

**İZMİR KATİP CELEBİ UNIVERSITY**  
**GRADUATE SCHOOL OF SCIENCE AND ENGINEERING**

**SMART BUSINESS ACCOUNTING SOFTWARE AS AN ANDROID  
MOBILE APPLICATION USING ARTIFICIAL INTELLIGENCE**



**M.Sc. THESIS**

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**January 2018**



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## **FOREWORD**

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Muhammet Serhat OKYAY





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## ABBREVIATIONS

<b>GA</b>	: Genetic Algorithm
<b>AI</b>	: Artificial Intelligence
<b>SQL</b>	: Structured Query Language
<b>GUI</b>	: Graphic User Interface
<b>IDE</b>	: Integrated Development Environment
<b>SDK</b>	: Software Development Kit
<b>MSSQL</b>	: Microsoft SQL Server





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## **SMART BUSINESS ACCOUNTING SOFTWARE AS AN ANDROID MOBILE APPLICATION USING ARTIFICIAL INTELLIGENCE**

### **SUMMARY**

In this study, the necessary data obtained from the databases (such as MSSQL, Mysql, Postgre SQL, etc.) of the softwares like ETA and NETSÍS that are used for preaccountancy of the local and global companies were read, some of the data were written to the databases, and this data was used by the end user by using mobile phones or tablets carrying Android operating systems and working with Internet and cloud technology. In addition, new data sets that are collected on a cloud system from the accounting data while the company is on was studied by genetic algorithms which are one of the artificial intelligence algorithms. Then, users were reported by the Application developed here to inform them about the company's and its brach offices' performances and making suggestions about such as financial budget estimation, fieldman area estimation, how to shape the workers investments. Our Applicationis worked on a system of local server, cloud server, mobile devices having Android operating system, and include a user interface and artificial intelligence working background. A model of forecasting of the sales characteristics of the sellers has been established through a model learning model based on the collected data. The generated genetic algorithm based classification model achieves % 88,33 performance.



# YAPAY ZEKA KULLANIMLI AKILLI MUHASEBE ANDROID MOBİL UYGULAMA YAZILIMI

## ÖZET

Bu çalışmada yerel ve global şirketlerin ön muhasebesi için kullanılan ETA, NETSİS, vb. Muhasebe yazılımlarının kullandığı ilişkisel veri tabanlarından (MSSQL, Mysql, Postgre SQL, vb.) istenilen data ların okunup, belli bilgilerin veri tabanına yazılması ve bu bilgilerin son kullanıcıya Andriod işletim sistemine sahip bir mobil telefon yada tablet üzerinden yerel sunucu sistemine internet üzerinden ve bulut teknolojisi kullanılarak mekandan bağımsız bir şekilde mobil uygulama olarak kullandırılmasını sağlamaktır. Ayrıca şirketin işleyişi anındaki muhasebe bilgilerinden toplanıp bulut sunucu üzerinde oluşturulan yeni veri setlerinin yapay zeka algoritmalarından genetik algoritma ile yorumlanıp şirketin genel performansı ve şirketin şubelerinin performansları hakkında kullanıcıya mali bütçe tahmini ve stok yatırım bütçesi tahmini ve yatırımlarının nasıl şekillenmesi gerektiği hakkında uygulama tarafından önerilerde bulunulmuştur. Uygulamamız yerel sunucu – bulut sunucu – Android işletim sistemli mobil cihaz arasındaki iletişimi, kullanıcı arayüzünü ve arka planda çalışacak olan yapay zeka ve uygulama servislerini barındırmaktadır. Toplanan veriden yola çıkılarak, makine öğrenmesi tabanlı bir model aracılığıyla satıcıların satış karakteristiklerine ilişkin bir tahminleme modeli oluşturulmuştur. Oluşturulan genetik algoritma tabanlı sınıflandırma modeli ile % 88,33 başarımla elde edilmiştir.



## 1. INTRODUCTION

The development of commercial life, the increase of the company's product range, the increase of the income and expense items in the enterprises, the minimization of the financial and financial losses of the companies and the necessity of determining the current status of the company necessitated the companies to operate a high number of high cost personnel. Also, as the size of the company increases, the amount of data increases and the processing of the data become more difficult. With the development and expansion of computer technology and the acceleration of its development, it has been possible to provide fast and improved accounting programs under the name of pre-accounting for the daily sales of companies, bank and cash accounts, billing transactions, checks and cash transactions (Figure 1.1). These programs have become a must for companies with logical algorithms, rapid and serial database creation and querying systems, they have provided and continue to provide significant gains. In Turkey, there are 1.7 million businesses, according to data of 2016 [1].

Bu bölümün geri kalanında, tez çalışması kapsamında geliştirilen yöntem ve araçlara ilişkin genel bilgiler sunulmaktadır.

These businesses are integrated with a large part directly or indirectly accounting programs. This means that a very large amount of data and transactions. The collection of company data on the basis of accounting computer programs, mathematical calculations or functional processes this data and reporting of this data plays an important role. Today, commercial accounting software that has been named in the field is based on MSSQL Server database management systems using SQL language in general. Thus MsSQL with the power of the SQL language of the database management systems associated with stability and speed, efficient and optimized software is turned off. Nowadays, this accounting software uses artificial intelligence algorithms to provide information or suggestions specific to the

company and its fields of activity to the company or its partners. The use of numerical data in genetic algorithms gave better results in the use of artificial intelligence algorithms in accounting. In addition, the development of mobile applications for the Android operating system is used. Android is an operating system that uses the Linux kernel. The android operating system is developed by Google, the open Handset Alliance and free software communities. This system designed for the touch screen which has Android operating system. These products are popular with users looking for high-tech, low-cost and customizable devices. Initially this includes tablets and smartphones, but nowadays it is also used in devices such as televisions, cars, game consoles, digital cameras and clocks Applications Android Software Development Kit (Software Development Kit - SDK) as is written in the Java language. This platform consists of ancillary tools such as debugger, software libraries and emulator [2, 3]. Android offers some techniques and methods to make memory more effective. Applications that are not used for a certain period of time, for example, they are taken in standby mode or turned off. Android SDK tools include the mobile tool emulator. That works on the computer, offers the possibility of using a virtual tool for testing the application. Thus, without the need for a physical device, the application can be tested successfully. When writing our program, we used Android studio in front end. In the back end programming section, the Keel program, which has powerful libraries for data processing, comes to the forefront.

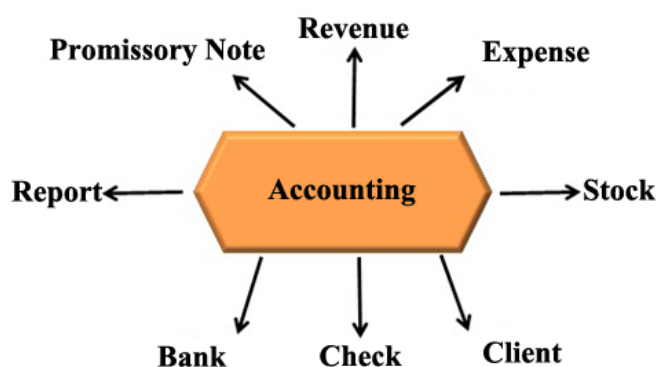


Figure 1.1: Improved accounting programs.

With the development and expansion of computer technology, more accounting applications can be done.

Android Studio is the official IDE for Android app development Integrated Development Environment, based on IntelliJ IDEA. On top of IntelliJ's developer tools and powerful editor for code, Android Studio offers even more features that enhance your productivity when building Android apps, such as [4, 5, 6]:

- Instant Run to push changes to your running app without building a new APK
- Build system on a flexible Gradle-based
- An emulator that is feature-rich and fast
- A unified environment
- Code templates and GitHub integration Lint tools to catch performance, usability, version compatibility, and other problems
- NDK and C++
- Frameworks and Extensive testing tools
- Built-in support for Google Cloud Platform,

Each project in Android Studio contains resource files and one or more modules with source code files. Types of modules contains:

- Google Engine modules App
- Android app module
- Modules of library

Android Studio displays your project files in the Android project view. That is organized by modules to provide smart reach to your project's fundamental code files.

All the files build are able to be seen at the top level under **Gradle Scripts** and each app unit contains these folders:

- **res**: includes all non-code resources, such as bitmap images XML layouts and UI strings,.
- **manifests**: AndroidManifest.xml file contains that.
- **java**: Java source code files, with JUnit test code.

## **1.1 What is Knowledge Extraction based on Evolutionary Learning?**

Knowledge Extraction based on Evolutionary Learning (KEEL ) is an open source Java software device that could be used for a large number of different informatic record detection tasks [7]. KEEL supplies a basic GUI based on data flow to design experiments with different datasets and computational intelligence algorithms (paying special notice to evolutionary algorithms) that assess the performance of the algorithms. It allows performing a whole examination of fresh computational intelligence proposals in comparison to existing ones. In addition, KEEL has been designed with a two-fold goal: education and research.

The SQL language that will be cited in the following sections of this study used for querying the databases, reporting these queries and creating new databases.

## **1.2 Structured Query Language (SQL)**

Structured Query Language (SQL) is usual computer language for relational database management and data manipulation. SQL is used to query, insert, update and modify data. Most relational databases hold SQL, which is an added benefit for database administrators (DBAs), as they are often essential to support databases across several unlike platforms.

SQL code is divided into four main categories [8]:

Queries are SELECT statement, which is further divided into sections, containing FROM, WHERE, SELECT and ORDER BY.

In addition, with the help of this language, the user will also enter information into the database. In the 4th section of this work, the named MSSQL server software is responsible for the checking of the databases and the accuracy and stability of the accounting program and the communication of the databases.

## **1.3 MSSQL**

Microsoft's SQL Server is (RDBMS) relational database management system. It is a featured database designed primarily to participate against competitors MySQL and Oracle Database. All major RDBMS, SQL Server supports ANSI SQL, the standard



SQL language. However, SQL Server contains also T-SQL, its own SQL execution. SQL Server Management Studio (earlier known Enterprise Manager) is SQL Server's core interface instrument, and it maintains 64-bit and 32-bit situations. SQL Server is occasionally arbitrat to as MSSQL Server and MSSQL.

Formerly out in 1989 released 1.0 by Microsoft company, in coincidence by Sybase, SQL Server and its early versions were parallel to Sybase. But, the Microsoft-Sybase corporation in the early 1990 dissolved, and Microsoft hold the rights to the SQL Server name. While , Microsoft released 2000-05-08 ver., which speciazed extra superior decisions and extra confidence.

Some features of examples contain: data support type of XML, dynamic views management, full-text hunt ability and mirroring database. SQL Server is presented in numerous editions with different attribute locate and rating options to assemble a kind of consumer requirements:

- Enterprise: Designed for huge enterprises with complex data necessities, Web-enabled databases and data warehousing . Has all the comments of SQL Server, and its license pricing expensive.
- Standard: Small and medium organizations targeted . Also maintains data warehousing and e-commerce.
- Workgroup: Targeted little organizations. User limits or no size or and can be used as the backend database for small server for Web desing or offices.
- Express: Free for reaching. Has the smallest quantity of features and reduced users and database field. Can be used as a reinstate for an database of access.

With the fast progress of today's technologies, many forecasting models and methods have been developed so that accounting software can be accelerated and additional suggestions can be presented to the user. The most common of these estimation methods and models are Artificial Intelligence methods. Artificial Intelligence is the ability to perform various activities of a computer in a manner similar to intelligent living. In other words, people's learning, thinking and reasoning skills are computerized so that problems can be solved [9].

## 1.4 Artificial Intelligence (AI)

Artificial intelligence (AI) is one of the area of computer science specialized that underlines the creation of intelligent machines which work and respond like humans. Some activities on computers with AI are intended to contain [10, 11, 12]:

- Preparation
- Problem solving
- Speech recognition
- Learning

Artificial intelligence is a branch of computer science that aims to create intelligent machines. It has become an necessary part of the technology production. Research related with artificial intelligence is highly technical and specialized. The core problems of artificial intelligence contain programming computers for certain traits such as:

- Information
- Sensivity
- Become skilled
- Preparation
- Analysis
- Problem solving
- Ability to manipulate and move objects

Information engineering is a main part of AI study. Machinery can often take action and respond similar to humans just if they have plentiful of knowledge relating to the humankind. Artificial intelligence have to admittance to items, roperties, categories, p and relations between all of them.. Initiating usual intelligence, reasoning, problem-solving power in machines is a tedious approach and difficulties.

Machine learning is another main part of AI. Learning lacking any kind of managementing needs an capability to identify modela in streams of input, while learning with adequate regulation includes numerical regressions and classification . Classification reveals the group an item belongs to and regression deals by obtaining a set of arithmetical input or output instances, thus discovering functions permitting

the generation of appropriate outputs from own inputsMachine perception deals with the capability to use sensory inputs to assume the different aspects of the world, while computer vision is the power to analyze visual inputs with a few sub-problems such as facial, object and gesture recognition.

The main aim of this study is to provide access to the accounting program that is actively used by the companies with the mobile Android operating system and make suggestion about the regional orientation with the utilization of artificial intelligence and the user's vendor channels. In the second part of this article, related work is given. In section 3th is part of methodology . Section 4 contains the improved system.





## **2. RELATED WORKS**

Recently, computer science and banking, finance and accounting are in close relationship. The fields that come to mind in terms of computer science are software engineering, network, image processing, internet security, mobile systems virtual reality, and artificial intelligence. The first interaction with the financial sector is focused around the computer science research tools. While working with accounting programs, researchers have developed interactive and intelligent software using data and account processing techniques and have opened them to server systems and remote access [13]. Computer science recommends many benefits to artificial intelligence. Methods for example soft computing techniques, genetic algorithm have been used to solve many real problems and successful results have been obtained. By modeling such techniques for artificial intelligence, billions of processes and data sets can be processed in the seconds, resulting in more efficient recommendations and speed.

Machine learning and artificial intelligence thanks to remarkable progress in the fields of accounting experts, accountants and business has become easier than ever before. Completed works are at a more professional level. These developments are complementary to the brain's power; very heavy calculations can be made, accounts become easier to maintain, and information becomes less troublesome to verify. Whereas learning to use the computer artificial intelligence in accounting and implementation stages of their intuition, still not reached the point of thinking like a human. The work in this area continues at full speed. But everything that has been developed has made the field of accounting professional, more productive, able to hold and handle much more customer information, more data-processing, and less time spent on all these tasks [14].

Developments, personal assistants, robot-recommended makers, machine learning, can be listed as conceptual computers. In fact, we have come to know artificial intelligence, which is over 60 years old, but recently we have started to be articulate

with artificial intelligence in almost all of today's fields. We encounter artificial intelligence in fields such as banking, investment transactions, and insurance transactions [15]

The best examples of artificial intelligence can be summarized as follows: visual perception, voice recognition, decision making, and language translation. In fact, these operations require human intelligence and can now be done by machines [15].

One of the most striking of which have artificial intelligence applications in the financial field are chatbot. Chatbots formed by abbreviation of chat and robot as words can be thought as the first seeds of artificial intelligence. These chatbots have been announced to be used by world-class companies such as MasterCard, Bank of America, RBS and American Express. At this point, users can be able to do very simple transactions such as transferring money, checking their accounts, asking the users questions and taking advice in the financial sense, and is not be necessary to go to the bank when doing these transactions. The most exciting side of the chatbot, the company will offer new distribution channels and this will reduce the amount spent for customer communication significantly. The advantage of chatbots is that they can perform complex operations and calculations within seconds. If financial applications are looked at, chatbots monitored customer balances, limit their spending, assess their spending habits, and monitor credit scores [16, 17].

Each sector is implementing artificial intelligence in different ways. For example, insurers use artificial intelligence to speed up the process flow and fight fraud. Develop banks, chatbots, increase customer satisfaction. In the management of active accounts and assets, artificial intelligence applications are rarely seen, but they have begun to be replaced by robot-advisors. [15].

Artificial intelligence can help people make decisions faster, better and cheaper. But at this point it is necessary to rely on machines and to cooperate with them.

When artificial intelligence applications are being conducted, they include the steps of collecting and preparing data, formulating analytical logic, and evaluating analytical results for accuracy. When the data are collected, they are analyzed by artificial intelligence and the correlations between the extracted data are calculated.

These correlations compliance values.If we look to the finance application, it can be seen in the five main areas of artificial intelligence applications [18]:

- 1) Text mining, voice recognition and semantic analysis
- 2) Anomaly detection in pattern recognition
- 3) Market analysis with data mining
- 4) The formulation of investment strategy
- 5) The use of information technology in system development

The increasing interest in mobile devices in recent years has increased usability with innovations that transform them into integral parts of our lives. These developments have opened a new era in mobile technology and have introduced various functional and smart applications. Research in smartphones and tablets has also contributed to the rapid development of Android software and is attempting to meet the needs of strong platform development. Mobile phones are important for micro, small and medium sized businesses as new accounting tools because they train these businesses for various cost components and strategies.Mobile accounting tools are becoming important for business circles and for better and practical accounting. A certain number of studies have been done on mobile accounting applications and are creating new and improved technologies using the Android platform[19, 20, 21] However, the lack of especially Turkish applications is striking and this type of application makes this work worthy of a limited number and diversity.





### **3. METHODOLOGY**

In this section, the methods used in the thesis study and the functions of the methods mentioned.

#### **3.1. Artificial Intelligence (AI)**

According to an idealized approach, artificial intelligence is an artificial operating system that exhibits high cognitive functions and autonomous behaviors such as learning, thinking, thinking, perception, connecting multiple concepts, problem solving, decision making, deduction and communication, which are unique to human intelligence [30] [21]. The objective of artificial intelligence, to emulate human intelligence through the computer, in this sense is to give a certain degree of computer learning ability [31] [22]. Artificial neural network approach to object-oriented (object-oriented) programming, genetic algorithms, fuzzy logic, and artificial intelligence is one of the most widely used methods. Genetic algorithm method is a method of artificial intelligence is used in this study.

In this section, detailed information about the genetic algorithm is also given. The positive and negative aspects of the method of applying the genetic algorithm to operational problems will be emphasized. The Genetic Algorithm is a search and optimization algorithm that is briefly supported by natural selection principles. The premises were put forward by John Holland [30] [21]. Genetic algorithm has many successful applications in the field such as optimization, machine learning, design, planning [31] [22].

#### **3.2. Genetic Algorithms (GA)**

When human history is examined, many important discoveries have emerged through imitation of nature. Nature has been an endless source of inspiration for people and continues to be. John Holland, who studies machine learning at the University of

Michigan, has been influenced by the theory of evolution and has succeeded in realizing the genetic process that takes place in the computer environment. Holland in 1975 has made studies and found that a book has put the name of the method genetic algorithms[30][21].

In those days, genetic algorithm research was not considered practical. In 1985, Holland doctoral student civil engineer David E. Goldbergs gas pipeline uses genetic algo. in his work on the audit of the gain was in practice has proved that it is possible[32][23].

GA is an intuitive search technique based on parameter coding that looks for solutions using random search methods. GA's working principle is mathematically modeling the evolutionary process that allows individuals who make up the population to compete with each other based on Darwin's best-practice principle, resulting in elimination [33][16]. Figure 2.1 shows the working steps. The genetic algorithm operates on some assumptions.

- Individuals are constantly struggling to resume their lives. While some of these struggles are lost, some of them may continue their existence in the next generation.
- The possibility of transmission to subsequent generations of individuals who survive are higher.
- First, an initial population is created to provide a basis for subsequent populations [34][24].

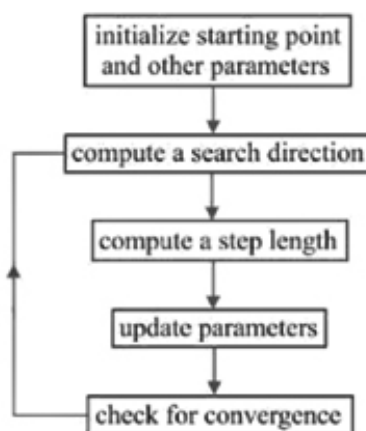


Figure 3.1: GA Basic Flowchart [35].

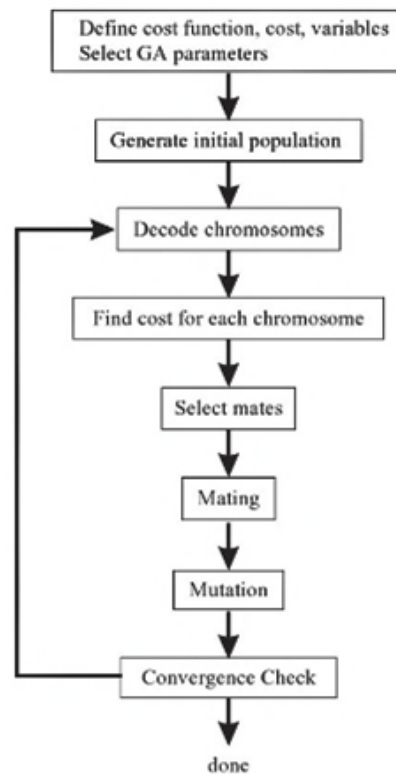


Figure 3.2: Genetic Algorithm Extended [35].

Some concepts in genetic science are used by arranging them according to genetic algorithm[18, 34].

*Gene*: The smallest unit of structure that carries genetic information. Bits are defined as genetic algorithm.

*Chromosome*: refers to one of the problem and possible solutions are composed of genes.

*Population*: A pool of chromosomes expressing the solution of the problem.

Before the algorithm starts, the amount of individuals at the population is determined with remains constant throughout the process.

*Selection*: Genetic algorithm works iteratively. It specifies which individuals in the population that have passed a certain number of transactions will transfer to the next iteration.

*Crossing:* The displacement of the genes of two chromosomes selected from within the population. As a result of this event two new individuals are formed.

*Mutation:* An alteration made on a randomly selected gene of one or more individuals. Mutation provides in-species diversity.

*Fitness Function:* The problem is the function of objective. The fitness of individual to the solution of the problem is calculated and determined according to the fitness function to be transferred to the next generation [18, 34].

### **3.3. Working Mechanisms of Genetic Algorithms**

The process of applying a probing of the genetic algorithm is as follows [33, 34].

- The fitness function and the initial parameters of the problem is determined. The number of initial intention population parameters, mutation rate, is value, such as stopping criterion.
- Expression forms of chromosomes that represent possible heals to the problem are created.
- The population of initial is generated randomly.
- The fitness value is calculated individual for each in the first population.
- Individuals with the highest fitness rate are selected for the breeding pool.
- Individuals selected from the breeding pool are first subjected to mutation treatment after crossing.
- Mutation results and crossover are calculated for the fitness values of the individuals.
- Latest individuals are added to the population.
- If the stopping criterion is met, stop, otherwise, continue from the fifth item for the next iteration.
- Last population, the individual with the best fitness value is the best solution to the problem [33,34].

#### **3.3.1 Fitness Function**

According to Dirk Büche et al. Fitness Function needs to be accelerated and explained by Gaussian process [36].

### **3.3.2 Genetic Algorithm Parameters**

Parameters must be defined before the algorithm starts processing.

*Possibility of Mutation:* It is said that any individual in the population is selected for mutation. In addition, how many individuals in a population will be affected by the population is a parameter that should be given at the beginning.

*Population Size:* This is the parameter that determines how many individuals the population will form. Population size may vary according to the structure of the problem.

*Stopping criterion:* In the genetic algorithm it is not always possible to achieve the best result. For this, algorithm steps can be used as a measure of reaching a certain number of iterations or approaching a certain value for solution.

### **3.3.3 Chromosome Design**

While solving the problem with genetic algorithm, a series of coding which express each individual is being done. Chromosome coding is one of the most important steps for resolving the problem quickly and achieving the most accurate solution of the algorithm. There are various encoding methods such as binary encoding, integer encoding, decimal encoding, and letter encoding. The coding of the chromosome should be appropriate to the structure of the problem and any possible solution should be designed to respond.

### **3.3.4 Initial Population**

The genetic algorithm works with set of solutions alternative of a on its own solution. The initial population is usually randomized.

### **3.3.5 Genetic Operators**

In the iterative genetic algorithm, the steps to be taken when generating the next generation from the current generation are selection, crossover and mutation.

*Selection:* The operator who determines which individuals from the present population will transfer to the latest population, or which individuals will undergo crossing or mutation. The selection method is derived from the individual's fitness

value. The most common selection method is roulette only. In addition to this, there are various selection methods such as random reproduction, tournament method, elitism.

*The Roulette Wheel Method* is based on the fact that the possibility of selecting an individual with a high fitness value is high. Individuals in the population are placed on a roulette wheel. The percentage of the individual who has a high fitness level is higher than that of the individual who has a low fitness level, while the percentage of the individual who wears the wheelchair is higher. With this method, individuals with top fitness values are likely to transfer to the next generation. Figure 3.3 shows the fitting percentage of the wheels according to the eligibility values of the individuals.

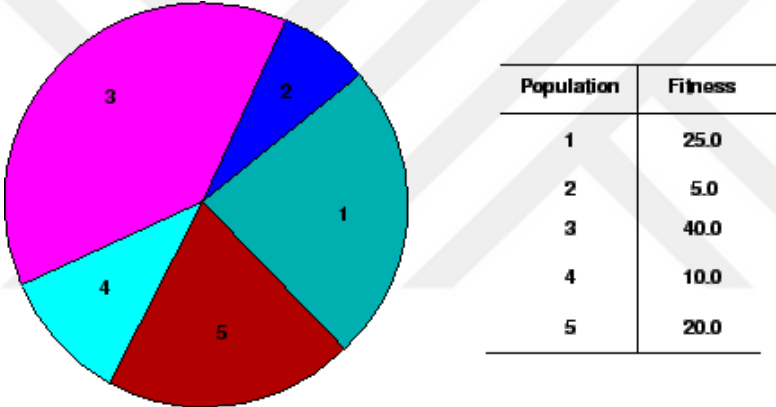


Figure 3.3: The Roulette Wheel example [37].

*The Tournament Method* is a tournament between randomly selected individuals from the population. Individuals are compared in pairs. The individual with the better fitness value is selected by winning the tournament.

*Reproduction Pool:* The selected individuals are taken to a pool by means of selection operators. This pool is called the breeding pool. The individuals to be taken for the crossing are taken from this pool and cross processed.

*Crossing:* Individuals selected from the breeding pool are randomly matched and cross processed. Due to the crossing of selected individuals, new offspring individuals that are not in the current population are created. Generated puppies carry the genes of their ancestors. In this way diversity is increasing. The simplest form of

crossing is the mutual exchange between genes by choosing a random spot on chromosomes. Figure 3.4 shows the example method. When the literature is examined, there are many crossing techniques according to the problem types. Real numbered crossover, permutation crossover, sequential crossover are some of them.

*Mutation:* Another way of providing diversity in the population. In this method a second individual is not needed. It is a process of changing a randomly selected gene of a randomly selected individual.

1:	1	1	1	0	1	0	1	1
2:	1	0	0	1	0	0	1	0
1:	1	0	0	0	1	0	1	1
2:	1	1	1	1	0	0	1	0

Figure 3.4: Crossing method.

### 3.4. Advantages and Disadvantages of Genetic Algorithms

When looking for a genetic algorithm probing solution, there are some important points that are separated from other algorithms. The Genetic Algorithm works with more than one solution, and there are likely to be bad solutions as well as good ones in the solution set. There is no guarantee of genetic algorithm when other algorithms select a certain starting point and improve the solution step by step. While there is a possibility that other algorithms may be inserted at the local minimum or maximum points, this situation arises in genetic algorithms by crossing and mutation. In this way, the closest result to the right is reached. It is not very efficient in terms of time because there are many calculation steps.

### 3.5. BioHEL (Bioinformatics-oriented Hierarchical Evolutionary Learning)

The BioHEL (Bioinformatics-oriented Hierarchical Evolutionary Learning) system is proposed by Bacardit *et al.* an evolutionary learning system to control huge size bioinformatic datas. BioHEL uses iterative rule study to create a set of rules. The rules in the result are developed, one at the time, using a ordinary genetic algorithm. Whenever the structure learns a new rule, adds it to the theory and deletes all included examples from the educated set. This terat is replicated iteratively until all cases are approved. furthermore, BioHEL incorporates a windowing system triesto improve its effectiveness identify Incremental Learning with Alternative Strata. That method divides the training set into equally shared strata. In every iteration, the GA selects a dissimilar stratum for its fitness computations derived from a simple round robin policy [38].

The general workflow of the system is inspied in the standard separate-and-conquer rule learning process, as represented by Figure 3.5.

```
Seperate and conquer algorithm  
Input : Examples  
Theory = 0  
While Examples  $\neq$  0  
  Rule = FindBestRule(Examples)  
  Covered = Cover ( Rule,Examples)  
  If RuleStoppingCriterion(Rule,Theory,Examples)  
    Exit While  
  EndIf  
  Examples = Examples \ Covered  
  Theory = Theory U Rule  
EndWhile  
Output : Theory
```

Figure 3.5: the standard separate-and-conquer rule learning process [38].



```

instanceSet * is = new instanceSet (argv [2], Train
classifier.aggregated ruleSet
classifierFactory Cf

Do {
  classifier *best = NULL
  for ( int i=0 i<tGlobals --NumRepetitionsLearning i++ {
    classifier *bestIt = RunGA()
    If ( best ==NULL || bestIt-- CompareToIndividual(best)>0) {
      if(best) cf.deleteClassifier(best)
      best=bestIt
    }
    If ( i<tGlobals--NumRepetitionsLearning - 1) {
      is--restart()
    }
    {
      if(isMajority(*best)){
        ruleSet.addClassifier(best)
        is--removeInstancesAndRestart(best)
      } else {
        cf.deleteClassifier(best)
        break
      }
    }
  }while (1)

```

Figure 3.6: General workflow for BioHEL [38].



#### **4. DEVELOPED SYSTEM**

Nowadays, the use technology of information is rapidly growing in the field of accounting as it is in every field. Recording, reporting, and analyzing functions of accounting can be realized in a very short time with the help of computers. On the other hand, the distribution of information technologies brings back some problems with it such as new corruptions. In this respect, Mobile Android programming, which enables faster and easier analysis and reporting of financial data with artificial intelligence that allows the modeling of human intelligence through computers, are important technologies that can be used to increase the efficiency of accounting inspection.

In the study, we aimed to state the effect of using Mobile Android programming and artificial intelligence in auditing practice in accounting inspection. Depending on this main purpose, first expert system software has been developed that brings expert systems from artificial intelligence technologies and Mobile Android programming together in accordance with the scope and reason of the study. After that, the data of the ideal company were evaluated with the developed expert system software, the sales and reach cycle. During this evaluation stage, the effects of the software (hence Mobile Android programming and artificial intelligence) on the accounting audit process are separately determined and the results obtained are explained in detail.

In this study, the useful data achieved from the database (MSSQL) of the software which was used ETA accounting software. Our mobile application can read and write some necessary data to the databases, and this data can be used by the end user by using mobile phones or tablets carrying Android operating systems and working with internet and cloud technology. In addition, new data sets that are collected on a cloud system from the accounting data while the company studied by genetic algorithms method BIOHEL which is one of the artificial intelligence algorithms. Then, users can be reported by the App developed here to inform them about the company's fieldsman performances and making suggestions about these workers working area

estimation, how to shape the workers investments. The Application worked on a system of local server, cloud server, mobile devices having Android operating system, and include a user interface and artificial intelligence working background. The most important aims of this study are supplying the most updated software and hardware technologies to companies.

Android programming is a piece of application code that works on the Android operating system on our mobile devices with the help of the necessary design and software tools. For this programming we use the Android studio program. This is a java-based language programs. We created the application interface and the code that works on the background of the application with the help of Android studio. The application database is available in our cloud server. This database is maintained on the MSSQL management system and the data of our ETA accounting program is on the cloud server. Our program connects to the necessary fields through the interface and data read and write operations are performed in this way.

The visual part of our app is built with the tools that Android Studio has for the mobile app interface. These tools keep the visual structure, colors, and fields that linked to the database with the XML infrastructure of our Android mobile application.

## Mobile Accounting Software

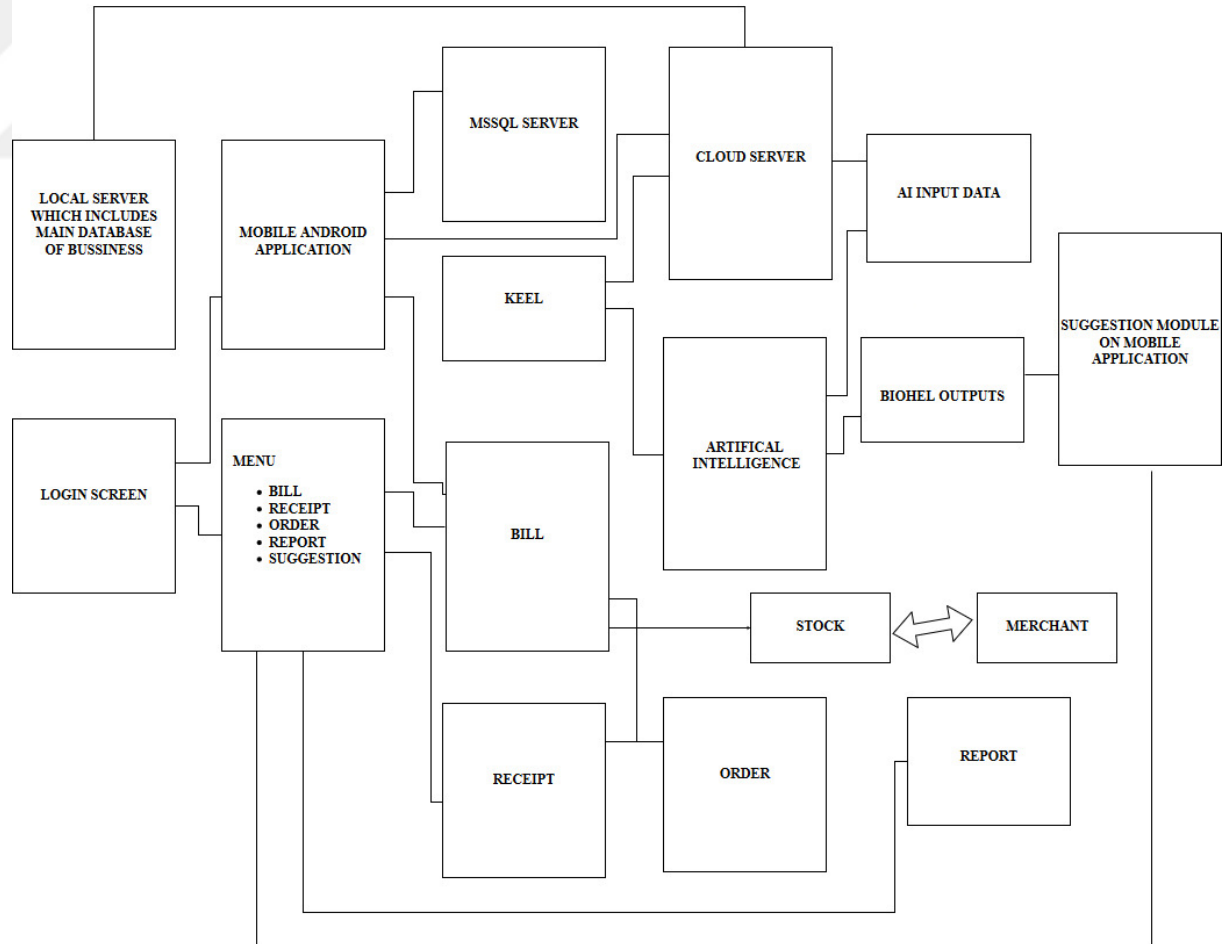


Figure 4.1: Mobile Application Flowchart.

The data that our application was hosted on the local servers of the companies themselves. This local server that is running in both the commercial and accounting programs are MSSQL database server where management is located. These servers are first applicant that our application applied and all kinds of company data (stock, current account, bank, check, cash flow, etc.) supplied from the first hand. On this site, which hardware features of our servers will not be occupied by our application for a long time, it is not a problem for the business demands on the server.

In the front end of our mobile application, the Android studio program used, and with the help of visual features and libraries of this program, the program's interface on the mobile phone and tablet designed. The interface can be in a separate resolution for the screen sizes of mobile phones, and a separate resolution for tablets. End users can able to use the contents determined according to the authority specifications that authorized in two separate groups as company owner and employees. For example, the company can be able to see the amount of cash in the owner's bank, but employees can not be able to access this information. This information, which can be used by our employees to enter orders, can be written to the relevant fields in the database of the main accounting program on the local server. This interface performs reading and writing from the databases on the local server of the main accounting program and reporting them to the user.

The software's artificial intelligence algorithms part of KEEL (Knowledge Extraction based on Evolutionary Learning) made in the media and execution was carried out in the cloud server. The reason for using cloud server is to alleviate the workload of mobile device and local server and to connect to local server and copy specified areas of database and keep it in the cloud server for a predetermined period before business demands are reached. The most important reason for this process is to speed up the application during the interrogation and reporting phases and not to slow down the operation of the commercial accounting program. We use artificial intelligence (AI) algorithms with the help of KEEL libraries, and the results and operations are executed on the cloud server, and the processor and RAM capacities of the Android device and the local server are used at minimum levels. Feedback and query turnaround time are shortened by the user.

We will use it from artificial intelligence algorithms, because genetic algorithm methods will process thousands and will limit the local server to CPU and RAM according to the size of the database of the company, so we will run this process only for data processing and we will run on our cloud server and eliminate unnecessary error and resource usage.

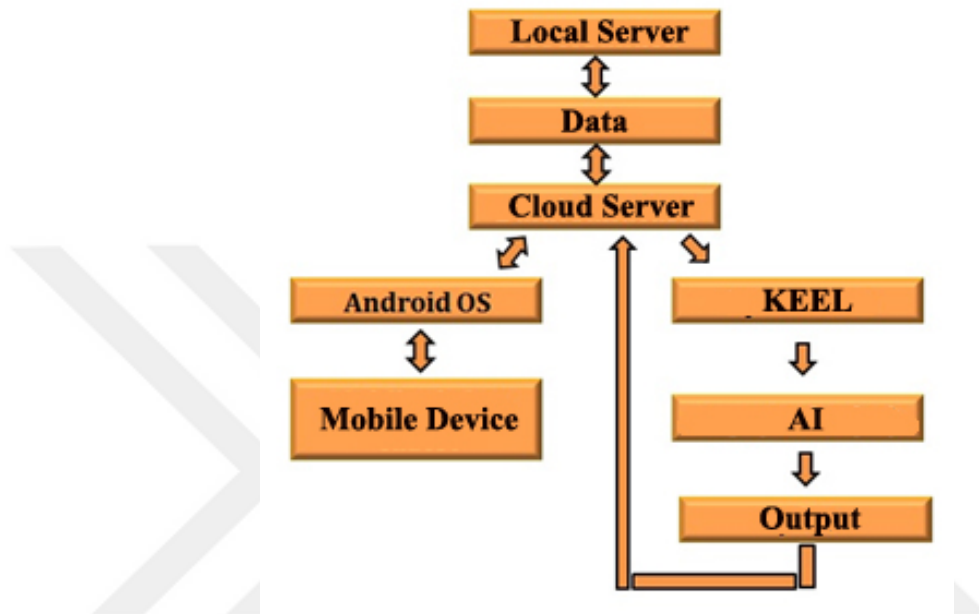


Figure 4.2: The pathway used in this study.

The database server of the accounting program uses the MSSQL database management system. Developed by Microsoft, this software provides us with a robust and secure database management system infrastructure for us to run our application with stability and strengths. Forming queries and databases were performed using the SQL language and API. Functional power and speed of the SQL language accelerated the coding of our application in query processing. The working road trace including these operations is given in Fig 4.1

The screen output in the work can also be seen in Figures 4.1 between 4.12.

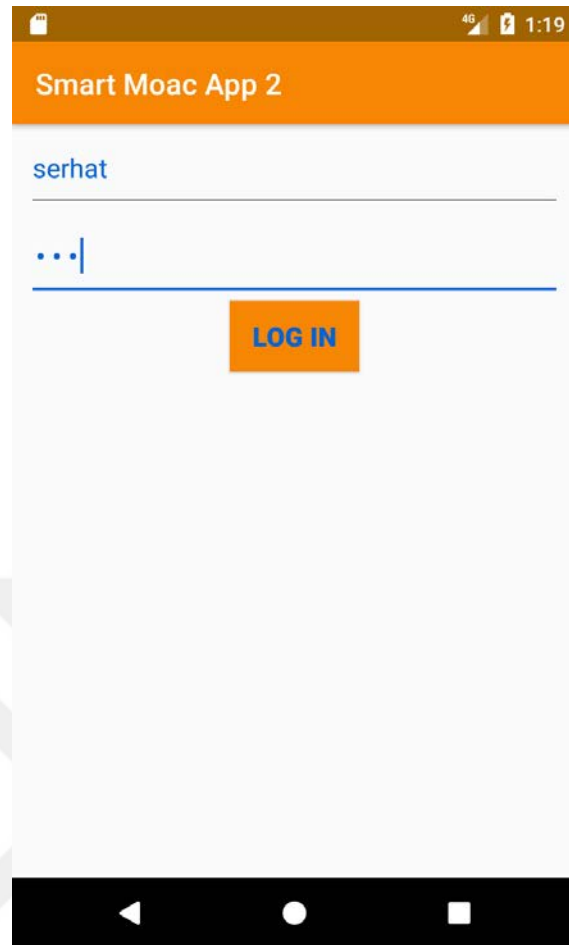


Figure 4.3: Log in Screen.

After running the mobile application on the portable mobile device, the authorization screen is displayed in front of the user. This screen provides access to the application by connecting to the user control database located in the cloud server and verifying the necessary user name and password. This user name and password is defined by the system specialist during the activation of the accounting program. Access to the submenus can be achieved by accessing the user name and password boxes displayed on the screen.



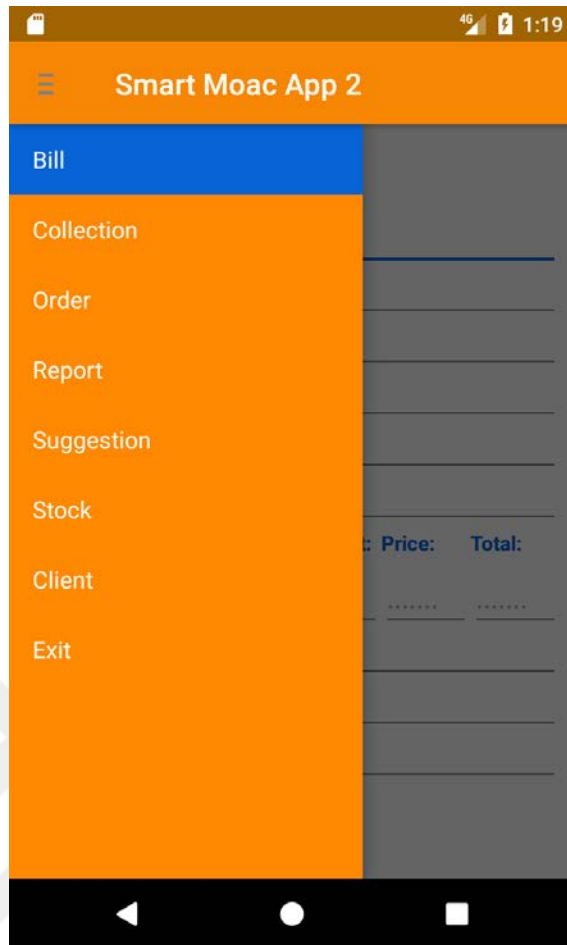


Figure 4.4: Drawer Menu.

After entering the application, the drop-down menu on the upper left side accesses the entry shortcuts of the recommendation menus associated with the invoice, collection, order, reports and artificial intelligence according to the process that the user wishes to perform.

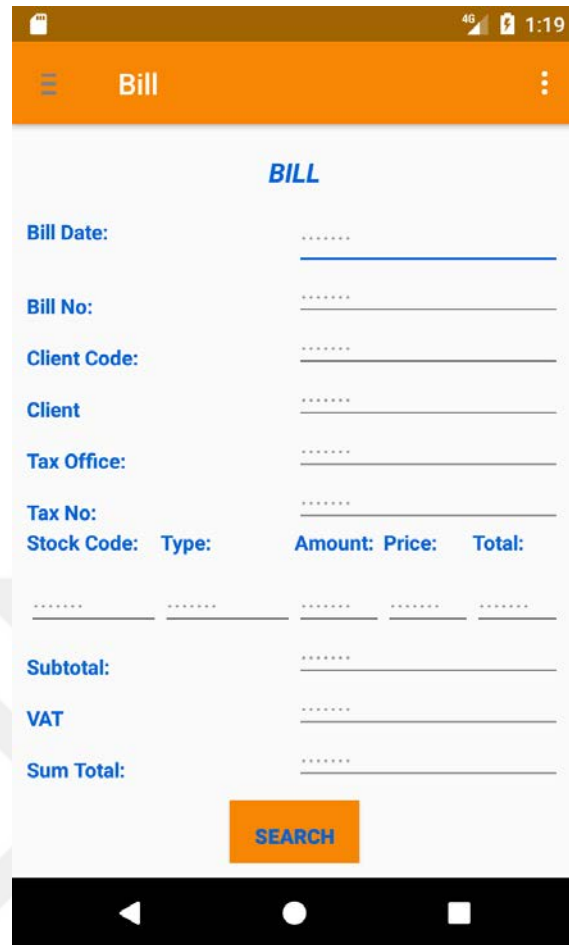


Figure 4.5: Bill Menu.

The user will log in to the invoice screen if he wishes to invoice with the help of the menu or to view a truncated invoice. In this screen, you can find the invoice date, invoice number, client code, client tax number, Tax office, Tax number, Inventory code, Stock type, Stock amount, Price, Amount, Subtotal, VAT, General totals. Each of these areas is located on the tabs of the cloud server of the main accounting program and information is read or written through the mobile interface. In this menu, customer's client card can be accessed with any of fields such as invoice no, client code, tax no, and search operation or invoice saving can be done.

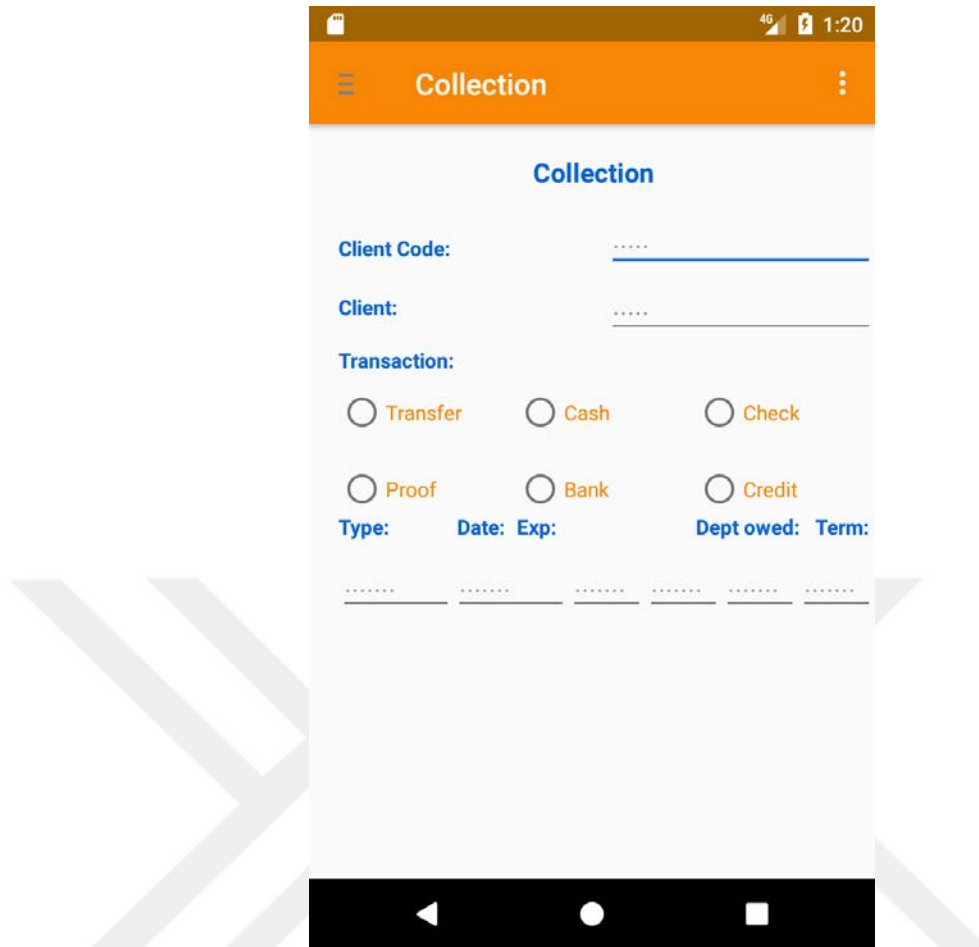


Figure 4.6: Collection Menu.

User can register for the payment to be received from the customer on the collection menu or can be questioned about the collection information already made. This menu will be filled with the client code, client title, transaction type, date, description, debts, receivables, due date fields and choosing one of the options such as Transfer, Cash, Check, Bills, Bank Transfer, Credit card payment and it can write the accounting program in the required database fields or read.

**Order**

**Order**

Order Date: .....

Order nO: .....

Client Code: .....

Client: .....

Tax Office: .....

Tax No: .....

Stock Code:	Type:	Amount:	Price:	Total:
.....	.....	.....	.....	.....

Subtotal: .....

VAT: .....

Sum Total: .....

**SEARCH**

Figure 4.7: Order Menu.

If the user wants to place an order with the help of the menu or to view a product (product) that has been ordered, he will enter the order screen. This screen contains the date of order, order number, client code, client title, tax office, tax number, stock code, stock type, stock amount, price, amount, subtotal, VAT, General total fields. Each of these areas is located on the tabs of the cloud server of the main accounting program and information is read or written through the mobile interface. In this menu, customer's current card can be reached with any of fields such as order no, client code, tax no and search operation or order registration can be done.

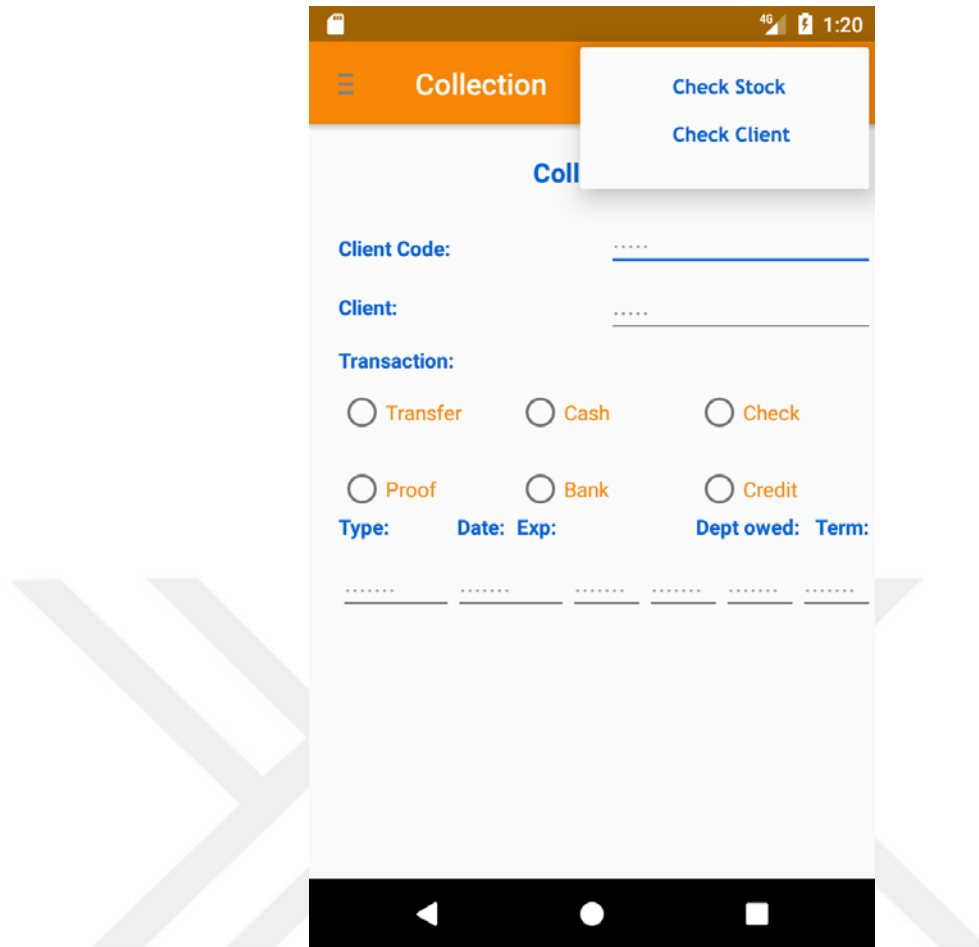


Figure 4.8: Stock - Client Menu.

This menu contains shortcuts to the Stock and client fields at the top right of the application. With the help of this menu, the user can access the inventory records and access the client information.

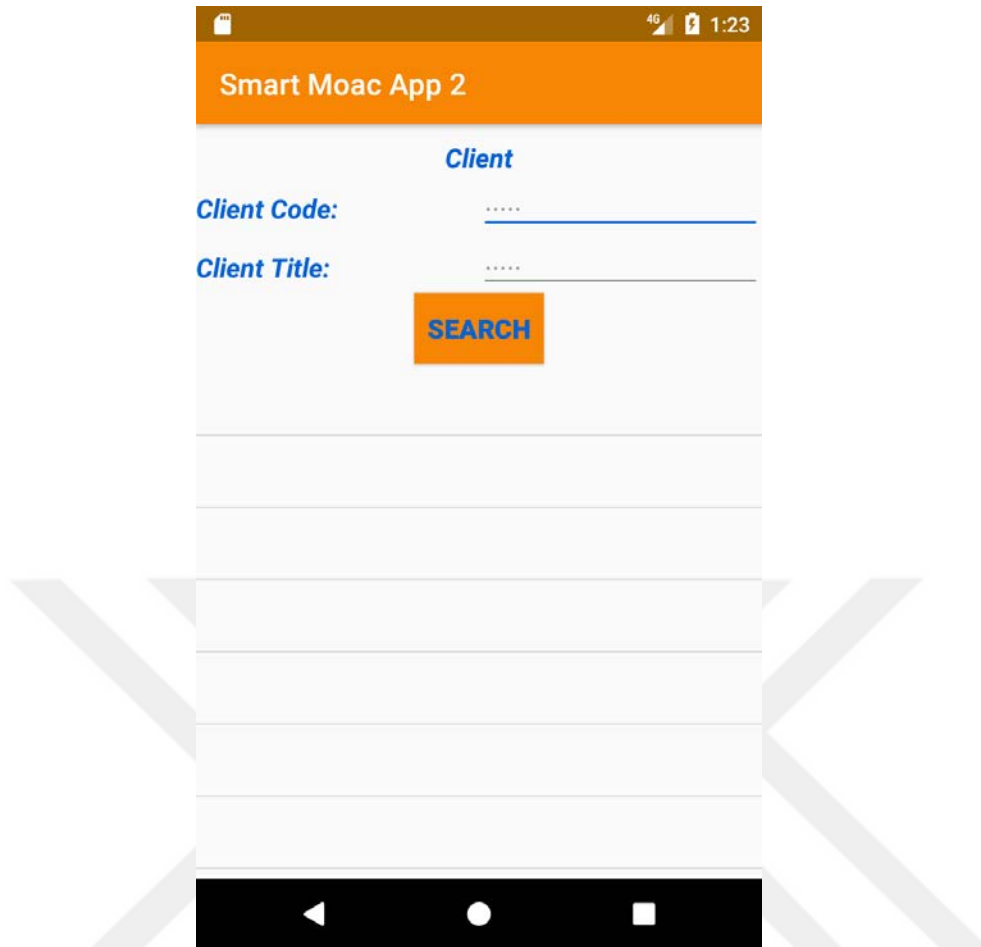


Figure 4.9: Client Menu.

With the help of the Client Menu, the user can access the client telephone number, address, tax office, tax number information of the client owner by entering any of the client code and client name information. This menu is only the inquiry screen.

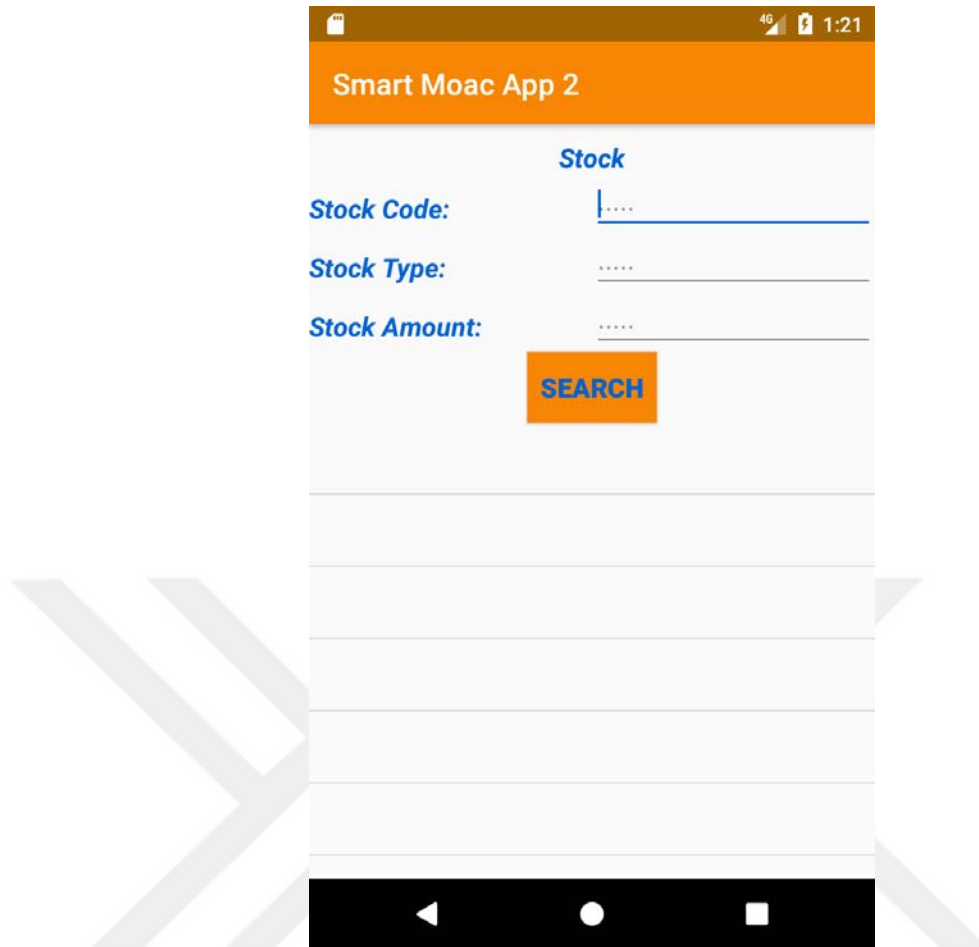


Figure 4.10: Stock Menu.

With the help of the Stock Menu, the user will be able to access information about the company's stocks of stock by entering any of the Stock Code, Stock Type and Stock amount information. This menu is only the query screen.

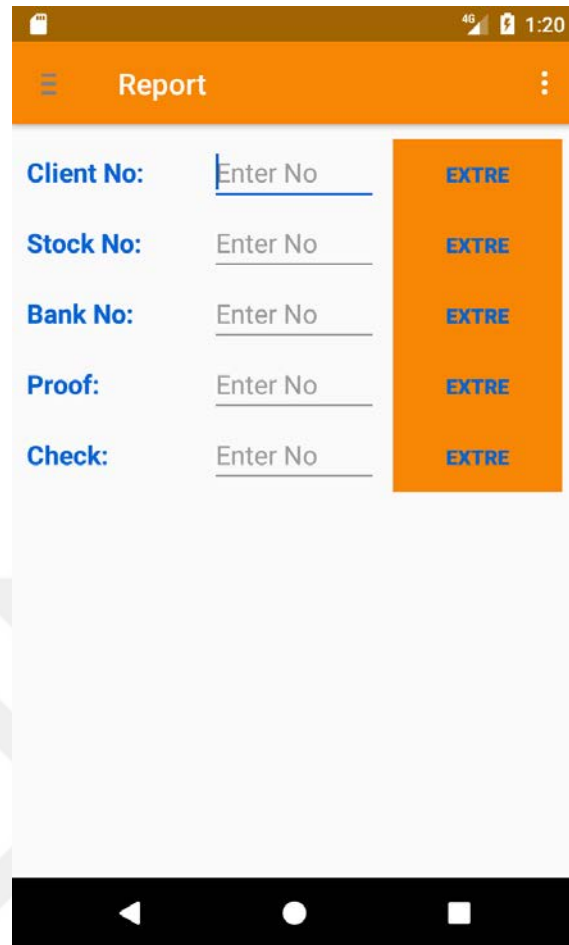


Figure 4.11: Report Menu.

This menu is the reporting section of the Accounting application. With this menu, user can collect information such as client no, stock no, bank no, proof, checks. The casting screen consists of rows and columns and is shaped according to the mobile device to be used.



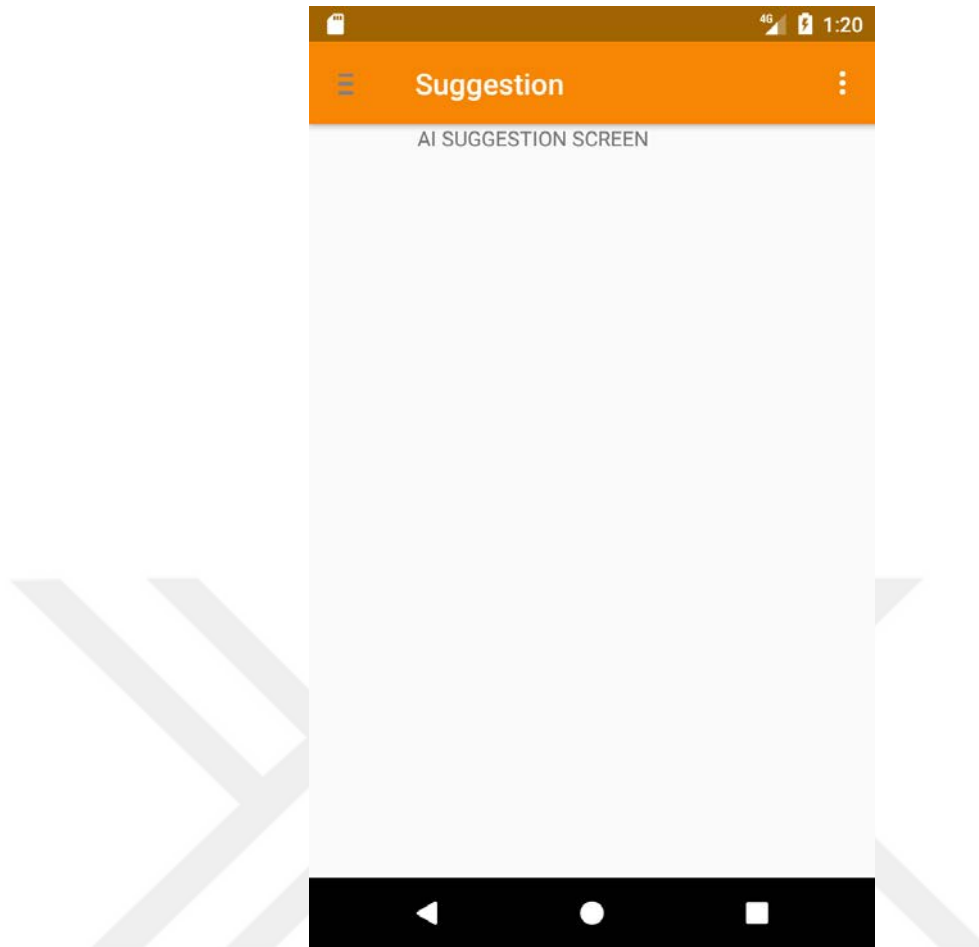


Figure 4.12: AI Suggestion Menu.

With this menu, the data obtained from the artificial intelligence algorithms executed in our application's cloud server presents the visual cast of the user in which fields they should work according to their performances and situations. The vendor provides the positioning image according to the zone and the user gives the forecast information to the manager of the firm.

In this section, the dataset used in the experimental studies, the criteria used to calculate the performance of different classification algo. used at the process of establishing the prediction model of the sales characteristics of the marketers from the data set and the experimental results are given.

#### **4.1. Data Set**

We have prepared for artificial intelligence algorithms based on the database of the AB named company on our cloud server. This database consists of tables where ETA accounting program is used on MSSQL. This database was created separately for each year. It called AB\_2016 and AB\_2017 database names after that. The name of the seller and the product information has been changed so that the name of the user is confidential and the product name is not used.

When extracting data from the database, the SQL language is used and the query result is merged with the resulting data on excel. Data for the year 2016 and 2017 are filtered for 6 vendors, 10 products, 6 regions by product-based turnover and total area-based sells were calculated. These calculations turnovers resulting figures are denominated in Turkish lira. These figures are presented to us in the vendor's sales performance and the opportunity to make inferences based on this performance. The data required for these inferences are filtered and processed with decision-making algorithms.

It has been considered as a classification problem to predict how sales people will show sales performances in different regions during the later time periods of the vendor, based on information such as current sales information, product information and region. In this direction, two different data sets were created. The first data set (5-graded classification) contains five basic label values for vendors: "verylow", "low", "medium", "high" and "very high". These cond dataset (3-grade classification) is divided into three levels of sellers' sales ratios, "low", "medium" and "high".

#### **4.2. Evaluation Criteria**

In evaluating the performance of the classification algorithms, the correct classification ratios (ACC), F-measure and area under the ROC curve were used. Accurate classification rate (ACC) is a statistical measure of how well a certain binary classification method correctly identifies a condition. The correct classification rate is calculated according to the following formula with the percentage the sum of the true negatives and of the true positive to the sum of true positive, false positive, and true negatives.

Table 4.1 Input data for GA.

Stocks (2016)	Ahmet	Hasan	Kemal	Buse	Pinar	Yasemin
	Aegean	Mediterranean	Black Sea	Eastern Anatolia	Marmara	Central Anatolia
A_Product	1,021,191.78	946,125.33	1,313,693.41	953,401.47	533,766.50	654,898.89
B_Product	183,227.82	229,769.56	230,444.49	58,653.40	161,961.15	139,465.09
C_Product	901,158.62	414,467.45	472,134.36	441,668.11	395,674.24	629,203.52
D_Product	75,322.60	39,002.83	47,943.06	54,285.20	67,748.44	52,524.83
E_Product	231,208.74	126,365.61	253,366.06	180,348.63	111,616.54	102,133.82
F_Product	0	0	6,480.02	15,477.48	16,892.65	1,101.60
G_Product	1,158,058.85	924,286.58	14,522.21	22,309.56	27,961.23	570,558.58
H_Product	150,154.22	132,292.49	33,597.09	18,501.81	12,077.79	57,717.60
I_Product	55,655.04	44,564.72	38,576.00	33,582.00	12,048.00	27,488.00
J_Product	609,222.57	350,953.21	606,877.76	188,486.73	178,954.44	276,503.64
Total Turnover	4,385,200.24	3,207,827.78	3,017,634.46	1,966,714.39	1,518,700.98	2,511,595.57
Stocks (2017)	Ahmet	Hasan	Kemal	Buse	Pinar	Yasemin
	Aegean	Mediterranean	Black Sea	Eastern Anatolia	Marmara	Central Anatolia
A_Product	2,921,504.36	2,138,906.21	2,943,779.19	1,018,613.56	1,099,196.52	2,036,083.39
B_Product	310,135.87	383,653.12	322,317.48	77,127.71	189,031.95	229,070.77
C_Product	1,402,915.09	666,101.62	1,491,770.79	733,337.59	1,306,271.52	1,425,317.59
D_Product	149,708.03	362,012.14	161,119.34	57,573.79	169,352.69	197,347.99
E_Product	398,775.90	211,270.40	351,799.29	278,480.90	152,553.06	158,912.17
F_Product	39,351.70	447,719.28	183,909.17	36,400.77	88,725.48	148,648.05
G_Product	1,265,492.60	1,304,539.99	82,165.13	7,897.50	21,015.20	391,904.09
H_Product	475,488.31	240,552.27	41,681.32	16,796.03	5,732.13	158,264.00
I_Product	73,200.66	232,041.00	130,363.19	36,748.60	22,823.20	112,005.20
J_Product	887,941.90	762,504.33	1,508,018.67	353,954.16	572,365.64	451,029.29
Total Turnover	7,924,514.42	6,749,300.36	7,216,923.57	2,616,930.61	3,627,067.39	5,308,582.54

$$ACC = \frac{TN + TP}{TP + FP + FN + TN} \quad (4.1)$$

Here, TN, TP, FP, and FN represent true negative, true positive, false positive, and false negative numbers, respectively. F-measure is an important evaluation measure in Information theory. The F-measure is calculated according to the following formula based on recall (REC) and sensitivity (PRE) criteria.

$$PRE = \frac{TP}{TP + FP} \quad (4.2)$$

$$PRE = \frac{TP}{TP + FN} \quad (4.3)$$

$$F - measure = \frac{2 \times PRE \times REC}{PRE + REC} \quad (4.4)$$

It is expected that the F-measure have a value in the range [0-1], and a good classification algorithm will obtain an F-measure value closeto 1.

The area under the ROC is another quantify that can be used in the performance of classification algorithms. ROC can be defined as positive positives, false positives. The AUC criterion value takes a value in therange 0-1. A good classification algorithm is expected to achieve an F-measure value close to 1.

### 4.3. Experimental Process

In the evaluation of the classification algorithms used in the experimental analyzes, 10-fold cross validation technique was used. In the 10-fold cross validation technique, the initial dataset is randomly divided into 10 equal parts, one of which is used as test data to test the model; the remaining part sare used for training purposes. The specified operation is performed ten times, with each piece being a test data, and average results are obtained. The basic classification algo. and the evolutionary classification algorithms used in testing alanalyze sare performed in the KEEL [10] (Triguero et al., 2017). KEEL is an open source Java based data mining environment. Basic classification algorithms and default parameter values found on the platform fore volutionary classification algorithms are used.

Table 4.2. Parameter values for classification algorithms.

The algorithm name	Abbreviation	Parameter list
Bojarczuk Genetic programming method	Bojarczuk_GP	Population size: 200, maximum generations: 200, maximum derivate size: 20, recombination probability: 0.8, copy probability: 0.01
Bioinformatics-oriented hierarchical evolutionary learning	BioHEL	Population size: 500, selection algorithm: tournament, tournament size: 4, crossover probability: 0.6, mutation probability: 0.6, elitism: True, number of iterations: 100, number of repetitions in learning: 2, generalization probability: 0.1, specialization probability: 0.1, winning method: ilas, number of strate windowing: 2, number of stages: 2, initial theory length ratio: 0.01, coverage breakpoint: 0.1, coverage ratio: 0.9
Real Encoding - Particle Swarm Optimization	REPSO	Number of iterations: 500
Particle Swarm Optimization - Linear Discriminant Analysis	PSOLDA	Number of iterations: 500
Genetic Algorithm with Neural Network	GANN	Hidden layers: 2, Hidden nodes: 15, Transfer: Htan, Eta: 0.15, Alpha: 0.10, Lambda: 0.0, number of BP cycles: 10000, Improve: 0.01, Elitism ratio: 0.1, Individuals: 100, range of W: 5.0, Connectivity: 0.5, maximum generations: 100
Falco Genetic programming method	FALCO	Population size: 200, maximum generations: 200, maximum derivate size: 20, recombination probability: 0.8, mutation probability: 0.1, copy probability: 0.01, alpha: 0.9
Fuzzy AdaBoost	GFS-AdaBoost	Number of labels: 3, Number of rules: 8
Tan Genetic programming method	Tan_GP	Population size: 150, maximum generations: 100, maximum derivate size: 20, recombination probability: 0.8, mutation probability: 0.1, copy probability: 0.01, w1: 0.7, w2: 0.8, elitism probability: 0.06, support: 0.3
Genetic Algorithm based Classifier System with Intervalar Rules	GAssist-Intervalar	Number of minimum deletion rules: 12, size penalty for minimum rules: 4, number of iterations: 500, number of strata: 2, initialization method: cw-init
Genetic Algorithm based Classifier System with Adaptive Discretization Intervals	GAssist	Number of minimum deletion rules: 12, size penalty for minimum rules: 4, number of iterations: 500, number of strata: 2, initialization method: cw-init
Memetic Pittsburgh Learning Classifier System	MPLCS	Number of iterations: 750, size penalty for minimum rules: 4, Number of minimum deletion rules: 12, number of strata: 2, initialization method: cw-init, probability of local search: 0.05, probability of RSW crossover: 0.1, number of parents for RSW crossover: 10, filter for smart crossover: 0.05
Pittsburgh Genetic Interval Rule Learning Algorithm	PGIRLA	Number of generations: 5000, Population size: 61, crossover probability: 0.7, mutation probability: 0.5, number of rules: 20

#### 4.4. Experimental Results

In this section, the correct classification rate and the F-measure and AUC criterion values for the forecasting model of sales characteristics are presented for 3 and 5 degree data set, based on the present data of the sellers, the sellers. Table 4.3 presents values for the 5-grade classification problem, and Table 4.4 presents the performance criteria used for evaluation for the 3-grade classification problem. When the experimental results presented in Table 4.3 are examined, it can be seen that the highest classification achievement is achieved by the Bioinformatics-oriented hierarchical evolutionary learning (BioHEL) algorithm and these cond best performance is obtained by the MPLCS (Membrane Pittsburgh Learning Classifier System) algorithm. Among the 20 classification algorithms used in the experimental analyzes, there are basic classification algorithms such as K-nearest neighbor algorithm, C4.5, logistic regression, supportvector machines and evolutionary classification algorithms such as REPSO, BioHEL, PSOLDA. When the results of the basic classification algorithms are examined, it is observed that the C4.5 algorithm gives higher values for all three evaluation criteria than the other classification algorithms.

Table 4.3. 5-performance criterion values for a graded classification problem.

Classifier	Accuracy Rate	F-measure	AUC Measure
KNN	41,67	0,43	0,43
C4.5	79,16	0,80	0,82
LDA	67,86	0,71	0,69
Logistic	42,50	0,44	0,43
C_SVM	69,64	0,71	0,73
NB	50,00	0,53	0,51
MLP	40,00	0,42	0,41
Decr-RBFN	76,92	0,79	0,78
Bojarczuk_GP	66,67	0,67	0,67
BioHEL	<b><u>88,33</u></b>	<b><u>0,93</u></b>	<b><u>0,91</u></b>
REPSO	76,92	0,79	0,79
PSOLDA	81,67	0,85	0,85
GANN	72,22	0,73	0,75
FALCO	68,15	0,70	0,71
GFS-AdaBoost	46,67	0,47	0,49
Tan_GP	56,67	0,58	0,58
GAssist-Intervalar	65,00	0,67	0,68
GAssist	60,83	0,61	0,63
MPLCS	<b>83,33</b>	<b>0,88</b>	<b>0,86</b>
PGIRLA	65,74	0,67	0,68

Table 4.4. 3-performance criterion values for a graded classification problem.

Classifier	Accuracy Rate	F-measure	AUC Measure
KNN	50,60	0,46	0,46
C4.5	84,51	0,87	0,91
LDA	74,16	0,75	0,75
Logistic	46,45	0,47	0,46
C_SVM	84,57	0,77	0,80
NB	60,71	0,55	0,54
MLP	53,43	0,44	0,44
Decr-RBFN	84,07	0,85	0,85
Bojarczuk_GP	86,05	0,73	0,75
BioHEL	<b><u>88,99</u></b>	<b><u>0,92</u></b>	<b><u>0,92</u></b>
REPSO	84,07	0,85	0,86
PSOLDA	84,17	0,84	0,82
GANN	87,70	0,79	0,84
FALCO	82,75	0,75	0,77
GFS-AdaBoost	51,00	0,51	0,54
Tan_GP	75,69	0,62	0,63
GAssist-Intervalar	78,93	0,72	0,74
GAssist	81,26	0,67	0,70
MPLCS	84,19	0,91	0,91
PGIRLA	79,83	0,72	0,75

The experimental results presented in Table 4.4 are similar to the experimental results presented in Table 4.3. For the 3-grade classification problem, the highest classification performance is obtained by Bioinformatics-oriented hierarchical evolutionary learning (BioHEL) algorithm. These cond best result is obtained by the MPLCS (Memestic Pittsburgh Learning Classifier System) algorithm.

Figure 4.13 shows a graphical representation of the correct classification rate values for different classification algorithms and for a 3-grade or 5-grade classification problem. In Figure 4.14, the variation of F-criterion values according to different classification algorithms and 3-grade or 5-grade classification problem is graphically shown. In Figure 4.15, the variation of AUC values according to different classification algorithms and 3-grade or 5-grade classification problem is graphically shown. As can be seen from Figures 4.13-4.15, the average performance criterion values of th eclassification algorithms are higher for the 3-grade classification problem than the 5-grade classification problem.



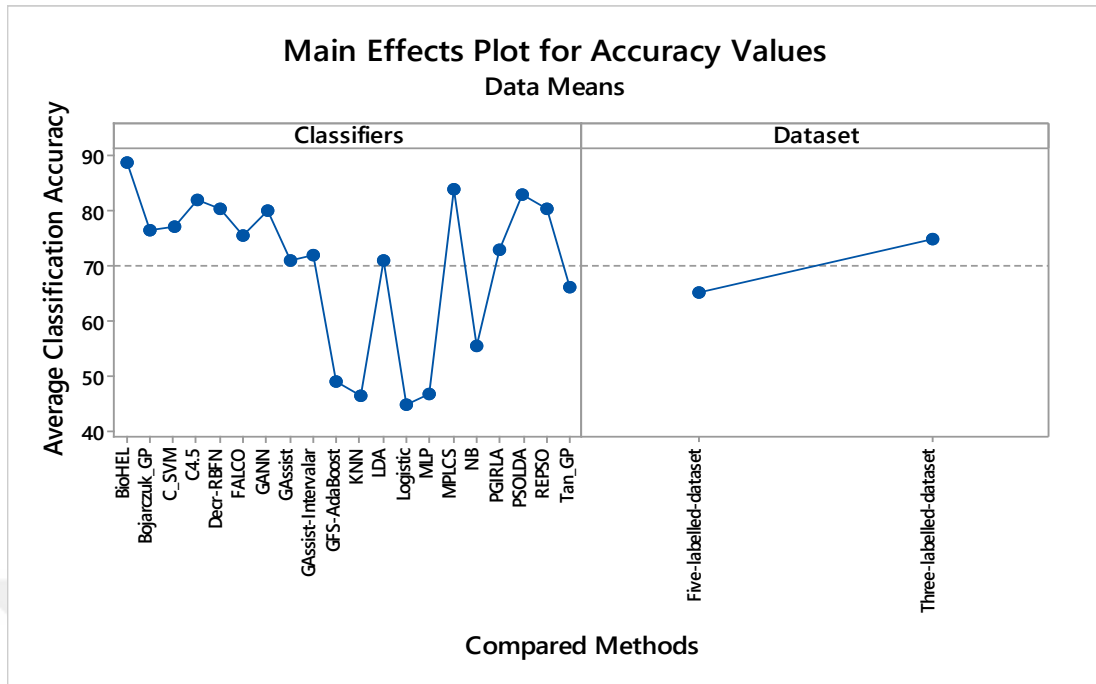


Figure 4.13. The basic effect diagram for the correct classification rate.

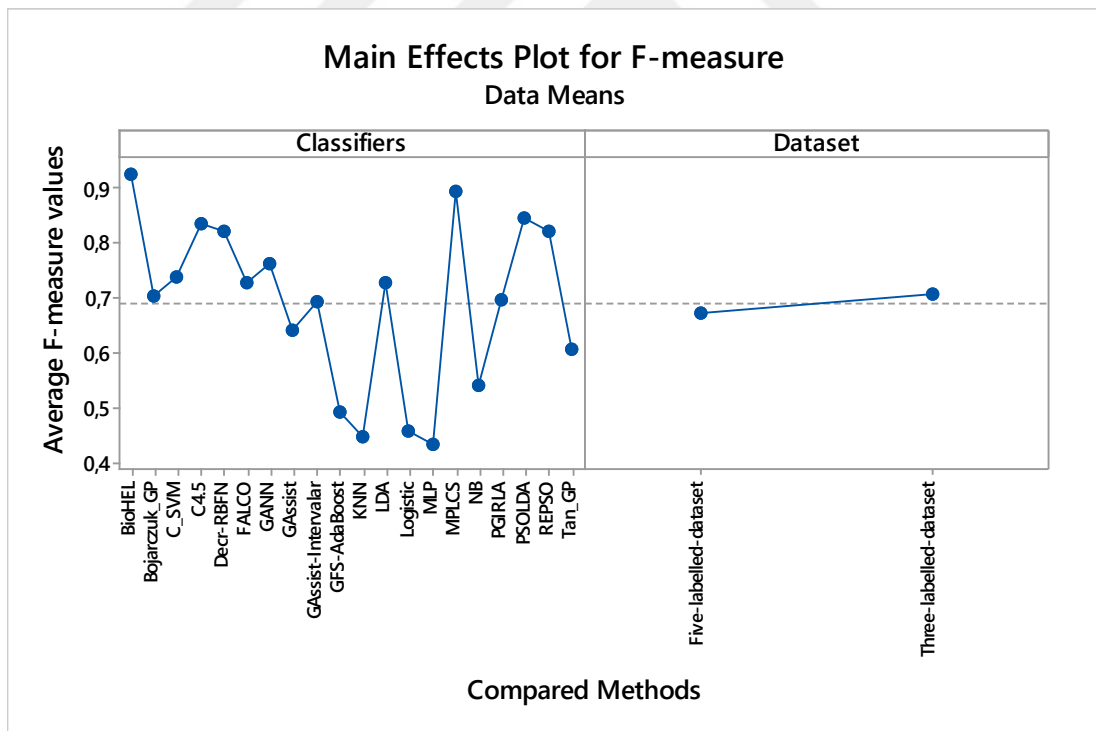


Figure 4.14. Diagram relating to the basic effects of F-measure.

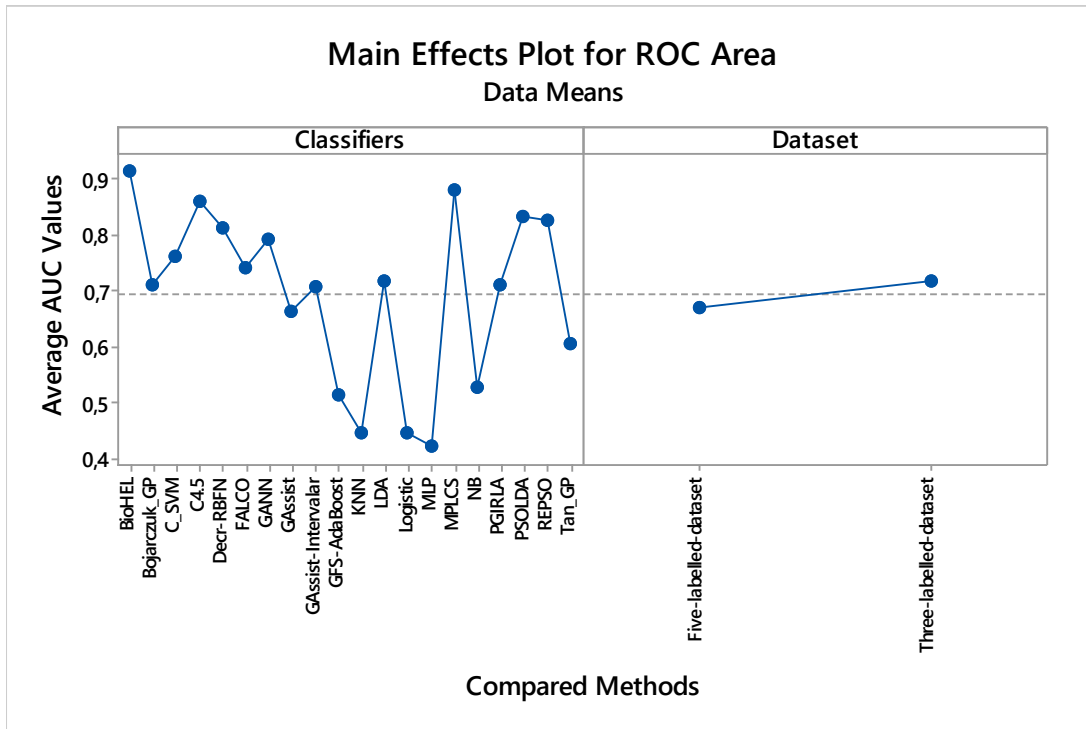


Figure 4.15. The main effect diagram on F-measure.

## **5.CONCLUSIONS and SUGGESTIONS**

Accounting is a science that tracks all transactions of all kinds of businesses, records transactions and concludes transactions. Accounting is extremely important for all organizations. Accounting is the most important part of any organization, as it follows the transactions of places such as government associations, associations, foundations, not just business organizations.

This work brought a new breath to commercial pre-accounting software such as ETA, which is heavily used by those who are interested in accounting business, and mobile phone integration of this software is done.

In our application, we integrated the most used accounting modules into your software. In this regard, we have built an infrastructure that is integrated into today's technology that uses cloud technology for mobile access. We made our application portable. Since we are working through cloud technology, we made it available everywhere we are. Without limitation, any user can enter data and / or view information at a specified level of application. BioHEL integration with artificial intelligence algorithms enabled us to make recommendations to the firm owner. We have secured the central database because we use it on a separate platform, separating the database from the local server is our innovation.

In future versions or development of our application, we recommend adding more accounting modules, artificial intelligence algorithms, and add-ons that can make inferences about the company structure and the company's income / expenditure balance. In addition, visual and more responsive sub-structure in reporting and front end will be more useful for future versions.

This work we've implemented as hardware and software was a success to realize in this mobile application. It needs better module implementation and user friendly responsive screen adaptation. however it is enough good to build this software at the same time as planned.

This study was presented at ASYU2017 and the results were partially published as full article [39].



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