# Engineering a Ruled-Based Software Solution for Credit Rating and Worthiness Assessment in Financial Operations

Victor Chukwudi Osamor (Corresponding author)

Department of Computer and Information Sciences (Bioinformatics Unit)

College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria
Tel: +234-8035650164    E-mail: vcosamor@gmail.com; vcosamor@yahoo.com


Karale Sira Wiwuga

Department of Computer and Information Sciences

College of Science and Technology Covenant University, Ota, Ogun State, Nigeria
Tel: +234-8057269358    E-mail: wiwuga.karale@gmail.com


Ifeoma P. Osamor

Department of Accounting & Finance (Accounting Unit)

Faculty of Management Sciences, Lagos State University, Ojo, Lagos State, Nigeria
E-mail: ifyposamor@yahoo.com


Adebola G. Musa

Department of Computer and Information Sciences

College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria
E-mail: bola_musa@yahoo.com

**Abstract**

In loan provision, the central worry is whether the borrower will default or payback. A good number of institutions world-wide have gone into distress owing to bad debt arising from inability to recover borrowed funds. Credit Rating is a technique that is widely used to evaluate applications tendered for credit, identify prospective borrowers, and manage existing credit accounts. This work is aimed at the development of a system capable of evaluating the credit worthiness of fund-seeking bank customers and other borrowers towards repayment capabilities of loan facility availed to them in due time. The method carefully examines who qualifies for a loan based on certain rules consisting of Payment History, Credit Owed, Credit Available, Age of Account, Crime Records, Medical Records, Amount to be borrowed.   and other factors. Percentage weights for assessment of each of these factors were proposed including threshold percentage above which credit is predicted adequate to be given. This factor creates a sort of satisfaction and level-playing field for correct assessment of lending risk.

**Keywords:** Credit rating, Worthiness, Financial operation, automation, Loan, Decision system

## I. Introduction

Credit scoring can be defined as a method used by credit providers to determine whether to grant credit to consumers (Koh et al., 2006). Credit rating estimates the credit worthiness of an individual, corporation or even a country. It is an evaluation made by credit bureaus or lending institutions of a customer's overall credit history (www.wikipedia.org). For the purpose of security of transactions, agencies usually give credit rating/grade (Gupta et al., 2010). The main goal of credit scoring model is to assign credit to applicants and this credit can either classify applicant as either bad or good. This implies the credit scoring problem belong

to the class of problem called classification problem (Anderson, 1984). The main issue faced by any lender is to ascertain if a would-be or actual borrower is likely to repay the loan or not. Also, there is a requirement for collaterals, co-signers and/or lending agreements from the lender (White, 2010). It's important for a lender to assess the probability that a borrower will fail to pay back, that is, assess the risk of default. In the United States, lenders use rating as an index of the risk of default (Martin, 2006). When credit rating is poor upon evaluation, it indicates a high risk of defaulting on a loan, and thus may lead to high interest rates or an outright refusal of loan by the creditor or lender. To this end, the Nigerian government created the Nigerian Deposit Insurance Company (NDIC) to insure depositors fund, this barely scratched the problem on the surface. The importance of the issue of Credit Rating in Banking Institutions cannot be over emphasized. The scoring model captures the relationship between the historical information and future credit performance. This can be represented as follows:

$$f(x_1, x_2, \ldots x_m) = y_n$$

where f is the credit scoring model that maps between the customer features $(x_1, x_2, \ldots x_m)$ and his creditworthiness $(y_n)$. f is a function which predicts the value of $y_i$, that is, the creditworthiness of customer i by knowing the $x_1, x_2, \ldots x_m$, which denote the customer features such as income and age (Lahsasna et al., 2010). It is no longer news that technology has in fact become a part of our everyday lives as almost all our daily activities has an aspect of technology playing active roles. As a result, so many sectors have adopted technology practices and the lending institutions, for example, the banks cannot be left behind. The role of information systems even in the banking industries cannot be overlooked as information systems are vital for managing both company and customer activities so as to yield effective and efficient production. Therefore, because credit rating evaluation is one of the many important activities in the banking industry it is indeed in need of information system called the expert system.

## 2. Related Works

Artificial Neural Networks (ANNs) are the most commonly used soft computing credit scoring modeling technique. Lahsasna et al. (2010) stated that Neural Networks, Genetic Algorithms and Support Vector Machines have been amongst the most accurate methods as compared to the other methods. Lahsasna et al. (2010) enunciated the various soft computing approaches to modeling credit scoring system. While some approach used single methods such as: Neural Networks, Genetic Algorithms, Support Vector Machines, other methods used hybrid approach. Hybrid approaches include: Neuro-fuzzy and Genetic-fuzzy. It was affirmed that soft computing methods will be a positive alternative to statistical methods. In the work of Ong et al., (2005), usage was made of Genetic Programming to build credit scoring model. Two numerical examples were employed to compare the error rate to other credit scoring models like the Neural Networks, Decision Trees, Rough Sets, and Logistic Regression. Empirically, it was discovered that Genetic Programming is more flexible and perform with better accuracy in the credit scoring problem significantly.

The recent work of Silva & Analide (2011) postulated that the decision mechanism from inforrmation called the client history data can help evaluate client's risk. This work viewed information as an asset relying less on technology. They affirmed that statistical analysis & deterministic systems are the most common classification systems used by financial organization in their application. Chen & Huang (2003) resolved two credit scoring problems via Neural networks and Genetic algorithm. The first problem was constructing Neural Network-based model which classifies client as accepted or rejected i.e. good or bad respectively. The second is to better understand the rejected and try to reassign the rejected to the preferably accepted class using Genetic Algorithm-based inverse classification technique. With this arrangement, the system can explain the conditions to rejected applicants. In this work, Neural Networks emerged as an important widely accepted technique for classification.

Crook et al. (2007) reviewed and discussed a selection of research topics in credit scoring assessment

including statistical method: Logistic Regression, Simple Linear Model; Mathematical Programming; Neural Networks, Fuzzy Logic, Classification Trees. Other concepts considered include Genetic Algorithm, Support Vector Machine and Nearest Neighbour. For the purpose of better explanation in the credit rating scheme, Huang et al. (2004) introduced an Artificial Intelligence based learning technique called Support Vector Machine. In the work, Back-Propagation Neural Networks was benchmarked against Support Vector Machine. The result showed that about 80% prediction accuracy was obtained for both Back-Propagation Neural Networks and Support Vector Machine for the Taiwan and United States market. Huang et al. (2006) used a hybrid Support Vector Machine credit rating model and when compared with Neural Networks, Genetic Programming and Decision Tree classifiers, the hybrid model achieved an identical accuracy of classification. Results showed that hybrid GA-SVM can perform feature selection and model parameters optimization tasks simultaneously. They concluded that SVM as an addition to the data mining methods is a promising one. Bellotti & Crook (2009) benchmarked the performance of SVM by comparing SVM with other well known systems such as Logistic Regression, Linear Discriminant Analysis, k-Nearest Neighbour. SVM was tested against a large database of credit card customers than considered in literature and the result showed that SVM was successful in comparison to established approaches of credit card customer classification.

Tsai & Wu (2008) opined that MultiLayer Perceptron trained by Back-Propagation Neural Networks is the most commonly used technique for financial decision making problems. In their work, they considered and compared the credit scoring performance of single classifiers against that of multiple classifiers. With three datasets used and in terms of prediction accuracy, multiple classifiers only perform better in one dataset. The diversified multiple classifiers were worse in all datasets. By the result obtained, Tsai & Wu (2008) concluded that it is better to consider three classifier architecture in order to make an optimal financial decision.

## 3. Methodology

The method carefully examines who qualifies for a loan based on certain rules consisting of Payment History, Credit Owed, Credit Available, Age of Account, Other factors also include, Crime Records, Medical Records and of course, the amount to be borrowed. The software is developed using Hypertext PreProcessor (PHP) embedded into HyperText Markup Language (HTML) source document. This source document is interpreted by a web server with a PHP processor module which generates the web page document and MYSQL that housed the database for the system.

### 3.1. The Manual Rating System

In the course of this research, we discovered that most banking institutions still practice the non-automated method of credit rating. There is still the burden of paper work and the problem of inefficiency in the course of handling the loan applications. The banking halls are still filled to their perimeter with people who await confirmation of their loan applications even when the applications have not left the desk of the staff on duty.

### 3.2. The Proposed System

The data collection technique for this study was purely oral interview based with additional information provided via the internet. The oral interview was first of necessity to establish the need for the introduction of the credit rating technique. Information on the credit activities of a person are detailed and stored in what is referred to as a Credit Record. When a customer approaches the bank for a credit or loan grant, the loan department checks the credit information of the customer if known. However, for an unknown persons, data gathering concerning the borrower commences, account is opened, physical house addresses are verified unilaterally by the staffs and the borrower is asked to furnish the loan department with all documents that

can help his credit rating. loan department We propose credit rating done by consideration of the totality of several factors which includes but not limited to the following with attached proposed weights: Payment history (10%), Credit owed previously (10%), Credit available to be borrowed (5%), Age of account (5%), Crime records (10), Medical Records (10%), Amount requested as credit (5%), Collaterals provision (30%), Purpose for Loan (5%), Other factors (10%).

From the information in the credit report, the lender determines the credit rating based on these major factors. Credit rating of 70% and above are predicted relatively clean value and may be considered to be given loan all things being equal. In developing the system, Dreamweaver was used to design the user interface, customer application form, as well as the credit record form using Hypertext Markup Language (HTML) for the coding. This is because HTML deals with frontend design of the application and is more concerned with how the application is presented to its user. Hypertext Preprocessor (PHP) served as the middleware that interacts with the user and was linked to MYSQL Server, the database backend of the application. It houses the credit record information as well as the applicant information. The PHP module contain the rules that is used to determine if the credit loan is approved or not based on certain factors mandatory to guarantee a low risk level status of the loan application especially the likelihood that loan repayment will not be defaulted.

## 4. Results and Discussion

A Rule-Based integrated approach is proposed, designed and implemented to provide a "high-performance" knowledge-based network, an explanation facility, and an input/output facility. This work resulted in the development of a robust system with several interfaces for the purpose of credit rating using a rule-based approach. Developed interfaces are Login Interface (Figure 1), Welcome page (Figure 2), Customer Information Interface (Figure 3) and Loan Application Interface (Figure 4). Figure 1 is the login page and is the first page the user sees after entering the URL (Unified Resource Locator). This page would be the home page of the organization that deploys the system. On starting the developed credit rating system, users will have to put the user name and password and when access is granted, the welcome page displayed as depicted in      Figure 2. There are various hyperlinked portions on the Welcome page including the link to go to the 'Create an Account Page and 'Apply for loan Page' can be accessed via their respective links.

In a similar case study, an expert system was designed by Yoon et al. (1994) which assist managers in forecasting the performance of stock prices to demonstrate the advantages of this integrated approach and how it can enhance support for managerial decision making. Our system ensures professional and efficient approval or disapproval of loan applications as the case may be. This is as a result of the carefully constructed rules made possible by considering various combinations of the factors considered earlier as parameter for the prediction of credit worthiness. Customers or clients having accounts with banks that deploy this system can login at their convenience and apply for loans instead of wasting man hours in the banking halls. The more timely a rating system is, the better is the discrimination between high-risk and low-risk issuers; and the more stable a rating system is, the fewer the transactions that are triggered by governance rules, leading to lower transaction costs (Loffler, 2004). This system also save the banking institutions from risk burdens as the rules aid in ensuring that only qualified people have their loans approved as against the customers manipulating their way into presenting false collaterals. This is made possible because, the bank themselves, research and investigates on the applicants as regards the factors considered for rating. For an effective deployment of this System, the following are the necessary requirements:

1. Operating System: Microsoft Windows NT/2000/XP/Vista/7

2. Internet Browser: Mozilla Firefox, Google Chrome.

3. Pentium III, 950MHZ, CPU

4.256MB RAM

5. Video Graphic Adapter (VGA) Color Screen

6. Modem or Ethernet Card

7. Keyboard and Mouse

8. Uninterruptible Power Supply.

9. Dreamweaver software (Adobe / Dreamweaver) installed on the computer system.

10. XAMPP or WAMP Server installed on the computer system.


## 5. Conclusion

The issue of Credit Rating cannot be over emphasized as every Banking institution sets goals to build a strong asset and customer base in order to handle liabilities, hence the introduction of loan application. Agencies such as bond investors, debt issuers and governmental officials have used credit as a surrogate measure of riskiness of the companies and bonds. They are important determinants of risk premiums and even the marketability of bonds (Huang et al., 2004). Numerous losses have been recorded by many banks as customers have either absconded or otherwise in a bid to avoid repaying their debts. The banks have the need to make efforts in a bid to recover the losses and avoid the risk of folding up. However, explanation of financial system or credit rating outcome by the loan department may be required for justification of certain credit application that is approved or rejected. Lu et al. (2006) focused on explanation rather than classification on the use of neural network rule extraction techniques based on the Genetic Programming (GP) to build intelligent and explanatory evaluation systems (Allen., 2003; Ikeda et al, 2004; Oussaidene et al., 1997). Our implementation of Credit Rating System is therefore of immense benefit to the banking industries as its focus is to achieve efficient and effective credit approval.


## Acknowledgement

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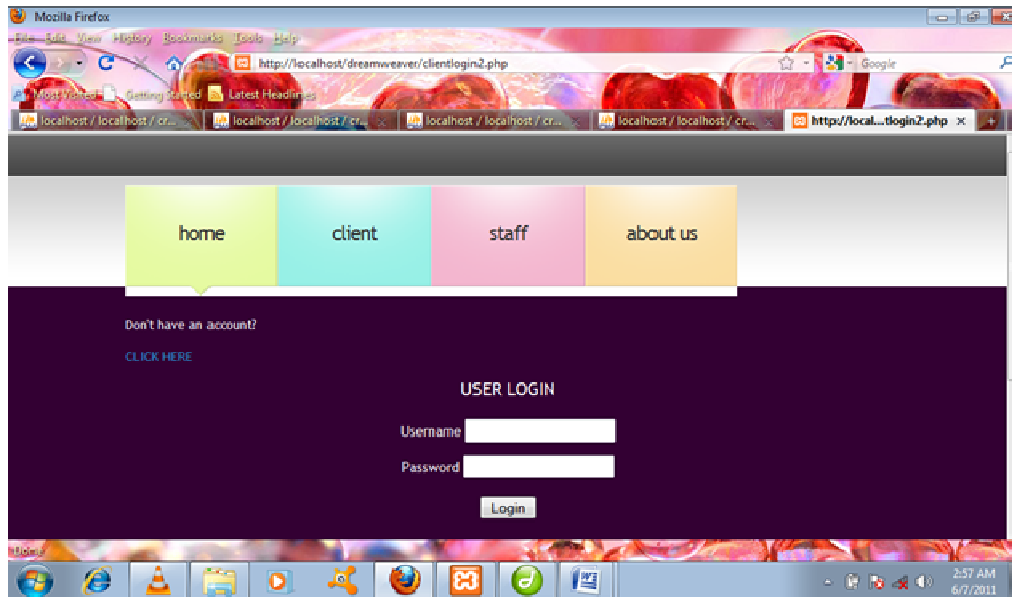
Figure 1: Login Page. The User logs in via this page using his/her Username and Password. A user that does not have an account can create an account by clicking on the 'CLICK HERE' link on this page as only account holders can proceed from this page.
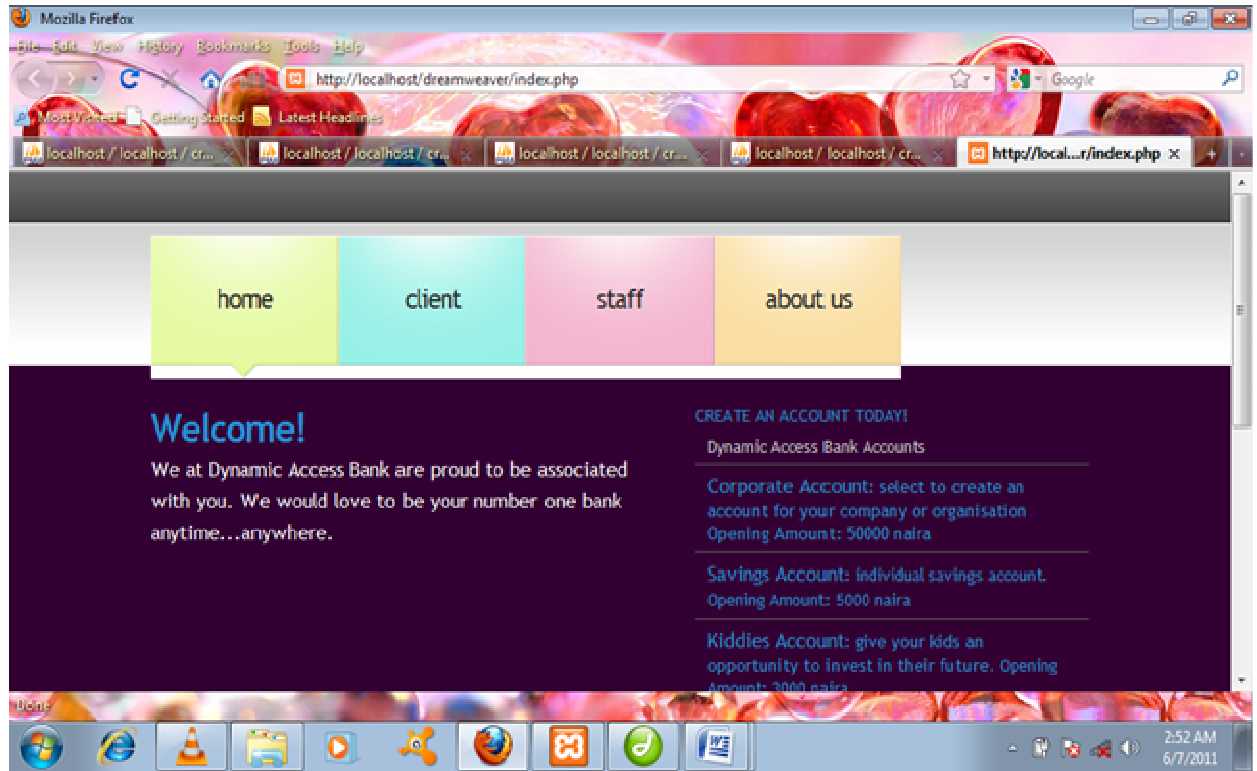
Figure 2: Welcome Page. The user sees this page after login, the user can decide to go to 'Create an Account' Page, 'Apply for loan' on behalf of customer or check the 'About Us' page .
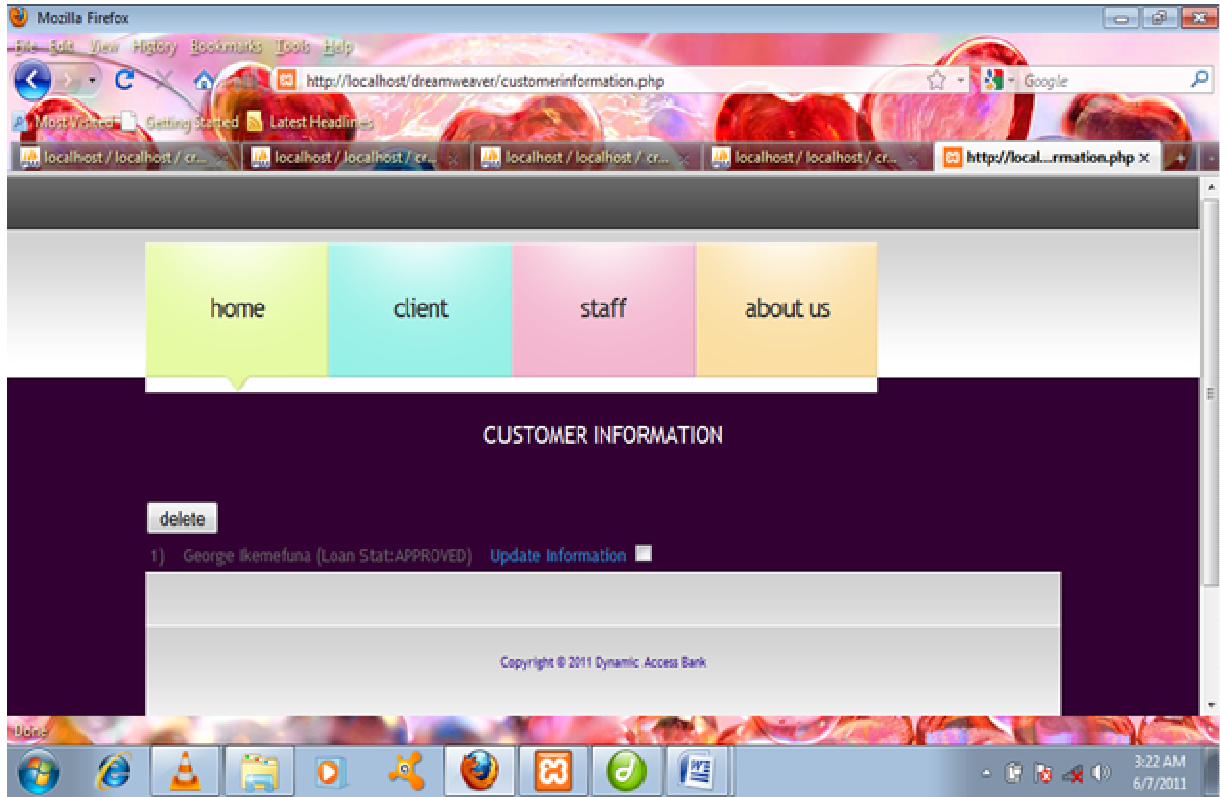
Figure 3. Customer Information Page. This gives the user the opportunity to create an account by entering the required information after which the user clicks the 'submit' button.
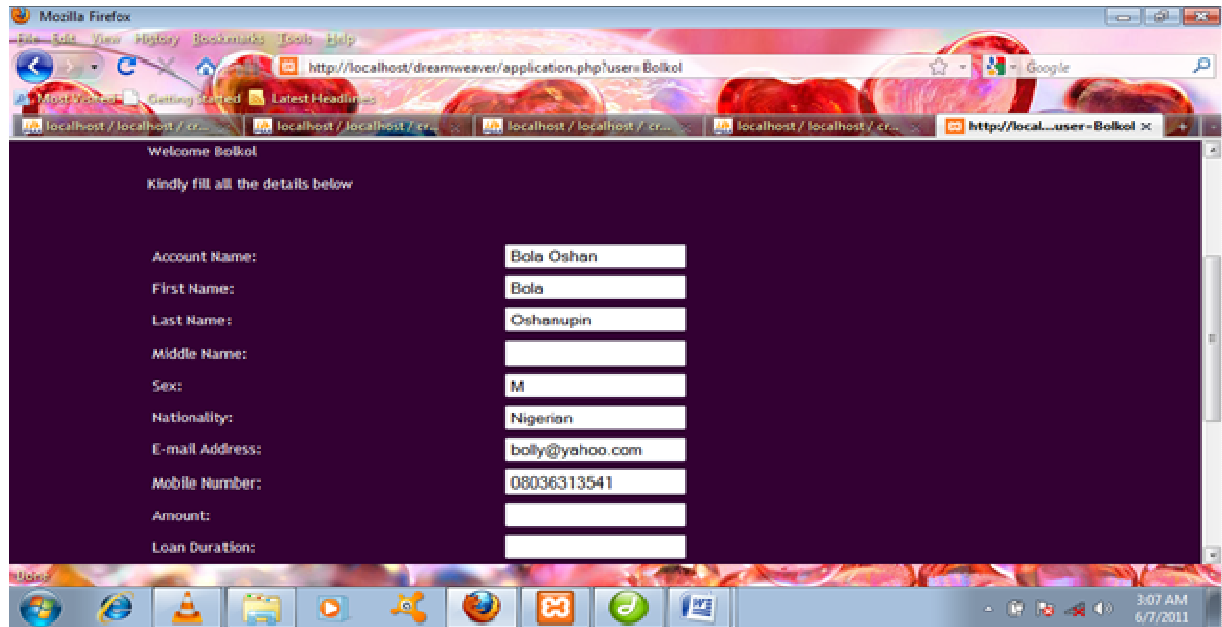
Figure 4: Loan Application Page. This page is accessed after the user logs in successfully. It displays information about the client such as the amount to be borrowed as well as the period of the loan (Loan Duration) and other factors responsible for rating the customer. Rating result is produced as output after analysis.

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