GURU NANAK COLLEGE OF ARTS, SCIENCE & COMMERCE

G.T.B NAGAR, MUMBAI-400037

DEPARTMENT OF INFORMATION TECHNOLOGY

MSc(IT) PART I SEMESTER II

Practical Journal IN

BLOCKCHAIN

Submitted by
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SEAT NO- 2510261

Academic Year
2021-22

GURU NANAK COLLEGE OF ARTS, SCIENCE & COMMERCE
G.T.B NAGAR, MUMBAI-400037

DEPARTMENT OF INFORMATION TECHNOLOGY

CERTIFICATE

This is to certify that Mr. / Miss. _____Aniket HInukale_____ of MSc(IT) Part-I Semester II Seat No. 2510261 has successfully completed the practical's in the subject of **BLOCKCHAIN** as per the requirement of University Of Mumbai in part fulfillment for the completion of Degree of Master of Science (INFORMATION TECHNOLOGY). It is also to certify that this is the original work of the candidate done during the academic year 2021-2022.

Subject In-Charge **In-Charge,MSc(IT)**

Date **College Seal** **Examiner**

BLOCKCHAIN

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Practical 1

Write the following programs for Blockchain in Python :

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

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

→

```
# import libraries
import hashlib
import random
import string
import json
import binascii
import numpy as np
import pandas as pd
import pylab as pl
import logging
import datetime
import collections
 pip install pycryptodome
 # following imports are required by PKI
import Crypto
import Crypto.Random
from Crypto.Hash import  SHA
from Crypto.PublicKey import RSA
from Crypto.Signature import PKCS1_v1_5


import binascii
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')


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):
     if self.sender == "Genesis":
       identity = "Genesis"
     else:
       identity = 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)
signature = t.sign_transaction()
print (signature)
```

Output:

BLOCKCHAIN

BLOCK CHAIN pract 1 (A) .ipynb

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```
[2] # import libraries
    import hashlib
    import random
    import string
    import json
    import binascii
    import numpy as np
    import pandas as pd
    import pylab as pl
    import logging
    import datetime
    import collections
```

```
[3] pip install pycryptodome
```

```
Collecting pycryptodome
  Downloading https://files.pythonhosted.org/packages/ad/16/9627ab0493894a11c68e46000dbcc82f578c8ff06bc2980dcd016aea9bd3/pycryptodome-3.10.1-cp35-abi3-manylinux2
     |████████████████████████████████| 1.9MB 4.8MB/s
Installing collected packages: pycryptodome
Successfully installed pycryptodome-3.10.1
```

BLOCK CHAIN pract 1 (A) .ipynb

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```
[5] import Crypto
    import Crypto.Random
    from Crypto.Hash import SHA
    from Crypto.PublicKey import RSA
    from Crypto.Signature import PKCS1_v1_5

    import binascii
```

```
import binascii
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')

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

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BLOCK CHAIN pract 1 (A) .ipynb

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```
    self.value = value
    self.time = datetime.datetime.now()
  def to_dict(self):
   if self.sender == "Genesis":
     identity = "Genesis"
   else:
     identity = 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)

signature = t.sign_transaction()
print (signature)
```

```
656f0e37653d1bc3c538de01595a9c7e4a603e03740d1ed450f1ea32f568663cebff7ec9757cdd35d4f8b1a3524341528a48674981265b68a477c06d57271d6250f45d6e3946a4f8166fff50251956fa
```

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Practical 2

Write the following programs for Blockchain in Python :

(I).Create multiple transactions and display them .

(II). Create a blockchain, a genesis block and execute it .

→

```
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 (' ----')

transactions = []

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

t1 = Transaction(
  Dinesh,
  Ramesh.identity,
  15.0
)

t1.sign_transaction()
transactions.append(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)
t5 = Transaction(
  Vijay,
  Seema.identity,
  7.0
)
t5.sign_transaction()
transactions.append(t5)
t6 = Transaction(
  Ramesh,
  Seema.identity,
  3.0
)
t6.sign_transaction()
transactions.append(t6)
t7 = Transaction(
```

```
  Seema,
  Dinesh.identity,
  8.0
)
t7.sign_transaction()
transactions.append(t7)
t8 = Transaction(
  Seema,
  Ramesh.identity,
  1.0
)
t8.sign_transaction()
transactions.append(t8)
t9 = Transaction(
  Vijay,
  Dinesh.identity,
  5.0
)
t9.sign_transaction()
transactions.append(t9)
t10 = Transaction(
  Vijay,
  Ramesh.identity,
  3.0
)
t10.sign_transaction()
transactions.append(t10)

for transaction in transactions:
  display_transaction (transaction)
  print ('.....')

class Block:
  def __init_(self):
    self.verified_transactions = []
```

```
    self.previous_block_hash = ""
    self.Nonce = ""

last_block_hash = ""

Dinesh = Client()

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

block0 = Block()

block0.previous_block_hash = None
Nonce = None

block0.verified_transactions.append (t0)

digest = hash (block0)
last_block_hash = digest

TPCoins = []

def dump_blockchain (self):
  print ("Number of blocks in the chain: " + str(len (self)))
  for x in range (len(TPCoins)):
    block_temp = TPCoins[x]
    print ("block # " + str(x))
    for transaction in block_temp.verified_transactions:
      display_transaction (transaction)
      print ('--------------')
    print ('====================================')
```

TPCoins.append (block0)

dump_blockchain(TPCoins)

Output:

```
[10] 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 ('-----')
```

```
[11] transactions = []
```

```
[12] Dinesh = Client()
     Ramesh = Client()
     Seema = Client()
     Vijay = Client()
```

```
[13] t1 = Transaction(
        Dinesh,
        Ramesh.identity,
        15.0
     )
```

```
[15] t1.sign_transaction()
     transactions.append(t1)
```

```
[16] 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)
     t5 = Transaction(
        Vijay,
        Seema.identity,
        7.0
     )
     t5.sign_transaction()
     transactions.append(t5)
     t6 = Transaction(
        Ramesh,
        Seema.identity,
        3.0
     )
     t6.sign_transaction()
     transactions.append(t6)
     t7 = Transaction(
        Seema,
        Dinesh.identity,
        8.0
     )
     t7.sign_transaction()
     transactions.append(t7)
     t8 = Transaction(
        Seema,
        Ramesh.identity,
        1.0
     )
     t8.sign_transaction()
     transactions.append(t8)
     t9 = Transaction(
        Vijay,
        Dinesh.identity,
        5.0
     )
```

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```
[16] t8.sign_transaction()
     transactions.append(t8)
     t9 = Transaction(
        Vijay,
        Dinesh.identity,
        5.0
     )
     t9.sign_transaction()
     transactions.append(t9)
     t10 = Transaction(
        Vijay,
        Ramesh.identity,
        3.0
     )
     t10.sign_transaction()
     transactions.append(t10)
```


```
[17] for transaction in transactions:
        display_transaction (transaction)
        print ('---------------')
```

```
sender: 30819f300d06092a864886f70d010101050003818d0030818                f2feecba6d
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00b5c36acef717c85079d5
-----
value: 15.0
-----
time: 2021-05-05 07:37:46.751762
-----
---------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181 0096e3e436b160bf2feecba6d
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00b5c36acef717c85079d5
-----
value: 15.0
-----
time: 2021-05-05 07:37:46.751762
-----
---------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181 0096e3e436b160bf2feecba6d
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00a3b073014e3d9a1e3353
-----
value: 6.0
-----
time: 2021-05-05 07:38:17.042489
-----
---------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181 00b5c36acef717c85079d5eb8
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00967bf6965c7e25f7c711
-----
value: 2.0
-----
time: 2021-05-05 07:38:17.044049
-----
---------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181 00a3b073014e3d9a1e335365f
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00b5c36acef717c85079d5
-----
value: 4.0
-----
time: 2021-05-05 07:38:17.045503
-----
---------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181 00967bf6965c7e25f7c711a30
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181 00a3b073014e3d9a1e3353
-----
value: 7.0
-----
```

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

```
[19] last_block_hash = ""
```

BLOCKCHAIN

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```
[20] Dinesh = Client()
```

```
[21] t0 = Transaction (
        "Genesis",
        Dinesh.identity,
        500.0
     )
```

```
[22] block0 = Block()
```

```
[23] block0.previous_block_hash = None
     Nonce = None
```

```
[24] block0.verified_transactions.append (t0)
```

```
[25] digest = hash (block0)
     last_block_hash = digest
```

```
[26] def dump_blockchain (self):
        print ("Number of blocks in the chain: " + str(len (self)))
        for x in range (len(TPCoins)):
           block_temp = TPCoins[x]
           print ("block # " + str(x))
           for transaction in block_temp.verified_transactions:
              display_transaction (transaction)
              print ('--------------')
           print ('====================================')
```

```
[27] TPCoins = []
```

```
[30] def dump_blockchain (self):
        print ("Number of blocks in the chain: " + str(len (self)))
        for x in range (len(TPCoins)):
           block_temp = TPCoins[x]
           print ("block # " + str(x))
           for transaction in block_temp.verified_transactions:
              display_transaction (transaction)
              print ('--------------')
           print ('====================================')
```

```
[31] TPCoins.append (block0)
```

```
[32] dump_blockchain(TPCoins)
```

```
Number of blocks in the chain: 1
block # 0
sender: Genesis
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100df7d100622cc76eab161
-----
value: 500.0
-----
time: 2021-05-05 07:41:01.767902
-----
--------------
====================================
```

Practical 3

Write the following programs for Blockchain in Python :

(I).Create a mining function and test it .

(II).Add blocks to the miner and dump the blockchain .

→

```
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 ("after " + str(i) + " iterations found nonce: "+ digest)
      return digest



last_transaction_index = 0


block = Block()
for i in range(3):
   temp_transaction = transactions[last_transaction_index]
   # validate transaction
   # if valid
   block.verified_transactions.append (temp_transaction)
   last_transaction_index += 1 mine ("test message", 2)



block.previous_block_hash = last_block_hash
block.Nonce = mine (block, 2)
digest = hash (block)
TPCoins.append (block)
last_block_hash = digest
```

```
# Miner 2 adds a block
block = Block()

for i in range(3):
  temp_transaction = transactions[last_transaction_index]
  # validate transaction
  # if valid
  block.verified_transactions.append (temp_transaction)
  last_transaction_index += 1
block.previous_block_hash = last_block_hash
block.Nonce = mine(block, 2)
digest = hash (block)
TPCoins.append (block)
last_block_hash = digest
# Miner 3 adds a block
block = Block()

for i in range(3):
  temp_transaction = transactions[last_transaction_index]
  #display_transaction (temp_transaction)
  # validate transaction
  # if valid
  block.verified_transactions.append (temp_transaction)
  last_transaction_index += 1

block.previous_block_hash = last_block_hash
block.Nonce = mine (block, 2)
digest = hash (block)

TPCoins.append (block)
last_block_hash = digest
dump_blockchain(TPCoins)
```

Full Output:

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```
# import libraries
import hashlib
import random
import string
import json
import binascii
import numpy as np
import pandas as pd
import pylab as pl
import logging
import datetime
import collections
```

```
[ ] pip install pycryptodome
```

```
Collecting pycryptodome
  Downloading https://files.pythonhosted.org/packages/ad/16/9627ab0493894a11c68e46000dbcc
     |████████████████████████████████| 1.9MB 5.6MB/s
Installing collected packages: pycryptodome
Successfully installed pycryptodome-3.10.1
```

```
[ ] # following imports are required by PKI
    import Crypto
    import Crypto.Random
    from Crypto.Hash import SHA
    from Crypto.PublicKey import RSA
    from Crypto.Signature import PKCS1_v1_5
```

```
[ ] import binascii
    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')


    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):
            if self.sender == "Genesis":
                identity = "Genesis"
            else:
                identity = 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)
```

```
[ ] signature = t.sign_transaction()
    print (signature)
```

```
251f28f6f523733739979611b404c755210b5b6a70f28d5eb3e3049f7dceea873e472f0df41a55152c71bb6f5
```

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

BLOCKCHAIN

```
[ ]  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 ('-----')
```

```
[ ]  transactions = []
```

```
[ ]  Dinesh = Client()
     Ramesh = Client()
     Seema = Client()
     Vijay = Client()
```

```
[ ]  t1 = Transaction(
        Dinesh,
        Ramesh.identity,
        15.0
     )
```

```
[ ]  t1.sign_transaction()
     transactions.append(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)
     t5 = Transaction(
        Vijay,
        Seema.identity,
        7.0
     )
     t5.sign_transaction()
     transactions.append(t5)
     t6 = Transaction(
        Ramesh,
        Seema.identity,
        3.0
     )
     t6.sign_transaction()
     transactions.append(t6)
     t7 = Transaction(
        Seema,
        Dinesh.identity,
        8.0
     )
     t7.sign_transaction()
     transactions.append(t7)
     t8 = Transaction(
        Seema,
        Ramesh.identity,
        1.0
     )
     t8.sign_transaction()
     transactions.append(t8)
     t9 = Transaction(
        Vijay,
        Dinesh.identity,
        5.0
     )
     t9.sign_transaction()
     transactions.append(t9)
     t10 = Transaction(
        Vijay,
        Ramesh.identity,
        3.0
     )
     t10.sign_transaction()
     transactions.append(t10)
```

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```
[ ] for transaction in transactions:
       display_transaction (transaction)
       print ('--------------')
```

```
sender: 30819f300d06092a864886f70d010101050003818d00308189028181008f5e89df98216eb2c1e4713
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac49
-----
value: 15.0
-----
time: 2021-04-08 06:10:52.172517
-----
--------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181008f5e89df98216eb2c1e4713
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86
-----
value: 6.0
-----
time: 2021-04-08 06:11:40.567785
-----
--------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac492d1
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100d776af73071682cb494e
-----
value: 2.0
-----
time: 2021-04-08 06:11:40.569278
-----
--------------
sender: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86384
-----
recipient: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac49
-----
value: 4.0
-----
time: 2021-04-08 06:11:40.570658
-----
--------------
sender: 30819f300d06092a864886f70d010101050003818d0030818902818100d776af73071682cb494e752
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86
-----
value: 7.0
-----
time: 2021-04-08 06:11:40.572173
-----
--------------
sender: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac492d1
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86
-----
value: 3.0
-----
```

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

```
[ ] last_block_hash = ""
```

```
[ ] Dinesh = Client()
```

```
[ ] t0 = Transaction (
       "Genesis",
       Dinesh.identity,
       500.0
    )
```

```
[ ] block0 = Block()
```

```
[ ] block0.previous_block_hash = None
    Nonce = None
```

```
[ ] block0.verified_transactions.append (t0)
```

BLOCKCHAIN

+ Code + Text | Copy to Drive | Connect | Editing

```
[ ] digest = hash (block0)
    last_block_hash = digest
```

```
[ ] def dump_blockchain (self):
       print ("Number of blocks in the chain: " + str(len (self)))
       for x in range (len(TPCoins)):
          block_temp = TPCoins[x]
          print ("block # " + str(x))
          for transaction in block_temp.verified_transactions:
             display_transaction (transaction)
             print ('--------------')
          print ('====================================')
```

```
[ ] TPCoins = []
```

```
[ ] def dump_blockchain (self):
       print ("Number of blocks in the chain: " + str(len (self)))
       for x in range (len(TPCoins)):
          block_temp = TPCoins[x]
          print ("block # " + str(x))
          for transaction in block_temp.verified_transactions:
             display_transaction (transaction)
             print ('--------------')
          print ('====================================')
```

```
[ ] TPCoins.append (block0)
```

```
[ ] dump_blockchain(TPCoins)
```

```
Number of blocks in the chain: 1
block # 0
sender: Genesis
-----
recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100bae5c5a46a1591af94c0
-----
value: 500.0
-----
time: 2021-04-08 06:16:28.464142
-----
--------------
====================================
```

```
[ ] 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 ("after " + str(i) + " iterations found nonce: "+ digest)
          return digest
```

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

```
'938c72d2197fa6c2294df7bc8cea6be98769aad888e3cfa15558c78469394ebd'
```

```
[ ] last_transaction_index = 0
```

```
[ ] block = Block()
    for i in range(3):
       temp_transaction = transactions[last_transaction_index]
       # validate transaction
       # if valid
       block.verified_transactions.append (temp_transaction)
       last_transaction_index += 1

    block.previous_block_hash = last_block_hash
    block.Nonce = mine (block, 2)
    digest = hash (block)
    TPCoins.append (block)
    last_block_hash = digest
```

BLOCKCHAIN

+ Code + Text | Copy to Drive | Connect | Editing

```
[ ] # Miner 2 adds a block
    block = Block()

    for i in range(3):
       temp_transaction = transactions[last_transaction_index]
       # validate transaction
       # if valid
       block.verified_transactions.append (temp_transaction)
       last_transaction_index += 1
    block.previous_block_hash = last_block_hash
    block.Nonce = mine(block, 2)
    digest = hash (block)
    TPCoins.append (block)
    last_block_hash = digest
    # Miner 3 adds a block
    block = Block()

    for i in range(3):
       temp_transaction = transactions[last_transaction_index]
       #display_transaction (temp_transaction)
       # validate transaction
       # if valid
       block.verified_transactions.append (temp_transaction)
       last_transaction_index += 1

    block.previous_block_hash = last_block_hash
    block.Nonce = mine (block, 2)
    digest = hash (block)

    TPCoins.append (block)
    last_block_hash = digest
```

```
[ ] dump_blockchain(TPCoins)
```

```
    time: 2021-04-08 06:11:40.570658
    -----
    --------------
    sender: 30819f300d06092a864886f70d010101050003818d0030818902818100d776af73071682cb494e752
    -----
    recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86
    -----
    value: 7.0
    -----
    time: 2021-04-08 06:11:40.572173
    -----
    --------------
    sender: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac492d1
    -----
    recipient: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86
    -----
    value: 3.0
    -----
    time: 2021-04-08 06:11:40.574036
    -----
    --------------
    ====================================
    block # 3
    sender: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86384
    -----
    recipient: 30819f300d06092a864886f70d010101050003818d00308189028181008f5e89df98216eb2c1e4
    -----
    value: 8.0
    -----
    time: 2021-04-08 06:11:40.575310
    -----
    --------------
    sender: 30819f300d06092a864886f70d010101050003818d0030818902818100a0b9b51bb0c81cbbad86384
    -----
    recipient: 30819f300d06092a864886f70d010101050003818d00308189028181008 2e40f44f9cef42cac49
    -----
    value: 1.0
    -----
    time: 2021-04-08 06:11:40.576645
    -----
    --------------
    sender: 30819f300d06092a864886f70d010101050003818d0030818902818100d776af73071682cb494e752
    -----
    recipient: 30819f300d06092a864886f70d010101050003818d00308189028181008f5e89df98216eb2c1e4
    -----
    value: 5.0
    -----
    time: 2021-04-08 06:11:40.578007
    -----
    --------------
    ====================================
```

Practical 4

Implement and demonstrate the use of the following in Solidity:

(I).Varaible

(II).Operators

(III).Loops

(IV).Decision Making

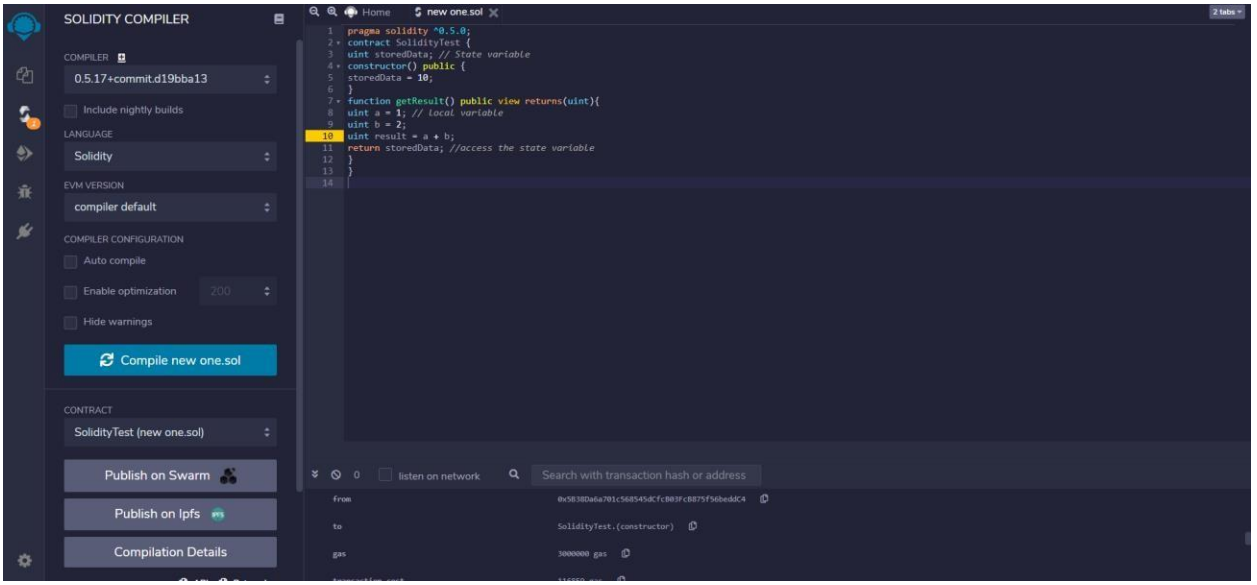
(V).Strings

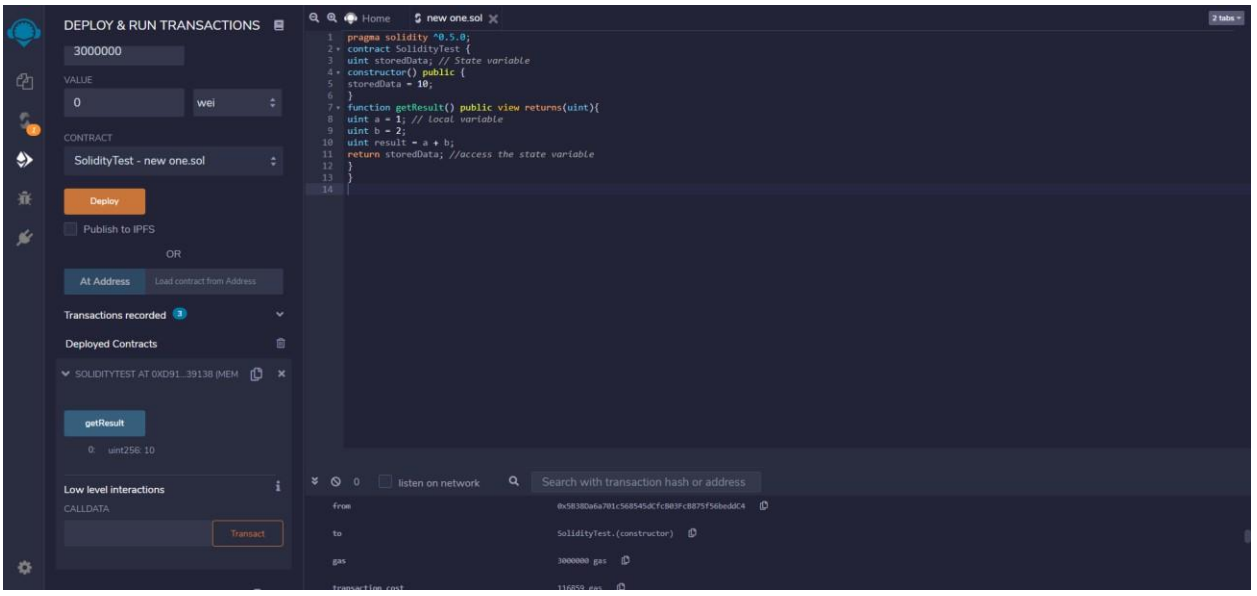
(I).Variable

```
pragma solidity ^0.5.0;
contract SolidityTest {
uint storedData; // State variable
constructor() public {
storedData = 10;
}
function getResult() public view returns(uint){
uint a = 1; // local variable
uint b = 2;
uint result = a + b;
return storedData; //access the state variable
}
}
```

Output:

BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile new one.sol
CONTRACT
SolidityTest (new one.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
Home
new one.sol
2 tabs
pragma solidity ^0.5.0;
contract SolidityTest {
uint storedData; // State variable
constructor() public {
storedData = 10;
}
function getResult() public view returns(uint){
uint a = 1; // local variable
uint b = 2;
uint result = a + b;
return storedData; //access the state variable
}
}
listen on network
Search with transaction hash or address
from
0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to
SolidityTest.(constructor)
gas
3000000 gas


DEPLOY & RUN TRANSACTIONS
3000000
VALUE
0
wei
CONTRACT
SolidityTest - new one.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
Deployed Contracts
SOLIDITYTEST AT 0XD91...39138 (MEM
getResult
0: uint256: 10
Low level interactions
CALLDATA
Transact
Home
new one.sol
2 tabs
pragma solidity ^0.5.0;
contract SolidityTest {
uint storedData; // State variable
constructor() public {
storedData = 10;
}
function getResult() public view returns(uint){
uint a = 1; // local variable
uint b = 2;
uint result = a + b;
return storedData; //access the state variable
}
}
listen on network
Search with transaction hash or address
from
0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to
SolidityTest.(constructor)
gas
3000000 gas

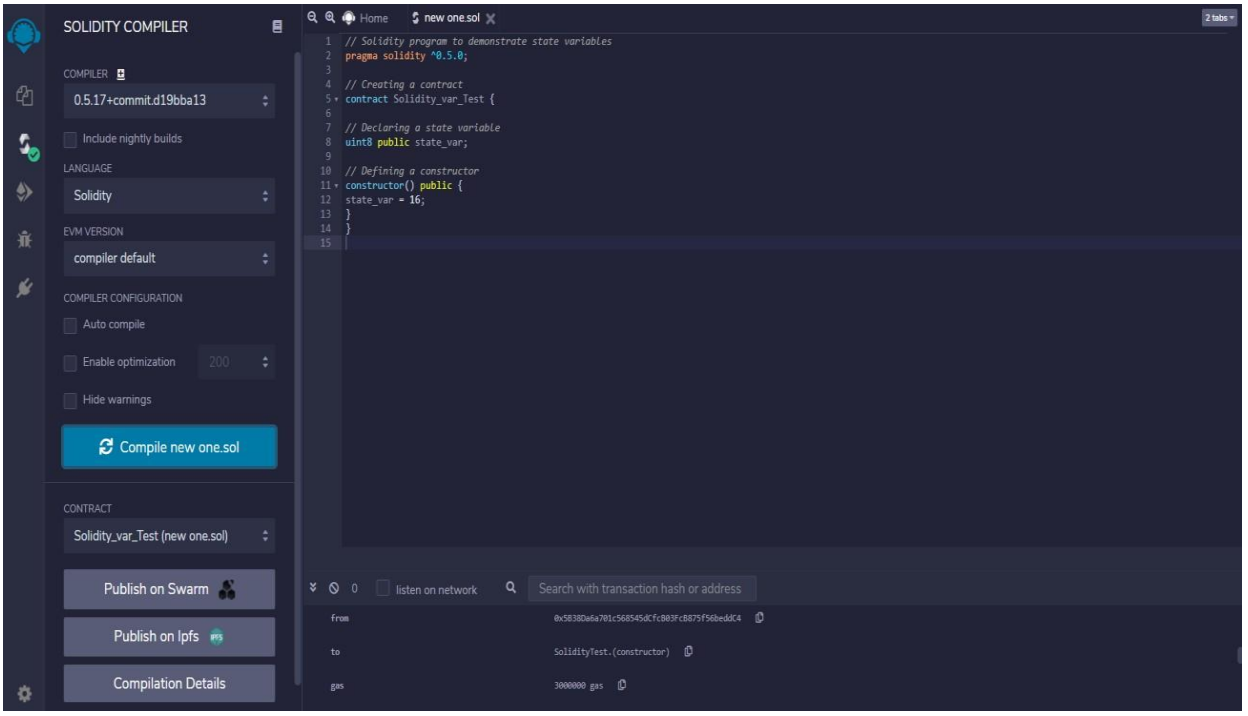
```
// Solidity program to demonstrate state variables
pragma solidity ^0.5.0;

// Creating a contract
contract Solidity_var_Test {

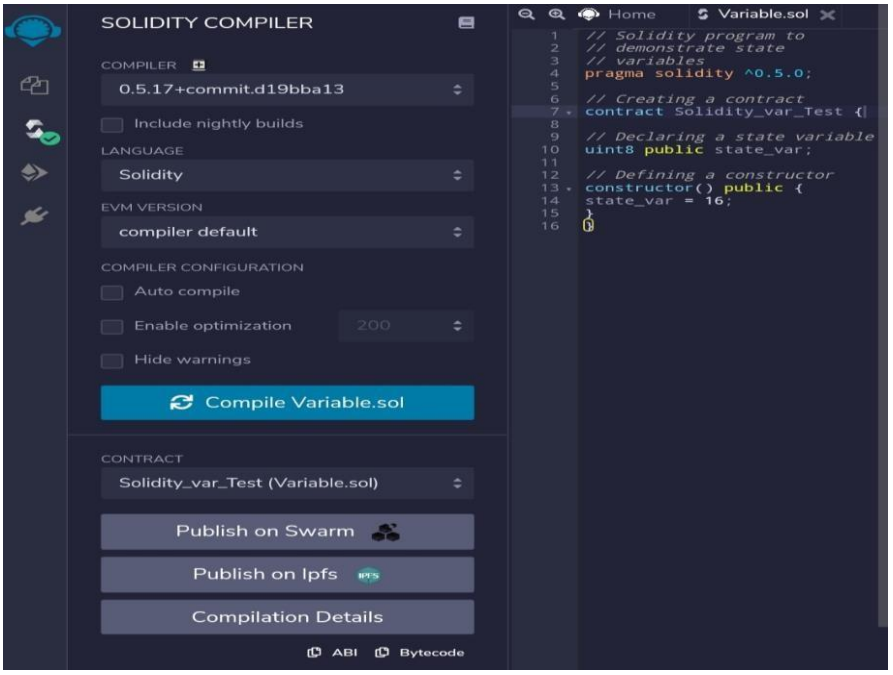
// Declaring a state variable
uint8 public state_var;

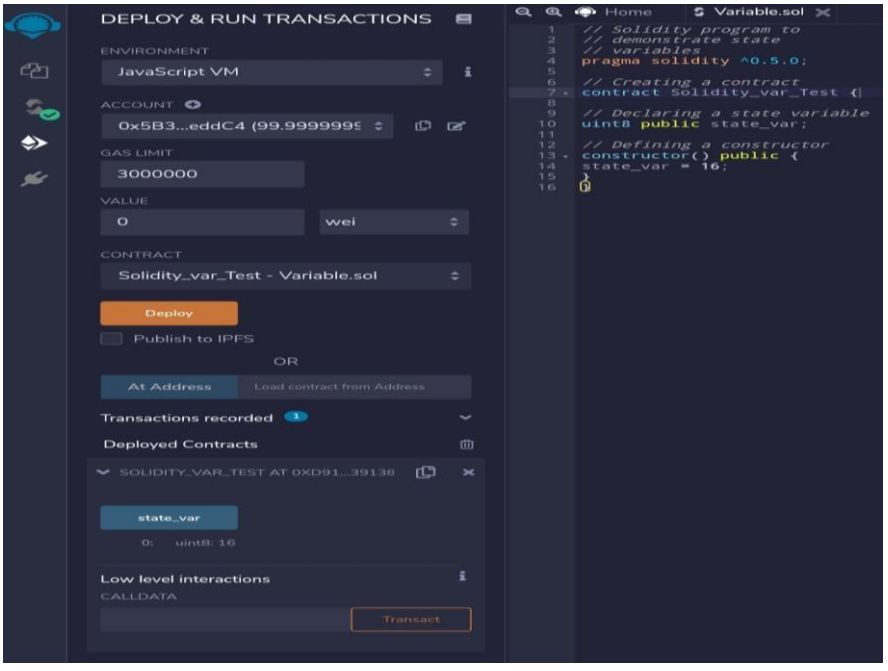
// Defining a constructor
constructor() public {
state_var = 16;
}
}
```

Output:



BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile Variable.sol
CONTRACT
Solidity_var_Test (Variable.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Home
Variable.sol
// Solidity program to
// demonstrate state
// variables
pragma solidity ^0.5.0;
// Creating a contract
contract Solidity_var_Test {
// Declaring a state variable
uint8 public state_var;
// Defining a constructor
constructor() public {
state_var = 16;
}


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
Solidity_var_Test - Variable.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
Deployed Contracts
SOLIDITY_VAR_TEST AT 0XD91...39138
state_var
0: uint8: 16
Low level interactions
CALLDATA
Transact
Home
Variable.sol
// Solidity program to
// demonstrate state
// variables
pragma solidity ^0.5.0;
// Creating a contract
contract Solidity_var_Test {
// Declaring a state variable
uint8 public state_var;
// Defining a constructor
constructor() public {
state_var = 16;
}

// **Solidity program to show Global variables**

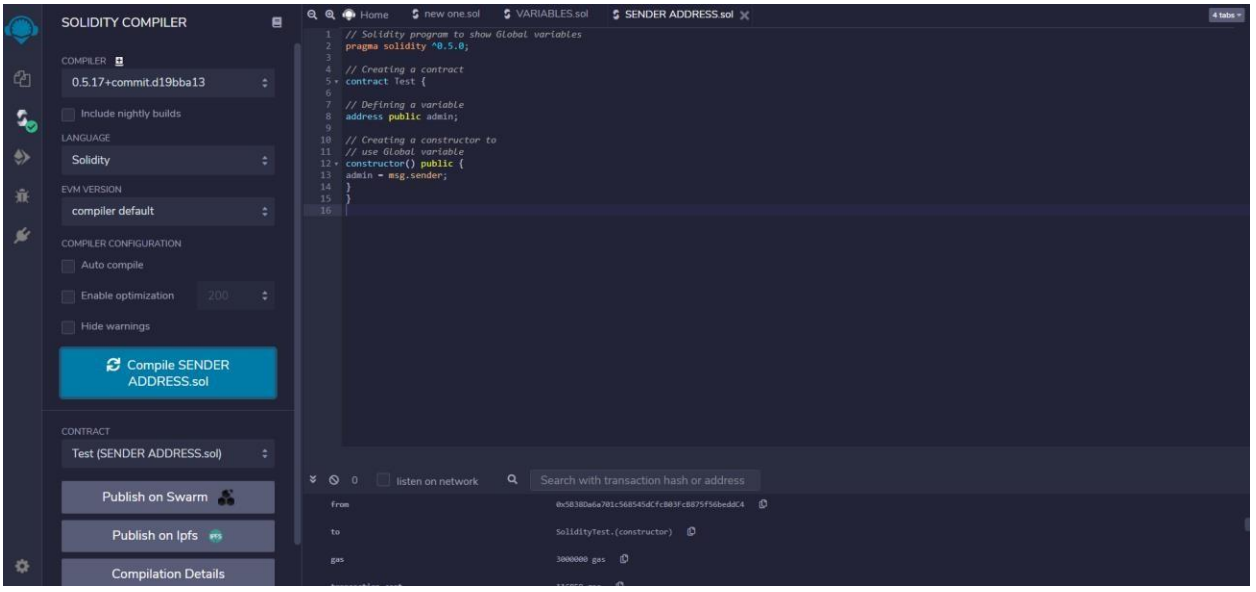
```
pragma solidity ^0.5.0;

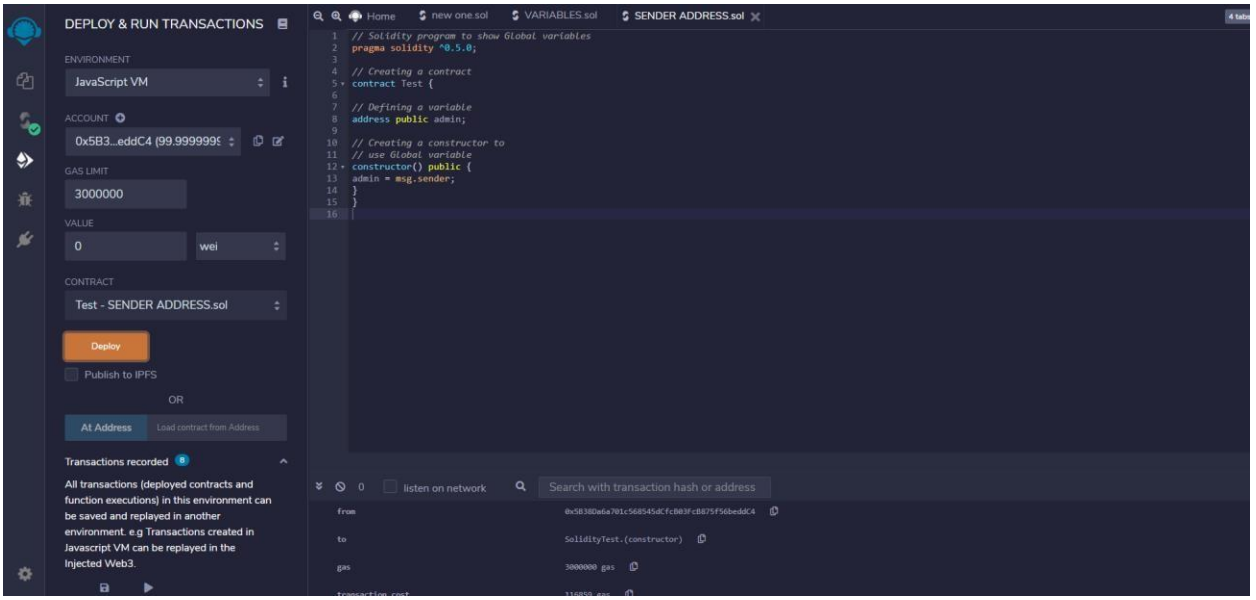
// Creating a contract
contract Test {

// Defining a variable
address public admin;

// Creating a constructor to
// use Global variable
constructor() public {
admin = msg.sender;
}
}
```

Output:





(II).Operators

```
// Solidity contract to demonstrate Arithematic Operator
pragma solidity ^0.5.0;

// Creating a contract
contract SolidityTest {

// Initializing variables
uint16 public a = 20;
uint16 public b = 10;
// Initializing a variable with sum
uint public sum = a + b;

// Initializing a variable with the difference
uint public diff = a - b;

// Initializing a variable with product
uint public mul = a * b;

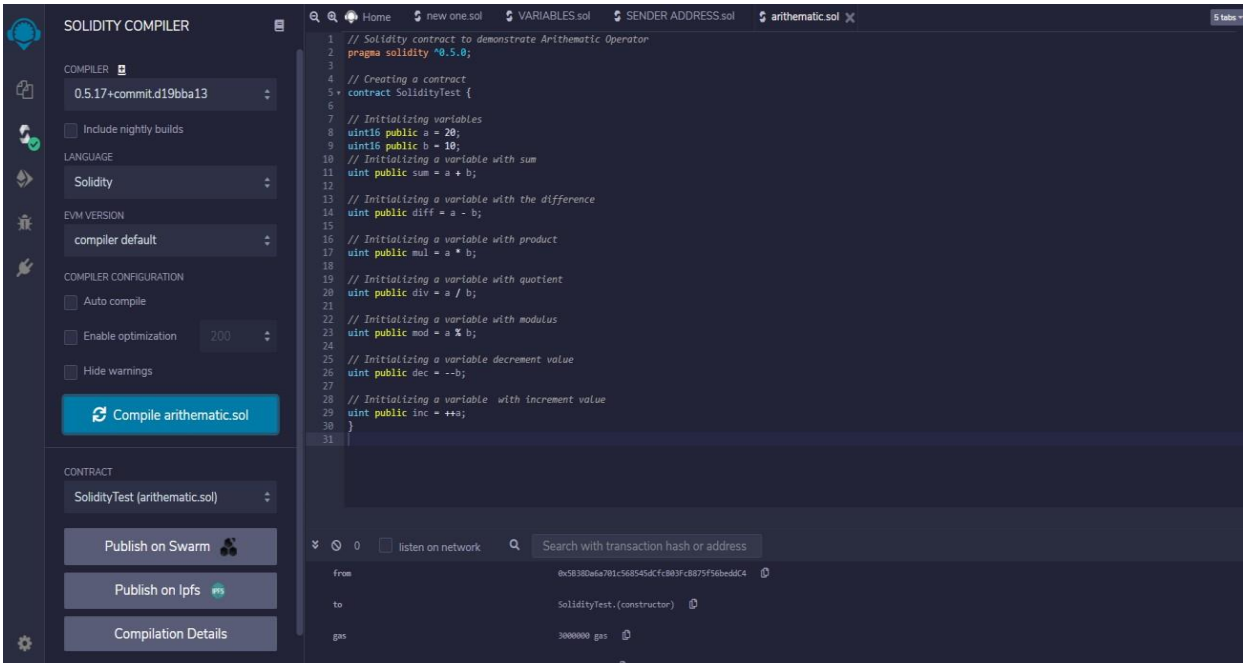
// Initializing a variable with quotient
uint public div = a / b;
```

```
// Initializing a variable with modulus
uint public mod = a % b;

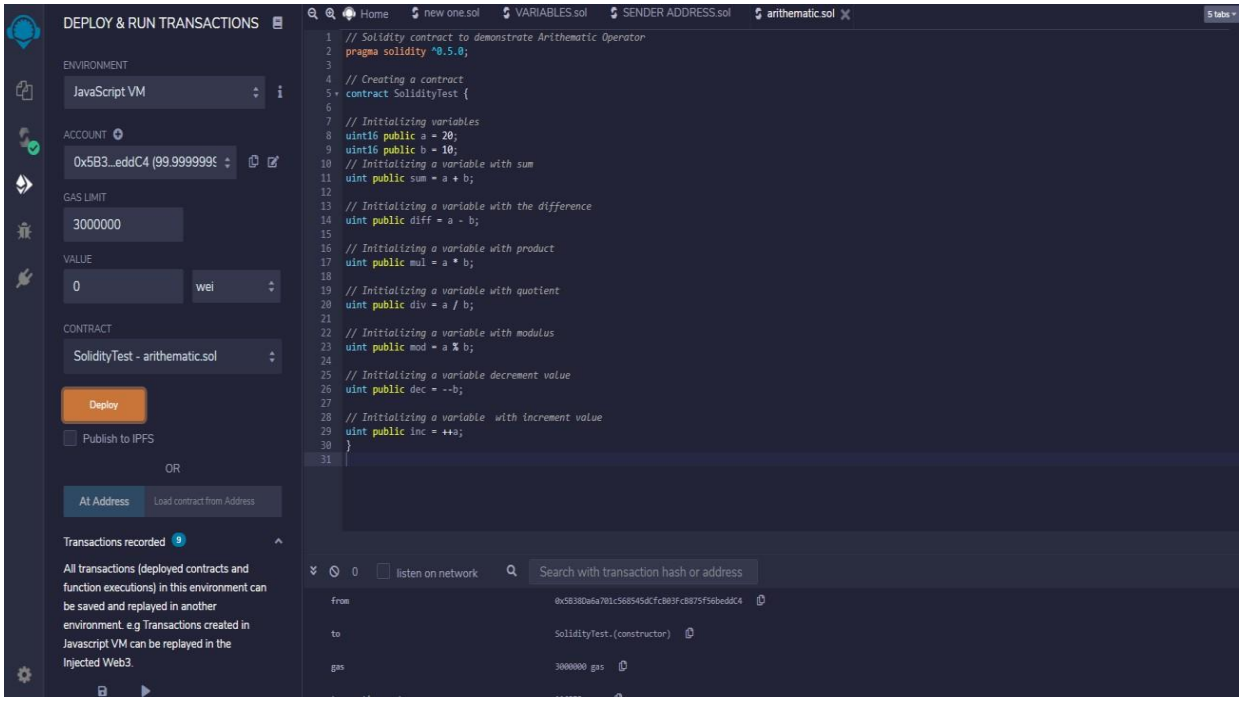
// Initializing a variable decrement value
uint public dec = --b;

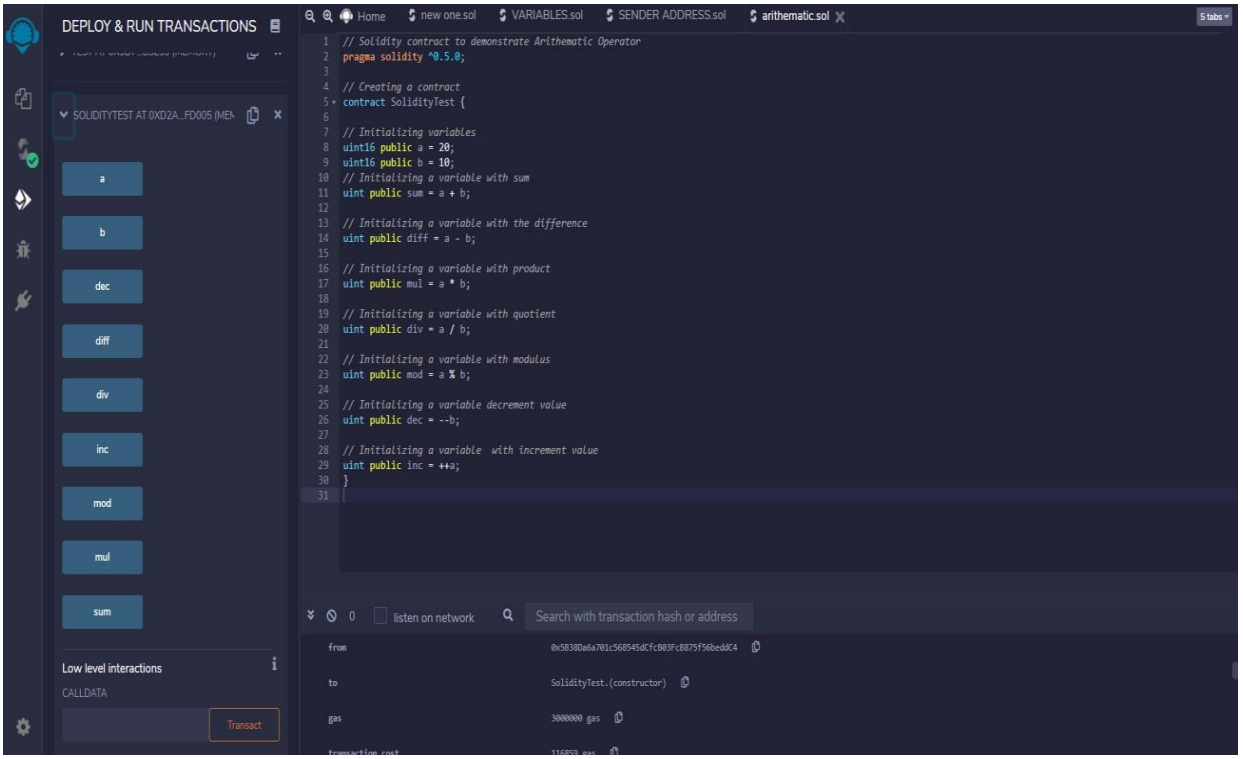
// Initializing a variable with increment value
uint public inc = ++a;
}
```

Output:



BLOCKCHAIN


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
SolidityTest - arithematic.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
All transactions (deployed contracts and function executions) in this environment can be saved and replayed in another environment. e.g Transactions created in Javascript VM can be replayed in the Injected Web3.
Home
new one.sol
VARIABLES.sol
SENDER ADDRESS.sol
arithematic.sol
5 tabs
// Solidity contract to demonstrate Arithematic Operator
pragma solidity ^0.5.0;
// Creating a contract
contract SolidityTest {
// Initializing variables
uint16 public a = 20;
uint16 public b = 10;
// Initializing a variable with sum
uint public sum = a + b;
// Initializing a variable with the difference
uint public diff = a - b;
// Initializing a variable with product
uint public mul = a * b;
// Initializing a variable with quotient
uint public div = a / b;
// Initializing a variable with modulus
uint public mod = a % b;
// Initializing a variable decrement value
uint public dec = --b;
// Initializing a variable with increment value
uint public inc = ++a;
}
listen on network
Search with transaction hash or address
from
0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to
SolidityTest.(constructor)
gas
3000000 gas


DEPLOY & RUN TRANSACTIONS
SOLIDITYTEST AT 0XD2A...FD005 (MEM
a
b
dec
diff
div
inc
mod
mul
sum
Low level interactions
CALLDATA
Transact
Home
new one.sol
VARIABLES.sol
SENDER ADDRESS.sol
arithematic.sol
5 tabs
// Solidity contract to demonstrate Arithematic Operator
pragma solidity ^0.5.0;
// Creating a contract
contract SolidityTest {
// Initializing variables
uint16 public a = 20;
uint16 public b = 10;
// Initializing a variable with sum
uint public sum = a + b;
// Initializing a variable with the difference
uint public diff = a - b;
// Initializing a variable with product
uint public mul = a * b;
// Initializing a variable with quotient
uint public div = a / b;
// Initializing a variable with modulus
uint public mod = a % b;
// Initializing a variable decrement value
uint public dec = --b;
// Initializing a variable with increment value
uint public inc = ++a;
}
listen on network
Search with transaction hash or address
from
0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to
SolidityTest.(constructor)
gas
3000000 gas

(IV).Decision Making

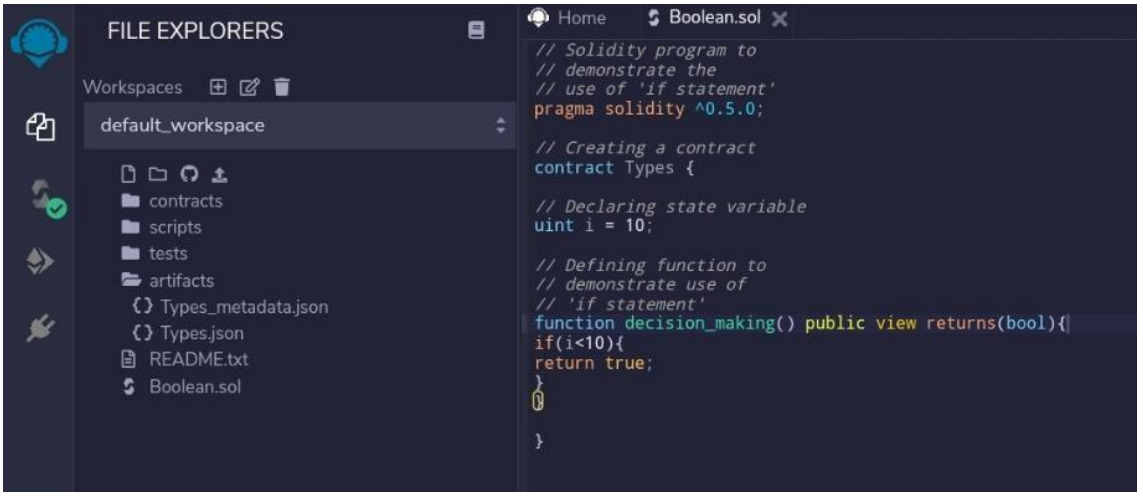
// **Solidity program to demonstrate the use of 'if statement'**

```
pragma solidity ^0.5.0;

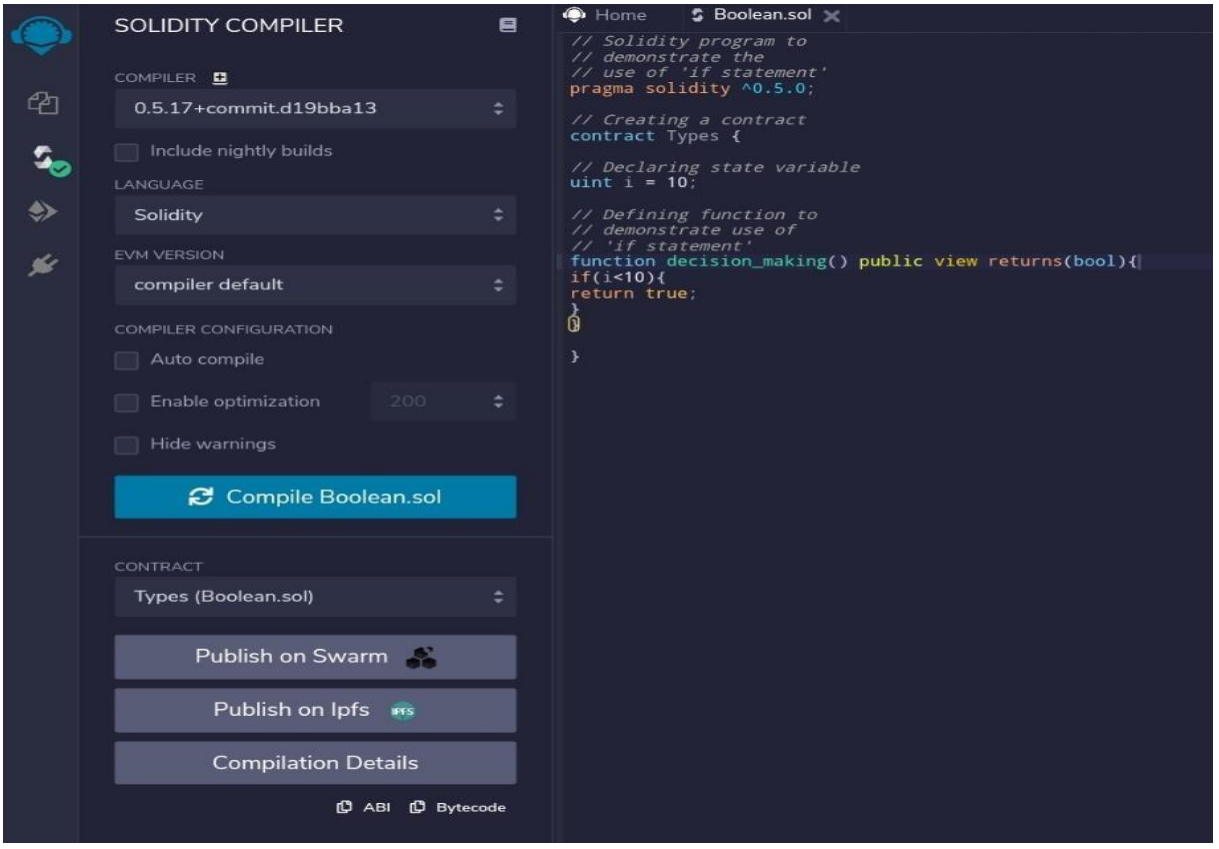
// Creating a contract
contract Types {
// Declaring state variable
uint i = 10;

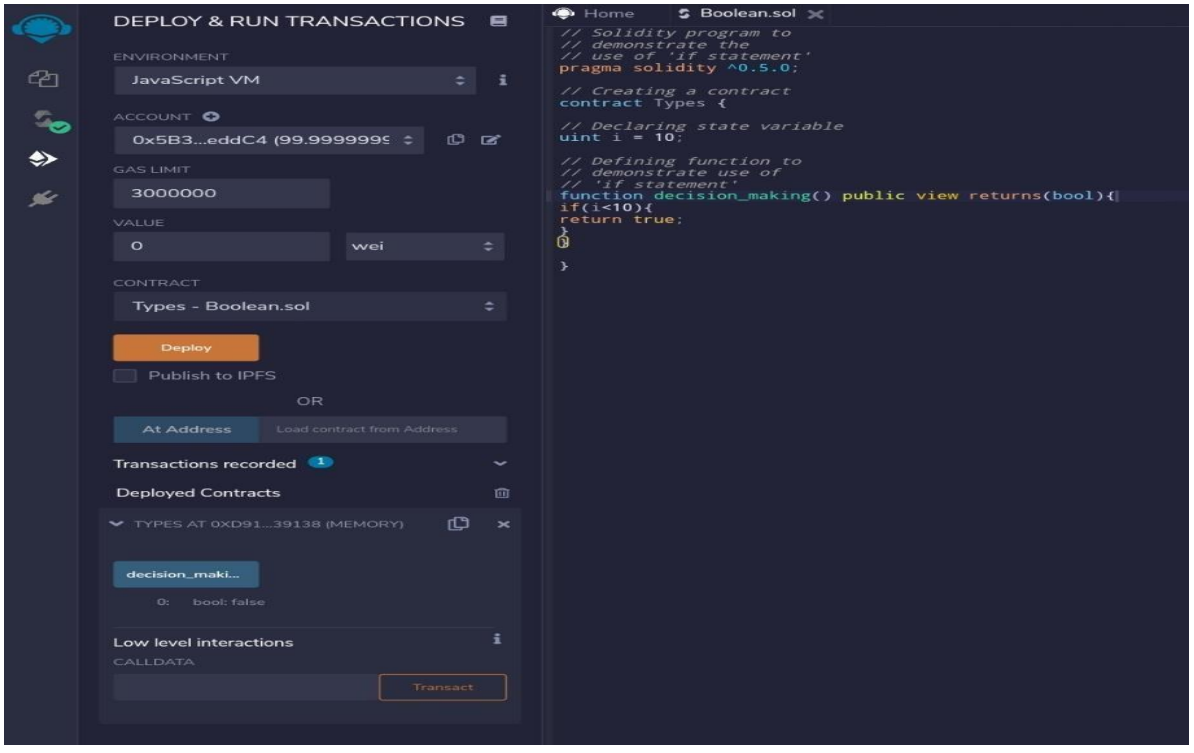
// Defining function to demonstrate use of 'if statement'
function decision_making() public view returns(bool){
if(i<10){
return true;
}
}
}
```

Output:



BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile Boolean.sol
CONTRACT
Types (Boolean.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Home
Boolean.sol
// Solidity program to
// demonstrate the
// use of 'if statement'
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variable
uint i = 10;
// Defining function to
// demonstrate use of
// 'if statement'
function decision_making() public view returns(bool){
if(i<10){
return true;
}
}


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
Types - Boolean.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
1
Deployed Contracts
TYPES AT 0XD91...39138 (MEMORY)
decision_maki...
0: bool: false
Low level interactions
CALLDATA
Transact
Home
Boolean.sol
// Solidity program to
// demonstrate the
// use of 'if statement'
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variable
uint i = 10;
// Defining function to
// demonstrate use of
// 'if statement'
function decision_making() public view returns(bool){
if(i<10){
return true;
}
}

```
// Solidity program to demonstrate the use of 'if...else' statement
pragma solidity ^0.5.0;

// Creating a contract
contract Types {

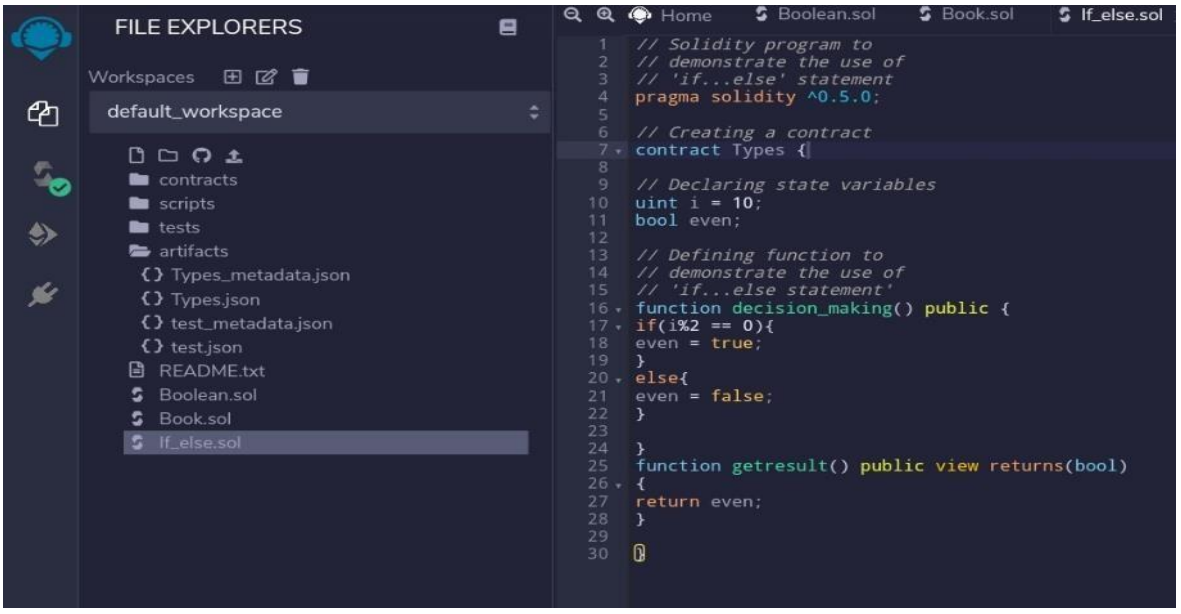
// Declaring state variables
uint i = 10;
bool even;

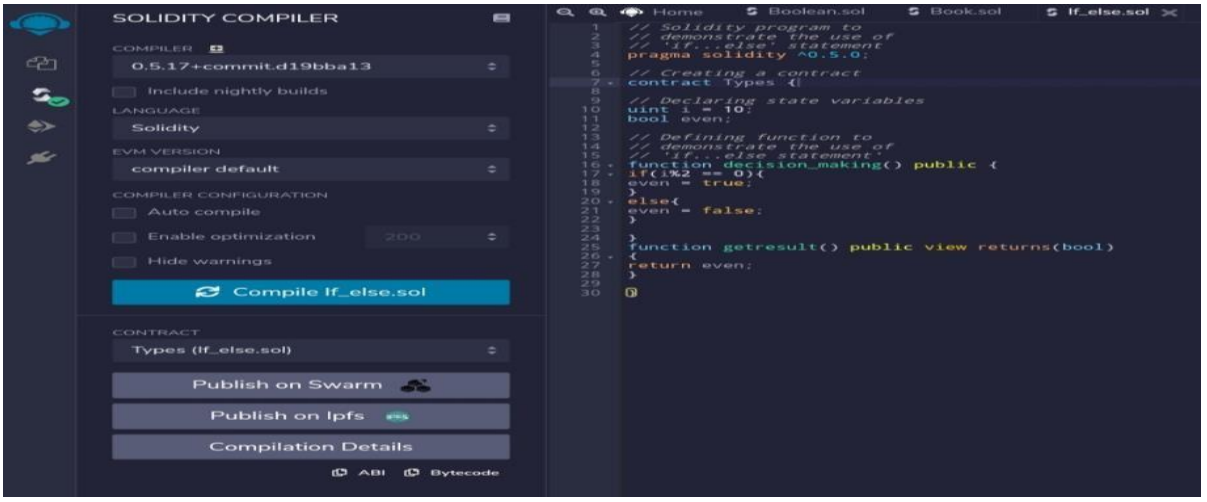
// Defining function to
// demonstrate the use of
// 'if...else statement'
function decision_making() public {
if(i%2 == 0){
even = true;
}
else{
even = false;
}
}
function getresult() public view returns(bool)
{
return even;
}

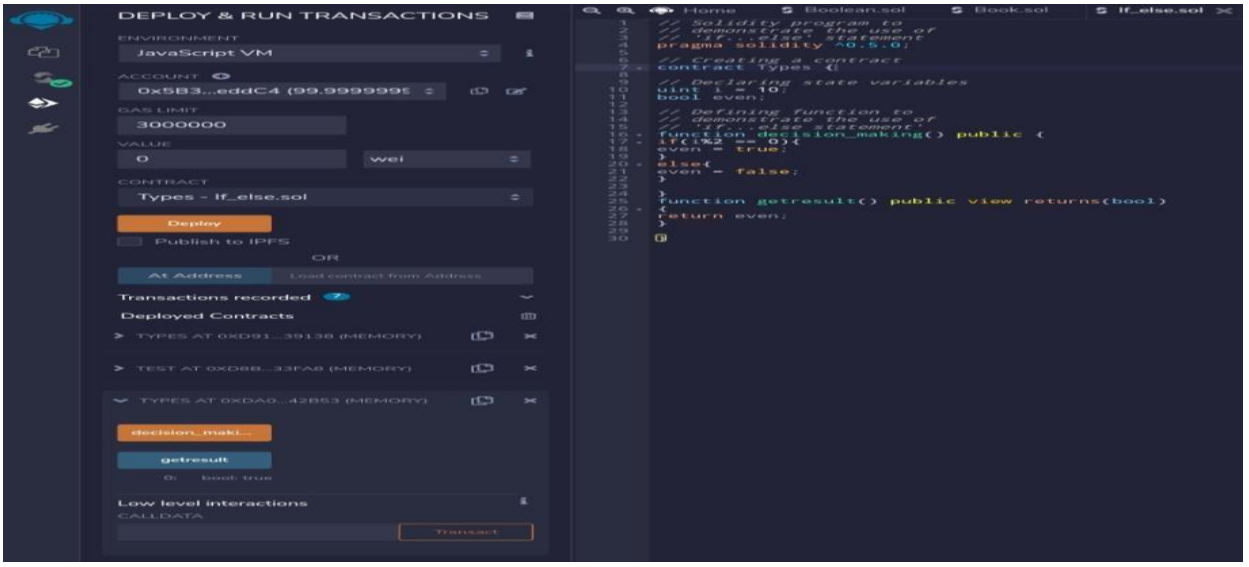
}
```

Output:

BLOCKCHAIN


FILE EXPLORERS
Workspaces
default_workspace
contracts
scripts
tests
artifacts
Types_metadata.json
Types.json
test_metadata.json
test.json
README.txt
Boolean.sol
Book.sol
If_else.sol
Home
Boolean.sol
Book.sol
If_else.sol
// Solidity program to
// demonstrate the use of
// 'if...else' statement
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variables
uint i = 10;
bool even;
// Defining function to
// demonstrate the use of
// 'if...else statement'
function decision_making() public {
if(i%2 == 0){
even = true;
}
else{
even = false;
}
}
function getresult() public view returns(bool)
{
return even;
}


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile If_else.sol
CONTRACT
Types (If_else.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
Types - If_else.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
Deployed Contracts
Low level interactions
CALLDATA
Transact

(III) Strings

```
// Solidity program to demonstrate
// how to create a contract
pragma solidity ^0.4.23;

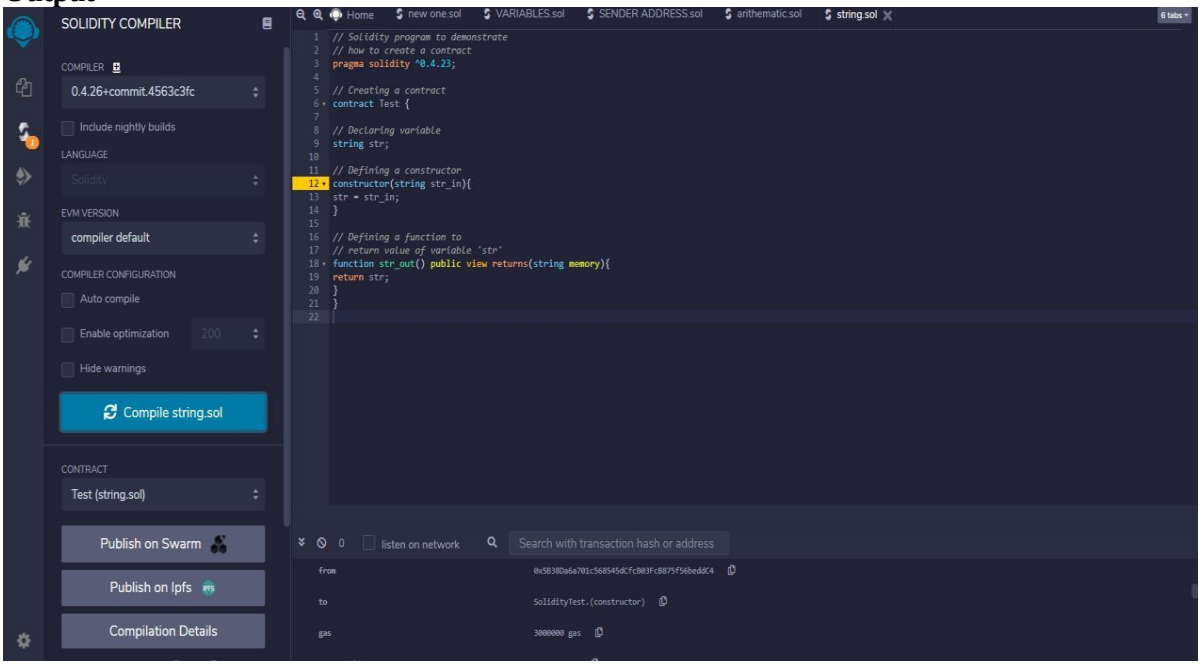
// Creating a contract
contract Test {

// Declaring variable
string str;

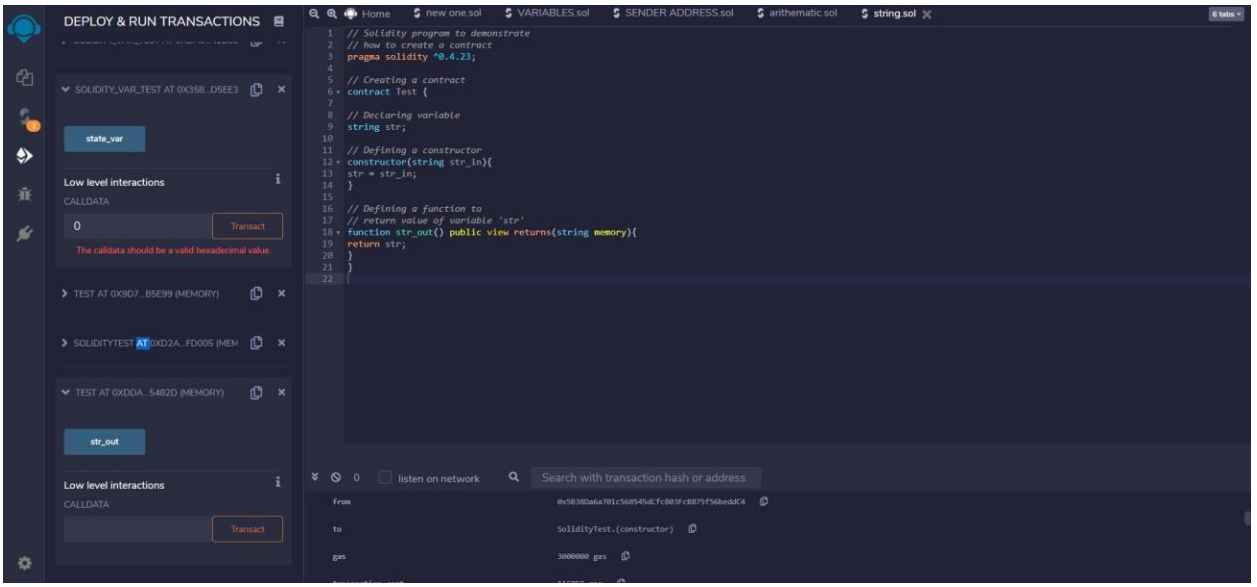
// Defining a constructor
constructor(string str_in){
str = str_in;
}

// Defining a function to
// return value of variable 'str'
function str_out() public view returns(string memory){
return str;
}
}
```

Output



BLOCKCHAIN


DEPLOY & RUN TRANSACTIONS
SOLIDITY_VAR_TEST AT 0X358...D5EE3
state_var
Low level interactions
CALLDATA
0
Transact
The calldata should be a valid hexadecimal value.
TEST AT 0X9D7...B5E99 (MEMORY)
SOLIDITYTEST AT 0XD2A...FD005 (MEM
TEST AT 0XDDA...5482D (MEMORY)
str_out
Low level interactions
CALLDATA
Transact
Home
new one.sol
VARIABLES.sol
SENDER ADDRESS.sol
arithematic.sol
string.sol
6 tabs
// Solidity program to demonstrate
// how to create a contract
pragma solidity ^0.4.23;
// Creating a contract
contract Test {
// Declaring variable
string str;
// Defining a constructor
constructor(string str_in){
str = str_in;
}
// Defining a function to
// return value of variable 'str'
function str_out() public view returns(string memory){
return str;
}
}
listen on network
Search with transaction hash or address
from
0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to
SolidityTest.(constructor)
gas
3000000 gas

Practical 5

Implement and demonstrate the use of the following in Solidity:

(I).Arrays

(II).Enums

(III).Structs

(IV).Mappings

(V).Coversations

(VI).Ether Units

(VII).Special Varaibles

(I).Arrays

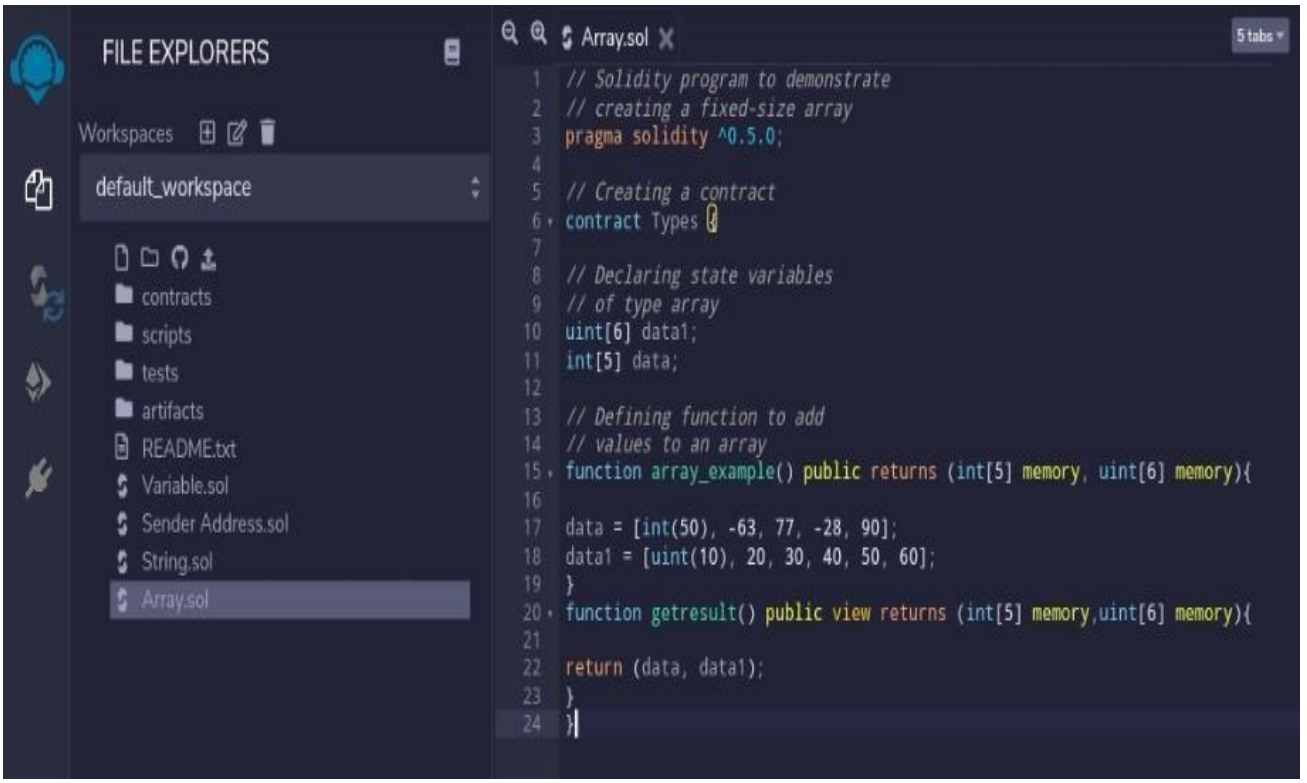
```
// Solidity program to demonstrate
// creating a fixed-size array
pragma solidity ^0.5.0;

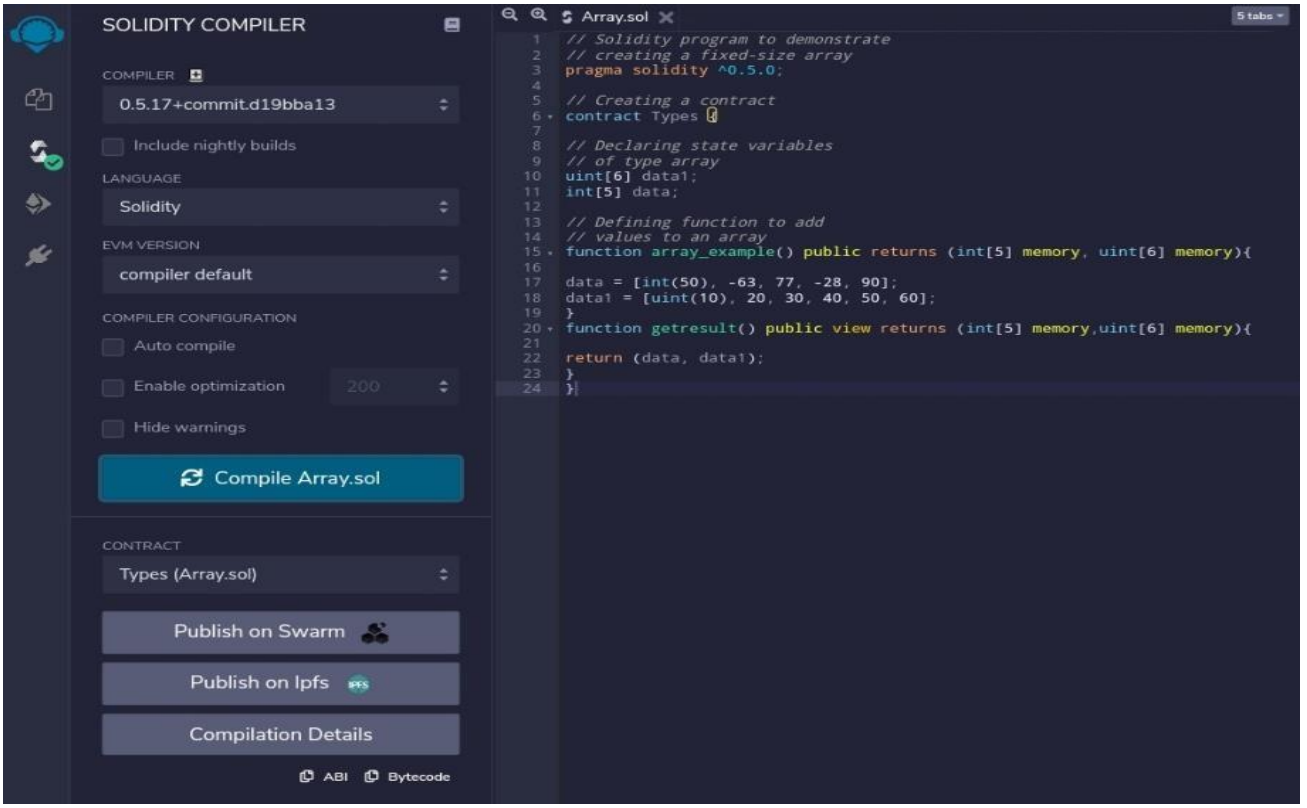
// Creating a contract
contract Types {

// Declaring state variables
// of type array
uint[6] data1;
int[5] data;

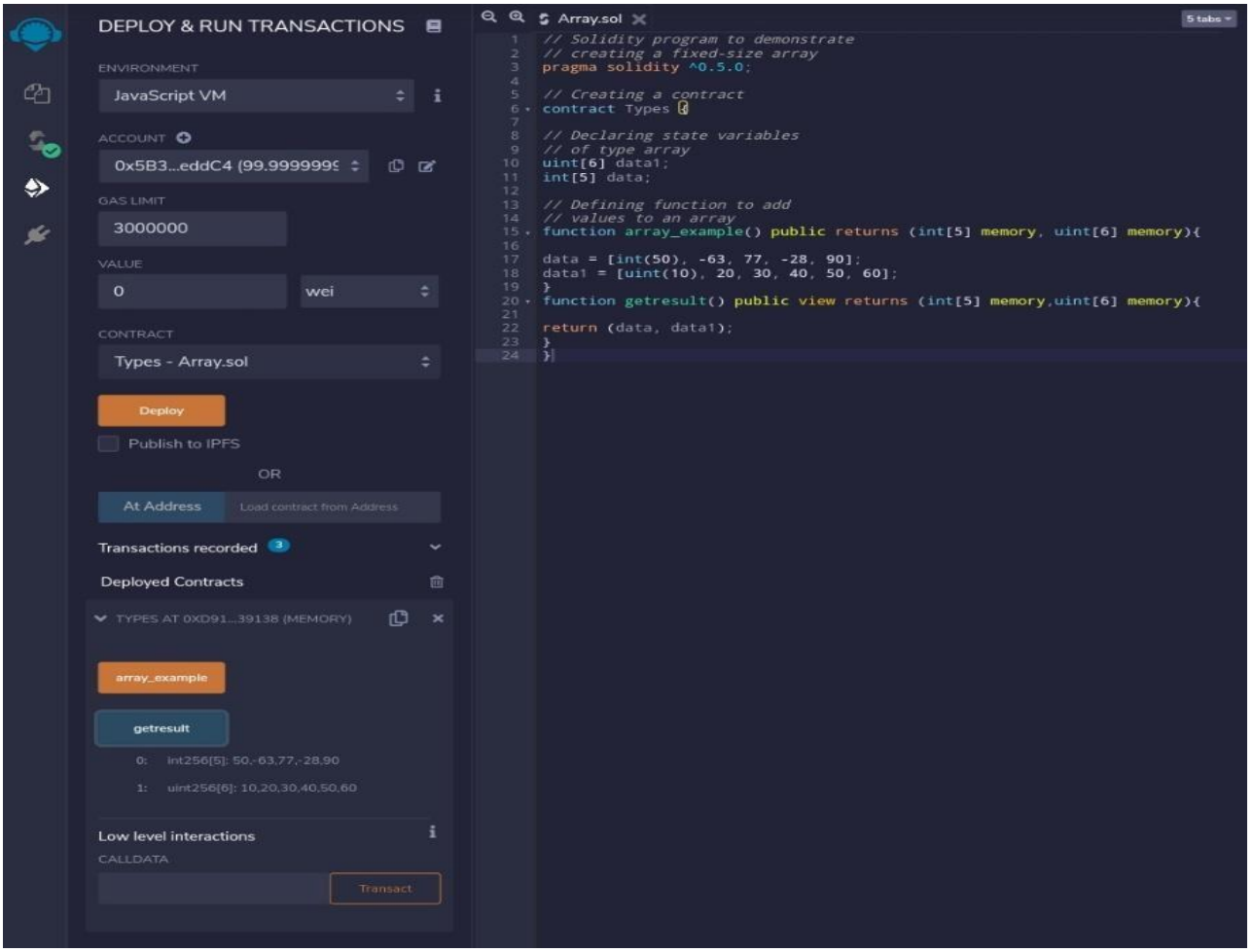
// Defining function to add
// values to an array
function array_example() public returns (int[5] memory, uint[6] memory){
data = [int(50), -63, 77, -28, 90];
data1 = [uint(10), 20, 30, 40, 50, 60];
}
function getresult() public view returns (int[5] memory,uint[6] memory){
return (data, data1);
}
}
```

Output:


FILE EXPLORERS
Workspaces
default_workspace
contracts
scripts
tests
artifacts
README.txt
Variable.sol
Sender Address.sol
String.sol
Array.sol
Array.sol
5 tabs
// Solidity program to demonstrate
// creating a fixed-size array
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variables
// of type array
uint[6] data1;
int[5] data;
// Defining function to add
// values to an array
function array_example() public returns (int[5] memory, uint[6] memory){
data = [int(50), -63, 77, -28, 90];
data1 = [uint(10), 20, 30, 40, 50, 60];
}
function getresult() public view returns (int[5] memory,uint[6] memory){
return (data, data1);
}
}


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile Array.sol
CONTRACT
Types (Array.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Array.sol
5 tabs
// Solidity program to demonstrate
// creating a fixed-size array
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variables
// of type array
uint[6] data1;
int[5] data;
// Defining function to add
// values to an array
function array_example() public returns (int[5] memory, uint[6] memory){
data = [int(50), -63, 77, -28, 90];
data1 = [uint(10), 20, 30, 40, 50, 60];
}
function getresult() public view returns (int[5] memory,uint[6] memory){
return (data, data1);
}
}

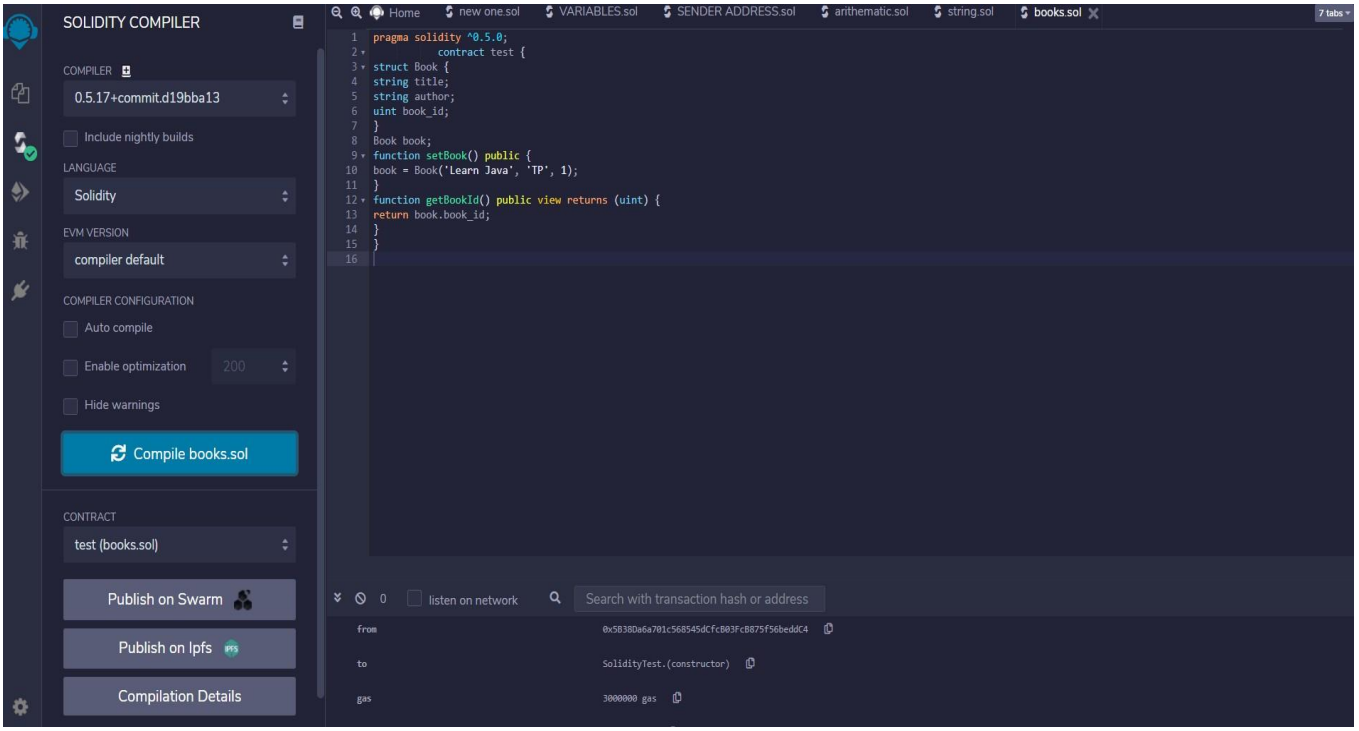
BLOCKCHAIN

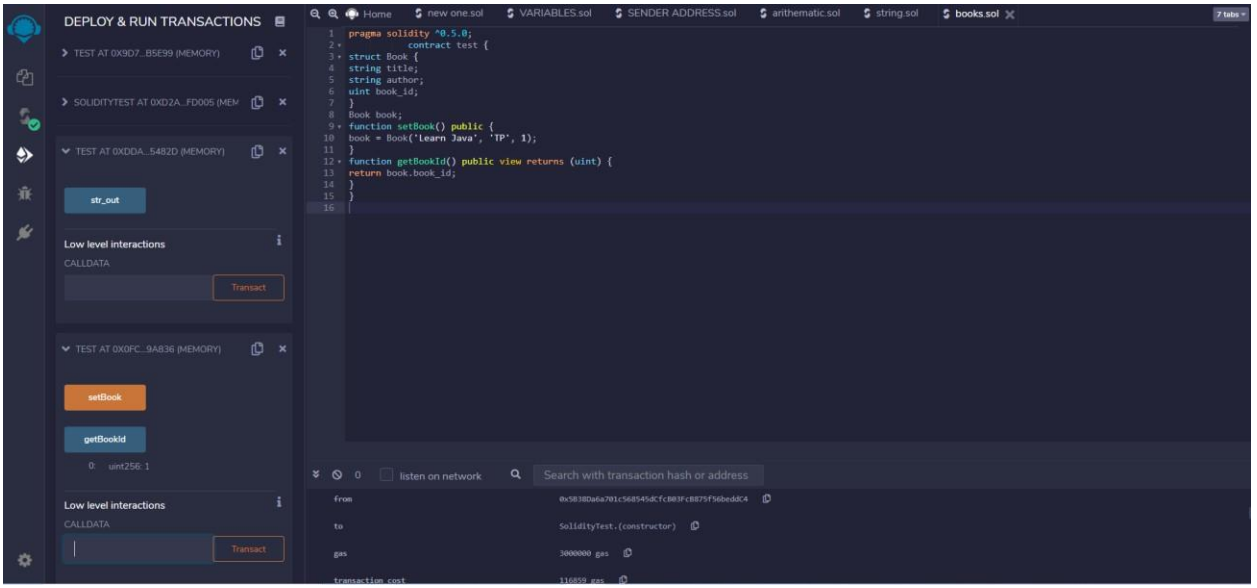

DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
Types - Array.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded 3
Deployed Contracts
TYPES AT 0XD91...39138 (MEMORY)
array_example
getresult
0: int256[5]: 50,-63,77,-28,90
1: uint256[6]: 10,20,30,40,50,60
Low level interactions
CALLDATA
Transact
Array.sol
5 tabs
// Solidity program to demonstrate
// creating a fixed-size array
pragma solidity ^0.5.0;
// Creating a contract
contract Types {
// Declaring state variables
// of type array
uint[6] data1;
int[5] data;
// Defining function to add
// values to an array
function array_example() public returns (int[5] memory, uint[6] memory){
data = [int(50), -63, 77, -28, 90];
data1 = [uint(10), 20, 30, 40, 50, 60];
}
function getresult() public view returns (int[5] memory,uint[6] memory){
return (data, data1);
}
}

(III).Structs

```
pragma solidity ^0.5.0;
 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:

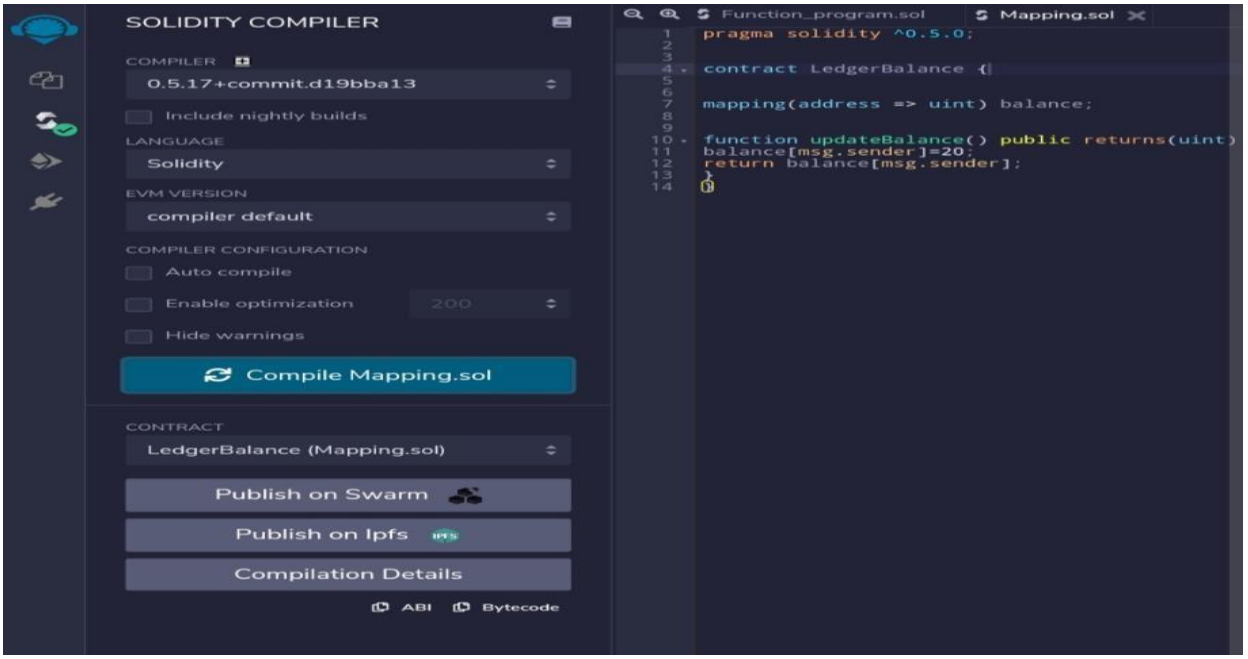


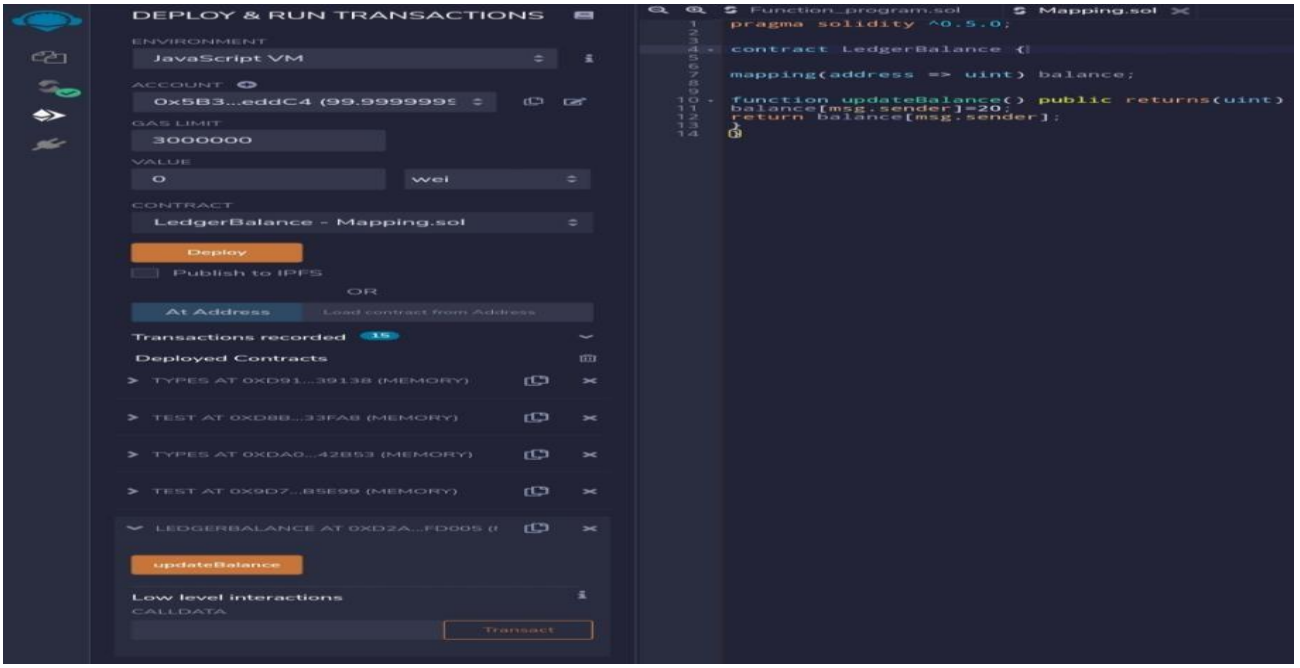


(IV).Mappings

```
pragma solidity ^0.5.0;
contract LedgerBalance {
mapping(address => uint) balance;
function updateBalance() public returns(uint) {
balance[msg.sender]=20;
return balance[msg.sender];
}
}
```

Output:



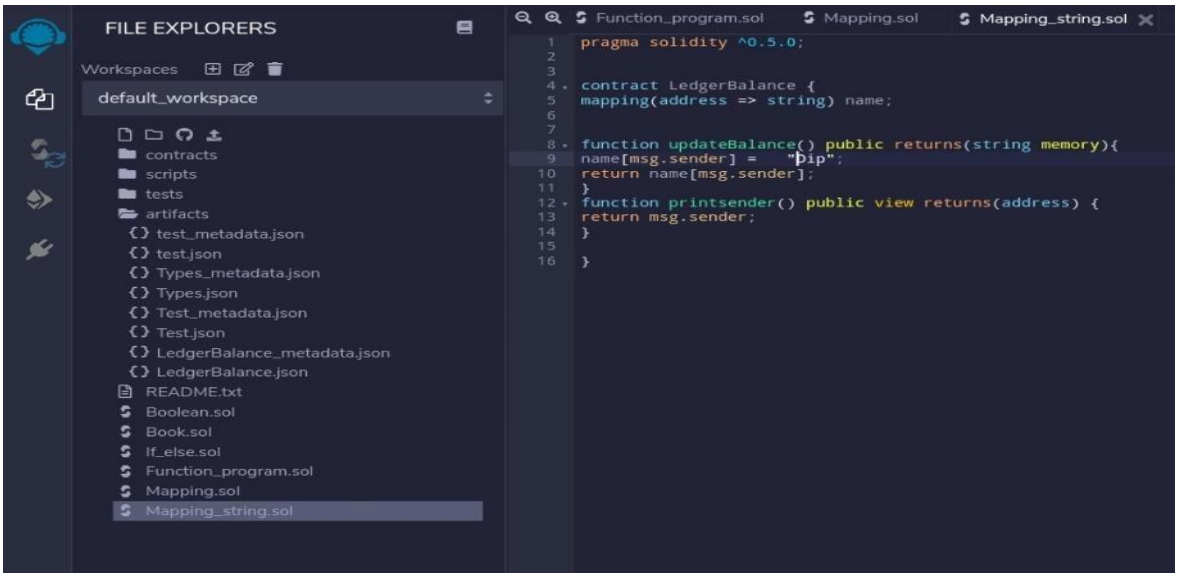


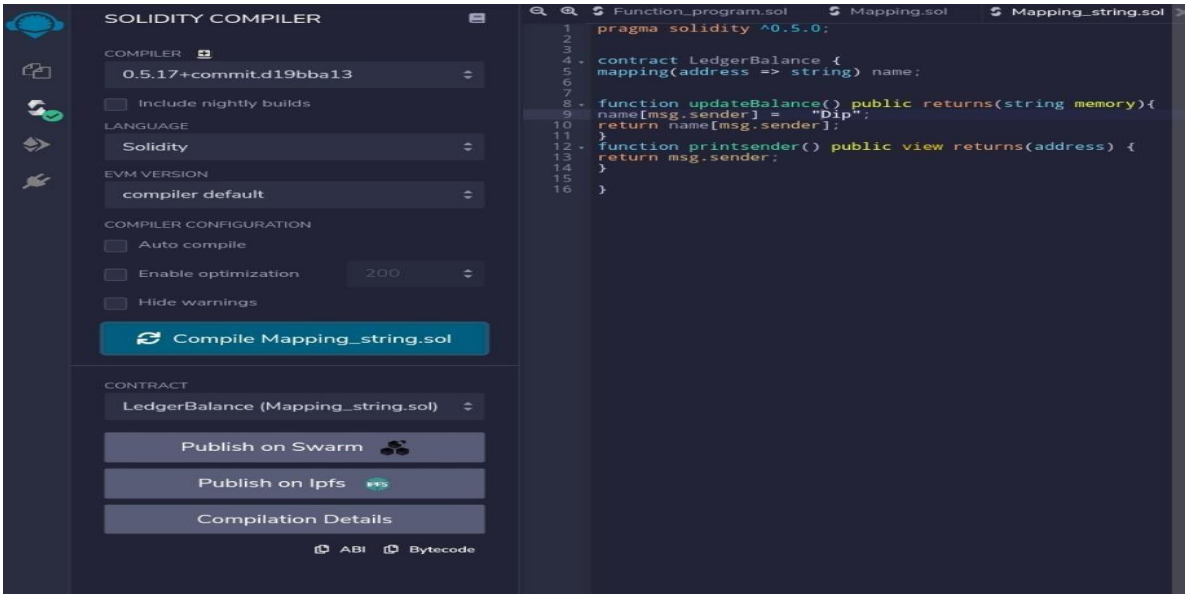

```
pragma solidity ^0.5.0;
contract LedgerBalance {
mapping(address => string) name;

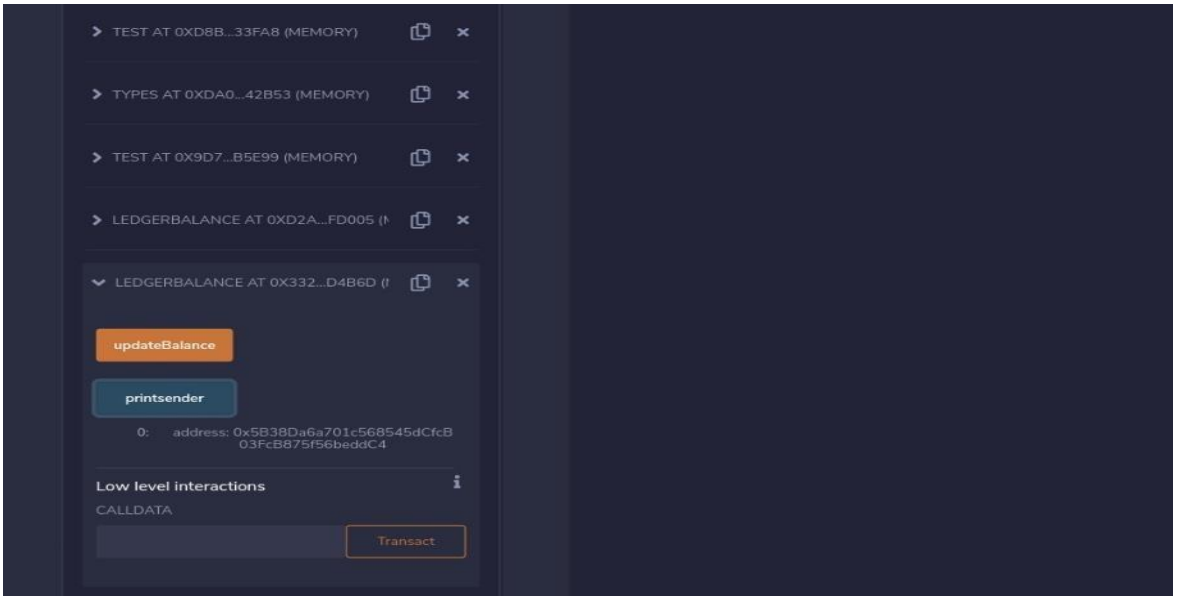
function updateBalance() public returns(string memory){
name[msg.sender] = "Dip";
return name[msg.sender];
}
function printsender() public view returns(address) {
return msg.sender;
}
}
```

Output:

BLOCKCHAIN


FILE EXPLORERS
Workspaces
default_workspace
contracts
scripts
tests
artifacts
test_metadata.json
test.json
Types_metadata.json
Types.json
Test_metadata.json
Test.json
LedgerBalance_metadata.json
LedgerBalance.json
README.txt
Boolean.sol
Book.sol
If_else.sol
Function_program.sol
Mapping.sol
Mapping_string.sol
Function_program.sol
Mapping.sol
Mapping_string.sol
pragma solidity ^0.5.0;
contract LedgerBalance {
mapping(address => string) name;
function updateBalance() public returns(string memory){
name[msg.sender] = "Dip";
return name[msg.sender];
}
function printsender() public view returns(address) {
return msg.sender;
}
}


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile Mapping_string.sol
CONTRACT
LedgerBalance (Mapping_string.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Function_program.sol
Mapping.sol
Mapping_string.sol
pragma solidity ^0.5.0;
contract LedgerBalance {
mapping(address => string) name;
function updateBalance() public returns(string memory){
name[msg.sender] = "Dip";
return name[msg.sender];
}
function printsender() public view returns(address) {
return msg.sender;
}
}


TEST AT 0XD8B...33FA8 (MEMORY)
TYPES AT 0XDA0...42B53 (MEMORY)
TEST AT 0X9D7...B5E99 (MEMORY)
LEDGERBALANCE AT 0XD2A...FD005 (
LEDGERBALANCE AT 0X332...D4B6D (
updateBalance
printsender
0: address: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
Low level interactions
CALLDATA
Transact

Practical 6

Implement and demonstrate the use of the following in Solidity :

(I).Functions

(II).View Functions

(III).Pure Functions

(IV).Fallback Functions

(V).Function Overloading

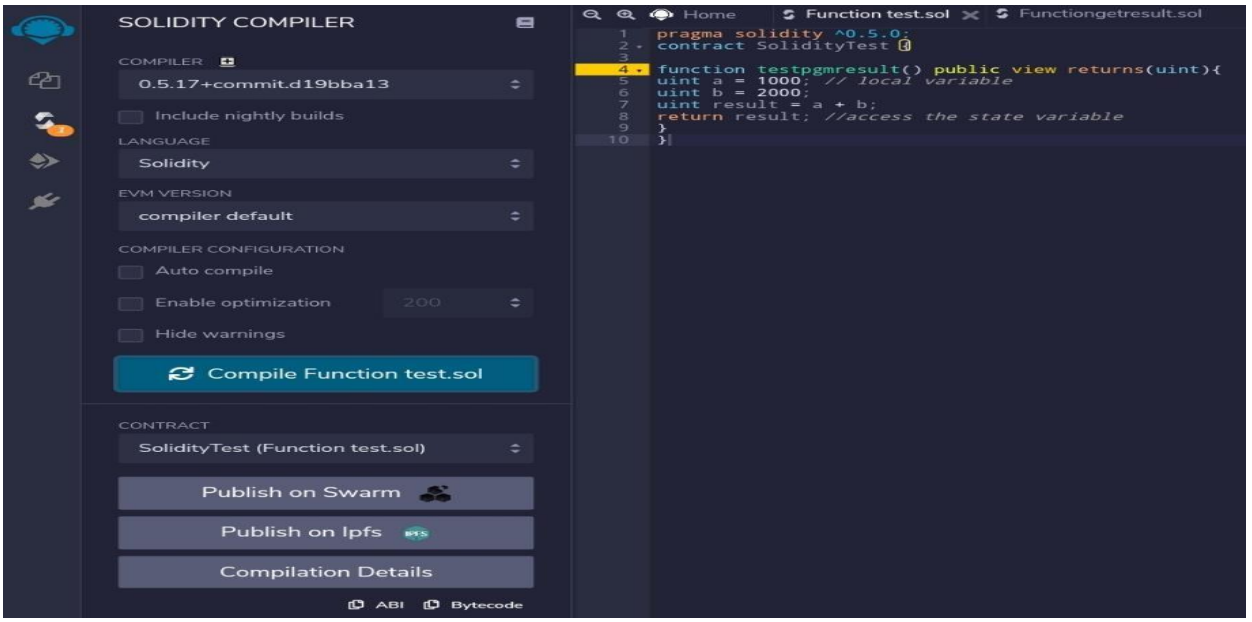
(VI).Mathematical Functions

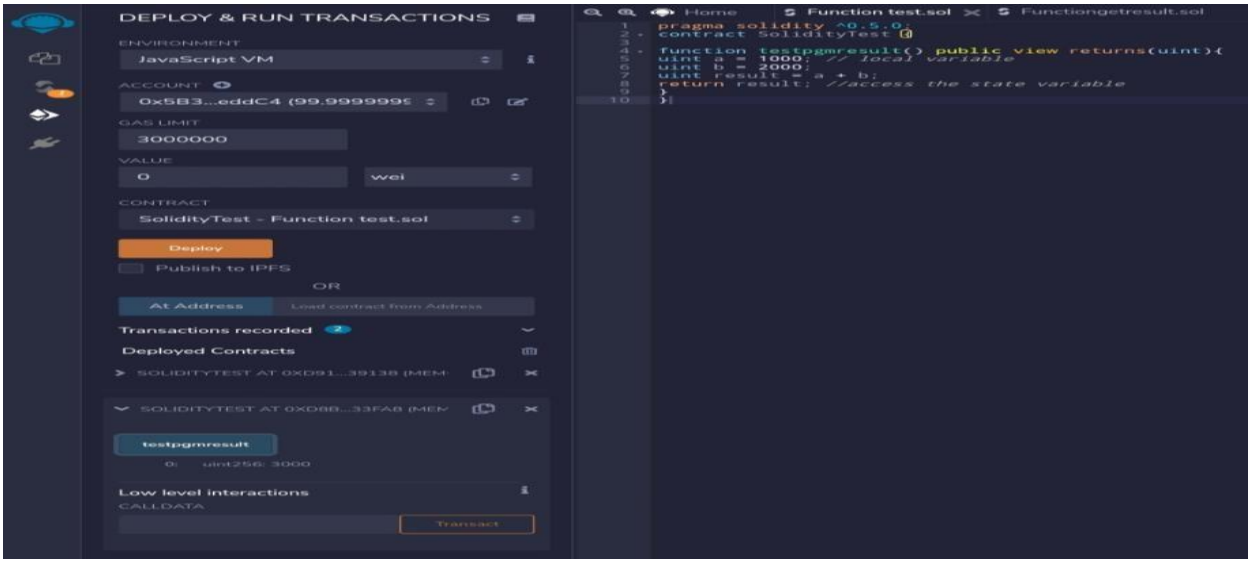
(VII).Cryptographic Functions

(I).Functions

```
pragma solidity ^0.5.0;
contract SolidityTest {
function testpgmresult() public view returns(uint){
uint a = 1000; // local variable
uint b =  2000;
uint result = a + b;
return result; //access the state variable
}
}
```

Output:

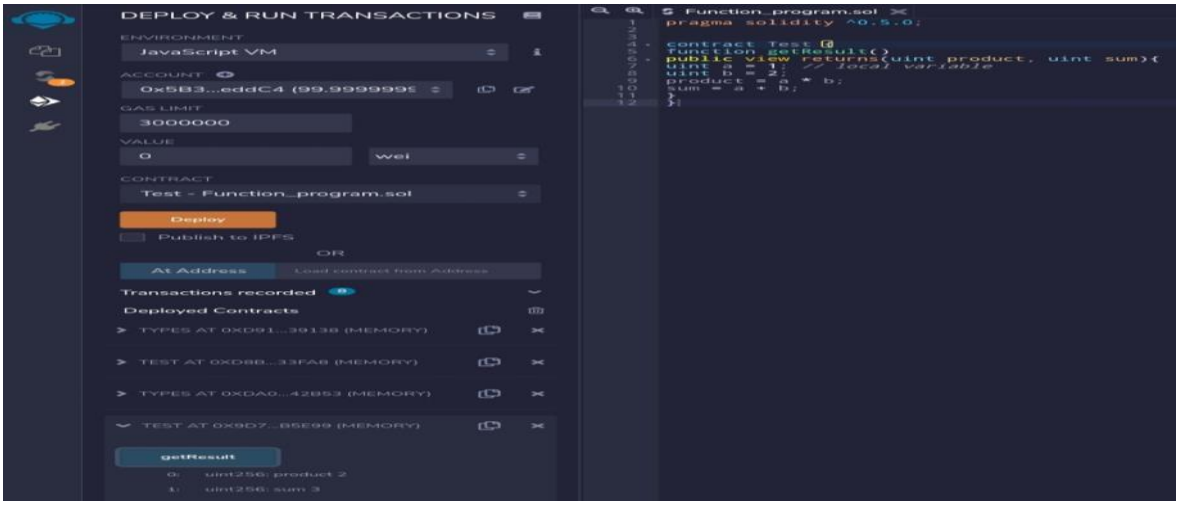


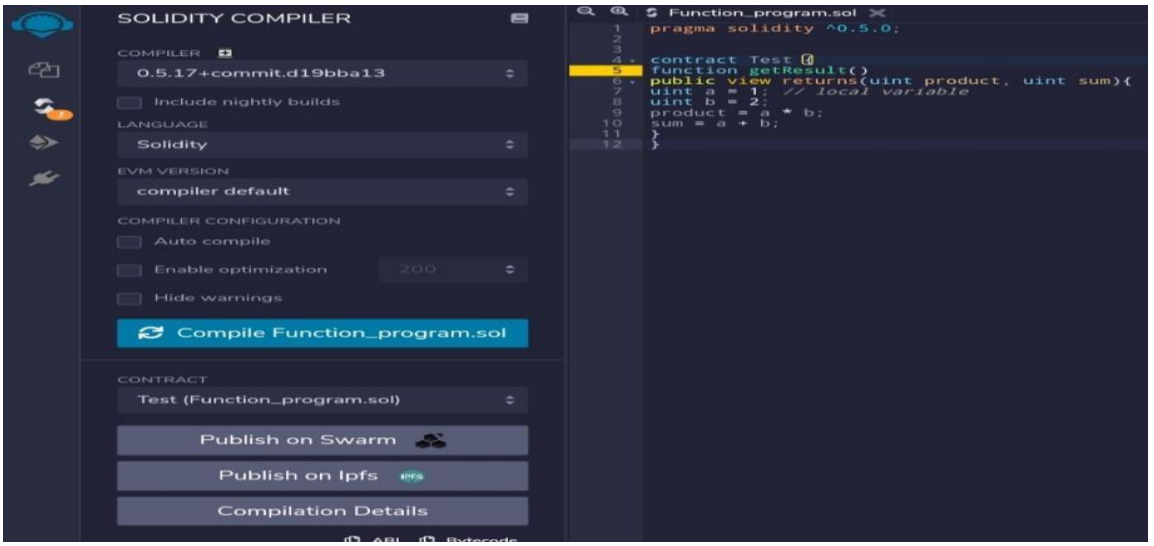


(II).View Functions

```
pragma solidity ^0.5.0;
contract Test {
function getResult() public view returns(uint product, uint sum){
uint a = 1; // local variable
uint b = 2;
product = a * b;
sum = a + b;
}
}
```

Output:





(III).Pure Functions

```
pragma solidity ^0.5.0;
contract C {
//private state variable
uint private data;

//public state variable
uint public info;

//constructor
constructor() public {
info = 10;
}
//private function
function increment(uint a) private pure returns(uint) { return a + 1; }

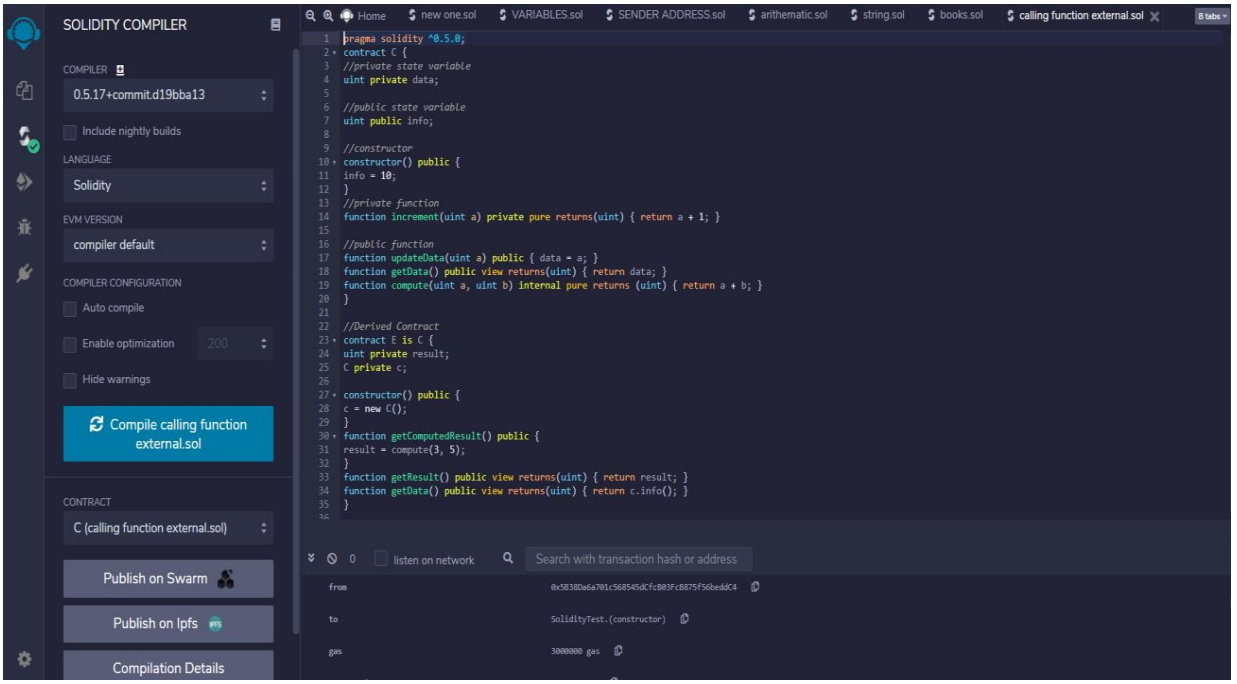
//public function
function updateData(uint a) public { data = a; }
function getData() public view returns(uint) { return data; }
function compute(uint a, uint b) internal pure returns (uint) { return a + b; }
}

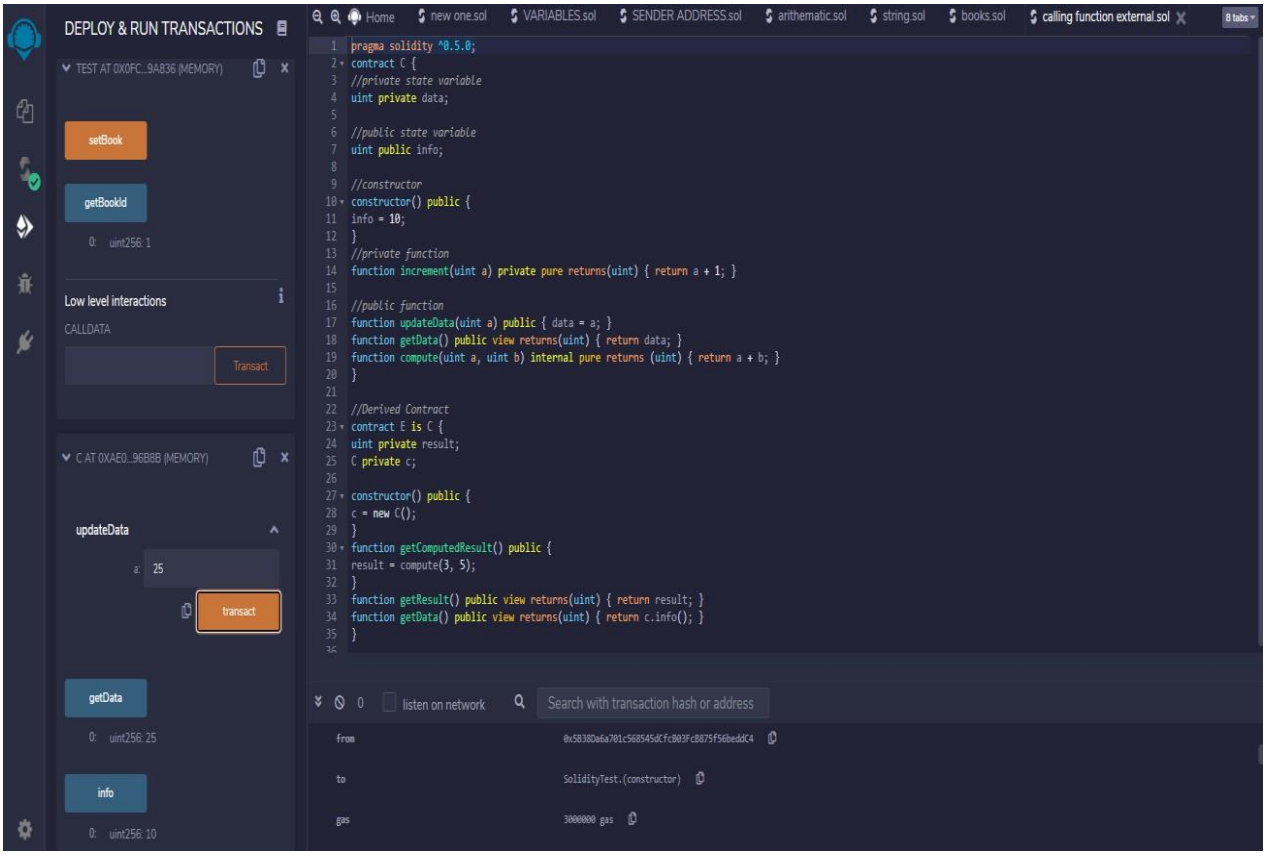
//Derived Contract
```

```
contract E is C {
uint private result;
C private c;

constructor() public {
c = new C();
}
function getComputedResult() public {
result = compute(3, 5);
}
function getResult() public view returns(uint) { return result; }
function getData() public view returns(uint) { return c.info(); }
}
```

Output:



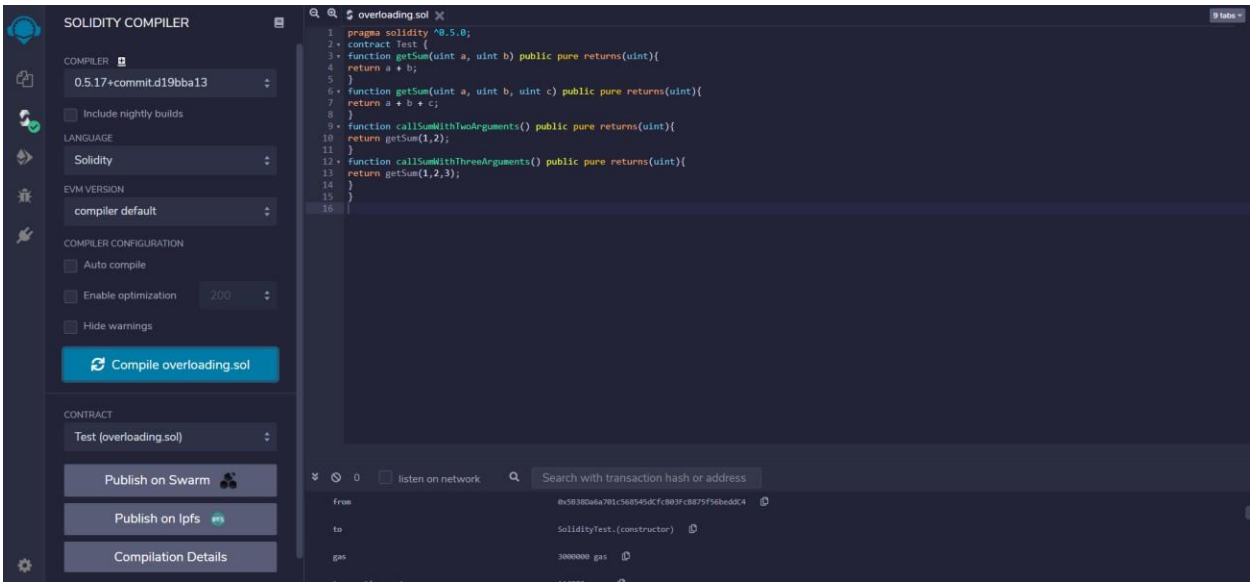


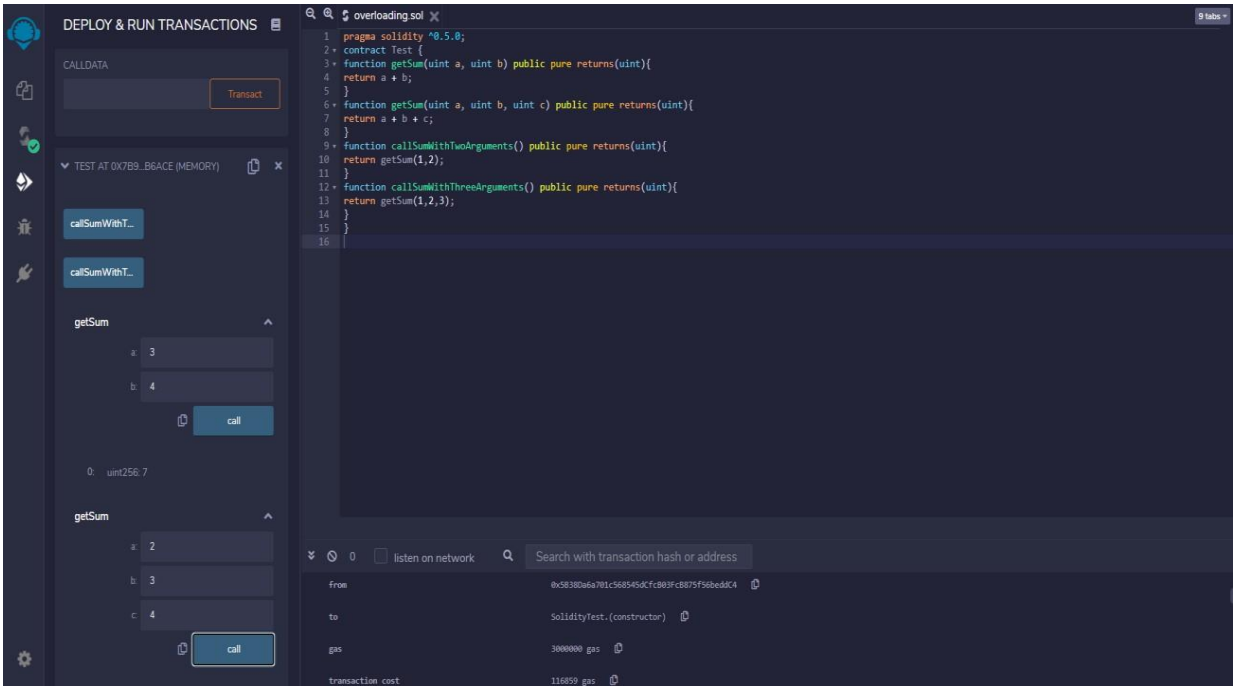
(V).Function Overloading

```
pragma solidity ^0.5.0;
contract Test {
function getSum(uint a, uint b) public pure returns(uint){
return a + b;
}
function getSum(uint a, uint b, uint c) public pure returns(uint){
return a + b + c;
}
function callSumWithTwoArguments() public pure returns(uint){
return getSum(1,2);
}
function callSumWithThreeArguments() public pure returns(uint){
return getSum(1,2,3);
}
}
```

BLOCKCHAIN

Output:

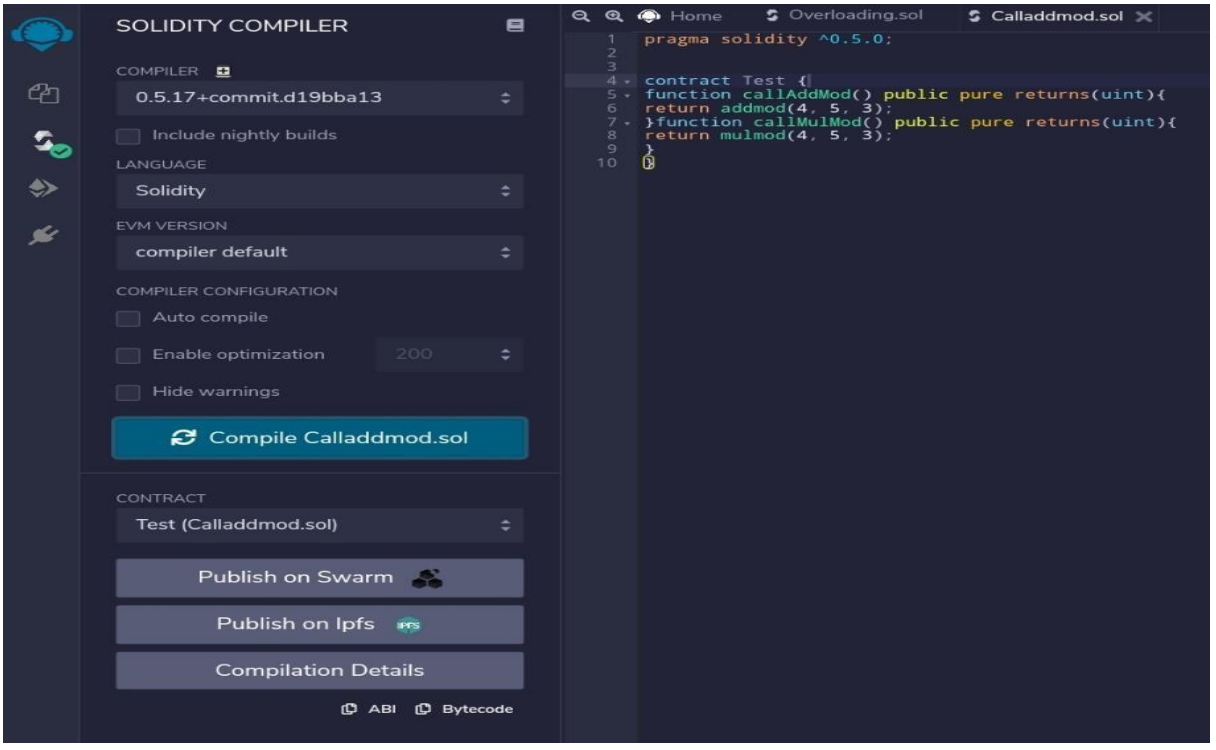


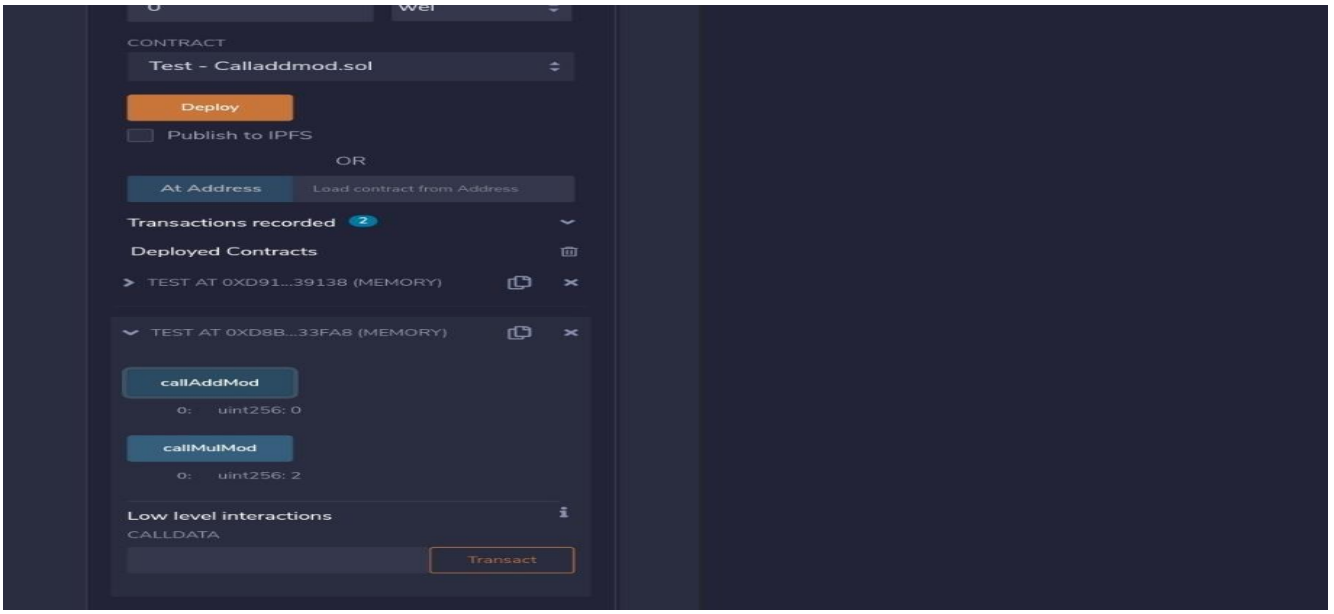


(VI).Mathematical Functions

```
pragma solidity ^0.5.0;
contract Test {
function callAddMod() public pure returns(uint){
return addmod(4, 5, 3);
}
function callMulMod() public pure returns(uint){
return mulmod(4, 5, 3);
}
}
```

Output:

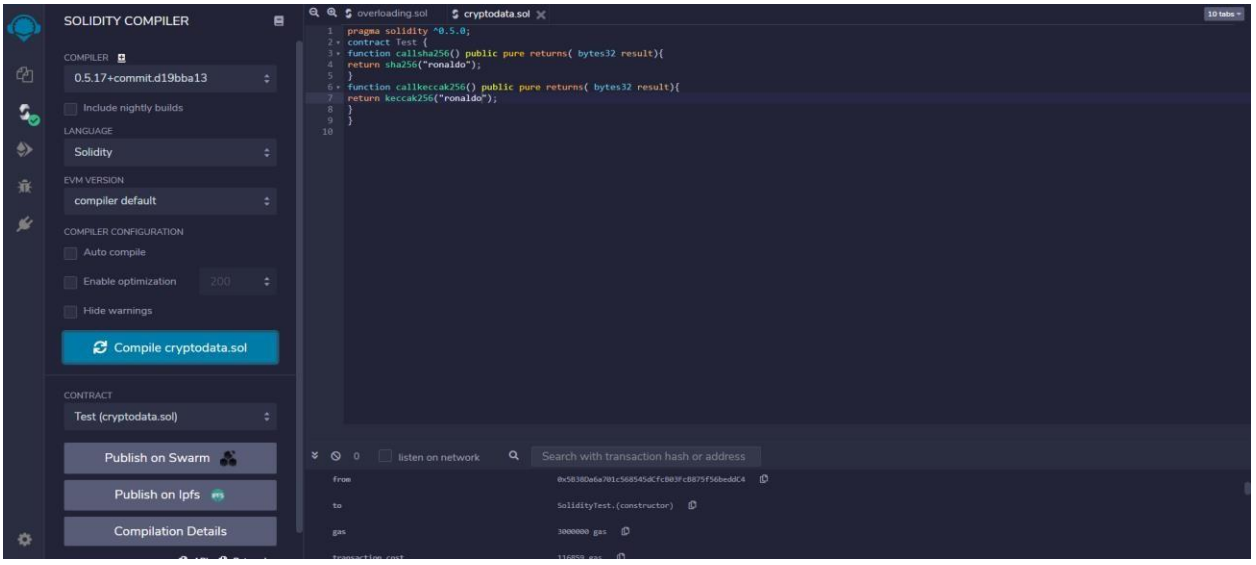




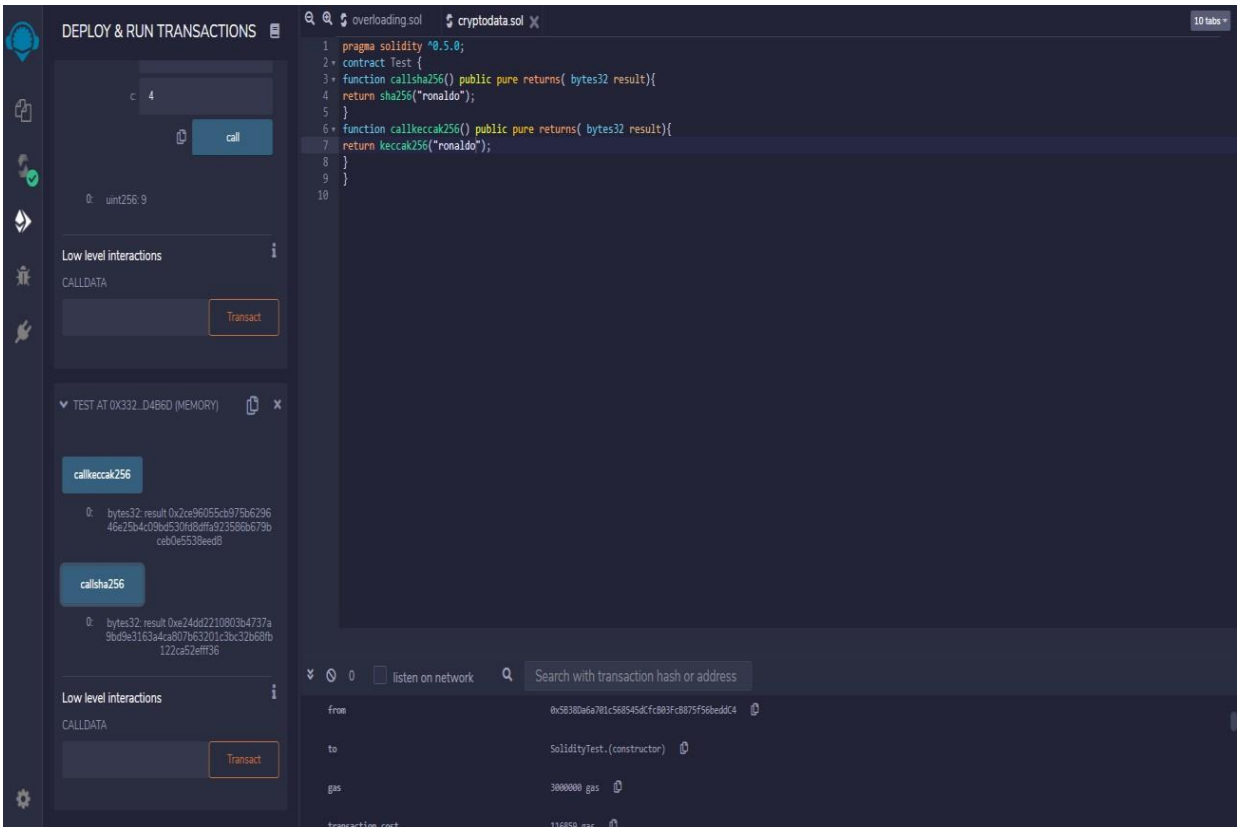
(VII).Cryptographic Functions

```
pragma solidity ^0.5.0;
contract Test {
function callsha256() public pure returns( bytes32 result){
return sha256("ronaldo");
}
function callkeccak256() public pure returns( bytes32 result){
return keccak256("ronaldo");
}
}
```

Output:



BLOCKCHAIN


DEPLOY & RUN TRANSACTIONS
c 4
call
0: uint256: 9
Low level interactions
CALLDATA
Transact
TEST AT 0X332...D4B6D (MEMORY)
callkeccak256
0: bytes32: result 0x2ce96055cb975b629646e25b4c09bd530fd8dffa923586b679bceb0e5538eed8
callsha256
0: bytes32: result 0xe24dd2210803b4737a9bd9e3163a4ca807b63201c3bc32b68fb122ca52efff36
Low level interactions
CALLDATA
Transact
overloading.sol
cryptodata.sol
10 tabs
pragma solidity ^0.5.0;
contract Test {
function callsha256() public pure returns(bytes32 result){
return sha256("ronaldo");
}
function callkeccak256() public pure returns(bytes32 result){
return keccak256("ronaldo");
}
}
listen on network
Search with transaction hash or address
from 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
to SolidityTest.(constructor)
gas 3000000 gas

Practical 7

Implement and demonstrate the use of the following in Solidity :

(I).Contracts

(II).Inheritance

(III).Constructors

(IV).Abstract Class

(V).Interfaces

(I).Contracts

```
// Solidity program to
// demonstrate how to
// write a smart contract
pragma solidity >= 0.4.16 < 0.7.0;

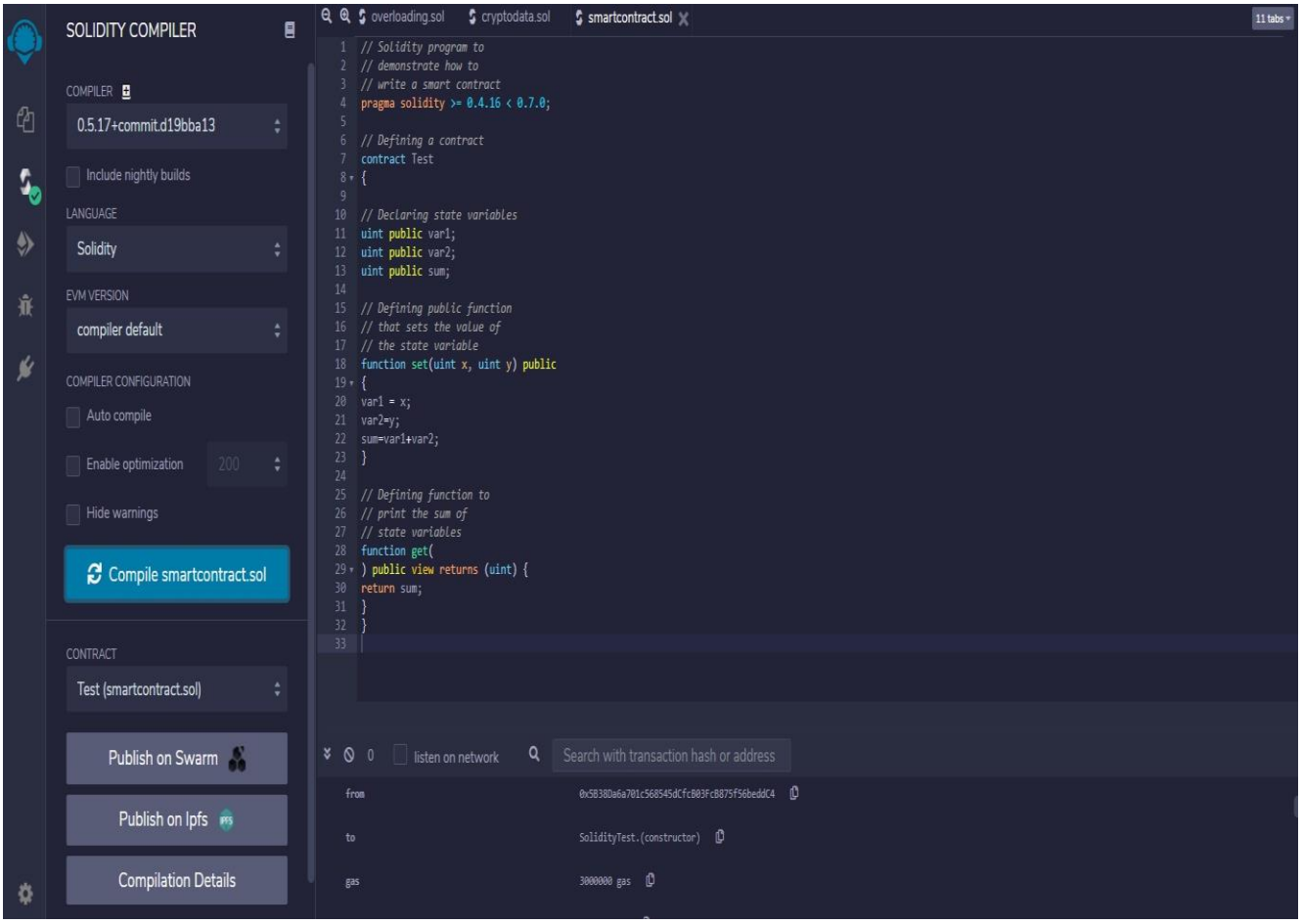
// Defining a contract
contract Test
{

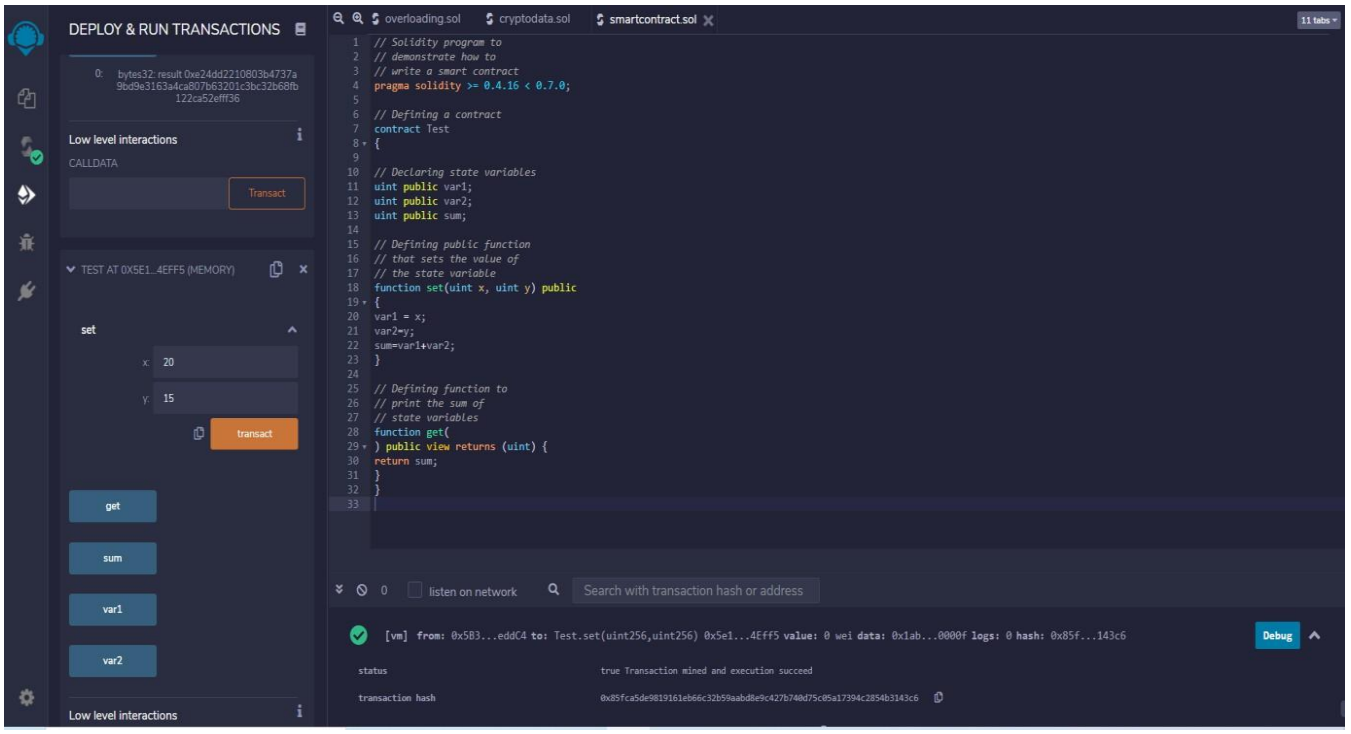
// Declaring state variables
uint public var1;
uint public var2;
uint public sum;

// Defining public function
// that sets the value of
// the state variable
function set(uint x, uint y) public
{
var1 = x;
var2=y;
sum=var1+var2;
}
```

```
// Defining function to
// print the sum of
// state variables
function get(
) public view returns (uint) {
return sum;
}
}
```

Output:





(II).Inheritance

```
// Solidity program to demonstrate Single Inheritance
pragma solidity >=0.4.22 <0.6.0;

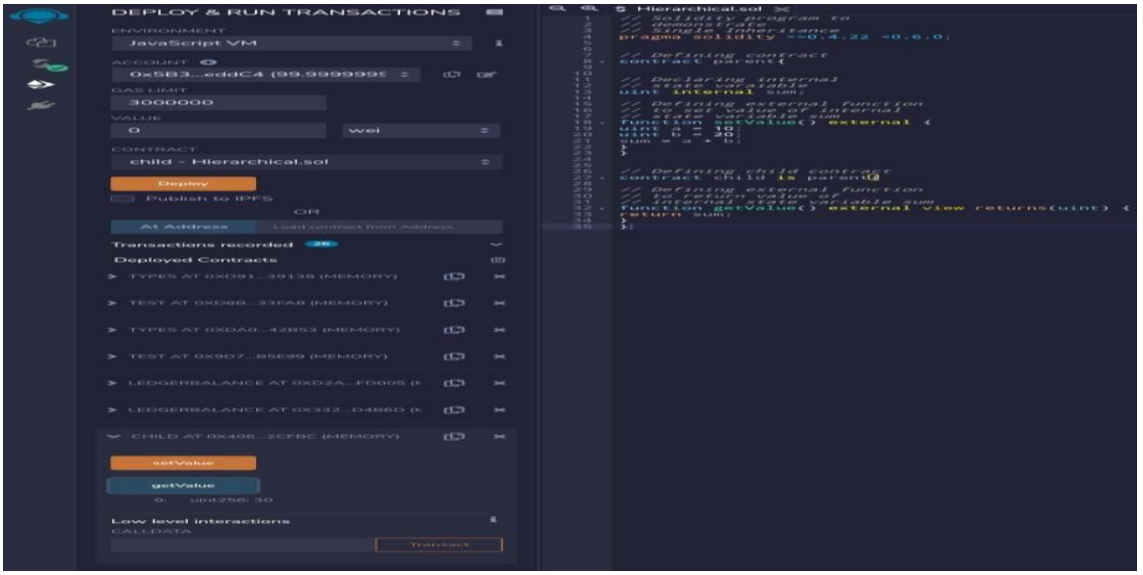
// Defining contract
contract parent{

// Declaring internal state varaiable
uint internal sum;

// Defining external function to set value of internal state variable sum
function setValue() external {
uint a = 10;
uint b = 20;
sum = a + b;
}
}
```

```
// Defining child contract
contract child is parent{
// Defining external function to return value of internal state variable sum
function getValue() external view returns(uint) {
return sum;
}
}
// Defining calling contract
contract caller {
// Creating child contract object
child cc = new child();
// Defining function to call setValue and getValue functions
function testInheritance() public {
cc.setValue();
}
function result() public view returns(uint ){
return cc.getValue();
}
}
```

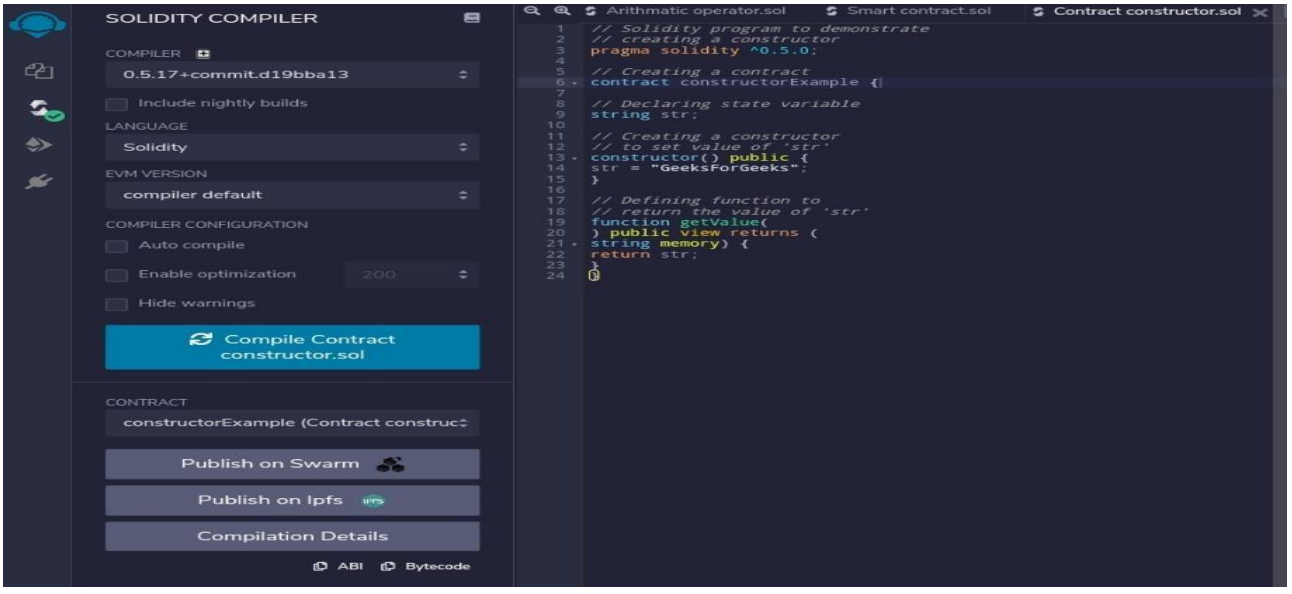
Output:



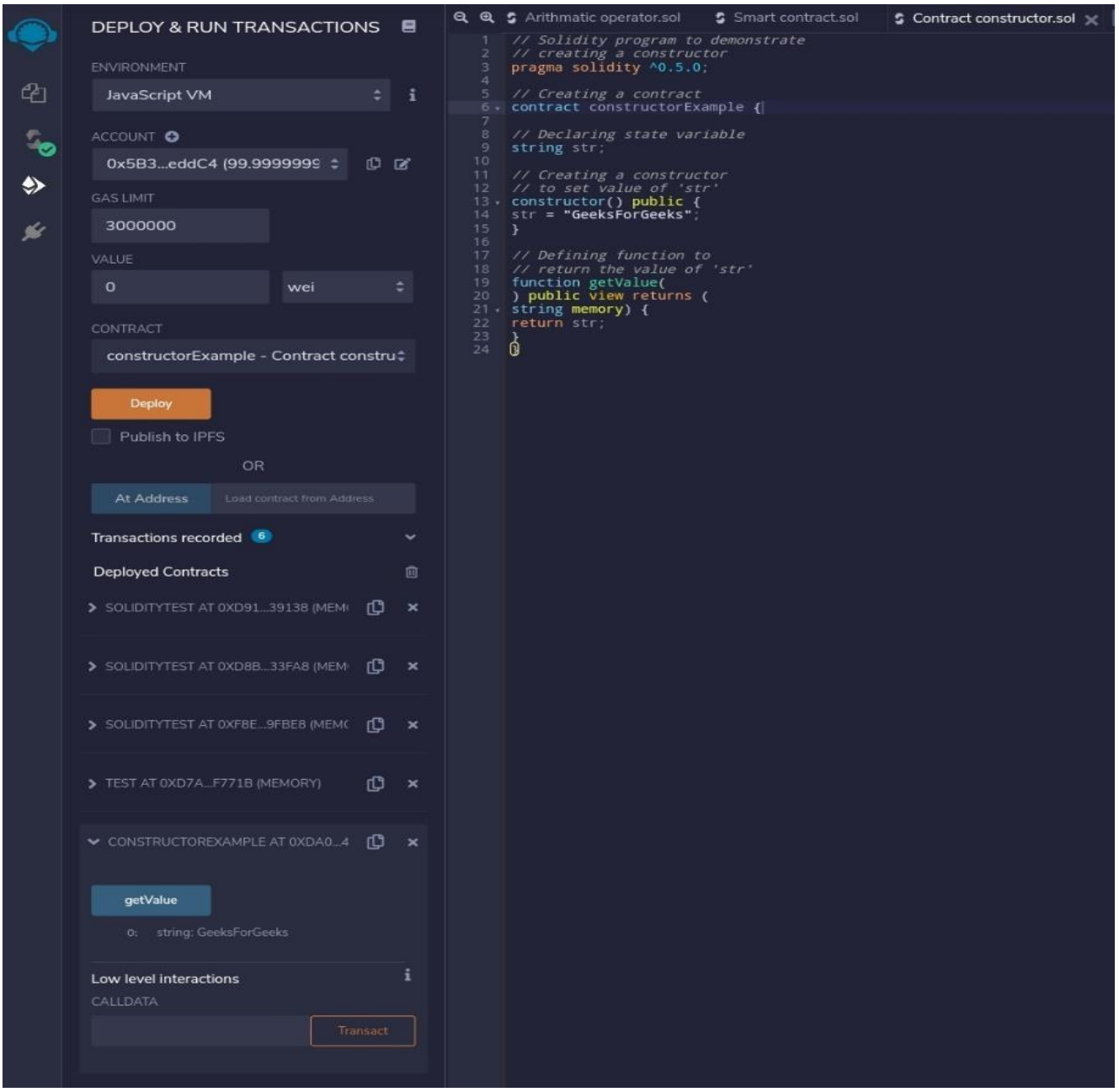
(III).Constructors

```
// Solidity program to demonstrate
// creating a constructor
pragma solidity ^0.5.0;
// Creating a contract
contract constructorExample {
// Declaring state variable
string str;
// Creating a constructor
// to set value of 'str'
constructor() public {
str = "GeeksForGeeks";
}
// Defining function to
// return the value of 'str'
function getValue(
) public view returns (
string memory) {
return str;
}
}
```

Output:



BLOCKCHAIN


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.9999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
constructorExample - Contract constru
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded 6
Deployed Contracts
SOLIDITYTEST AT 0XD91...39138 (MEM
SOLIDITYTEST AT 0XD8B...33FA8 (MEM
SOLIDITYTEST AT 0XF8E...9FBE8 (MEMO
TEST AT 0XD7A...F771B (MEMORY)
CONSTRUCTOREXAMPLE AT 0XDA0...4
getValue
0: string: GeeksForGeeks
Low level interactions
CALLDATA
Transact
Arithmatic operator.sol
Smart contract.sol
Contract constructor.sol
// Solidity program to demonstrate
// creating a constructor
pragma solidity ^0.5.0;
// Creating a contract
contract constructorExample {
// Declaring state variable
string str;
// Creating a constructor
// to set value of 'str'
constructor() public {
str = "GeeksForGeeks";
}
// Defining function to
// return the value of 'str'
function getValue(
) public view returns (
string memory) {
return str;
}
}

BLOCKCHAIN

Practical 8

Implement and demonstrate the use of the following in Solidity :

(I).Libraries

(II).Assembly

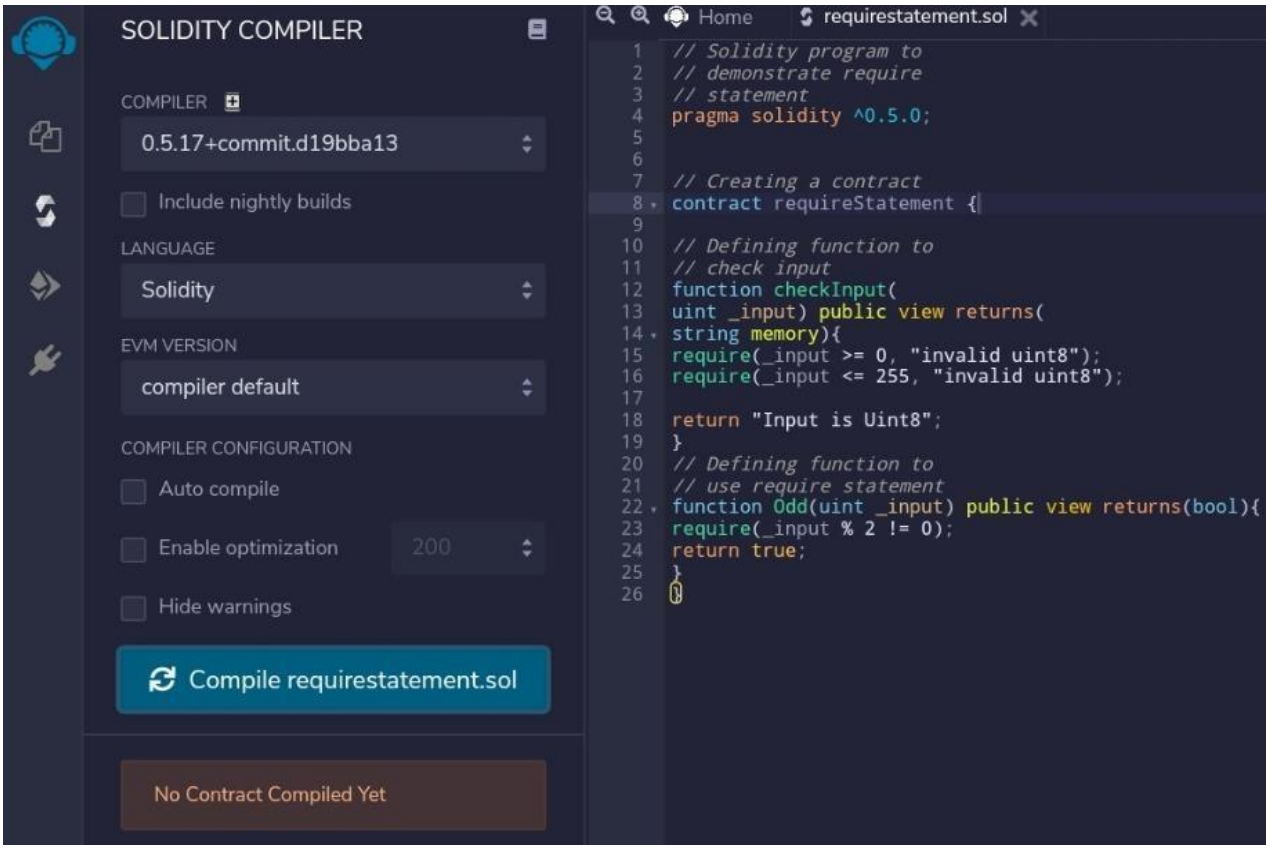
(III).Events

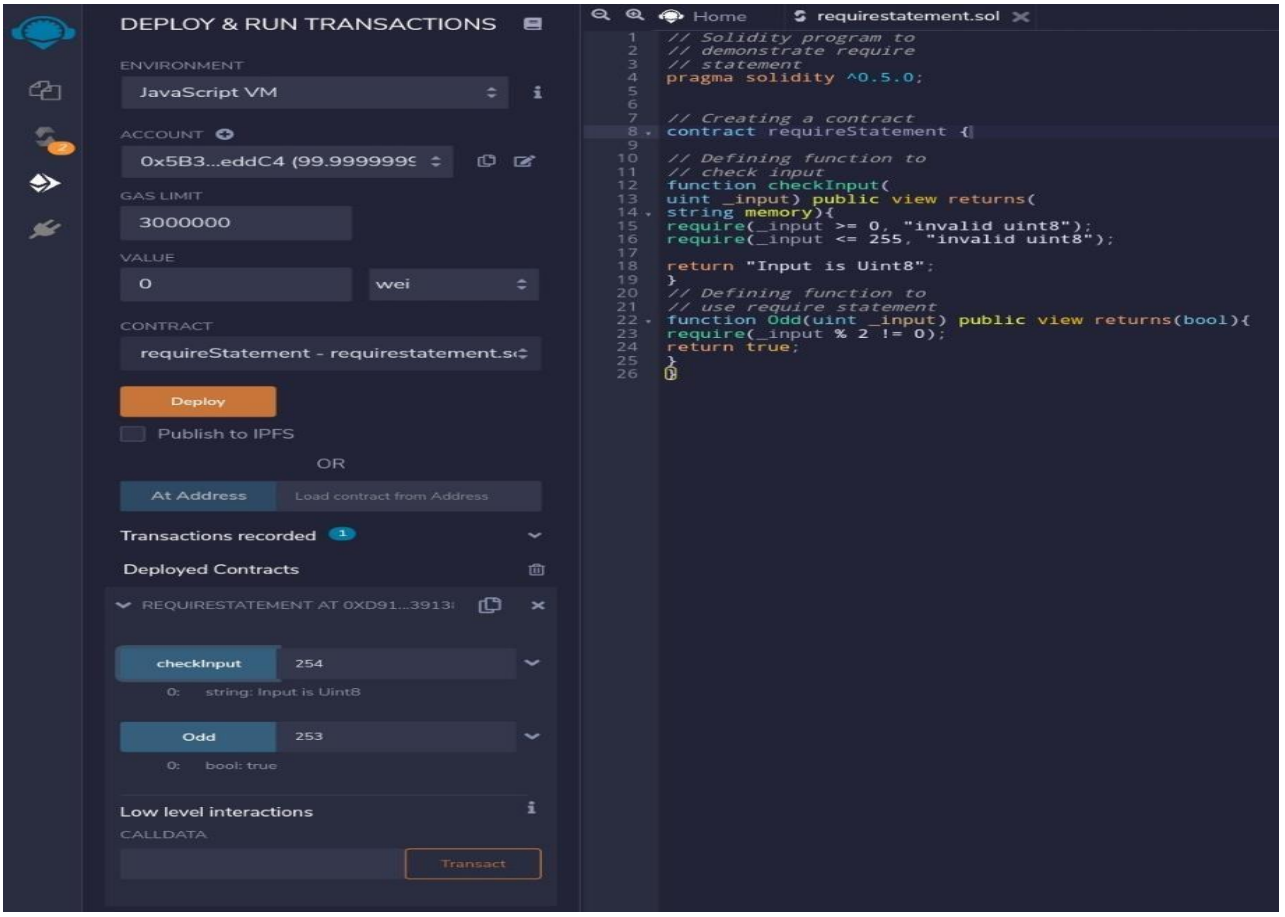
(IV).Error Handling

(IV).Error Handling

```
// Solidity program to demonstrate require statement
pragma solidity ^0.5.0;
// Creating a contract
contract requireStatement {
// Defining function to check input
function checkInput(
uint _input) public view returns(
string memory){
require(_input >= 0, "invalid uint8");
require(_input <= 255, "invalid uint8");
return "Input is Uint8";
}
// Defining function to use require statement
function Odd(uint _input) public view returns(bool){
require(_input % 2 != 0);
return true;
}
}
```

Output:


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile requirestatement.sol
No Contract Compiled Yet
Home
requirestatement.sol
// Solidity program to
// demonstrate require
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract requireStatement {
// Defining function to
// check input
function checkInput(
uint _input) public view returns(
string memory){
require(_input >= 0, "invalid uint8");
require(_input <= 255, "invalid uint8");
return "Input is Uint8";
}
// Defining function to
// use require statement
function Odd(uint _input) public view returns(bool){
require(_input % 2 != 0);
return true;
}


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
requireStatement - requirestatement.s
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded 1
Deployed Contracts
REQUIRESTATEMENT AT 0XD91...3913
checkInput
254
0: string: Input is Uint8
Odd
253
0: bool: true
Low level interactions
CALLDATA
Transact
Home
requirestatement.sol
// Solidity program to
// demonstrate require
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract requireStatement {
// Defining function to
// check input
function checkInput(
uint _input) public view returns(
string memory){
require(_input >= 0, "invalid uint8");
require(_input <= 255, "invalid uint8");
return "Input is Uint8";
}
// Defining function to
// use require statement
function Odd(uint _input) public view returns(bool){
require(_input % 2 != 0);
return true;
}

```
// Solidity program to demonstrate assert statement
pragma solidity ^0.5.0;

// Creating a contract
contract assertStatement {

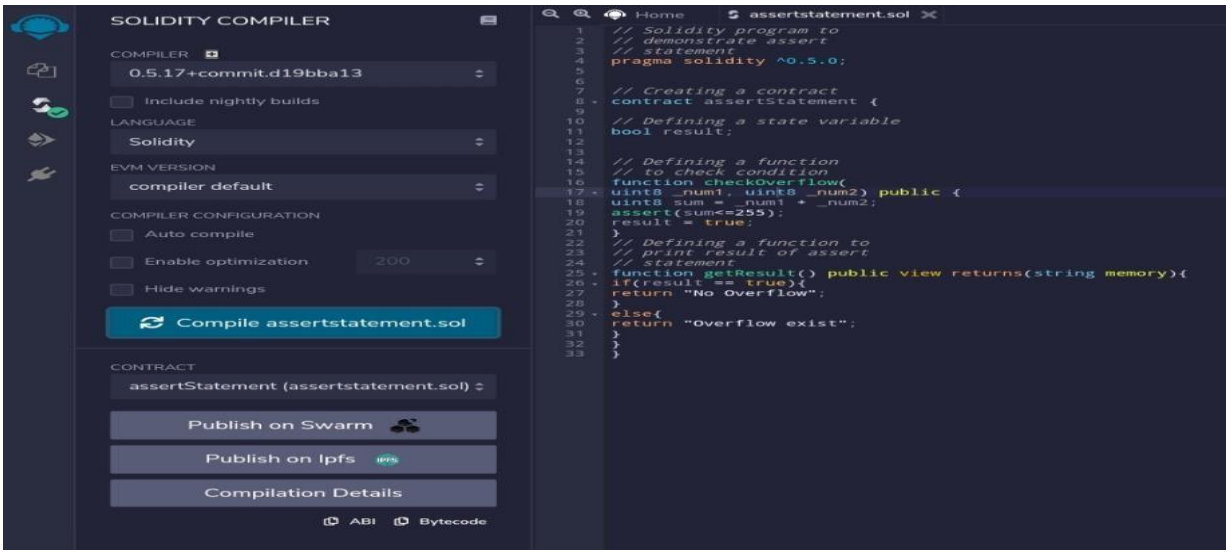
// Defining a state variable
bool result;

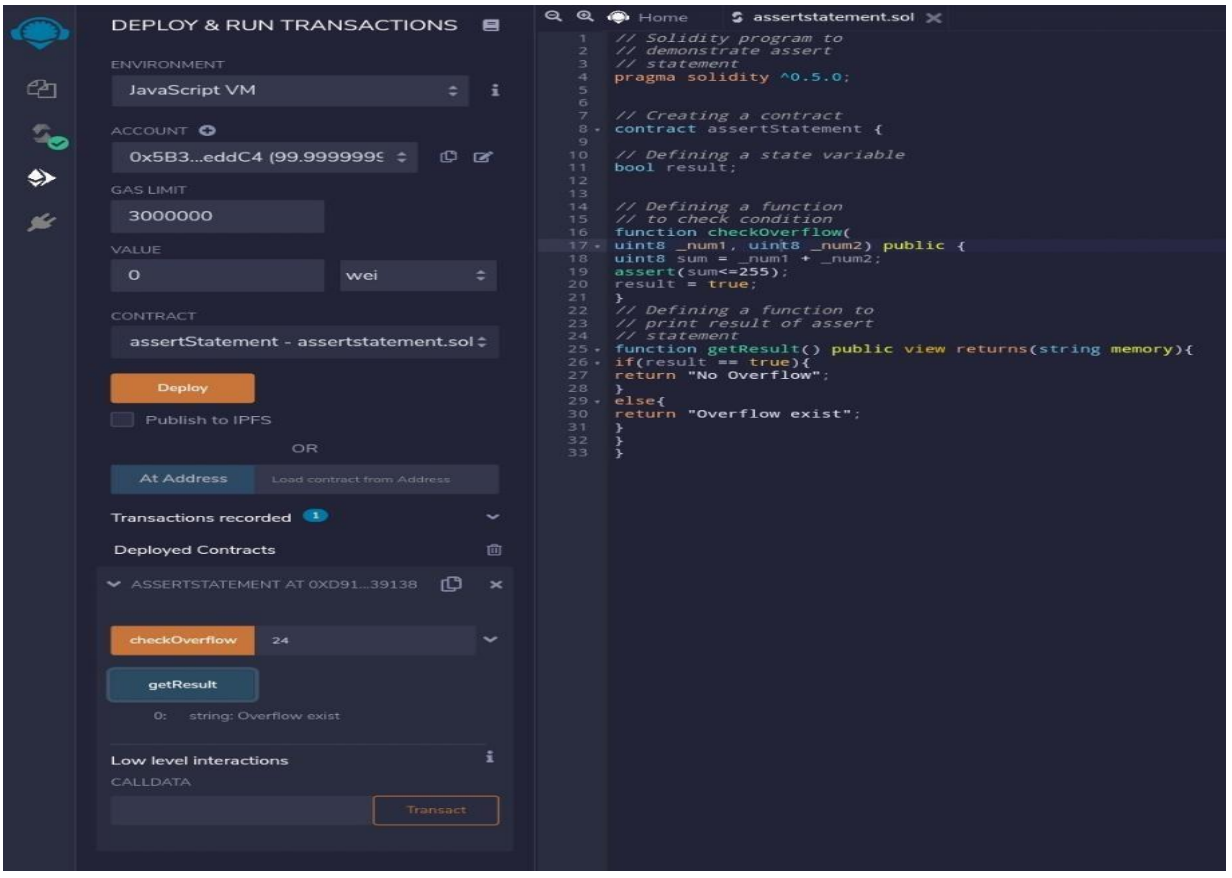
// Defining a function to check condition
function checkOverflow(
uint _num1, uint _num2) public {
uint8 sum = _num1 + _num2;
assert(sum<=255);
result = true;
}

// Defining a function to print result of assert statement
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}
}
```

Output:

BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile assertstatement.sol
CONTRACT
assertStatement (assertstatement.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Home
assertstatement.sol
// Solidity program to
// demonstrate assert
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract assertStatement {
// Defining a state variable
bool result;
// Defining a function
// to check condition
function checkOverflow(
uint8 _num1, uint8 _num2) public {
uint8 sum = _num1 + _num2;
assert(sum<=255);
result = true;
}
// Defining a function to
// print result of assert
// statement
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}
}


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
assertStatement - assertstatement.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded
1
Deployed Contracts
ASSERTSTATEMENT AT 0XD91...39138
checkOverflow
24
getResult
0: string: Overflow exist
Low level interactions
CALLDATA
Transact
Home
assertstatement.sol
// Solidity program to
// demonstrate assert
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract assertStatement {
// Defining a state variable
bool result;
// Defining a function
// to check condition
function checkOverflow(
uint8 _num1, uint8 _num2) public {
uint8 sum = _num1 + _num2;
assert(sum<=255);
result = true;
}
// Defining a function to
// print result of assert
// statement
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}
}

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pragma solidity ^0.5.0;

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contract assertStatement {

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// Defining a function
// to check condition
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assert(sum<=255);
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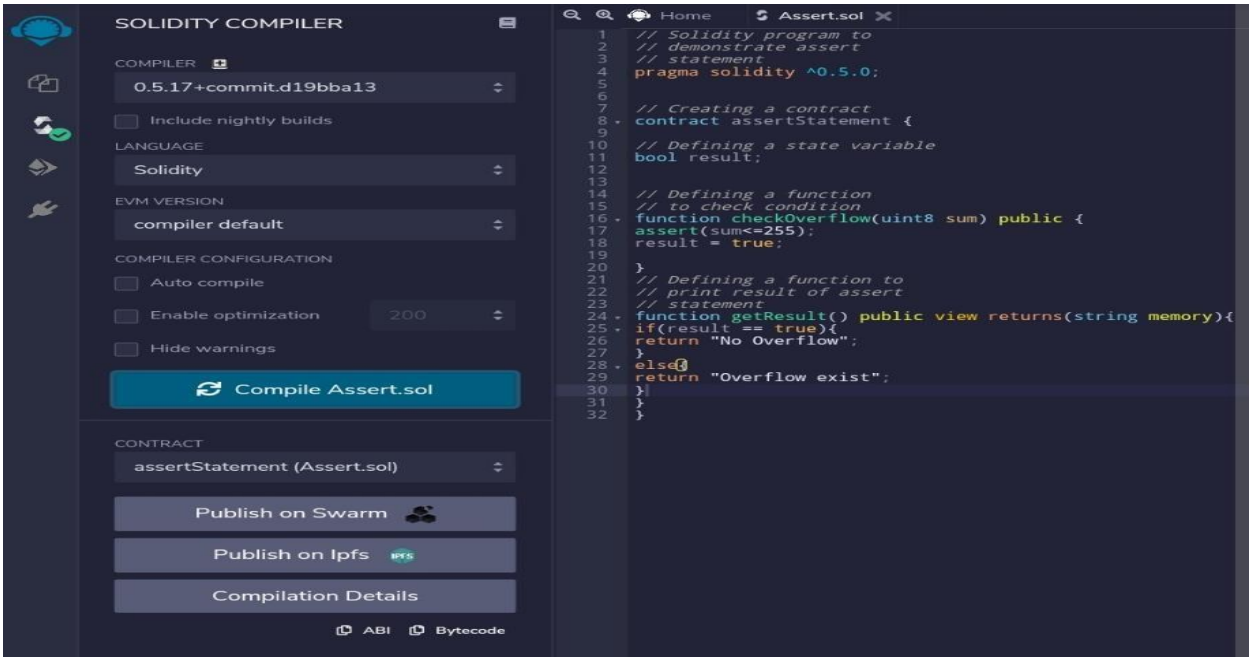
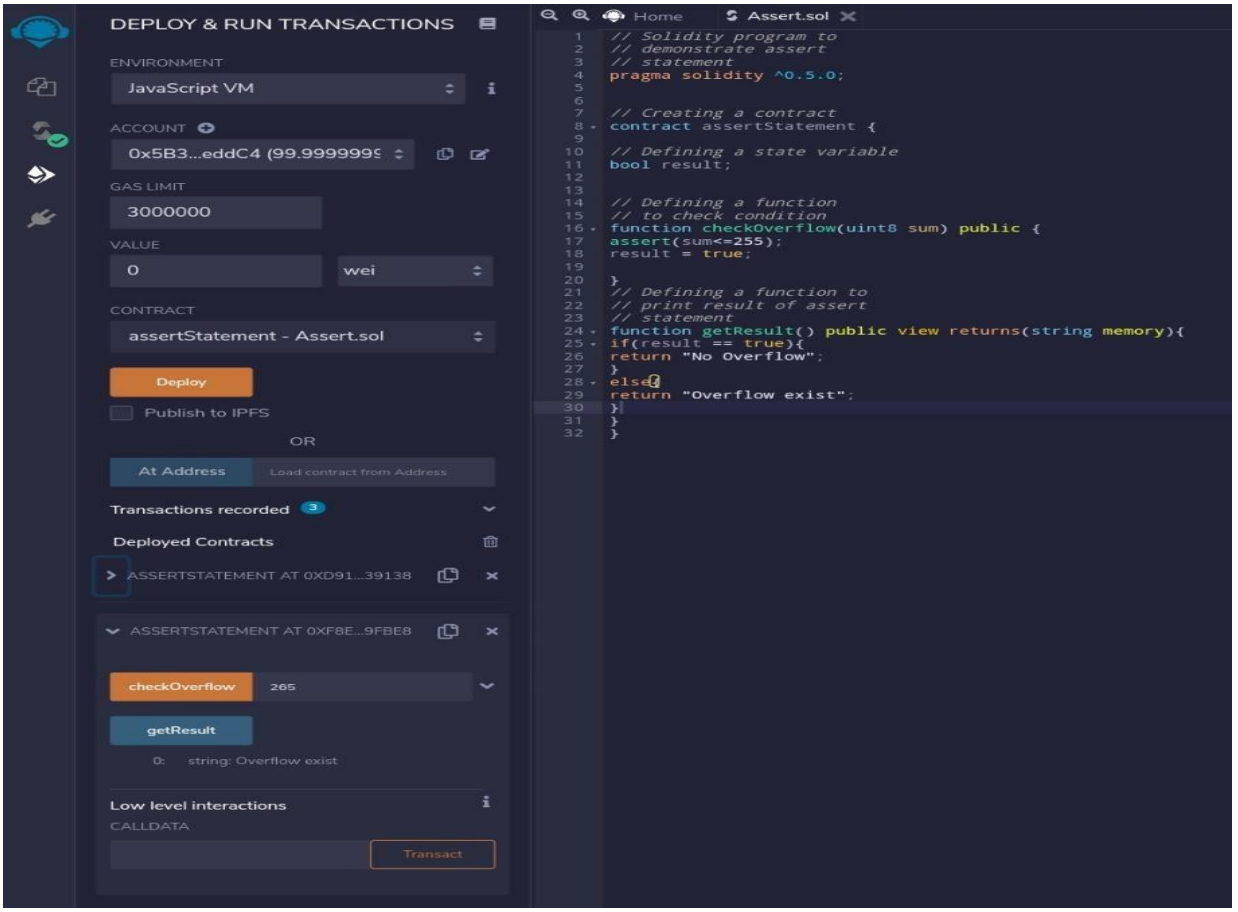
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}
}
```

Output:

BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile Assert.sol
CONTRACT
assertStatement (Assert.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
ABI
Bytecode
Home
Assert.sol
// Solidity program to
// demonstrate assert
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract assertStatement {
// Defining a state variable
bool result;
// Defining a function
// to check condition
function checkOverflow(uint8 sum) public {
assert(sum<=255);
result = true;
}
// Defining a function to
// print result of assert
// statement
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}
}


DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
JavaScript VM
ACCOUNT
0x5B3...eddC4 (99.999999
GAS LIMIT
3000000
VALUE
0
wei
CONTRACT
assertStatement - Assert.sol
Deploy
Publish to IPFS
OR
At Address
Load contract from Address
Transactions recorded 3
Deployed Contracts
ASSERTSTATEMENT AT 0XD91...39138
ASSERTSTATEMENT AT 0XF8E...9FBE8
checkOverflow
265
getResult
0: string: Overflow exist
Low level interactions
CALLDATA
Transact
Home
Assert.sol
// Solidity program to
// demonstrate assert
// statement
pragma solidity ^0.5.0;
// Creating a contract
contract assertStatement {
// Defining a state variable
bool result;
// Defining a function
// to check condition
function checkOverflow(uint8 sum) public {
assert(sum<=255);
result = true;
}
// Defining a function to
// print result of assert
// statement
function getResult() public view returns(string memory){
if(result == true){
return "No Overflow";
}
else{
return "Overflow exist";
}
}

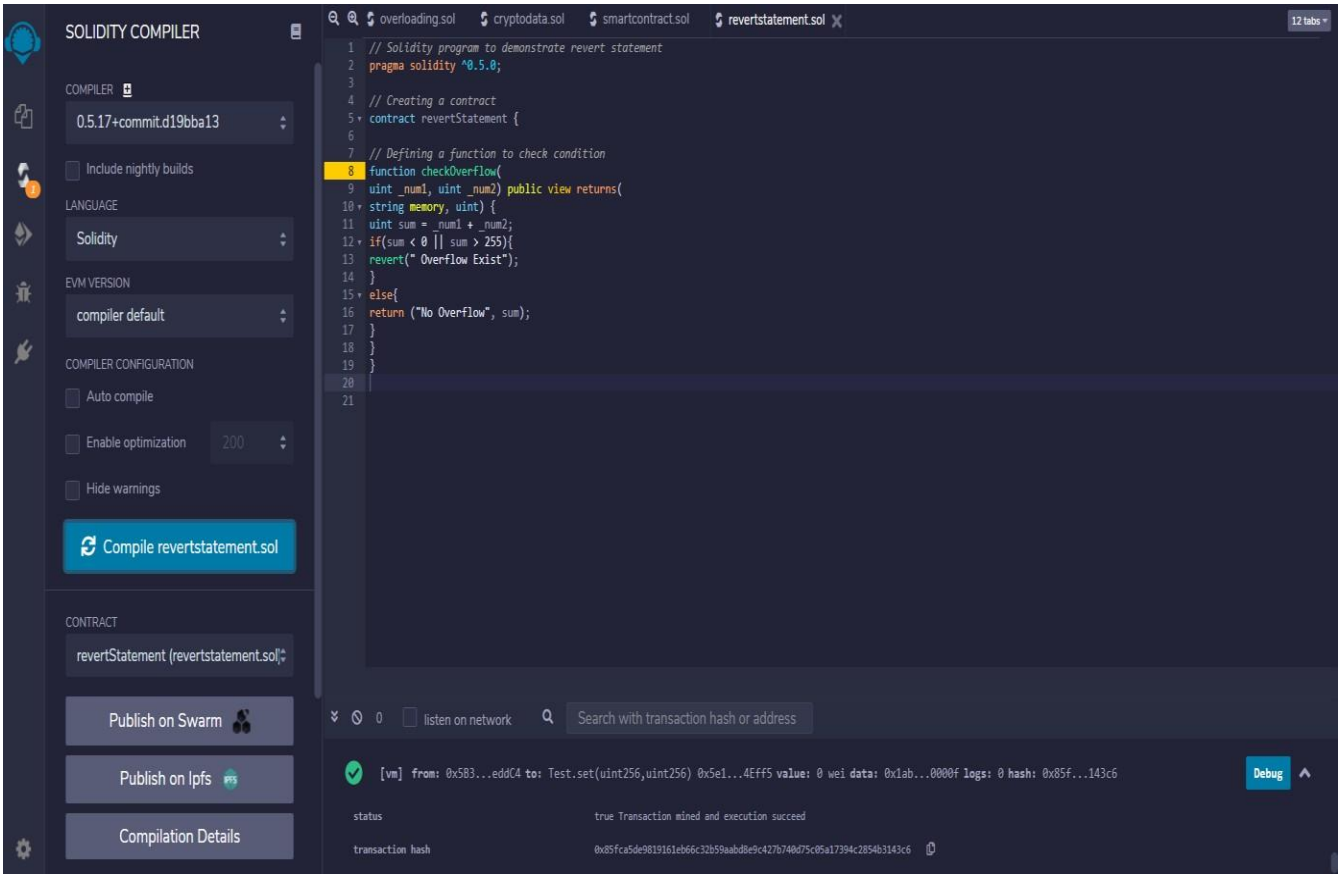
```
// Solidity program to demonstrate revert statement
pragma solidity ^0.5.0;

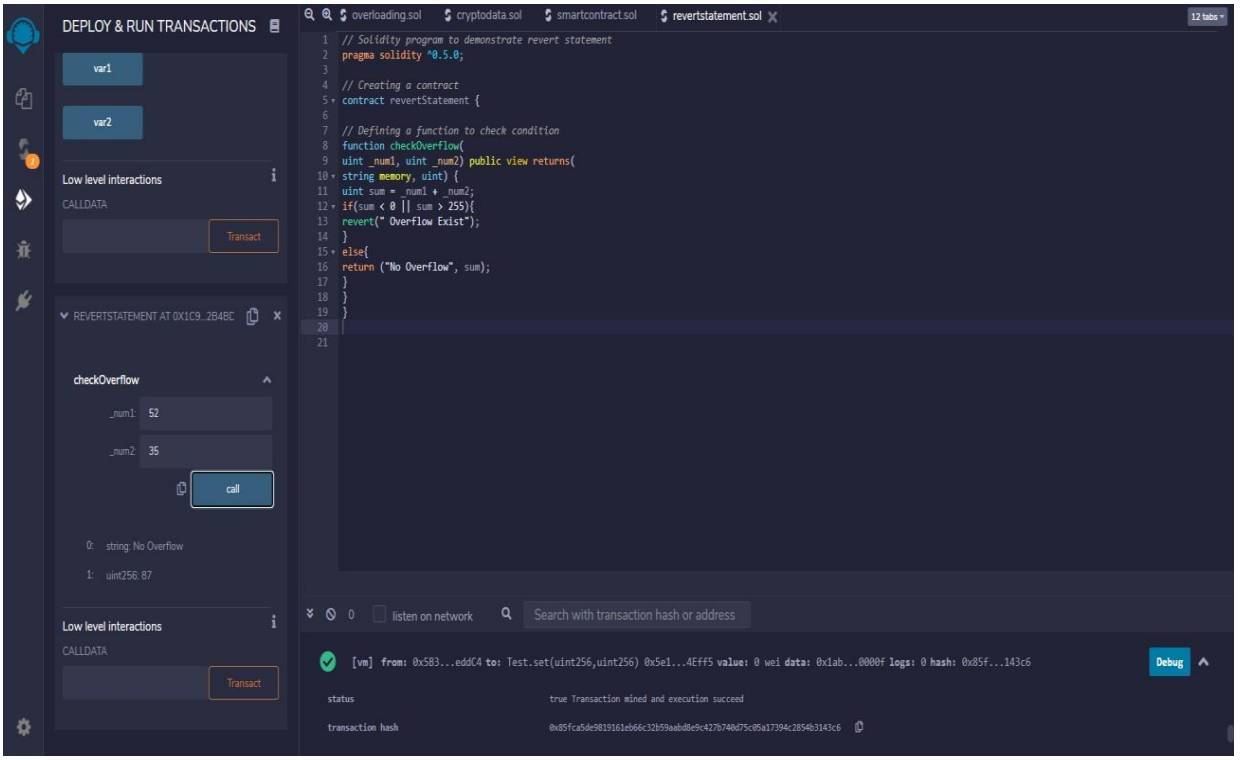
// Creating a contract
contract revertStatement {

// Defining a function to check condition
function checkOverflow(
uint _num1, uint _num2) public view returns(
string memory, uint) {
uint sum = _num1 + _num2;
if(sum < 0 || sum > 255){
revert(" Overflow Exist");
}
else{
return ("No Overflow", sum);
}
}
}
}
```

Output:

BLOCKCHAIN


SOLIDITY COMPILER
COMPILER
0.5.17+commit.d19bba13
Include nightly builds
LANGUAGE
Solidity
EVM VERSION
compiler default
COMPILER CONFIGURATION
Auto compile
Enable optimization
200
Hide warnings
Compile revertstatement.sol
CONTRACT
revertStatement (revertstatement.sol)
Publish on Swarm
Publish on Ipfs
Compilation Details
overloading.sol
cryptodata.sol
smartcontract.sol
revertstatement.sol
12 tabs
// Solidity program to demonstrate revert statement
pragma solidity ^0.5.0;
// Creating a contract
contract revertStatement {
// Defining a function to check condition
function checkOverflow(
uint _num1, uint _num2) public view returns(
string memory, uint) {
uint sum = _num1 + _num2;
if(sum < 0 || sum > 255){
revert(" Overflow Exist");
}
else{
return ("No Overflow", sum);
}
}
}
listen on network
Search with transaction hash or address
[vm] from: 0x583...eddC4 to: Test.set(uint256,uint256) 0x5e1...4Eff5 value: 0 wei data: 0x1ab...0000f logs: 0 hash: 0x85f...143c6
Debug
status
true Transaction mined and execution succeed
transaction hash
0x85fca5de9819161eb66c32b59aabd8e9c427b740d75c05a17394c2854b3143c6


DEPLOY & RUN TRANSACTIONS
var1
var2
Low level interactions
CALLDATA
Transact
REVERTSTATEMENT AT 0X1C9...2B4BC
checkOverflow
_num1: 52
_num2: 35
call
0: string: No Overflow
1: uint256: 87
Low level interactions
CALLDATA
Transact
overloading.sol
cryptodata.sol
smartcontract.sol
revertstatement.sol
12 tabs
// Solidity program to demonstrate revert statement
pragma solidity ^0.5.0;
// Creating a contract
contract revertStatement {
// Defining a function to check condition
function checkOverflow(
uint _num1, uint _num2) public view returns(
string memory, uint) {
uint sum = _num1 + _num2;
if(sum < 0 || sum > 255){
revert(" Overflow Exist");
}
else{
return ("No Overflow", sum);
}
}
}
listen on network
Search with transaction hash or address
[vm] from: 0x583...eddC4 to: Test.set(uint256,uint256) 0x5e1...4Eff5 value: 0 wei data: 0x1ab...0000f logs: 0 hash: 0x85f...143c6
Debug
status
true Transaction mined and execution succeed
transaction hash
0x85fca5de9819161eb66c32b59aabd8e9c427b740d75c05a17394c2854b3143c6