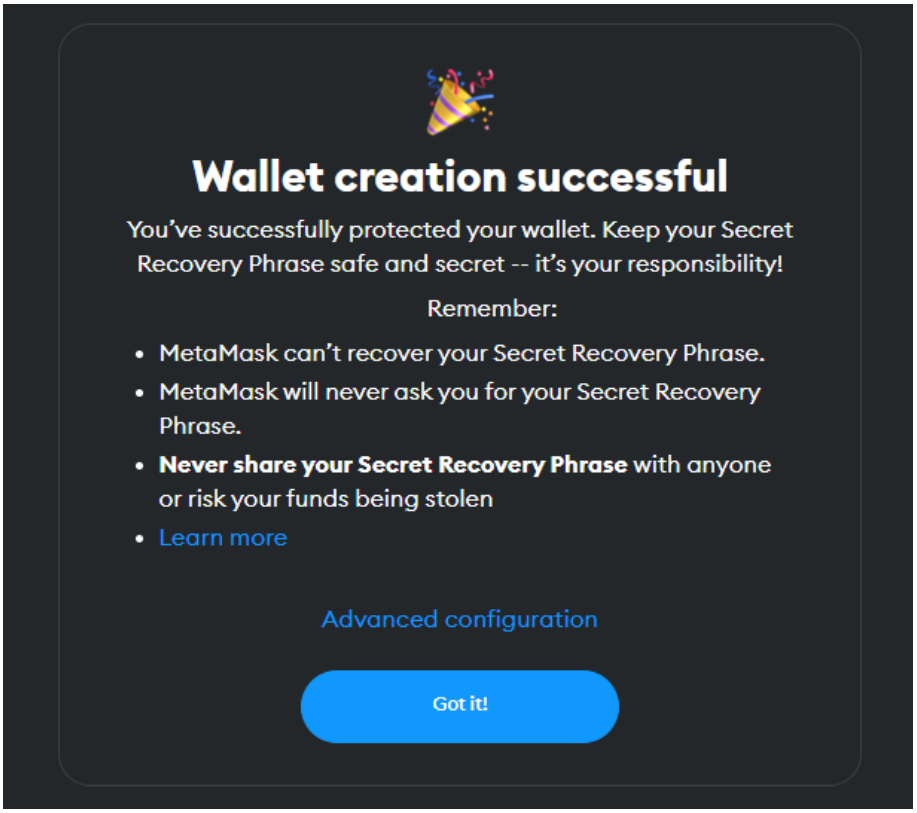
Step 5-> Click on Reveal Secret Recovery Phrase button and save the words in the same sequence



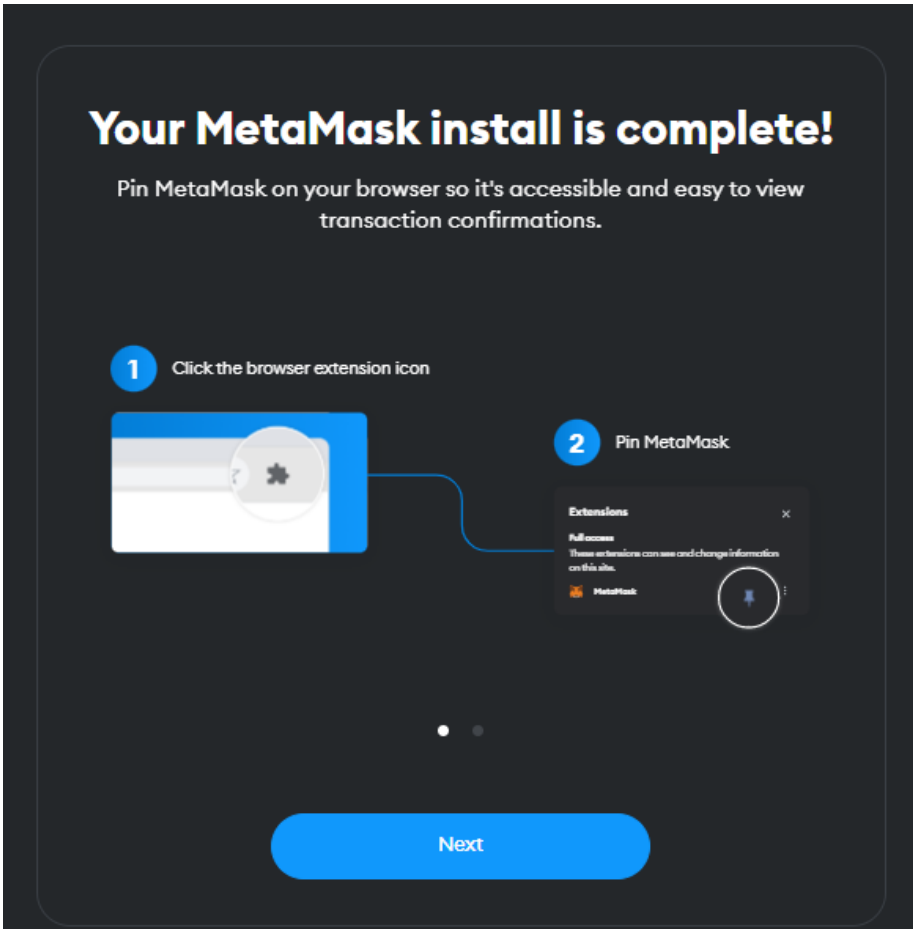
Step 6-> Enter the respective words in the empty positions and click Confirm.



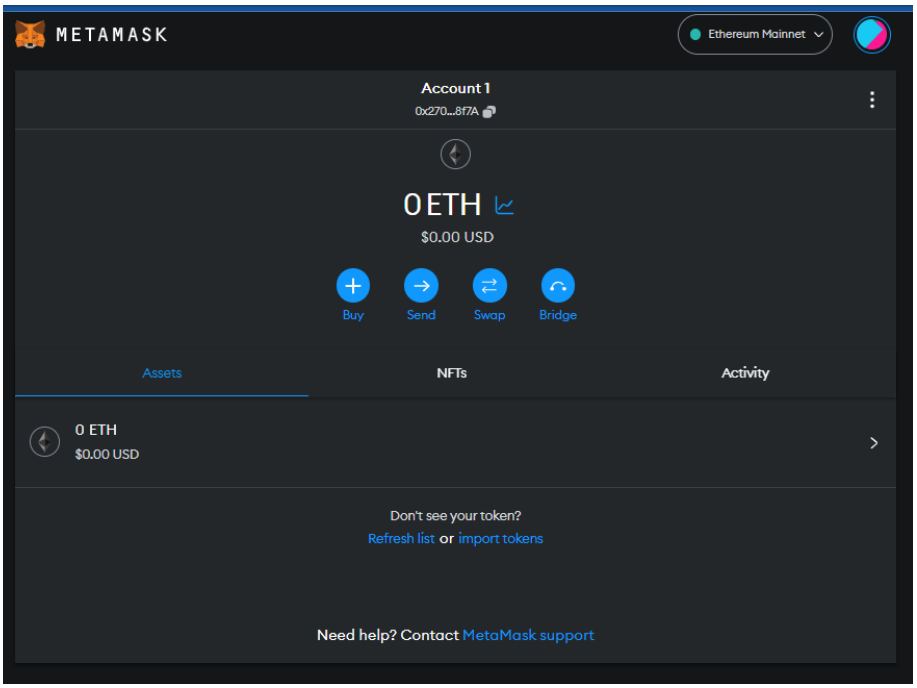
Step 7-> Click Got it!



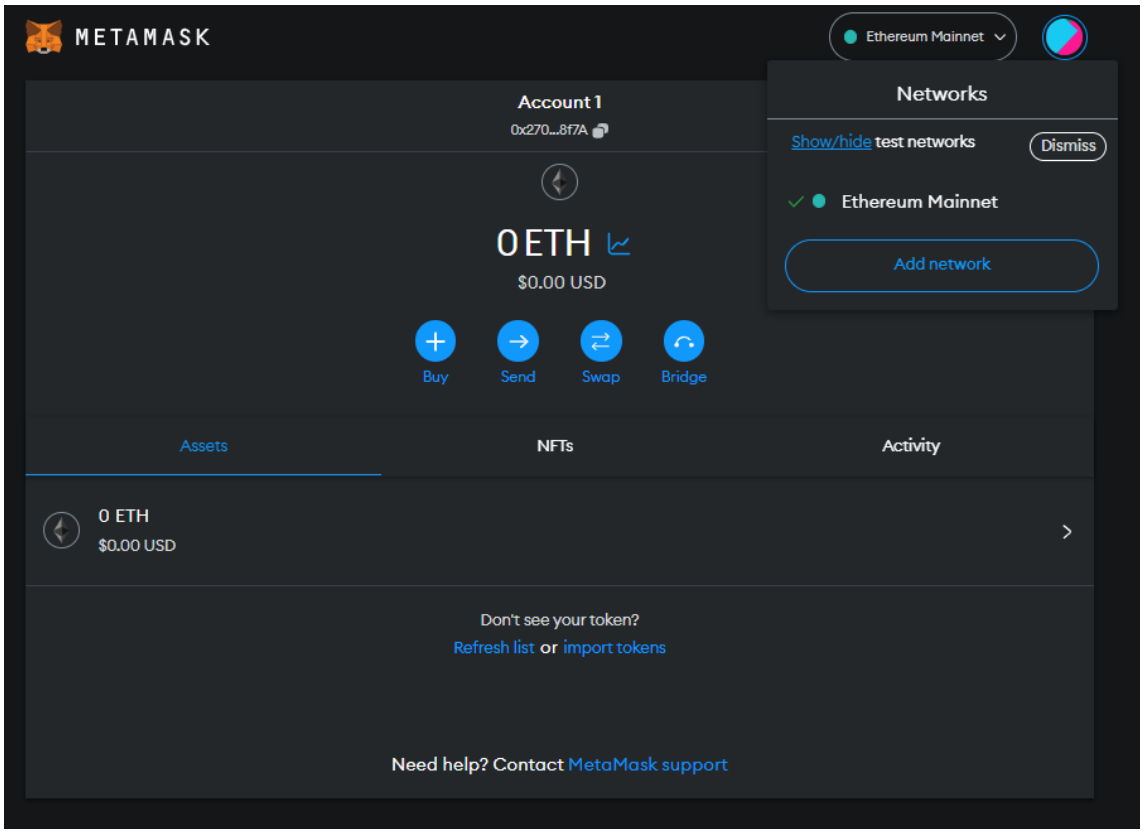
Step 8-> Click on Next

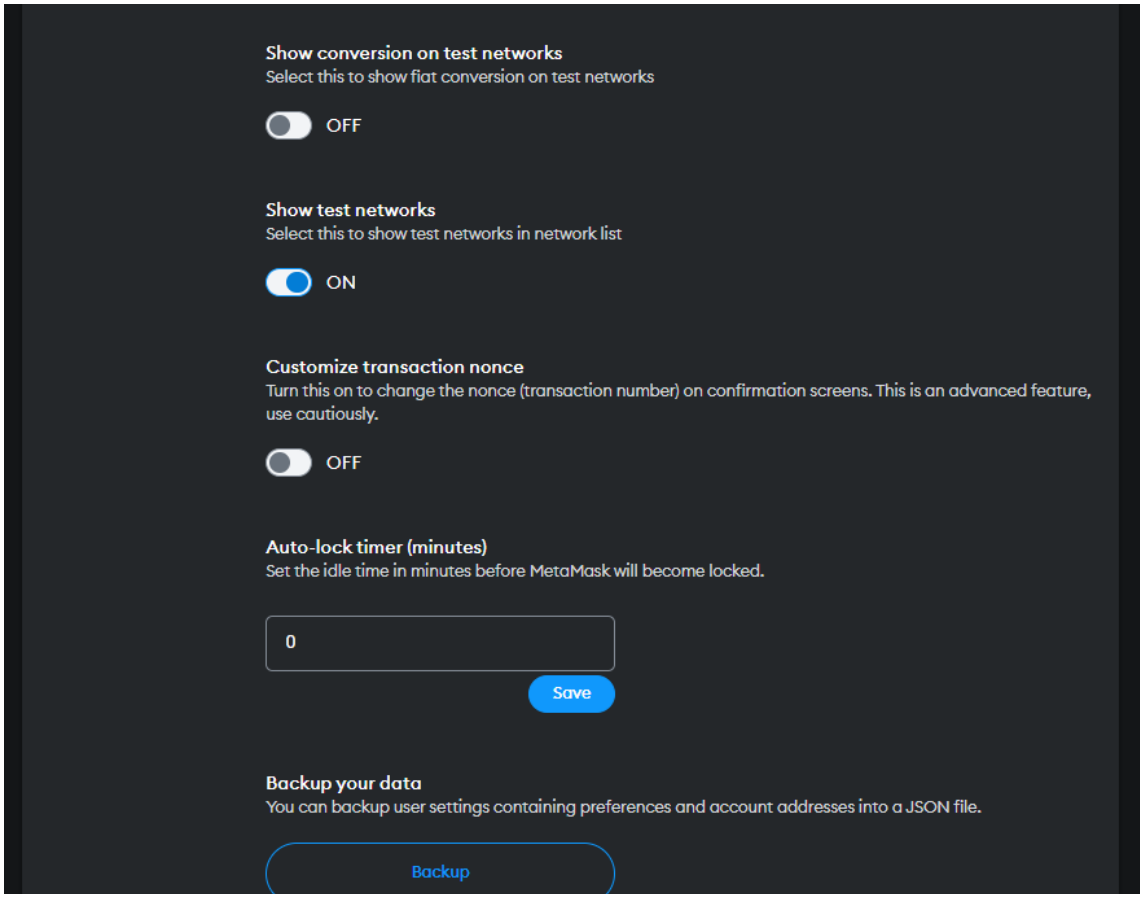


Step 9-> Following will be the Dashboard

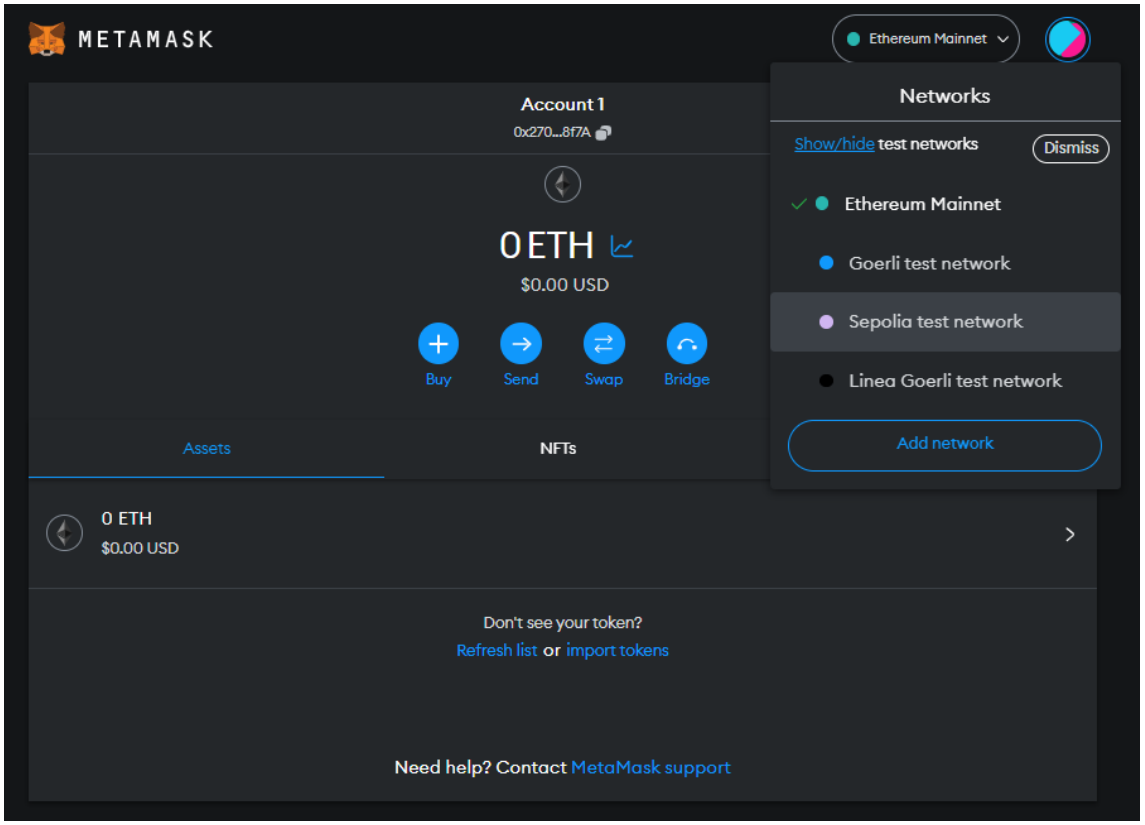


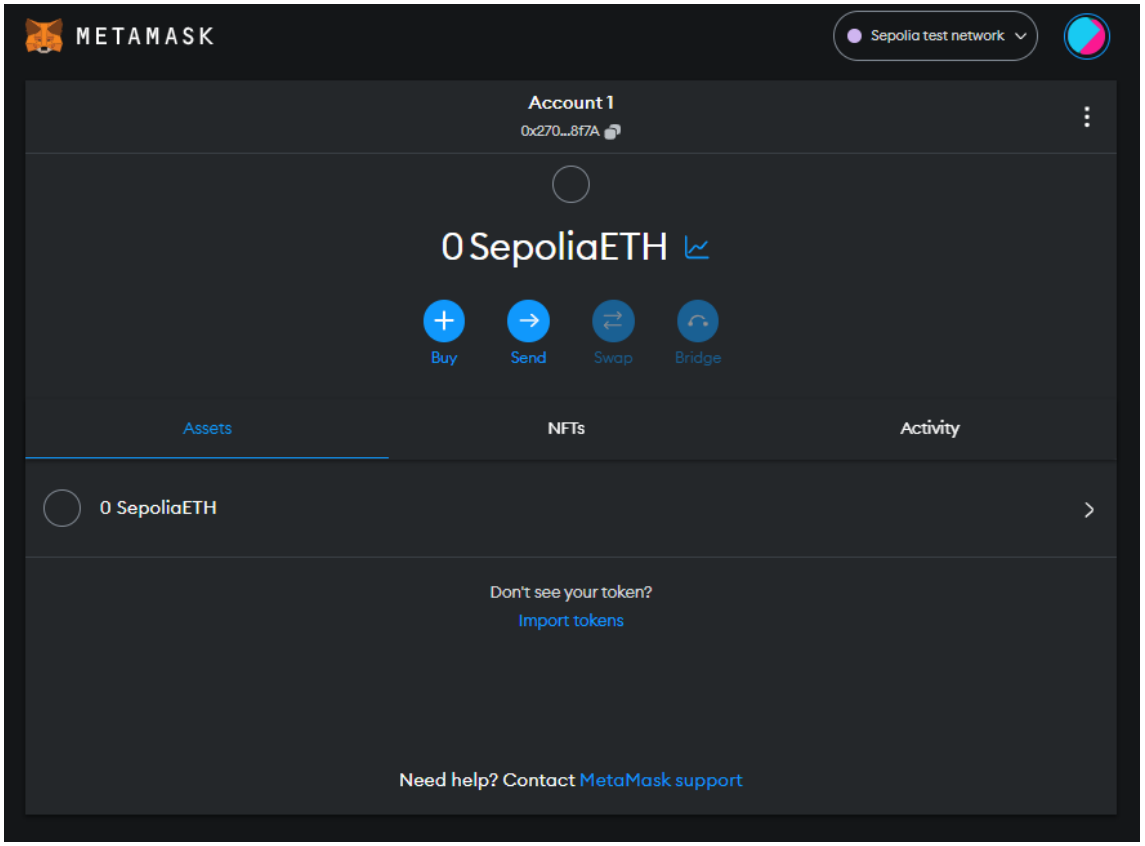
Step 10-> Click on Ethereum Mainnet button. Next click on Show/hide test networks.



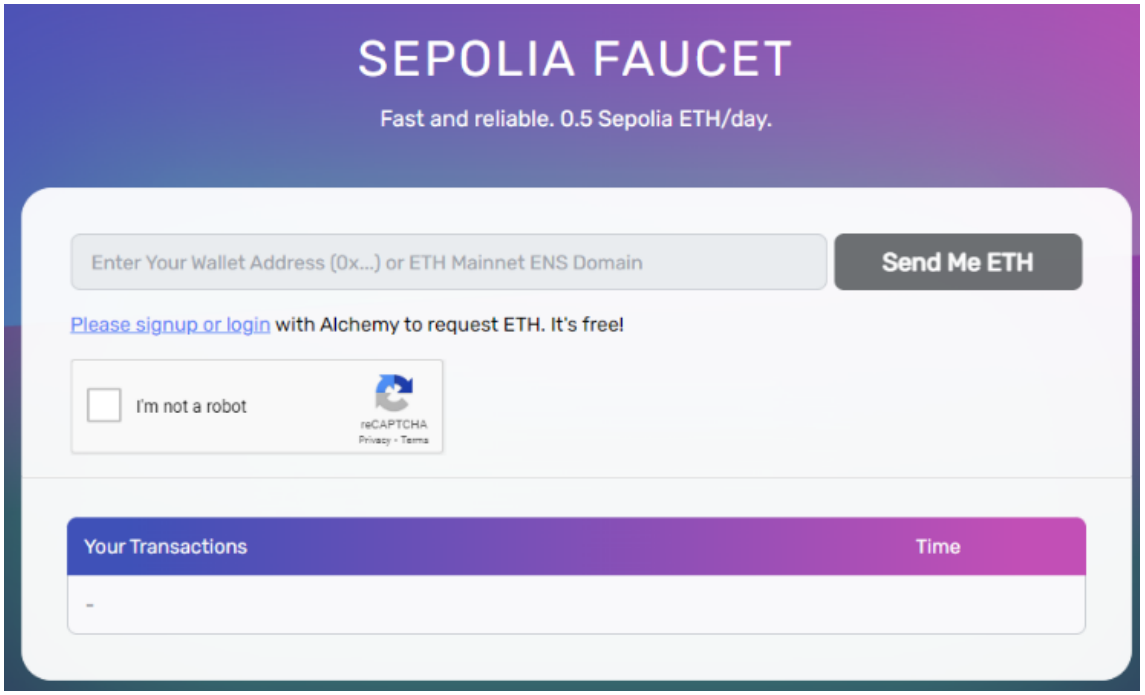

Show conversion on test networks
Select this to show fiat conversion on test networks
OFF
Show test networks
Select this to show test networks in network list
ON
Customize transaction nonce
Turn this on to change the nonce (transaction number) on confirmation screens. This is an advanced feature, use cautiously.
OFF
Auto-lock timer (minutes)
Set the idle time in minutes before MetaMask will become locked.
0
Save
Backup your data
You can backup user settings containing preferences and account addresses into a JSON file.
Backup

Step 11-> Check if tesnets are shown by clicking on Etherum Mainnet button. Click on Sepolia test network.

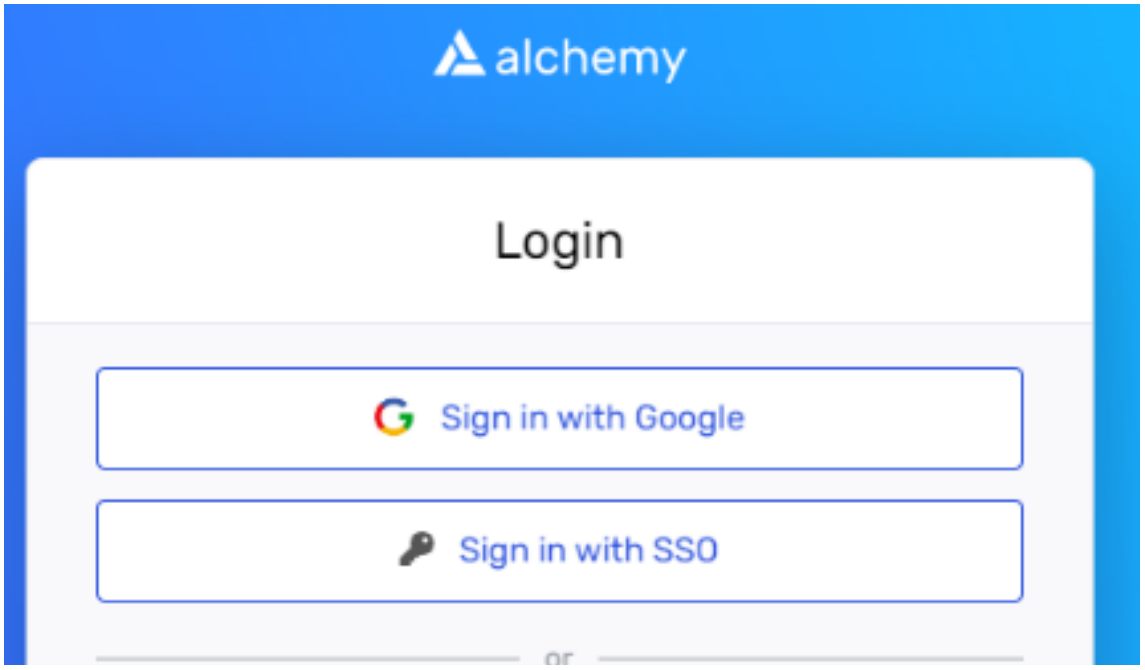



METAMASK
Sepolia test network
Account 1
0x270...8f7A
0 SepoliaETH
Buy
Send
Swap
Bridge
Assets
NFTs
Activity
0 SepoliaETH
Don't see your token?
Import tokens
Need help? Contact MetaMask support

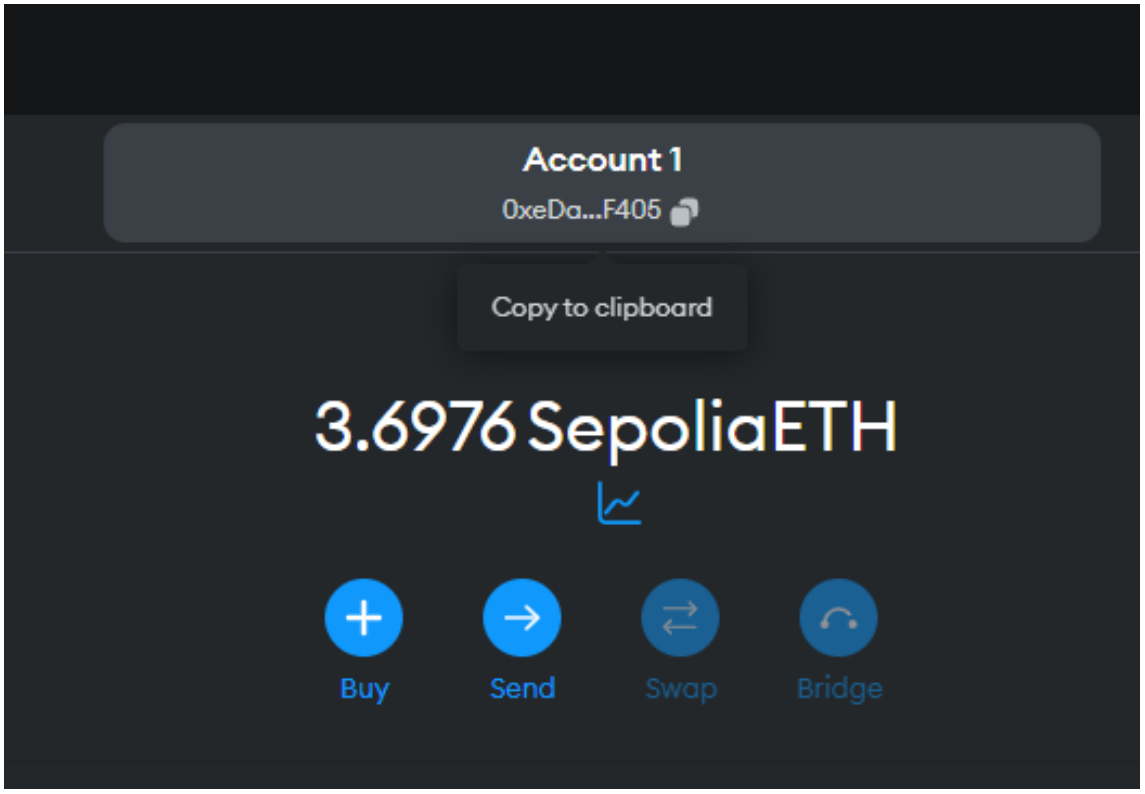
Step 12-> Go to https://sepoliafaucet.com/ and Click on Alchemy Login button.



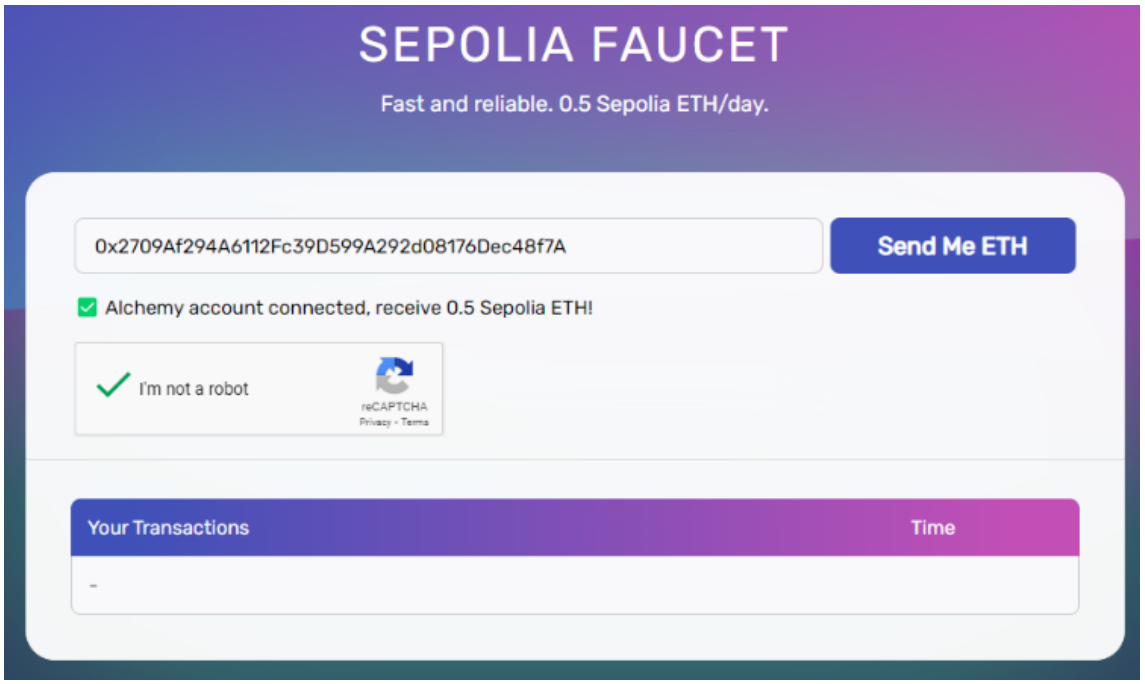
Step 13-> Login to a gmail account in another browser tab and click on Sign in with Google



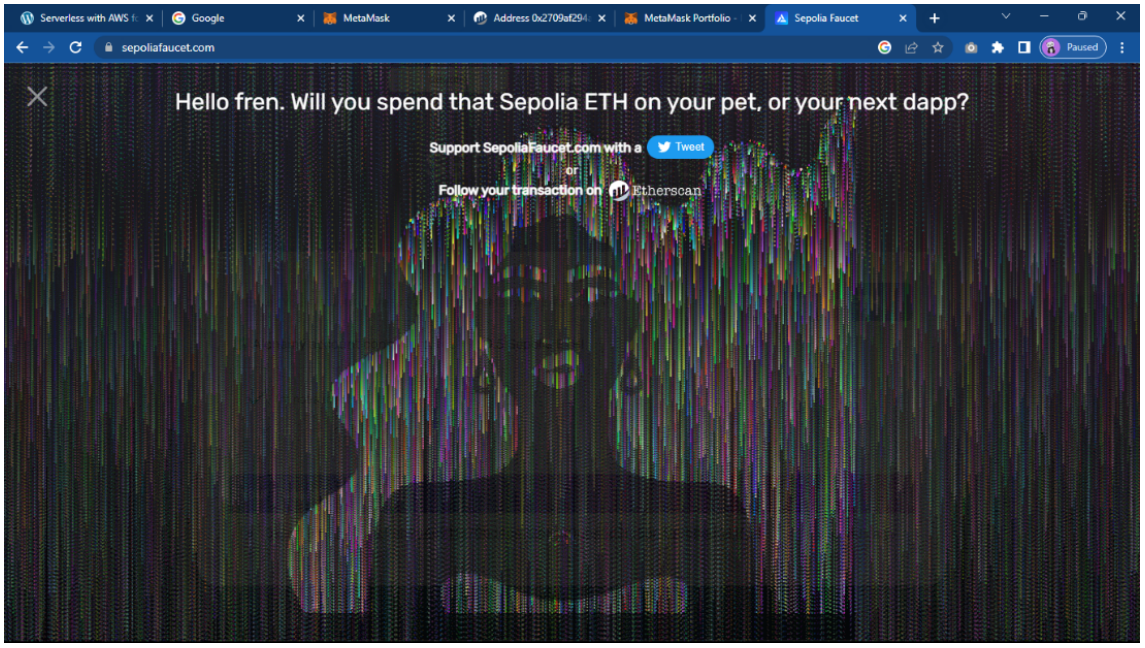
Step 14-> Now go to MetaMask and copy the account address.



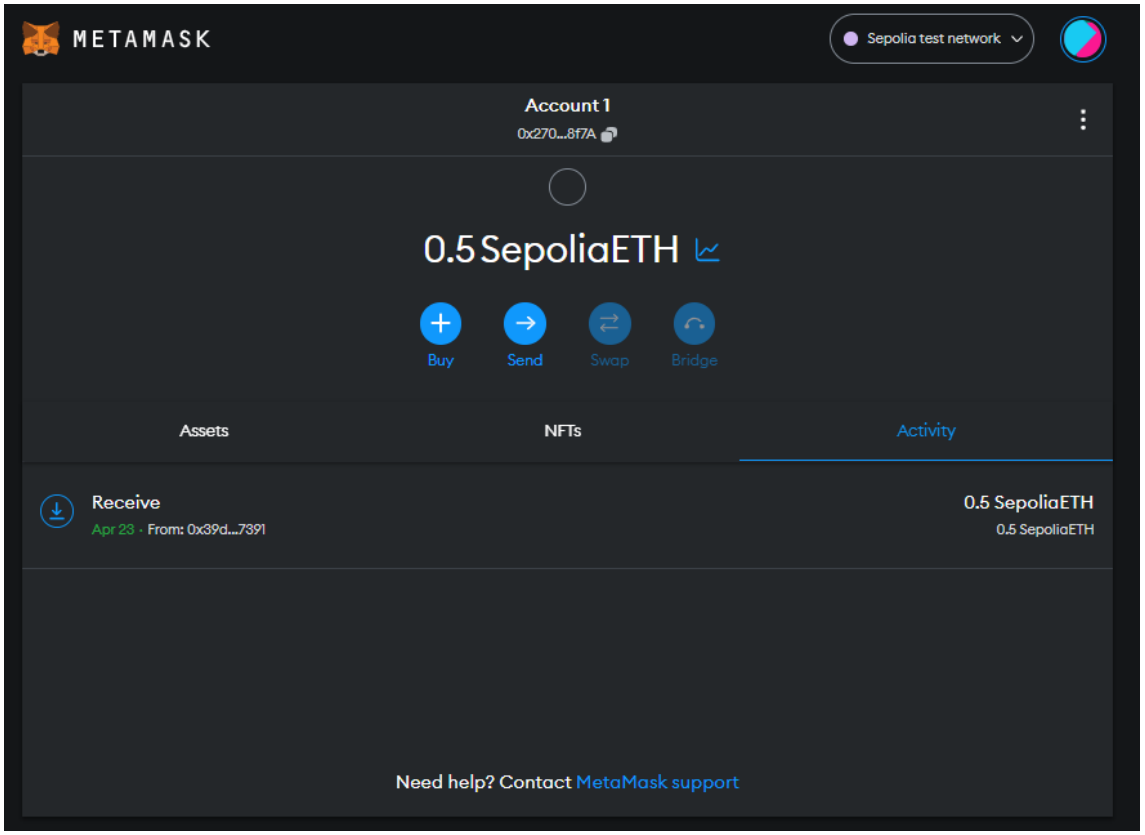
Step 15-> Paste the address and click on Send Me ETH.



Step 16-> Your ETH transfer is succesfull. You should see a similar animation.



Step 17-> Check your MetaMask account for Sepolia test network. 0.5 ETH will be added.



Practical-3 Implement and demonstrate the use of the following in Solidity

1. To execute Solidity scripts go to ->https://remix.ethereum.org/

2. Open contracts folder and starting writing scripts. The scripts are compiled using Solidity compiler.

3. The following scripts were compiled using 0.5.0+commit.1d4f565a Solidity compiler

4. Deploy the scripts to execute code

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

1. Variable

```
pragma solidity ^0.5.0;

contract variable_demo {
    uint256 sum = 4; //state variable
    uint256 x;
    address a;
    string s = "welcome";

    function add(uint256) public {
        uint256 y = 2; //local variable sum = sum+x+y:
        sum = sum + x + y;
    }

    function display() public view returns (uint256) {
        return sum;
    }

    function displayMsg() public view returns (string memory) {
        return s;
    }
}
```

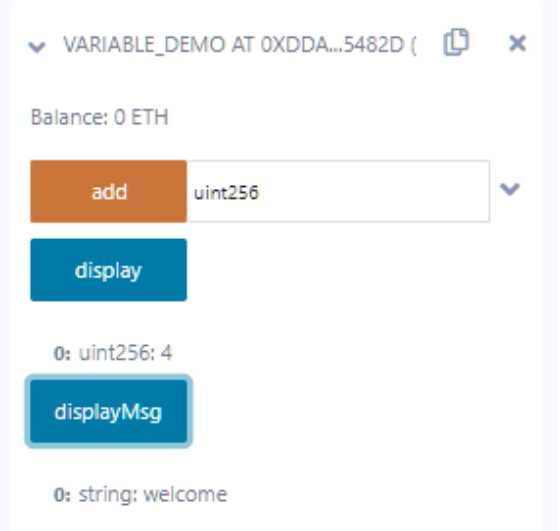


FIGURE 1 -DISPLAYING VARIABLE VALUE

2. Strings

```
pragma solidity ^0.5.0;

contract LearningStrings {
    string text;

    function getText() public view returns (string memory) {
        return text;
    }

    function setText() public {
        text = "hello";
    }

    function setTextByPassing(string memory message) public {
        text = message;
    }
}
```

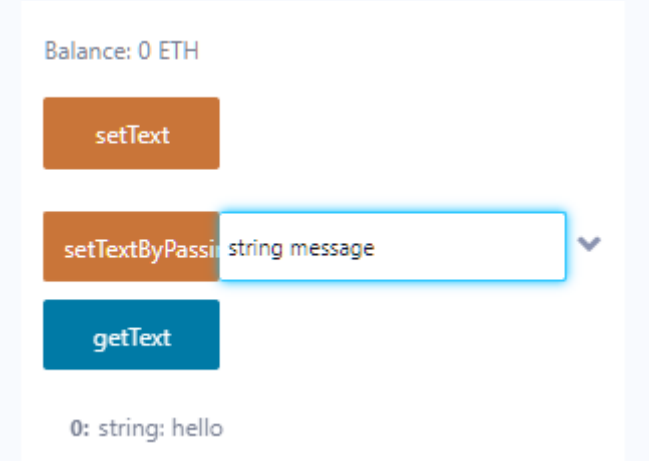


FIGURE 2 - BEFORE SETTING NEW STRING VALUE

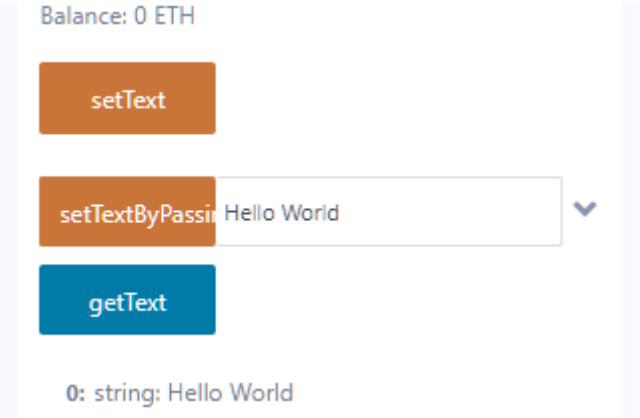


FIGURE 3 - AFTER SETTING STRING VALUE

3. Operators

```
pragma solidity ^0.5.0;

contract SolidityTest {
    uint16 public a = 20;
    uint16 public b = 10;
    uint256 public sum = a + b;
    uint256 public diff = a - b;
    uint256 public mul = a * b;
    uint256 public div = a / b;
    uint256 public mod = a % b;
    uint256 public dec = --b;
    uint256 public inc = ++a;
}
```

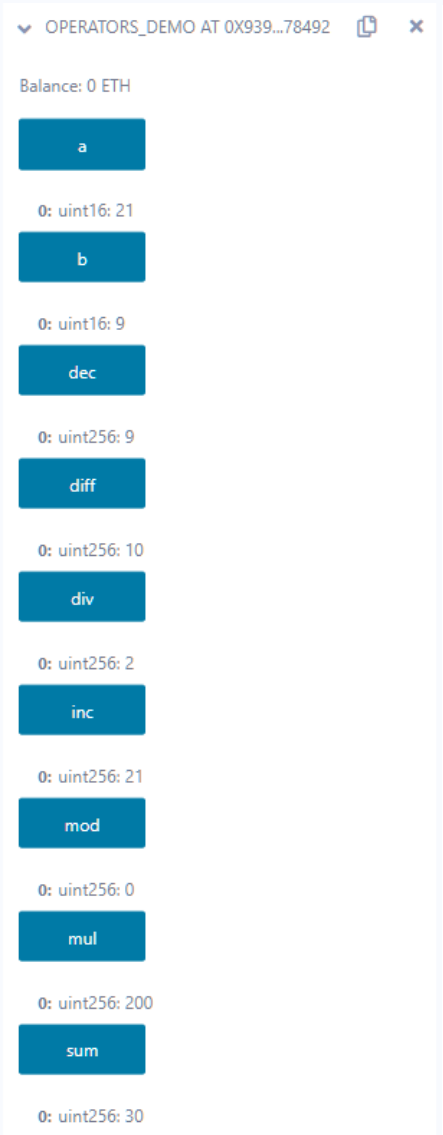


FIGURE 4 - ALL OPERATORS OF SOLIDITY DISPLAYED

4. Array

```
pragma solidity ^0.5.0;

contract arraydemo

{

    //Static Array

    uint[6] arr2=[10,20,30];

    function dispstaticarray() public view returns(uint[6] memory)

    {

        return arr2;

    }

    //Dynamic Array

    uint x=5;

    uint [] arr1;

    function arrayDemo() public

    {

        while(x>0)

        {

            arr1.push(x);

            x=x-1;

        }

    }

    function dispdynamicarray() public view returns(uint[] memory)

    {

        return arr1;

    }

}
```

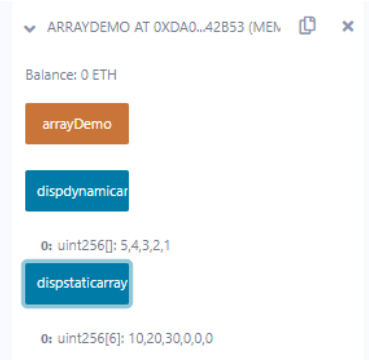


FIGURE 5 - ARRAY DISPLAYED

5. Decision Making

If Else

```
pragma solidity ^0.5.0;

contract ifelsedemo

{

    uint i=10;

    function decision_making() public view returns(string memory)

    {

        if(i%2==0)

        {

            return "even";

        }

        else

        {

            return "Odd";

        }

    }

}
```

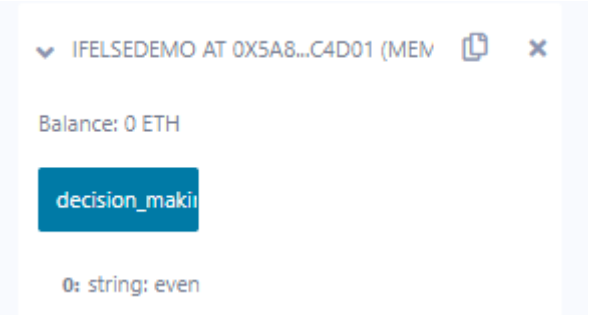


FIGURE 6 - IF ELSE OUTPUT

6. Loops

For Loop

```
pragma solidity ^0.5.0;

contract loopDemo

{

    uint [] data;

    function forDemo() public returns(uint[] memory)

    {

        for(uint i=0; i<10; i++){

            data.push(i);

        }

        return data;

    }

    function disp() public view returns(uint[] memory)

    {

        return data;

    }

}
```

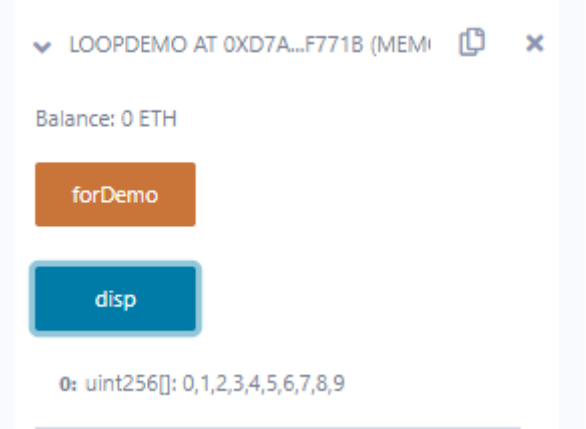


FIGURE 7 - APPENDING VALUES TO ARRAY USING FOR LOOP

While Loop

```
pragma solidity ^0.5.0;

contract whiledemo

{

    uint [] data;

    uint x=0;



    function whileLoopDemo() public

    {

        while(x<5)

        {

            data.push(x);

            x=x+1;

        }

    }



    function dispwhileloop() public view returns(uint[] memory)

    {

        return data;

    }

}
```

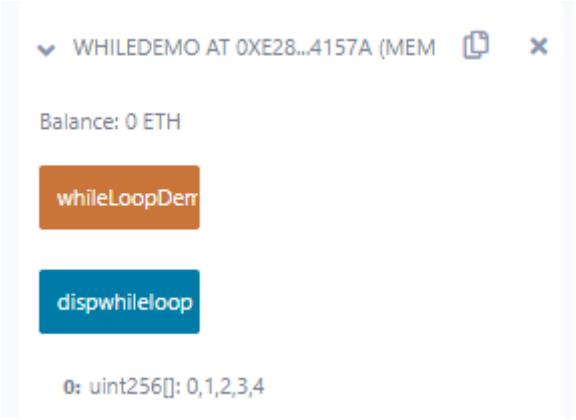


FIGURE 8 - APPENDING VALUES TO ARRAY USING WHILE LOOP

Do While

```
pragma solidity ^0.5.0;

// Creating a contract
contract DoWhile {
    // Declaring a dynamic array
    uint256[] data;

    // Declaring state variable
    uint8 j = 0;

    // Defining function to demonstrate
    // 'Do-While loop'
    function loop() public returns (uint256[] memory) {
        do {
            j++;
            data.push(j);
        } while (j < 5);
        return data;
    }
    function display() public view  returns(uint256[] memory){
        return data;
    }
}
```

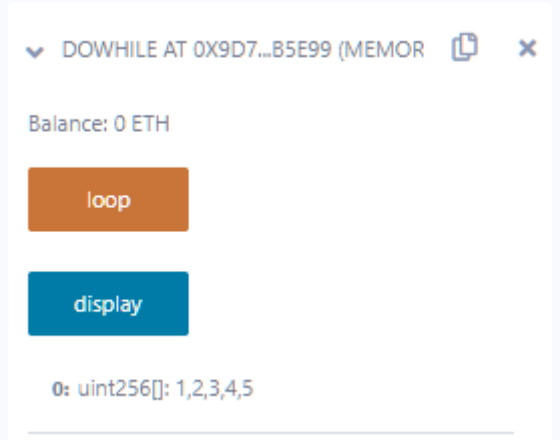


FIGURE 9 APPENDING VALUES TO ARRAY USING DO WHILE LOOP

7. Enums

```
pragma solidity ^0.5.0;

contract enumdemo {
    enum week_days {
        Monday,
        Tuesday,
        Wednesday,
        Thursday,
        Friday,
        Saturday,
        Sunday
    }

    week_days week;
    week_days choice;
    week_days constant default_value = week_days.Sunday;

    function set_value() public {
        choice = week_days.Tuesday;
    }

    function get_choice() public view returns (week_days) {
        return choice;
    }

    function get_defaultvalue() public view returns (week_days) {
        return default_value;
    }
}
```

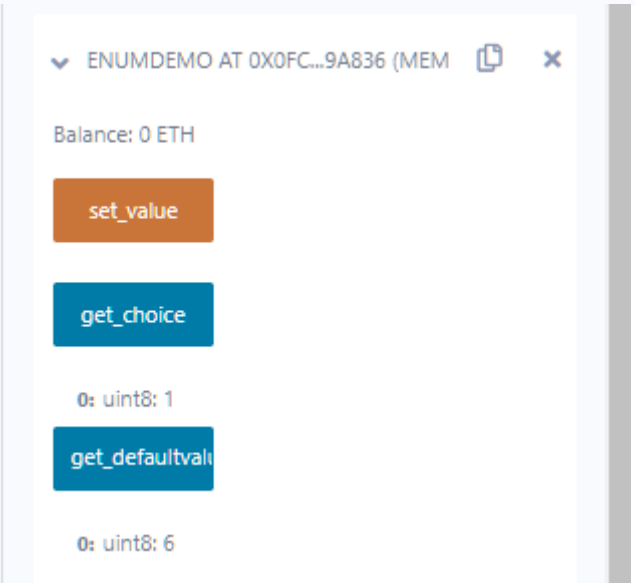


FIGURE 10 - ACCESSING ENUM VALUES

8. Structs

```
pragma solidity ^0.5.0;

contract structdemo {
    struct Book {
        string name;
        string author;
        uint256 id;
        bool availability;
    }
    Book book2;
    Book book1 = Book("A Little Life", "Hanya Yanagihara", 2, false);

    function set_details() public {
        book2 = Book("Almond", "Sohn won-pyung", 1, true);
    }

    function book_info()
        public
        view
        returns (
            string memory,
            string memory,
            uint256,
            bool
        )
    {
        return (book1.name, book1.author, book1.id, book1.availability);
    }

    function get_details()
        public
        view
        returns (
            string memory, string memory, uint256, bool
        )
    {
        return (book2.name, book2.author, book2.id, book2.availability);
    }
}
```

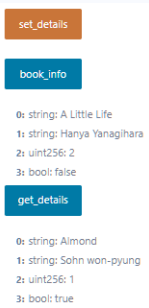


FIGURE 11- STRUCTURE DATATYPE IN SOLIDITY

9. Mappings

```
pragma solidity ^0.5.0;

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();
        return ledgerBalance.balances(address(this));
    }
}
```

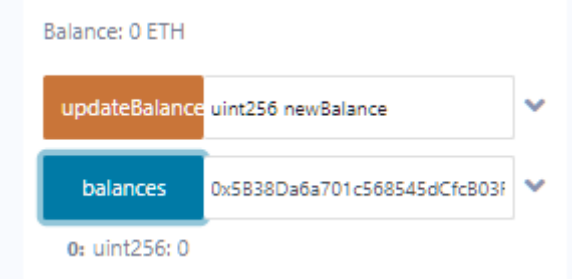


FIGURE 12 - BEFORE UPDATING BALANCE

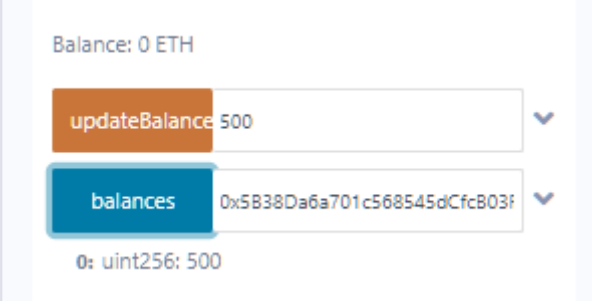


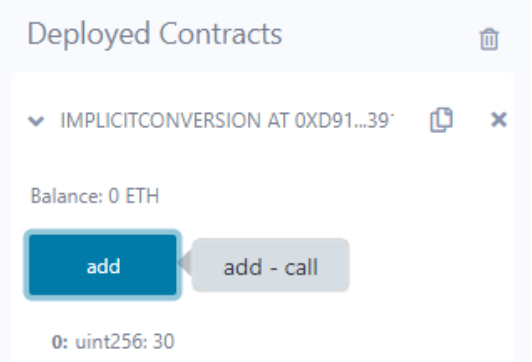
FIGURE 13 - AFTER UPDATING BALANCE

10.Conversions

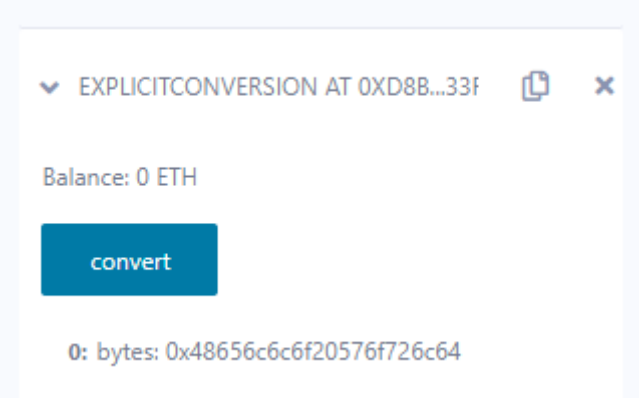
```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract ImplicitConversion {
    function add() public pure returns (uint256) {
        uint256 a = 10;
        uint256 b = 20;
        return a + b;
    }
}

contract ExplicitConversion {
    function convert() public pure returns (bytes memory) {
        string memory str = "Hello World";
        bytes memory b = bytes(str);
        return b;
    }
}
```

Step 1-> Deploy both contracts

Step 2-> Open Implicit Conversion and click on add button to sum and display value



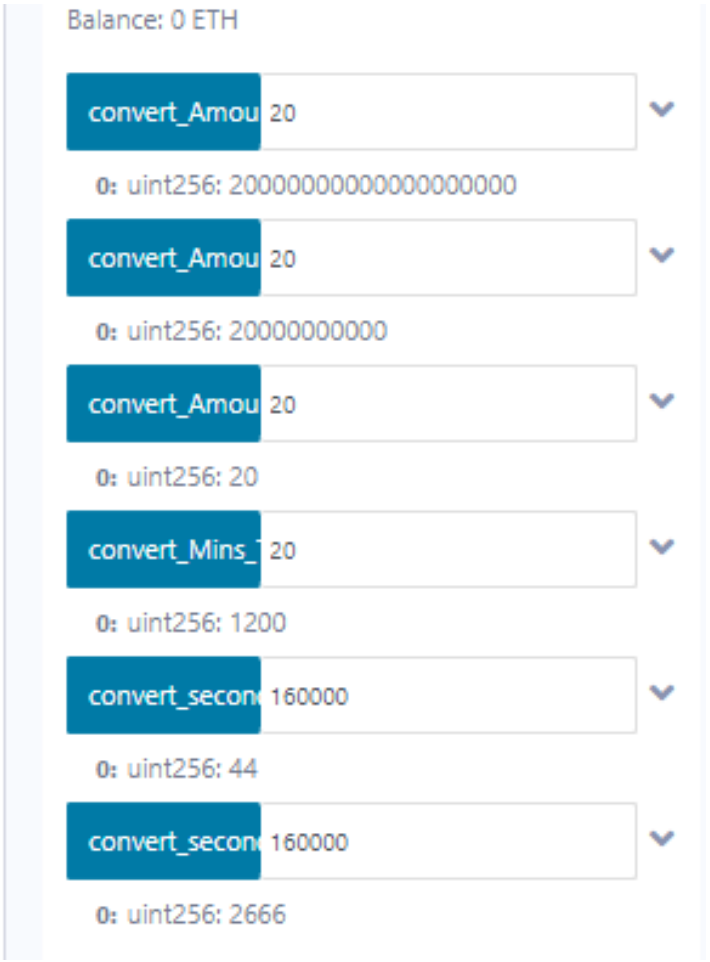
Step 3-> Open Explicit Conversion and click on convert button



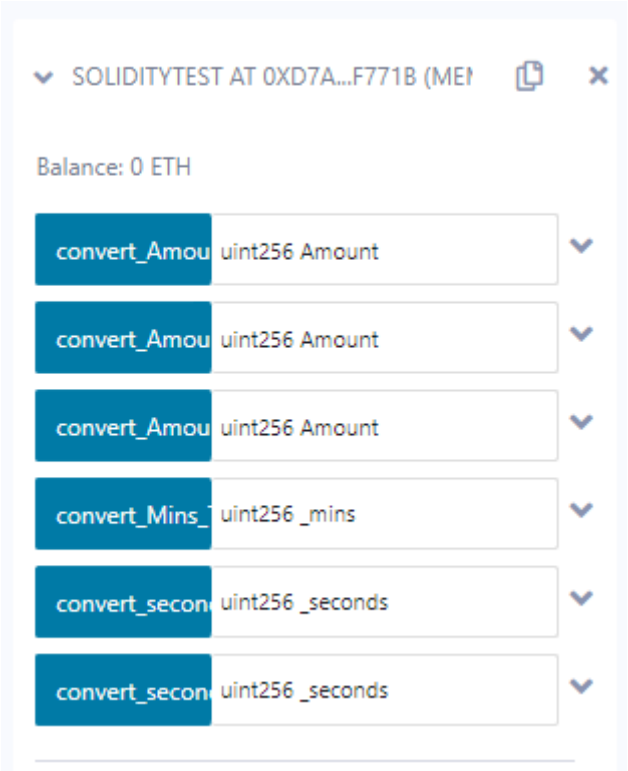
11.Ether Units

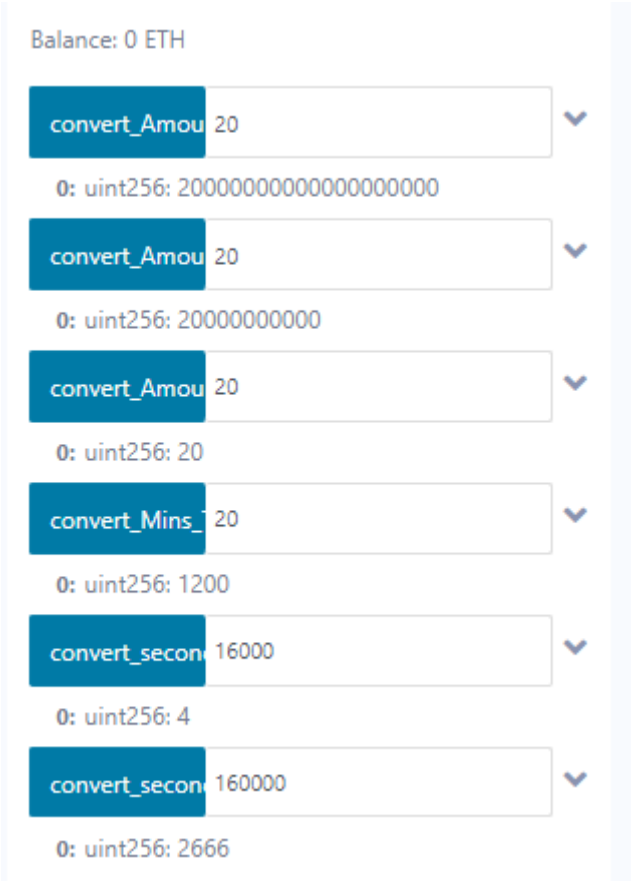
```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

contract SolidityTest {
    function convert_Amount_to_Wei(uint256 Amount)
        public
        pure
        returns (uint256)
    {
        return Amount * 1 wei;
    }

    function convert_Amount_To_Ether(uint256 Amount)
        public
        pure
        returns (uint256)
    {
        return Amount * 1 ether;
    }

    function convert_Amount_To_Gwei(uint256 Amount)
        public
        pure
        returns (uint256)
    {
        return Amount * 1 gwei;
    }

    function convert_seconds_To_mins(uint256 _seconds)
        public
        pure
        returns (uint256)
    {
        return _seconds / 60;
```

```
    }

    function convert_seconds_To_Hours(uint256 _seconds)
        public
        pure
        returns (uint256)
    {
        return _seconds / 3600;
    }

    function convert_Mins_To_Seconds(uint256 _mins)
        public
        pure
        returns (uint256)
    {
        return _mins * 60;
    }
}
```



Step 1-> Provide values to each function and click on them

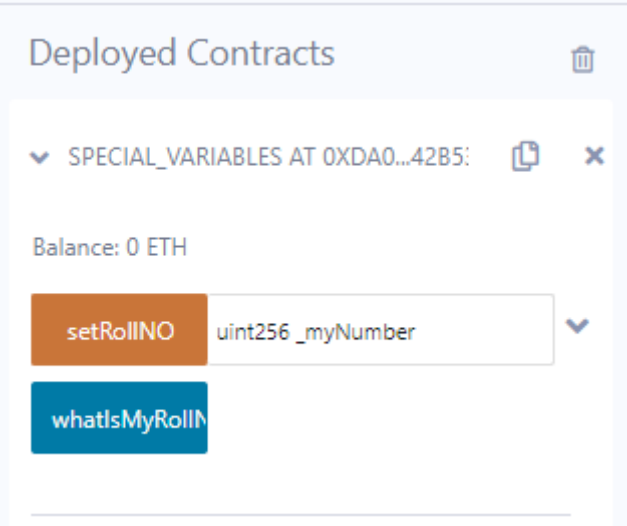




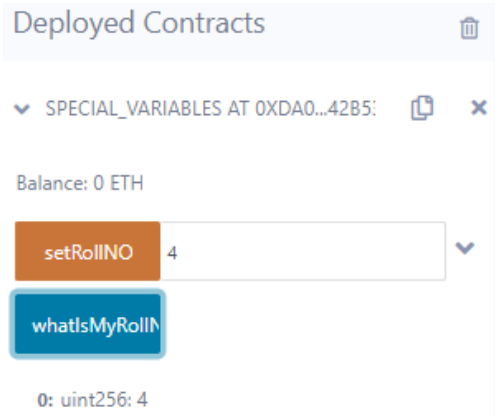
12.Special Variables

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

contract Special_Variables {
    mapping(address => uint256) rollNo;

    function setRollNO(uint256 _myNumber) public {
        rollNo[msg.sender] = _myNumber;
    }

    function whatIsMyRollNumber() public view returns (uint256) {
        return rollNo[msg.sender];
    }
}
```

Step 1-> Deploy contract Special Variables



Step 2-> Input a number for setRollNO function and click on it & whatIsMyRollNumber button


Deployed Contracts
SPECIAL_VARIABLES AT 0XDA0...42B5:
Balance: 0 ETH
setRollNO
4
whatIsMyRollN
0: uint256: 4

B)Functions, Function Modifiers, View functions, Pure Functions, Fallback Function, Function Overloading, Mathematical functions, Cryptographic functions

1. **View Functions**

```
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;
    }
}
```

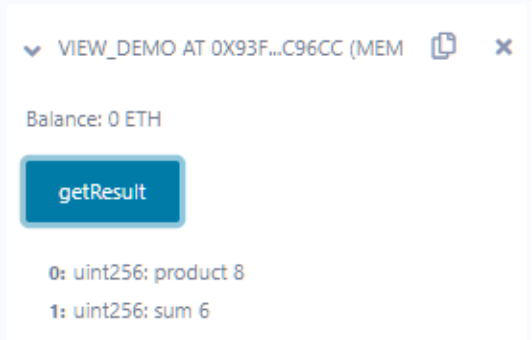


FIGURE 14 - VIEW FUNCTION DEMO

2. Pure Functions

```
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;
    }
}
```

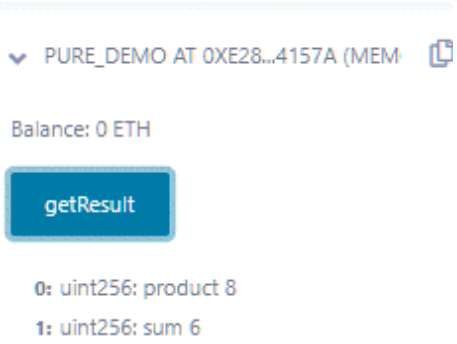


FIGURE 15 - PURE FUNCTION OUTPUT

3. Mathematical Functions

```
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);

    }

}
```

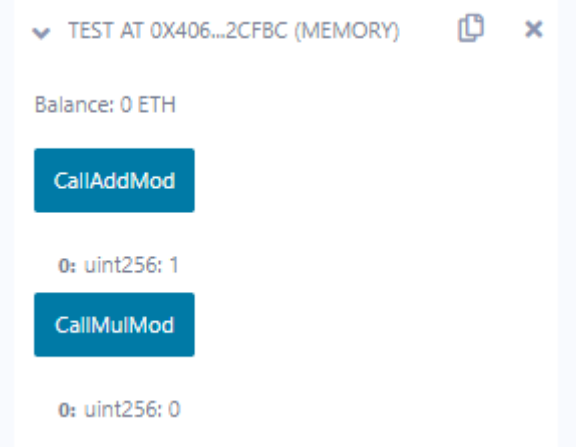


FIGURE 16 - MATHEMATICAL FUNCTIONS IN SOLIDITY

4. Cryptographic Functions

```
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");

    }

}
```

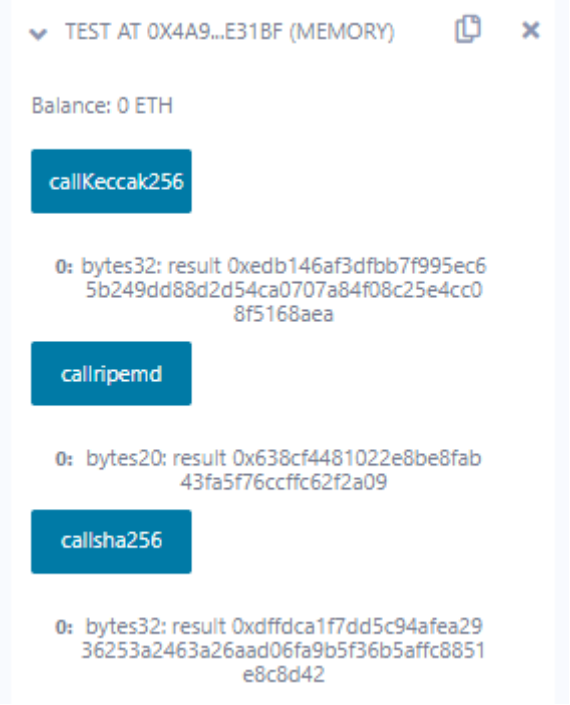
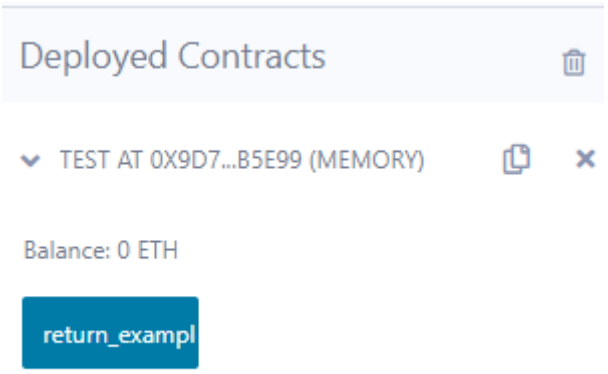


FIGURE 17 - CRYPTOGRAPHY ALGORITHMS IN SOLIDITY

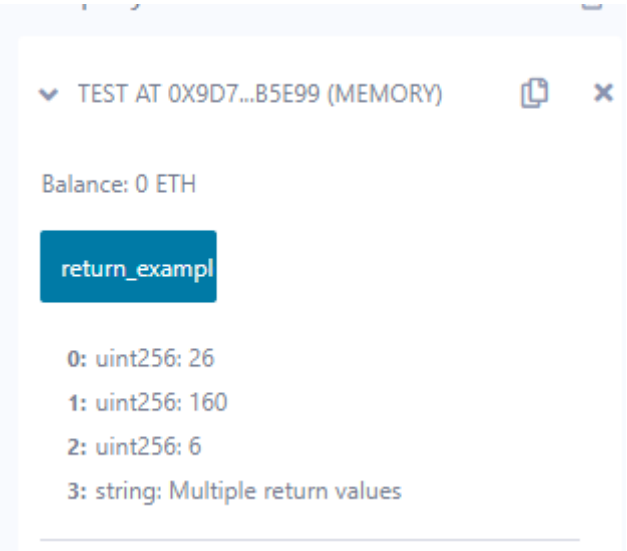
5. Functions

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.4.22 <0.9.0;

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);
    }
}
```

Step 1-> Deploy Test Contract



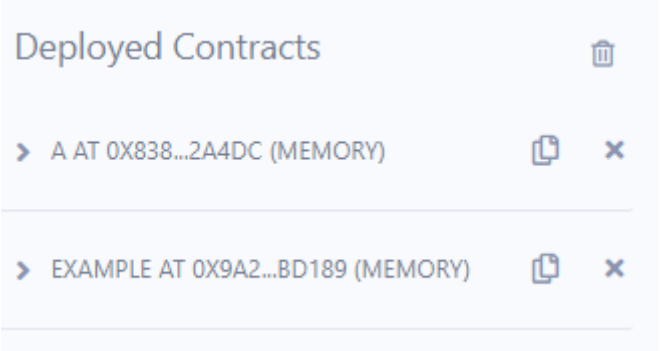
Step 2-> Click on return_example button to display all values



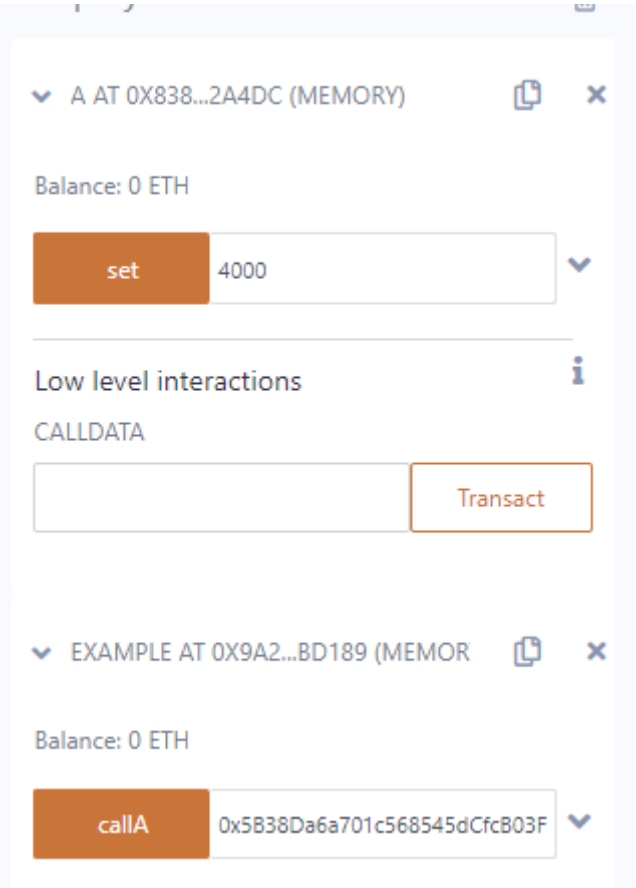
6. Fallback Function

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.12;

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));
    }
}
```

Step 1-> Deploy both A & example contracts



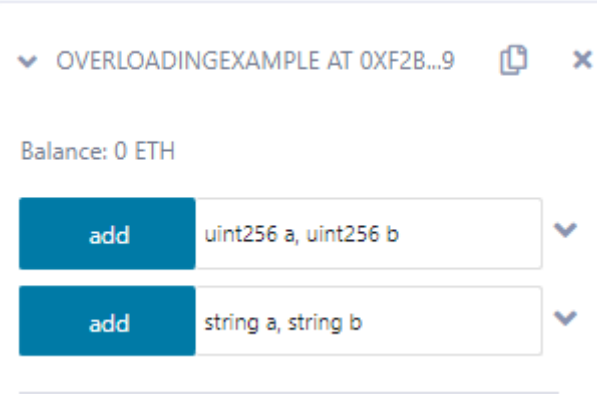
Step 2-> Provide values to both deployed contracts accordingly(use any address)



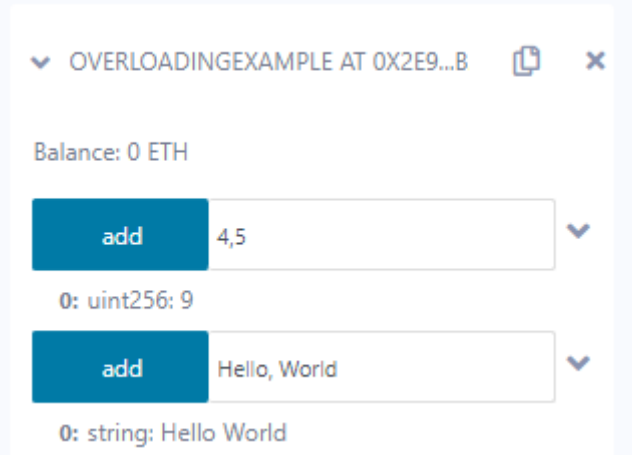
7. Function Overloading

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

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));
    }
}
```

Step 1-> Deploy Overloading Example contract

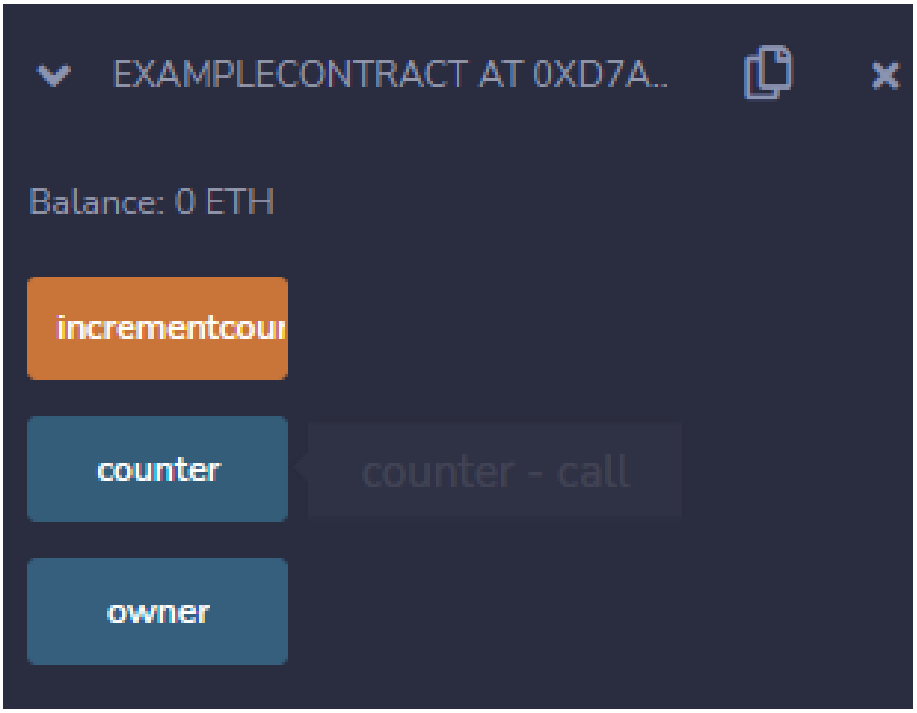


Step 2-> Give integer and string values to both add functions as below

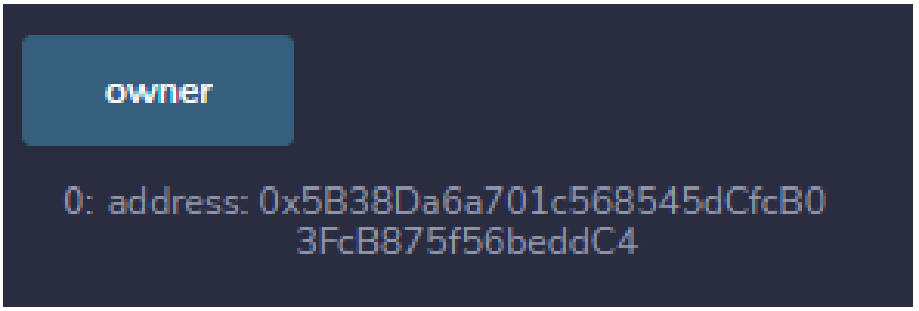


8. Function modifiers

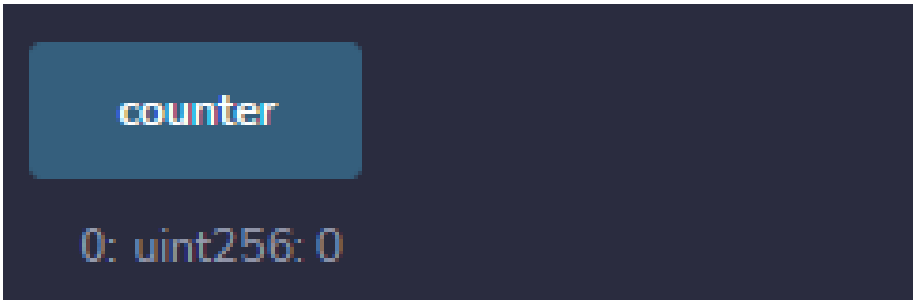
```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.0;

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++;
    }
}
```



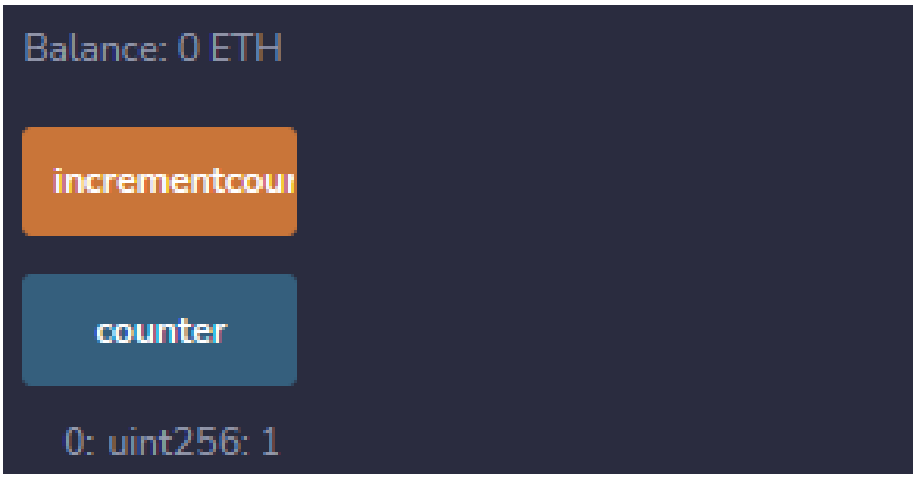
Step 1-> Click on owner button



Step 2-> Click on counter button initially it is 0.



Step 3-> Then click on increment counter button and again click on counter button, the counter has been increased



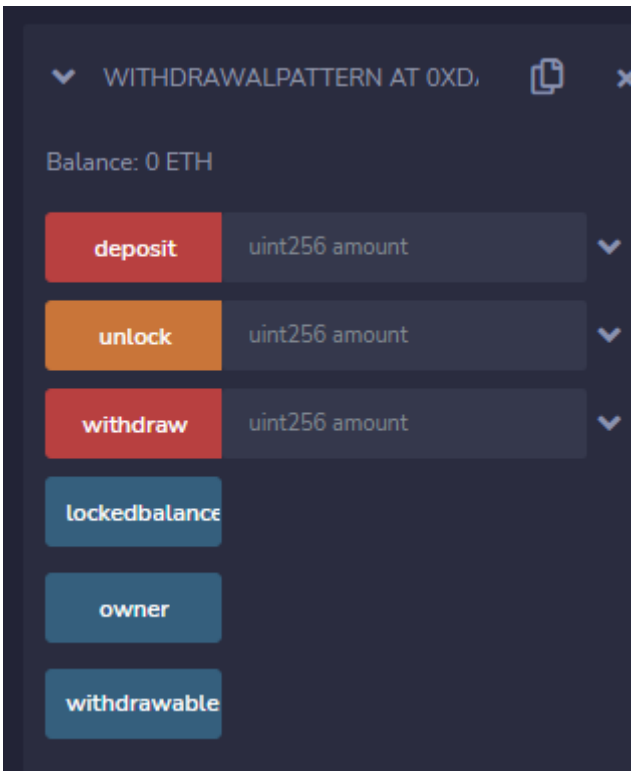
Practical-4 Implement and demonstrate the use of the following in Solidity

A) Withdrawal Pattern, Restricted Access

1) Withdrawal Pattern

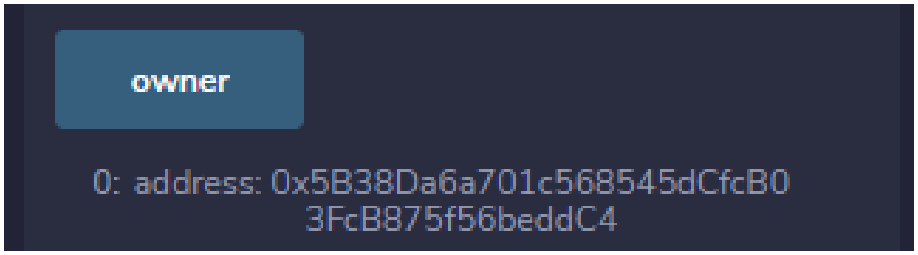
```
// SPDX-License-Identifier: MIT
pragma solidity 0.8.18;

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;
    }
}
```

Outputs:

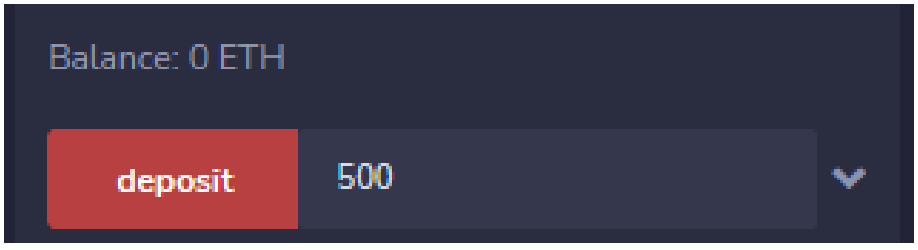


Flow of execution

Step 1-> Click on owner



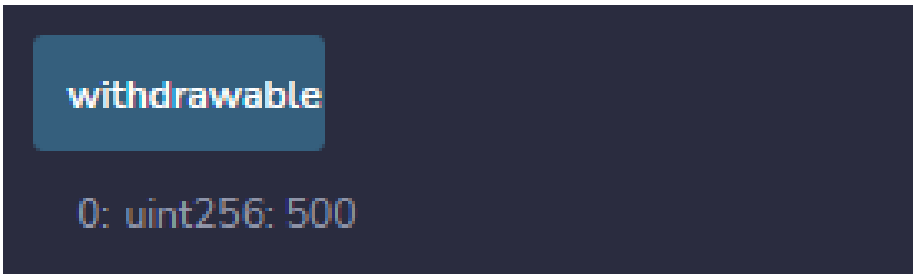
Step 2-> Enter an amount and click on deposit



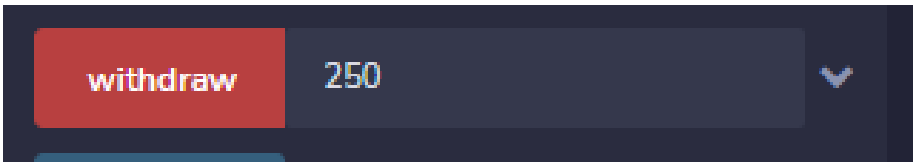
Step 3-> Click on locked balance button to display the locked amount in the account

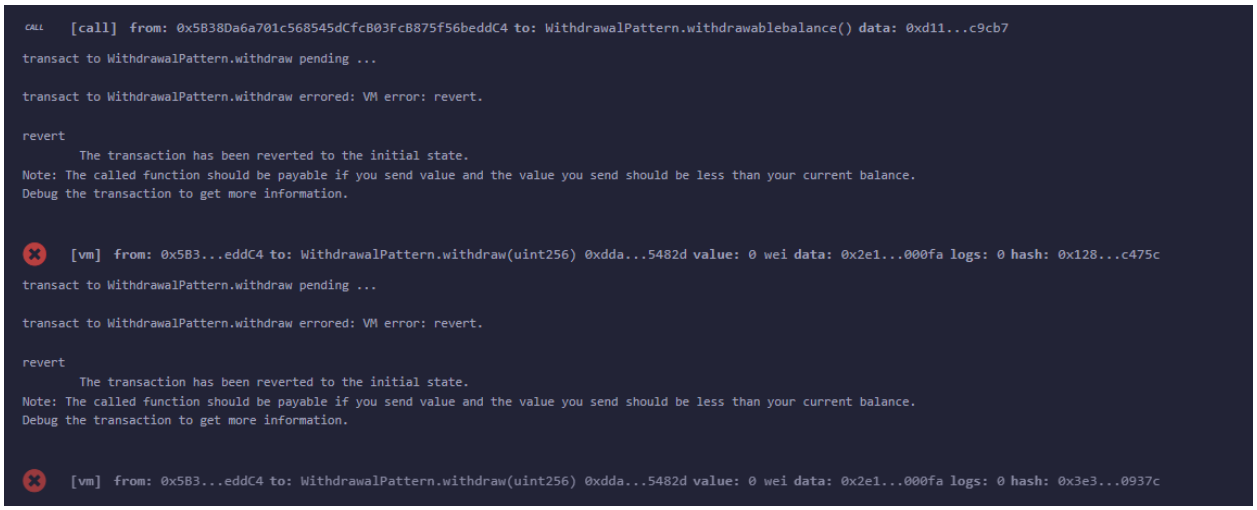
Step 4-> Click on withdrawable balance button

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



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.

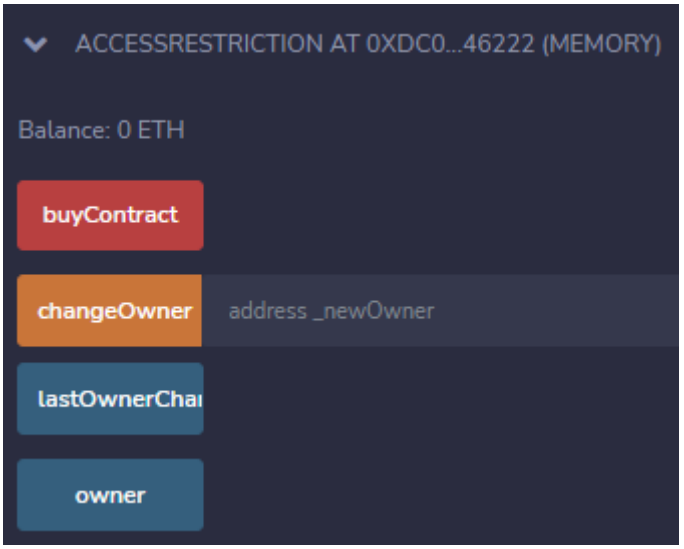




2) Restricted Access

```
//SPDX-License-Identifier: MIT
pragma solidity ^0.8.18;

contract RestrictedAccess {
    address public owner = msg.sender;
    uint256 public creationTime = block.timestamp;

    modifier onlyBy(address _account) {
        require(msg.sender == _account, "Sender not authorized!");
        _;
    }

    modifier onlyAfter(uint256 _time) {
        require(block.timestamp >= _time, "Function was called too early!");
        _;
    }

    modifier costs(uint256 _amount) {
        require(msg.value >= _amount, "Not enough Ether provided!");
        _;
    }

    function forceOwnerChange(address _newOwner)
        public
        payable
        costs(200 ether)
    {
        owner = _newOwner;
    }

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

    function disown() public onlyBy(owner) onlyAfter(creationTime + 3 weeks) {
        delete owner;
    }
}
```

Output

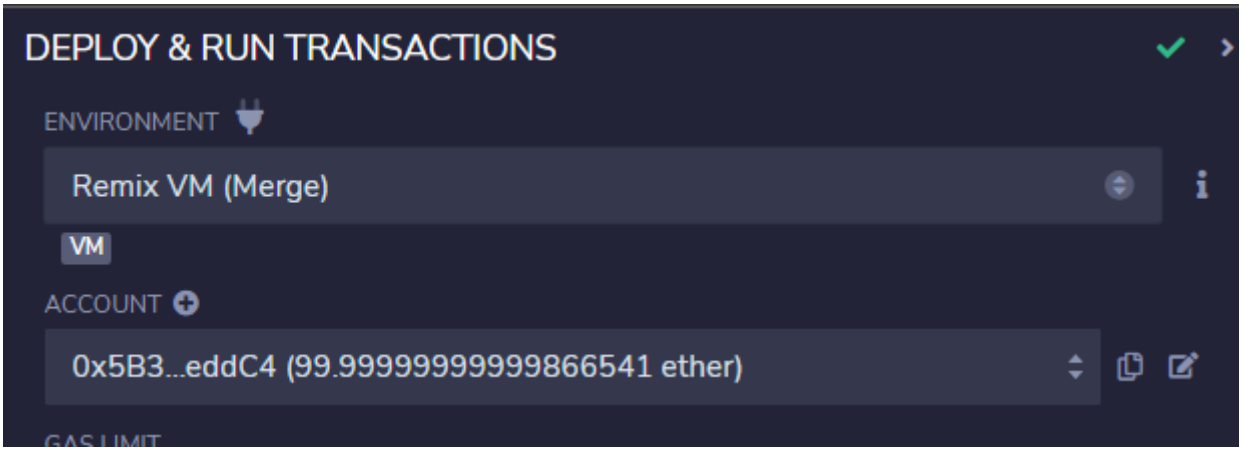


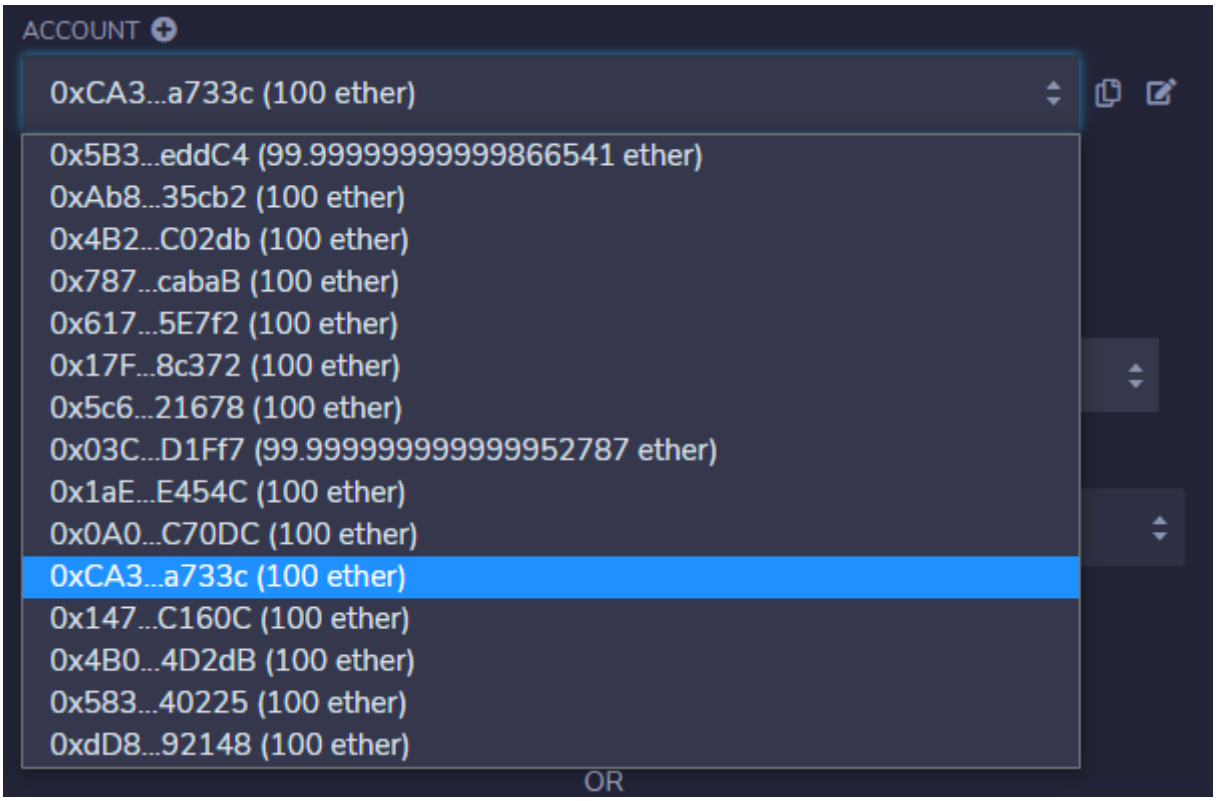
Flow of execution

Step 1-> Click on owner to create an owner object

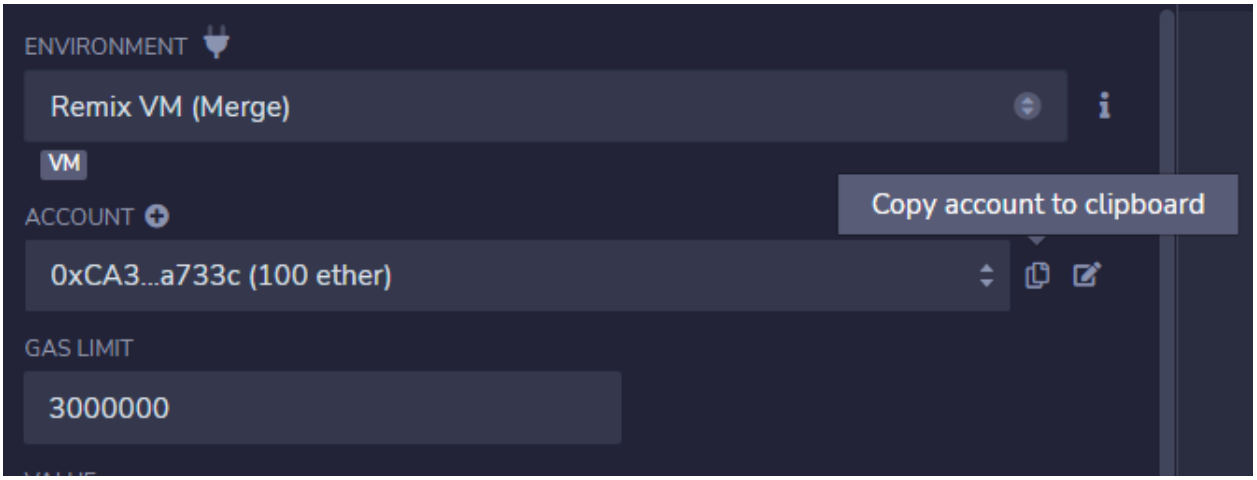
Step 2-> Click on lastOwnerChange button

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

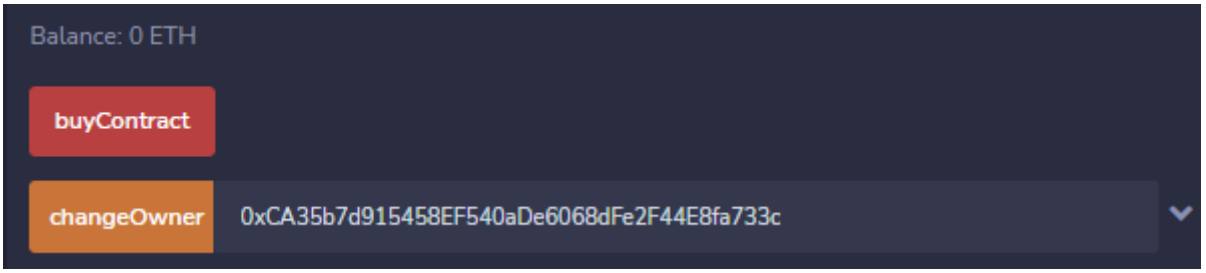




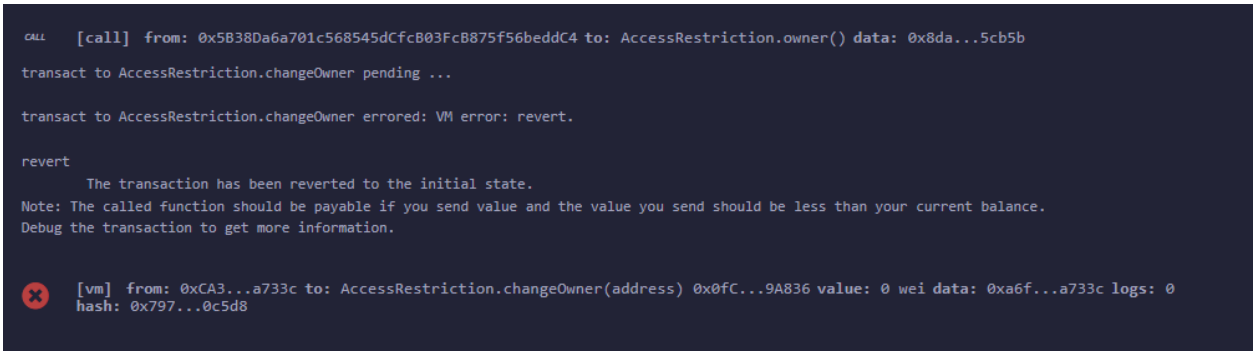
Step 4-> Copy the address


ENVIRONMENT
Remix VM (Merge)
VM
ACCOUNT
Copy account to clipboard
0xCA3...a733c (100 ether)
GAS LIMIT
3000000

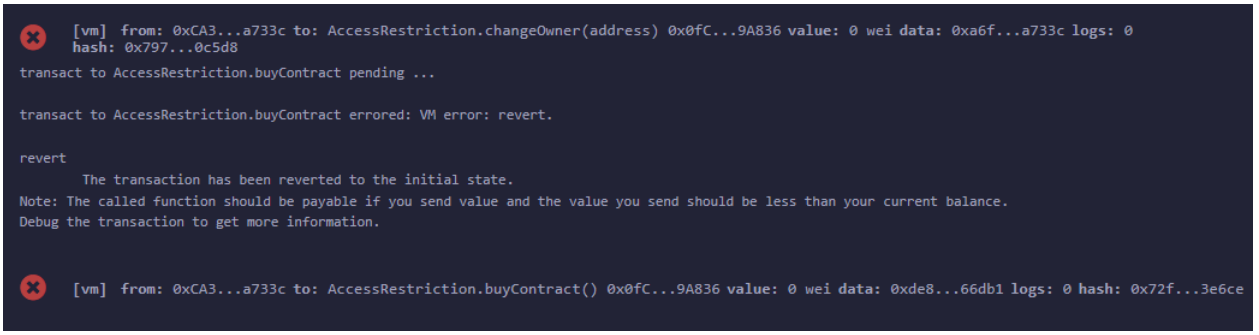
Step 5-> Paste the address in changeOwner input and click on changeOwner.



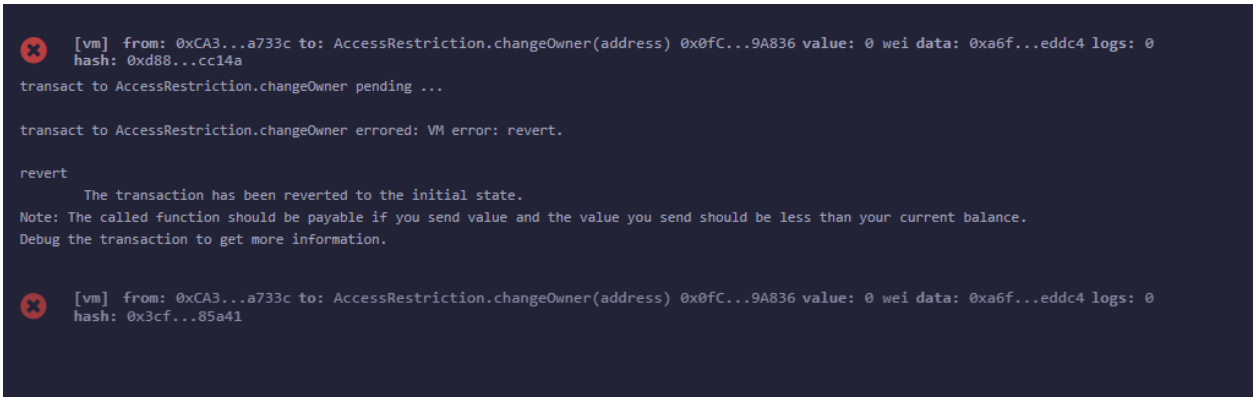
Step 6-> You should get an error as following



Step 7-> If you click on buycontract it should give an error as follows



Step 8-> Now, paste the actual address of the account in the changeowner input and click on changeowner

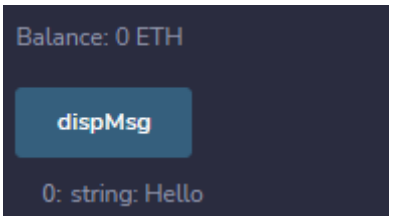


B) Contracts, Inheritance, Constructors, Abstract Contracts, Interfaces

1) Contracts

```
pragma solidity ^0.5.0;

contract Contract_demo {
    string message = "Hello";

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

Output

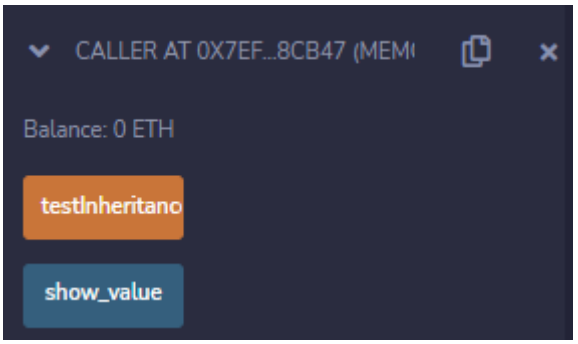


2) Inheritance

```
pragma solidity >=0.4.22 <0.6.0;

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();
    }
```

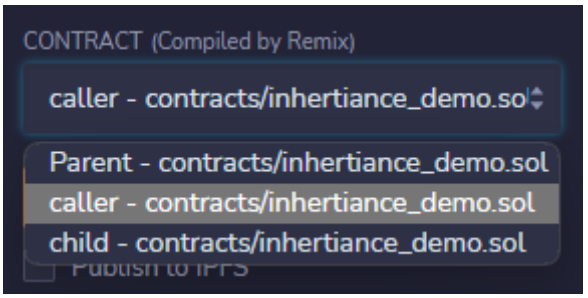
```
    function show_value() public view returns (uint256) {
        return cc.getValue();
    }
}
```

Outputs

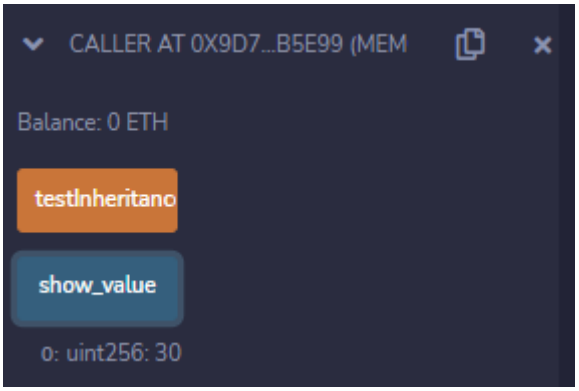


Flow of execution

Step 1-> Select caller contract to deploy in Contract and deploy



Step 2-> Click test Inheritance and then click on show_value to view value



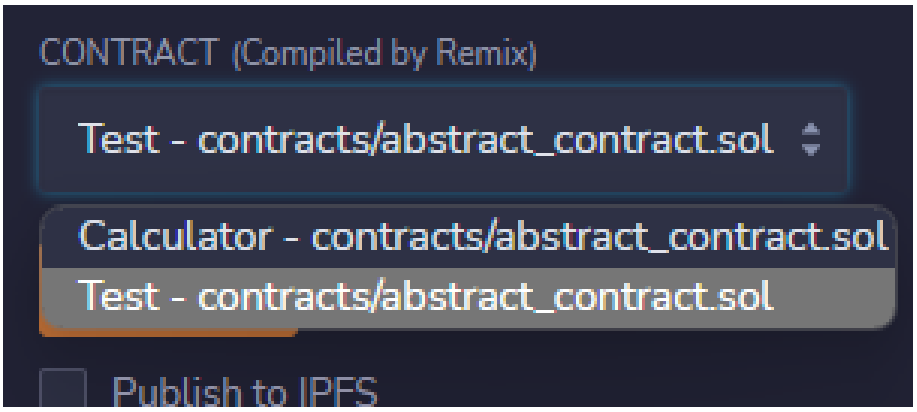
3) Abstract Contracts

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.17;

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;
    }
}
```

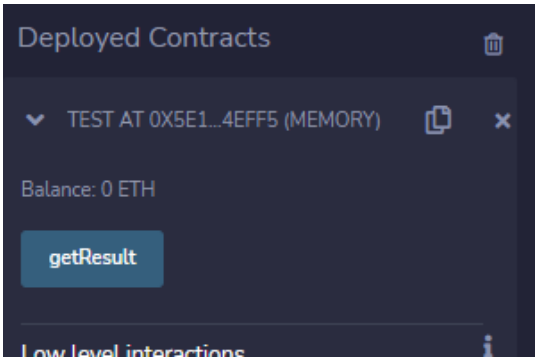
Outputs

Flow of execution

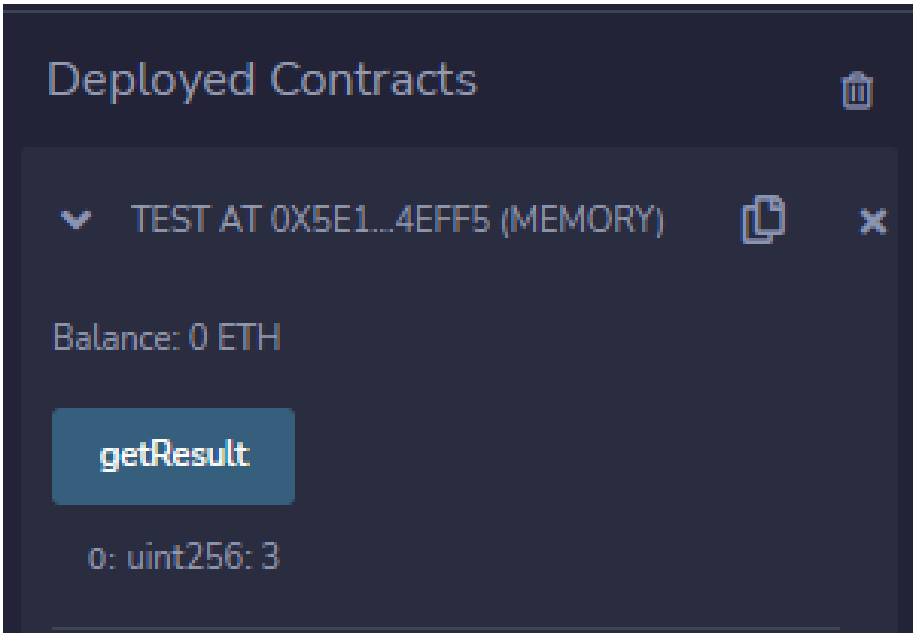
Step 1-> Select Test contract and deploy



Step 2-> The contact will deploy as below



Step 3-> Click on getResult to get sum of a+b



4) Constructors

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

// Creating a contract
contract constructorExample {
    string str;

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

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

Outputs

Flow of execution

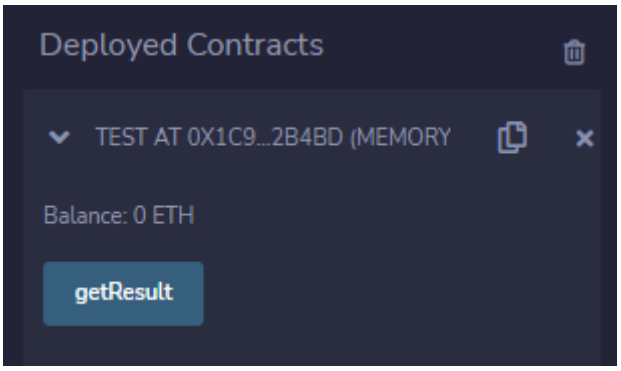
Step 1-> Click on getValue to print string

5) Interfaces

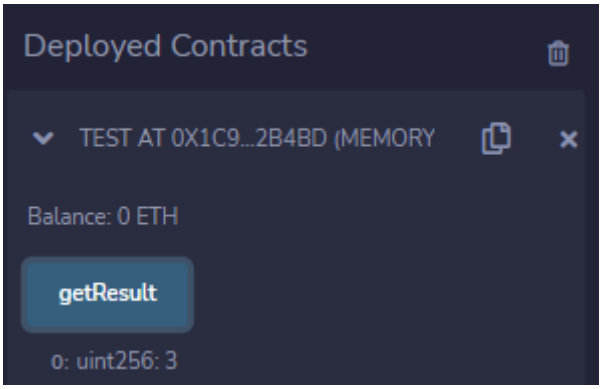
```
pragma solidity ^0.5.0;

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;
   }
}
```

Outputs

Flow of execution



Step 1-> Click on getResult to display sum



C) Libraries, Assembly, Events, Error handling.

1) Libraries

myLib.sol Code

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.7.0 <0.9.0;

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;
    }
}
```

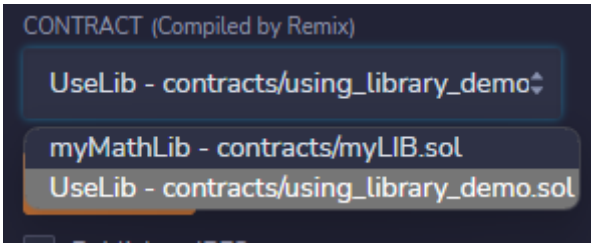
using_library.sol Code

```
// SPDX-License-Identifier: MIT
pragma solidity >=0.7.0 <0.9.0;

import "contracts/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);
    }
}
```

Outputs

Flow of execution

Step 1-> Change contract to UseLib and deploy.



Step 2-> The deployed contract should be same as below

Step 3-> Input values to both getexponent and getsum functions as below

Step 4-> Execute both functions. You will get below output

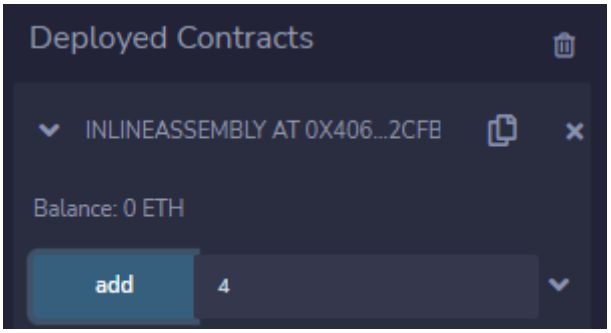
2) Assembly

```
// SPDX-License-Identifier: GPL-3.0
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)
        }
    }
}
```

Outputs

Flow of execution

Step 1-> Input a number for add function

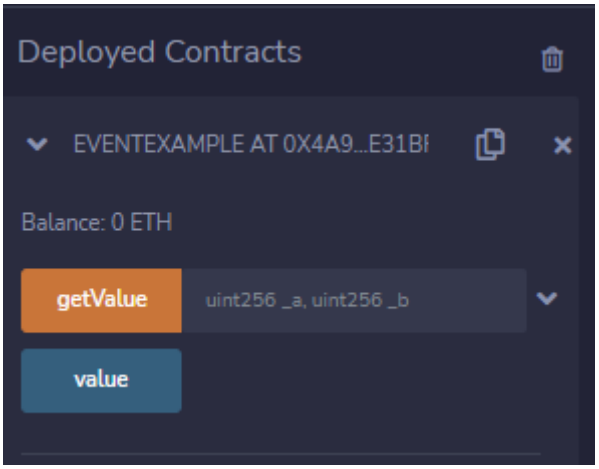


Step 2-> Click add to output sum

3) Events

```
// 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;
    }
}
```

Outputs



Flow of execution

Step 1-> Provide values to getValue function and click on it.

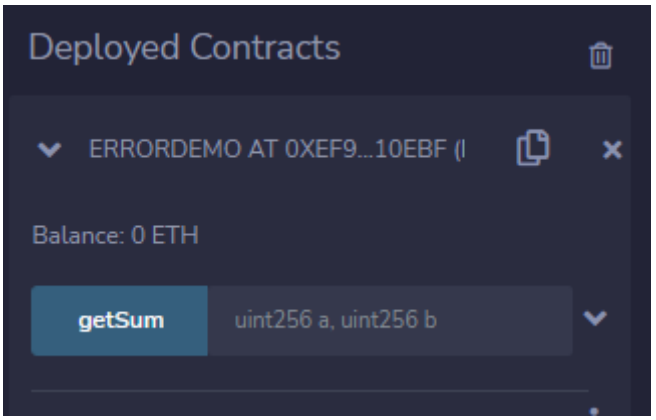
Step 2-> In the terminal check for logs

4) Error Handling

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.5.17;
```

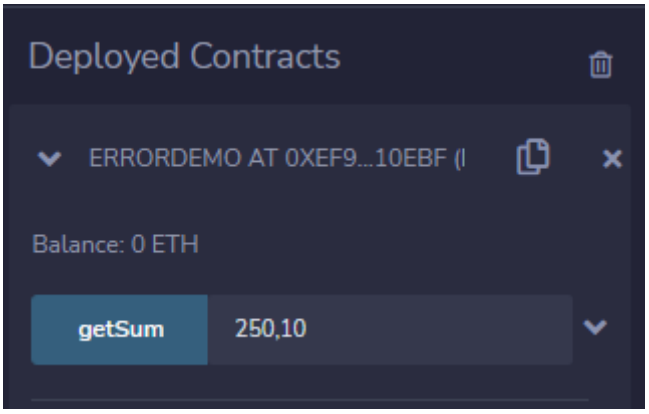
```
contract ErrorDemo {
    function getSum(uint256 a, uint256 b) public pure returns (uint256) {
        uint256 sum = a + b;
        // require(sum < 255, "Invalid");
        assert(sum<255);
        return sum;
    }
}
```

Output

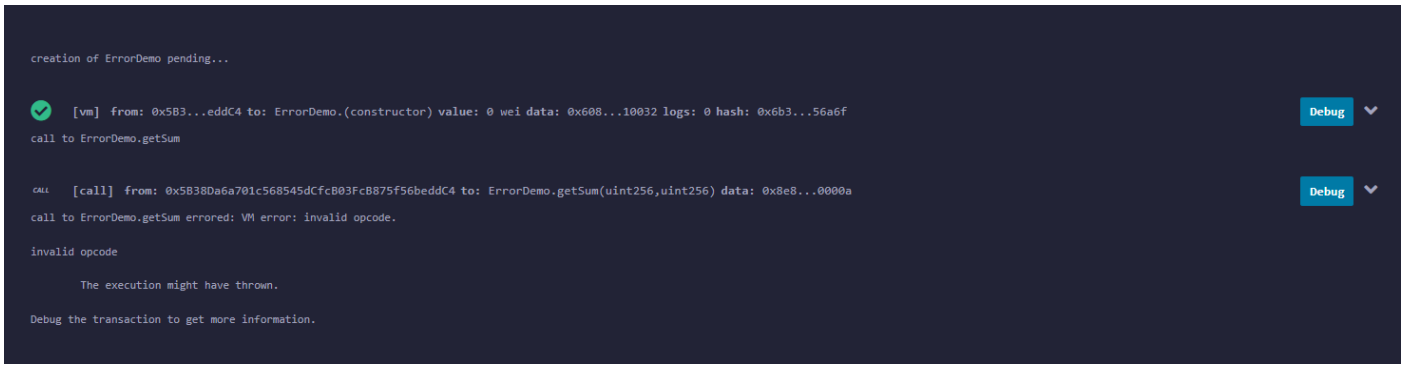


Flow of execution

Step 1-> Provide some values and press on getSum



Step 2-> Check terminal panel



PRACTICAL-5 WRITE A PROGRAM TO DEMONSTRATE MINING OF ETHER

```
const Web3 = require('web3');

const web3 = new Web3(new
Web3.providers.HttpProvider('http://127.0.0.1:7545')); // Replace with your
Ganache HTTP provider


async function mine() {
    const accounts = await web3.eth.getAccounts();
    const coinbaseacc1 = accounts[0];
    const coinbaseacc2 = accounts[1];
    console.log(`Mining ether on Ganache with coinbase address:
${coinbaseacc1}`);

    while (true) {
        try {
            await web3.eth.sendTransaction({
                from: coinbaseacc1,
                to: coinbaseacc2,
                value: 50,
            });
            console.log(`Mined a new block!`);
        } catch (err) {
            console.error(err);
        }
    }
}

mine();
```

Output

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac6>npm install web3
npm WARN deprecated source-map-url@0.4.1: See https://github.com/lydell/source-map-url#deprecated
npm WARN deprecated source-map-resolve@0.5.3: See https://github.com/lydell/source-map-resolve#deprecated
npm WARN deprecated urix@0.1.0: Please see https://github.com/lydell/urix#deprecated
npm WARN deprecated resolve-url@0.2.1: https://github.com/lydell/resolve-url#deprecated
npm WARN deprecated uglify-es@3.3.9: support for ECMAScript is superseded by `uglify-js` as of v3.13.0

added 651 packages, and audited 1097 packages in 1m

85 packages are looking for funding
  run `npm fund` for details

19 vulnerabilities (9 moderate, 10 high)

To address issues that do not require attention, run:
  npm audit fix

To address all issues (including breaking changes), run:
  npm audit fix --force

Run `npm audit` for details.
```

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac6>node ethermine.js
Mining ether on Ganache with coinbase address: 0xC050FE4d9bAc591d29538e2FD9cCA848B29489D0
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
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Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
Mined a new block!
```

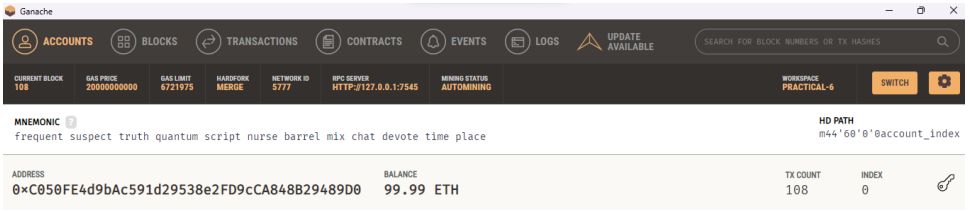

PRACTICAL-6 DEMONSTRATE THE RUNNING OF THE BLOCKCHAIN NODE

Step 1-> Create a folder named ethermine and a JSON file named genesis.json and write the following lines in it.

```
{
    "config": {
        "chainId": 3792,
        "homesteadBlock": 0,
        "eip150Block": 0,
        "eip155Block": 0,
        "eip158Block": 0
    },
    "difficulty": "2000",
    "gasLimit": "2100000",
    "alloc": {
        "0×0b6C4c81f58B8d692A7B46AD1e16a1147c25299F": {
            "balance": "9000000000000000000"
        }
    }
}
```

Step 2-> Run command **geth account new –datadir C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine testnet-blockchain**

```
C:\Users\Achsah>geth account new --datadir C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical
\ethermine
INFO [04-20|20:03:09.337] Maximum peer count                       ETH=50 LES=0 total=50
Your new account is locked with a password. Please give a password. Do not forget this password.
Password:
Repeat password:

Your new key was generated

Public address of the key:   0x77CB2BdBC0f1743bC73E92fla8blAB80BEDB35AE
Path of the secret key file: C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine\key
store\UTC--2023-04-20T14-33-26.959134300Z--77cb2bdbc0f1743bc73e92fla8blab80bedb35ae

- You can share your public address with anyone. Others need it to interact with you.
- You must NEVER share the secret key with anyone! The key controls access to your funds!
- You must BACKUP your key file! Without the key, it's impossible to access account funds!
- You must REMEMBER your password! Without the password, it's impossible to decrypt the key!
```

Step 3-> Run command **geth account new --datadir C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine**

```
C:\Users\Achsah>geth --datadir C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine i
nit C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine\genesis.json
Fatal: invalid genesis file: math/big: cannot unmarshal "\"3792\"" into a *big.Int

C:\Users\Achsah>geth --datadir C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine i
nit C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine\genesis.json
INFO [04-20|20:23:47.707] Maximum peer count                       ETH=50 LES=0 total=50
INFO [04-20|20:23:47.717] Set global gas cap                       cap=50,000,000
INFO [04-20|20:23:47.720] Using leveldb as the backing database
INFO [04-20|20:23:47.720] Allocated cache and file handles         database=C:\Users\Achsah\Document
s\MScIT\sem4\blockchain_practical\ethermine\geth\chaindata cache=16.00MiB handles=16
INFO [04-20|20:23:47.741] Using LevelDB as the backing database
INFO [04-20|20:23:47.765] Opened ancient database                  database=C:\Users\Achsah\Document
s\MScIT\sem4\blockchain_practical\ethermine\geth\chaindata\ancient/chain readonly=false
INFO [04-20|20:23:47.767] Writing custom genesis block
INFO [04-20|20:23:47.773] Persisted trie from memory database      nodes=1 size=147.00B time="636.4µ
```

Step 4-> Run command **geth --identity "localB" --http --http.port "8280" --http.corsdomain "*" --http.api "db,eth,net,web3" --datadir "C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine" --port "30303" --nodiscover --networkid 5777 console**. This command will enable geth console.

```
C:\Users\Achsah>geth --identity "localB" --http --http.port "8280" --http.corsdomain "*" --http.api
"db,eth,net,web3" --datadir "C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\ethermine" --
port "30303" --nodiscover --networkid 5777 console
INFO [04-20|20:29:41.383] Maximum peer count                       ETH=50 LES=0 total=50
INFO [04-20|20:29:41.389] Set global gas cap                       cap=50,000,000
INFO [04-20|20:29:41.392] Allocated trie memory caches             clean=154.00MiB dirty=256.00MiB
INFO [04-20|20:29:41.396] Using leveldb as the backing database
INFO [04-20|20:29:41.396] Allocated cache and file handles         database=C:\Users\Achsah\Document
s\MScIT\sem4\blockchain_practical\ethermine\geth\chaindata cache=512.00MiB handles=8192
INFO [04-20|20:29:41.412] Using LevelDB as the backing database
INFO [04-20|20:29:41.420] Opened ancient database                  database=C:\Users\Achsah\Document
s\MScIT\sem4\blockchain_practical\ethermine\geth\chaindata\ancient/chain readonly=false
INFO [04-20|20:29:41.423] Disk storage enabled for ethash caches   dir=C:\Users\Achsah\Documents\MSc
IT\sem4\blockchain_practical\ethermine\geth\ethash count=3
INFO [04-20|20:29:41.424] Disk storage enabled for ethash DAGs     dir=C:\Users\Achsah\AppData\Local
\Ethash count=2
INFO [04-20|20:29:41.426] Initialising Ethereum protocol           network=5777 dbversion=<nil>
INFO [04-20|20:29:41.427]
INFO [04-20|20:29:41.430] ------------------------------------------------------------------------
--------------------------------------------------------------------------------
```

Step 5-> Run the command **miner.setEtherbase('0xC050FE4d9bAc591d29538e2FD9cCA848B29489D0')** in the geth console

Step 6-> Run the command **miner.start()** to start mining

```
To exit, press ctrl-d or type exit
> INFO [04-20|20:29:45.021] Mapped network port                    proto=tcp extport=30303 intport=303
NP IGDv1-IP1"

>
> miner.setEtherbase('0xC050FE4d9bAc591d29538e2FD9cCA848B29489D0')
true
> miner.start()
INFO [04-20|20:34:45.673] Updated mining threads                 threads=4
INFO [04-20|20:34:45.674] Transaction pool price threshold updated price=1,000,000,000
null
> INFO [04-20|20:34:45.683] Commit new sealing work                number=1 sealhash=2e6f57..6db9c6 un
=0 fees=0 elapsed=7.571ms
INFO [04-20|20:34:45.686] Commit new sealing work                number=1 sealhash=2e6f57..6db9c6 uncl
 fees=0 elapsed=9.940ms
INFO [04-20|20:34:47.975] Generating DAG in progress             epoch=0 percentage=0 elapsed=1.636s
INFO [04-20|20:34:49.873] Generating DAG in progress             epoch=0 percentage=1 elapsed=3.534s
```

Step 7-> Below screenshots are the mining processes running on your local machine.

```
INFO [04-20|20:38:42.556] Generating DAG in progress               epoch=0 percentage=98 elapsed=3m5
6.216s
INFO [04-20|20:38:46.897] Generating DAG in progress               epoch=0 percentage=99 elapsed=4m0
.557s
INFO [04-20|20:38:46.901] Generated ethash verification cache      epoch=0 elapsed=4m0.561s
INFO [04-20|20:38:48.755] Successfully sealed new block            number=1 sealhash=2e6f57..6db9c6
hash=ccf3e9..10adff elapsed=4m3.071s
INFO [04-20|20:38:48.765] "🔨 mined potential block"                number=1 hash=ccf3e9..10adff
INFO [04-20|20:38:48.756] Commit new sealing work                  number=2 sealhash=cb4ba0..84eldd
uncles=0 txs=0 gas=0 fees=0 elapsed="504.9µs"
INFO [04-20|20:38:48.770] Commit new sealing work                  number=2 sealhash=cb4ba0..84eldd
uncles=0 txs=0 gas=0 fees=0 elapsed=14.488ms
INFO [04-20|20:38:49.389] Successfully sealed new block            number=2 sealhash=cb4ba0..84eldd
hash=4c7137..a04b67 elapsed=632.526ms
```

Step 8-> To stop the mining press **Ctrl+D**

```
INFO [04-20|20:39:21.980] Commit new sealing work                  number=17 sealhash=923697..cb5b4d
 uncles=0 txs=0 gas=0 fees=0 elapsed=117.201ms
INFO [04-20|20:39:21.984] Ethereum protocol stopped
INFO [04-20|20:39:22.046] Transaction pool stopped
INFO [04-20|20:39:22.047] Writing cached state to disk             block=16 hash=f09f60..c23237 root
=0c083a..cddeff
INFO [04-20|20:39:22.081] Persisted trie from memory database      nodes=3 size=408.00B time=1.5741m
s gcnodes=0 gcsize=0.00B gctime=0s livenodes=31 livesize=3.83KiB
INFO [04-20|20:39:22.087] Writing cached state to disk             block=15 hash=d73b6d..f4a2cf root
=903c8d..6038c0
INFO [04-20|20:39:22.089] Persisted trie from memory database      nodes=2 size=262.00B time=0s
  gcnodes=0 gcsize=0.00B gctime=0s livenodes=29 livesize=3.58KiB
INFO [04-20|20:39:22.098] Writing snapshot state to disk           root=d56154..abe42a
INFO [04-20|20:39:22.130] Persisted trie from memory database      nodes=0 size=0.00B   time=0s
  gcnodes=0 gcsize=0.00B gctime=0s livenodes=29 livesize=3.58KiB
INFO [04-20|20:39:22.135] Writing clean trie cache to disk         path=C:\Users\Achsah\Documents\MS
cIT\sem4\blockchain_practical\ethermine\geth\triecache threads=4
INFO [04-20|20:39:22.323] Persisted the clean trie cache           path=C:\Users\Achsah\Documents\MS
cIT\sem4\blockchain_practical\ethermine\geth\triecache elapsed=143.729ms
INFO [04-20|20:39:22.490] Blockchain stopped
```

PRACTICAL-7 CREATE YOUR OWN BLOCKCHAIN AND DEMONSTRATE ITS USE

Create a javascript folder with the following code in any folder of your choice.

JavaScript Code

```
const SHA256 = require("crypto-js/sha256");
class Block {
  constructor(index, timestamp, data, previousHash = "") {
    this.index = index;
    this.timestamp = timestamp;
    this.data = data;
    this.previousHash = previousHash;
    this.hash = this.calculateHash();
  }

  calculateHash() {
    return SHA256(
      this.index +
        this.previousHash +
        this.timestamp +
        JSON.stringify(this.data)
    ).toString();
  }
}

class Blockchain {
  constructor() {
    this.chain = [this.createGenesisBlock()];
  }

  createGenesisBlock() {
    return new Block(0, "21/04/2023", "Genesis Block", "0");
  }

  getLatestBlock() {
    return this.chain[this.chain.length - 1];
  }

  addBlock(newBlock) {
    newBlock.previousHash = this.getLatestBlock().hash;
```

```
    newBlock.hash = newBlock.calculateHash();
    this.chain.push(newBlock);
  }

  isChainValid() {
    for (let i = 1; i < this.chain.length; i++) {
      const currentBlock = this.chain[i];
      const previousBlock = this.chain[i - 1];

      if (currentBlock.hash !== currentBlock.calculateHash()) {
        return false;
      }

      if (currentBlock.previousHash !== previousBlock.hash) {
        return false;
      }
    }

    return true;
  }
}

//Blockchain Implementation

let myCoin = new Blockchain();
myCoin.addBlock(new Block(1, "22/04/2023", { amount: 4 }));
myCoin.addBlock(new Block(2, "22/04/2023", { amount: 8 }));
//console.log('Is blockchain valid? ' + myCoin.isChainValid());
console.log(JSON.stringify(myCoin, null, 4));
```

Output

Flow of execution

Step 1-> Make sure you have installed nodejs in your system

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac9>node -v
v14.17.5
```

Step 2-> We need **crypto –js** node module to make our own blockchain. So install it as following

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac9>npm install crypto-js
npm WARN @react-native-community/geolocation@2.0.2 requires a peer of react@* but none is in
npm WARN @react-native-community/geolocation@2.0.2 requires a peer of react-native@* but non
elf.
npm WARN Achsah No description
npm WARN Achsah No repository field.
npm WARN Achsah No license field.

+ crypto-js@4.1.1
added 1 package from 1 contributor and audited 161 packages in 1.383s

5 packages are looking for funding
  run `npm fund` for details

found 8 vulnerabilities (2 moderate, 6 high)
  run `npm audit fix` to fix them, or `npm audit` for details
```

Step 3-> Run the above code in command line using command: node main.js

```
C:\Users\Achsah\Documents\MScIT\sem4\blockchain_practical\prac9>node main.js
{
    "chain": [
        {
            "index": 0,
            "timestamp": "21/04/2023",
            "data": "Genesis Block",
            "previousHash": "0",
            "hash": "32dd10ad547e8e81623998bdffa2d8e9e3863fd252f5c3ea1cbea4ae26f54b1c"
        },
        {
            "index": 1,
            "timestamp": "22/04/2023",
            "data": {
                "amount": 4
            },
            "previousHash": "32dd10ad547e8e81623998bdffa2d8e9e3863fd252f5c3ea1cbea4ae26f54b1c",
            "hash": "eb78a02763c37cfc2b1c4e331df64ca34733e47e017ef320d92ae89b148de5a3"
        },
        {
            "index": 2,
            "timestamp": "22/04/2023",
            "data": {
                "amount": 8
            },
            "previousHash": "eb78a02763c37cfc2b1c4e331df64ca34733e47e017ef320d92ae89b148de5a3",
            "hash": "946b1f95d7761daee4f0c5d33a671c003ef5682333fd9a2d182a73104e9aea88"
        }
    ]
}
```