

# Loan Customer Analysis System using Row-wise Segmentation of Behavioral Matrix (RSBM)

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**Abstract** – Different types of studies are going on among researchers and different approaches are adopted by the bankers to analyze the behavior of the loan applicants to approve those loans. Bankers collect customer data to analyze their behavior in order to predict the possibility of recovery of the amount. Domain experts can think about a new approach to make this process fast. The data used to analyze customer behavior are actually patterns. And Artificial Neural Networks (ANN) are very good tool to train a system for known patterns and later can be used to identify unknown patterns. In this paper a two dimensional binary pattern matrix is formed on the basis of some questionnaires to identify different customer behavior. The matrix is further segmented row-wise and each row is presented to perceptron for training purpose of the ANN, which is used to complete the process of loan approval.

**Keywords-** ANN, Row-wise Segmentation, Perceptron, Behavioral Pattern of customers

## I. INTRODUCTION

ANNs can be used in financial institutions such as banks. The financiers provide loan to its customers and expect the timely recovery of the loan to run the company properly. But in some cases it becomes very difficult for the organization to recover the even the principal amount borrowed by the client. It becomes very important for the financiers to analyze the behavior of the customers before the approval of the loan. ANNs can be used for this purpose. ANNs can be developed that are trained to learn the behavioral patterns of different types of customers and helps the companies to take decisions to approve the loans and policies. Banks use various approaches such as collecting customer data to analyze the behavior before the loan approval. Customer data collected by questionnaires can be used to create behavioural patterns of different customers. These behavioural patterns can be converted into binary vectors. These vectors can be used to train an Artificial Neural Network (ANN) developed in this paper using Perceptron learning rule. The trained ANN can letter verify an unknown customer behavior pattern to reach to a concrete decision.

A segmentation approach, called Column-wise Segmentation Technique (CSBM) has already been used to recognize handwritten characters written in different handwriting styles [1]. Perceptron learning rule has been used here to train the ANN [2, 3, 4, 5]. ANN techniques are very helpful tools to analyze credit risk in financial and

banking industry [6]. Various applications of IT are discussed to mitigate the problems of loan fraud [7].

In this paper, an attempt has been made using an ANN technique called Row-wise segmentation to train the ANN for some known customer behavior and later take decisions for unknown customer behaviour. The overall program is divided into three parts, segmenting the customer behaviour matrix, forming row vectors and training the ANN. Finally, testing has been done by providing unknown behavioural patterns taken from different individuals.

## II. METHODOLOGY

The overall approach adopted in this paper has been classified into four phases. Phase I generates a binary matrix using the answers given by the customer under verification. In Phase II the designing of ANN has been designed and developed. Phase III trains the ANN by using those patterns which is considered suitable to approve a loan and finally testing of the ANN is discussed in Phase IV by considering some matrixes generated out from different customer behaviours.

### A. Input Matrix Generation

Inputs are arranged in the form of two dimensional binary pattern matrixes which are prepared by collecting some customer data by asking questionnaires. Here an example has been taken where the applicant has applied for a loan of Rs.25,00,000/- and the ANN has been trained for a single

two dimensional input matrix. The single input matrix has been prepared by preparing a question set which may be prepared by considering the previous experiences and the current market expenses. For example questions may be based of customer’s income, family background, assets, profession, customer expenditure nature etc.

Depending upon the questionnaires a two dimensional behavioural matrix has been prepared where each group of question is considered as a row of the matrix. The answers are considered as binary inputs where ‘Yes’ is considered as binary ‘1’ and ‘No’ is considered as binary ‘0’. The question set used here generates the following matrix:

1	0	1	0
0	1	1	1
1	1	0	1
1	1	0	0

The answers are decided in such a manner that generally a customer having this type of characteristics pattern is supposed to repay the loan in time and this behaviour is considered as a favourable behavior pattern to approve the loan.

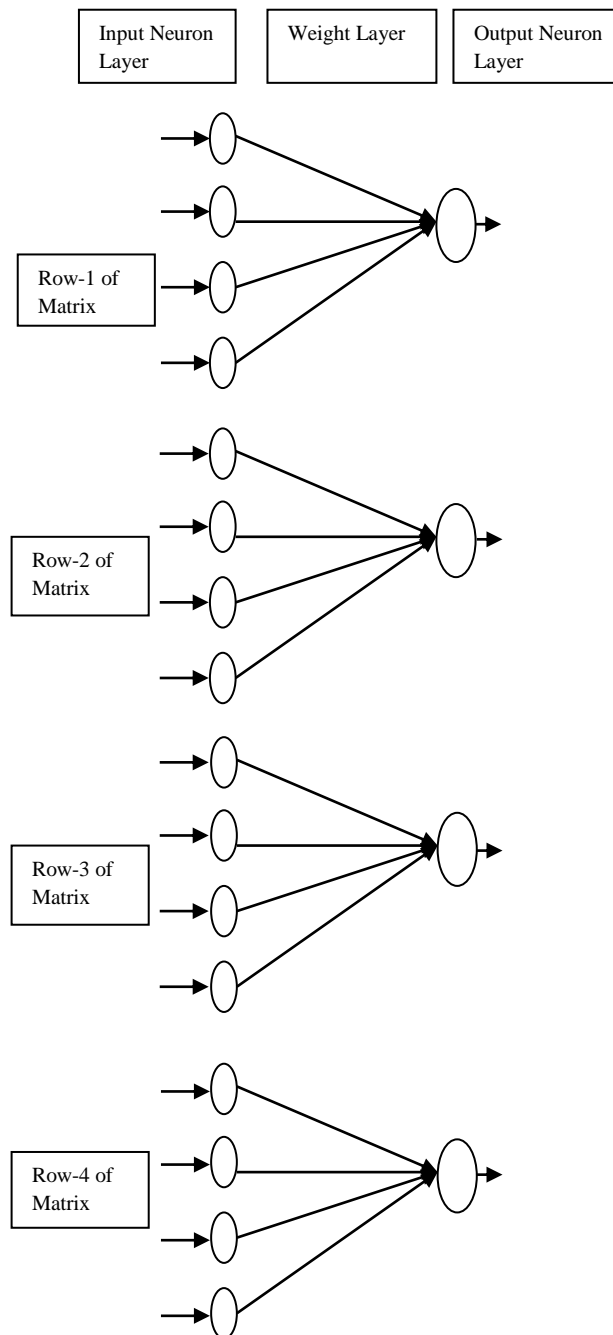
**B. Architecture of RSBM-net**

An ANN has been designed which can be trained using the matrix discussed above and tested for matrixes of same dimension which are generated by the behavioural patterns of the loan applicants. Figure 1, displays the ANN named as RSBM-net. It consists of two layers of neurons. The first layer of neuron is the input neuron layer and the second layer of neuron is the output neuron layer. Input neuron layer consist of sixteen neurons. The input neuron layer is divided into four segments where each segment is a row of the matrix. There are four neurons in the output layer. Each row segment is connected to one individual neuron in the output layer forming four perceptrons

[3]. There is one weight layer which is sand-witched between two neuron layers. There are sixteen weight elements in the weight vector.

**C. Training the RSBM**

All the elements in the weight vector is initialized to zero. The training starts by presenting the vector generated by the applicant’s behavior. Before presentation some preprocessing has been done to the matrix by converting it into a bipolar matrix for better learning [3]. A bipolar matrix consists of only 1s and -1s, where the 0s of the binary matrix are replaced by -1s. Each row of the matrix is presented to corresponding segment of the ANN for training.



**Figure 1: Architecture of RSBM-net**

**D. Testing the ANN**

The RSBM-net has been tested by feeding some matrixes generated by questioning the loan applicants under verification. While testing it has been decided that, if three or more neurons produce 1s for the testing vector then that

vector is considered successful and the applicant responsible for creating the matrix is considered for loan approval.

### III. RESULT ANALYSIS

RSBM-net has been developed for this kind of application. The model has been trained and tested for small demo data and found successful. Table 1, displays the results produced by presenting ten sets of questionnaires to the ANN.

### IV. DISCUSSION

The method developed and discussed here has been compared with the already available and found methods in this domain and it was found that most of the AI methods are rule based. For small databases rule based approach is comfortable but if we go for a vast range of loan applicants rule based systems become cumbersome. But ANN models can be trained with few matrixes but can be tested for huge amount of data.

**Table 1: Result Analysis**

Question	Row-1	Row-2	Row-3	Row-4	Approval
Set-1	1	1	1	1	Yes
Set-2	1	1	1	1	Yes
Set-3	1	0	1	1	Yes
Set-4	1	0	0	1	No
Set-5	1	1	1	0	Yes
Set-6	1	1	1	1	Yes
Set-7	0	0	0	1	No
Set-8	0	0	0	0	No
Set-9	1	0	1	1	Yes
Set-10	1	1	1	0	Yes

### V. CONCLUSION

This method is an approach of using ANN in this way. This is tested for very few demo data and found successful. In future this approach can be used for live and real time data and can stop loan frauds in financial institutions and will be a very helpful tool for the bankers.

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