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Artificial Intelligence in Banking Sector: Operational Functions

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Abstract
Artificial intelligence in the form of deep learning is evolving gradually to introduce us the new era of fourth industrial revolution. Today, Deep learning has come forward to support experts in finance related system from approving loans, to credit scores, to managing assets, and assessing risks. Financial institutions are getting ready to adapt this advanced level of data science.
Deep learning is a class of machine learning algorithms that uses multiple layers to progressively extract higher level features from the raw input. For example, in image processing, lower layers may identify edges, while higher layers may identify the concepts relevant to a human such as digits or letters or faces. [i]
Machine learning or Deep learning has had prolific applications in finance well before the advent of mobile banking apps, proficient chatbots, or search engines. Finance world have the high volume, accurate historical records, and quantitative nature, few industries are better suited for artificial intelligence. There are more use cases of machine learning in finance than ever before, the reason behind this is more accessible computing power and more accessible machine learning tools (such as Python or Google's Tensorflow).

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I. Credit Card And Loan Sanction Operation

Credit Card
It is said that future of credit and risk management is being shaped by artificial intelligence and robotic process automation.[ii] Built in algorithms will automate credit decisions and risk management will not only save valuable time of bank employees but also prevent fraudulent and maximize profit margins.

Deep learning will save eighty percent of time and it will make decision making ten to hundred percent quicker.[iii]

But starting of usage of AI or deep learning is a big hurdle to overcome. Many financial institutes are not flexible to use it because of not having adequate data to start. But there are many companies ready to help with their existing dataset to begin with.

Credit card eligibility
Requirement of getting credit card
1. Must be 18 years of age
2. Should have some verification card

For salaried person
3. Must have fixed income
4. Salary (Equivalent to the desired threshold level)
5. Tax identification number
6. Job experience

For businessman:
1. Annual business revenue and estimated monthly spend
2. Tax identification number
3. Years in business and number of employees

So the potential data can be divided into two categories:
1. Salaried person
2. Businessman

In linear regression there will be two linear regression curve, one for Salaried person and other for businessman. Previous data of two categories will be fed on the regression function.

Here we will see how deep learning will evolve to predict a good client for credit card.

Working with Dataset

We can work with a dataset for having optimized result to get the eligible client to get a credit card. In banking system, at first bank wants to know whether the person seeking credit card is a salaried person or a businessman. Because the requirement criteria for these two type of professionals are different.

Potential Dataset

Customer
Name
NID/Social Security Number/Voter Id
DoB (Date of Birth)
Gross salary
Service Life/experience
Credit info

Database 1: Customer (Salaried)

Customer
Name
NID/Social Security Number/Voter Id
DoB (Date of Birth)
Yearly turnover
Service Life/experience
Credit info

Database 2: Customer (Business Man)

Loan sanction

If we have to apply deep learning in loan sanction operation; a weightage system can be introduced in a manner that if a loan proposal related data inserted in the activation function give positive output, loan will be sanctioned, otherwise not.

Customer
Name
NID/Social Security Number/Voter Id
DoB (Date of Birth)
Yearly turnover
Valid legal mortgage paper
Credit info

Database 3: Customer (Potential borrower)

II. Functional Operation Of Deep Learning

To apply deep learning in the business model of banking industry, adequate data is very essential. It will help the function to have accurate result. Now a days, data should not be a problem. Banking industries are automated and each organization have their previous customer data. Even there are some individual organization who can not only build the system but also provide their readymade data to feed the system for testing purpose.

Linear regression: Statistics to functional deep learning

Deep learning is essentially a form of applied statistics with increased emphasis on the use of computers to statistically estimate complicated functions and a decreased emphasis on proving confidence

intervals around these functions; we therefore present the two central approaches to statistics: frequentist estimators and Bayesian inference.

Linear regression is used to solve a regression problem. In otherwords, the goal is to build a system that can take a vector $x \in \mathbb{R}^n$ as input and predict the value of a scalar $y \in \mathbb{R}$ as its output. In the case of linear regression,the output is a linear function of the input. Let ŷbe the value that our modelpredicts *y* should take on. We define the output to be

$\hat{y} = wx$ [iv]

Neural Network Training

Neural network is a network which is made up of neurons connected to each other; at the same time, each connection of our neural network is associated with a weight that depicts the importance of this relationship in the neuron when multiplied by the input feature(input value).[v]

It is called neural network because each connected function is working together just like as human brain where each neuron cell is connected together.

In case of human we can see that he have to learn from his environment, from his parents and from school. At very age, he know nothing. But with the help of his parents, environment he gradually learns and day by day he masters many skills.

In neural network, it is almost same. It needs to feed data. It will study data with the built in function and decisions needed to be taken will be taught to it. The output from the function will be observed. And if desired output is not found, then more fine tuning is done. Once output is perfect, it is granted for its real world operation.

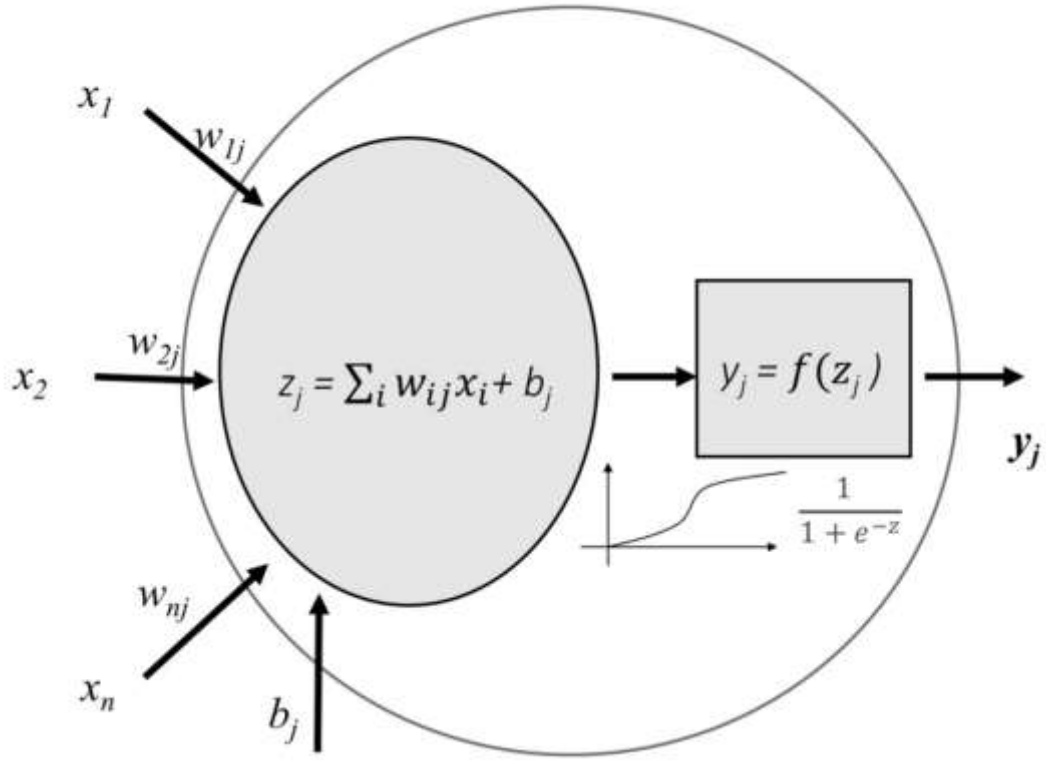

Figure 1: Neuron (source: https://torres.ai)

In neural network training each neuron has an **activation function** that defines the output of the neuron. Usage of activation function is done to introduce non-linearity in the modeling capabilities of the network.

Training of neural network comprises of learning the values of parameters (weights w_i and *bj* biases). This learning process in a neural network as an iterative process of "going and return" by the layers of neurons. The "going" is a forwardpropagation of the information and the "return" is a backward propagation of the information. This is the most genuine part of Deep Learning.

So if we can understand this iterative process we can realize the basic fundamental operation of deep learning.

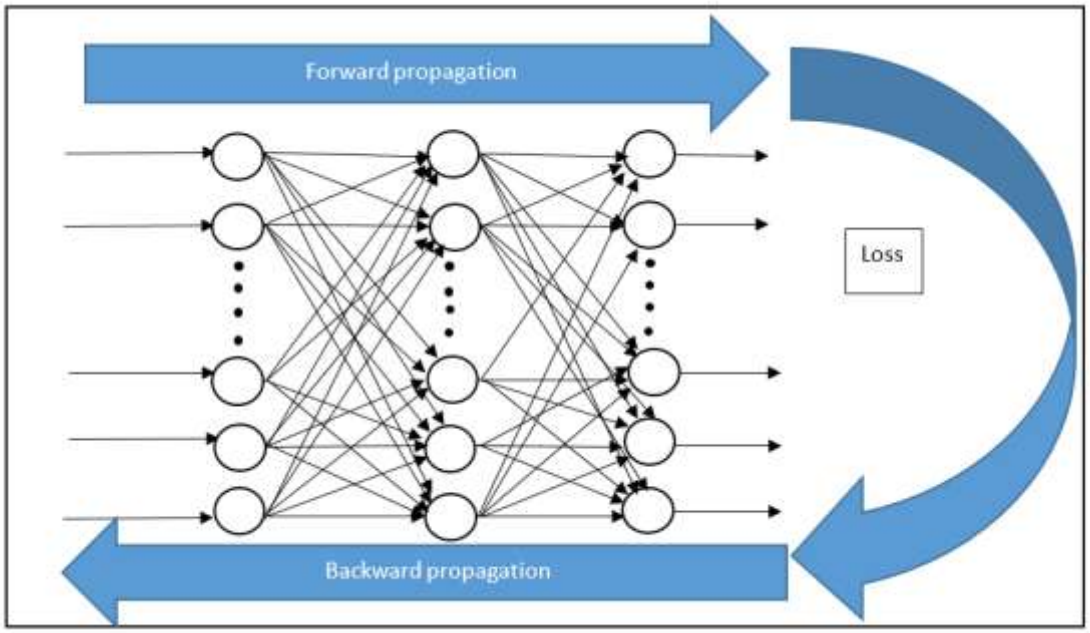

Figure 2: Neural network with forward and backward propagation

Here inputs for the neural network arex_1, x_2 and x_3. All input features will be passed to the hidden neuron. Here we are considering one hidden network only. The whole operation is shown in figure 3. There are two important steps here. At first step input features x_1, x_2 and x_3 will be multiplied with weights $\square_1$, $\square_2$ and $\square_3$ respectively. Summation of product of inputs and weights will be obtained as output and bias b_1 will be added here.

$Y=[x_1\square_1+x_2\square_2+x_3\square_3]+b_1$. . . . . ….(3)[vi]

Weight w_4 will be multiplied with the output hidden layer.

Thenactivation function will be applied. Activation function

Z= Act(y)…….(4)

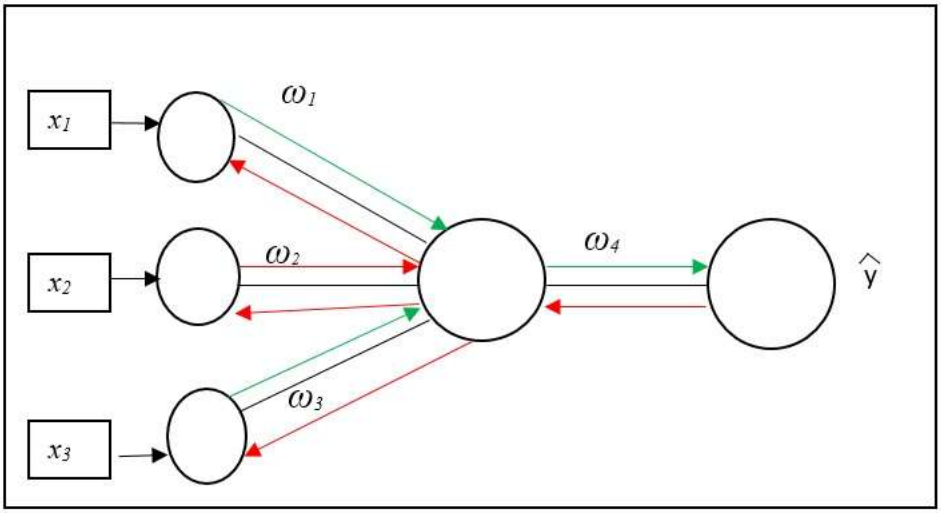

Figure 3: input feature with weight

Sigmoid function can be used as activation function. Sigmoid function transforms a value in between zero to one.

Next it will go and passed to output layer. In this step also some weights will be assigned.

Suppose we get the predicted outputy= 0 from the network. But based on the given dataset for which we already know that it should have the desired output 1.

Thus we now need to calculate the difference between desired output and obtained output by loss function,

$L = (y-\hat{y})^2$.

In the loss function,
L= $(y-\hat{y})^2$
= $(1-0)^2$
=1
During training session the weights of the equation 1 should be updated in a manner so that the value of loss function is reduced.

Here, as we discussed loss value is 1. Now optimizer will try to reduce the loss value. In order to reduce the loss value, back propagation method will be applied. Which means the weights w1, w_2 and w_3, $w_4$will be updated.

At first w_4 will be updated.

$\square_{4\ new} = \square_{4\ old} - \eta \frac{\partial L}{\partial \omega_4}$
Where η =learning rate
$\frac{\partial L}{\partial \omega_4}$ = derivative of loss with respect to derivative of $\square_4$.

Here we have to know that learning rate should be very small value. Small value will help the global minima function in the gradient descent when we want to achieve the particular point.

Similarly, $\square_{3\ new} = \square_{3\ old} - \eta \frac{\partial L}{\partial \omega_4}$
So, to clarify, the green arrow in figure 3 shows the forward propagation and the red arrows shows the backward propagation.

When the predicted output is not accurate, backward propagation is done and updating of respective weights are done. Then again forward propagation is done to see the updated output. One forward propagation plus one backward propagation jointly made an epoch. To have desired output several epochs are done.

After having the desired result with satisfied amount of dataset; value of weights are finalized while $\hat{y}$*and* $y$will match finally.

For multiple record, we have to define cost function= $\sum_{i=1}^{n}(y-\hat{y})^2$

III. Getting Result

For those two types of customer dataset, deep learning will compare the existing database of credit card holders of that bank along with potential customer. It will compare that whether a person is eligible for credit card or not. If it sees that potential customer is not fulfilling all the criteria of a credit card holder or the customer is risk prone to bank liability then it will reject the application of the customer. If it sees that the new application is eligible then it will approve the credit card application based on the data provided to it.

All those process can be handed to deep learning process if the bank has enough data to provide an accurate solution.

Below are examples of machine learning being put to use actively today. Bear in mind that some of these applications leverage multiple AI approaches – not exclusively machine learning.

IV. Conclusion

We are in the verge to enter in the fourth industrial revolution where AI will be a panacea for profit maximization, cyber security, risk management, fraudulent protection and so many more future problems. In the global economy of digitization consisting data-ocean where machine never sleeps; it will be very much difficult to survive without AI.

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