E-LENDING PLATFORM

A Dissertation submitted to the University of Hyderabad in partial fulfillment of the degree of

MASTER OF TECHNOLOGY

in

Information Technology

by

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CERTIFICATE

This is to certify that the dissertation entitled **"E-Lending Platform"** submitted by **Vijaya Kumar Bandiki** bearing Reg. No **09MCMB21** in partial fulfillment of the requirements for the award of Master of Technology in Information Technology is a bonafide work carried out by him under my supervision and guidance.

The dissertation has not been submitted previously in part or in full to this or any other University or Institution for the award of any degree or diploma.

Dr. V. Radha
Assistant Professor, IDRBT.
Signature of the Supervisor

Head of the Department

Dean of the School

DECLARATION

I, **Vijaya Kumar Bandiki,** hereby declare that this Dissertation entitled **"E-Lending Platform"**, submitted by me under the guidance and supervision of **Dr. V. Radha, Assistant Professor, IDRBT**, is a bonafide work. I also declare that it has not been submitted previously in part or in full to this University or other University or Institution for the award of any degree or diploma.

Date: Name: **Vijaya Kumar Bandiki**

Signature of the Student

Regd. No. **09MCMB21**

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to Dr. V. Radha, Assistant Professor, IDRBT, Hyderabad, who generously supported and guided me throughout my project, IDRBT for providing me with the infrastructure and technical support that I need for this project. The project would not have been possible without her assistance.

I also thank Mr. B.Sambamurthy, Director, IDRBT, and Prof. Dr. Arun Agarwal, Dean, School of MCIS, Prof. Dr. C.R.Rao, Head of the Department (DCIS), University of Hyderabad for extending their cooperation.

The guidance of all the faculty members of IDRBT and the Department of Computer and Information Sciences, University of Hyderabad has been precious and timely. I wish to thank them for being very patient, understanding and helpful.

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PAPER COMMUNICATED

- Vijaya Kumar Bandiki and V.Radha, "**E-Lending Platform",** ***International Conference on Computer Science and Information Technology,*** 2011. (Under Review)

E-Lending Platform

Abstract

The web offers lenders a new channel – one that is open 24 hours a day, 7 days a week, anywhere in the world. Web-based lending presents an opportunity to add value and build loyalty for existing customers, attract new customers, reduce lending costs, improve customer service, and maximize loan profit. Online Lending is a powerful, economical way to add the Internet channel to loan pipeline, setting the stage for dramatic growth in loan revenues. Online lending offers an increased outreach to people living in isolated rural areas. This increased outreach would further reduce both transaction costs from economies of scale and financing costs through larger loan negotiations. The term eLending or e-Lending is a relatively new term and is used to describe a new medium for bankers and other lenders to engage in online lending activity. The e-Lending platform allows loan seekers with an opportunity to compare, search, apply and receive loans from various banks. The platform allows customers to contact directly with the banks and get loans directly. The customers are rated based on the credit score given by the platform; the banks can offer different interest rates to different rated customers. The customers can select their own choice of bank to get loan.

CONTENTS

1. Introduction

As the Internet matures, many lending organizations are attracted by the exciting new business opportunities for collaboration, customer service, and improved servicing of loans. The emerging online business models are now creating deep value for customers, lenders, and brokers. There are many loan seekers, who don't know which bank will offer less interest rate to them to get loans. The banks also don't know who are the loyal customers can repay the loan amount back and who are not. Our objective is to connect both the two loan seekers and banks to make successful lending. The e-lending platform gives a credit score to each customer which is calculated from the credit history of the customer. The credit score represents the credit risk of the customer. Based on the credit score the banks can offer different interest rates to customer. If the customer is having good credit score, the banks may compete to give loan to the customer. This provides the opportunity to get loans at cheaper interest rates.

1.1Motivation

There are so many lending websites which allows investors to invest money directly to the borrowers. The borrower details and amount required are displayed in the social lending websites. The investor can invest any amount to any selected customer. The borrowers will pay the monthly interest which will be directly credited to the investor's account.

There are so many loan seekers who want money to borrow and there are so many lenders also. Many loan seekers don't know which bank will offer less interest rate to them to get loans. The banks also don't know who are the loyal customers that can repay the loan amount back and who are not.

If there is a mechanism of rating best customers, so that if a customer is rated that he is a genuine customer and is loyal, the banks can easily give loan to the best customer. So we want to build a platform which uses the rating of the customer to give loans and banks will lend the money to the rated customers.

1.2 Objective

To create an Online Lending Platform that allows customers and banks to engage in a lending activity. The platform allows loan seekers with an opportunity to compare, search, apply and receive loans from various banks. The banks will lend money based on the rating of the customer.

1.3 Lending

Lending means

a. To give or allow the use of temporarily on the condition that the same or its equivalent will be returned.

b. To provide (money) temporarily on condition that the amount borrowed be returned, usually with an interest fee. [25]

1.4 E-Lending

As the Internet matures, many lending organizations are attracted by the exciting new business opportunities it enables through its extended geographical reach, time-zone-independent business hours, and expanded base of prospective customers.[1]

The term eLending or e-Lending is a relatively new term and is used to describe a new medium for bankers and other lenders to engage in online lending activity. The e-lending strategy of Lending Solutions, Inc. offers credit unions a heightened, 24/7 lending presence on the Internet through a private-labeled Web application, automated decision and underwriting support.[33]

E-Lending is a powerful, economical way to add the Internet channel to lender's loan pipeline, setting the stage for dramatic growth in loan revenues. E-Lending builds loan production in three ways. [30]

1. First, by placing your loan operations online and converting the application process into an anytime, anywhere activity, E-Lending greatly extends the reach of your loan production team.
2. Second, by streamlining the process, E-Lending increases the percentage of consumers actually completing applications. Thanks to its powerful decision engine and real-time links to credit bureaus, E-Lending can walk applicants

through data entry, pull a credit report, and render a decision in less than five minutes.

3. By presenting consumers with a variety of alternatives based on their preferences and credit scores, it increases the likelihood that consumers will find a loan that meets their needs and accept your offer.

1.4.1 Why lend online?

The web offers lenders a new channel – one that is open 24 hours a day, 7 days a week, anywhere in the world. It enables financial institutions of all kinds to quickly implement new businesses and new business models, without the expense of opening and staffing new branch locations.

Web-based lending presents an opportunity to add value and build loyalty for existing customers, attract new customers, reduce lending costs, improve customer service, and maximize loan profitability.[33]

1.4.2 Advantages of E-Lending

- Electronic data can allow a borrower to apply for a loan quickly from their home at any time of the day or night.
- Data can be transmitted electronically without the use of paper, telephones or fax machines.
- E-Lending is quicker than traditional loan processes and it can save both parties time and money.
- E-Lending presents an opportunity to add value and build loyalty for existing customers, attract new customers, reduce lending costs, improve customer service, and maximize loan profitability.
- The advantages of eLending are increasing as websites continually make it easier for consumers to fill out online applications.
- Consumers may benefit from eLending programs due to the increased efficiency of online lending, as ordinary Snail mail may not be required from eLenders. A loan application, a credit report, an appraisal report, and title insurance reports may all be sent via email to and from the parties.

1.4.3 Challenges of Lending on Web

While the web offers tremendous opportunities, it also introduces challenges. Challenge Number One is simply building the website. More than just a well-designed homepage, an online lending site must integrate into the lender's operations so that the online business becomes an integral part of existing business processes. Accomplishing this integration in a timely manner has proven to be more complex than many lenders have anticipated.[33]

The next challenge is the quality of the services offered through electronic lending. In order to succeed in the competitive online market, lenders must offer superior services that attract new customers and foster customer retention. Doing this online introduces difficulties that lenders may not have encountered in other business channels. Because there is no human expert to guide applicants on the web, applicants can easily get confused. They may fail to get the best solution – or perhaps any solution at all – because they don't understand the lending process, the terminology, or how to complete the forms.

Rogue Lending Sites Can Be Very Dangerous To Consumers. They are very competitive in their attempt to grab the eye of the consumer and direct it toward a service or item

1.5 Social Lending

Person-to-person lending (also known as peer-to-peer lending, peer-to-peer investing, and social lending; abbreviated frequently as P2P lending) is a certain breed of financial transaction (primarily lending and borrowing, though other more complicated transactions can be facilitated) which occurs directly between individuals or "peers" without the intermediation of a traditional financial institution. Person-to-person lending is for the most part a for-profit activity, this distinguishes it from person-to-person charities, and person-to-person philanthropy and crowd funding which also create connections between donors and recipients of donations but are nonprofit movements.[14]

Various models and variations of person-to-person lending services have evolved based on different combinations of the following main parameter settings:

- Direct vs. indirect lending
- Secured vs. unsecured lending
- Prior familiarity of lenders and borrowers
- Services offered

1.6 Technological Introduction

1.6.1 XML and XSD

- XML stands for Extensible Markup Language (XML). XML is a set of rules for encoding documents in machine-readable form. It is defined in the XML 1.0 Specification produced by the W3C, and several other related specifications, all gratis open standards. [16]

The design goals of XML emphasize simplicity, generality, and usability over the Internet. It is a textual data format with strong support via Unicode for the languages of the world. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in web services.

- XML is designed to transport and store data. XML is important to know, and very easy to learn. XML is a markup language much like HTML
- XML was designed to carry data, not to display data
- XML tags are not predefined. You must define your own tags
- XML is designed to be self-descriptive [3]

- XSD stands for XML Schema Definition (XSD). The XML Schema language is also referred to as XML Schema Definition (XSD). The purpose of an XML Schema is to define the legal building blocks of an XML document, just like a DTD. [17]

An XML Schema:

- defines elements that can appear in a document
- defines attributes that can appear in a document
- defines which elements are child elements
- defines the order of child elements

- defines the number of child elements
- defines whether an element is empty or can include text
- defines data types for elements and attributes
- defines default and fixed values for elements and attributes

1.6.2 XSI

XSI is a tool or software (currently under development in IDRBT) used to generate user interface for any given xml schema document, cull out data entered through interface, create xml documents from data entered by user and validate xml document against the schema. The motive behind XSI is to provide a unique view of the forms given by the service providers to all its customers. We use XSI to send XML document to the other parties, where they open the XML documents in XSI which presents a GUI format of XML, fills it and sends back to the platform. [9][10]

1.6.3 Webservices

A Web service is a service that is identified by a URL and can be accessed by applications via Web protocols in accordance with the contract that describes its programmatic interface. Web Services can be thought of as Internet middleware with XML (Extensible Markup Language) as the basic web services protocol. [4][5][7][18]

Web Services can convert your application into a Web-application, which can publish its function or message to the rest of the world.

- Web services are application components.
- Web services communicate using open protocols
- Web services are self-contained and self-describing
- Web services can be discovered using UDDI
- Web services can be used by other applications
- XML is the basis for Web services

The basic Web services platform is XML + HTTP.

XML provides a language which can be used between different platforms and programming languages and still express complex messages and functions. The HTTP protocol is the most used Internet protocol.

Web services platform elements:

- SOAP (Simple Object Access Protocol)
- UDDI (Universal Description, Discovery and Integration)
- WSDL (Web Services Description Language)

1.6.4 SOAP:

SOAP is a standard way of serializing the information needed to invoke services located on remote systems so that the information can be sent over a network to the remote system, in a format the remote system can understand, regardless of what platform the remote service runs on or what language it's written in (or) more simple: SOAP is a protocol for accessing a Web Service. [19]

- SOAP is a communication protocol
- SOAP is a format for sending messages
- SOAP is designed to communicate via Internet
- SOAP is platform independent
- SOAP is language independent
- SOAP is based on XML
- SOAP is simple and extensible

1.6.5 WSDL

WSDL is an XML-based language for locating and describing Web services. [20]

- WSDL stands for Web Services Description Language
- WSDL is based on XML
- WSDL is used to describe Web services and locate Webservices
- WSDL is a W3C standard

1.6.6. UDDI

UDDI is a directory service where companies can register and search for Web services.

- UDDI is a directory for storing information about web services
- UDDI is a directory of web service interfaces described by WSDL
- UDDI communicates via SOAP
- UDDI is built into the Microsoft .NET platform

2. Literature Survey

2.1 What is Credit scoring?

'Credit' simply means, 'buy now and pay later', whether the purchase is for short-term consumption, durable goods and other assets that provide users with valuable services, or productive enterprises. Scoring refers to the use of a numerical tool to rank order cases according to some real or perceived quality. Scores are usually presented as numbers that represent a single quality, while grades may be presented as letters (A, B, C, etc.) or labels (export quality, investment grade) to represent one or more qualities. [1]

Credit scoring is the use of statistical models to transform relevant data into numerical measures that guide credit decisions. Credit scoring is the use of predictive models (algorithms), to rank cases by their probability of being 'good' or 'bad' at a future date, based upon lenders' past experiences. [1]

When you make an application for credit, the creditor or lender uses your credit score to quickly make a credit/no-credit decision. This same decision can very well be made by simply viewing your credit report, but the credit score makes decision-making easier and less subjective. [1]

Credit scores give lenders a fast, objective measurement of your credit risk. Before the use of scoring, the credit granting process could be slow, inconsistent and unfairly biased.

2.2 Where is credit scoring used?

Credit scores provide the greatest value, when they are used to guide decisions that affect the customer. In decision processes, lenders define different scenarios using scores and policy, and then the action to be taken in each case—like accept/reject, maximum loan value or repayment, interest rate, loan term, etc. Alternatively, underwriters may consider scores as one of several inputs into a credit decision. The cost benefits of decision automation are placing incredible pressure upon organizations to limit the use of underwriters, to cases where their specialist

knowledge is absolutely essential, especially where there is significant information that cannot be captured within the scoring process, and potential profits are high. [1]

Credit scores go under a variety of different names, depending upon where and how they are used. The labels usually refer to: (i) the information source; (ii) the task being performed; or (iii) what is being measured.

2.2.1 Labels of Credit score

The most common labels used are

- Application Score : Used for new business origination, and combines data from the customer, past dealings, and the credit bureaux.
- Behavioural Score : Used for Account management (limit setting, over-limit management, authorizations), and usually focuses upon the behaviour of an individual account.
- Collections Score : Used as part of the collections process, usually to drive predictive dialers in outbound call centers, and incorporates behavioural, collections, and bureau data.
- Customer Score : Combines behaviour on many accounts, and is used for both account management and cross-sales to existing customers.
- Bureau Score : A score provided by the credit bureau, usually a delinquency or bankruptcy predictor that summarizes the data held by them. [1]

2.2.2 Score Triggers

A major defining feature in credit scoring is what triggers the score calculation in practice:

Trigger	Usual area
Request	Application
Time	Behavioural
Entry	Recovery
Transaction	Fraud
Event warning	Behavioural/fraud
Campaign	Response

2.2.3 Data Sources

As indicated, credit scoring is highly dependent upon data. It is obtained from a number of different sources, and then assessed prior to making a decision. For retail credit, the sources include, but are not limited to:

Customer - Application forms, financial statements, asset details.
Internal data - Past dealings, other account behaviour.
Bureau data - Credit bureaux (private and public), other lenders, court records.

2.3 Why is credit scoring used?

- Credit score represents the creditworthiness of a person. A credit score is primarily based on credit report information typically sourced from credit bureaus.
- Lenders, such as banks and credit card companies, use credit scores to evaluate the potential risk posed by lending money to consumers and to mitigate losses due to bad debt.
- Lenders use credit scores to determine who qualifies for a loan, at what interest rate, and what credit limits. Lenders also use credit scores to determine which customers are likely to bring in the most revenue.
- Credit scoring also has a lot of overlap with data mining, which uses many similar techniques. [7]

2.4 Advantages of Credit score

- People can get loans faster.
  - Scores can be delivered almost instantaneously, helping lenders speed up loan approvals. Today many credit decisions can be made within minutes. Even a mortgage application can be approved in hours instead of weeks for borrowers who score above a lender's “score cutoff”. Scoring also allows retail stores, Internet sites and other lenders to make “instant credit” decisions. [13]
- Credit decisions are fairer.
  - Using credit scoring, lenders can focus only on the facts related to credit risk, rather than their personal feelings. Factors like your gender, race, religion, nationality and marital status are not considered by credit scoring.
- Credit “mistakes” count for less.

- If you have had poor credit performance in the past, credit scoring doesn't let that haunt you forever. Past credit problems fade as time passes and as recent good payment patterns show up on your credit report. Unlike so-called “knock out rules” that turn down borrowers based solely on a past problem in their file, credit scoring weighs all of the credit-related information, both good and bad, in your credit report.

➢ More credit is available.

- Lenders who use credit scoring can approve more loans, because credit scoring gives them more precise information on which to base credit decisions. It allows lenders to identify individuals who are likely to perform well in the future, even though their credit report shows past problems.

➢ Credit rates are lower overall.

- With more credit available, the cost of credit for borrowers decreases. Automated credit processes, including credit scoring, make the credit granting process more efficient and less costly for lenders, who in turn have passed savings on to their customers. And by controlling credit losses using scoring, lenders can make rates lower overall. [13]

2.5 Mechanics of Credit scoring

Credit scoring is the use of predictive models (algorithms), to rank cases by their probability of being ‘good’ or ‘bad’ at a future date, based upon lenders’ past experiences. The logic is simple: a ‘good’ customer is one to be welcomed with open arms (low risk); and a ‘bad’ customer is one that would have been turned away, had the lender known better (high risk).[1] Scoring algorithms can take many forms, but the most common are regression formulae of the form:

$$\text{Regression formula } y = \beta_0 + \beta_1.X_1 + \beta_2.X_2 + \ldots\ldots\ldots\ldots + \beta_n.X_n$$

This formula has four main components:

x - *independent/predictor variable*, which may be the original variable, a transformed variable, or dummy 0/1 flags indicating whether or not that attribute applies.

β - *Regression coefficient* or *parameter estimate*, factor by which that variable will be weighted, which for dummy variables indicates relative importance.

y - dependent/response/target function associated with the outcome, which is usually: (i) 0 for bad and 1 for good; (ii) a logistic unit (logit); or (iii) a probability unit (probit).

e - residual/error term, which is the portion that cannot be explained, and is ignored when the model is applied in practice.

The regression coefficients are derived to provide a model that best explains the relationship between predictors and the response function. In retail credit, traditional scorecards use classed variables, where the points are only allocated if that condition holds true. [1]

Condition	Score
If age < 29 then	Deduct 20
If age >= 45 then	Add 50
If no home phone then	Deduct 30
If existing customer then	Add 20

Table 2.1: Functions involved in calculating Credit score

Different ways of developing credit scoring models have evolved over the years, and not all models take on the traditional form. There are other means of transforming the data, and deriving estimates. Predictive modelling techniques can be classified into two broad camps: (i) parametric, which make assumptions about the data; and (ii) non-parametric, which do not require any assumptions.

2.5.1 Parametric Techniques

Traditional scorecards are developed primarily using parametric techniques: discriminant analysis (DA), linear probability modelling (LPM), and logistic regression. [1] While powerful, they require assumptions that do not always hold true. For all intents and purposes, DA and LPM can be treated as one, as LPM is used as a part of DA. LPM is quick and easy, and was the tool of choice for many years. Referring back to the regression formula, with LPM the response function is:

Linear probability modeling $y \cong G/(G+B)$

where G and B are the counts of goods and bads respectively. LPM has been subjected to a great deal of criticism though, because it is not usually considered suitable for modelling binary outcomes. Even so, it is still commonly used, because most of the criticisms have been addressed by how the technique is applied. In contrast, logistic regression is slower, but better suited to modelling dualities. It works by deriving an estimate of the natural log odds:

Logistic (logit) regression $y \cong e^{G/B}$

2.5.1 Non-parametric techniques

Because of the assumptions required when using parametric techniques, many people have tried to use non-parametric techniques. Many of these come from the field of machine learning, and include neural networks (NNs), genetic algorithms, and K-nearest neighbours[1]. The greatest criticisms of these techniques relate to: (i) lack of transparency; and (ii) potential overfitting. Most are not associated with traditional scorecards, but can be used to develop them. Other techniques that have been tried are decision trees and linear programming, but these have not been very successful.

2.6 Industrial Credit Scoring

This section describes how various organizations are giving ratings to the clients.

2.6.1 FICO Credit Scoring

While there are several different versions of the credit score, the most commonly used version is the FICO score. Developed by the Fair Isaac Company, the FICO score is used by many creditors and lenders to decide whether or not to extend credit to you. [13]

FICO Scores are calculated from a lot of different credit data in your credit report. This data can be grouped into five categories as outlined below. The percentages in the chart reflect how important each of the categories is in determining your FICO score.

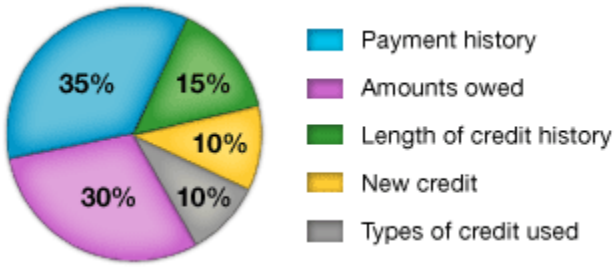

Fig 2.1: Fico credit score

These percentages are based on the importance of the five categories for the general population. For particular groups - for example, people who have not been using credit long - the importance of these categories may be somewhat different.

- **Payment History**

  - Account payment information on specific types of accounts (credit cards, retail accounts, installment loans, finance company accounts, mortgage, etc.)
  - Presence of adverse public records (bankruptcy, judgments, suits, liens, wage attachments, etc.), collection items, and/or delinquency (past due items)
  - Severity of delinquency (how long past due)
  - Amount past due on delinquent accounts or collection items
  - Time since past due items (delinquency), adverse publicrecords (if any), or collection items (if any)
  - Number of past due items on file, number of accounts paid as agreed

- **Amounts Owed**

  - Amount owing on accounts.
  - Amount owing on specific types of accounts.
  - Lack of a specific type of balance, in some cases.
  - Number of accounts with balances.
  - Proportion of credit lines used (proportion of balances to total credit limits on certain types of revolving accounts)
  - Proportion of installment loan amounts still owing (proportion of balance to original loan amount on certain types of installment loans)

- **Length of Credit History**

  - Time since accounts opened.
  - Time since accounts opened, by specific type of account.
  - Time since account activity.

- **New Credit**

  - Number of recently opened accounts, and proportion of accounts that are recently opened, by type of account.
  - Number of recent credit inquiries

2.6.2 CIBIL Credit Information Reports

CIBIL - India's first credit information bureau- is a repository of information, which contains the credit history of commercial and consumer borrowers. CIBIL provides this information to its Members in the form of credit information reports. CIBIL's equity was held by State Bank of India, Housing Development Finance Corporation Limited, Dun & Bradstreet Information Services India Private Limited and Trans Union International Inc. The shareholding pattern was in the proportion of 40:40:10:10 respectively. [11]

The CIR includes the following information:

- Basic borrower information like:
  i. Name
  ii Address
- In case of individuals:

  iii. Identification numbers
  iv. Passport ID
  v. Voters ID
  vi. Date of birth
- In case of non-individuals
  vi. D-U-N-S®
  vii. Number
  viii. Registration Number

ix. Legal Constitution

- Records of all the credit facilities availed by the borrower
- Past payment history
- Amount overdue
- Number of inquiries made on that borrower, by different Members
- Suit-filed status.

The CIR does not contain:

- Income / Revenue details
- Amount(s) deposited with the bank
- Details of borrowers' assets
- Value of asset(s) mortgaged
- Details of investment(s)

2.6.3 CRISIL Credit Ratings

CRISIL - Credit Rating Information Services of India Ltd, is a global analytical company providing ratings, research, and risk and policy advisory services, India's leading ratings agency. [12]

CRISIL's ratings process is designed to ensure that all ratings are based on the highest standards of independence and analytical rigour. From the initial meeting with the management to the assignment of the rating, the rating process normally takes three to four weeks. However, CRISIL has sometimes arrived at rating decisions in shorter timeframes, to meet urgent requirements. The process of rating starts with a rating request from the issuer, and the signing of a rating agreement. CRISIL employs a multi-layered, decision making process in assigning a rating.

- Ratings awarded by major credit rating agencies:
  - AAA - : Highest Safety
  - AA - : High Safety
  - A - : Adequate Safety
  - BBB - : Moderate Safety
  - BB - : Sub moderate Safety
  - B - : Inadequate Safety
  - C - : Substantial Risk
  - D - : Default

2.7 Social Lending platforms across the world

Social Lending, or peer-to-peer lending, essentially brings individuals together to lend and borrow money directly from each other, cutting out the middle man (the bank). Borrowers are able to get low cost loans, lenders are able to get great returns while helping their fellow man, and both parties win.

- Dhanax, Location: India, http://www.dhanax.com/ [31]
- Lenders can lend loans to borrowers that are screened by an "agent".
- The agents typically are small microfinance organizations, rural technology centers or non government organizations.
- Minimum investment for lenders is Rs 1,000.
- Maximum investment per lender is Rs 1 million.
- Borrower can borrow up to Rs 20,000.
- DhanaX charges lenders a 100 Rs sign up fee and 1.5% fee of the monthly repayments. Borrowers are charged 6.5% of the loan amount.
- Only Indian nationals can lend, non-resident Indians can lend provided their bank account matches certain specifications

- India's first online platform for micro-credit.[32]
- Non-profit Organization.
- The borrower’s details are displayed at the website.
- Investors invest money directly to the required borrowers.
- Borrowers will pay the monthly interests which are directly credited to the investor’s account.
- Team: Ramakrishna-Co-Founder, CEO., Smita-Co-Founder & COO

Other Lending platforms:

- Auxmoney, Twitter: @auxmoney, Facebook: auxmoney-GmbH, Location: Germany
- Boober, Location: Italy
- Cashare, Facebook: Cashare, Twitter: @cashare, Location: Switzerland
- CommunityLend, Twitter: @communitylend, Location: Canada
- Comunitae, Twitter: @Comunitae, Location: Spain
- Donjoy, Location: Korea
- Fairplace, Location: Brazil
- Finansowo, Facebook: Finansowo, Location: Poland
- Fixura, Location: Finland
- FriendsClear, Location: France
- Funding Circle, Facebook: Funding Circle, Location: UK
- Fyananz, Location: US
- GreenNote, Facebook: GreenNote, Location: US
- HypoDate, Location: Netherlands,
- iGrin, Location: Australia
- isePankur, Facebook: isePankur, Twitter: @isepankur, Location: Estonia
- Kokos, Twitter: @kokospl, Location: Poland
- LendingClub, Facebook: Lending Club, Twitter: @lendingclub, Location: US
- Lendit, Twitter: @LenditNZ, Location: New Zealand,
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- LoanLand, Location: Sweden
- Lubbus, Location: Spain
- Maneo, Twitter: @sociallendingJP, Location: Japan
- Money Auction, Location: Korea
- Noba, Location: Hungary
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- Smava, Twitter: @smava, Location: Germany
- Trundo, Location: Netherlands
- Uppspretta, Twitter: @uppspretta, Location: Iceland
- Vittana, Twitter: @vittana, Location: US
- YES-secure, Facebook: YES-secure, Twitter: @YES_secure, Location: UK
- ZimpleMoney, Location: US,
- Zopa, Twitter: @Zopa, Location: UK

2.8 Websites surveyed

www.LendingTree.com

www.BankRate.com

www.HSH.com

http://www.thefreedictionary.com/lending

http://en.wikipedia.org

http://money.howstuffworks.com/personal-finance/debt-management/credit-score.htm

http://www.ecompare.co.in/credit-report-action.cfm

http://www.freeyearlycreditreportus.com

www.cibil.com

www.myfico.com

http://www.w3schools.com

http://www.lendingsolutions.com/e-lending

http://elending.blogspot.com

3. Proposed Architecture and Solution

3.1 Architecture Diagram

In the proposed architecture, there are mainly six phases. They are Authorization, Registration, Validation, Credit Score calculation, Trading and Loan Approval and Acceptance phase.

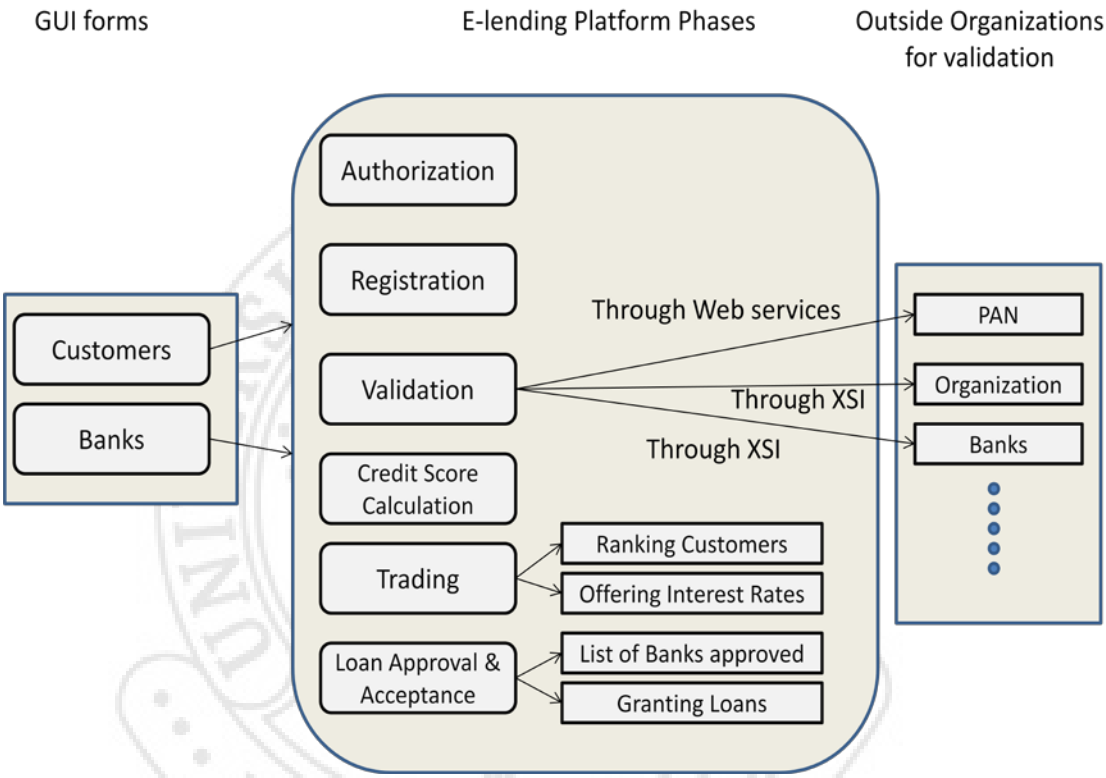


Fig 3.1: Architecture of E-Lending platform

3.2 Overview of E-Lending Platform

The platform asks authorization. So the customer has to register before login into the platform. The platform asks customer details like personal details, income details, working details, net worth details, etc. Once the customer is registered, the credit score is calculated for the customer.

The banks also need to provide authorization. So, banks also need to be registered. The platform asks bank details such as name, username, address, phone number, etc.

After registration, when a bank logins into the platform list of customers with credit score are displayed to the banks.

The bank selects any customer and clicks to see the details. If the customer got any offers previously it displays to the bank. The platform asks the offering interest for the specified customer. The banks need to enter the interest rate.

When a customer logins into the platform, he/she will be informed showing the details of the bank offering interest to him/her. The customer can get many offers from different banks.

If the customer is satisfied with offered interest rate, he/she can select any bank to get loan. The customer has to send an approval request to the bank requesting for approving the loan.

The bank when logins with the platform, the platform displays the list of approval requests made by the customer.

The bank selects the customer and sends the acceptance response back to the customer.

The platform displays the response back to the customer.

Sequential flow diagram:

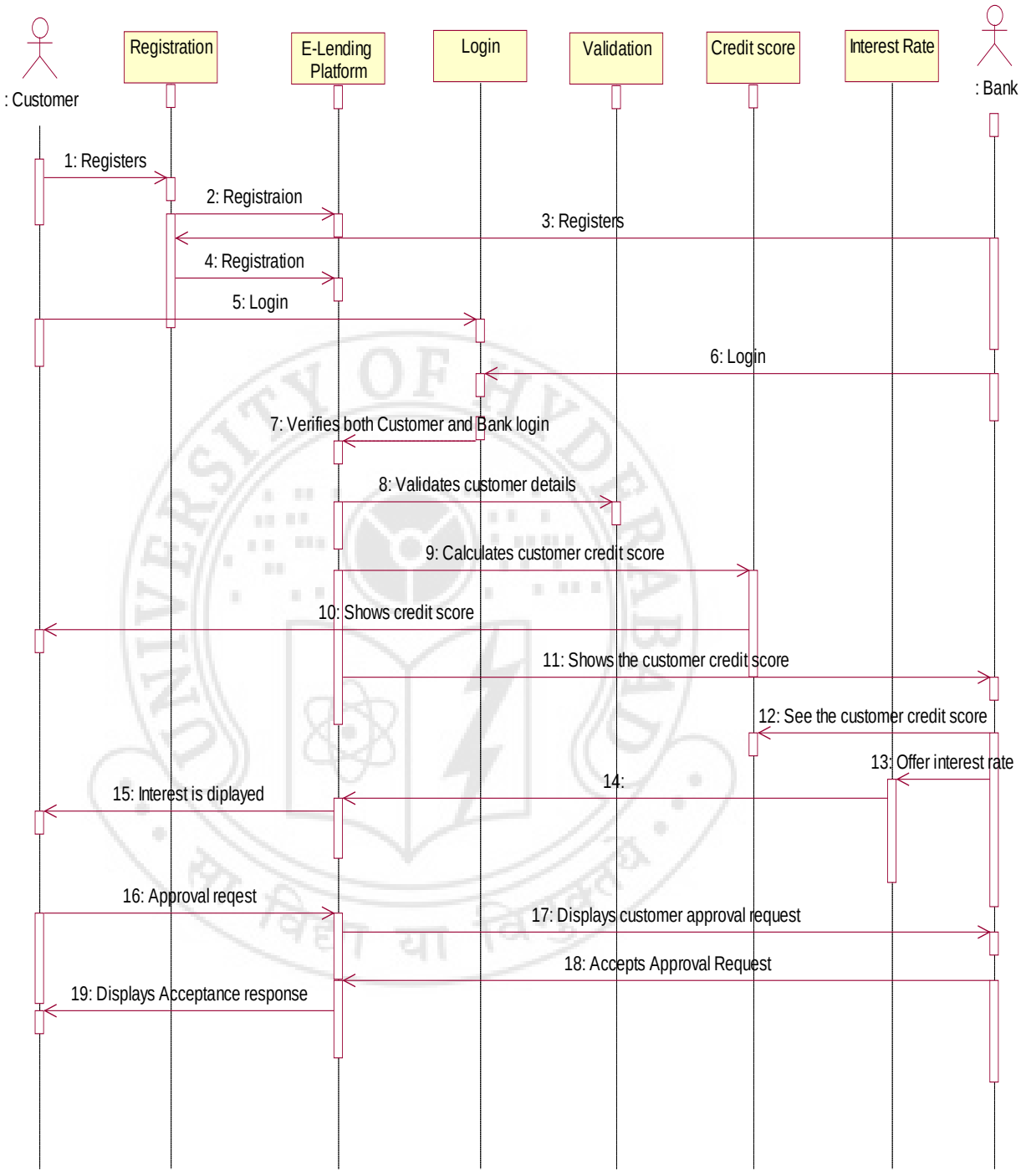


Fig 3.2: Sequential diagram of E-Lending platform

3.3 Phases of E-Lending Platform

3.3.1 Authorization

It is the first phase of the E-lending platform where the customers and banks need to be authorized to login into the platform. The Login page is created for customer side and bank side separately.

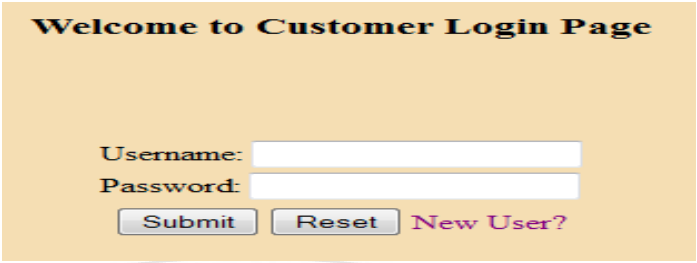


Fig 3.3: Customer login page

3.3.2 Registration

To login into the platform, the customers and banks need to be registered. In the customer registration page, the customer details like username, password, email, personal details, Income details, Employment Details, Net worth Details and Banking Details.

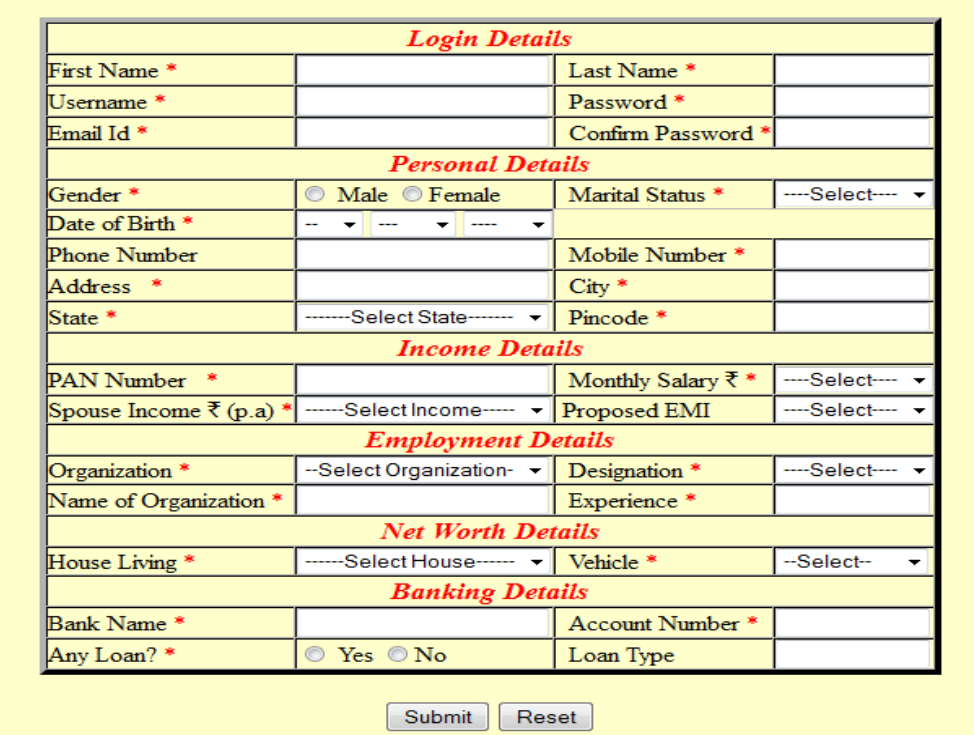


Fig 3.4: Customer registration page

In bank registration page, bank details such as name of the bank, address,

phone number, etc. are collected.

In the both registration pages JavaScript validations are used to validate entering details and these details are stored in MSAccess database.

3.3.3 Validation

In the validation phase, we are checking the details of customer against three modules: PAN database to check whether the customer is paying taxes rightly or not, Working organization to check employment details and Bank to check whether the customer has taken any loan or not and if so, whether the customer paying dues regularly or not.

- In checking tax details against PAN database we are using Web services.

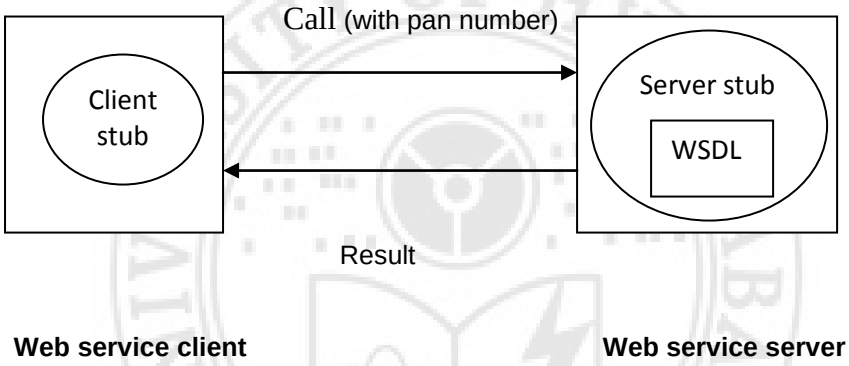


Fig 3.5: Webservices

We have to write a web service client program with the URL of the service and names of the services.

We created a web service which provides a tax detail service when is requested by a web service client program with a PAN number.

We have created a MSAccess Database which contains details of customer tax details. When a Webservice server program is called by a webservice client program with a PAN number, the webservice server internally checks the details of the customer PAN number in the database and sends result back to the client program.

The PAN database checking is useful in calculating the credit score of the customer.

- In checking the details of customer with Organization and Bank, we are using XSI tool to communicate with the organization and bank in the form of XML documents[16].

In organization side, we have created XML files which contain the working

details like Name of the employee, identity number, Salary, Experience, etc….These XMLs are written mainly in the form of choice lists so that the other parties can't modify the data. They can only select the option listed in the choices.

➢ In bank side, we have created XML file which contain details like Name of candidate, identity, whether the customer has any loan or not – if yes, whether the customer paying amount regularly or not, payment history, etc….

We also created XSDs to provide restrictions on the entering values in the XML.[16][17]

```
<?xml version="1.0" encoding="UTF-8"?>

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified" attributeFormDefault="unqualified">

        <xs:element name="B.VijayKumar" type="xs:string">

            <xs:simpleType>

                <xs:restriction base="xs:string">

                        <xs:enumeration value="Yes"/>

                    <xs:enumeration value="NO"/>

                </xs:restriction>

            </xs:simpleType>

        </xs:element>
                :
                :
                :
        </xs:sequence>

        </xs:group>

</xs:schema>
```

Fig 3.6: XSD file

We send XML file to the organizations using the XSI tool which has send module to send it preferred locations.

Fig 3.7: Sending XML document to other party

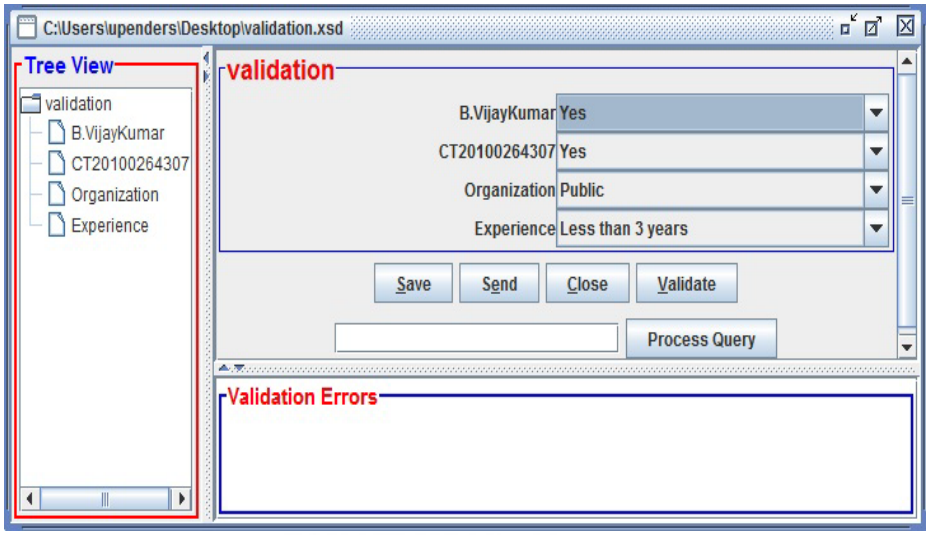


Fig 3.8: GUI format of XML document

The organizations and banks open the XML file in the XSI tool. The XSI tool displays the XML in GUI format [9] [10]. The XMLs are designed mainly in the form of list boxes such that the banks and organizations can select only their option. After selecting their options, they will send it back to the platform. We receive the XML files with their options.

3.3.4 Credit score calculation

We are using Logistic Regression technique to calculate the credit score of the customer and classify the customer into above mentioned classes. We used KNIME tool with Weka Integration to classify the customers.

3.3.4.1 Logistic Regression:

Logistic regression (sometimes called the logistic model or logit model) is used for prediction of the probability of occurrence of an event by fitting data to a logit function logistic curve. It is a generalized linear model used for binomial regression. Like many forms of regression analysis, it makes use of several predictor variables that may be either numerical or categorical.[8][1]

The equation of the Logistic regression is

$$Z = \beta_0 + \beta_1.X_1 + \beta_2.X_2 + \ldots\ldots\ldots\ldots + \beta_n.X_n$$

where Z is is a measure of the total contribution of all the independent variables used in the model and is known as the logit, β0 is called the "intercept" and β1, β2, β3, and so on, are called the "regression coefficients" of x1, x2, x3 respectively.

An explanation of logistic regression begins with an explanation of the logistic function:

$$f(z) = \frac{e^z}{e^z + 1} = \frac{1}{1 + e^{-z}}$$

The input is z and the output is f(z). The logistic function is useful because it can take as an input any value from negative infinity to positive infinity, whereas the output is confined to values between 0 and 1. The variable z represents the exposure to some set of independent variables, while f(z) represents the probability of a particular outcome, given that set of explanatory variables.

Our data set mainly contains 7 parameters: Pancheck, Salary, Spincome, emi, organizationtype, house, vehicle, and loan and there are 9 classes as mentioned above.

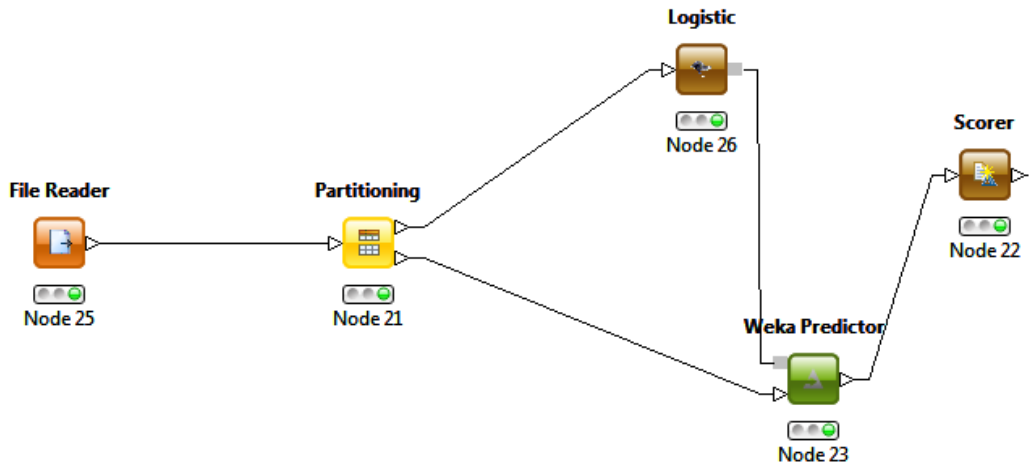
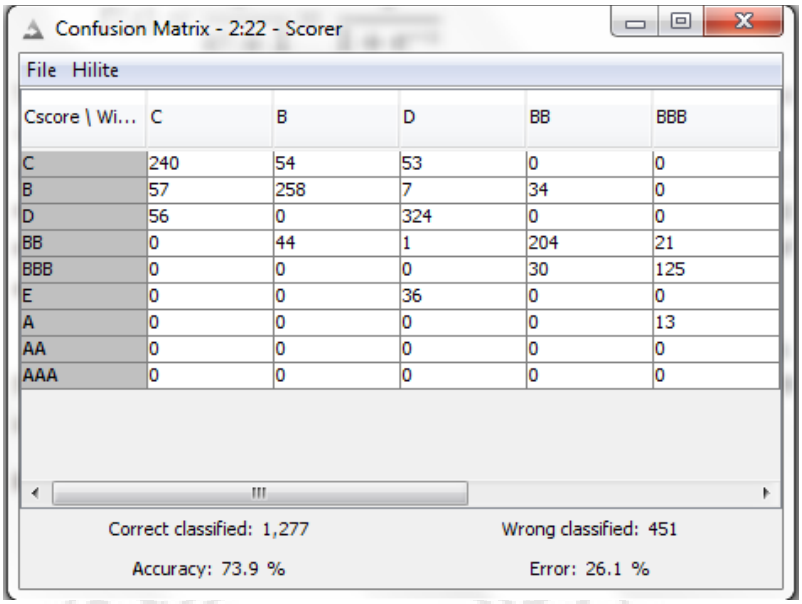


Fig 3.9: Neural Network diagram of Logistic Regression

Result:



Cscore \ Wi...	C	B	D	BB	BBB
C	240	54	53	0	0
B	57	258	7	34	0
D	56	0	324	0	0
BB	0	44	1	204	21
BBB	0	0	0	30	125
E	0	0	36	0	0
A	0	0	0	0	13
AA	0	0	0	0	0
AAA	0	0	0	0	0

Table 3.1: Confusion matrix of Classification

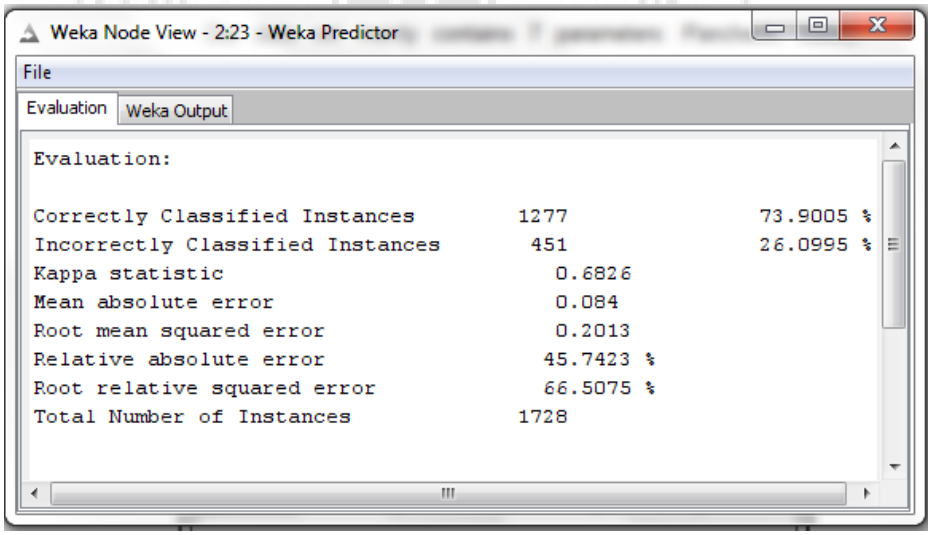


Table 3.2: Evaluation

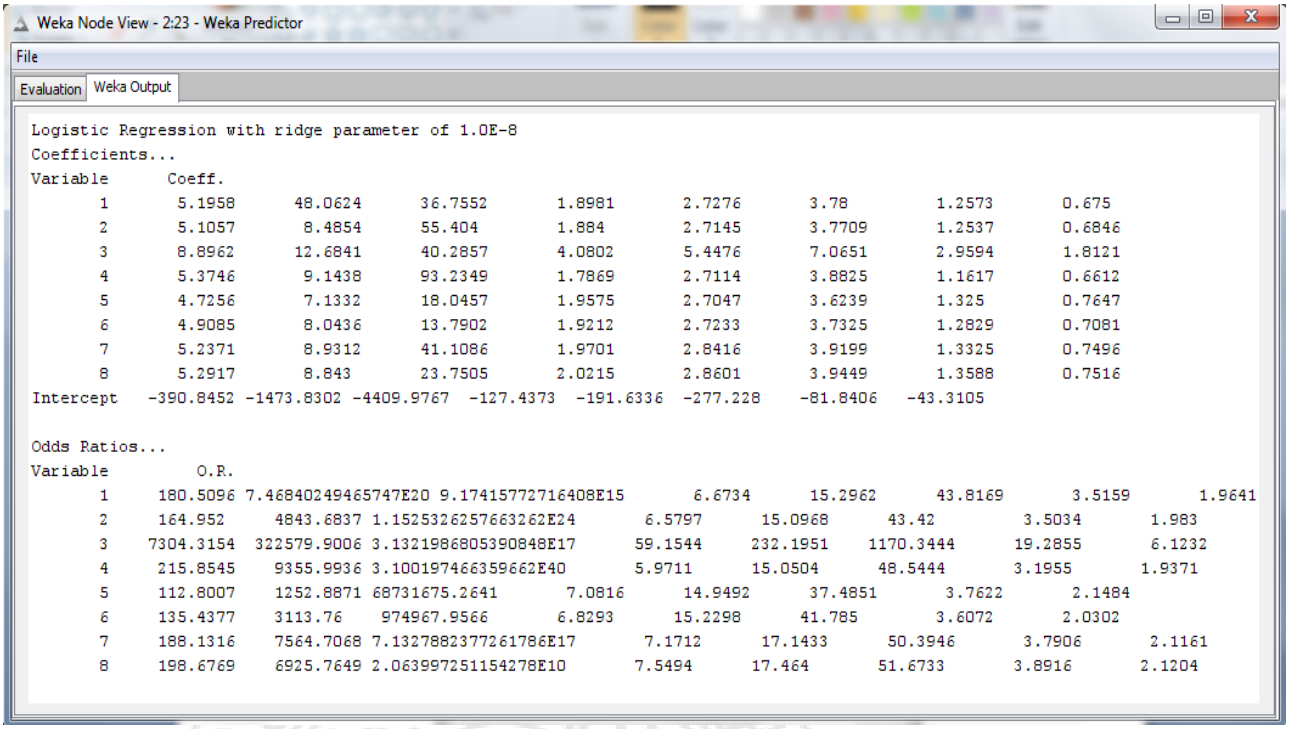


Table 3.3: Weka Output

3.3.5 Trading

After credit score phase, next phase is trading. The customers with their rating are presented to the Banks.

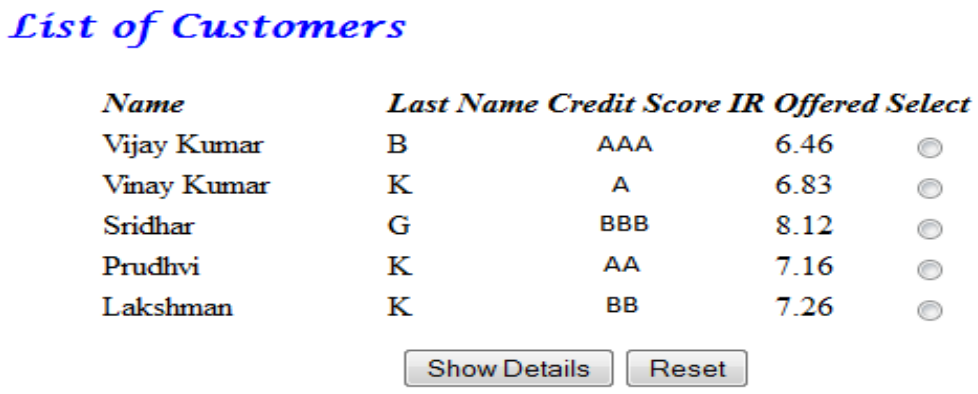


Fig 3.10: List of customers presented to banks

The banks then offer interest rates to customers. Top rated customers can get less interest rate compared to other customers. Different rated customers may get different interest rates from different banks. The customer details and offered interest rates are displayed to all banks. So if a customer is top rated, other bank may offer

less interest rate to same customer. The customer can get many offers and he/she can select any bank to get loan.

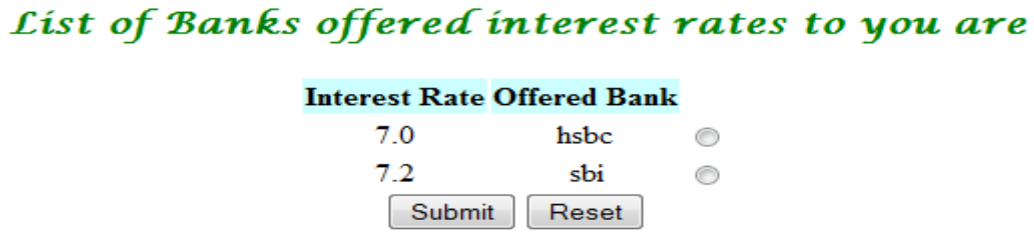


Fig 3.11 List of banks offering interest rates to customer

Since the top rated customer have less risk compared to others, the banks will tend to move towards the best customer to give loan. This provides the competition between the banks so that the customers will be benefitted with less interest rate.

3.3.6 Loan Approval and Acceptance

Once the customer is offered interest rate, he/she can send approval request to the bank to accept the loan request. The banks can see the list of approval requests

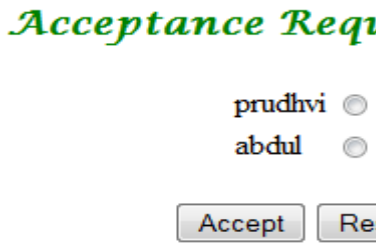


Fig 3.12 Approval requests from customer

The bank sends the acceptance response back to the customer. Then the customer will get a message from a bank that the bank has accepting his/her approval request to getloan. Now the customer can get loan from bank.

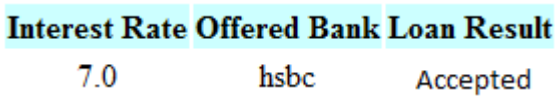


Fig 3.13 Acceptance response from bank

4. Implementation Details

4.1 Hardware Details

Model : Hp PC

Processor : Intel(R) Core™2 Duo CPU

Installed memory (RAM) : 4GB

System type : 32-bit OS

4.2 Software Details

Operating System : Windows 7 Professional

Softwares Used : Jdk 1.6, Netbeans 6.9 IDE with Apache Tomcat 6.0.26, XSI, MS Access Database

4.3 Tools and Technologies used

We have used XSI tool and Java, JSP, XML, Webservices technologies in out project.

4.3.1 Installation Procedure

- Download jdk 1.6 software, run it and accept the default path. Install full program. After successful installation, create the following path in Environment variables as follows.

Right click on Mycompter, Goto properties->Advanced System settings -> Environment variables, create a variable name PATH in user variables and variable value as C:\Program Files\Java\jdk1.6.0_21\bin.

- Download the Netbeans 6.9 IDE, run it and accept the default path. Install full program. This Netbeans IDE installation includes Tomcat 6.0.26. The default port number for Tomcat is 8080.

4.4 Coding Procedure

- The coding starts with creating Jsp pages to collect data from the customers. To store the entering data, we create an MSAcess database. We have created a

database and “custdetails” table with 32 fields, “users” table with two fields(username, password) and “bankusers” table with two fields(blogin, bpass).

- The “custdetails” table contains the following fields: Name, Lname, Creditscore, Username, Email, Gender, Marstat, Dd, Mm, Yy, Pnum, Mnum, Addr, City, State, Pin, Pan, Sal, Spincome, Emi, Orgtype, Desig, Orgname, Exp, House, Vehicle, Bankname, Accnum, Loan, Loantype. We have used Sno as a primary key and which is automatically created by MSAccess as Autonumber.
- The customer registration page includes all the above fields to be entered, which are created in GUI page with JSP. Here we use JavaScript validations to validate the entering details.
- The same registration page is created for banks also. The “bankusers” table contains two fields: blogin, bpass with blogin as primary key. The “users” table also contains two fields: username, password with username as primary key.
- After creating database and GUI pages successfully, the next step is to create connection between these two. To connect these two, we use JDBC program. To create a connection with database we have to create initially a data source name. Goto Control panel -> Administrative tools -> UserDSN-> Add-> MicrosoftAccessDriver->Finish. Enter the datasoruce name and click on select to select the database (accdb) file. After database creation when a user enters the details, the details will be stored in database.
- In the customer registration page, once the customer is registered successfully, another table with customer’s username is created automatically by the program to store the Acceptance result of loan from the bank.
- In the bank registration page, once the bank is registered successfully, another table with bank username is created automatically by the program to store the customer name that is requested for approving a loan.
- Next step is to calculate the credit score. We have coded to calculate the credit score from the data being collected by customer.
- In the calculation of credit score, one factor we have used is web services.
- To calculate web service server program Goto Netbeans Project, Right click on it and click Webservice. Give it a name and give a package name. Then click Finish and write code.

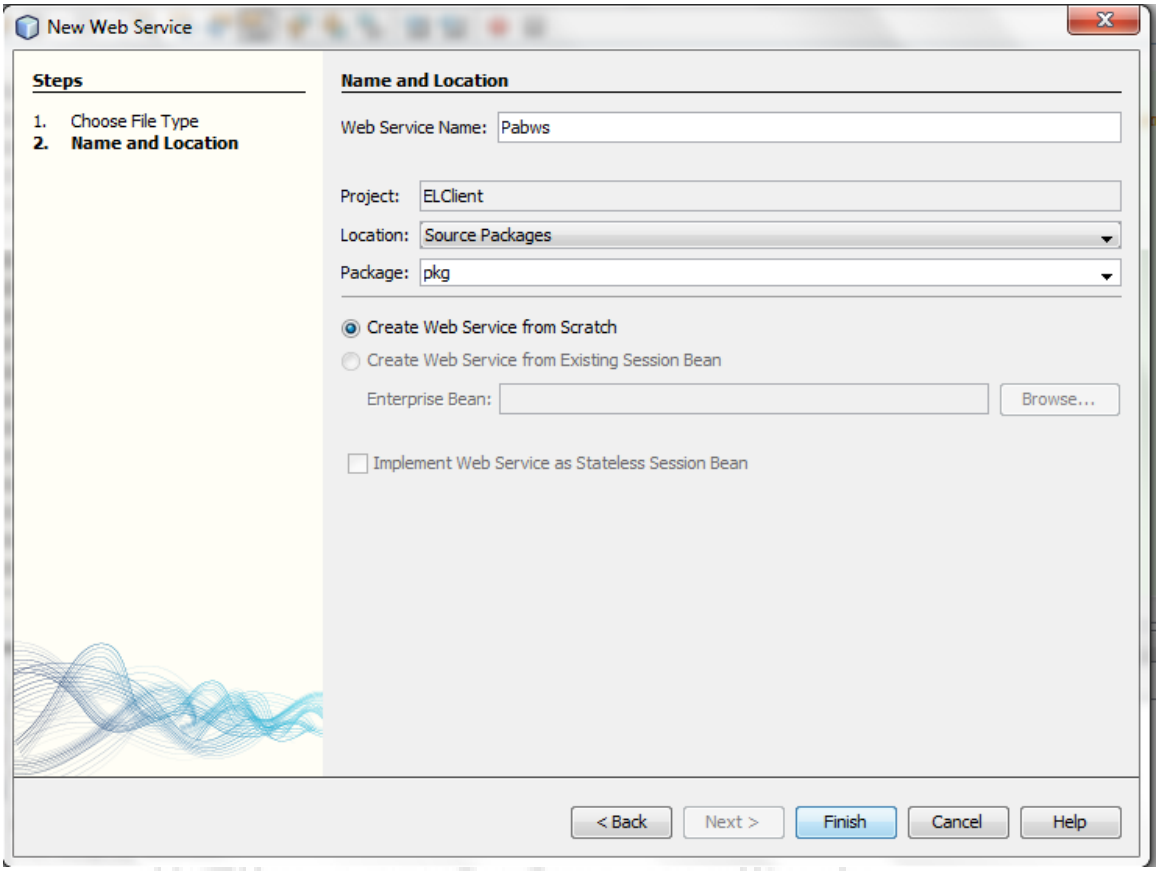


Fig 4.1Webservice server program

After writing code, save it and deploy it into the Tomcat. Right click on the project and click on TestWebservice. Then a WSDL file is created. Copy the URL from the browser. This is used in creating the Webservice client program.

Right click on the project and click on webservice client, click on WSDL from URL and paste the URL copied in the above step. Enter the package name and click on Finish.

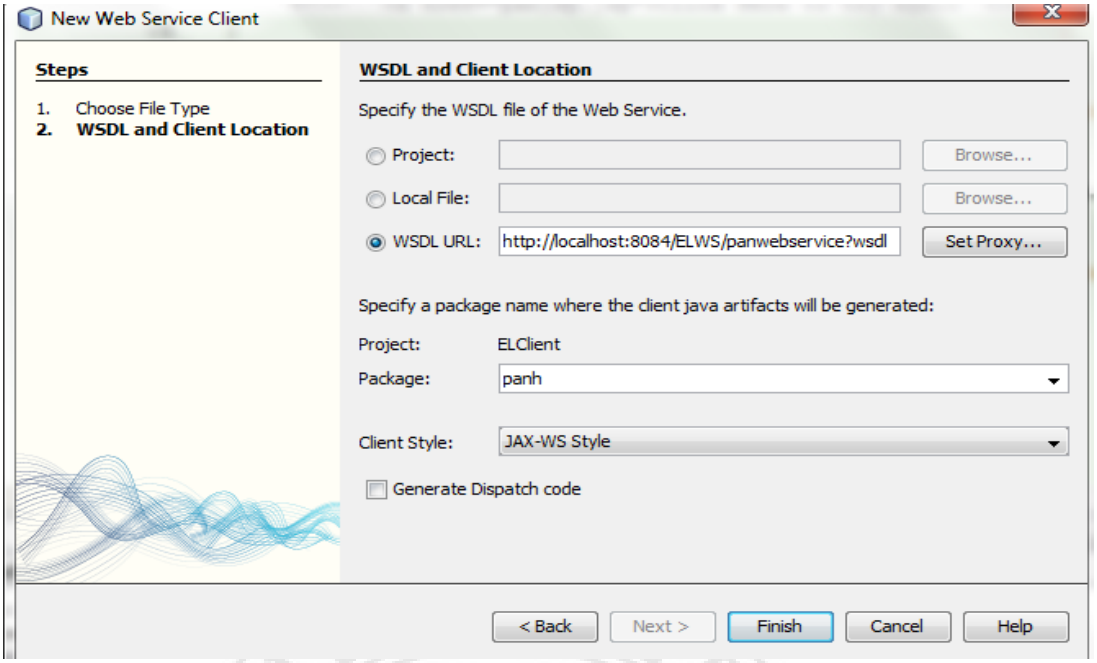


Fig 4.2 Webservice client program

After creating the client program, right click on the project click on Deploy and then Run on it. After entering the Pan number we will get the result displayed in command prompt window.

- After calculation of credit score, the customers are presented to bank. This is done by displaying the Name, Last Name, Creditscore, InterestRate offered from the custdetails table.
- The banks click on the “Showdetils” button to see if the customer has already got any offers or not. Then the bank enters interest rate to the specified customer. The offered interest is stored in the customer username table.
- When customers re-login into the platform, the platform displays the details of bank from the table. Then the customer can select any bank to send approval request. The customer name is stored in the bank username table.
- When banks re-login into the platform, the platform displays the names of the customers requested for approving loan. The bank selects the customer and sends the acceptance by clicking accept button. This is again stored into the customer named table.
- When customers re-login into the platform, the platform displays the acceptance response stored in the customer named table.

4.5 Screenshots

- Home page of E-Lending platform

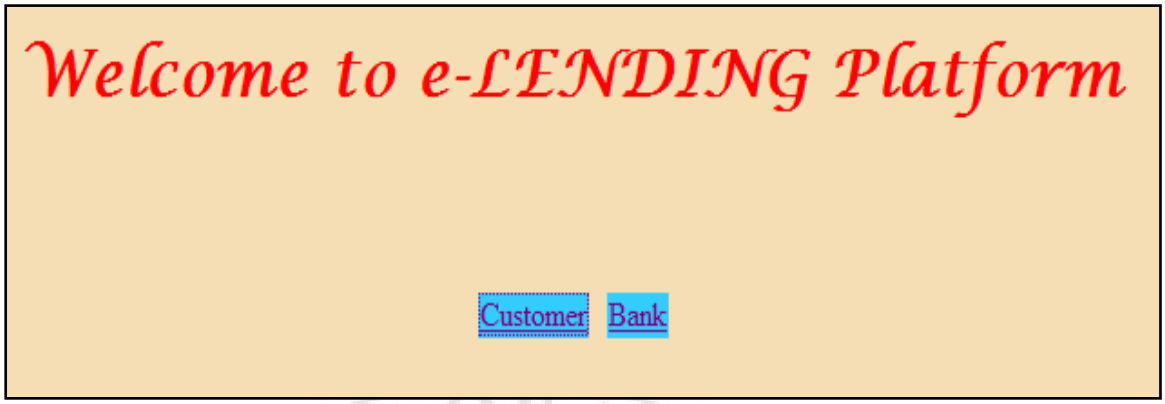


Fig 4.3 Home page of E-Lending platform

- The customer login page

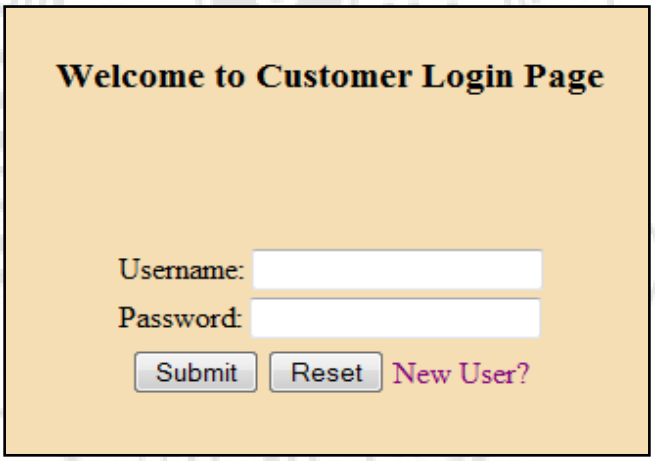


Fig 4.4 Customer login page

- The bank login page

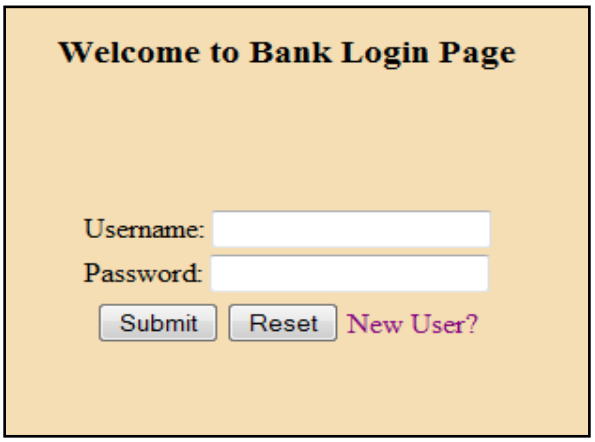


Fig 4.5 Customer login page

- The customer registration page

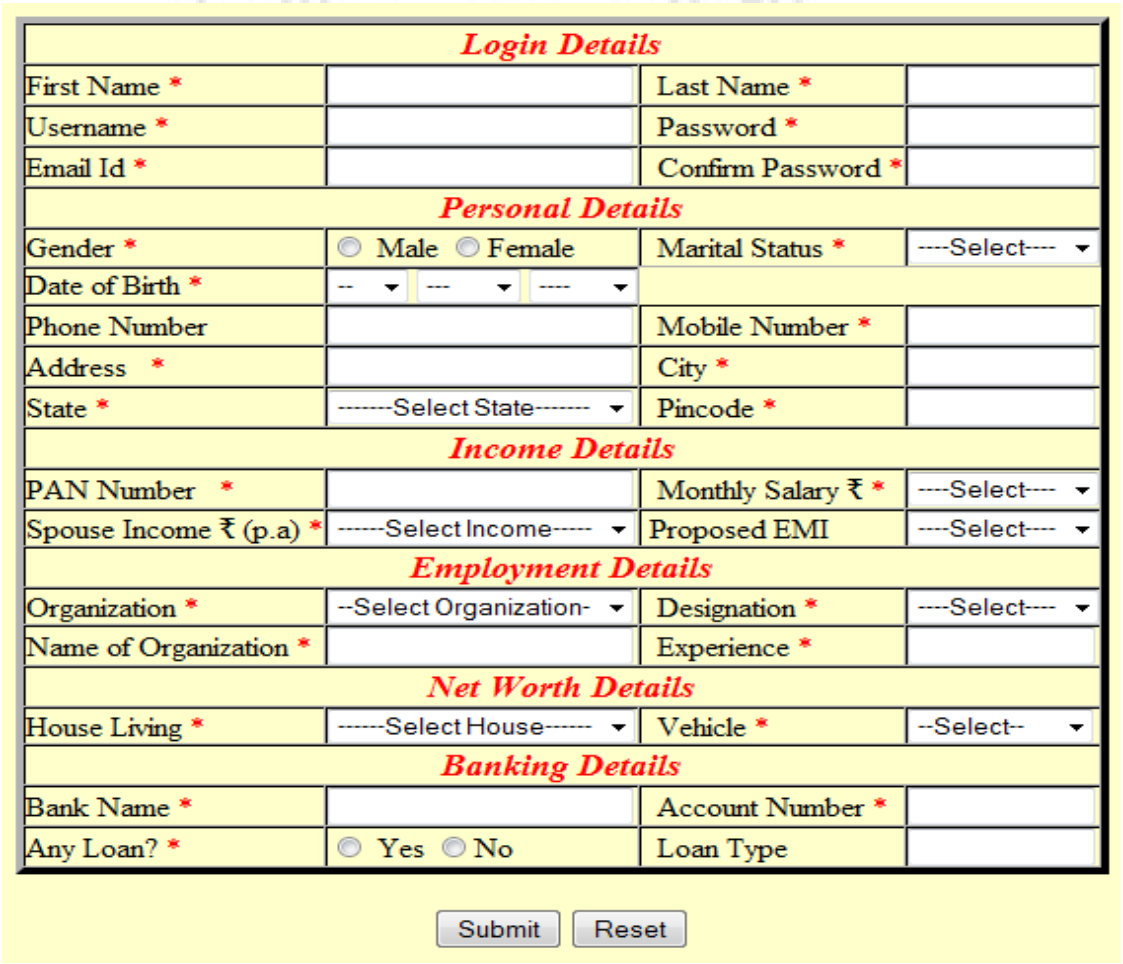


Fig 4.6 Customer registration page

➢ The bank registration page

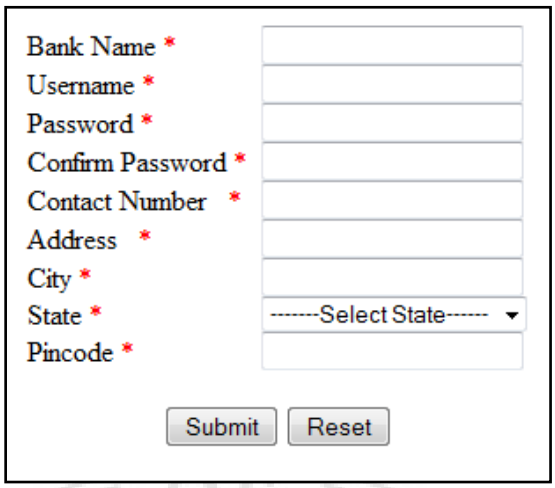


Fig 4.7 Bank registration page

➢ When a customer initially registers and login into the platform, the following message is displayed.

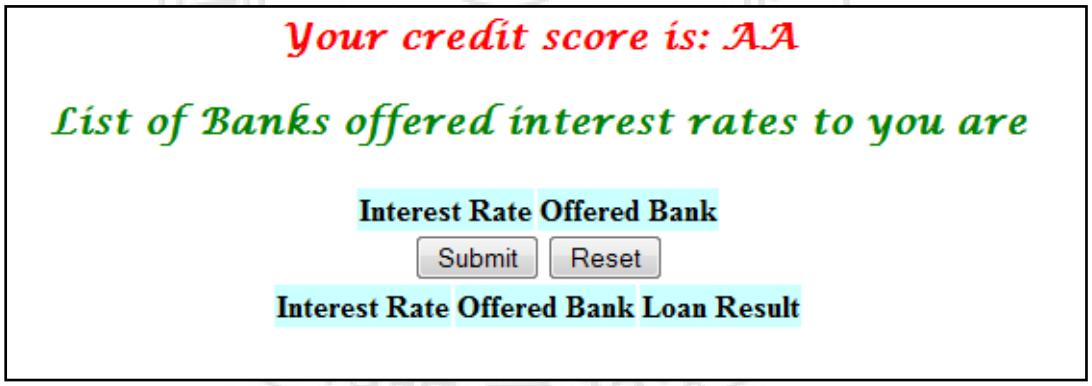


Fig 4.8 Credit score displayed to customer

➢ Later when a bank initially registers and login into the platform, the list of customers with credit scores are displayed.

Fig 4.9 Details of Customers displayed to Bank

The bank can select any customer and if it clicks show details the following window is displayed.

- If the customer is new customer and if no bank has offered any interest rate to him/her then the following is displayed.

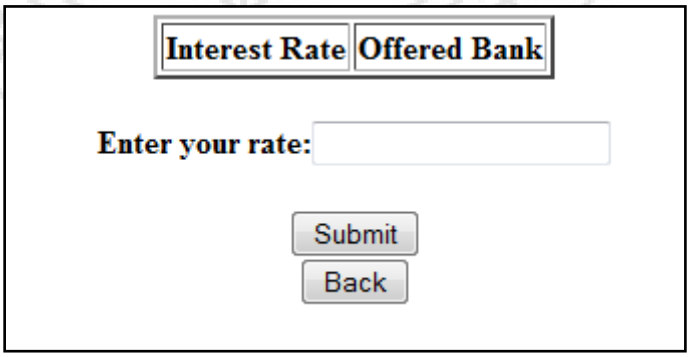


Fig 4.10 Interest rate page displayed to bank, when customer has no offers

The bank enters its interest rate here and click on submit. The following message is displayed.

Fig 4.11 Offer message at bank side.

- If the customer has already offered some interest by other banks the following is displayed

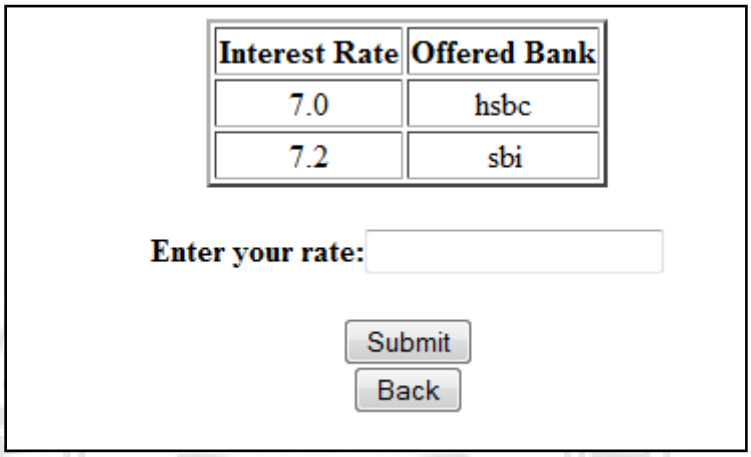


Fig 4.12 Interest rate page displayed to bank, when customer has previous offers

➢ If a customer is already registered, and when login into the platform the following is displayed. The customer can get loan offers from different banks.

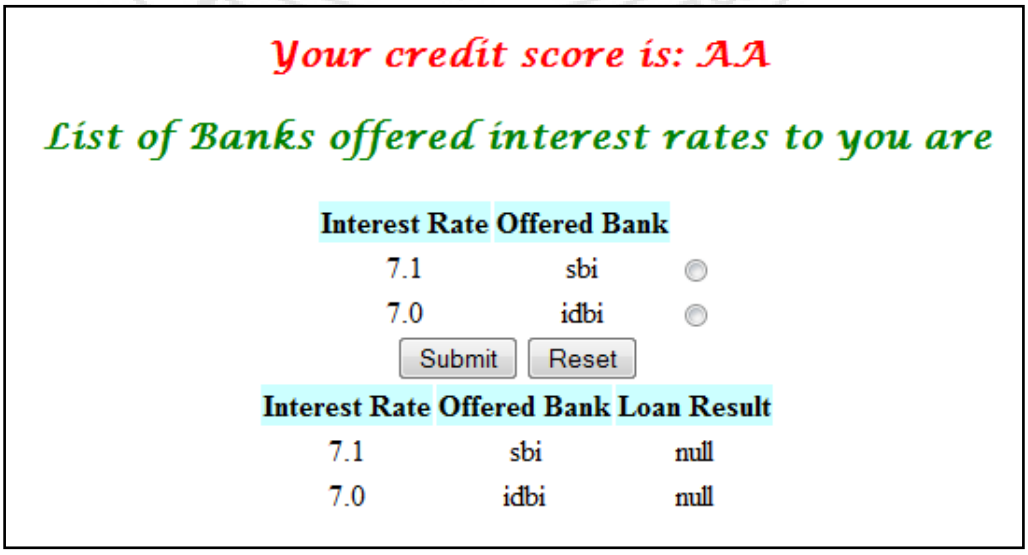


Fig 4.13 List of banks offered interest rates to customer.

The above window displays the details of interest rate offered banks. The customer can select any bank and press submit button to send an approval request for loan. Then the following window is displayed at the bank side when logins into the platform.

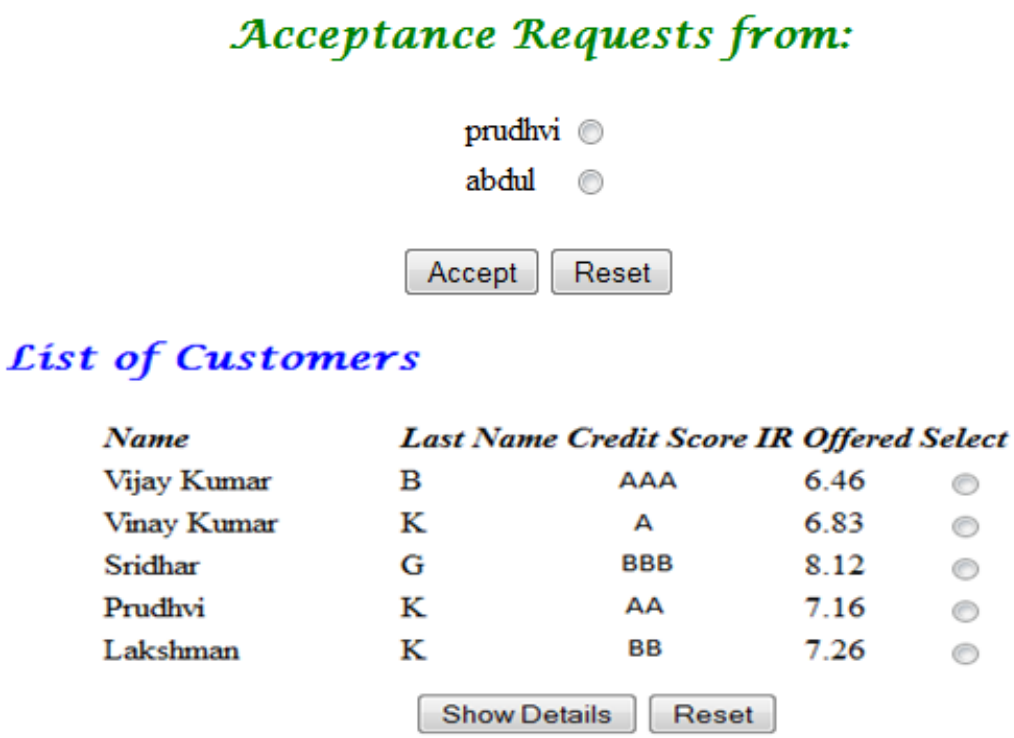


Fig 4.14 Approval requests from the customer at bank side

➢ Now, the bank has to accept the loan request sent by the customers. The bank selects the customer and clicks on Accept. The following message is displayed at the bank side.

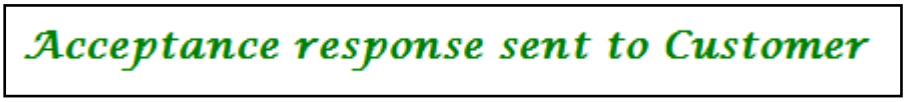


Fig 4.15 Accepting acceptance request from customer at bank side.

➢ The customer will get message as loan accepted from the bank. The following window is displayed.

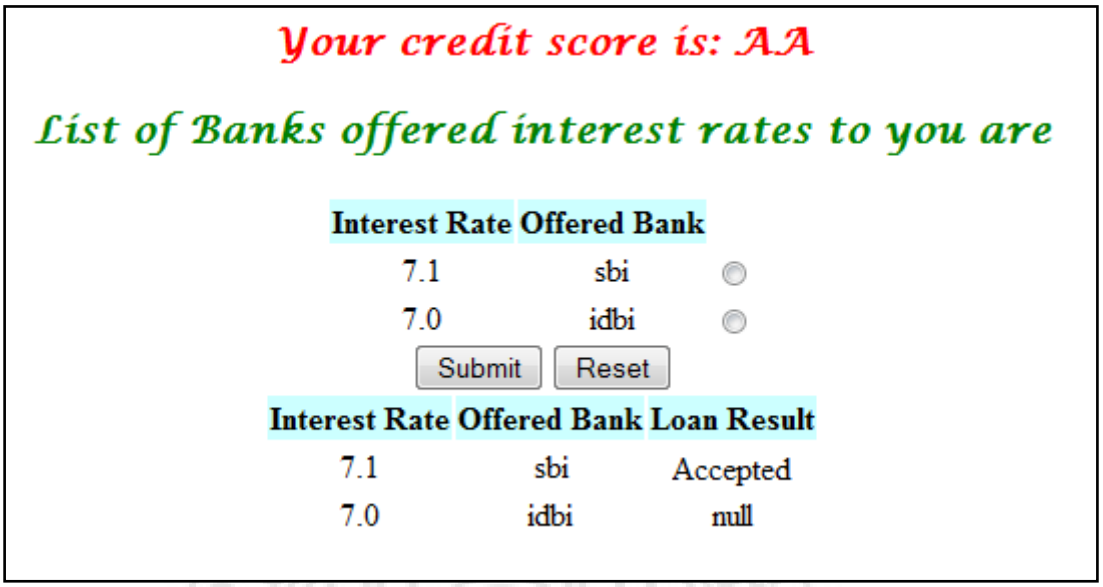


Fig 4.16 Acceptance of loan response from bank at customer side

5. Conclusion

5.1 Conclusion

The E-lending platform is a quick, easier, 24x7, advanced platform to get loans from different banks with less interest rates. Since the customer is validated, the banks can trust the customer based on the credit score and can give loans quickly and safely. The customers need not to go to each bank to get loan, but the banks will compete to give loans to the customers. The customers with good credit scores will get loans with cheaper interest rates.

5.2 Future Scope

- We are calculating credit score seperately; credit scoring method can be enhanced and integrated automatically into the platform.
- We are doing XSI validations also seperately; this can be updated.
- The customer and banks are login into the platform one after another. But there is a chance that both banks and customers can login at a time into the platform. Such a mechanism has to be updated.
- We have created basic GUI forms to enter the data; those can be enhanced to look good by using web templates.

6. References

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[3] http://www.w3schools.com/xml/default.asp

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