Electing World Bank President: World Bank President

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1. **Problem Statement:**

Each country that belongs to the World Bank has a certain amount of vote share in electing the president of the World Bank. Voting share is based on the share a given country holds in the bank which is in turn based on the economic size of the country. Most of the major players in voting are countries like USA, Japan, Germany. But most countries form country groupings that "share" a director. For example, the executive director from Austria, represents Austria, Belarus, Belgium, the Czech Republic, Hungary, Kosovo, Luxembourg, the Slovak Republic, Slovenia, and Turkey. When he casts his vote, he votes the collected voting share of those countries, and there is no provision for splitting up that share.

The nomination process for world bank president has selected three official candidates from three different countries – the USA and India.

Firstly, candidates are interviewed by Bank's executive board directors representing different countries

After the interview, **directors** and **bank employees** can upvote and downvote the candidates:

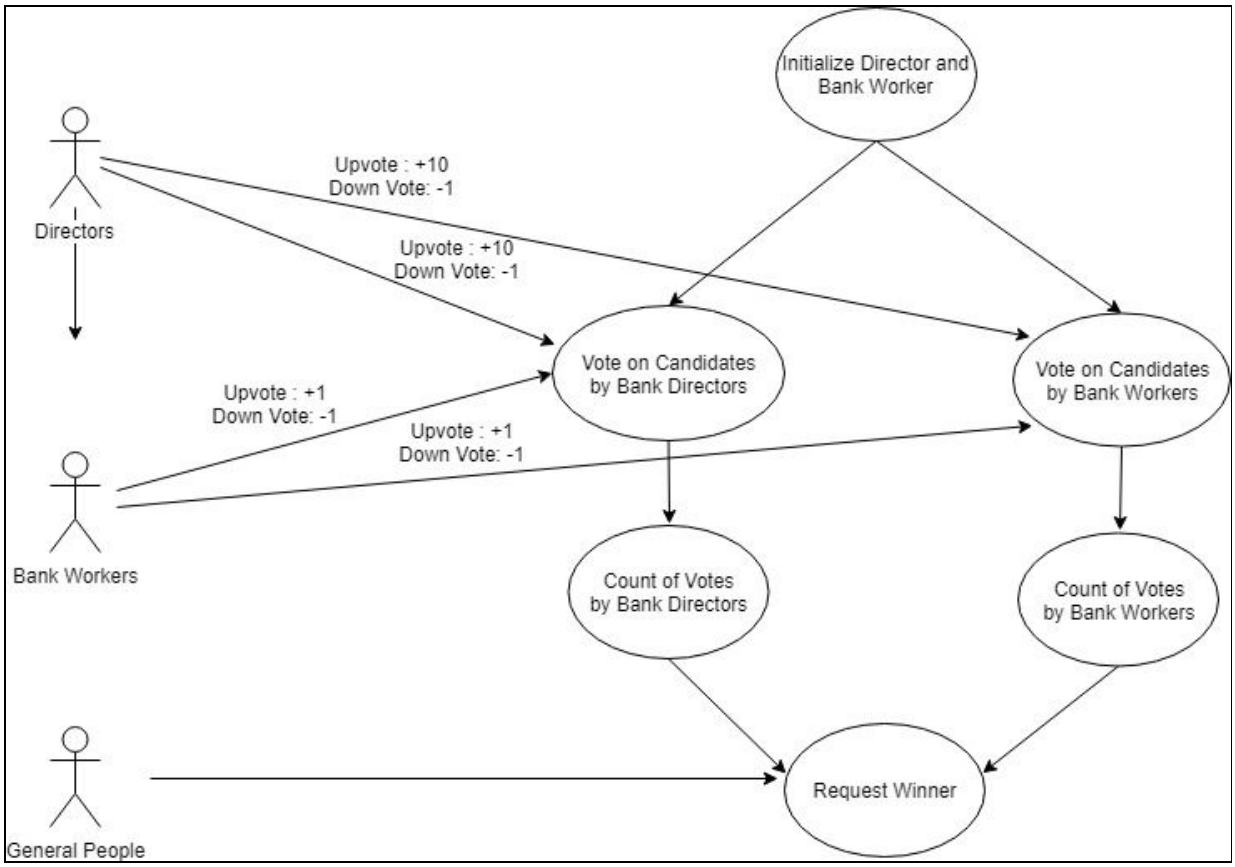
- **Upvote:**
    1. Each director can give as many upvotes as he wants to multiple candidates. The weight for each director's upvote is 10.
    2. Each bank employee can give as many votes as he wants to multiple candidates. The weight for each bank worker's vote is 1.
- **DownVote:**
    1. Each director and bank employee can give as many downvotes as he wants to multiple candidates. Each down vote will decrement the total vote count by 1.

After the voting is done, the winner will be declared which is the candidate who gets the maximum number of votes.

Link: https://foreignpolicy.com/2012/03/28/a-primer-on-world-bank-voting-procedures/

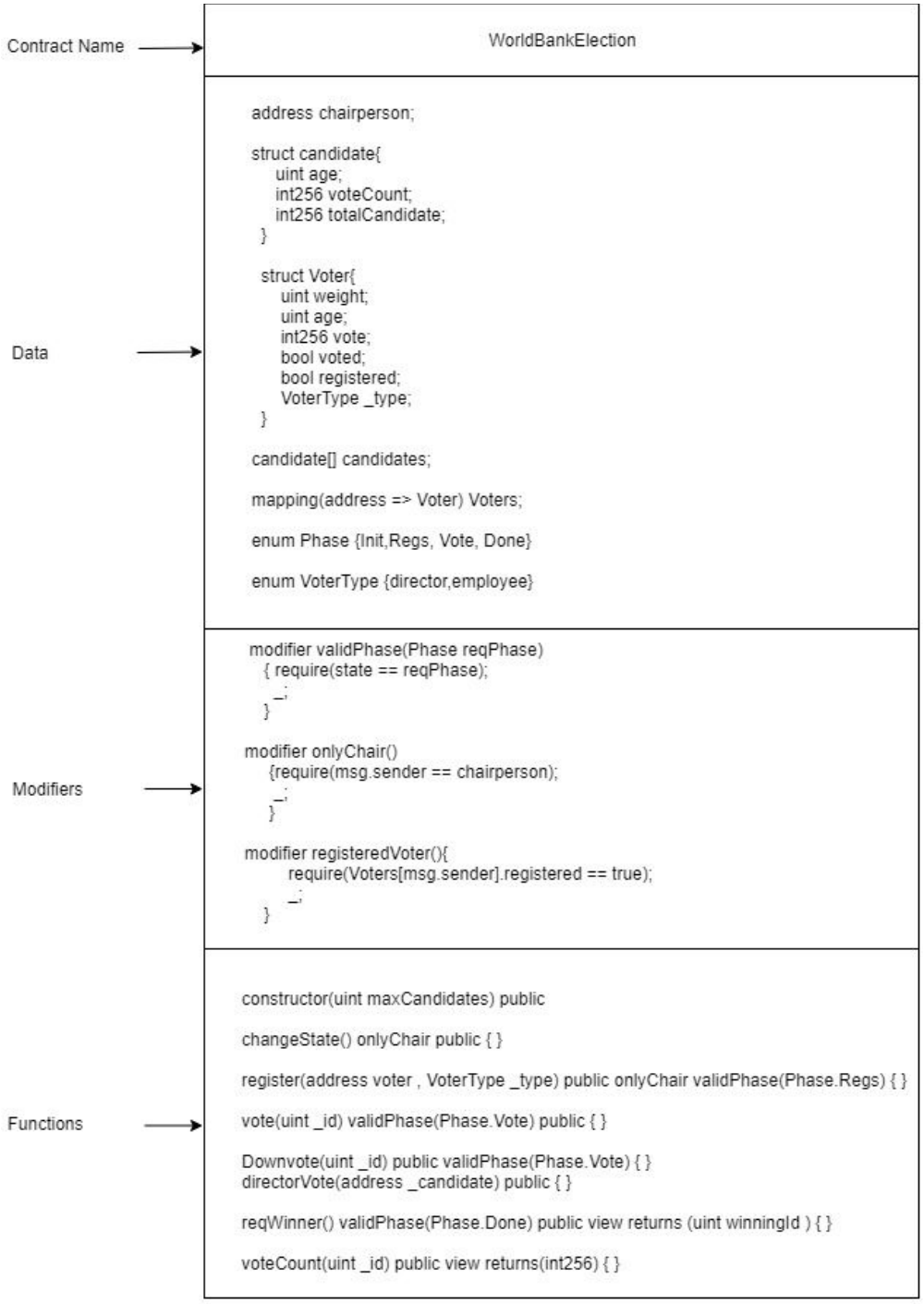
2. Planning and Design:

2.1 Use Case Diagram:



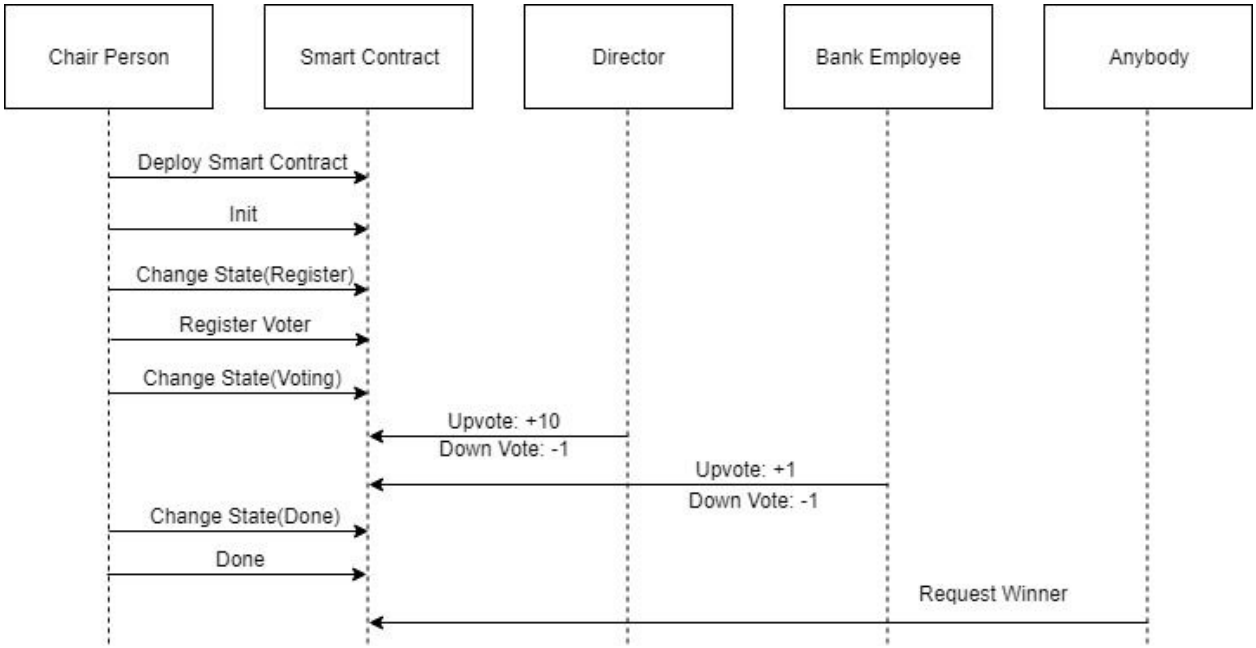
Use Case Diagram

2.2 Contract Diagram:



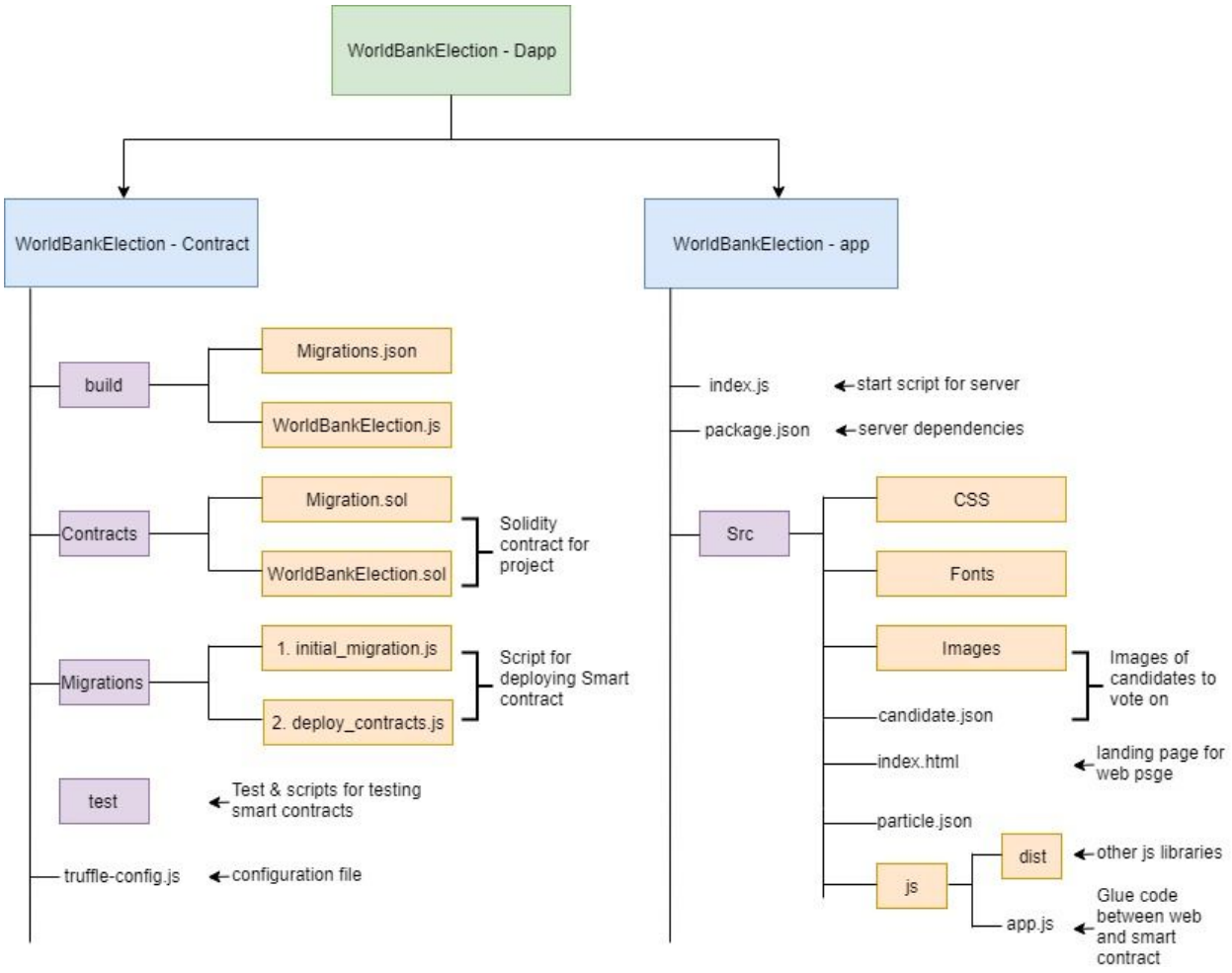
Contract Diagram

2.3 Sequence Diagram:



Sequence Diagram

3. Architecture Design:



World Bank Election Architecture

4. Code:

```
pragma solidity^0.5.2;

contract WorldBankElection{
   struct candidate{
     uint age;
     int256 voteCount;
     int256 totalCandidate;
   }
   struct Voter{
      uint weight;
      uint age;
      int256 vote;
      bool voted;
      bool registered;
      VoterType _type;
   }
   candidate[] candidates;
   address chairperson;
   mapping(address => Voter) Voters;
   enum Phase {Init,Regs, Vote, Done}
   Phase public state = Phase.Init;

   enum VoterType {director,employee}

    modifier validPhase(Phase reqPhase)
   { require(state == reqPhase);
     _;
   }

   modifier onlyChair()
    {require(msg.sender == chairperson);
     _;
    }

   modifier registeredVoter(){
       require(Voters[msg.sender].registered == true);
       _;
   }

```

```
    constructor(uint maxCandidates) public{
        chairperson = msg.sender;
        Voters[chairperson]._type = VoterType.director;
        Voters[chairperson].weight = 10;
        Voters[chairperson].voted = false;
        state = Phase.Regs;
        candidates.length = maxCandidates;
    }

     function changeState(Phase x) onlyChair public {

        require (x > state );

        state = x;

    }

    function register(address voter , VoterType _type) public onlyChair
validPhase(Phase.Regs){

        require (! Voters[voter].voted);
        Voters[voter]._type == _type;
        if( _type == VoterType.director)
        {
        Voters[voter].weight = 10;
        }
        else
        {
         Voters[voter].weight = 1;
        }
        Voters[voter].voted = false;
    }


     function Downvote(uint _id) public validPhase(Phase.Vote)
    {
         Voter memory sender = Voters[msg.sender];
        require (!sender.voted);
        require (_id < (candidates.length));
        sender.voted = true;
```

```
        sender.vote = int256(_id);
        candidates[_id].voteCount -= 1;
    }

    function vote(uint _id) validPhase(Phase.Vote) public
    {

      Voter memory sender = Voters[msg.sender];
      require (!sender.voted);
      require (_id < (candidates.length));
      sender.voted = true;
      (sender.vote) = int256(_id);
      (candidates[_id].voteCount) += int256(Voters[msg.sender].weight);
    }

    function reqWinner() validPhase(Phase.Done) public view returns (uint winningId ) {
        int256 winningVoteCount = 0;
        for (uint8 i = 0; i < candidates.length; i++)
            if (candidates[i].voteCount > winningVoteCount) {
                winningVoteCount = candidates[i].voteCount;
                winningId = i;
            }
       assert(winningVoteCount>=1);
    }

     function voteCount(uint _id) public view returns(int256)
    {
        int256 count = candidates[_id].voteCount;
        return count;
    }
}
```

Link to complete code(zip folder): https://buffalo.box.com/s/0bgtsugpgjstogsftvw17hpngqqlm3nz

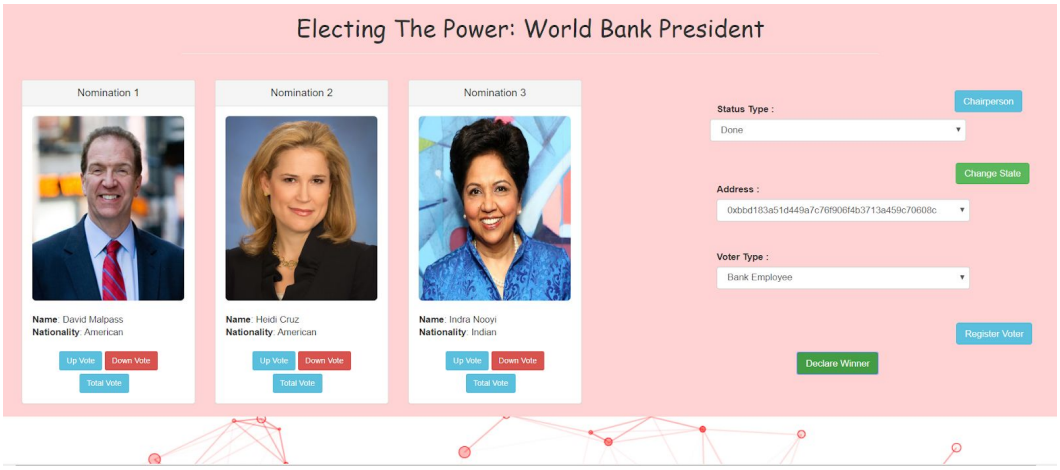
5. WorkFlow:

1. Click on Ganache and quickstart it.

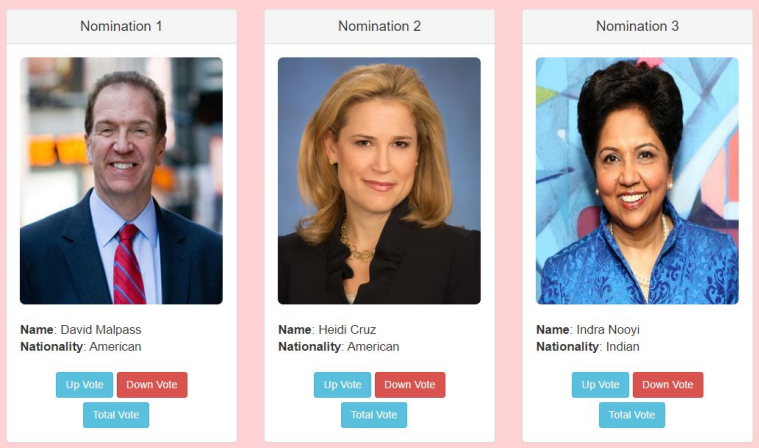
2. Open the command prompt and provide the following command

```
cd WorldBankElection-contract
truffle compile
truffle migrate --reset
cd ..
cd WorldBankElection-app
node index.js
```

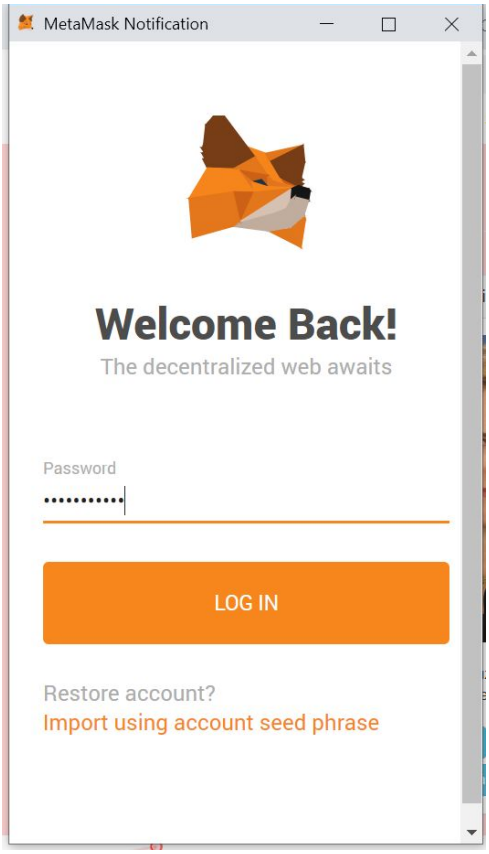
The Decentralized World Bank Election Dapp starts running in localhost:3000. Now, it is ready for testing.

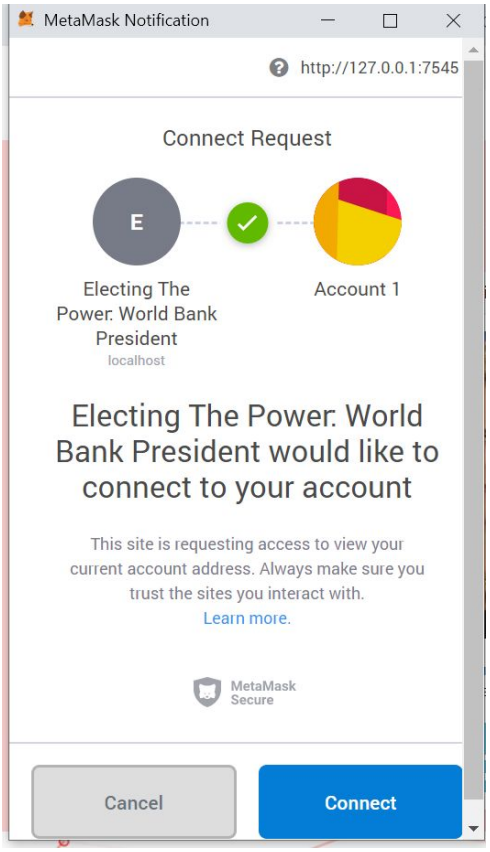


We have three candidates nominated for the position of president from two different locations USA and India- David Malpass, Heidi Cruz, Indra Nooyi.



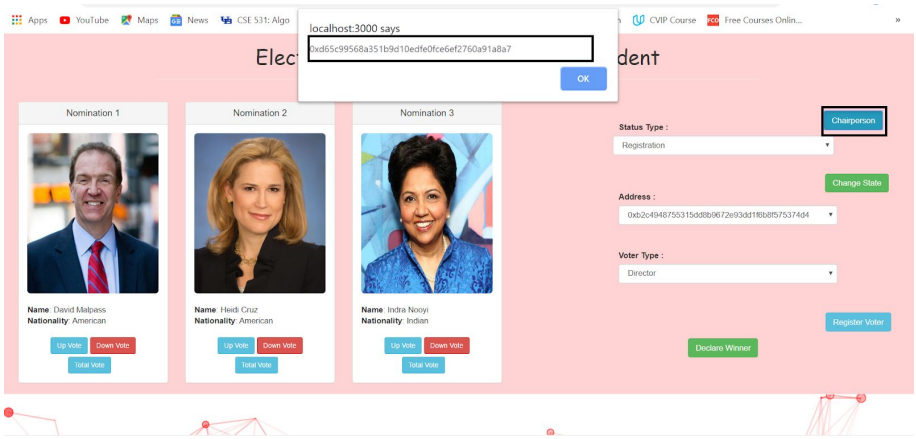
3. Connect the application with Metamask using the seed phrase.





4. Ganache and Metamask should show the same accounts and Ether values. Reset the accounts 1,2 and 3 in metamask.

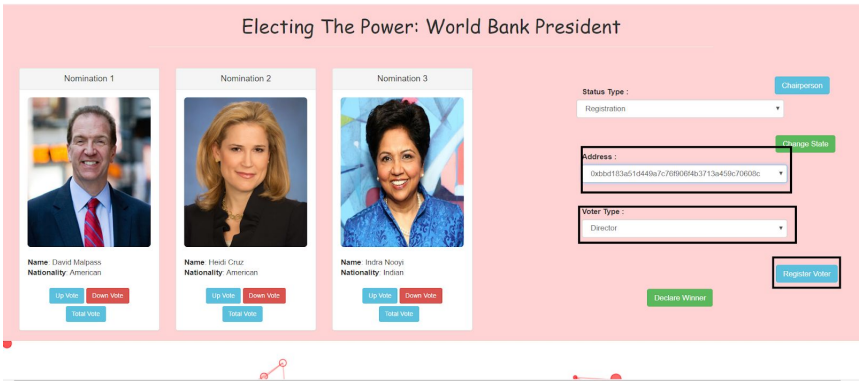
5. We will first check the address of the chairperson by clicking the chairperson button.



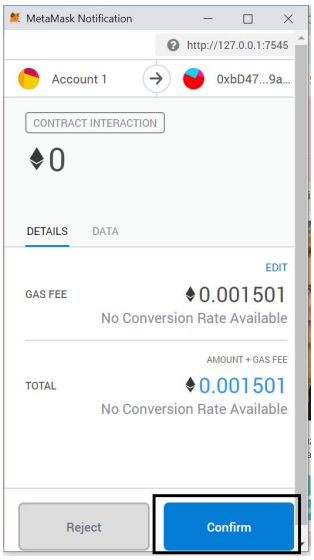
6. Set the same address in the metamask. Initially, the app is in Registration phase so we will register voters. There are two types of voters- 1. Director 2. Bank Employee

First, we will register the director voter type whose vote weight is 10. Select the address from Address dropdown and voter type from as director from voter type drop-down and click Register.

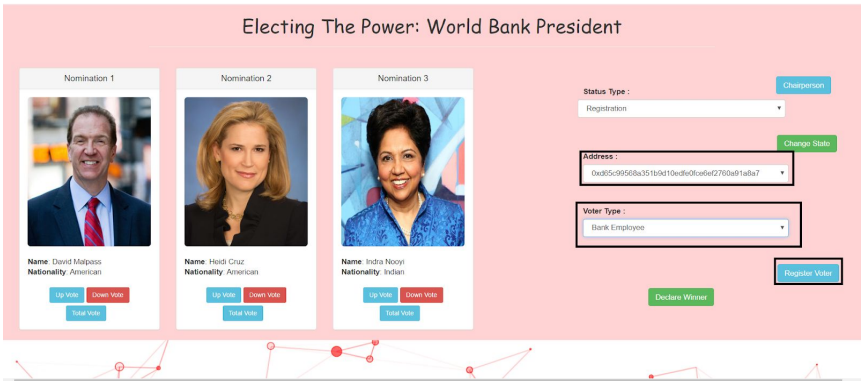
Register Voter is only allowed by chairperson. So, select the chairperson account in the metamask.



The transaction gets completed after clicking confirm.

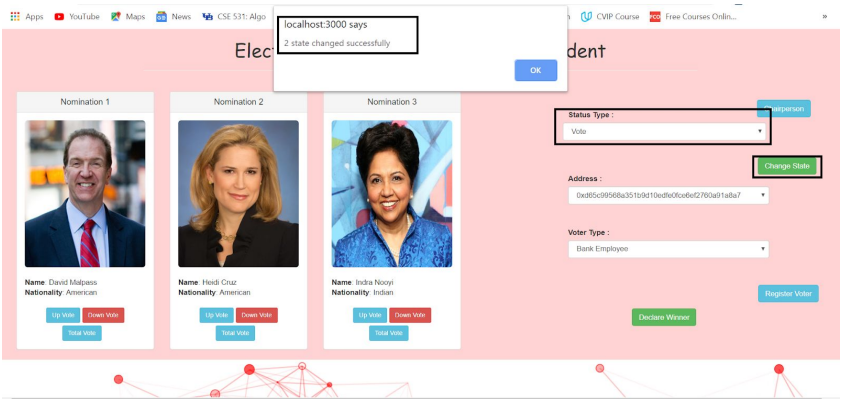


7. Now follow the above steps to register Bank Employee whose vote weight is 1.



8. Now change the status phase from Registration to Vote to continue with voting. Change Status is only allowed by chairperson. So select the chairperson account in the metamask.

Select the status vote from status type dropdown and click change status button. The transaction gets confirmed.

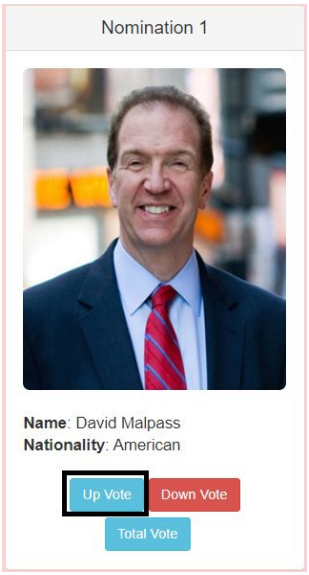


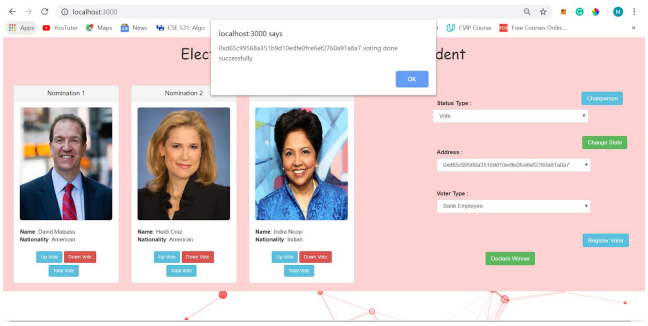
9. There are two types of voting allowed- 1. Upvote 2. Downvote.

Firstly we select the voter account in the metamask and address dropdown who wants to vote.

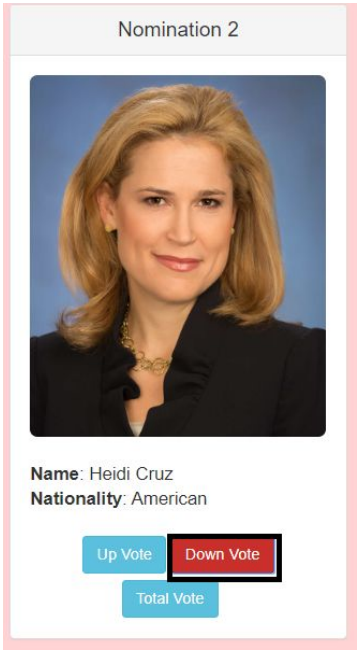
Now, We will upvote for David Malpass by clicking the Upvote button.

We can check the vote count after voting by clicking the total vote button.

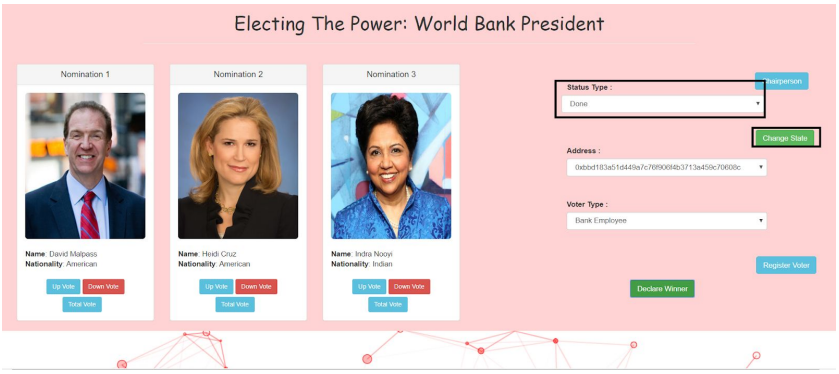




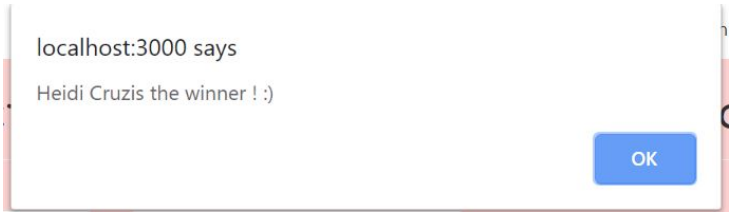
10. We can DownVote for any candidate by clicking the downvote button and setting the voter account in the metamask. The weight of downvote for both director and bank employee is 1.



11. After the voting is complete, to check the winner we will have to change the phase from voting to done by selecting the done option from status type dropdown and click change status.



12. Finally, we can request the winner by clicking the Declare Winner button.



Workflow Video: https://www.loom.com/share/65c5ef41c6e947509eea2630f1af47fc

6. Test Plan:

Input:

- There are three candidates to be elected.
- Chairperson is responsible for changing the state and registering the voters.
- Two types of voters are available: Director and Bank Employee.
- Director and Bank Employee both can upvote and downvote the candidates and their upvote/downvote weight is different.

Positive Test Case:

- Chairperson will be able to register a voter (Director or Bank Employee) once the state has been changed to “Register”.
- Voting will be started once the state has been changed to “Vote” by the chairperson.
- Directors can upvote or down vote for the candidates of their choice successfully and for each upvote, weight is 10 and for each downvote, total votes will be decremented by 1.
- Bank Employee can upvote or down vote for the candidates of their choice successfully and for each upvote, weight is 1 and for each downvote, total votes will be decremented by 1.
- The total vote which will determine the winner is the total of Director’s vote and Bank Employee’s vote.

Negative Test Case:

- If anyone else apart from the chairperson tries to change the state or register the voter, it will show error message.
- When the chairperson will try to register the voters without changing the state error message will be shown.
- When the application is in any other state apart from “vote”, and a voter attempts to vote, it can’t be done, and the error message will be shown.
- Being in any other state apart from “Done”, “Declare Winner” will not work.