CSE 526 Blockchain Project

instaMoney: P2P blockchain based decentralized money lending solution

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1. Issues Addressed

The issues of the present money lending market are the following:

- Major players are large financial institutions as lenders. This doesn't give an equal and fair opportunity to small players, individuals and corporations to break into the market.
- The whole financing system is centralized. All of the data resides with the big institutions.
- The lending institution can charge unfair interest rates to needy people while giving out cheaper loans to their rich close relatives. For example, Nirav Modi scam.
- Lack of a floating interest rate for retail borrowers.
- Lack of transparency.
- Lack of trust. If hackers or internal corrupt employees get access to bank servers, they can edit numbers which can cause severe damage to a country on a large scale.
- Susceptible to government policies and powerful people's influence.
- Collapse of these financial institutions sends ripples across the whole world and breaks down the back of the global economy.
- Possible risk of losing financial data. For example, in case of a war if the bank's data centers are destroyed, people can get rid of their credit card bills. Example

2. Abstract

In today's world, people seek loans from banks, which is a time-consuming and complicated process. Banks in this economy function as a middleman, taking a significant amount of money as processing fees, taxes, and excessive interest rates. Banks generate these loans by borrowing cash from people's savings and fixed deposit accounts, and they demand significantly higher interest rates than savings account holders. Credit card firms are no exception. It makes it harder for borrowers to secure a fair and transparent loan. With this in mind, a peer-to-peer lending model leveraging blockchain technology as a trust layer can solve the above issues. For example, if a person needs to make a large investment, like purchasing a home, but does not have enough liquid cash to do it all at once, they will seek a bank loan. They can instead borrow the same amount using this platform. Lenders are in the same predicament. High-net-worth individuals, non-banking financial firms (NBFCs), banks, and governments with large cash reserves expect a reasonable rate of return on their assets. Investing in a bank or government bonds, on the other hand, may only generate enough return to cover inflation. Instead, these HNIs may lend money through the instaMoney platform and earn a 7-20% annual return on investment.

Key Intuitions:

- Ropsten Ether generation is slow and students will need it to transact on the marketplace. Some students have surplus, some will have shortage.
- One student can lend to another on a per-day interest basis.
- Blockchain networks will establish trust between parties such that they can claim later they are owed so and so, from someone else.

How instaMoney can help:

- Decentralized financing removes the middleman (Banks) in a credit-lending market.
- Decentralized ledger solves the problem of losing crucial financial data
- Multiple nodes in the network validating the loan contracts ensure that no data can be tampered with.
- Can prevent money-laundering.
- Can prevent some large-scale financial crisis.
- Establishes trust between the borrower and lender. The lender can claim that this person took this lump-sum amount from them and agreed to pay x% interest.
- Establishes transparency. Borrower knows exactly from whom he is borrowing rather than knowing a middleman. Also, since the interest rate is floating based on market demand and supply, both involved parties can be sure that they are signing up a loan deal at an optimal and fair interest rate.
- Operated and controlled by the smart contract. Hence is not susceptible to intervention by government and powerful personalities.
- Immune to hacking or DDoS attacks.
- Avail loans at a significantly lower interest rate as a liquid marketplace like this promotes high competition between lenders.

3. Historical Significance

In the 2008 financial crisis, banks lent out huge proportions of sums to individuals with low credit worthiness. These individuals did not have enough earning potential to avail such loans, however, since they were getting it at such attractive interest rates, they took it and went on a buying frenzy. They bought more and more houses beyond their living standards and hence the housing prices kept rising, into a bubble. When the bubble burst, these people were unable to pay back the loan to banks leading to a collapse of the banking infrastructure. Banks were the major culprits of the 2008 crisis and this taught us a good lesson. Bitcoin was developed in 2009 to bring in transparency, remove centralized financing and avoid such imprudent financing activities in the future.

4. Actors

Borrower

He can find a good deal and take the loan as per his requirements from the freely floating market of lenders. He can repay his loan as well. He can also view the details of the loans he has taken already.

Lender

Can deposit money in the smart contract and put it up for sale at a certain interest rate. He can also cancel his previous order which has not been executed (not found a matching borrower) and the money is lying idle. The lender can also become a borrower if need be.

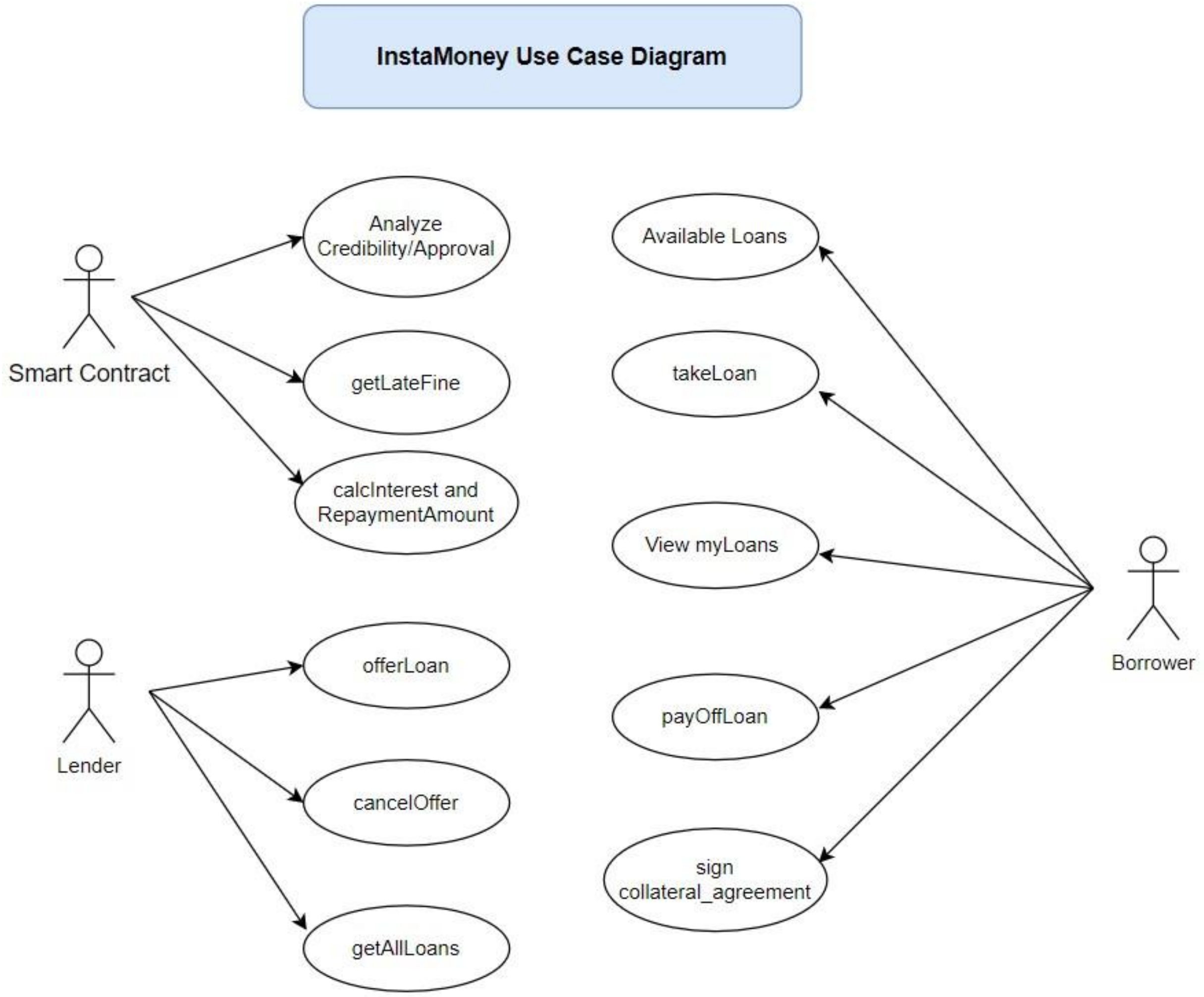
Smart Contract

Validates, verifies, certifies, checks minimum credit rating requirements and executes transactions.

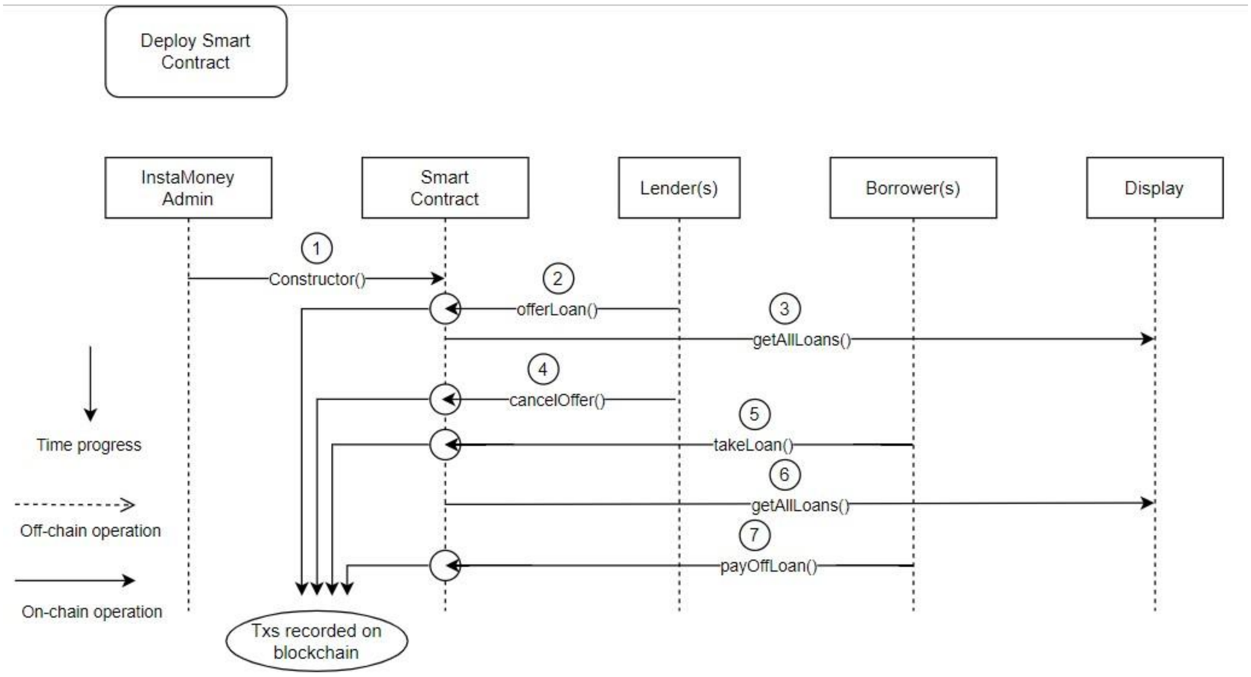
5. Token

We plan on using the Ropsten Ethers as our crypto token since this is a marketplace for money itself. If a custom token name is required, we would name it as **Mudra**.

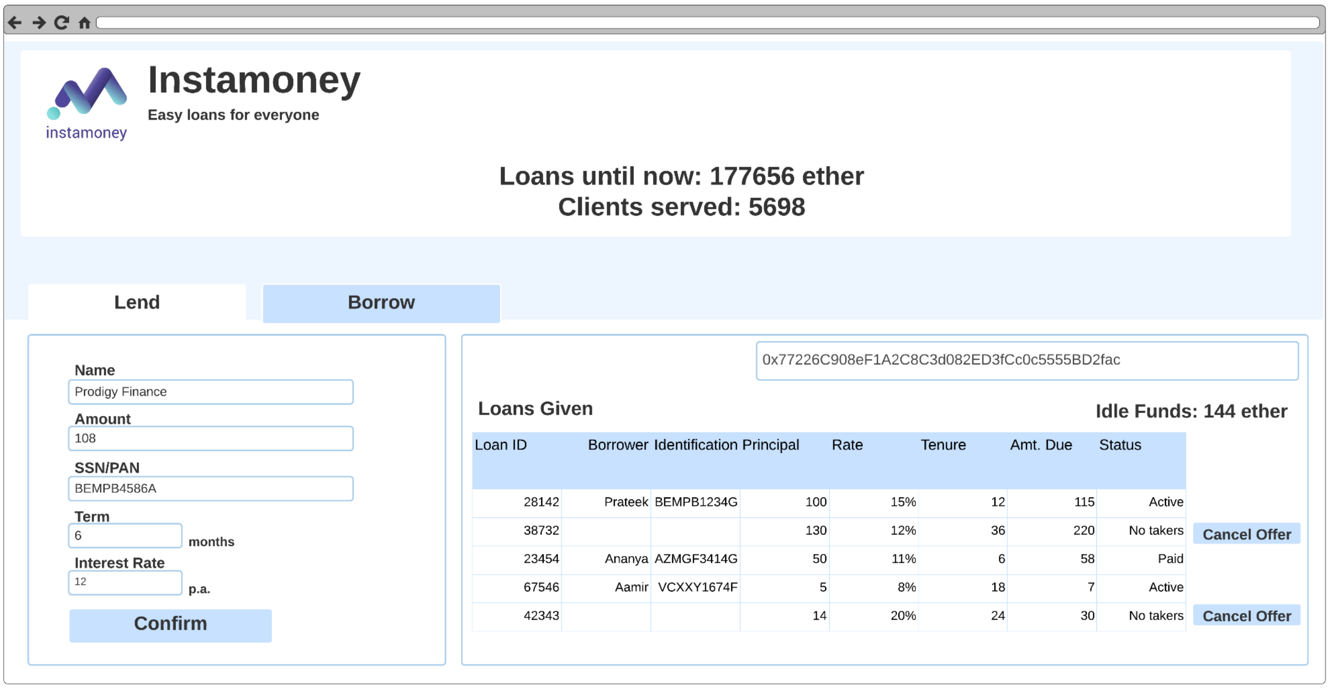
6. Use-Case Diagram



7. Sequence Diagram



8. Wireframes



Instamoney

Easy loans for everyone

Loans until now: 177656 ether

Clients served: 5698

Name: Prodigy Finance

Amount: 108

SSN/PAN: BEMPB4586A

Term: 6 months

Interest Rate: 12 p.a.

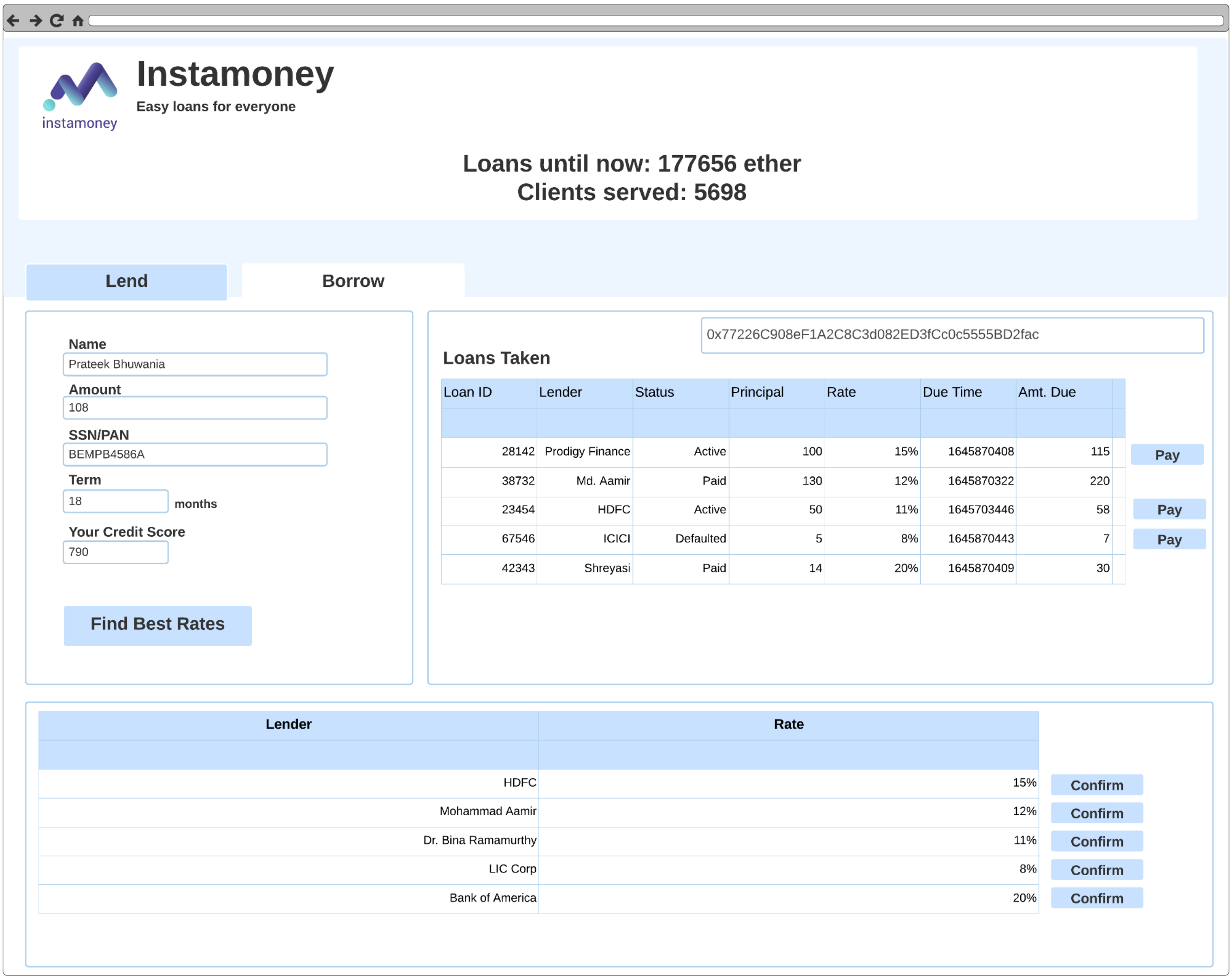
Confirm

0x77226C908eF1A2C8C3d082ED3fCc0c5555BD2fac

Loans Given

Idle Funds: 144 ether

Loan ID	Borrower	Identification	Principal	Rate	Tenure	Amt. Due	Status	
28142	Prateek	BEMPB1234G	100	15%	12	115	Active	
38732			130	12%	36	220	No takers	Cancel Offer
23454	Ananya	AZMGF3414G	50	11%	6	58	Paid	
67546	Aamir	VCXXY1674F	5	8%	18	7	Active	
42343			14	20%	24	30	No takers	Cancel Offer



Instamoney

Easy loans for everyone

Loans until now: 177656 ether

Clients served: 5698

Name: Prateek Bhuwania

Amount: 108

SSN/PAN: BEMPB4586A

Term: 18 months

Your Credit Score: 790

Find Best Rates

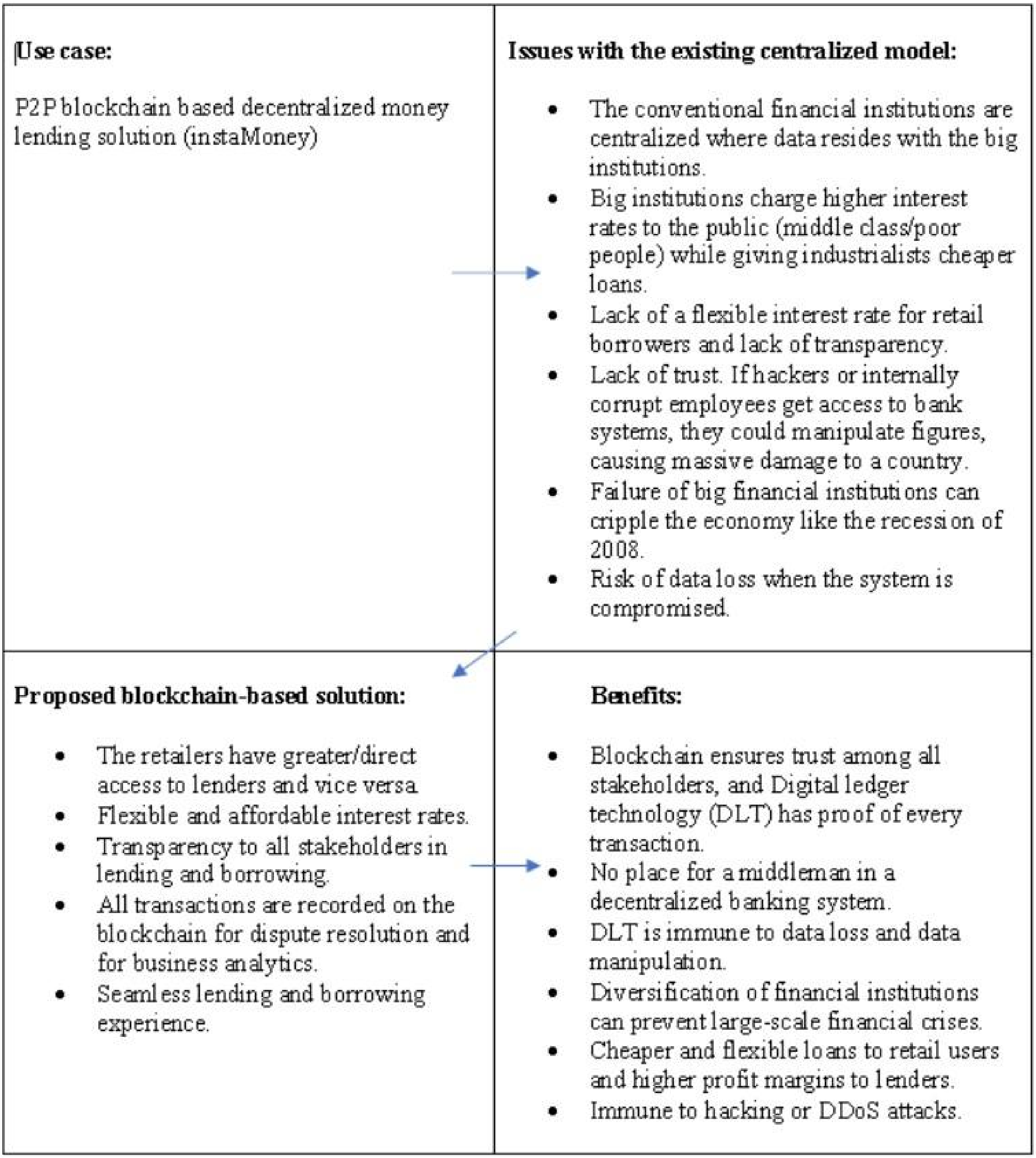
0x77226C908eF1A2C8C3d082ED3fCc0c5555BD2fac

Loans Taken

Loan ID	Lender	Status	Principal	Rate	Due Time	Amt. Due	
28142	Prodigy Finance	Active	100	15%	1645870408	115	Pay
38732	Md. Aamir	Paid	130	12%	1645870322	220	
23454	HDFC	Active	50	11%	1645703446	58	Pay
67546	ICICI	Defaulted	5	8%	1645870443	7	Pay
42343	Shreyasi	Paid	14	20%	1645870409	30	

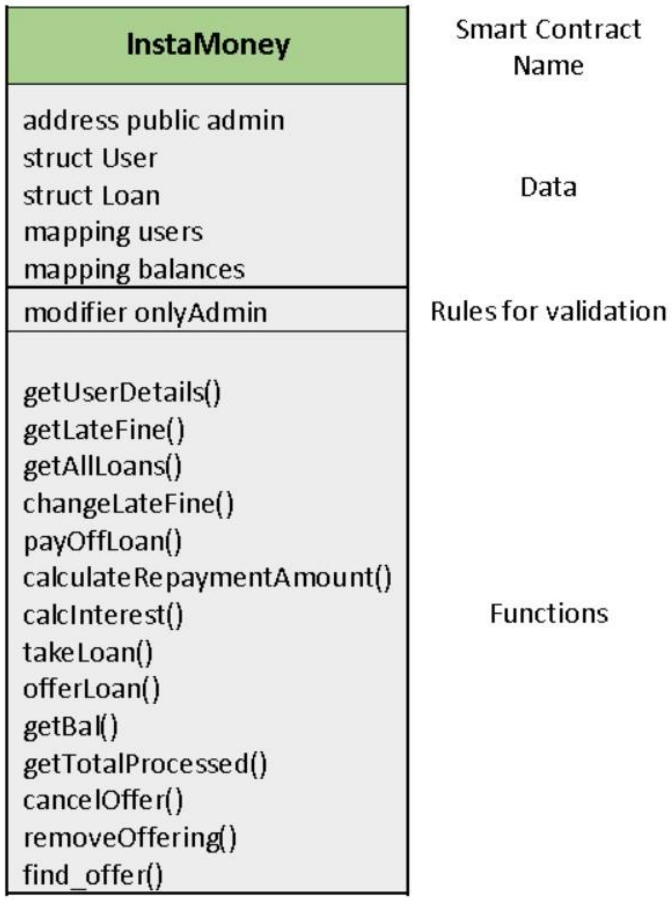
Lender	Rate	
HDFC	15%	Confirm
Mohammad Aamir	12%	Confirm
Dr. Bina Ramamurthy	11%	Confirm
LIC Corp	8%	Confirm
Bank of America	20%	Confirm

9. Quad Chart diagram



|**Use case:** P2P blockchain based decentralized money lending solution (instaMoney)	**Issues with the existing centralized model:** • The conventional financial institutions are centralized where data resides with the big institutions. • Big institutions charge higher interest rates to the public (middle class/poor people) while giving industrialists cheaper loans. • Lack of a flexible interest rate for retail borrowers and lack of transparency. • Lack of trust. If hackers or internally corrupt employees get access to bank systems, they could manipulate figures, causing massive damage to a country. • Failure of big financial institutions can cripple the economy like the recession of 2008. • Risk of data loss when the system is compromised.
Proposed blockchain-based solution: • The retailers have greater/direct access to lenders and vice versa. • Flexible and affordable interest rates. • Transparency to all stakeholders in lending and borrowing. • All transactions are recorded on the blockchain for dispute resolution and for business analytics. • Seamless lending and borrowing experience.	**Benefits:** • Blockchain ensures trust among all stakeholders, and Digital ledger technology (DLT) has proof of every transaction. • No place for a middleman in a decentralized banking system. • DLT is immune to data loss and data manipulation. • Diversification of financial institutions can prevent large-scale financial crises. • Cheaper and flexible loans to retail users and higher profit margins to lenders. • Immune to hacking or DDoS attacks.

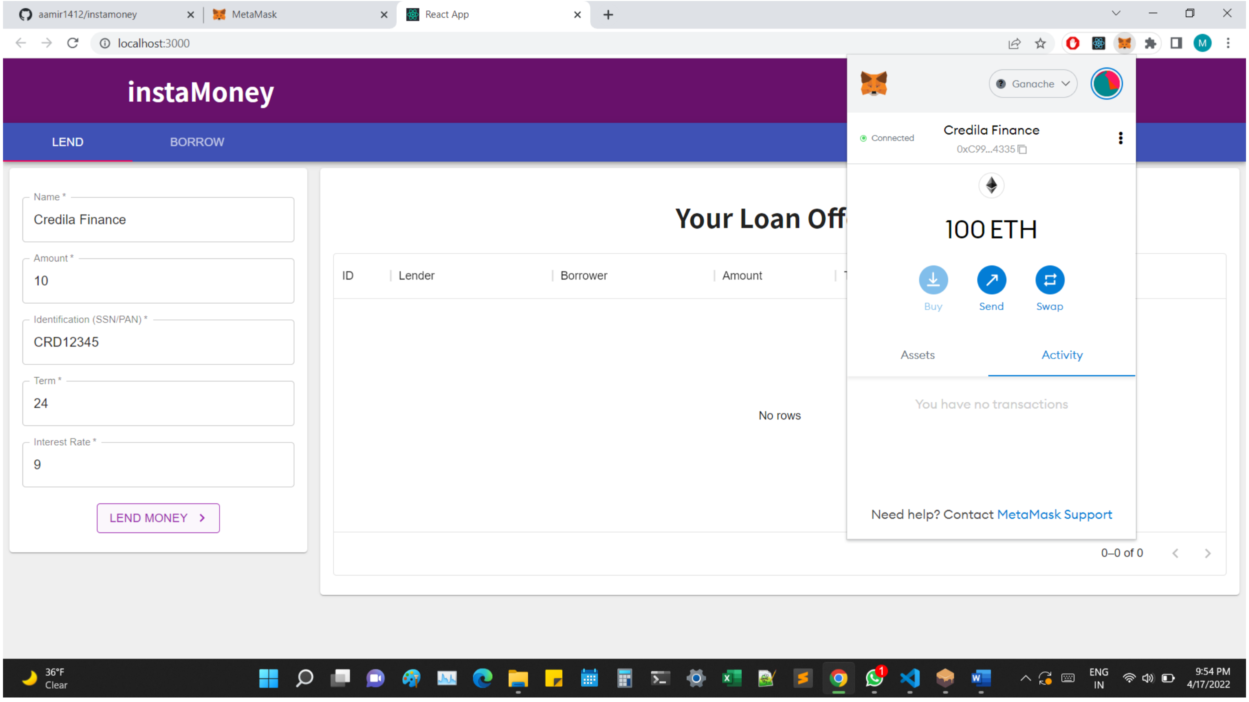
10. Contract Diagram



11. Instructions to deploy, test and interact

1. Start Ganache. Quickstart
2. Install node and npm. We have tested using node verion v16.14.2 and v14.6.0, npm version 8.5.2 and 6.14.7
3. Install required node packages:
   - `npm install --save --legacy-peer-deps`
   - `npm install truffle`
4. Deploy the contract
   - `truffle compile`
   - `truffle migrate --reset`
5. Start the web app
   - `cd client`
   - `npm install`
   - `npm run start`
6. Open Browser. Visit localhost:3000
7. Connect MetaMask to Ganache Provider, import accounts from Ganache using the keyphrase and connect to current site.
8. Reload Page (`Ctrl + Shift + R`)

12. instaMoney Dapp Walkthrough:



Name * Credila Finance

Amount * 10

Identification (SSN/PAN) * CRD12345

Term * 24

Interest Rate * 9

Your Loan Off

ID	Lender	Borrower	Amount

No rows

0–0 of 0

Credila Finance
0xC99...4335

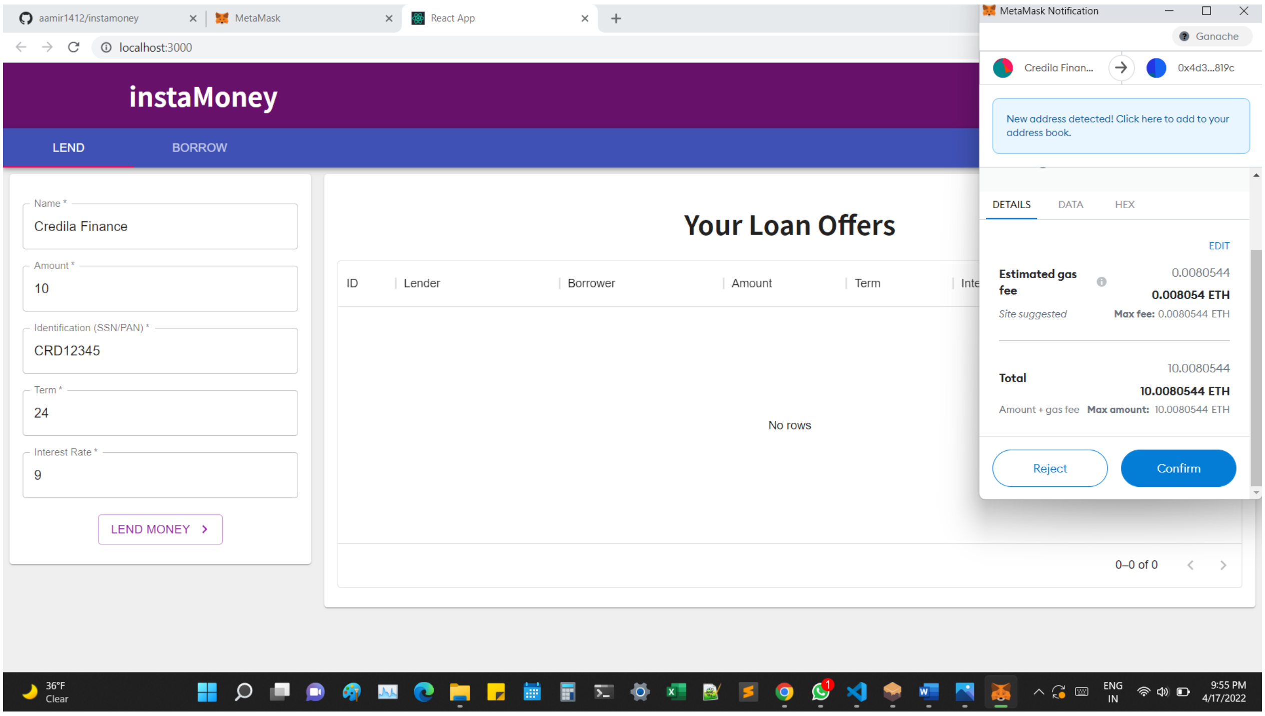
100 ETH

You have no transactions

Need help? Contact MetaMask Support

9:54 PM
4/17/2022

This is the landing page of our Dapp. We are in the LEND tab, where a lender can lend a loan. Credila Finance is lending a loan. Its current wallet balance is 100 ETH.



Name * Credila Finance

Amount * 10

Identification (SSN/PAN) * CRD12345

Term * 24

Interest Rate * 9

Your Loan Offers

ID	Lender	Borrower	Amount	Term	Inte

No rows

0–0 of 0

Credila Finan... → 0x4d3...819c

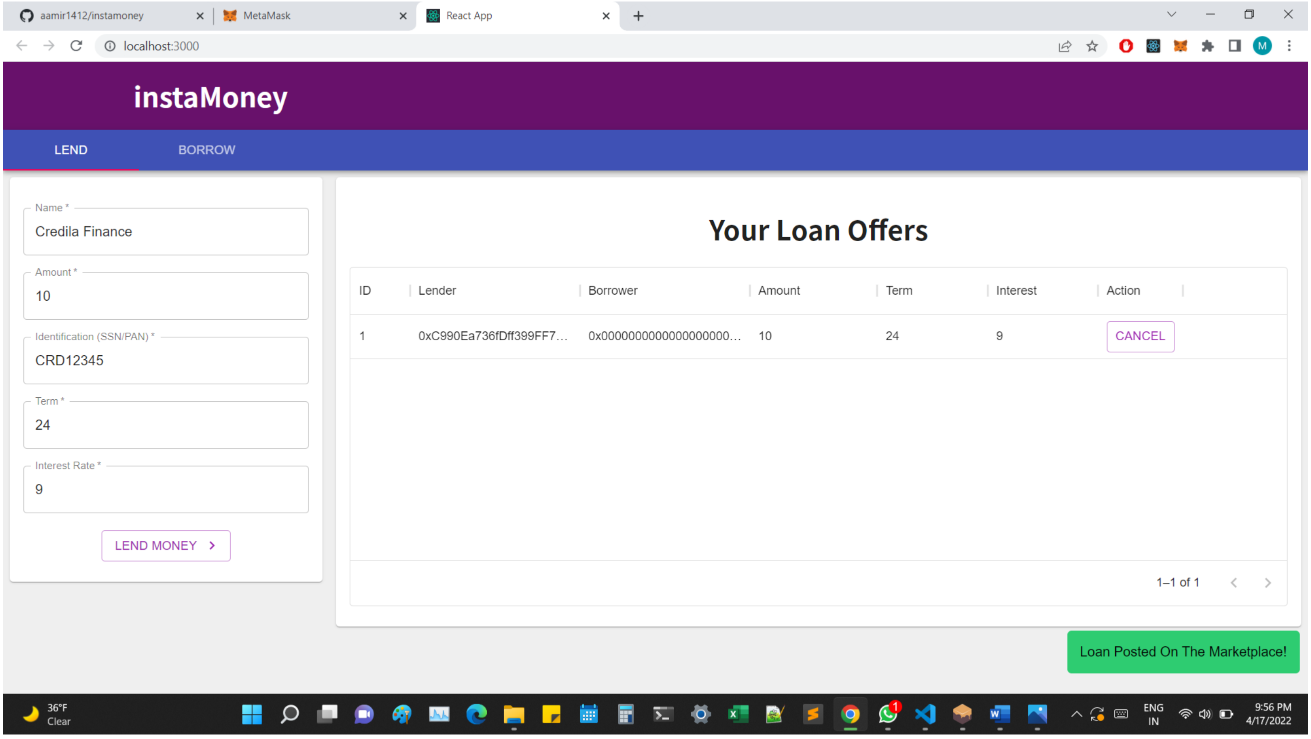
New address detected! Click here to add to your address book.

Estimated gas fee 0.0080544
0.008054 ETH
Site suggested Max fee: 0.0080544 ETH

Total 10.0080544
10.0080544 ETH
Amount + gas fee Max amount: 10.0080544 ETH

9:55 PM
4/17/2022

When the lender presses the LEND MONEY button, it is prompted to verify digitally through Metamask wallet. On confirming, the loan is posted in the Marketplace.



Name * Credila Finance

Amount * 10

Identification (SSN/PAN) * CRD12345

Term * 24

Interest Rate * 9

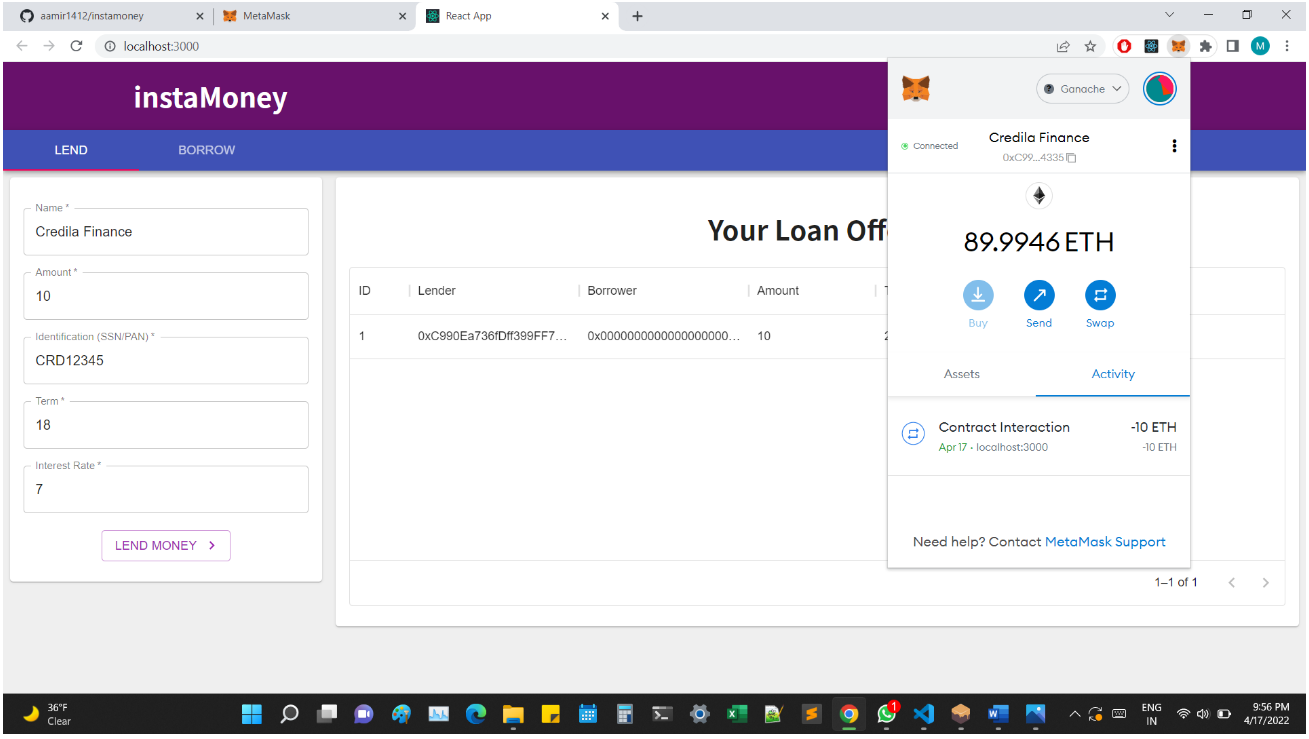
Your Loan Offers

ID	Lender	Borrower	Amount	Term	Interest	Action
1	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10	24	9	CANCEL

1–1 of 1

Loan Posted On The Marketplace!

Under ‘Your Loan Offers’ we can see the offered loan and a popup at the right bottom says ‘Loan Posted on The Marketplace’.



Name * Credila Finance

Amount * 10

Identification (SSN/PAN) * CRD12345

Term * 18

Interest Rate * 7

Your Loan Off

ID	Lender	Borrower	Amount
1	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10

1–1 of 1

Connected

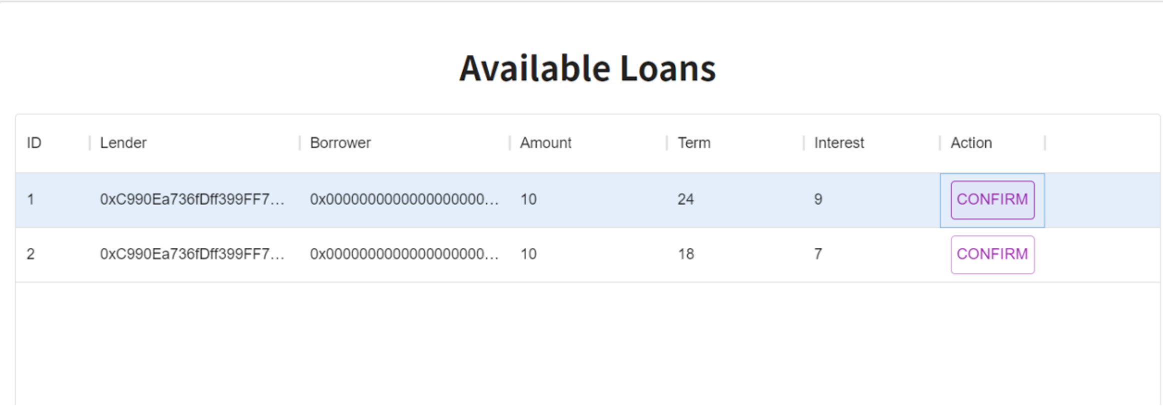
Credila Finance
0xC99...4335

89.9946 ETH

Contract Interaction -10 ETH
Apr 17 · localhost:3000 -10 ETH

Need help? Contact MetaMask Support

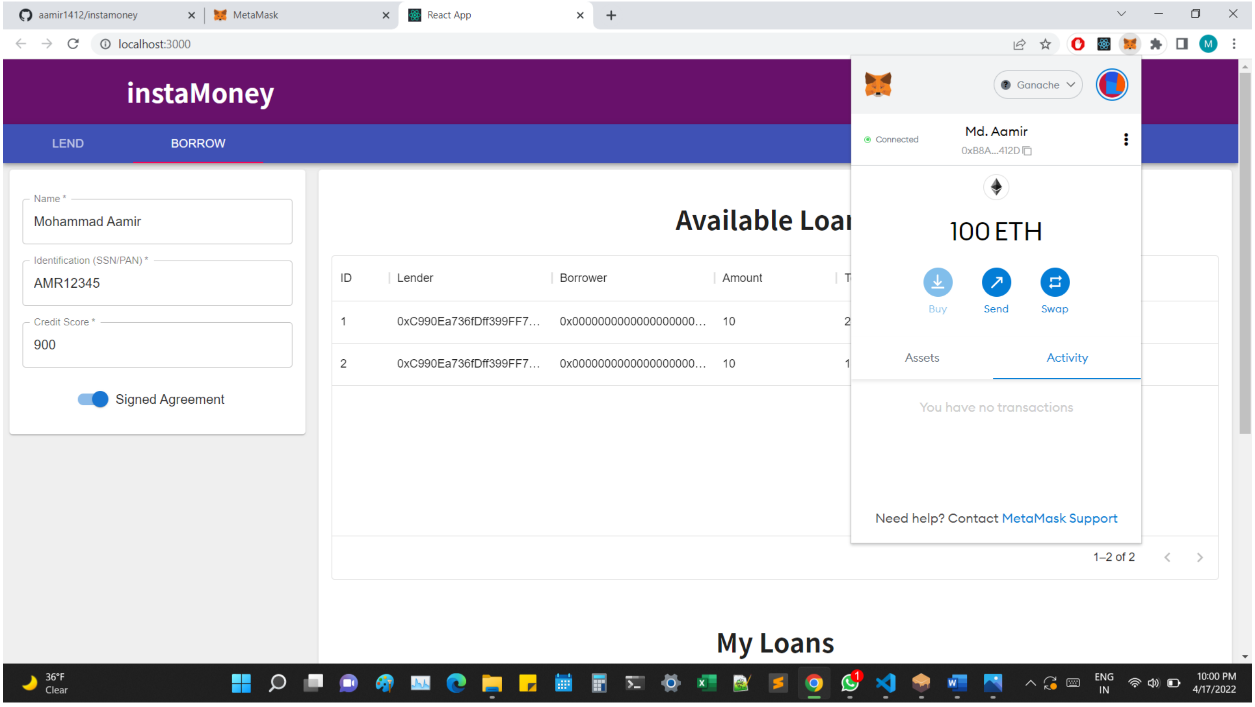
From the Metamask Wallet we can see that 10 ETH + gas fee is deducted from the lender. Similarly, a lender can post multiple loans on the Marketplace.



Available Loans

ID	Lender	Borrower	Amount	Term	Interest	Action
1	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10	24	9	CONFIRM
2	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10	18	7	CONFIRM

Now the borrower can see the loans as Available Loans. The Client can choose any of the loans as per liking.



Name * Mohammad Aamir

Identification (SSN/PAN) * AMR12345

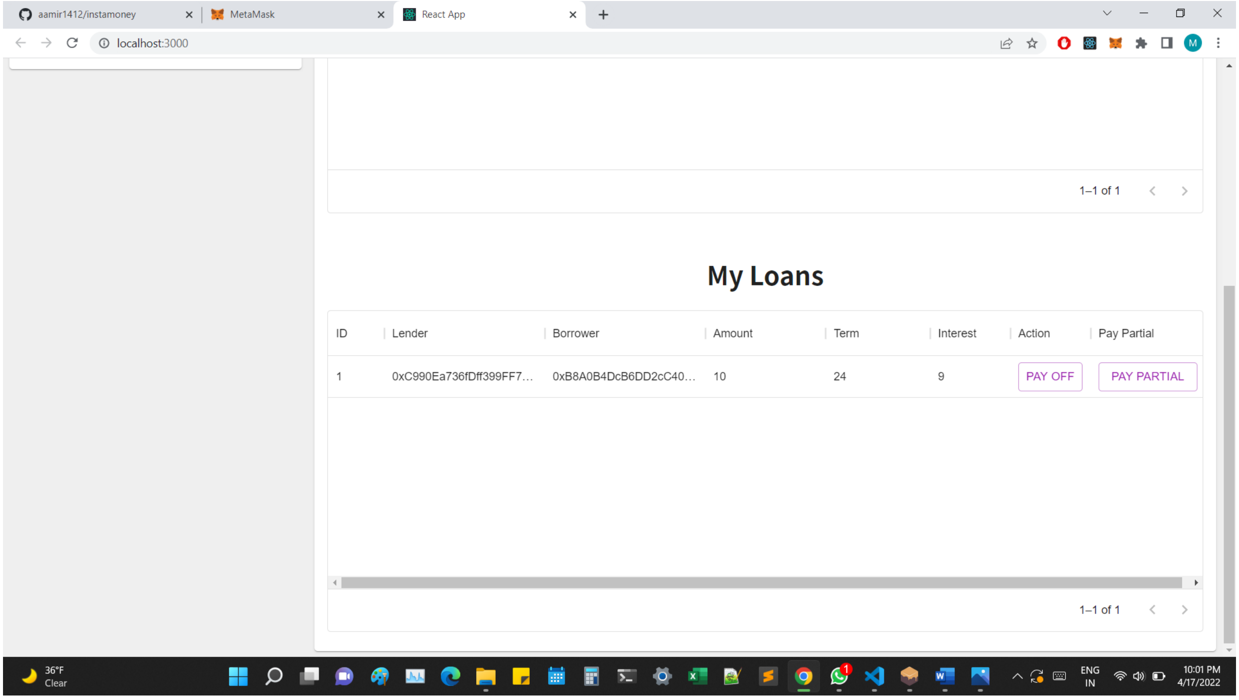
Credit Score * 900

Signed Agreement

ID	Lender	Borrower	Amount	T
1	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10	2
2	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10	1

1–2 of 2

The Borrower must enter its details, like Name, Identification, Credit Score, and Signed Agreement. The credit score must be above the required limit and the user must sign the agreement to get the loan. Further, the borrower has 100ETH but after taking the loan its Metamask wallet balance will be increased by the loan amount minus some gas fee.

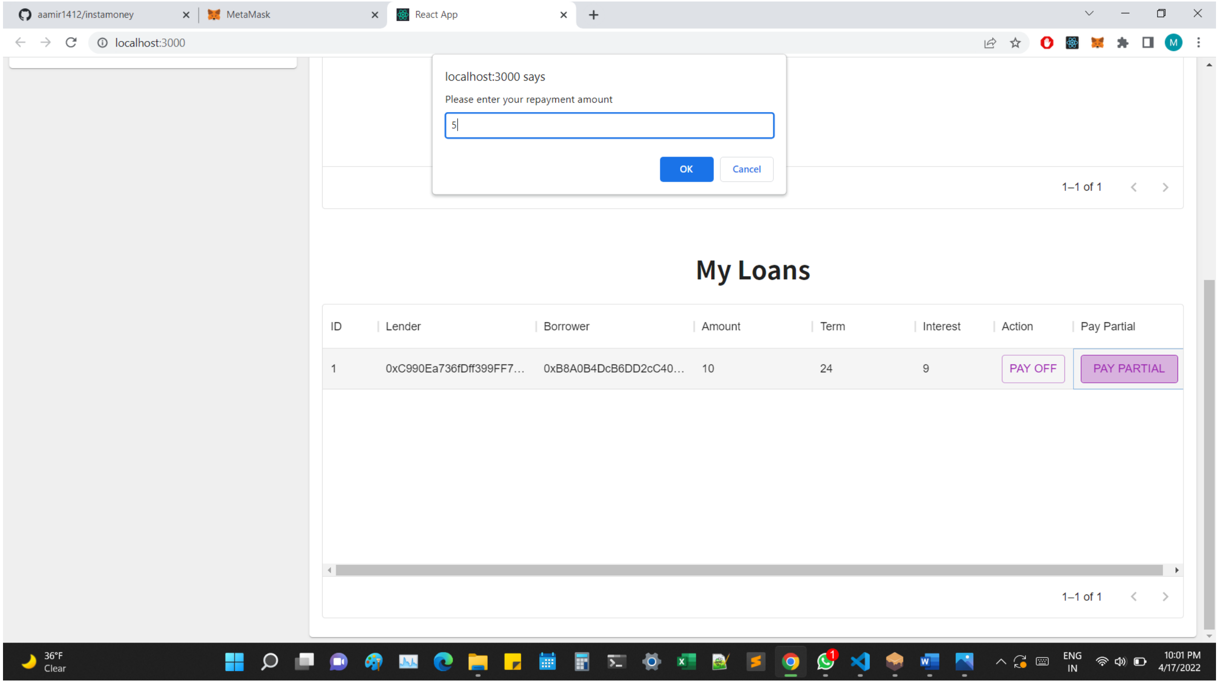


My Loans

ID	Lender	Borrower	Amount	Term	Interest	Action	Pay Partial
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10	24	9	PAY OFF	PAY PARTIAL

1–1 of 1

Now, the borrower can see the loans taken by him. From here he can repay the loans. The loan can be repaid either partially or completely. In this case I have chosen to pay the loan partially and payoff completely in two steps. At first step it will pay 5 ETH + interest and then the remaining amount + interest. See the below image for reference.



localhost:3000 says

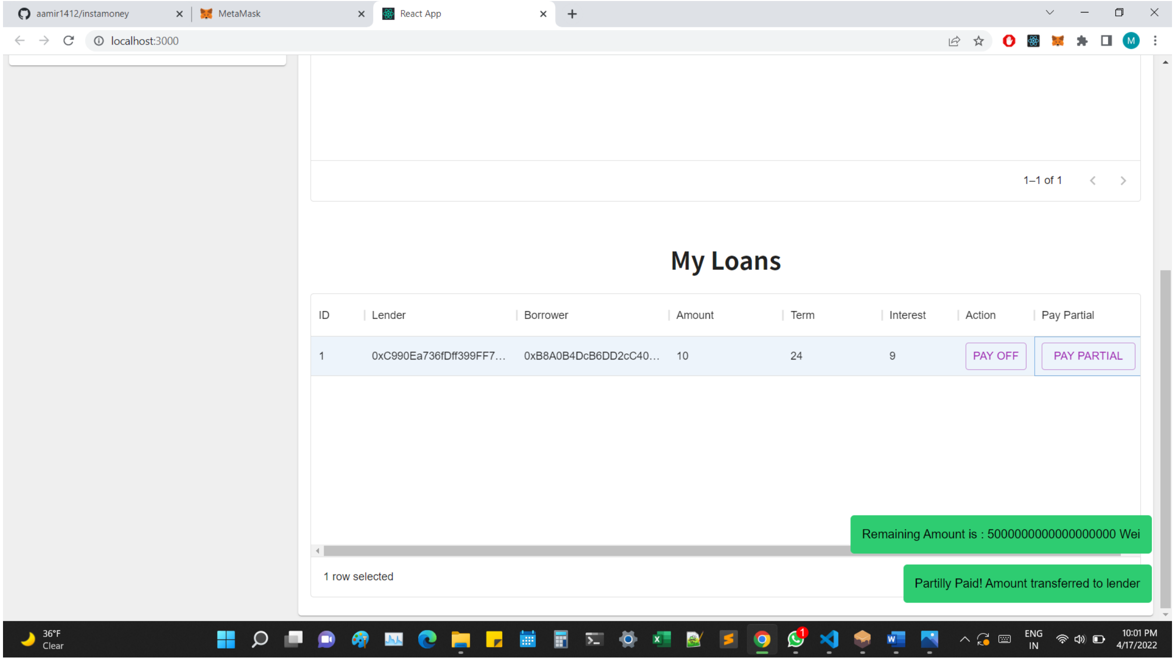
Please enter your repayment amount

5

My Loans

ID	Lender	Borrower	Amount	Term	Interest	Action	Pay Partial
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10	24	9	PAY OFF	PAY PARTIAL

1–1 of 1



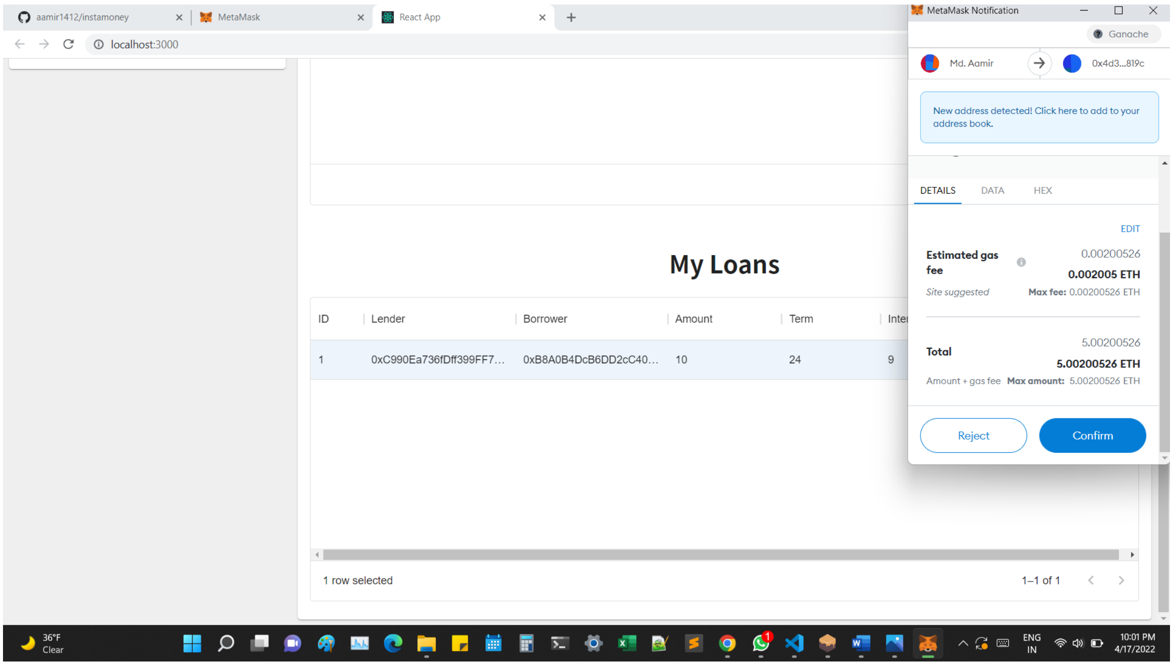
My Loans

ID	Lender	Borrower	Amount	Term	Interest	Action	Pay Partial
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10	24	9	PAY OFF	PAY PARTIAL

1 row selected

Remaining Amount is : 5000000000000000000 Wei

Partilly Paid! Amount transferred to lender



My Loans

ID	Lender	Borrower	Amount	Term	Inte
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10	24	9

1 row selected

1–1 of 1

MetaMask Notification

Ganache

Md. Aamir → 0x4d3...819c

New address detected! Click here to add to your address book.

DETAILS DATA HEX

EDIT

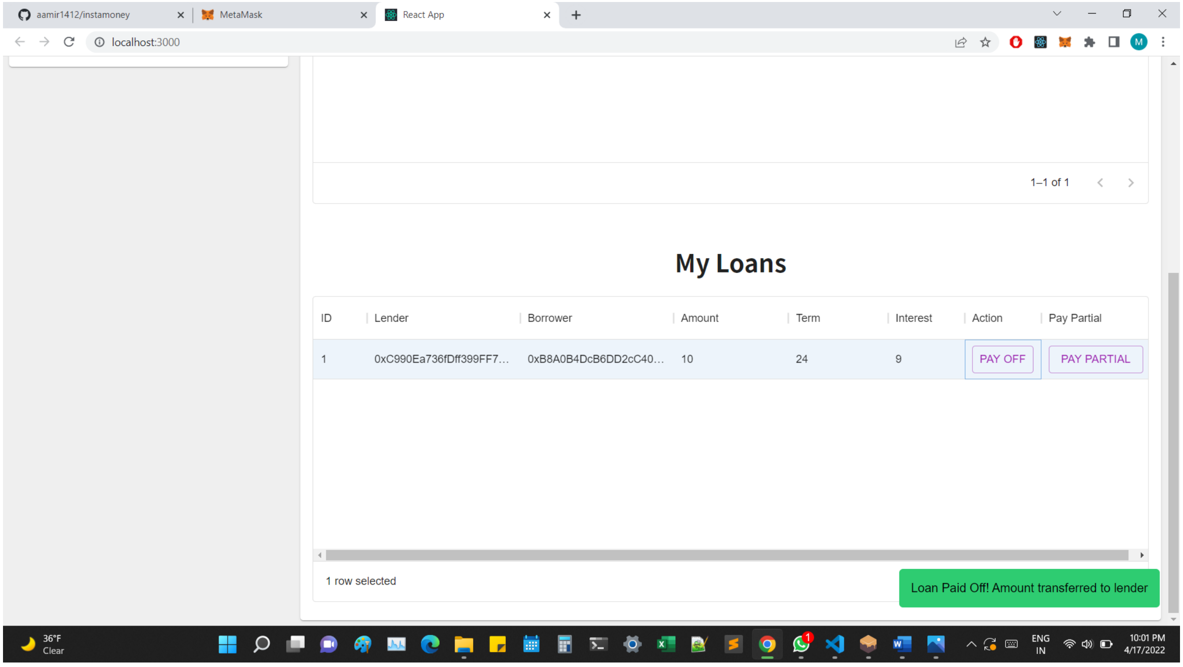
Estimated gas fee 0.00200526 **0.002005 ETH**

Site suggested **Max fee:** 0.00200526 ETH

Total 5.00200526 **5.00200526 ETH**

Amount + gas fee **Max amount:** 5.00200526 ETH

Reject Confirm



1–1 of 1

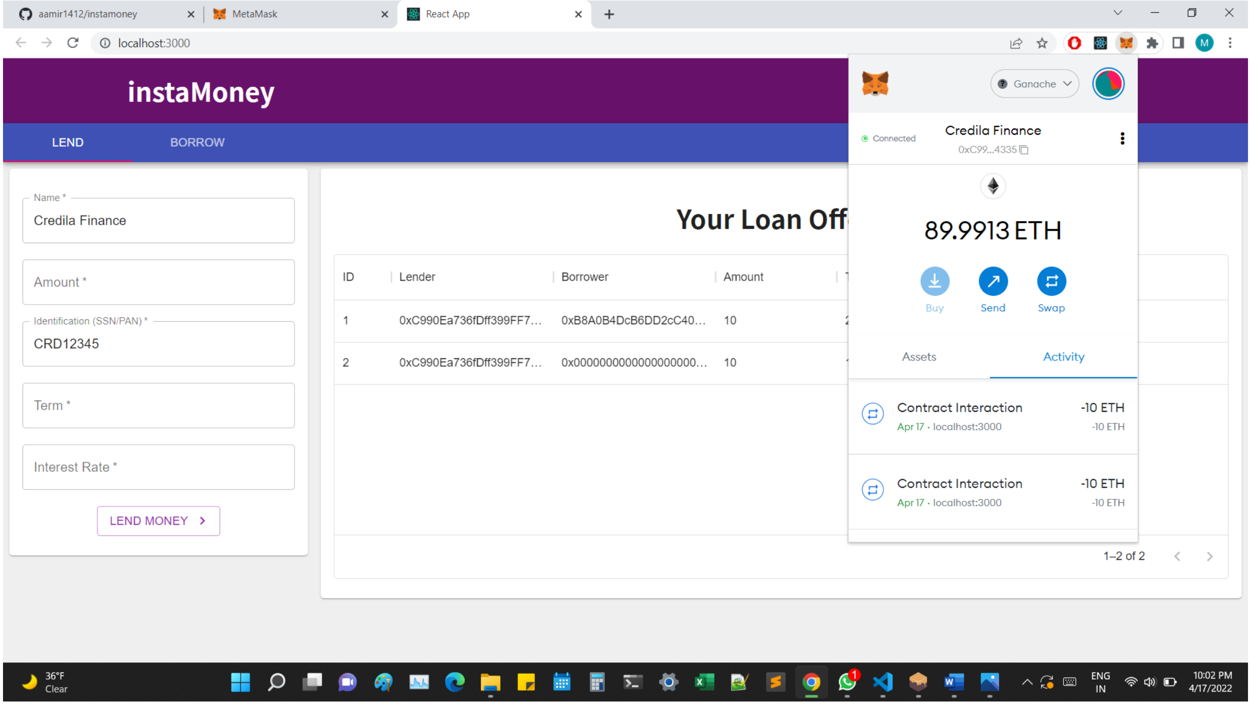
My Loans

ID	Lender	Borrower	Amount	Term	Interest	Action	Pay Partial
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10	24	9	PAY OFF	PAY PARTIAL

1 row selected

Loan Paid Off! Amount transferred to lender

Additionally, the Lender can also cancel it Loan offer from the Marketplace given no one has taken that loan. The lender wallet balance is 89.99 ETH. Below are the images for that process.



Name * Credila Finance

Amount *

Identification (SSN/PAN) * CRD12345

Term *

Interest Rate *

Your Loan Off

ID	Lender	Borrower	Amount
1	0xC990Ea736fDff399FF7…	0xB8A0B4DcB6DD2cC40…	10
2	0xC990Ea736fDff399FF7…	0x0000000000000000000…	10

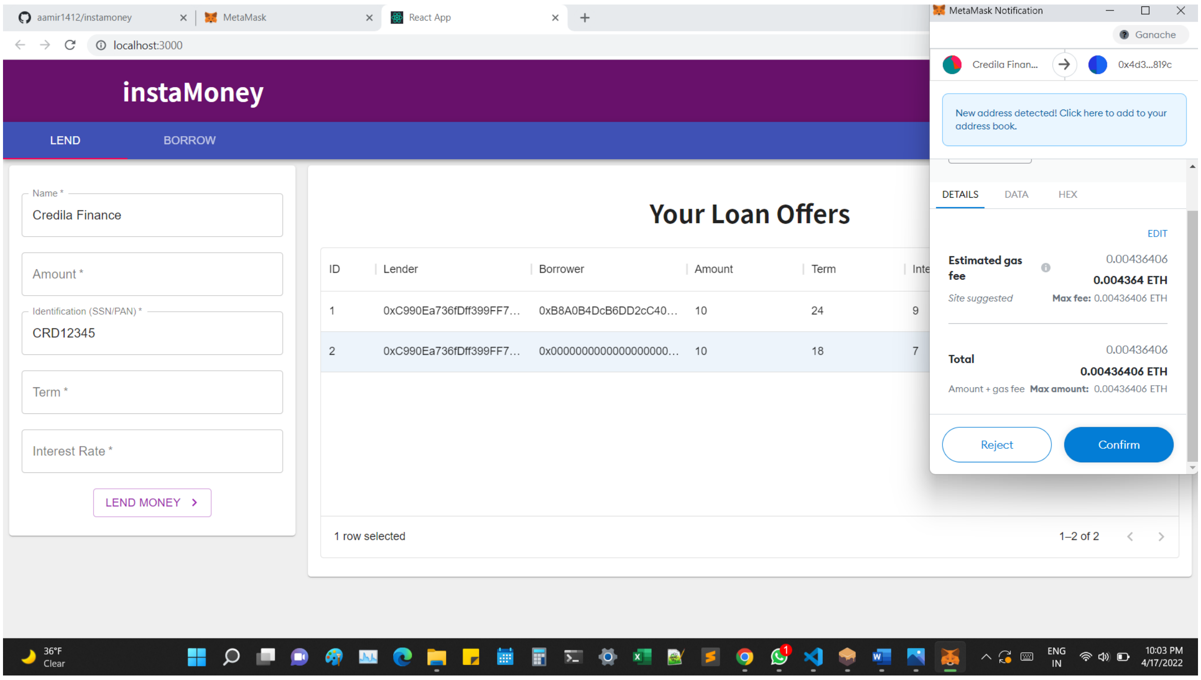
1–2 of 2

Credila Finance
0xC99...4335

89.9913 ETH

Contract Interaction -10 ETH
Apr 17 · localhost:3000 -10 ETH

Contract Interaction -10 ETH
Apr 17 · localhost:3000 -10 ETH



instaMoney

Name * Credila Finance

Amount *

Identification (SSN/PAN) * CRD12345

Term *

Interest Rate *

LEND MONEY >

Your Loan Offers

ID	Lender	Borrower	Amount	Term	Inte
1	0xC990Ea736fDff399FF7...	0xB8A0B4DcB6DD2cC40...	10	24	9
2	0xC990Ea736fDff399FF7...	0x0000000000000000000...	10	18	7

1 row selected 1–2 of 2

MetaMask Notification

Ganache

Credila Finan... → 0x4d3...819c

New address detected! Click here to add to your address book.

DETAILS DATA HEX

EDIT

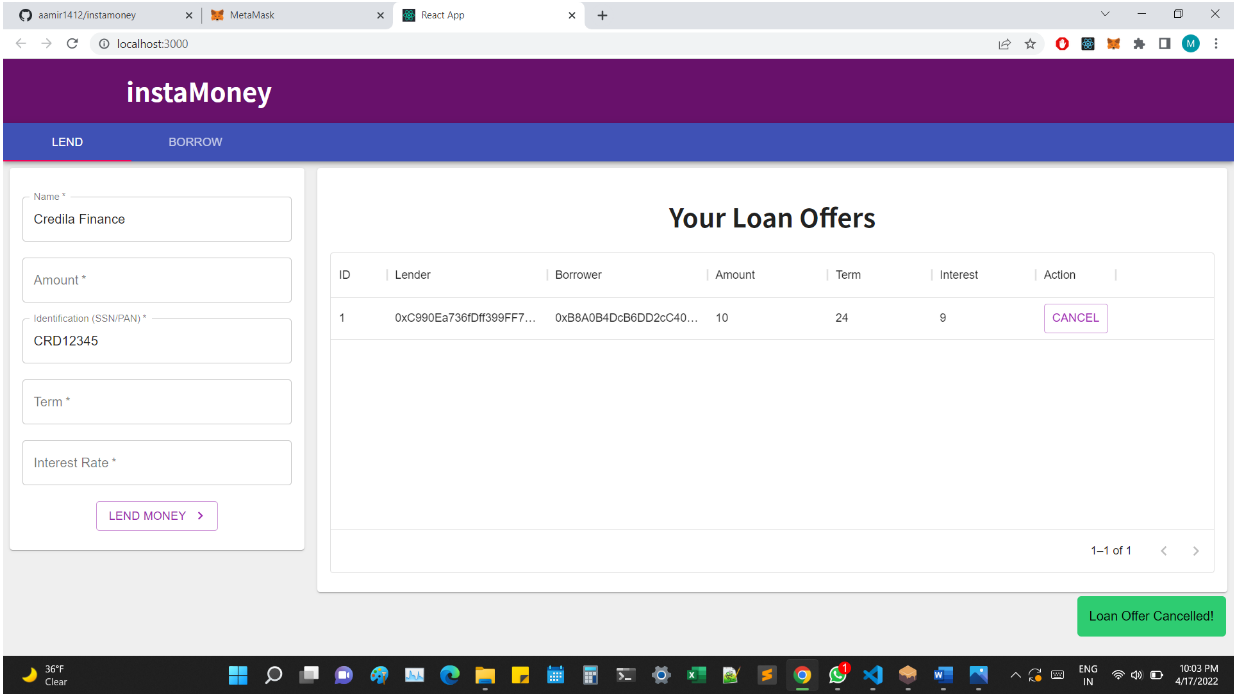
Estimated gas fee 0.00436406 0.004364 ETH

Site suggested Max fee: 0.00436406 ETH

Total 0.00436406 0.00436406 ETH

Amount + gas fee Max amount: 0.00436406 ETH

Reject Confirm



instaMoney

Name * Credila Finance

Amount *

Identification (SSN/PAN) * CRD12345

Term *

Interest Rate *

LEND MONEY >

Your Loan Offers

ID	Lender	Borrower	Amount	Term	Interest	Action
1	0xC990Ea736fDff399FF7...	0xB8A0B4DcB6DD2cC40...	10	24	9	CANCEL

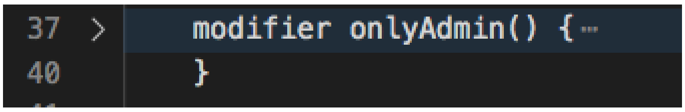
1–1 of 1

Loan Offer Cancelled!

On confirming the loan cancellation action, the posted loan is removed and the lender gets back its money into its wallet.

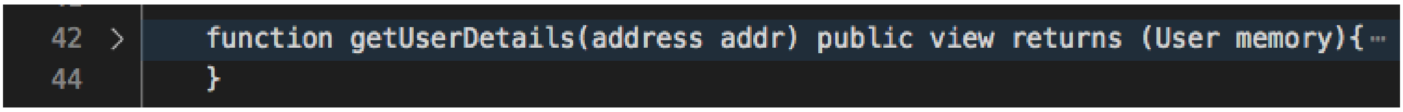
Code Walkthrough

Solidity Contract



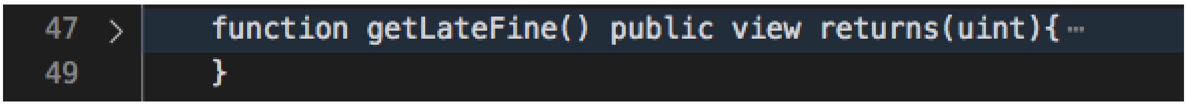
```
    modifier onlyAdmin() {⋯
    }
```

This modifier is used in the function signature to say that only admin can excute the function. Otherwise not. The Admin is the person who deployed the contract. He has a special functionality where he can change the late fine amount. The amount is added to repayment amount in case the borrower misses his payment on the due date.



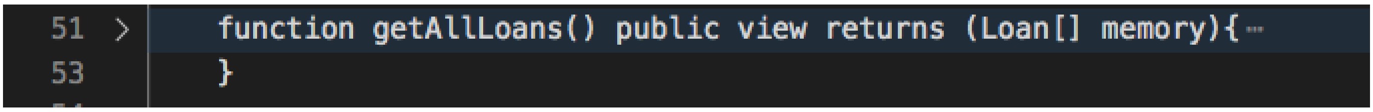
```
    function getUserDetails(address addr) public view returns (User memory){⋯
    }
```

It is a public method consumed by the UI app to fetch the details of the current connected user. This info is used to prefill information on the textboxes.



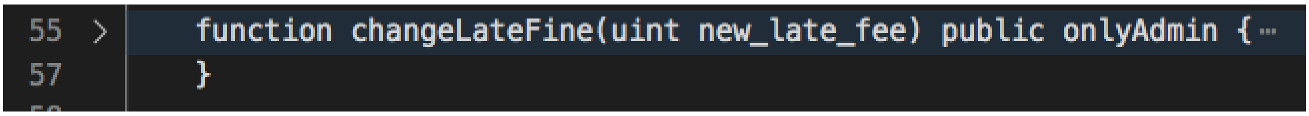
```
    function getLateFine() public view returns(uint){⋯
    }
```

Is used by the admin/UI to check what is the late fine amount



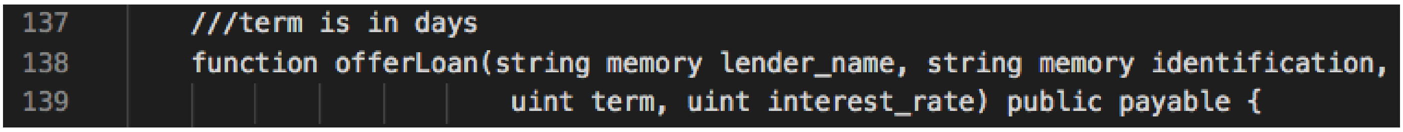
```
    function getAllLoans() public view returns (Loan[] memory){⋯
    }
```

This publicly exposed method is used to get an array of all loans to be displayed on the UI. It does not cost any gas as it is view only.



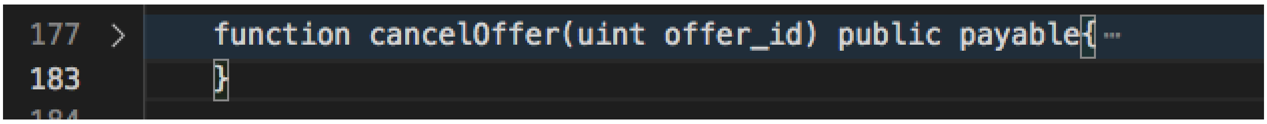
```
    function changeLateFine(uint new_late_fee) public onlyAdmin {⋯
    }
```

Admin can use this method to change the fine amount.



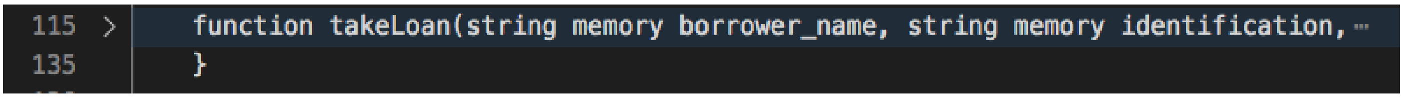
```
    ///term is in days
    function offerLoan(string memory lender_name, string memory identification,
                        uint term, uint interest_rate) public payable {
```

The lender can offer a new loan through this method which will be listed on the Loans marketplace Instamoney.



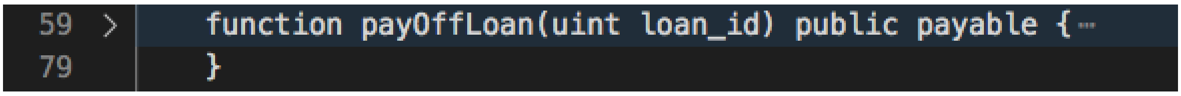
```
    function cancelOffer(uint offer_id) public payable{⋯
    }
```

The lender may cancel the loan offer he just made if he changes his mind. The money will be deposited back to his account immediately. He can only cancel loans which have not been sanctioned to any borrower yet.



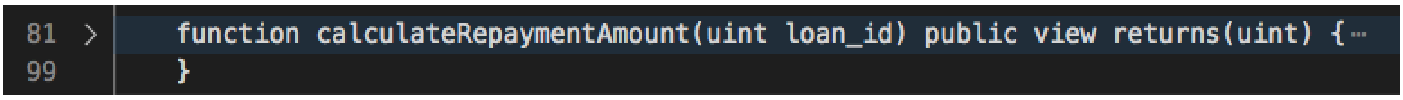
```
    function takeLoan(string memory borrower_name, string memory identification,⋯
    }
```

The borrower can take the loan which matches his requirements if he agrees to sign the collateral agreement. The money will be debited from the contract balance and immediately be transferred to the borrower.



```
    function payOffLoan(uint loan_id) public payable {⋯
    }
```

The borrower can choose to pay back his loan either partially or in full. If he borrowed 12 ethers for 12 months he may choose to settle the complete loan in one payment or he may choose to make partial payments of 1 ether every month. Of course with some extra interest as agreed upon by him at the time of taking the loan. If is makes the payment after 12 months, then some late fees will also be added to the repayment.

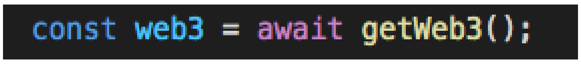


```
    function calculateRepaymentAmount(uint loan_id) public view returns(uint) {⋯
    }
```

This method calculates the repayment that is due at the current time for a particular loan. While making a repayment, the user would want to know how much he needs to pay back including interest amount, principal amount and other charges if any.

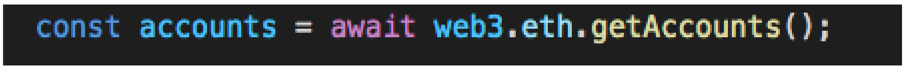
React UI App

During the App component load, we make instances of all the web3 functionality we will need and store them in the object's state to be used later.



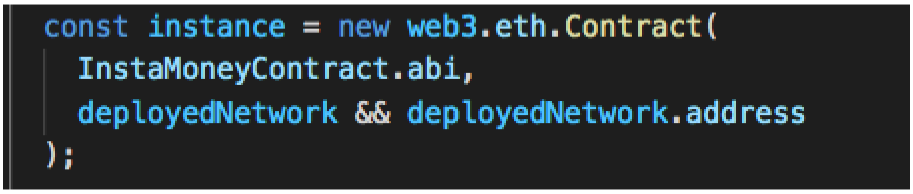
```
const web3 = await getWeb3();
```

Gets the web3 instance. Could be a singleton internally, not sure. web3 instance helps us to make connections to the blockchain network we are connected to, requesting and receiving information over the network. It hides the details of the network calls.



```
const accounts = await web3.eth.getAccounts();
```

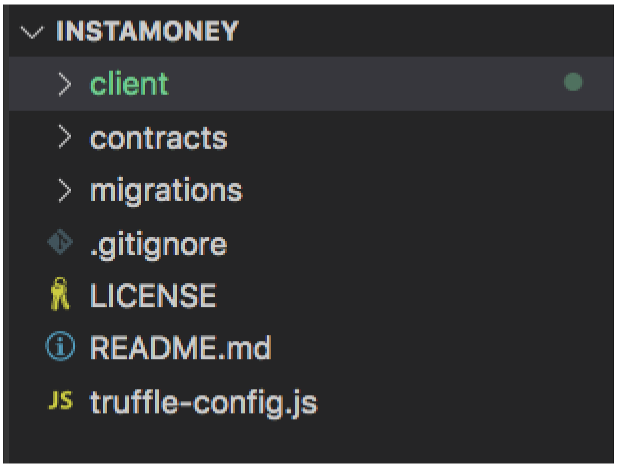
Pulls the details of the ethereum accounts connected to the current website. If not connected yet, the user will have to connect for smooth functionality. accounts[0] represents the



```
const instance = new web3.eth.Contract(
  InstaMoneyContract.abi,
  deployedNetwork && deployedNetwork.address
);
```

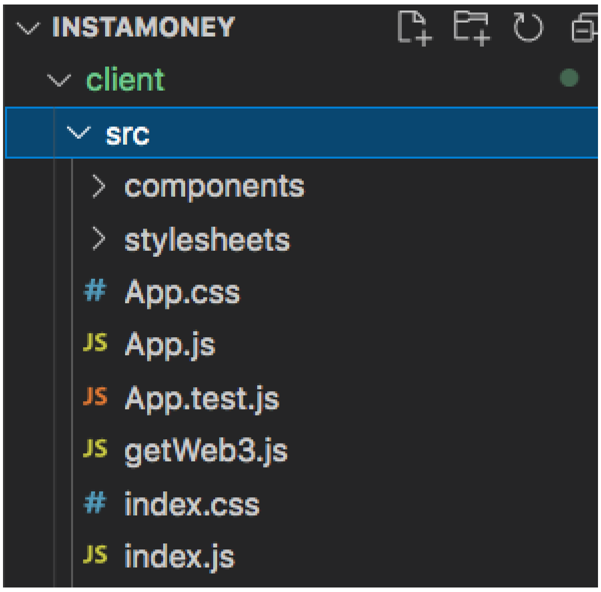
Creates an instance of the InstaMoneyContract which we deployed on the Ganache. Basically, it will have information about all the ABIs available to you. ABIs are very similar to APIs in which they state exactly how you should interact with the contract. It defines the Interface between you and the contract.

Project Structuring



```
INSTAMONEY
  > client
  > contracts
  > migrations
  .gitignore
  LICENSE
  README.md
  truffle-config.js
```

'client' folder contains the web application
'contracts' folder contains the solidity contracts.
'truffle-config.js' indicates where the compiled contracts should go such that web app can use the ABIs generated. It also indicates other things like what version of solidity and how to connect to the test chain.



```
INSTAMONEY
  client
    src
      components
      stylesheets
      App.css
      App.js
      App.test.js
      getWeb3.js
      index.css
      index.js
```

The web app is structured as shown above. It has an src folder containing all of the app code. The components are React custom components used across the UI. stylesheets contain css beautifying parameters. index.js is where the browser starts. It tells the browser how to render the app. App.js is another parent component containing state and information about the web3 instance to connect to the test chain.