

Práctica 4

Ejercicio 1: ¡A votar!

Implementación de un sistema de votación:

1.1 Contrato DhondtElectionRegion

```
contract DhontElectionRegion {  
  
    uint immutable private regionId;  
  
    mapping(uint => uint) private weights;  
  
    uint[] internal results;  
  
    constructor(uint _nPartidos, uint _regionId) {  infinite gas 12600 gas  
        savedRegionInfo();  
        regionId = _regionId;  
        results = new uint[](_nPartidos);  
    }  
  
    function savedRegionInfo() internal {  infinite gas  
        weights[28] = 1; // Madrid  
        weights[8] = 1; // Barcelona  
        weights[41] = 1; // Sevilla  
        weights[44] = 5; // Teruel  
        weights[42] = 5; // Soria  
        weights[49] = 4; // Zamora  
        weights[9] = 4; // Burgos  
        weights[29] = 2; // Malaga  
    }  
  
    function registerVote(uint partido) internal returns (bool) {  infinite gas  
        if (partido < 0 || results.length <= partido)  
            return false;  
        results[partido] += weights[regionId];  
        return true;  
    }  
}
```

1.2 Contrato PollingStation

```
abstract contract PollingStation {

    bool public votingFinished;


    bool private votingOpen;


    address private president;


    constructor(address _president) {  - gas - gas
        president = _president;
        votingOpen = false;
        votingFinished = false;
    }


    modifier execPresident {
        require(msg.sender == president, "error (execPresident)");
        _;
    }

    modifier isVotingOpen {
        require(votingOpen, "error (isVotingOpen)");
        _;
    }

    function openVoting() external execPresident  - gas {
        require(!votingOpen, "error (openVoting)");
        votingOpen = true;
    }

    function closeVoting() external execPresident {  - gas
        require(!votingFinished, "error (closeVoting)");
        votingOpen = false;
        votingFinished = true;
    }

    function castVote(uint id) external virtual {}  - gas

    function getResults() external view virtual returns(uint[] memory) {}  - gas
}
```

1.3 Contrato DhondtPollingStation

```
contract DhontPollingStation is DhontElectionRegion, PollingStation {

    constructor(address presi, uint _nPartidos, uint regionId) DhontElectionRegion(_nPartidos, regionId) PollingStation(presi) {}

    function castVote(uint id) external override {
        require(registerVote(id), "error (castVote)");
    }

    function getResults() external view override returns(uint[] memory) {
        require(votingFinished, "error (getResults)");
        return results;
    }
}
```

1.4 Contrato Election

```
contract Election {

    mapping (address => bool) public votantes; // Es un mapa que funciona como un set

    address public autoridad; // Poner la visibilidad de esto

    uint private nPartidos;

    mapping (uint => DhontPollingStation) public sedes;

    uint[] private regiones;

    modifier onlyAuthority {
        require(msg.sender == autoridad, "error (onlyAuthority)");
        _;
    }

    modifier freshId(uint regionId) {
        require((address)(sedes[regionId]) == address(0), "error (freshId)");
        _;
    }

    modifier validId(uint regionId) {
        require((address)(sedes[regionId]) != address(0), "error (validId)");
        _;
    }

    modifier validPartido(uint partido) {
        require(partido < nPartidos, "error (validPartido)");
        _;
    }

    constructor(uint _nPartidos) {
        autoridad = msg.sender;
        nPartidos = _nPartidos;
    }

    function createPollingStation(uint regionId, address president) external freshId(regionId) onlyAuthority returns (DhontPollingStation) {
        sedes[regionId] = new DhontPollingStation(president, nPartidos, regionId);
        regiones.push(regionId);
        return sedes[regionId];
    }

    function castVote(uint regionId, uint partido) external validId(regionId) validPartido(partido) {
        require(!votantes[msg.sender], "error (castVote)");
        sedes[regionId].castVote(partido);
        votantes[msg.sender] = true;
    }

    function getResults() external view onlyAuthority returns (uint[] memory) {
        uint[] memory resultadosTotales = new uint[](nPartidos); // Se inicializa a 0 todos los partidos
        for (uint i = 0; i < regiones.length; ++i) {
            uint[] memory resultados = sedes[regiones[i]].getResults(); // Aqui se maneja que todas esten cerradas
            for (uint j = 0; j < resultados.length; ++j)
                resultadosTotales[j] += resultados[j];
        }
        return resultadosTotales;
    }
}
```

Ejercicio 2:

2.1

Role	Address
Authority	0x5B38Da6a701c568545dCfcB03FcB875f56beddC4
President 1	0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2
President 2	0x4B20993Bc481177ec7E8f571ceCaE8A9e22C02db
Voter 1	0x78731D3Ca6b7E34aC0F824c42a7cC18A495cabaB
Voter 2	0x617F2E2fD72FD9D5503197092aC168c91465E7f2
Voter 3	0x17F6AD8Ef982297579C203069C1DbfFE4348c372
Voter 4	0x5c6B0f7Bf3E7ce046039Bd8FABdfD3f9F5021678
Voter 5	0x03C6FcED478cBbC9a4FAB34eF9f40767739D1Ff7

2.2

Creamos un contrato Election con la dirección de Authority y 3 partidos:

```
[vm] from: 0x5B3...eddC4 to: Election.(constructor) value: 0 wei data: 0x608...00003 logs: 0 hash: 0x342...bdf80

status                                0x1 Transaction mined and execution succeed

transaction hash                       0x34260ad0164559f8d682ded9d51b6f38408c09364a494cdf370804df922bdf80 ⓘ

block hash                            0x5dcfba0bd497dd52e47ada8f943684fc9fbd5bfeaa6367fd914f6d69867ccf9f ⓘ

block number                          52 ⓘ

contract address                      0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

from                                  0x5B38Da6a701c568545dCfc803Fc8875f56beddC4 ⓘ

to                                    Election.(constructor) ⓘ

gas                                    1406851 gas ⓘ

transaction cost                       1223688 gas ⓘ

execution cost                         1092684 gas ⓘ

input                                  0x608...00003 ⓘ

decoded input                          {
                                         "uint256 _nPartidos": "73452093890636736710135851689417889144122135119992709277622146450112049122718"
                                   } ⓘ

decoded output                         - ⓘ

logs                                   [] ⓘ ⓘ
```

2.3

Creamos las dos sedes electorales, la primera en Madrid y la segunda en Teruel mediante la función **createPollingStation** con las direcciones del president 1 y el president 2.

President1: 0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2

Sede: Madrid Id: 28

Dirección de la sede creada: 0x18bFF3b399EAcBBcFea6709053ad1709fc073690

```
[vm] from: 0x5B3...eddC4 to: Election.createPollingStation(uint256,address) 0x332...D486D value: 0 wei data: 0xa44...35cb2 logs: 0 hash: 0x27f...ed6bb

status                                0x1 Transaction mined and execution succeed

transaction hash                       0x27f0cc2fa01bc1a614a1917c97ca2e52085006ac78f49483ef9b1b1c1e8ed6bb ⓘ

block hash                            0xa0bb82045f09d26ecfa84681f14b63abff938356755e895831bd7d0ce81d98c9 ⓘ

block number                          53 ⓘ

from                                  0x5B38Da6a701c568545dCfc803Fc8875f56beddC4 ⓘ

to                                    Election.createPollingStation(uint256,address) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

gas                                    770192 gas ⓘ

transaction cost                       669732 gas ⓘ

execution cost                         648160 gas ⓘ

input                                  0xa44...35cb2 ⓘ

decoded input                          {
                                         "uint256 regionId": "28",
                                         "address president": "0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2"
                                   } ⓘ

decoded output                         {
                                         "0": "address: 0x18bFF3b399EAcBBcFea6709053ad1709fc073690"
                                   } ⓘ

logs                                   [] ⓘ ⓘ
```

President2: 0x4B20993Bc481177ec7E8f571ceCaE8A9e22C02db

Sede: Teruel Id: 44

Dirección de la sede creada: 0x1Eae946CaB3Cfa4cAf87226bf6886208619C0948

✓ [vm]	from: 0x5B3...eddC4 to: Election.createPollingStation(uint256,address) 0x332...D486D value: 0 wei data: 0xa44...c02db logs: 0 hash: 0xcdc...9a824		
status	0x1 Transaction mined and execution succeed		
transaction hash	0xcdc5a557200e41ce9bf28b4490d18e731aaf4f757f9245f2af509b73c639a824		
block hash	0x8b57841320cb9f8d7488cbd80c1648edaf00ef9f89babace2d677a1085ad73e7		
block number	54		
from	0x5B38Da6a701c56854dCfc803Fc8875f56beddC4		
to	Election.createPollingStation(uint256,address) 0x3328358128832A260C76A4141e19E2A943CD486D		
gas	750527 gas		
transaction cost	652632 gas		
execution cost	631060 gas		
input	0xa44...c02db		
decoded input	{ "uint256 regionId": "44", "address president": "0x4B20993Bc481177ec7E8f571ceCaE8A9e22C02db" }		
decoded output	{ "0": "address: 0x1Eae946CaB3Cfa4cAf87226bf6886208619C0948" }		
logs	[]		

2.4.

Cada presidente llama a la función openVoting:

Transacción del President1 para openVoting:

```
✓ [vm] from: 0xAb8...35cb2 to: DhontPollingStation.openVoting() 0x18b...73690 value: 0 wei data: 0xaff...c0670 logs: 0 hash: 0x9db...31c08

status          0x1 Transaction mined and execution succeed
transaction hash 0x9dbeff4618c6e5ac57c12a097b4ec2d4a0d2e9f09cc940fcd34f8c8b91631c08 ⓘ
block hash      0x60f565ccc3035d2e85bb5ce0f98d83b6debd31415fcfd3b7183da01502990c3 ⓘ
block number    55 ⓘ
from            0xAb8483f64d9C6d1EcF9b849Ae677dD3315835cb2 ⓘ
to              DhontPollingStation.openVoting() 0x18bff3b399EAcb8cFea6709053ad1709fc073690 ⓘ
gas             30811 gas ⓘ
transaction cost 26792 gas ⓘ
execution cost   5728 gas ⓘ
input           0xaff...c0670 ⓘ
decoded input    {} ⓘ
decoded output    {} ⓘ
logs            [] ⓘ ⓘ

transact to DhontPollingStation.openVoting pending ...
```

Transacción del President2 para openVoting:

```
✓ [vm] from: 0x482...C02db to: DhontPollingStation.openVoting() 0x1Ea...C0948 value: 0 wei data: 0xaff...c0670 logs: 0 hash: 0xca8...9f9a8

status          0x1 Transaction mined and execution succeed
transaction hash 0xca86606062996228ebe3c90e82d908aa0f68882faf1b59e7a0c0f7f0eb89f9a8 ⓘ
block hash      0x2268ce9bbe947572ab3ff8ac18d430edbf6a7efa3ca3de50c9e33833c7c45e03 ⓘ
block number    56 ⓘ
from            0x4820993Bc481177ec7E8f571ceCaE8A0e22C02db ⓘ
to              DhontPollingStation.openVoting() 0x1Eae946CaB3Cfa4cAf87226bf6886208619C0948 ⓘ
gas             30811 gas ⓘ
transaction cost 26792 gas ⓘ
execution cost   5728 gas ⓘ
input           0xaff...c0670 ⓘ
decoded input    {} ⓘ
decoded output    {} ⓘ
logs            [] ⓘ ⓘ
```

2.5

Emitimos un voto con cada una de las siguientes direcciones mediante la función castVote:

Voter1: Partido 1 en Madrid.

```
✓ [vm] from: 0x787...caba8 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00001 logs: 0 hash: 0xd99...96cf3

status          0x1 Transaction mined and execution succeed
transaction hash 0xd990c3ac78276f260e7a62be4f97b47529dc0bb608f0dbc48096d616f8396cf3 ⓘ
block hash      0xbf7ced5e4eb5f5b61a00235392ce35869cd1cd69530eb1e2c2d133e7a390d58b ⓘ
block number    57 ⓘ
from            0x78731D3Ca6b7E34aC0F824c42a7c18A495caba8 ⓘ
to              Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ
gas             90269 gas ⓘ
transaction cost 78494 gas ⓘ
execution cost   57150 gas ⓘ
input           0x2c0...00001 ⓘ
decoded input    {
                  "uint256 regionId": "28",
                  "uint256 partido": "1"
                } ⓘ
decoded output   {} ⓘ
logs            [] ⓘ ⓘ
```

Voter2: Partido 0 en Teruel.

```
✓ [vm] from: 0x617...5E7f2 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00000 logs: 0 hash: 0xf44...4ee5e

status          0x1 Transaction mined and execution succeed
transaction hash 0xf44d42a03890e8333d813959eb22b3d16d161365a933a4f8835600bbcd4ee5e ⓘ
block hash      0x4cb2b73d3e870ad2fccfe6de2265163a52b128da389a6d43c0b84292d6987214 ⓘ
block number    58 ⓘ
from            0x617F2E2fD72FD9D5503197092aC168c91465E7f2 ⓘ
to              Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ
gas             90255 gas ⓘ
transaction cost 78482 gas ⓘ
execution cost   57150 gas ⓘ
input           0x2c0...00000 ⓘ
decoded input    {
                  "uint256 regionId": "44",
                  "uint256 partido": "0"
                } ⓘ
decoded output   {} ⓘ
logs            [] ⓘ ⓘ
```


Voter3: Partido 2 en Madrid.

[vm] from: 0x17F...8c372 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00002 logs: 0 hash: 0x86e...34715

status	0x1 Transaction mined and execution succeed
transaction hash	0x86e95b0c253d4a987b0752a8f3de787d76b5adfc0be15549f6fb7e2232534715 🔗
block hash	0x11ade9b047dd21f7350e54b39ff69439c3ab1c032a1827806ce20e782877ace6 🔗
block number	59 🔗
from	0x17f6AD8Ef982297579C203069C1DbfFE4348c372 🔗
to	Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D 🔗
gas	90269 gas 🔗
transaction cost	78494 gas 🔗
execution cost	57150 gas 🔗
input	0x2c0...00002 🔗
decoded input	<div><div>{</div><div><div>"uint256 regionId": "28",</div><div>"uint256 partido": "2"</div></div><div>}</div></div> 🔗
decoded output	<div><div>{}</div></div> 🔗
logs	<div><div>[]</div></div> 🔗 🔗

Voter4: Partido 1 en Madrid.

[vm] from: 0x5c6...21678 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00001 logs: 0 hash: 0x124...144af

status	0x1 Transaction mined and execution succeed
transaction hash	0x1244c9bc4e9be2f22953634dab4eec62c1dd173f865886ae2f3a39ac04c144af 🔗
block hash	0x57a75a8d3bf9e27e028ff415be02a8091f655e2dffa42ae8228115bfe9358ca 🔗
block number	60 🔗
from	0x5c680f7Bf3E7ce046039Bd8FABdFD3f9F5021678 🔗
to	Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D 🔗
gas	70604 gas 🔗
transaction cost	61394 gas 🔗
execution cost	40050 gas 🔗
input	0x2c0...00001 🔗
decoded input	<div><div>{</div><div><div>"uint256 regionId": "28",</div><div>"uint256 partido": "1"</div></div><div>}</div></div> 🔗
decoded output	<div><div>{}</div></div> 🔗
logs	<div><div>[]</div></div> 🔗 🔗

President1: Partido 1 en Madrid.

```
✓ [vm] from: 0xAb8...35cb2 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00001 logs: 0 hash: 0x244...5ae20

status                                0x1 Transaction mined and execution succeed

transaction hash                       0x2448503112eae0b60d3e6618d37a9dbda4478cb1b43a872a27a9308ba045ae20 ⓘ

block hash                            0xe79ac10ccfc08826cca5469dc52e7d528a8c25b7d2dff59e89bbab70b2a44b3 ⓘ

block number                           61 ⓘ

from                                   0xAb8483f64d9C6d1EcF9b849Ae677dD3315835cb2 ⓘ

to                                     Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

gas                                     70604 gas ⓘ

transaction cost                       61394 gas ⓘ

execution cost                         40050 gas ⓘ

input                                  0x2c0...00001 ⓘ

decoded input                          {
                                     "uint256 regionId": "28",
                                     "uint256 partido": "1"
                                   } ⓘ

decoded output                         {} ⓘ

logs                                   [] ⓘ ⓘ
```

Voter5: Partido 0 en Teruel.

```
✓ [vm] from: 0x03C...D1Ff7 to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00000 logs: 0 hash: 0x82d...58c50

status                                0x1 Transaction mined and execution succeed

transaction hash                       0x82dcd081f359a1e12bc4a4117c7922d79404fec0cd89afac33b1cca11f058c50 ⓘ

block hash                            0x5e72ce24e34f9e9ecb8ed6020c0ae46320dc732e208ed24bbe7084b226738f7e ⓘ

block number                           62 ⓘ

from                                   0x03C6FcED478c8bc9a4fA834eF9f4076773901Ff7 ⓘ

to                                     Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

gas                                     70590 gas ⓘ

transaction cost                       61382 gas ⓘ

execution cost                         40050 gas ⓘ

input                                  0x2c0...00000 ⓘ

decoded input                          {
                                     "uint256 regionId": "44",
                                     "uint256 partido": "0"
                                   } ⓘ

decoded output                         {} ⓘ

logs                                   [] ⓘ ⓘ
```

President2: Partido 1 en Teruel.

```
✓ [vm] from: 0x4B2...C02db to: Election.castVote(uint256,uint256) 0x332...D486D value: 0 wei data: 0x2c0...00001 logs: 0 hash: 0x46c...65f6a

status                                0x1 Transaction mined and execution succeed

transaction hash                       0x46cf9aaf95e9adf51fbd792d29cdd9985563f985b1b4b443378a41895c965f6a ⓘ

block hash                             0x33ecb1eea2e7f78d91ab984e05271ebdc81ae9040dc9bd5f9ba9f0733fda9967 ⓘ

block number                           63 ⓘ

from                                   0x4B209938c481177ec7E8f571ceCaE8A9e22C02db ⓘ

to                                    Election.castVote(uint256,uint256) 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

gas                                    90269 gas ⓘ

transaction cost                        78494 gas ⓘ

execution cost                         57150 gas ⓘ

input                                  0x2c0...00001 ⓘ

decoded input                          {
    "uint256 regionId": "44",
    "uint256 partido": "1"
} ⓘ

decoded output                         {} ⓘ

logs                                   [] ⓘ ⓘ
```

2.6

Llamamos a la función `getResults` con la dirección de la Authority:

```
call [call] from: 0x58380a6a701c568545dCfcB03fcB875f56beddC4 to: Election.getResults() data: 0x471...7f97c

from                                   0x58380a6a701c568545dCfcB03fcB875f56beddC4 ⓘ

to                                    Election.getResults() 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

execution cost                        16516 gas (Cost only applies when called by a contract) ⓘ

input                                  0x471...7f97c ⓘ

decoded input                         {} ⓘ

decoded output                        {
  "error": "failed to decode output: Error: overflow [ See: https://links.ethers.org/v5-errors-NUMERIC_FAULT-overflow ] {fault:\\"overflow\\", operation:\\"toNumber\\", value:\\"3963877391197344453575983046348115674221708746828753546331534351588865746044\\", code=NUMERIC_FAULT, version=bignumber/s.7.0}"
} ⓘ

logs                                   [] ⓘ ⓘ

call to Election.getResults errored: Error occurred: revert.

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

Se puede ver que, como en las sedes no han cerrado las votaciones, se revierte la llamada.

2.7

Cerramos las votaciones con ambos presidentes con la función closeVoting:

closeVoting de Presidente 1:

```
✓ [vm] from: 0xAb8...35cb2 to: DhontPollingStation.closeVoting() 0x18b...73690 value: 0 wei data: 0xc63...1b292 logs: 0 hash: 0x26e...3c613
status                                0x1 Transaction mined and execution succeed
transaction hash                       0x26ef5b913dfc406096ad4c1620cd32743c276f76d10a864c33d8de16eda3c613
block hash                            0x4877b47c68365e89ca76b084c83f217748f1349a7b8a0c4aaa700847c3b62ab5
block number                           64
from                                   0xAb8483f64d9c6d1EcF9b849Ae677d03315835cb2
to                                     DhontPollingStation.closeVoting() 0x18bffa3b399EAc88cFea6709053ad1709fc073690
gas                                    31086 gas
transaction cost                       27031 gas
execution cost                         5967 gas
input                                  0xc63...1b292
decoded input                          {}
decoded output                         {}
logs                                   []
transact to DhontPollingStation.closeVoting pending ...
```

closeVoting de Presidente 2:

```
✓ [vm] from: 0x4B2...C02db to: DhontPollingStation.closeVoting() 0x1Ea...C0948 value: 0 wei data: 0xc63...1b292 logs: 0 hash: 0x746...b9802
status                                0x1 Transaction mined and execution succeed
transaction hash                       0x74606623935ecf801cddb0ef6ed1546c546b93aad1890e7df52e5e27ee5b9802
block hash                            0x62e7b0af46e50c92155ba6af3ad56a5178d56b79b367e6b55d02174ec0299f4
block number                           65
from                                   0x4B209938c481177ec7E8f571ceCaE8A9e22C02db
to                                     DhontPollingStation.closeVoting() 0x1Eae946Ca83Cfa4cAf87226bf6886208619C0948
gas                                    31086 gas
transaction cost                       27031 gas
execution cost                         5967 gas
input                                  0xc63...1b292
decoded input                          {}
decoded output                         {}
logs                                   []
```

2.8

Llamamos a la función `getResults` con la dirección de uno de los presidentes en su sede, llamamos al `president1` que muestra los votos que se han obtenido en Madrid.

```
CALL [call] from: 0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2 to: DhontPollingStation.getResults() data: 0x471...7f97c

from
    0xAb8483F64d9C6d1EcF9b849Ae677dD3315835cb2 ⓘ

to
    DhontPollingStation.getResults() 0x18bF3b399EAc8BcFea6709053ad1709fc073690 ⓘ

execution cost
    11561 gas (Cost only applies when called by a contract) ⓘ

input
    0x471...7f97c ⓘ

decoded input
    {} ⓘ

decoded output
    {
        "0": "uint256[]: 0,3,1"
    } ⓘ

logs
    [] ⓘ ⓘ
```

2.9

Llamamos a la función `getResults` con la dirección de la autoridad administrativa:

```
call to Election.getResults

CALL [call] from: 0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 to: Election.getResults() data: 0x471...7f97c

from
    0x5B38Da6a701c568545dCfcB03FcB875f56beddC4 ⓘ

to
    Election.getResults() 0x3328358128832A260C76A4141e19E2A943CD486D ⓘ

execution cost
    47762 gas (Cost only applies when called by a contract) ⓘ

input
    0x471...7f97c ⓘ

decoded input
    {} ⓘ

decoded output
    {
        "0": "uint256[]: 10,8,1"
    } ⓘ

logs
    [] ⓘ ⓘ
```

Nos queda que los resultados generales son:

Partido	Resultado
0	10
1	8
2	1

