Credit Score System -An Application using Flutter

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Abstract---**The Credit Score System is a fiscal analysis tool that enables individualities or associations to assess their creditworthiness. This aims to help borrowers understand the criteria that lenders use to determine creditworthiness and give guidance on how to ameliorate credit scores. Credit Score is grounded on algorithms that calculate credit scores grounded on an existent's credit report, which includes information on payment history, credit application, credit age, credit blend, and new credit inquiries. The system uses these factors to calculate a credit score ranging from 300 to 900. This provides interactive tools that allow druggies to input their credit report data and admit an instant credit score. It also provides individualized recommendations on how to ameliorate the credit score, similar as paying bills on time, reducing credit application, and avoiding too numerous new credit operations. Credit Score System is designed to be stoner-friendly and accessible to anyone who wants to ameliorate their credit score. It's free to use and provides precious perceptivity into how credit scores are calculated and how to ameliorate them. The Credit Score System Project is a precious fiscal analysis tool that provides druggies with an instant credit score and individualized recommendations on how to ameliorate it. It's designed to be stoner-friendly and accessible to anyone who wants to maintain a good credit score. It's a free to use design that can help individualities and associations achieve their fiscal pretensions.**

Keywords -- FICO, UI, Json, NoSQL, Gauge Library

INTRODUCTION

A credit score is a three-digit number that reflects an individual's creditworthiness. It is a measure of an individual's likelihood of repaying a loan or credit card debt. Credit scores are used by lenders and financial institutions to evaluate the risk of lending money to an individual. A higher credit score means that an individual is more likely to get approved for loans and credit with favorable interest rates and terms. A credit score is calculated based on an individual's credit report, which includes information about their payment history, credit utilization, credit age, credit mix, and new credit inquiries.

Payment history is the most important factor and reflects how reliably an individual has paid their bills on time. Credit utilization is the amount of credit that an individual has used compared to their credit limit. Credit age is the length of time that an individual has held their credit accounts. Credit mix is the variety of credit types that an individual has, such as credit cards, loans, and mortgages. New credit inquiries reflect the number of times an individual has applied for credit recently. Credit scores range from 300 to 850, with higher scores indicating better creditworthiness. A score of 700 or above is generally considered a good credit score. A score of 800 or above is considered excellent. A score below 600 is considered poor and may result in higher interest rates or even rejection of the loan application.

Maintaining a good credit score requires responsible payment behavior, managing credit utilization, and avoiding too many new credit applications. Regularly checking one's credit report for errors and disputing them with the credit bureau is also important to maintain a good credit score. A good credit score is important not only for obtaining loans and credit but also for renting a home, getting a job, and even obtaining insurance policies.

Credit score system involve designing and developing an algorithm or program that can accurately calculate a person's creditworthiness based on their credit history and other financial information.

The credit score system is an important tool used by lenders to assess the creditworthiness of applicants. The higher the score, the lower the risk for the lender. Therefore, it is crucial to have an accurate and reliable credit scoring system.

Some of the challenges in developing a credit score system project includes accessing and analyzing large amounts of data, creating an algorithm that can accurately predict creditworthiness, and ensuring the security and privacy of the data used in the system.

Overall, credit score system projects provide an excellent opportunity for students and professionals to develop their programming and data analysis skills while tackling a real-world problem that affects millions of people.

The credit score system is a financial tool that reflects an individual's creditworthiness. It is calculated based on an individual's credit report and helps lenders evaluate the risk of lending money to an individual. Maintaining a fair credit score requires responsible payment behavior, managing credit utilization, and avoiding many new credit applications. Checking one's credit report regularly is also important to maintain a nice credit score.

1.BACKGROUND

The credit score system has its roots in the mid-20th century when credit reporting agencies began tracking credit information on individuals and businesses. In the United States, the Fair Credit Reporting Act (FCRA) was passed in 1970, which set the legal framework for credit reporting agencies and established the right of individuals to access their credit reports.

The use of credit scores as a tool for evaluating creditworthiness began in the 1980s with the introduction of the FICO score. FICO (Fair Isaac Corporation) is a company that provides credit scoring software to lenders and financial institutions. The FICO score is the most widely used credit score in the United States and is calculated based on an individual's credit report.

Over time, other credit reporting agencies and credit scoring models have emerged. In India, Credit Information Bureau (India) Limited (CIBIL) was the first credit reporting agency to be established in 2000. CIBIL provides credit reports and credit scores to lenders and financial institutions based on an individual's credit history.

The credit score system has become an essential tool for lenders and financial institutions to evaluate the risk of lending money to an individual or organization. A good credit score is important for obtaining loans and credit with favorable interest rates and terms. It is also essential for other financial endeavors such as renting a home, getting a job, and obtaining insurance policies.

The credit score system has a rich history dating back to the mid-20th century when credit reporting agencies began tracking credit information. Over time, credit scores have become an essential tool for lenders and financial institutions to evaluate creditworthiness. A good credit score is important for obtaining loans and credit with favorable terms and is essential for other financial endeavors.

2.METHODOLOGY AND CALCULATIONS

The methodology of the credit score system involves several steps to calculate the credit score based on an individual's credit report. The methodology and calculations of the credit score system may vary depending on the credit bureau and scoring model used. However, the general methodology of the credit score system includes the following steps:

Step 1: Credit Report Data Collection

The credit bureau collects data from multiple sources, such as banks, credit card companies, and other financial institutions, to generate an individual's credit report. The credit report includes information about payment history, credit utilization, credit age, credit mix, and new credit inquiries.

Step 2: Credit Score Calculation

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The credit bureau uses a scoring model to calculate the credit score based on the data collected in the credit report. The scoring model assigns weights to each factor in the credit report to determine the credit score. For example, payment history may have a higher weight than credit age.

Step 3: Credit Score Range

The credit score is typically a three-digit number ranging from 300 to 850, with higher scores indicating better creditworthiness. The range of credit scores may vary depending on the credit bureau and scoring model used.

Step 4: Credit Score Interpretation

Lenders and financial institutions interpret credit scores to evaluate the risk of lending money to an individual or organization. A higher credit score indicates a lower risk, and a lower credit score indicates a higher risk.

Calculations of credit score system:

The specific calculations of the credit score system may vary depending on the credit bureau and scoring model used. The most widely used credit score in the United States is the FICO score, which uses the following factors and weights to calculate the credit score:

Payment history (35%)

Credit utilization (30%)

Credit age (15%)

Credit mix (10%)

New credit inquiries (10%)

The FICO score calculates the credit score by analyzing the credit report data using a complex algorithm. The algorithm assigns points based on each factor and then combines the points to generate the credit score. Other credit bureaus and scoring models may use different factors and weights to calculate the credit score. The methodology and calculations of the credit score system involve several steps to collect credit report data, calculate the credit score using a scoring model, determine the credit score range, and interpret the credit score. The specific calculations of the credit score system may vary depending on the credit bureau and scoring model used.

3. CREDIT SCORE SYSTEM

The credit score system is used by lenders and other financial institutions to evaluate the creditworthiness of an individual when they apply for credit. The credit score helps them assess the risk of lending money to that individual and make informed decisions about whether to approve their loan application or not.

Here are some ways in which the credit score system is used:

Credit card applications: When a person applies for a credit card, the issuer will typically check their credit score to determine their creditworthiness. The credit score helps the issuer decide whether to approve the application, what credit limit to offer, and what interest rate to charge.

Loan applications: When a person applies for a loan, such as a personal loan, auto loan, or mortgage, the lender will typically check their credit score. The credit score helps the lender decide whether to approve the loan application, what interest rate to charge, and what loan terms to offer.

Renting a home or apartment: Landlords may check a person's credit score as part of the rental application process to determine whether they are likely to pay rent on time and to evaluate their overall financial responsibility.

Employment screening: Some employers may check a person's credit score as part of the hiring process to assess their financial responsibility and trustworthiness.

Insurance applications: Some insurance companies may check a person's credit score as part of the application process to determine their risk level and set premiums.

Overall, the credit score system is a critical part of the financial industry that helps lenders and other institutions evaluate the creditworthiness of individuals and make informed decisions about lending and other financial transactions.

3.1 Features
The application comprises of a login page which is for both customers and admin. The login authentication is done in the Google's database i.e., the firestore.

The admin will have the following features:

1. To create a new user, a customer or give someone the functions of an admin.

2.   To change the details of the existing customer.
3.   To delete an existing customer
4.   To modify the loan details of a customer.
5.   To view the customers in ordering of the credit score, i.e., the customers with a lower credit score will appear at the top.

The Customer will have the following features:

1.   To view their own credit score
2.   To know their current status
3.   To know chances of availing a new loan
4.   To view their previous loan transactions
5.   To get suggestions so as to improve their current status

4. SYSTEM ARCHITECTURE

The system architecture of credit score system is as shown above. The user and Admin have separate login modules. Once the user login, they will have access to options like viewing their account details, account balance, credit score and also an option to apply for a loan. Once a user applies for a loan, their credit score is checked to find whether they are eligible for the loan or not. If found eligible, the loan is approved by the bank. If not eligible, they will be given options to improve their credit score through different methods like: Paying their credit card bills on time, Lowering the loan amount for which they have applied, Completing the pending loans or increasing the interest rate. The user can improve their credit score by opting any of the stated methods.

When the admin login to their module, they will have access to several functions like, approving loan requests, details of active customers being displayed, add/delete customers and modify customer details. The displayed information to the user as well as the information updated by the admin are stored in a Firebase database. Data flows in and out of the database as per requirements.
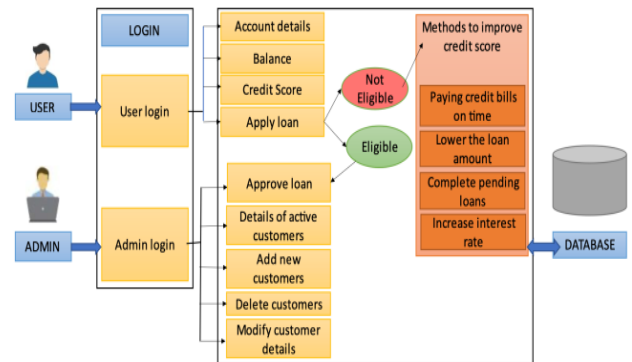
4.1 Platform
A mobile app development framework that was introduced by Google is Flutter It was launched in 2017 and has since gained popularity among developers due to its ease of use and cross-platform capabilities.

It uses the Dart programming language, which is easy to learn and offers a fast development cycle. Flutter also comes with a rich set of pre-built widgets and tools that make it easy to create visually appealing and interactive user interfaces.

One of the key benefits of Flutter is the hot-reload feature, it allows developers to see changes made in the code at real-time without restarting the application. This feature speeds up the development process and makes it easy to test and refine the app.

Flutter also provides access to native features like camera, geolocation, and sensors, allowing developers to create powerful and feature-rich mobile applications. Additionally, Flutter integrates well with popular development tools like Android Studio and Visual Studio Code, making it easy for developers to get started with the platform.

Overall, Flutter is a popular mobile application development platform that offers fast development cycles, cross-platform capabilities, and a rich set of pre-built tools and widgets. It is a great option for developers who want to create high-performance mobile applications for both Android and iOS platforms.

4.2 Interface Implementation
Flutter provides a powerful and flexible framework for building user interfaces that are visually appealing and

interactive. Here are some key concepts and tips for implementing interfaces in Flutter:

Widgets: Widgets are the basic building blocks of a Flutter interface. They are responsible for creating and displaying visual elements on the screen, such as buttons, text, images, and input fields. Flutter provides a set of pre-built widgets, as well as the feature to create custom widgets to meet specific design requirements.

Layouts: Layouts are used in arranging the widgets on the screen. Flutter provides a variety of built-in layout widgets, such as Row, Column, and Stack, which can be used to create complex UI designs. These widgets are flexible and can be customized to fit the specific design requirements.

Material Design: Flutter provides support for Google's Material Design guidelines, which offer a set of design principles and guidelines for creating consistent and visually appealing UIs. Material Design widgets, such as App Bar, Floating Action Button, and Bottom Navigation Bar, can be used to create modern and responsive user interfaces.

Animation: Flutter has built-in support for animation, which can be used to create visually appealing and interactive UI elements. Animations can be used to add motion and interactivity to UI elements such as buttons, menus, and transitions between screens.

Responsive Design: Flutter provides support for creating responsive UIs that adapt to different screen sizes and orientations. Widgets such as Expanded, Flexible, and MediaQuery can be used to create layouts that adjust dynamically based on the screen size and orientation.

State Management: Flutter provides several options for managing the state of the UI, which is critical for creating interactive user interfaces. Stateful widgets can be used to hold and update UI state, and Flutter provides several state management libraries such as Provider and Bloc to manage complex UI state.

Overall, Flutter provides a powerful and flexible framework for implementing interfaces that are visually appealing and interactive. By using the built-in widgets, layouts, and design principles, developers can create modern and responsive UI designs that meet specific design requirements.

4.3 Database Implementation

Firebase Cloud Firestore is a cloud-based NoSQL document database provided by Google as part of the Firebase suite of app development tools. Firestore provides a flexible and scalable database solution for mobile and web applications, allowing developers to store, sync, and query data in real-time.

Documents are used to store data by firestore, which are similar to JSON objects, and collections, which are groups of documents. Data can be structured in any way that makes sense for the application and can be accessed through a variety of client libraries or REST APIs.

Here are some key features of Firebase Cloud Firestore:

1. Real-time updates: Firestore provides real-time synchronization between clients and servers, so changes made to the database are automatically updated in real-time across all connected clients.

2. Scalability: Firestore is designed to scale automatically based on demand, allowing developers to easily handle high traffic loads and unpredictable usage patterns.

3. Security: Firestore provides a set of security rules that allow developers to define granular access controls for their data, ensuring that only authorized users can access and modify data.

4. Offline support: Firestore provides offline support, allowing users to continue working with the app even when there is no internet connection. Data changes made while offline are automatically synchronized with the server when the device reconnects to the internet.

5. Data queries: Firestore provides a powerful query engine that allows developers to filter, sort, and search data based on specific criteria, making it easy to retrieve and work with data in a variety of ways.

6. Integration with other Firebase services: Firestore integrates with other Firebase services, such as Firebase Authentication and Cloud Functions, allowing developers to build complex and feature-rich applications.

Overall, Firebase Cloud Firestore provides a powerful and flexible document database solution for mobile and web applications. With real-time updates, scalability, security, offline support, and powerful data querying capabilities, Firestore makes it easy for developers to build modern and

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feature-rich applications that scale to meet the needs of their users.

4.4 Libraries Used:

Material Library: The Material Design library is a set of design guidelines and components for creating Android apps with a consistent look and feel. The guidelines were developed by Google and provide a set of principles for creating modern, clean, and responsive user interfaces. The Material Design library includes a range of components that are designed to work together seamlessly, including typography, color palettes, icons, layout, and animations. The library provides a consistent and intuitive user experience across different devices and screen sizes.

In addition to the design guidelines, the Material Design library includes a set of pre-built UI that developers can use in their apps, such as buttons, text fields, menus, tabs, and dialogs. These components are designed to be flexible and customizable, allowing developers to create unique and compelling user interfaces that follow the Material Design principles.

The Flutter Material library provides a set of widgets that implement the Material Design guidelines and can be easily customized to fit the specific needs of an app. By using the Flutter Material library, developers can quickly and easily create beautiful and responsive user interfaces that follow the Material Design principles.

Guage Library: Flutter provides a rich set of widgets and libraries that developers can use to build beautiful and functional user interfaces. One of the libraries that can be used in Flutter is the Gauge library.

The Gauge library provides a set of widgets that can be used to create gauges and meters in Flutter applications. These widgets are designed to be highly customizable, allowing developers to create gauges that fit the specific needs of their app.

The Gauge library includes several pre-built widgets, including:

1. RadialGauge: Used to create a circular gauge with customizable labels, ranges, and pointers.
2. LinearGauge: Used to create a horizontal or vertical gauge with customizable labels, ranges, and pointers.
3. SemiRadialGauge: Used to create a semi-circular gauge with customizable labels, ranges, and pointers.
4. DigitalGauge: Used to create a digital gauge with customizable labels and ranges.

These widgets can be customized with a variety of properties, such as color, size, and shape, to create a wide range of gauges and meters.

5.EXPERIENCE

Credit scores have grown in significance in our daily lives recently since lenders use them to assess a borrower's creditworthiness. With the development of digital technologies, many financial institutions have created tools that can forecast a customer's credit score. Customers can utilise these tools, which offer a great user experience, to learn more about their credit position.

5.1 User Experience

Any application's success depends heavily on user engagement and experience, and credit score prediction applications are no exception. These applications must be created with the user in mind, be simple to use, and deliver precise results. The application would feature an easy-to-use interface that leads the user through the process of acquiring their credit score in order to do this.

When the user moves through the process of collecting their credit score, the application must be set up to give them feedback. The user must be given clear and simple feedback that explains their credit situation and points out areas where they might raise their score. For instance, the application can recommend actions the user might take to raise their credit limit or pay off their outstanding bills in order to raise their credit score.

The accuracy of the predicted credit score is a key component of user engagement and experience. Customers rely on these applications to accurately inform them of their credit standing, so any inaccuracies in the prediction could have serious repercussions. Because of this, the application needs to be built to deliver trustworthy and accurate results based on a variety of variables like credit history, debt-to-income ratio, and other financial indicators.

The process of user interaction with a credit score system typically involves several steps. These steps can vary

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depending on the specific application, but generally, they involve the following:

1. User Registration: The user will need to register with the credit score system by providing their personal information, such as name, address, and PAN number. This information is necessary to verify the user's identity and pull their credit history.
2. Credit Report Retrieval: Once the user has registered, the credit score system will retrieve their credit report from the database where the information is stored. This report will contain information about the user's credit history, and outstanding debts.
3. Credit Score Calculation: The credit score system will then use the information from the user's credit report to calculate their credit score. The credit score is a numerical value of the user's creditworthiness, and it ranges from about 300 to 850, with higher scores indicating better creditworthiness.
4. Credit Score Display: Once the credit score has been calculated, the credit score system will display the score to the user with the help of a radial gauge implemented in the application. The user will be able to see their score and any relevant factors that may have impacted their score, such as outstanding debts or late payments.
5. Feedback and Recommendations: Finally, the credit score system may provide feedback and recommendations to the user on how they can improve their credit score. This may include suggestions such as paying off outstanding debts, reducing credit utilization, or disputing any errors on their credit report.

A customer credit score prediction application's performance depends heavily on how users interact with and use it. The software must be created to be user-friendly, offer concise and clear feedback, and produce reliable results. When designed properly, these applications can aid users in understanding their credit standing and taking action to strengthen their financial situation.

Overall, the interface between a user and a credit score system is generally intended to give people a simple and practical way to get their credit score and learn more about their creditworthiness. Users can take charge of their financial situation and manage their credit by following these steps.

5.2 Usability Analysis

Based on the general principles of usability, a credit score system should be evaluated on several key factors, including:

1. Ease of Use: The credit score system is simple to operate, with simple instructions and an easy-to-use interface.
2. Efficiency: There will not be a lot of waiting or delays, and the system should deliver prompt and precise results.
3. Accuracy: Based on the user's credit history and financial indications, the credit score system will offer trustworthy and accurate credit score projections.
4. Feedback: The system would give the customer clear, concise feedback regarding their credit score and any relevant circumstances that might have affected it.
5. Recommendation: The algorithm will give the user specific advice on how to raise their score, such as repaying past-due payments or lowering their credit utilization.
6. Security: The system is secure, with appropriate measures in place to protect the user's personal information and credit history.

Overall, the credit score system is designed to be user-friendly, efficient, accurate, and secure, providing users with the information and insights they need to make informed decisions about their credit.

payments.

6. CIBIL SCORE ANALYSIS

CIBIL score is a credit score provided by the Credit Information Bureau (India) Limited (CIBIL), which is one of the major credit bureaus in India. It is a three-digit number ranging from 300 to 900, and it is based on the individual's credit history and repayment behaviour. The CIBIL score analysis typically involves evaluating the various factors that contribute to the score. These factors include:

1. Payment history: This element considers the person's credit account repayment practices, including their use of credit cards and loans.

Negative events like late payments, defaults, and other occurrences can greatly affect the score.

2. Credit utilization: This element takes into account how much credit has been used in comparison to the available credit limit. High utilization rates may be a sign that a person relies excessively on credit and may find it difficult to pay back debts.

3. Credit mix: This component examines the many credit accounts, including credit cards, loans, and mortgages, that the person has. The ability to safely manage a variety of credit can be demonstrated by a wide mix of credit.

4. Length of credit history: This aspect checks how long the person has had credit accounts. Longer credit histories can show that a person has a more established credit history and a history of making timely payments.

5. Credit inquiries: This element examines the frequency with which creditors or credit reporting organizations have viewed the individual's credit file. A person who makes several inquiries in a short period of time may be overly aggressive in their search for credit and run a higher default risk.

Lenders and financial organizations use the CIBIL score analysis to evaluate a person's creditworthiness and determine if they are qualified for loans and other financial products. A client with a higher score poses a lesser credit risk, whereas one with a lower score may be more likely of defaulting on loans or credit card

6.1 Classification Of Cibil Score

CIBIL scores are generally classified into four categories – excellent, good, average, and poor - based on the score range. The classification is as follows:

1. Excellent: An excellent CIBIL score is when maintained above 750, and it indicates that an individual has a very strong credit profile. Lenders and financial institutions generally consider a score above 750 to be an excellent score, as it reflects a high level of creditworthiness and responsible credit management.

2. Good: A CIBIL score in the range of 650 to 750 is considered good. Individuals with a good score are likely to have a better chance of getting approved for loans or credit cards, as they are perceived as lower credit risks.

3. Average: A CIBIL score between 550 and 650 is considered average. Individuals with an average

score may face some difficulty in getting approved for credit products, and they may be offered higher interest rates or lower credit limits.

4. Poor: A CIBIL score below 550 is considered poor. Individuals with a poor score are considered high-risk borrowers and may have difficulty getting approved for loans or credit cards. If they are approved, they are likely to be offered very high interest rates and other unfavourable terms.

It is important to note that these classifications may vary slightly between different lenders and financial institutions.

6.2 Credit Scoring Process

Customers must first visit the bank and complete a special application with a customer service representative in order to begin the process of obtaining a credit loan from the bank. The application is then forwarded to the business and credit risk departments. The process is subject to internal and external CIBIL level scoring checks, with accepted scores ranging from 300 to 900. The average accepted score is 700.The bank then assigns various weights. Additionally, within the time frame of between 10 and 15 days, assessed customers' details like bank history, income, banking balance stability, and other information will be used in this process. Additionally, a number of variables, like credit limit, duration from account inception, length of payments, and others, have an impact on scores. The following criteria and principles for credit risk assessment approaches can help improve a credit score.

CONCLUSION

In order to assess a borrower's creditworthiness, lenders frequently employ the credit scoring system. A person's credit history, income, debt-to-income ratio, and other pertinent criteria are taken into account when determining the risk involved in lending to them.

Informed decisions may be made by lenders with the aid of a well-designed credit scoring system, which can also help

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to reduce lending-related risks. The ability to comprehend one's creditworthiness and take proactive efforts to raise one's credit score over time can also be helpful to people.

Additionally, because they have the potential to be discriminatory, some factors, like race or gender, shouldn't be included in credit scoring models. All things considered, credit scoring systems are a crucial tool for lenders to evaluate risk and make wise lending decisions. But it's crucial to make sure the scoring models are impartial, transparent, and fair.

Finally, the credit score system is a crucial instrument that is used to determine a person's creditworthiness. It considers elements including credit use, payment history, duration of credit history, categories of credit, and recent credit queries. A borrower who has a higher score is typically more likely to return their bills fully and on time.

Being approved for loans with lower interest rates, getting credit cards with bigger credit limits and rewards programs, and even being able to rent an apartment or get cheaper insurance are just a few of the many advantages of having outstanding credit. A low credit score might make it challenging to get credit and may lead to increased interest rates, fees, and unfavourable terms.

People should be aware of their credit scores and take action to raise them if necessary. This can be accomplished by paying bills on time, maintaining a low credit utilisation rate, building a strong credit history, and refraining from opening an excessive number of new credit accounts at once. By doing this, people can increase their creditworthiness and have access to the advantages of having a high credit score. The system will ease the working of the employees in a bank. It will serve as a guide for micro finance institutions. The system helps in designing and implementing custom score-cards for customer. Also, it helps in processing the original data to a standardized form. It guides an employee to access his current score and suggest methods to improve his score to acquire loan.

REFERENCES

[1] Alasbahi, R., & Zheng, X. (2022). An Online Transfer Learning Framework With Extreme Learning Machine for Automated Credit Scoring. *IEEE Access*, *10*, 46697-46716.

[2] Dastile, X., & Celik, T. (2021). Making deep learning-based predictions for credit scoring explainable. *IEEE Access*, *9*, 50426-50440.

[3] Chen, X., Li, S., Xu, X., Meng, F., & Cao, W. (2020). A novel GSCI-based ensemble approach for credit scoring. *IEEE Access*, *8*, 222449-222465.

[4] Rani, G. E., Reddy, A. T. V., Vardhan, V. K., Harsha, A. S. S., & Sakthimohan, M. (2020, August). Machine Learning based Cibil Verification System. In *2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT)* (pp. 780-782). IEEE.

[5] Zhang, Z., Niu, K., & Liu, Y. (2020). A deep learning based online credit scoring model for P2P lending. *IEEE Access*, *8*, 177307-177317.

[6] Lin, C., Luo, M., Huang, X., Choo, K. K. R., & He, D. (2021). An efficient privacy-preserving credit score system based on noninteractive zero-knowledge proof. *IEEE systems journal*, *16*(1), 1592-1601.

[7] Parvin, A. S., & Saleena, B. (2020, December). An ensemble classifier model to predict credit scoring-comparative analysis. In *2020 IEEE International Symposium on Smart Electronic Systems (iSES)(Formerly iNiS)* (pp. 27-30). IEEE.

[8] Adams, N. M., Blunt, G., Hand, D. J., & Kelly, M. G. (2000). Data mining for fun and profit. *Statistical Science*, *15*(2), 111-131.

[9] Guo, S., He, H., & Huang, X. (2019). A multi-stage self-adaptive classifier ensemble model with application in credit scoring. *IEEE Access*, *7*, 78549-78559.

[10] Calibo, D. I., & Ballera, M. A. (2019, February). Variable selection for credit risk scoring on loan performance using regression analysis. In *2019 IEEE 4th International Conference on Computer and Communication Systems (ICCCS)* (pp. 746-750). IEEE.

[11] Yu, X., Yang, Q., Wang, R., Fang, R., & Deng, M. (2020). Data cleaning for personal credit scoring by utilizing social media data: An empirical study. *IEEE Intelligent Systems*, *35*(2), 7-15.