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PRESENTING A DECISION TREE-BASED DATA MINING MODEL TO INCREASE THE SECURITY OF USERS' INFORMATION IN THE USE OF ELECTRONIC SERVICES CONSIDERING INTERNET BANKING SYSTEM

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ABSTRACT:
THE MAIN GOAL OF THIS RESEARCH STUDY IS TO PRESENT A DATA MINING MODEL BASED ON A DECISION TREE TO INCREASE THE SECURITY OF USERS' INFORMATION IN THE USE OF ELECTRONIC SERVICES. TO DETERMINE THE SECURITY OF USERS' INFORMATION IN THE USE OF ELECTRONIC SERVICES. THEREFORE, BASED ON THE DATA AVAILABLE IN THE DATABASE OF 4376 CUSTOMERS OF ELECTRONIC SERVICES IN THE BANK OF AGRICULTURE, THE DATA WAS ANALYZED IN THE DATA MINING MODELS OF CLASSICAL DECISION TREE, NAIVE BIZ, RANDOM FOREST, ROOT TREE, DEEP LEARNING AND NEURAL NETWORK. THEREFORE, BY RUNNING THE RAPIDMINER SOFTWARE, THE OUTPUT OF THE MODEL WAS ANALYZED IN THE PARAMETERS OF ACCURACY, CLASSIFICATION ERROR PERCENTAGE, KAPPA COEFFICIENT AND ABSOLUTE ERROR, AND THE RESULTS SHOWED THAT THE CLASSIC DECISION TREE MODEL AND THE RANDOM FOREST MODEL WERE THE BEST WITH 99.42 PERCENT EACH. HAVE WHILE THE ROOT TREE IS NOT IN A GOOD CONDITION WITH 87.88, IN RELATION TO THE CLASSIFICATION ERROR, THE CONDITIONS OF THE CLASSIC DECISION TREE AND DECISION FOREST MODELS AND THEN THE NEURAL NETWORK MODEL WERE FOUND TO BE MORE SUITABLE THAN OTHER DATA MINING MODELS; IN RELATION TO THE KAPPA ERROR, THE CLASSICAL DECISION TREE AND RANDOM FOREST OBTAINED A MORE FAVORABLE SITUATION THAN OTHER METHODS WITH 0.989, ALSO IN RELATION TO THE ABSOLUTE NORMAL ERROR, THE CLASSICAL DECISION TREE AND RANDOM FOREST EACH SHOWED A LOWER ERROR WITH A RATE OF 0.039.

KEY WORDS: DATA MINING; DECISION TREE; ELECTRONIC BANKING; USER INFORMATION SECURITY; ELECTRONIC SERVICES; RAPIDMINER SOFTWARE; DECISION FOREST MODELS; DATA SECURITY; INTERNET BANKING SYSTEM; CLOUD COMPUTING

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INTRODUCTION

In order to reach their competitive position and maintain their market share, companies based on information technology should also pay attention to the opinions of customers. Technologies and programs under these technologies play a very key role. Nowadays, due to the high volume of work that companies have in competitive markets, it is very necessary to use programs. Among these programs that can play a significant role in the performance of companies is cloud computing. In fact, information security is a computing method based on large computer networks such as the Internet, which provides a new model for the supply, consumption and delivery of information technology services using the Internet. In such a situation, users are trying to access it based on their needs and regardless of the location of the service and the method of data delivery. In this research, we intend to provide a data mining model based on a decision tree to increase the security of users' information in the use of electronic services. On the other hand, Birau et al. [1] investigated the importance of customer relationship management (CRM) for a sustainable development of the banking sector. Samartha et al. [2] examined relevand aspects regarding the implications of mobile - banking applications based on the “Unified theory of acceptance and use of technology” (UTAUT) modified model.

Information and communication technologies, including the Internet, which has become a vital part of human life today, are expanding day by day [3]. In addition, Karbassi Yazdi et al. [4] suggested that the service industry represents a key factor for achieving a sustainable economic development. Aligned with the needs of community members such as information security, fast processing, dynamic and instant access, creating mutual cooperation, the power to focus on organizational projects instead of wasting time to maintain servers, and most importantly, savings. It has become very important in costs. The solution proposed today in the field of technology for such problems is the technology called cloud computing [5]. In cloud computing, data is less stored on personal computers or servers located in your business environment [6].

On the other hand, networks provide access to knowledge, resources, market and technology for institutions. A collaborative network (cooperative) is a reflection of organizational nature, infrastructure, business processes, resources and relationships that support a joint effort to achieve some collective benefits, whether the benefit is in the program, service or product [7]. Collaborative networks have advantages. including: speed, complementary roles, development dimension, competitiveness, promotion and optimization of resources and innovation. The formation and implementation of collaborative networks also faces problems. The most important of them is technological in nature and is mainly focused on matters such as the integration and coordination of internal and external operations [8].

Cloud computing is a technology that has taken into account the stated issues and problems. Cloud computing is an Internet-based computing model that provides a new model for supply, consumption and delivery of information technology services (including software, information and shared computing resources) by using the Internet. The word "cloud" is a metaphorical word that refers to the Internet, and in computer network diagrams, the shape of a cloud is also used to represent the Internet network [9]. The reason for comparing the Internet to the cloud is that the Internet, like a cloud, hides its technical details from the users and creates a layer of abstraction between these technical details and the users. Cloud computing is an emerging format for applications that aim to share data, information, knowledge, calculations and services among users [10].

Today, every decision made in business is somehow related to the world of information technology, and in the meantime, service providers are competing to get more customers. Moreover, Ullal et al. [11] examined the importance of Artificial Intelligence (AI) driven machines and argued that represent the future in the case of services industry. In recent years, cloud computing is becoming an important technology in the field of information technology [12]. Experts in this field believe that cloud computing will transform processes in the field of information technology [13]. Since this technology is now in its infancy, a scientific standard definition that is generally accepted has not yet been provided for it, but most experts agree on parts of the definition of this phenomenon. In their research, Hashem et al. [14] define cloud computing as a model for having comprehensive, easy and on-demand network access to a set of configurable computing resources (such as: networks, servers, storage space, programs) applications and services) that can be quickly provided or released (released) with minimal work and effort or the need for the intervention of the service provider [15].

In general, it can be said that hardware data centers and processing service provider software are called "cloud computing". Cloud computing is a new processing method in which expandable and often virtualized resources are offered as a processing service through communication networks such as local networks and the Internet [5]. The focus of this model is to serve the user based on demand, without the user needing special equipment for processing or knowing where this processing is performed. This service can be likened to the electricity supply network, where the subscriber supplies the necessary energy to use his electrical devices without needing to know how electricity is produced and the exact location of its production, just by connecting through a port [16]. Generally, cloud computing consumers do not own the physical infrastructure of the cloud [17], but rent it from third-party providers to avoid capital costs. They consume resources as a service and pay only for the resources they use. Many of the provided cloud computing services provide the possibility of using these services in a similar way to industries by using the public computing model. These items are among the necessities of this research.

The objectives of the present research include two main categories (providing a data mining model based on decision tree to increase the security of users' information in the use of electronic services) and secondary objectives (identifying the factors affecting the security of databases in order to establish data security in the Internet banking system; Determining the accuracy of data mining methods to determine the security of databases in order to establish data security in the Internet banking system; determining the accuracy of data mining methods to determine the security of databases in order to establish data security in the Internet banking system.

According to the objectives of the research, the research questions are as follows:

What is the appropriate model for database security to establish data security in the internet banking system?

- What are the effective factors on the security of databases to establish data security in the internet banking system?
- What is the accuracy of data mining methods to determine the security of databases in order to establish data security in the internet banking system?
- What is the accuracy of data mining methods to determine the security of databases in order to establish data security in the internet banking system?

2. THEORETICAL FOUNDATIONS AND RESEARCH BACKGROUND

Telecommunications companies made it possible to access virtualized communications. In this way, instead of creating independent physical structures for each user, it was possible to share physical infrastructure for a wide range of users. In 2002, Amazon created its web service, which played an important role in the development of cloud computing. Since 2006, this company has provided access to its system through Amazon Web Services based on universal processing. Google also brought cloud services to the general public by providing Google Docs cloud service in the same year, and after that, different companies have provided various services on the basis of cloud computing [18]. In this research, according to the main research objectives in relation to providing a decision tree-based data mining model to increase the security of users' information in the use of electronic services, the theoretical foundations and background of the research have been presented.

- *The concept of cloud computing*

This technology is becoming one of the essential technologies of users and people in this era. Thanks to cloud computing technology, users will be able to access the data or programs they need from anywhere in the world. In this way, in order to optimize the consumption of computer resources around the world and save costs, it is possible to create a cloud mass of computers - a collection of virtual computers - and using virtualization technology, these resources used for different and numerous applications. Users can also submit their requests to use the resources they need to the providers of these services and in exchange for using the resources they get, according to the duration of use and the type of resource used, the cost Pay much less than upgrading the system and installing the program.

- *Cloud computing in small and medium business companies*

In the past years, the researches about cloud computing, its applications, advantages and challenges have been expressed and it has shown cloud computing as one of the most used discussions among the IT specialists of organizations. Mehdiabadi et al. [19] examined the effect of industry 5.0 on the development of banking industry considering the major importance of technology.

- *Advantages and disadvantages of using cloud computing*

Today, cloud providers prefer to invest in cloud services instead of infrastructure issues. The advantages of using cloud computing give this method a special advantage. If companies do not use cloud services, they will have to spend a huge amount of money to build a personal data center and attract more human resources.

Its advantages can be mentioned as follows: saving time and money/increasing availability/fast and automatic recovery in case of system failure/high efficiency/high scalability during peak usage/in cloud computing technology, users through any type of tool from such as desktop computers, portable computers, smart phones, etc. will be able to access the provided services. by using this technology, even areas that are at risk of natural disasters can benefit from the facilities provided in the cloud without the need to establish the infrastructure of this technology in that area. / Among the main advantages of this technology, we can mention higher relative security, ease of creation and continuation of business and business, more appropriate management of large data, provision of services in large dimensions.

Disadvantages include: pay per use / lack of full control over the server where the data is stored / the data is completely dependent on the providers; The most essential part of an

organization is their information, if it gets damaged, that organization will fail./ Since a large amount of data is kept in databases, their transfer is very difficult and requires high speed of the Internet./ Organizations are provided with great care. The providers choose their services; Therefore, sometimes they want to replace them, in which case they face many problems.

- *Cloud computing and organizational performance*

The expansion of new generation Internet networks and the World Wide Web has led to the creation and presentation of a new generation of service-based systems called cloud computing. Cloud computing includes the approaches of providing software services, platform, data and even hardware as a service. The software as a service approach is now a low-cost and low-risk approach that includes various solutions for the organization's resource planning system, customer relationship management, and supply chain management. This approach also solves the challenges of updating and upgrading.

Various researches confirm that cloud computing can be effective in improving organizational performance and strengthening it in organizations in three ways. 1) Software as a service: in which the application software is installed and launched in the cloud for the use of customers. In fact, in this way, the field of customer orientation is considered as one of the pillars of improving organizational performance in performance evaluation approaches. 2) Platform as a service: This model includes operating systems, services, database management and validation, whose programs are placed in the cloud by cloud developers or users. Infrastructure as a service: In this model, the user can use a series of basic computing resources such as processing power, storage, network components or middleware.

These two factors, reducing complexity and cost, are factors that can reduce the failure rate of complex systems such as resource planning systems. These features have caused an effort to reduce the complexity of implementing information technologies in organizations, and in the software as a service approach, service providers produce web-based application software and put it on the Internet for their customers to use. It hosts and executes. Customers do not need to purchase software license or additional infrastructure equipment and access to software based on their needs.

- *Strategic orientation and cloud computing*

The contents of the concept of strategic orientation and cloud computing are presented. However, the lack of research in this regard proves that the issue of strategic orientation and cloud computing has not been theoretically investigated until now. For this reason, the researcher has decided to provide key information about these two variables. The strategic orientation of companies will be created when companies have goals and activities that are coordinated by cloud computing and supporting information systems. In fact, there is a belief that the most stable cloud computing systems are those based on technology; which is integrated and deeply integrated with the aspects of strategic orientation and strategic thinking of the organization.

- Ehsanifar et al. [20], in their research study, showed that statistical models and neural networks are a new generation of data mining techniques that have been greatly developed in the last two decades. And it has always been a question of which one performs better in forecasting.
- Suherman and Simatupang [21], in their research, stated that with the advancement of technology and the expansion of the use of the Internet in organizations, a model called cloud computing was presented, which is used as a new paradigm for providing services. This new technology has many advantages for the organization. As there are

advantages to adopting cloud services, there are also concerns in the implementation of this service. In this article, cloud computing and its application in the supply chain are first described, then the challenges and risks of using cloud computing in the supply chain are discussed.

- Salleh and Hussin [22], in their research, stated that large business organizations as well as small and medium-sized companies have been using cloud computing for some time, and every day more business organizations are drawn to cloud infrastructure and technologies. Based on this, their research identified and presented a model for the effective factors of cloud computing adoption in large and small industries in Malaysia. The results showed that according to the indicators considered for four factors (human, organizational, environmental and technological factors in the industry sector), all four factors were identified as effective factors, which led to the drawing of a suitable model for the Malaysian industry sector. Also, the model presented for the researched industry sector in this research will be an efficient tool to examine the adoption of cloud computing in other Malaysian organizations.
- Ross and Blumenstein [23], in their research, stated that with the increase in the use of cloud computing, the complexity of structures has grown on this basis. This study examines resource management techniques and presents their classification based on certain characteristics. This method evaluates parameters and their platform has been used to evaluate resource management techniques. In addition, research challenges should be considered and a new method for resource management techniques has been proposed. At the end of this work, a discussion about the use of user profiles and its future trend has been proposed.
- Alshamaila et al. [24], in their research, stated that cloud computing is an example of creative destruction, which as a supporter of business strategy has increasingly replaced information and communication technology in the traditional way, and the organization's information technology needs for management in ways Creates new and innovative. The development of cloud computing technology creates a global market for the development and sale of products and services based on it.

3. RESEARCH METHOD

The current research seeks to provide a data mining model based on decision tree to increase the security of users' information in using electronic services. In terms of method, it is part of descriptive-survey research of correlation type. In terms of purpose, it is part of applied research. The theoretical foundations of this research were collected from library sources and the necessary data for data analysis were obtained from the bank database. Therefore, based on the location, it is a type of field research. In order to analyze the data, the registered information of customers in the company has been used, this information is shown in Table 1.

Indicator	Symbol
Age of customers	X1
Customer history	X2
Gender of customers	X3
Customer deposit type	X4

Table 1. Registered data of the company

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The data is related to 4376 data related to bank customers registered between 2021 and 2022. In order to collect data from the dataset related to users' information, to compare values with and without electronic banking, data mining is performed on them. Data analysis is done using data mining models based on categories using data mining software on the bank dataset.

Data classification for information security is very important in security systems. In fact, these are the target customers who are chosen to offer new products and services in direct database security. Therefore, improving the process of identifying target customers in the competitive conditions prevailing in the industry is very important.

Data mining algorithms are optimal models that are used in forecasting and have shown significant accuracy. The results of these algorithms help in better decision-making, but also reveal some hidden and unknown patterns that may not have been given special attention. Some of these Algorithms Include: decision trees, support vector machine and Naive Bayes model.

Support Vector Machine (SVMs): is one of the supervised learning methods used for classification and regression. It is a binary classifier that works by mapping data from the original input space to a higher-dimensional space to separate them.

Decision Tree: The decision tree is commonly used in operations research, specifically in decision analysis, to determine the strategy that is most likely to achieve the goal. Another use of decision trees is to describe conditional probability calculations.

Naive Bayes: This algorithm is based on Bayes theorem for predictive modeling. Bayes' theorem uses a method to categorize phenomena based on the probability of occurrence or non-occurrence of a phenomenon, and the probability of occurrence of a phenomenon is calculated and categorized.

4. FINDINGS

The dataset is related to 4376 users of electronic bank services with the following features:

Execution time: for each user, the execution time is calculated once without using electronic banking and once with electronic banking. The use of electronic banking definitely reduces time. But the amount of its reduction depends on other factors such as system hardware and computing platform. Definitely, the system has a higher efficiency when there is a proper interval between the execution time.

Amount of memory: definitely one of the features of electronic banking is saving the amount of memory used. For each user, the amount of memory used without electronic banking and with electronic banking is also stored in the dataset for each user.

Calculation speed: One of the most important items in computer systems is the speed of Internet-based calculations. In the data set, the calculation speed in megabytes without electronic banking and with electronic banking is stored in the data set.

1. Data preparation for data mining

- Determining the difference between the execution time of electronic and cloud-free banking

According to the model designed in Figure 1, the difference in execution time between electronic and cloud-free banking is stored in a new dataset.

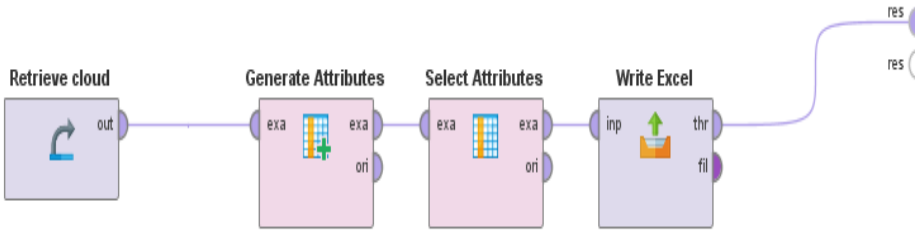

Figure 1. Dataset preparation

2. Classification of dataset data with data mining models

- Naive Bayes classification model

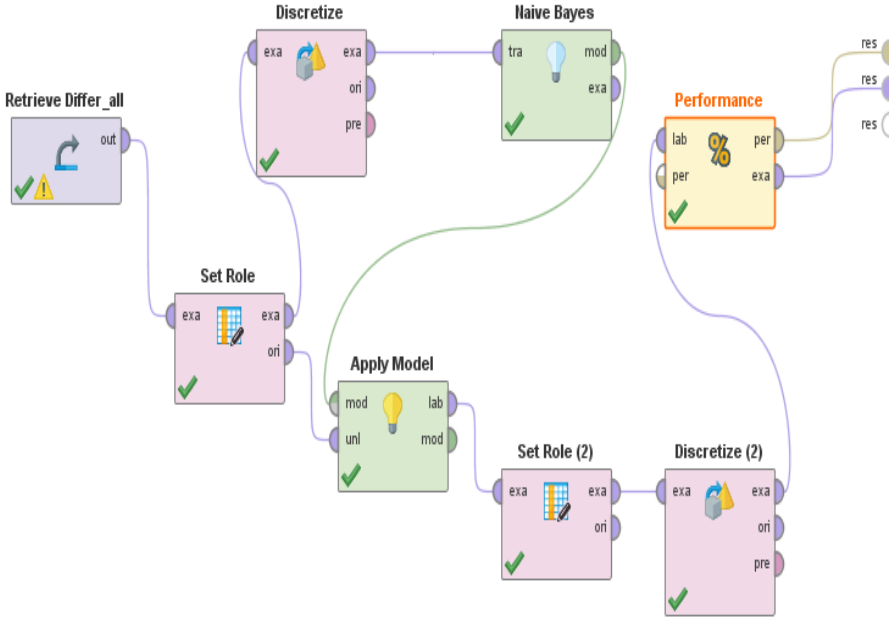

Figure 2. Naive Bayes category

- Classic decision tree model

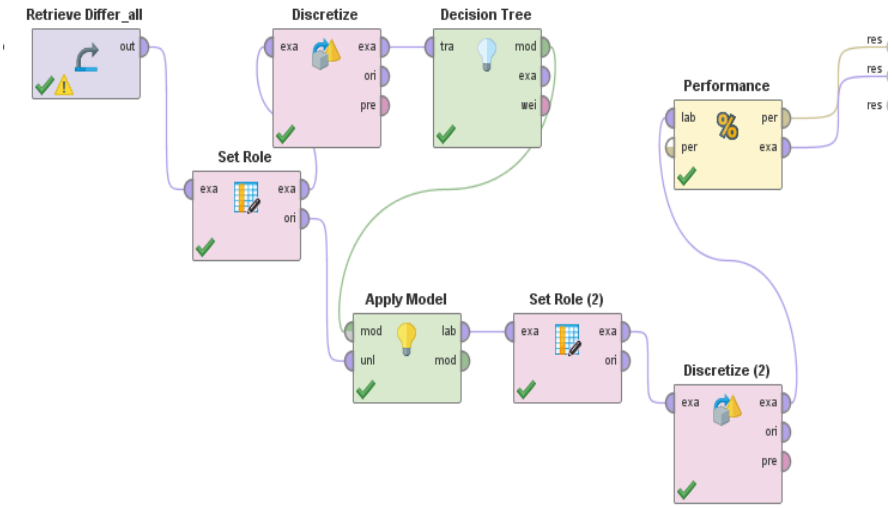

Figure 3. Classic decision tree classification model

- Deep learning model

An issue that is very important in deep learning is how to present information. Providing information to the machine should be in such a way that the machine receives the key information in the shortest time that it can make a decision based on them. When designing deep learning algorithms, we should pay attention to the transformation factors that explain the observed information, these factors are usually not observable factors, but rather factors that influence the observable category or are born of human mental structures to simplify matters.

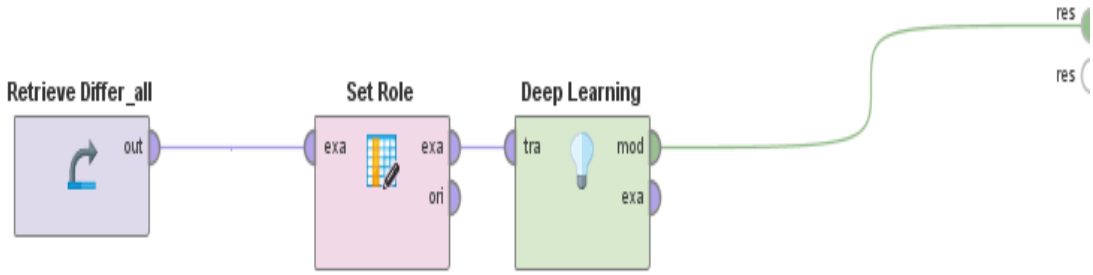

Figure 4. Deep learning model

- Neural Network

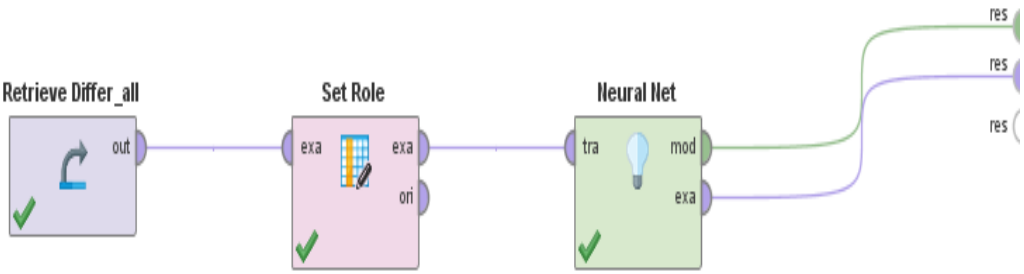

Figure 5. Neural network model

- AutoMLPneural network model

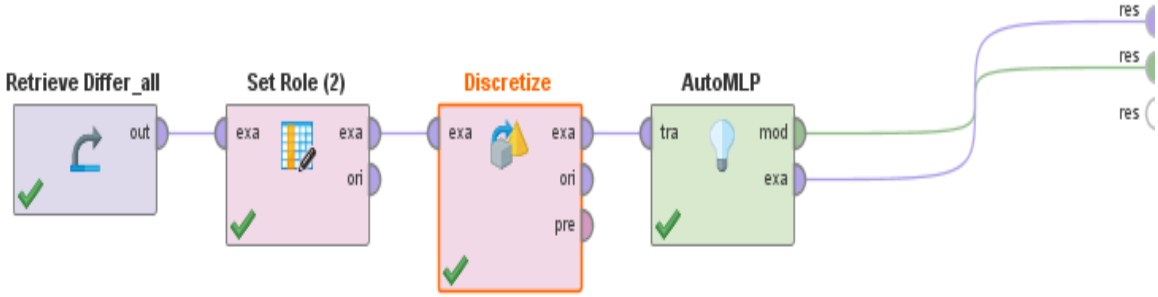

Figure 6. AutoMLPmodel

- Support vector machine model

Support vector machines are developed based on the principle of structural error minimization from statistical (computational) learning theories. This classifier has shown much better performance than other methods in text classification. One of the important

factors in text learning is that the learner (categorizer) has the ability to make appropriate generalizations using a small number of educational data.

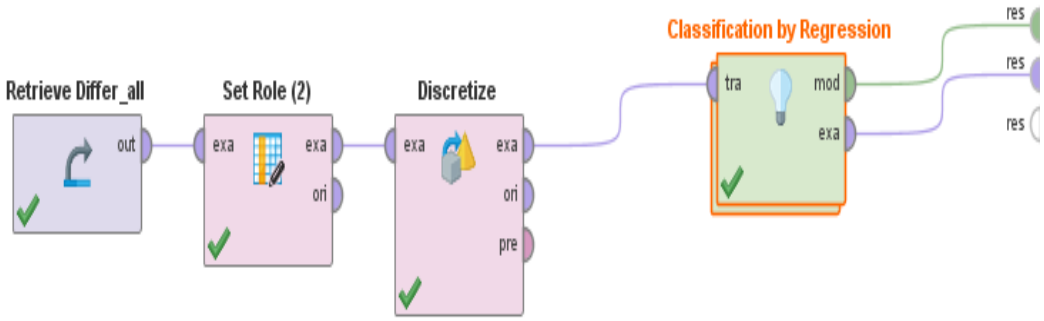

Figure 7. Support vector machine model

Simulation results

In Table 2, the implemented data mining models have been evaluated in terms of accuracy.

Accuracy (percentage)	Data mining model
99.42	Decision Tree
88.77	Naïve Bayes
99.42	Random forest
87.88	Decision stump
98.13	Deep Learning
99.20	AutoMLP

Table 2. Accuracy of data mining models

As you can see in this table, the classic decision tree and decision forest models and then the neural network model have more optimal conditions than the rest of the data mining models.

In Table 3, the amount of classification error has been examined. In this table as in Table 2, the conditions of classic decision tree and decision forest models and then the neural network model are more suitable than other data mining models.

Classification error (percentage)	Data mining model
0.27	Decision Tree
11.23	Naïve Bayes
0.27	Random forest
13.10	Decision stump
1.87	Deep Learning
0.80	AutoMLP

Table 3. Classification error

The kappa coefficient is a numerical measure between -1 and +1, the closer it is to +1, it indicates the presence of proportional and direct agreement. Sizes close to -1 indicate the existence of reverse agreement and sizes close to zero indicate no agreement. The table below shows the amount of kappa coefficient in the data mining models of this thesis. Table 4 shows the kappa coefficient values of the proposed models with other models.

Kappa coefficient	Data mining model
0.989	Decision Tree
0.695	Naïve Bayes
0.989	Random forest
0.674	Decision stump
0.934	Deep Learning
0.975	AutoMLP

Table 4. Kappa coefficient

Table 5 compares the proposed models with other models in terms of absolute normal error.

Absolute normal error	Data mining model
0.039	Decision Tree
0.166	Naïve Bayes
0.039	Random forest
0.200	Decision stump
0.063	Deep Learning
0.039	AutoMLP

Table 5. Absolute normal error

5. CONCLUSIONS

The aspect of security in banking is an important issue for individuals and companies that seek to achieve a suitable level of security. The cloud processing of an organization is to determine security mechanisms for many large companies such as banks. This technology uses access controls to enforce security by banking at a high level. Among the factors that can be effective in increasing the motivation of people in using electronic banking services, we can mention the quality of services, favorable support, saving time and money, ease of use, security of information and transactions, and confidentiality, among which, security It is considered the most basic motivating factor for customers in using this electronic platform; Because in the past, according to the physical archiving of information and limited access to internal networks of banks, and of course, the application of management controls, physical protections and limiting the number of people who had access to internal networks of banks, the amount of risk of publication and misuse of information was largely controlled. and this is despite the fact that today, with the connection of banking networks to the global information network and the use of a wide range of audiences from these facilities at the national and global levels, securing the financial information treasure has been defined as a requirement and responsibility for financial and credit institutions. , since electronic banking as a portal in the internet space can provide the possibility of performing all financial operations of customers, standardization and determining the access limit of users in order to maintain the security of assets and information is always emphasized; Therefore, in order to maintain the confidentiality of information, it is necessary to confirm the authenticity of transactions, easy and online access to related systems, determine the limits of authority and ceiling of transactions and implement security protocols, identify risks and threats related to the field of electronic banking.

The main goal of this research was to present a data mining model based on decision tree to increase the security of users' information in using electronic services. In this research, a classification process was carried out on the dataset related to customers. Therefore, based on the data available in the database of 4376 customers of electronic services in banks, the data was analyzed in the data mining models of classical decision tree, Naïve Bayes, random

forest, root tree, deep learning and neural network. Therefore, by running RapidMiner software, the output of the model was analyzed in terms of accuracy, classification error percentage, kappa coefficient and absolute error, and the results showed that the classic decision tree and random forest models each have the best condition with 99.42%. While the root tree is not in a favorable condition with 87.88, in relation to the classification error, the conditions of the classic decision tree and decision forest models and then the neural network model were found to be more suitable than other data mining models; In relation to the Kappa error, the classical decision tree and random forest obtained a more favorable situation than other methods with 0.989, also in relation to the absolute normal error, the classical decision tree and random forest each showed a lower error with a rate of 0.039. The relevant results show the appropriate model in connection with the classic decision tree and the forest, which can be pointed to the fact that the use of electronic banking increases the speed of calculations, reduces the working time of users, and increases the speed of exchange. information and reducing the amount of RAM memory used in users. Also, data mining models based on classical decision tree and random forest had better results than other data mining models.

Based on the results and the best models seen in the database for the establishment of cloud computing, the results can be considered in line with the research studies of the following: Gilpin and Lawler [8], Mouratidis et al. [3], Brumă [12] and Jones et al. [13]. In these models, the importance of the classic decision tree model has been pointed out and the direction of intelligent systems of related data mining models has been analyzed.

6. RESEARCH PROPOSALS

- Using multi-criteria decision-making methods to prioritize factors affecting the security of databases to increase the security of users' information in the use of electronic services.
- The combined use of metaheuristic methods such as genetic algorithm and neural network to predict and provide a model to increase the security of users' information in the use of electronic services.
- Analyzing data on other banks and comparing its results with the results of the current research.

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