Experiment No.8
To create a private ethereum blockchain using Ganache and Truffle
Date of Performance:5—10—23
Date of Submission:10—10—23

AIM: To create a private ethereum blockchain using Ganache and Truffle

Objective: To create private ethereum blockchain and deploy smart contract on it

Theory:

Smart contracts are programs stored on a blockchain. The term 'smart contract' was first coined by Nick Szabo in 1994. It's a collection of code (its functions) and data (its state) that resides at a specific address on the Ethereum blockchain. One of the main features is that they are immutable once deployed on the blockchain. Solidity and Vyper are the two most active programming languages used to write smart contracts on the Ethereum blockchain with Solidity being the top choice for most developers as it is an object-oriented, statically-typed language and is strongly influenced by more popular OOP languages like JavaScript and C++.

Ganache

Ganache is a personalized blockchain for Ethereum development. It can be used to run tests, execute commands, and inspect states while controlling how the chain operates. Ganache is an Ethereum simulator that makes developing Ethereum applications faster, easier, and safer. It is provided by Truffle Suite and can be downloaded from https://www.trufflesuite.com/ganache. The below image shows the view of Ganache

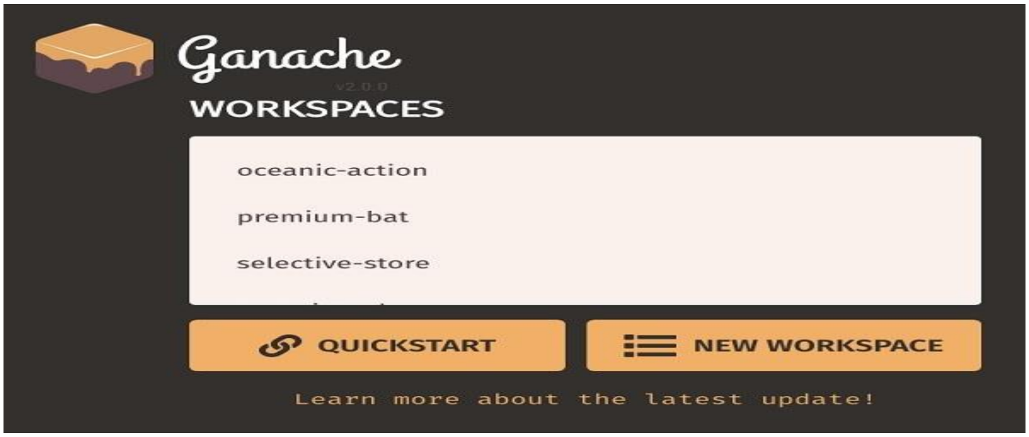


Fig.8.1 Ganache view

Truffle

Truffle is the most popular development framework for Ethereum. Truffle takes care of managing your contract artifacts so you don't have to. Includes support for custom deployments, library linking and complex Ethereum applications. Truffle is used to test contracts in both javascript and solidity.

Process:

Step 1. Install Ganache , Download Ganache from the website https://truffleframework.com/ganache

Step 2. Install Truffle by executing the following command at the command prompt:

```
npm install –g truffle
```

To install Truffle you need to have Node and NPM along with Python setup on your machine.

Step 3. To verify if Truffle is installed successfully, execute the following command at the command prompt.

```
truffle version
```

Step 4. To start a project in Truffle, go into a directory and type the init command:

```
truffle init
```

This will create a new project with the required directory: contracts, migrations, test

Step 5. Create the required contract file in solidity and save it in the contracts directory

Step 6. Create a migration file in javascript and save it in migrations directory

Step 7. Run the following command to deploy the contract on Ganache

```
truffle Test
```

Ganache should be running while executing this command. The contract deployed will be visible in the contracts tab of the Ganache.

Code:

Election.sol

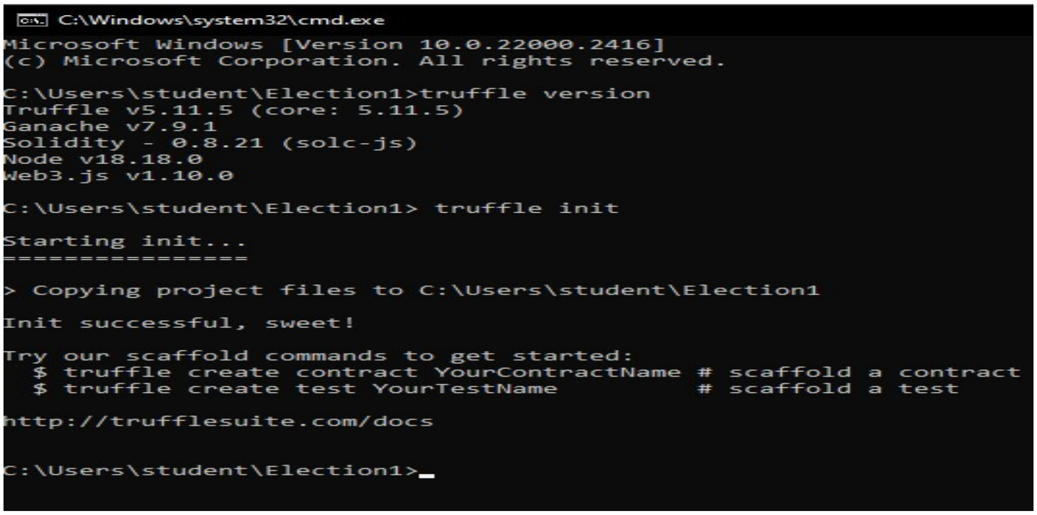
```
pragma solidity ^0.5.16;

contract Election {

  // Model a Candidate

  struct Candidate {

     uint id;

     string name;

     uint voteCount;

  }

  // Store accounts that have voted

  mapping(address => bool) public voters;

  // Read/write candidates

  mapping(uint => Candidate) public candidates;

  // Store Candidates Count

  uint public candidatesCount;
```

```
    constructor () public {

        addCandidate("Candidate 1");

        addCandidate("Candidate 2");

    }

    function addCandidate (string memory _name) private {

        candidatesCount ++;

        candidates[candidatesCount] = Candidate(candidatesCount, _name, 0);

    }

    function vote (uint _candidateId) public {

        // require that they haven't voted before

        require(!voters[msg.sender]);

        // require a valid candidate

        require(_candidateId > 0 && _candidateId <= candidatesCount);

        // record that voter has voted

        voters[msg.sender] = true;

        // update candidate vote Count

        candidates[_candidateId].voteCount ++;}

}
```

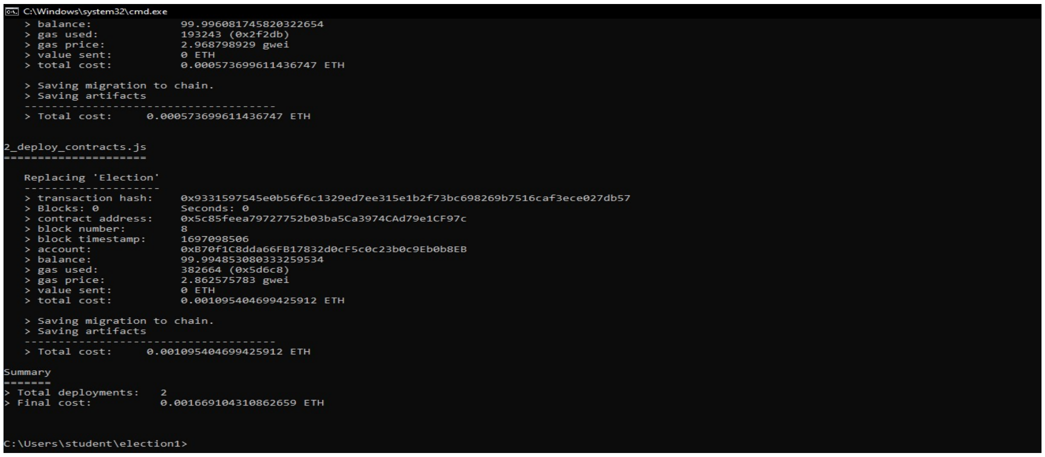
2_deploy_contracts

```
var Election = artifacts.require("./Election.sol");

module.exports = function(deployer) {

  deployer.deploy(Election);

};
```

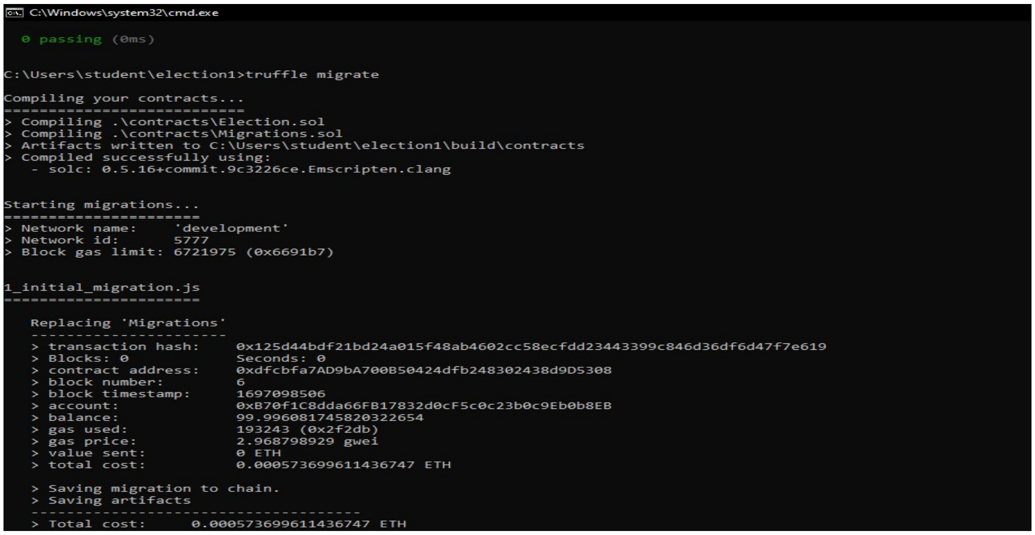
Output:



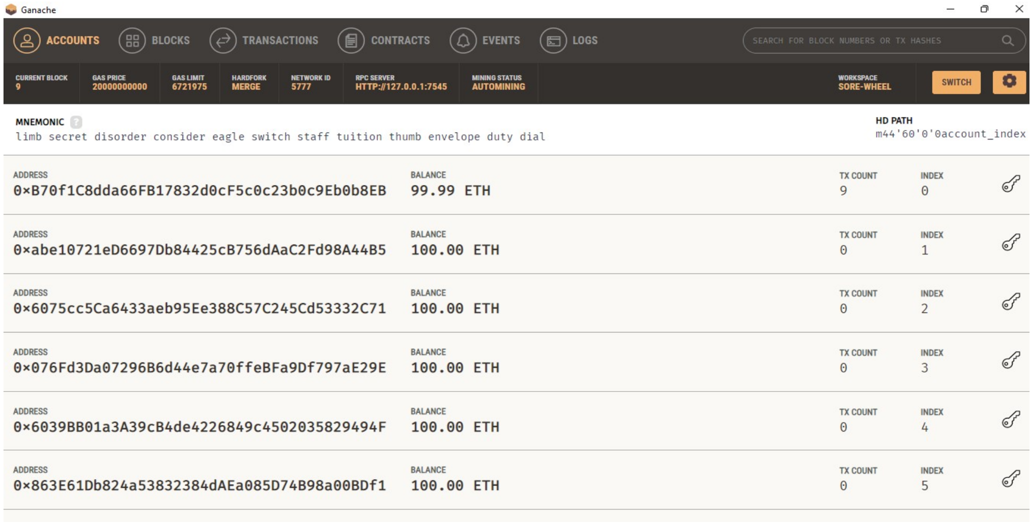
```
Microsoft Windows [Version 10.0.22000.2416]
(c) Microsoft Corporation. All rights reserved.

C:\Users\student\Election1>truffle version
Truffle v5.11.5 (core: 5.11.5)
Ganache v7.9.1
Solidity - 0.8.21 (solc-js)
Node v18.18.0
Web3.js v1.10.0

C:\Users\student\Election1> truffle init

Starting init...
================

> Copying project files to C:\Users\student\Election1

Init successful, sweet!

Try our scaffold commands to get started:
  $ truffle create contract YourContractName # scaffold a contract
  $ truffle create test YourTestName         # scaffold a test

http://trufflesuite.com/docs

C:\Users\student\Election1>_
```



```
   > balance:             99.996081745820322654
   > gas used:            193243 (0x2f2db)
   > gas price:           2.968798929 gwei
   > value sent:          0 ETH
   > total cost:          0.000573699611436747 ETH

   > Saving migration to chain.
   > Saving artifacts
   -------------------------------------
   > Total cost:     0.000573699611436747 ETH


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

   Replacing 'Election'
   --------------------
   > transaction hash:    0x9331597545e0b56f6c1329ed7ee315e1b2f73bc698269b7516caf3ece027db57
   > Blocks: 0            Seconds: 0
   > contract address:    0x5c85feea79727752b03ba5Ca3974CAd79e1CF97c
   > block number:        8
   > block timestamp:     1697098506
   > account:             0xB70f1C8dda66FB17832d0cF5c0c23b0c9Eb0b8EB
   > balance:             99.994853080333259534
   > gas used:            382664 (0x5d6c8)
   > gas price:           2.862575783 gwei
   > value sent:          0 ETH
   > total cost:          0.001095404699425912 ETH

   > Saving migration to chain.
   > Saving artifacts
   -------------------------------------
   > Total cost:     0.001095404699425912 ETH

Summary
=======
> Total deployments:   2
> Final cost:          0.001669104310862659 ETH


C:\Users\student\election1>
```



```
C:\Windows\system32\cmd.exe
  0 passing (0ms)

C:\Users\student\election1>truffle migrate

Compiling your contracts...
===========================
> Compiling .\contracts\Election.sol
> Compiling .\contracts\Migrations.sol
> Artifacts written to C:\Users\student\election1\build\contracts
> Compiled successfully using:
   - solc: 0.5.16+commit.9c3226ce.Emscripten.clang


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


1_initial_migration.js
======================

   Replacing 'Migrations'
   ----------------------
   > transaction hash:    0x125d44bdf21bd24a015f48ab4602cc58ecfdd23443399c846d36df6d47f7e619
   > Blocks: 0            Seconds: 0
   > contract address:    0xdfcbfa7AD9bA700B50424dfb248302438d9D5308
   > block number:        6
   > block timestamp:     1697098506
   > account:             0xB70f1C8dda66FB17832d0cF5c0c23b0c9Eb0b8EB
   > balance:             99.996081745820322654
   > gas used:            193243 (0x2f2db)
   > gas price:           2.968798929 gwei
   > value sent:          0 ETH
   > total cost:          0.000573699611436747 ETH

   > Saving migration to chain.
   > Saving artifacts
   -------------------------------------
   > Total cost:     0.000573699611436747 ETH
```

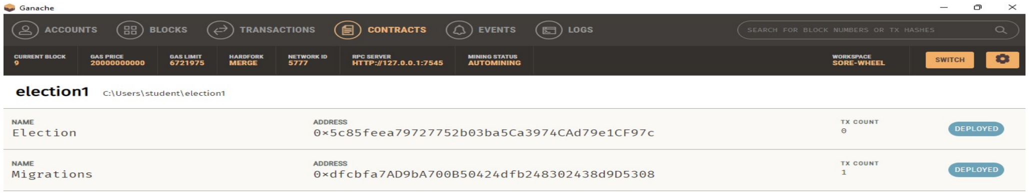


CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
9	20000000000	6721975	MERGE	5777	HTTP://127.0.0.1:7545	AUTOMINING	SORE-WHEEL

MNEMONIC
limb secret disorder consider eagle switch staff tuition thumb envelope duty dial

HD PATH
m44'60'0'0account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×B70f1C8dda66FB17832d0cF5c0c23b0c9Eb0b8EB	99.99 ETH	9	0
0×abe10721eD6697Db84425cB756dAaC2Fd98A44B5	100.00 ETH	0	1
0×6075cc5Ca6433aeb95Ee388C57C245Cd53332C71	100.00 ETH	0	2
0×076Fd3Da07296B6d44e7a70ffeBFa9Df797aE29E	100.00 ETH	0	3
0×6039BB01a3A39cB4de4226849c4502035829494F	100.00 ETH	0	4
0×863E61Db824a53832384dAEa085D74B98a00BDf1	100.00 ETH	0	5



CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
9	20000000000	6721975	MERGE	5777	HTTP://127.0.0.1:7545	AUTOMINING	SORE-WHEEL

election1 C:\Users\student\election1

NAME	ADDRESS	TX COUNT	
Election	0×5c85feea79727752b03ba5Ca3974CAd79e1CF97c	0	DEPLOYED
Migrations	0×dfcbfa7AD9bA700B50424dfb248302438d9D5308	1	DEPLOYED

Conclusion:

Ganache and Truffle serve as essential tools for establishing a private Ethereum blockchain. Ganache provides a convenient, lightweight local Ethereum network that simplifies the experimentation with smart contracts and decentralized applications (DApps) for developers. Meanwhile, Truffle offers a comprehensive set of tools for the development and deployment of smart contracts on the Ethereum platform, streamlining the entire process. When used in conjunction, Ganache and Truffle significantly optimize the development cycle, boosting efficiency, and reducing the intricacies associated with creating and testing Ethereum-based solutions. In summary, Ganache and Truffle are invaluable in facilitating the setup and deployment of personal Ethereum blockchains, primarily for development and experimentation purposes.