ÇANKAYA UNIVERSITY

FACULTY OF

ENGINEERING

COMPUTER ENGINEERING DEPARTMENT

Project Report

Version 1

CENG 408

Innovative System Design and Development II

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<What Will My GPA Be? >

Efnan Gülkanat

201311021

Meltem Daşdemir

201311014

Sergen İspir

201311026

Advisor: *Prof. Dr. Erdoğan DOĞDU*

Contents

Abstract

Today with Machine Learning and other statistical methods, we can understand and find patterns from big data. In this case, we are going to discuss that how student data would be useful for academic success and result of other related works. In detail, early intervention in academic life helps students to change their course of education and graduate early with better grades. In this project, we used to help universities to understand their students and teaching efficiency in their institutions by learning from data and also administrators to cope with advising students efficiently. We will develop a software tool which is analyzing and visualizing data from past student enrollments in classes and their grades. For this purpose, we are going to use different kind of machine learning algorithms for classification and regression problems in python environment and Kibana for visualizing data. Furthermore, we are going to try to improve and analysis past works accuracies.

Key Words:

Machine Learning, Kibana, Visualization, Python, Analyses, Classifications, Regression, University Information System

Özet

Makine Öğrenimi ve diğer istatistiksel yöntemlerle, büyük verilere ait kalıpları anlayabilir ve bulabiliriz. Bu durumda, öğrenci verilerinin akademik başarı ve diğer ilgili çalışmaların sonuçları için nasıl faydalı olacağını tartışacağız. Ayrıntılı olarak, akademik hayatta erken değişiklikler yapılması, öğrencilerin eğitimlerine yön vermelerine yardımcı olur. Bu projede öğrencilerin verimli bir şekilde bilgilendirilmesine yardımcı olmak için üniversitenin verilerden ve yönetici bilgilerinden verileri öğrenerek, öğrencilerin akademik etkinliklerini öğrenmelerinde yardımcı olduk. Mezun ve mezun olmamış öğrenci kayıtlarından gelen veriyi analiz eden ve görselleştiren bir yazılım aracı geliştireceğiz. Bu amaçla Python ortamında sınıflandırma ve gerileme problemleri için farklı türde makine öğrenme algoritmaları kullanacağız ve veriyi görselleştirmek için Kibana kullanacağız. Ayrıca, geçmişteki çalışma doğruluklarını iyileştirmeye ve analiz etmeye çalışacağız.

Anahtar Kelimeler:

Makine öğrenimi, Kibana, Görselleştirme, Analizleme, Python, Sınıflandırma, Regresyon, Üniversite Bilgilendirme Sistemi

1. Introduction

1.1 Motivation

We are a group of senior students in computer engineering department who are interested in machine learning and big data. Our purpose is combining machine learning with our department information such as course grades, students' success, fail rates and etc. We try to enhance student success to show us their future GPAs or course grades. Some of the project members have taken the course of data mining. Besides machine learning, our project includes Database Structure and Web development. We use the Python programming language because it is useful, understandable and very suitable for our project. In order to do our project well, we tried to study various materials, research about the design and to strengthen the programming language.

1.2 Related Work

As listed below there are three applications for the prediction student success.

1. Georgia State University (GSU)
2. Maryland University College (PASS)
3. An Application in the University of Dartmouth

These all three projects aimed to able to predict the success of students. The first GSU project is about the graduation rates. They aimed to increasing of the university graduation rates. The second PASS project aimed to monitor academic progress identifies success factors, and implements interventions that encourage student success and the last project aimed to discover what influences students' grades. We explained these projects in the Literature Search section.

2. Literature Search

2.1 Big Data Analyses and Big Data to Improve Graduation Rates

Educational software development has become important for students' academic and social life. One of the aims of academic evaluation is to determine which student needs to help. For this purpose, the ability to collect unique data using technology has become more accurate and less burdensome.

1.1 Three ways to Collecting and Analyzing Data

Academic research suggests that technological tools can predict results by collecting or analyzing data according to three different categories. One way to estimate the results is to measure how much the students use the curriculum materials; For example, a study conducted by Reynol Junco of the State of Iowa investigated whether working with online textbooks would predict class outcomes. Using data from more than 200 students in 11 college classes [1] he found that students could predict the performance of the number of days they used the course book, which was actually a better predictor than previous lecture notes. Another recent research led by Nynke Bos from the University of Amsterdam [2] also suggests that the time spent watching online lessons can also predict course outcomes when combined with participation in classes . These two studies show that a student's prior knowledge of the class can provide a warning.

A second way to predict student outcomes is to focus on student involvement. This survey, which includes data from learning management systems (LMS), shows that regardless of whether someone has opened a book or not and that certain behaviors (such as sending a message) may be indicative of future learner performance. Another example came from a group of researchers led by Andrew Krumm; one step further, LMS data was used to design early warning systems for university students in the STEM program. In their assessment [3] they found evidence that using LMS data to place students in different need categories improved the cohort average GPA over a period of three years .

The most difficult technological (and computational) success is actually estimating the results of the students by evaluating the knowledge of the students. In a new study led by Stanford's Paulo Blikstein, they investigated whether machine learning algorithms could predict computer science course grades based on the progress of a student's code at a single assignment. Algorithms - usually a cluster analysis algorithm - are simply grouped according to how the students change their codes to one another without trial. After examining how the computer grouped the students, the researchers found that a group contained a code that gradually improved, while another group could easily determine that it contained codes that always entered the barricade. The link between these group classifications and the final lecture notes was not overwhelming, but researchers have found evidence that the information provided by the machine learning algorithm predicts course outcomes. In particular, students [4] with better codes (separated by categorization by algorithm in one assignment) performed 7.9% better on average in classroom midterms for students with weak class codes . These surveys enable teachers to better understand their students without making additional assessments.

1.2 Many Factors of effecting GPA

Paul Gore, who presided at the University of Utah with a predicted analytical issue, joined to webinar in prestigious mid-west university. This webinar's topic is related to how university to use data to predict student success. According to the webinar made, it is possible to reach the information of the student, the average of the high school, the information about the preparation scores. The Student Management System [5] is one of these sources . It controls the degeneracy of the student. Controls the interaction of the learner with his classmates, the assignments he/she

has submitted, and the homework assignments he/she has not visited. The information system has developed in detail to reach the knowledge of the learners. Where the studies were willing to share, the fitness measures of the predictive models look pretty good, achieving classification success rates in the 70% to 80% range. Interpretations in the social media affect the success of the student. These interpretations are thought to be related to factors affecting the school life and affect the graduation. The goal of each study is different. There are common elements when looking towards a goal. In the first semester the area is equipped with elements such as GPA look, specific courses offered. Paul, who heads the University of Utah, said that there are some categories that are effective in the success of the student. The researcher noted that the academic interests and responsibilities of the learners, academic effectiveness, educational commitment, and participation in school activities affect GPA and its success. It was understood that measuring the success of a student would be easier if these elements were noted. In a study conducted at a seminar, the GPA and read achievement were influenced by the fact that there were many factors affecting the student in the research and by showing the way to success, increasing the motivation of the students.

2.2 Models of Predictive Students Success

In this part of the literature we will mention that how universities use big data and what applications to prediction student success. As listed below there are three applications for the prediction student success.

1. Georgia State University (GSU)
2. Maryland University College (PASS)
3. An Application in the University of Dartmouth

These all three projects aimed to able to predict the success of students. The first GSU project is about the graduation rates. They aimed to increasing of the university graduation rates. The second PASS project aimed to monitor academic progress identifies success factors, and implements interventions that encourage student success and the last project aimed to discover what influences students' grades. The table below shows universities data and project results.

Table 1. List of projects

University	Project	Data	Results	Purpose
Georgia State University	GPS(Graduation and Progression Success)	Analyzed 2.5 million grades earned by students in	The University graduation rates have increased by 6 points since 2013 and Graduates take	To better utilize the time of advisers in college and to get more students from the finish line and create a list of

		more than 10 years of courses	lessons half a semester ago and also they are limited to spending about $ 12 million.	factors that affect the chance of graduation
Maryland University Collage	PASS (Predictive Analytics for Student Success)	All students who enrolled in Spring 2015 and Spring 2012	Tool can correctly classify 76.8% of students as having a first class GPA success.	Following academic progress and completion of community transfer students, identifying success factors, and implementing interventions that encourage student success.
University of Dartmouth	SmartGPA	Thirty of the University students collected behavioral data	The results are GPA can be affected by where and how students spend their time and also the predicted GPA strongly correlates with the facts obtained from students' transcripts ($r = 0.81$ and $p < 0.001$) and estimates the grade average within ± 0.179 of the reported grades.	They show that with smartphone information, there are a number of important behavioral factors that are significantly related to the term and collective GPA, including time series analysis such as activity, speech interaction, mobility, class participation, learning and party.

The projects are explained in detail below.

2.2.1 Georgia State University (GSU) Project

In another research on large data research, it was investigated how university graduation rates could be increased. The Georgia State University (GSU), who conducted this research, analyzed 2.5 million grades earned by students in more than 10 years of courses in order to establish a list of factors affecting their chances of graduation by working with Education Advisory Board

(EAB), an external consulting firm. EAB then developed an early warning system for Graduation and Progression Success (GPS). The system is updated daily and includes a number of alerts that help advisors keep students on the road before graduation. For example, if a student does not receive a satisfactory grade that he needs, the advisor will be alerted. Timothy M. Renick, a GSU vice-president who leads the project, gives this example [6]: In the first political science class, A or B's area graduates 75% in political science. If you get a C, your chances are down to 25 percent. With this practice, students have begun to plan together with their advisors to get additional teacher help, get a summer class, or perhaps change the main branches. As a result of this research, school graduation rates have increased by 6 points since 2013. Low-income, first-generation and minority students have closed their graduation rate recognition.

2.2.2 Predictive Analytics for Student Success(PASS) Project

The Predictive Analytics for Student Success(PASS) project is one of the models for predicting students' success. While researching and completing the Pass Project, University of Maryland University College (UMUC) partnered with two colleges. These are Montgomery College (MC) and Prince George's Community College (PGCC). The aim of the PASS project [7] is to: monitor the academic progress and completion of community transfer students, identify success factors, and implement interventions that encourage student success. The project consists of three phases. Each phase is built on the results of the previous phase so that research development and comprehensive analyzes are maintained. Within this project, the Success Calculator was developed as a consulting tool based on an estimated model of student achievement. The First Term Success Calculator uses students' demographic data and course-taking behaviors to predict the probability of gaining a GPA of 2.0 or higher during the first semester of the UMUC. Within the project, predictive modeling was used to create models related to significant milestones in students' academic orbit; including a successful first-term GPA, re-enrollment, continuity and graduation.

2.2.3 An Application in the University of Dartmouth

Andrew Campbell, a computer research professor, found in his research that there was no relationship between students' class continuity and their grades. Thus, Campbell agreed with the University of Darthmouth to discover what influences students' grades. He has developed an application where thirty of the university students collect behavioral data. Thanks to this application, students can learn GPA based on where and how they spend their time. Campbell says [8] "Students who spend more time without distraction will fare better at school.". It was created to think of how a practitioner who predicts GPA will create a competitive environment in universities where and how the learners spend their time. GPA was created to think that a practitioner would create a competitive environment in universities about where and how students spend their time. Campbell is planning to test in a larger group of students at the University of Texas in Austin next semester. This application exemplifies a project in which data analysis is used to increase student success and graduation rates. Finally, Campbell says companies can do such data analysis to see if employees are productive.

2.3. Methods for Using Predictive Analytics for Student Success

The application rate in higher education increased, business intelligence techniques were applied. Predictive analytics is used in higher education to manage finance, operations, tools and equipment. Predictive analytics is focused on student success in higher education. For higher learning and success in schools, it is necessary to identify specific students and determine their performance. Reliable results are obtained when asking the right research results when performing predictive analysis because it contains certain rules. Predictive analytics [9] is used to push students with predicted skill levels based on test results rather than personal passions and interest. In order to keep students engaged, you must accelerate, automate and optimize your student retention strategies to support them. Maximize your student recruitment with a range of specialist services from QS Enrolment Solutions (formerly Hobsons Solutions). Hobsons is working on student-focused work to encourage many students to succeed. The student has been following regularly since the first year. Even if the students are technically ready, they see themselves at the middle school level. Hobsons aims to change this solution by presenting career advancement solutions to the second-year students until graduation. The students are expected to graduate with regard to the student. The students must make sure that they have achieved their student's success and permanence through strategic record management when applying. This has helped to increase student achievement and make predictions by controlling the student. Hobsons has determined the GPA ratio by increasing the motivation of students with various applications, especially graduate students.

2.3.1 Considerable Five Methods for Using Predictive Analytics for Student Success

There are many important considerations that we need to look into and investigate when starting the journey of using predictive analytics to support student achievement. In one study, it was emphasized that analytics based on guessing are some important points that need to be carefully considered in order to be based on morality. They are explaining more detail five guiding practices into report.

First one is that have a vision and plan. Developing a vision and plan for data use will help guide an estimated analytical effort. Without such planning, intelligent analysis can be used to do more harm than good harm to students.

Second one is that Build a Supportive Infrastructure. A supportive infrastructure [10] ensures that the analytical benefits of the project are understood and welcomed by the university stakeholders and that processes and other support are performed to assist the data effort.

The third guiding practice is that work to ensure proper use of data. Data is required for estimating models and algorithms. Consider the quality of privacy and security issues as well as the interpretation of your data and data in order to ethically create and use the results of these models and applications.

The fourth guiding practice is that design predictive analytics models and algorithms that avoid bias. It is important that predictive models and algorithms are built to reduce prejudice and test for correctness. Also, be sure to match the vendor with the vendor who can promise to design it so that it does not intentionally code the bias and can be tested for accuracy and the final guiding practice is that Meet Institutional Goals and Improve Student Outcomes by Intervening with Care. Develop the institution's goal by ending the product and intervening in a positive sense of these objectives with the results of the students.

In the meantime, the personnel involved in the intervention in the institution should be trained in how to respond appropriately and test the effectiveness of the interventions once deployed. Another resource to consideration before the predictive analytic success is that IPASS-Predicitive Analytics Checklist. This list [11] is a checklist of these matters. It is one of the applications in EDUCAUSE. As a result of these ethics and methods, it is very important to careful about predictive student success.

2.4. Predicting Student Success with Machine Learning

Machine learning is one of the most popular approach today that understand patterns from data and there are lots of different areas that working with machine learning. Machine Learning algorithms are powerful tools which can obtain remarkable results from big data. In this section, firstly, we are going to mention about data which can usable for predict student success and secondly, some related works about machine learning and results of them.

2.4.1 Data for Predicting Student Success

For this project, our data contains graduated students transcripts but other researches and related works in this area shows that students grades are not only determinant to estimate. Many different factors or attributes would useful to increase correctness, make a prediction or support original data. In addition, any attribute can be the most significant one.

Reynol [1] hypothesized that digital textbook usage data can predict students' course grades with using linear regression analyses and more than 200 students' data. Moreover, he found that usage of digital textbooks data was better predictor than students' previous course grades. Also, factor of time spent reading was better predictive for course grades. Nynke [2] suggests that data of time spent on watching online courses, can also predict outcomes of students' exam performances. Leah [3] examined students' online activities to predict academic success and researchers found 15 variables such as number of mails sent and number of discussion messages posted that correlation with students' final grades using regression modeling. Further, model identified 81% of students' who fails on course.

Table 2. Different factors on success

Study	Attribute/Feature	Result
Reynol [1]	Digital textbook usage, time spent on reading	Found that digital textbook usage and time spent is better predictor than previous grades
Nynke [2]	Time spent on watching online course	Time spent can be usable on exam performances
Leah [3]	Student online activity	Found 15 variables that related with final grades and identified 81% of failed students on certain course

2.4.2 Machine Learning in Practice

In this part, some related works explained in detail.

A study from Stanford University, Martin, Sharon and Chinmay [12] attempted to construct a value-predictor that predicting grade of a student for a given course using Support Vector Machines (SVM) and Collaborative Filtering (CF) techniques on Matlab environment and taken data from CourseRank recommendation system which is contains information of anonymized students' transcripts and courses. In general, there were four key features; Previous course history, recent grades by department, students' major and concurrent courses. Also, while students' major was a most significant predictor for a particular course, students' previous course grades was the predictor for another course. Results of this study that neither SVM and CF provide better grade predictions than an estimate of the average grade of each student.

Another research from Information Technology University (ITU), Lahore, Pakistan evaluated students' academic performances in Electrical Engineering Department. Researchers [13] says that machine learning techniques would help to students' for improve their performance in different courses and predict students' GPA in registered courses. They analyzed 225 undergraduate student data on different techniques; Restricted Boltzmann Machine (RBM), Collaborative Filtering and Matrix Factorization (MF) which is very popular approach in recommendation systems to systematically analyzing. The dataset contains features such as high school percentage, entry test scores, course credits and so on. Additionally, they have mentioned some limitations of this study. Limited dataset used for study and root mean squared error (RMSE) can predict more clear if there are more information of students' GPAs. They found that RBM was better technique to estimate students' performances in courses.

University Sains Malaysia has provided an overview to predict students performances using data mining techniques and they also focused on that how this techniques can use for identifying the most significant attributes in data. In Malaysia, usually final grades which is based on course

structure, final exam score, assessment mark and extracurricular activities have used for evaluate to student performance. They [14] proposed a systematical review to support main objective of study which contains identifying the gaps in existing prediction methods and the variables used in analyzing students performance, to study the existing prediction methods for student performance. In study, they shows a list of attributes and list of methods used in prediction students' performance. Neural networks are used for high school background, internal and external assessments and student demographics. K-Nearest Neighbor, Naive Bayes and Support Vector Machines are used for internal assessments, cumulative grade point average(CGPA), extra-curricular activities and Decision trees for many attributes such as scholarship, social network interaction, assessments which has been used the most often and psychometric factors that is identified as student interests, study behavior, engage time and family support. At the end of the study, they found that the most effective method was neural networks. Accuracies of methods are 98% with Neural Networks followed by Decision Trees by 91%, Naive Bayes gave lower prediction accuracy with 78%. Lastly, K-Nearest Neighbor and Support Vector Machines with 83% accuracy obtained. They also mentioned that result of this work depending on features or attributes that were used. Neural Networks gave highest prediction because of internal and external assessments. With only one attribute, NN's accuracy was decreased by 1%.

In another project about this topic, three different machine learning algorithms have used to measure student performance. These are Linear regression, Decision trees, Naive Bayes classifier. In the linear regression method, there is a scoring system for the age of the student and whether they passed the exam[15]. One (1) for past students, zero(0) for past students. The regression algorithm can find approximate values and graph the results. In the regression algorithm, the acceptable value can be between 0 and 1. Decision trees, the age of a student, and GPA, are measured. The value of the test is based on the age and the group. The success of the student is estimated by reaching the result by defining independent variables from each other in the decision tree. The success of the student is estimated by reaching the result by defining independent variables from each other in the decision tree. It uses the P (A \ B) formula to find out the probability. It calculates the achievements of people using age and GPA. It compares the likelihood of transition from 0 to 1 using the same data. Different algorithms have used in the result finding section.

Table 3. List of studies in detail

Study	Purpose	Data	Method(Success Rate)
Hunt, Lin & Kulkarni [12]	Predict student grades using transcripts and courses	CourseRank recommendation system data	Support Vector Machines, Collaborative Filtering

Iqbal, Qadir, Mian, Kamiran [13]	Evaluate student performance and predicting GPA for a certain course	A real-world data contains 225 undergraduate student from Information Technology University	Restricted Boltzmann Machine, Collaborative Filtering, Matrix Factorization
Shahiri, Husain, Rashid [14]	Overview for predicting student performance and trying to find most significant attribute	Unknown Data	Neural Networks (98%), Decision Tree (91%), Naive Bayes (78%), K-Nearest Neighbor (83%), Support Vector Machines (83%)
Pojon [15]	Predict students' GPA	Unknown Data	Linear regression, Decision trees, Naive Bayes classifier
Blikstein, Worsley, Piech, Sahami, Cooper, Koller [4]	Estimates for identifying successful students	Unknown Data	Clustering analysis
Vorhies [5]	Using data to predict the success of students	The Student Management System Data	Classification model

2.5 Applications

The table below shows the purposes of the applications, what data they are doing with it, and which machine language method they are using.

Table 4. List of applications in detail

Goal	Works	Data	Method	Success Rate
Predict Gpa	1.Pass project	All students who enrolled in Spring 2015 and Spring	using data mining, predictive modeling,	Tool can correctly classify 76.8% of students as having a first class GPA

		2012	including cluster analyses and logistic regression	success.
	2.SmartGPA	The dataset is collected from 30 undergrads and 18 graduate students over a 10-week term in spring 2013	Data mining	The predicted GPA strongly correlates with the ground truth with r = 0.81 and p < 0.001.
	3.GPS Project	Analyzed 2.5 million grades earned by students in more than 10 years of courses	Unknown	In addition, during the 2012-2013 academic year, the total number of undergraduate students increased by 9% for a 4-year graduation.
Monitor and model student progress in institutions	1.Pass Project	First-year university students were randomly assigned to the control group (n = 33) and the test group (n = 90), transferred from MC and PGCC.	predictive models and data mining techniques	Test-Control GPA 2.70 2.66 Successful Course Completion 78% 69% Re-Enrollment 74% 75%
	2.SmartGPA	The dataset is collected from 30 undergrads and 18 graduate students over a 10-week term in spring 2013.	Web usage mining	r = −0.398, p = 0.029
Predict Graduation	1.Pass Project	first semester of transfer to UMUC was between Spring	using data mining, predictive	Effect size measures suggest that between 20.0%, according to

		2005 to Spring 2012	modeling, including cluster analyses and logistic regression	Cox and Snell's R2, and 26.7%, according to Nagelkerke's R2

3.Software Requirement Specification

3.1. Introduction

3.1.1 Purpose

This document describes a system capable of estimating the objective Student Evaluation Performance System. There are different conditions for different users and students in Student Evaluation Performance System.

In this system, students have the option of calculating future GPA through old lessons' grades and also the system allows students to choosing only one lesson and calculating new final score through just this choosen lesson. On the other hand, the system does not always calculate GPA or new future course notes, it can predict length of a study and dropout for a student to our school.

In terms of other users, the system aimed to inform about previous lessons information including who passes, fails, lesson grades or students' informations with graphs. Especially departmenthead,facultyhead, rector and professors can be used our system. This document contains information on the following topics. The identified headings specify the specified functions and details of the work to be performed. Otherwise, the SRS document describes the functions and activities of persons using the Student Evaluation Performance System. This document describes how stakeholders' needs are addressed.

3.1.2 Scope of Project

Students often want to have future knowledge of the notes. In addition, teachers may want to be informed about GPA or previous lessons' letter grades and also in universities, there are worries caused by student grades and uncertainty. In the system, students can have knowledge about GPA estimation so that way teachers can also. A system for GPA prediction or other predictions were developed to remove the problems for teachers and students.

The goal of the Student Evaluation Performance System is to create a guide that can be answered by the questions, which may be information for students. Students use this system by making different entries. Students need to find usernames and passwords in order to access the system. It is possible for other users to input by usernames to the stakeholder. Users(except students) have detailed information about the lessons of students from past years after they have been logged in.

The Student Evaluation Performance System has two user entrances, users such as rector, faculty head, department head, profesors and students. After entering the user, there are different options for other users and students. Users except of the students can get all the information about past years. They can reach all of students' grades, lessons' informations and they can access the graphs based on years of students' GPAs. Students can calculate their average from graduation, or choose a course and system calculate final score through just this choosen lesson. Also, they can learn prediction of dropout of a school or length of a study. In other words, the fact that students know their future is important to them. For example, if the system calculates a low GPA, the student may be aware of his / her situation and then he / she can fix it and work more. So knowing GPA in advance affects how they will perform in lessons in the future. On the other hand other users reach the informations about the previous lessons' with students' success or failures and also they can reach statistical data with graphics or lists of lessons' informations.

3.1.3 Glosarry

Term	Definition
Participant	The user who interacts with the web address of Student Evaluation Performance System. Generally departmenthead,facultyhead, rector or students of the Cankaya University
Stakeholders	Any person who has contribution in the project
Web Site Environment	The environment that allows students learn new GPAs or allows to other important persons to show old lessons' informations and graphics

Data of students	Students' personal informations and also their grades in lessons
Data of previous lessons	All informations about previous lessons. For example, letter grades, how many people passed or failed, graphics of the success rate or failure rate and exc

3.1.4 Overview of the Document

The second part of the document describes functionalities of our project. Informal requirements are described and it is a context for technical requirement specification in the Requirement Specification chapter. Requirement Specification chapter is written for software developers and details of the functionality of the project are described in technical terms.

3.2. Overall Description

3.2.1 Product Perspective

Student Performance Evaluation System: It is a web-based program that allows students to learn future GPAs and also allows teachers or other workers learn previous lessons' all informations with graphics or lists. The project divided into two parts: student mode and other users mode such as rector, faculty head, department head and professors. Student mode allows student learn new future predictions. For example, they can learn future GPAs. Students enter previous lessons' letter grades then the system calculates new GPA or student choose a lesson and the system calculate new final score through just this choosen lesson. On the other hand, students can learn prediction of dropout for a university and length of a study. Mutual mode allows users to learn previous lessons' informations with graphics and lists and also they can create new models for predictions.

3.2.1.1 Development Methodology

For developing the project, we have planned to use Scrum which is an agile software development methodology. Agile development is opened to change and also ıt allows high level of team communication, fast and continuous product delivery, test-driven understanding and simple and realistic planning. It is incremental and iterative development. Scrum is based on short cycle output generation and feedback thought. It is aimed primarily at developing important requirements for the project. It can easily apply the changes needed throughout the project time. One of Scrum's innovations [16] is the graph of the remaining features / number of days past, showing the progress of the project clearly and continuously. All activities inside the Scrum take place in Sprint. Every Sprint includes tasks which has own story points and risk points.

Development team should have a daily meeting every morning which should be maximum 15 minutes. Product owner is the person who delivers the requirements. Development team is the group of developers who work on the project according to schedule. Thanks to constant feedbacks, it is easier to cope with changes. Sprint is very important feature for Scrum methodology. At the end of each sprint, a part of project has been completed and it has been presented to customer for validation. Thanks to all advantages, Scrum methodology is more proper to our project.

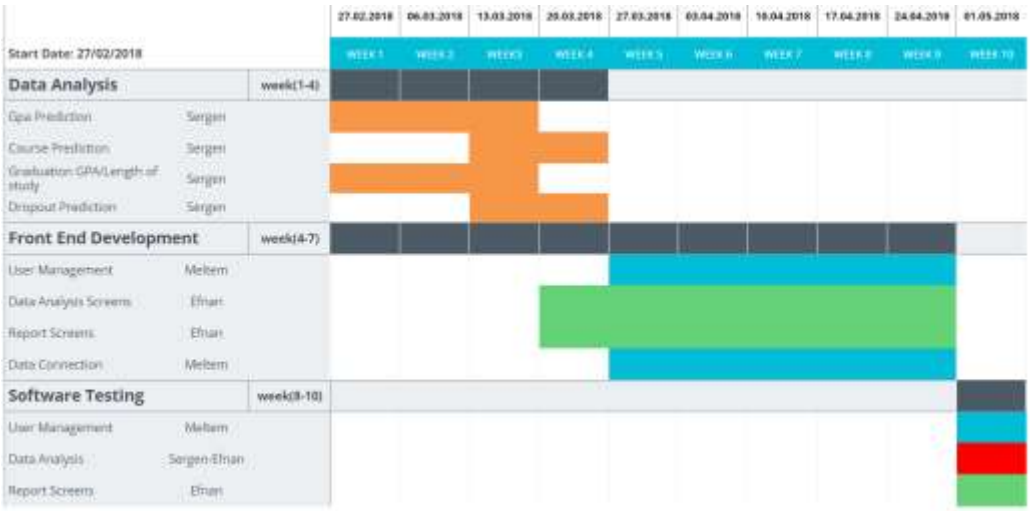


Figure 1 Gantt Chart of Work Plan

3.2.2 User Characteristic

3.2.2.1 Participants

3.2.2.1.1

Participant must be a student, professor, rector, faculty head, department head of the Cankaya University.

3.2.2.1.2

Participant must read and understand Turkish language due to simulation language is Turkish.

3.2.2.1.3

If participant is a student, he or she must enter at least the first term letter grades.

3.3. Requirements Specification

3.3.1 External Interface Requirements

3.3.1.1 User interfaces

The user interface will be worked on web application.

Figure 2 Homepage Panel

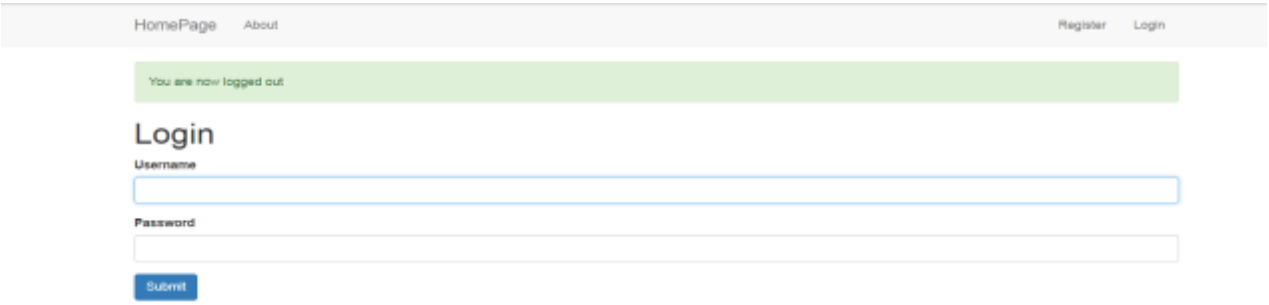


Figure 3 Login Panel

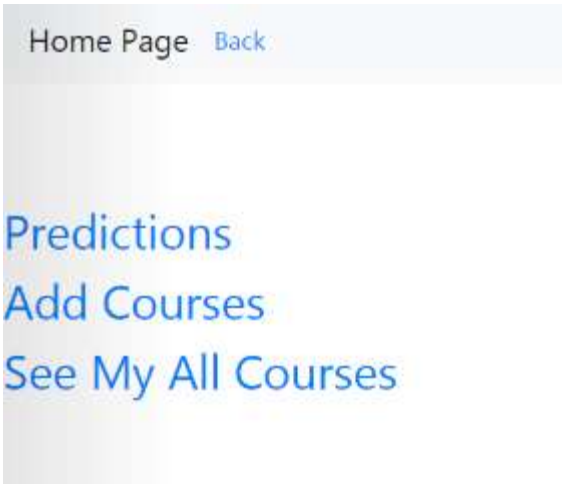


Figure 4 Student Panel

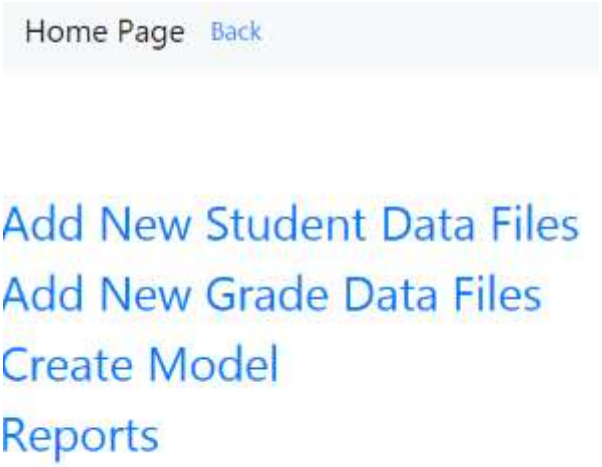


Figure 5 Rector-Faculty Head-Professor-Department Head Panel

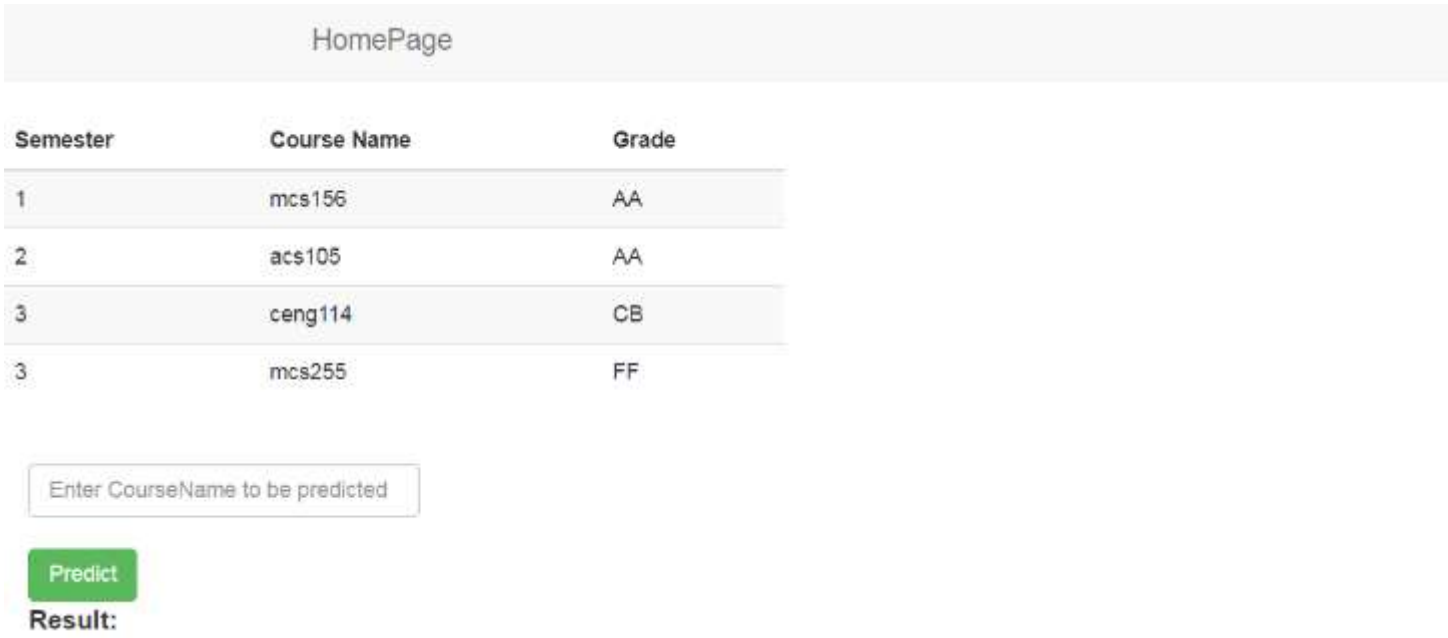


Figure 6 Course Prediction Panel

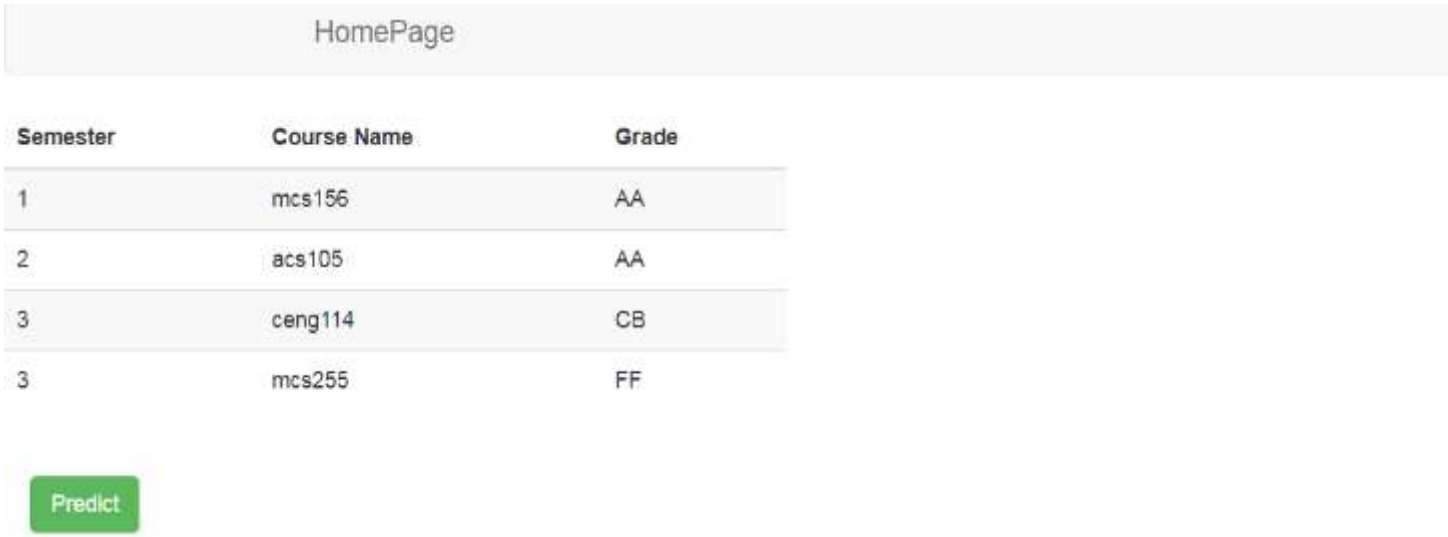


Figure 7 GPA Prediction Panel

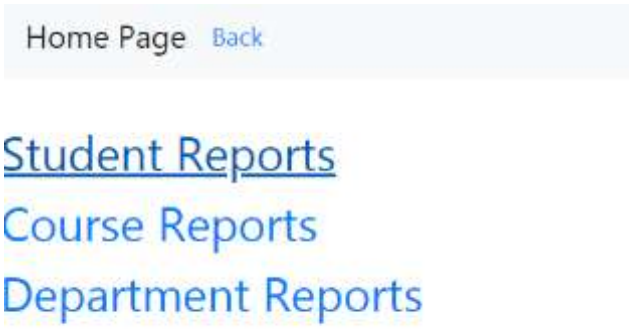


Figure 8 Report Panel

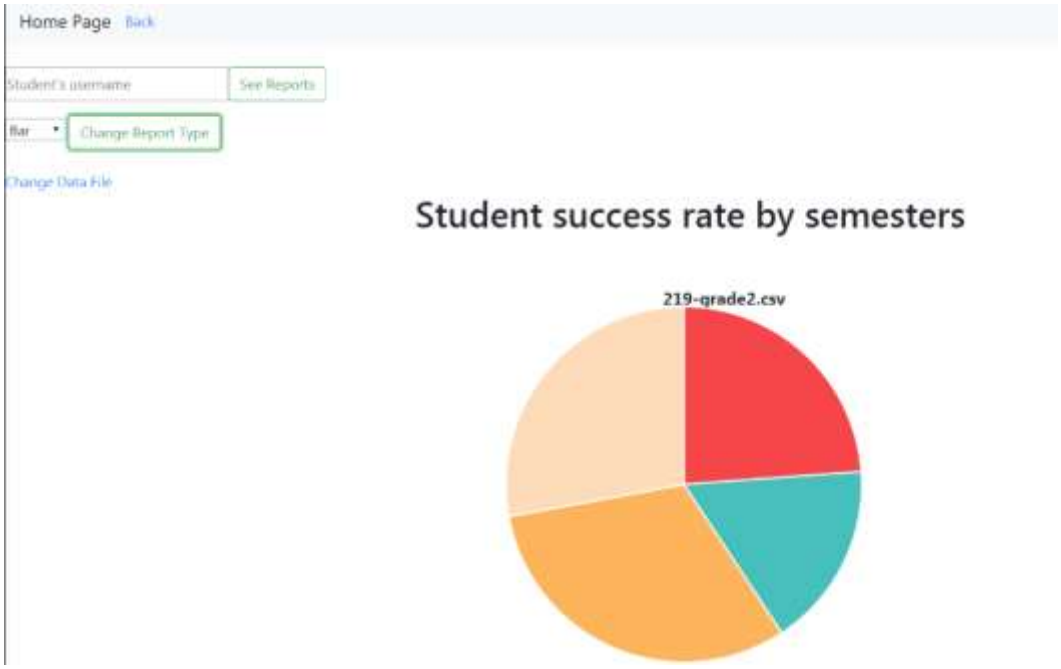


Figure 9 Student Success Rate Panel

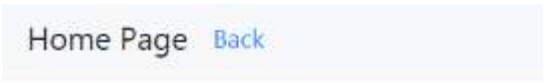


Figure 10 Create Model Homepage Panel

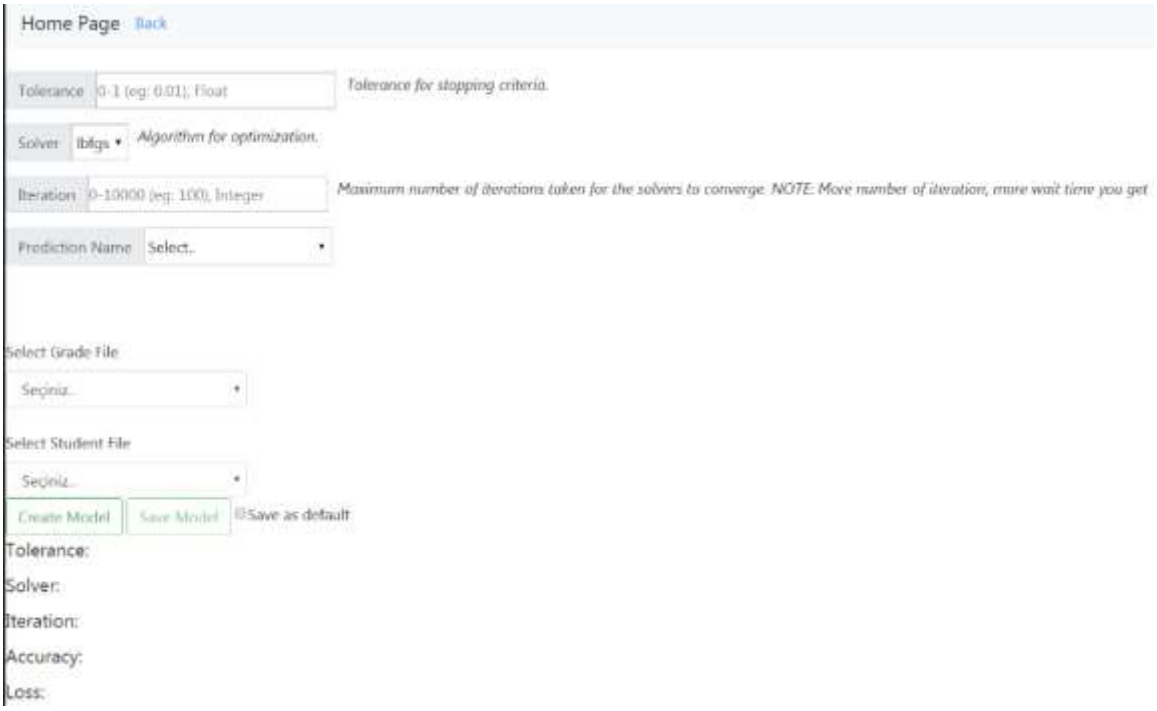


Figure 11 Create Model Panel

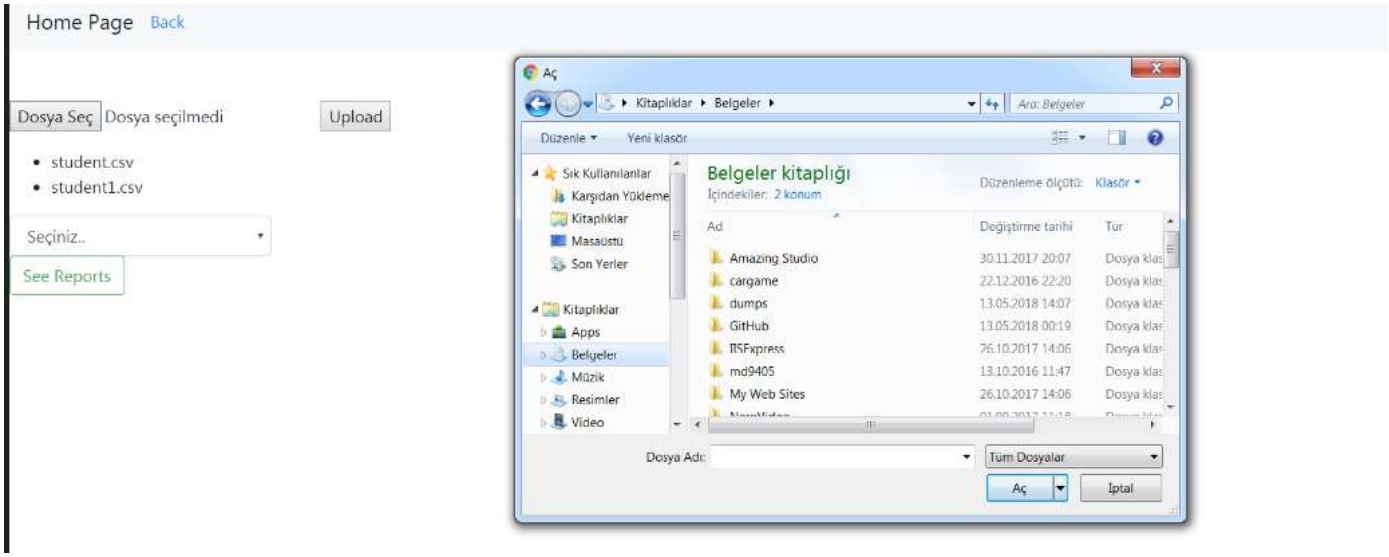


Figure 12 Add Data File Panel

3.3.1.2 Hardware interfaces

There is no external hardware interface requirement.

3.3.1.3 Software interfaces

MySql should be download to computer.

3.3.1.4 Communications interfaces

There is no external communication interface requirement.

3.3.2 Functional Requirements

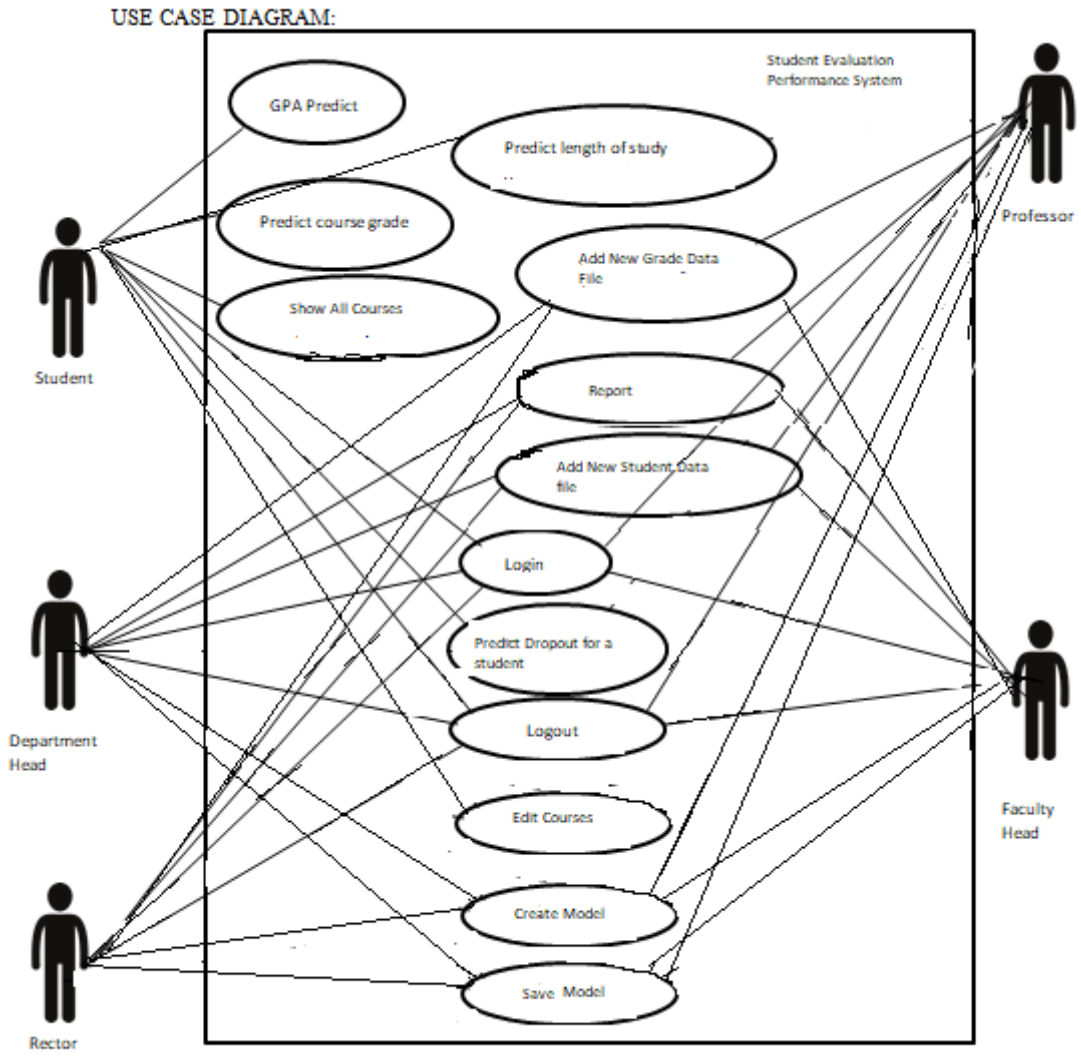


Figure 13 Student Performance Evaluation System Diagram

3.3.2.1 Profile Management Use Case

Use Case

1. Login
2. Logout

Diagram

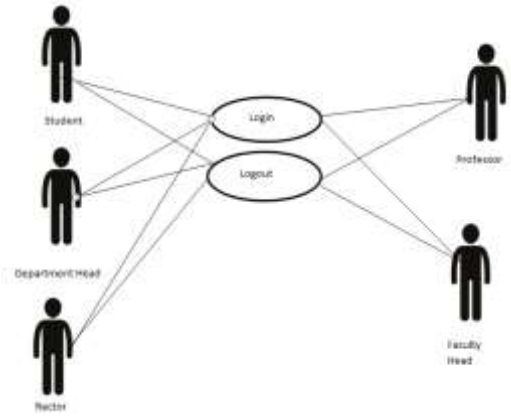


Figure 14 Profile Management Use Case

Brief Description:

Login Use Case describes related actions that all users (admin) can perform. The user of the system should login before starting to use our system. Students must login using student mail as username and password. Professors, Rector, Faculty Head,Department Head must login using uviversity mail as username and password.

Initial Step by Step Description:

1. Participants should start system with login.
2. Participants must login using username and password.
3. Participants can exit from system.

3.3.2.2 GPA Predict Use Case

Brief Description:

Students easily learn new future GPA through old lessons grades. The system access old lesson grades and predicts new GPA.

Initial Step by Step Description:

1. Student clicks ‘GPA Prediction’ button.
2. The system opens GPA Predict Panel and access student’s old lessons grades.
3. Student clicks ‘Predict’ button.
4. The system calculates new future GPA and shows this number into the GPA Predict panel.

Diagram

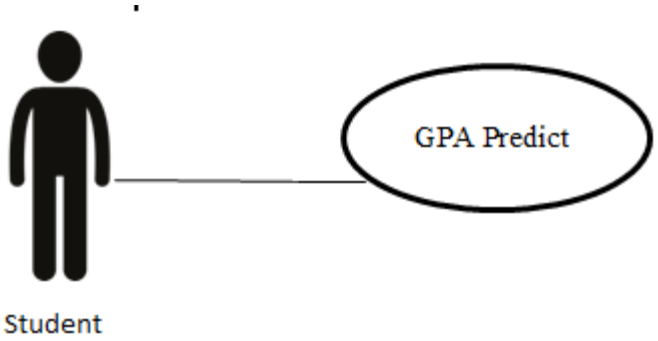


Figure 15 GPA Predict Use Case

3.3.2.3 Predict Course Grade Use Case

Brief Description:

When student login to the system, he/she be able to see own transcript. Student can selects course whatever they want and the system calculates future final grade of this choosen lesson.

Initial Step by Step Description:

1. Student click ‘Course Grade Prediction’ button.
2. The system opens Predict Course Grade Panel.
3. Student chooses any lesson which includes students department.
4. Student clicks ‘Predict’ button.
5. The system predicts new final score and appears into the Predict Course Grade panel.

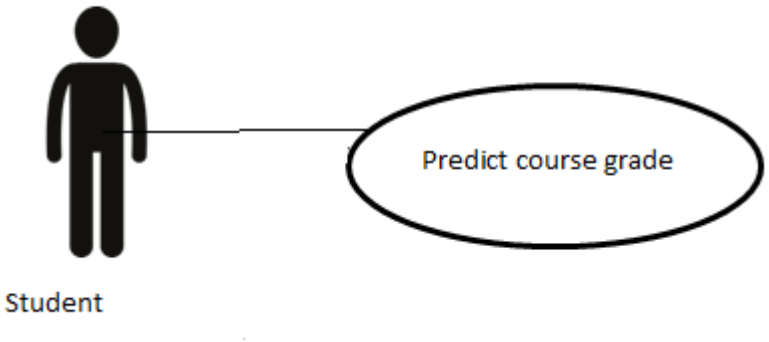


Figure 16 Predict Course Grade Use Case

3.3.2.4 Show All Courses Use Case

Brief Description:

Students learns all courses through a list. List includes semesters,course grades and names of courses.

Initial Step by Step Description:

1. The user clicks ‘Show All Courses’ button.
2. System opens Show All Courses panel.
3. System access that student previous courses and create a list which includes these courses.
4. The system shows related informations about this student with list into the Learn Student Information panel.

Diagram

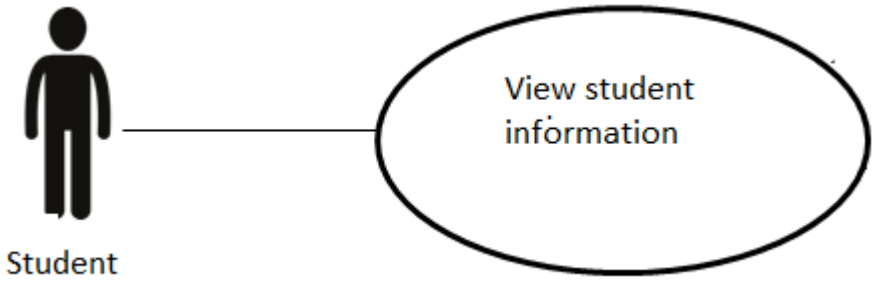


Figure 17 Show All Courses Use Case

3.3.2.5 Report Use Case

Brief Description:

The user(excluding Student) get detailed report with graphs or lists about:

-Grade distributions: by course/year, course/program/year, department/year, gender/year

-Graduation distributions: by length/dept/year, length/univ/year

-Course success distributions: fail/pass rates/year

-Dropout distributions: by department/year

-Average GPA distributions: by dept/year

Initial Step by Step Description:

1. The user clicks ‘Report’ button.
2. System opens Report panel.
3. The user choose which informations’ report want to see.
4. System access all informations about this chosen report.
5. System creates graphs or lists with these informations.
6. System shows this lists or graphs into the Detailed Report panel.

Diagram

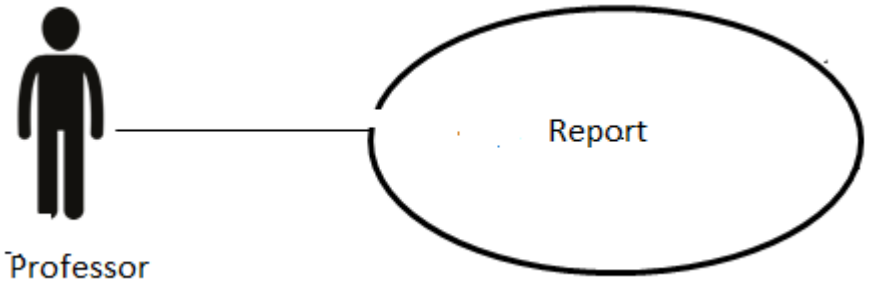


Figure 18 Report Use Case

3.3.2.6 Predict Length of Study Use Case

Brief Description:

Students can learn prediction of students graduation GPA and their length of study.

Initial Step by Step Description:

1. The user clicks ‘Length of study prediction’ for a student button.
2. System opens Predict length of study panel.
3. The user clicks ‘Predict’ button.
4. System predicts length of the study for a that student.
5. System shows this prediction into a Predict length of study panel.

Diagram

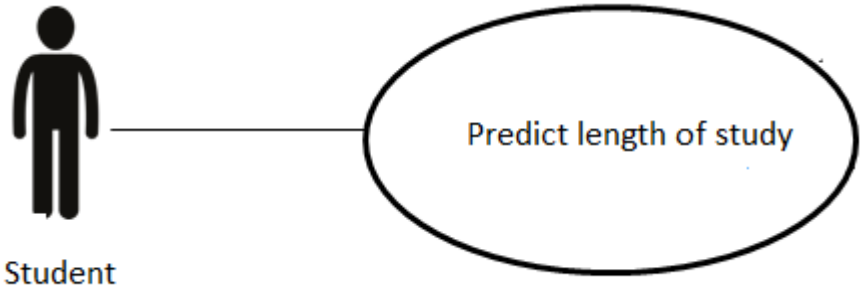


Figure 19 Predict length of study and graduation GPA Use Case

3.3.2.7 Create a Model Use Case

Brief Description:

Creating machine learning model for prediction.

Initial Step by Step Description:

1. The user clicks 'Create Model' button.
2. User selects types of creating new models.
3. User enter parameters for models and clicks create model button.
4. User can save models into databases.
5. The system create and save model and getting predictions through that data files.

Diagram

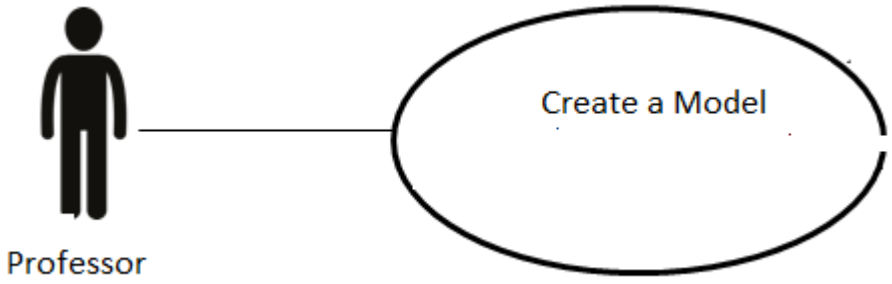


Figure 20 Create a Model Use Case

3.3.2.8 Add New Student Data File Use Case

Brief Description:

Users (except Students) can add new .csv files which includes our university students' informations.

Initial Step by Step Description:

1. The user clicks 'Add New Student Data Button' user selects which data file to add.
2. The system add new data file and show new predictions and reports for that file.

Diagram

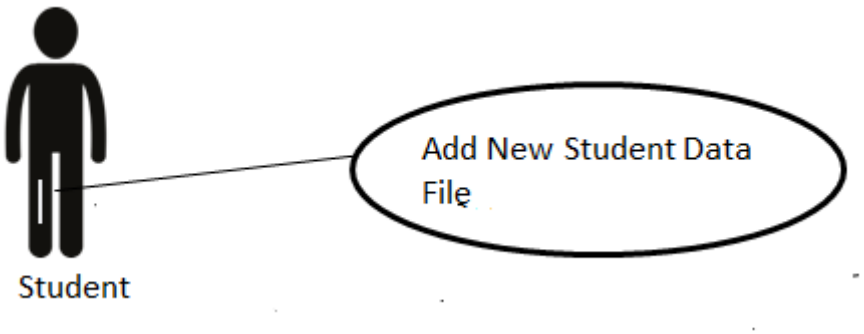


Figure 21 Add New Student Data File Use Case

3.3.2.9 Predict dropout for a student Use Case

Brief Description:

Students can learn the prediction of dropout for a our University.

Initial Step by Step Description:

1. The user clicks 'Dropout Prediction' button.
2. System opens predict dropout for a student of study panel.
3. The user clicks 'Predict' button.
4. System predicts dropout for a student with True or False.
5. System shows this predictions into a Predict dropout for a student panel.

Diagram

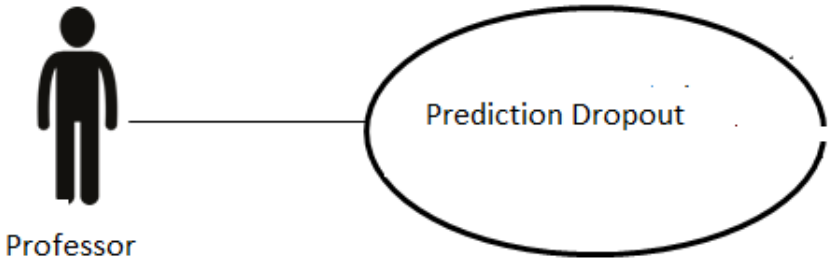


Figure 22 Predict dropout for a student Use Case

3.3.2.10 Edit Courses Use Case

Brief Description:

Students can edit their previous courses' informations.

Initial Step by Step Description:

1. The user clicks 'See My All Courses' button.
2. System opens Learn Student Information panel.
3. System shows the list of courses and 'Edit Lessons' button.
4. The user clicks 'Edit Lessons' button.
5. System opens Edit Courses panel.

Diagram

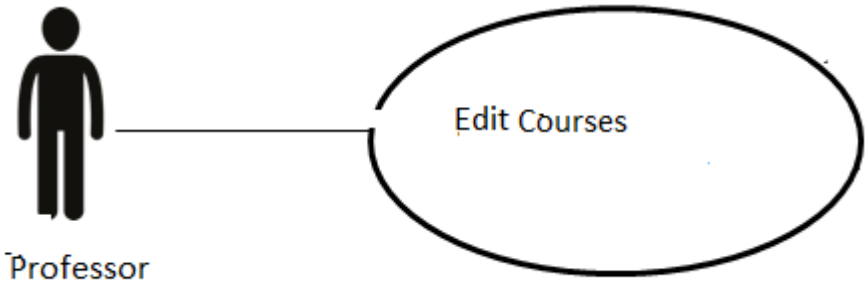


Figure 23 Edit Courses Use Case

3.3.2.11 Add New Grade Data File Use Case

Brief Description:

Users (except Students) can add new .csv files which includes our university students' grades informations.

Initial Step by Step Description:

1. The user clicks 'Add New Grade Data Button' user selects which data file to add.
2. The system add new data file and show new predictions and reports for that file.

Diagram

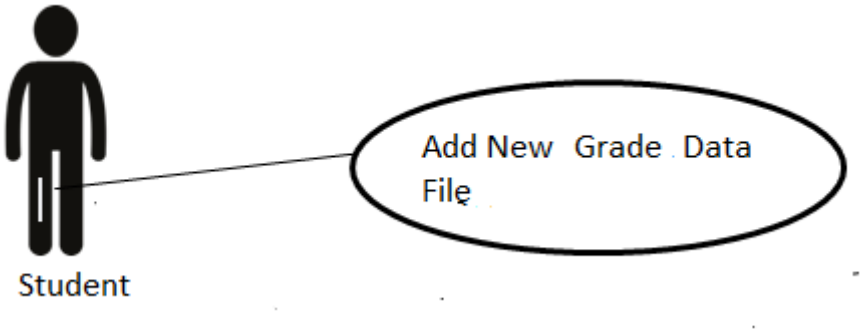


Figure 24 Add New Grade Data File Use Case

3.3.2.12 Save Model Use Case

Brief Description:

Users (except Students) can save a model as default or not after create model. If model is saved as default then related prediction function will use that default model.

Initial Step by Step Description:

1. The user clicks 'Create a Model' button.
2. System opens Create a Model panel.
3. System shows textbowes and dropdown lists for parameters.
4. User give parameters to models and click 'Create a Model' button.
5. The system shows 'Save Model' button.
6. The user clicks 'Save Model' button and model is saved as default.

Diagram

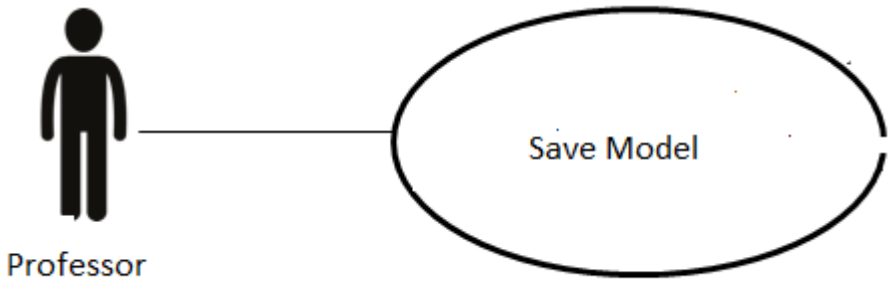


Figure 25 Save Model Use Case

3.3.3 Nonfunctional Requirements

3.3.3.1 Adaptability

Web application can work on different web browsers, therefore user's PC be able to run web browsers.

3.3.3.2 Security

The system keeps all students' informations with high security.

3.3.3.3 Performance

The system gives advice or alerts user immediately.

3.3.3.4 Usability

The system is easy to operate and the design of the system is very clear.

4.Software Design Document

4.1 Introduction

4.1.1 Purpose

The purpose of this Software Design Document is "Student Evaluation Performance System" to give detailed information about the project.

The target audience is primarily the students, teachers, rector, department head, faculty head. When GPA is calculated, students can get clearer results about their education life. The teacher, rector, department chair, faculty president may have knowledge about the information, graphics and various documents belonging to the student. Students are expected to take GPA calculations in the future by taking past course grades. The other users are aimed to get information about the students, graphics, course contents.

The aim of the system is to create an easy-to-use ui that both realistic and user-friendly. The prediction functions are available for students. All users can enter system via username and password. Student be able to do GPA prediction, course grade prediction, dropout prediction and length of the study prediction. Users except students can create machine learning models and save them, add new data file to system, view report. They exit the system after their processes are finished.

All the elements that can help the user from the system are in the category when they are entered into the system. Our prediction functions can be in the form of an application site that will be easy to reach by everyone. SDD, Block Diagram, and UML Diagram are available for better and detailed introduction to the system.

4.1.2 Scope

This document should read “Student Evaluation Performance System” provides details and information about the design of the project.

Python is an object-oriented, interactive, modular, handy high-level programming language. Python graphical faces are very convenient to use in intermediate design, web site construction, database access and software. It has a dynamic structure and can be integrated very quickly and easily into languages.

Python was rich in visuality and easy to maintain. Thanks to Python, we used Flask for web development. Flask is a micro framework for Python. Flask provides diversity and ease of visualization. We can easily combine Python code to Flask so that way the design of the web site becomes more dynamic. We preferred Python programming language that can perform operations quickly and dynamically because it had a lot of features in its structure. Thus, people entering the system can easily exit the system after using the system and performing the necessary operations. The designed user interface is made more dynamic.

4.1.3 Glossary

Term	Definition

BLOCK DIAGRAM	This is a schema that which comprise of blocks to show compononents of the system.
SDD	Software Design Document.
WEB SITE ENVIRONMENT	The environment that allows users learn predictions or informations about lessons, students and exc.
PARTICIPANT	The user who interact with the what wiill my gpa be? web site.
UML DIAGRAM	It is a modelling language of visualizing a software program using a collection of diagrams.

4.1.4 Overview of Document

The remaining chapters and their contents are listed below.

Section 2, discusses the Architectural Design of the project. In this section, users and their actions, pre-conditions and post conditions. The software development method used is mentioned.

Section 3 is Use Case Realization. In this section which is designed according to use cases in SRS document, a block diagram of the system, visuals and explanations.

4.2. Architecture Design

4.2.1 System Design Approach

For developing the project, we have planned to use Scrum which is an agile software development methodology. Agile development is opened to change and also ıt allows high level of team communication, fast and continuous product delivery, test-driven understanding and simple and realistic planning. It is incremental and iterative development. Scrum is based on short cycle output generation and feedback thought. It is aimed primarily at developing important requirements for the project. It can easily apply the changes needed throughout the project time. One of Scrum’s innovations [1] is the graph of the remaining features / number of days past, showing the progress of the project clearly and continuously. All activities inside the Scrum take place in Sprint. Every Sprint includes tasks which has own story points and risk points. Development team should have a daily meeting every morning which should be maximum 15 minutes. Product owner is the person who delivers the requirements. Development team is the

group of developers who work on the project according to schedule. Thanks to constant feedbacks, it is easier to cope with changes. Sprint is very important feature for Scrum methodology. At the end of each sprint, a part of project has been completed and it has been presented to customer for validation. Thanks to all advantages, Scrum methodology is more proper to our project.

4.2.1.1 Class Diagram

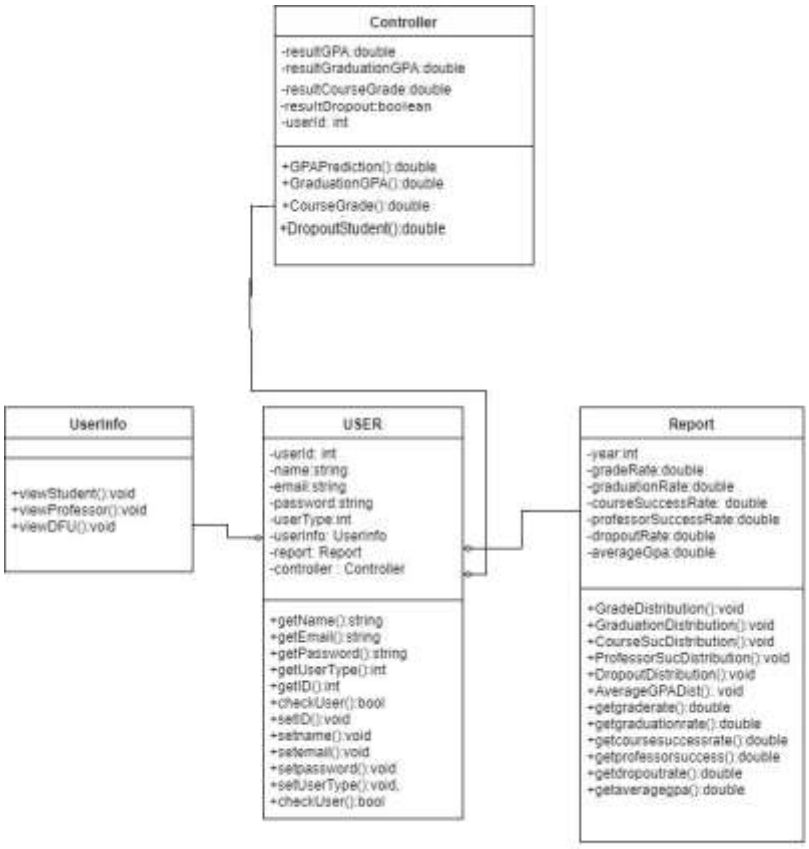


Figure 26 Class Diagram

The class diagram consists of four tables. User, Controller, Report, UserInfo tables. The User tables contains UserInfo, Controller, and Report tables. There are five user types in the User table. Users can login to the system using email and passwords. The UserInfo table holds information for students, professor, department head, faculty head, and university head. In the controller table there are functions such as GPA estimation, GPA estimation of those who can graduate, list of classroom drop-outs, lecture notes, which courses should be taken for high GPA. In the reporting table; the distribution of grades, the proportion of graduates, course success rates,

the success rate of teachers, the average distribution of GPA estimates, and the distribution of classroom attendants by years.

4.2.1.2 Database Tables

4.2.1.2.1 Function Trained Data Table

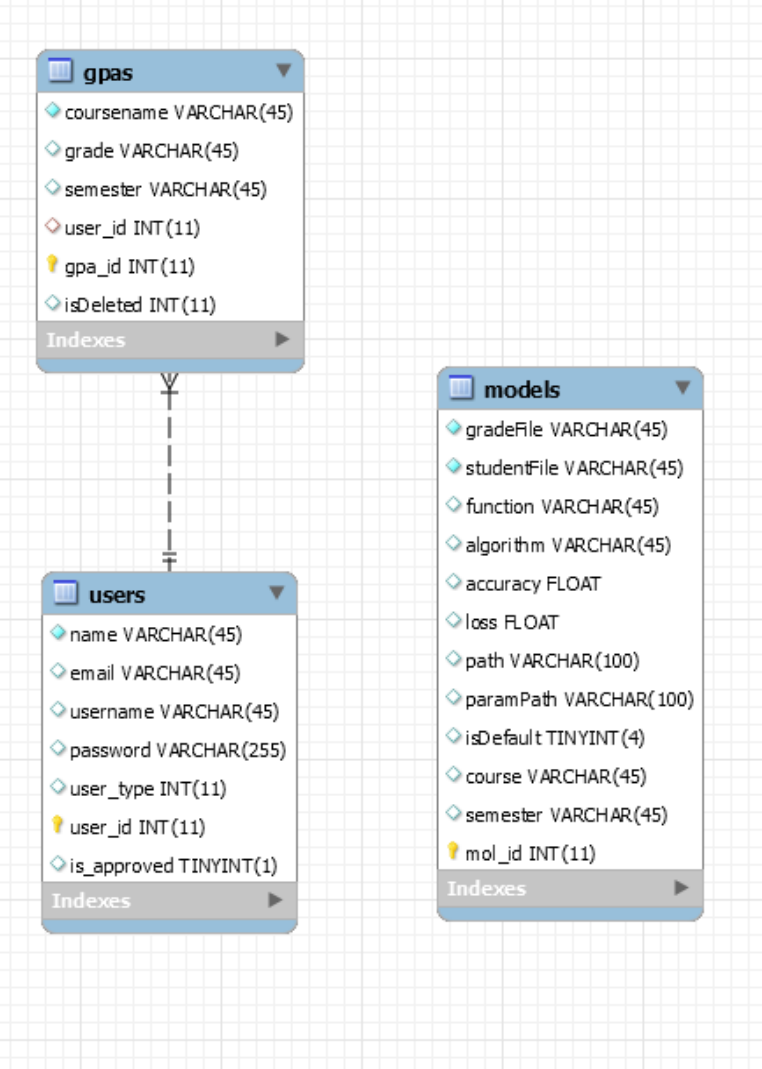


Figure 27 Function Trained Data Table

Description:

Users tables contains information of students, professors, department head, faculty head and university head. Student's added course informations such as course name, course grade and semester are stored in gpas table. All changes about courses happens in this table. System provides to create machine learning models and prediction using this models. Therefore, our models information and their paths are stored in models table. Models are created by using grade and student csv files. Each row includes model algorithm. For instance, If data trained with logistic regression algorithm name is logistic. Not only models information stored but accuracy and loss of model as well. If model is default then related prediction function use that model.

2.1.3 Sequence Diagram

4.2.1.3 Sequence Diagram

4.2.1.3.1 Login

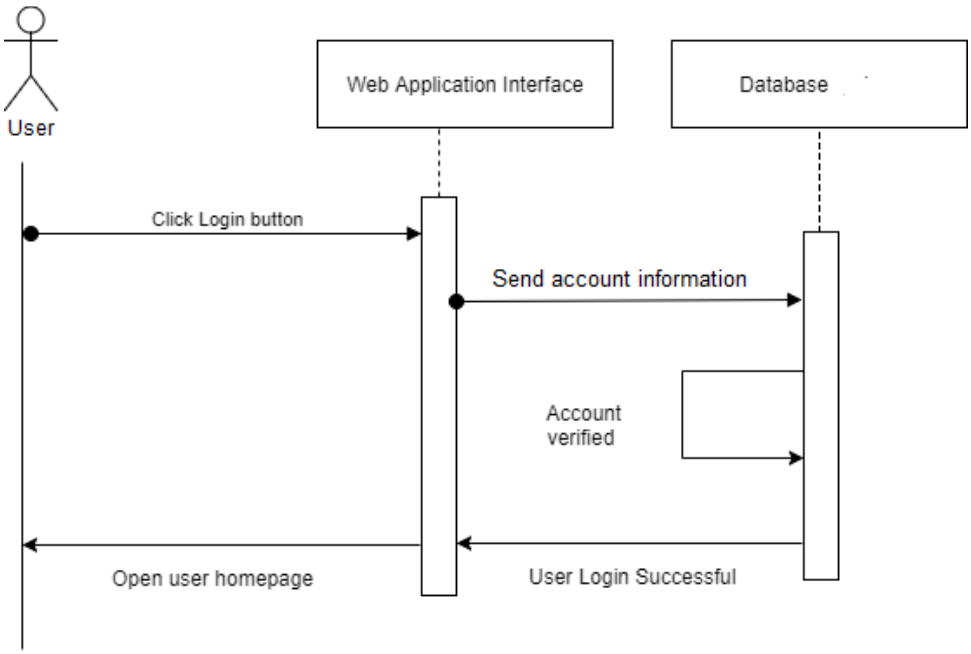


Figure 28 Login

In figure 1, all participants enter their emails and passwords then the system sends this information to the database and if the informations about people information is exist, they can login to the web page succesfully and access their homepages.

4.2.1.3.2 Show all courses

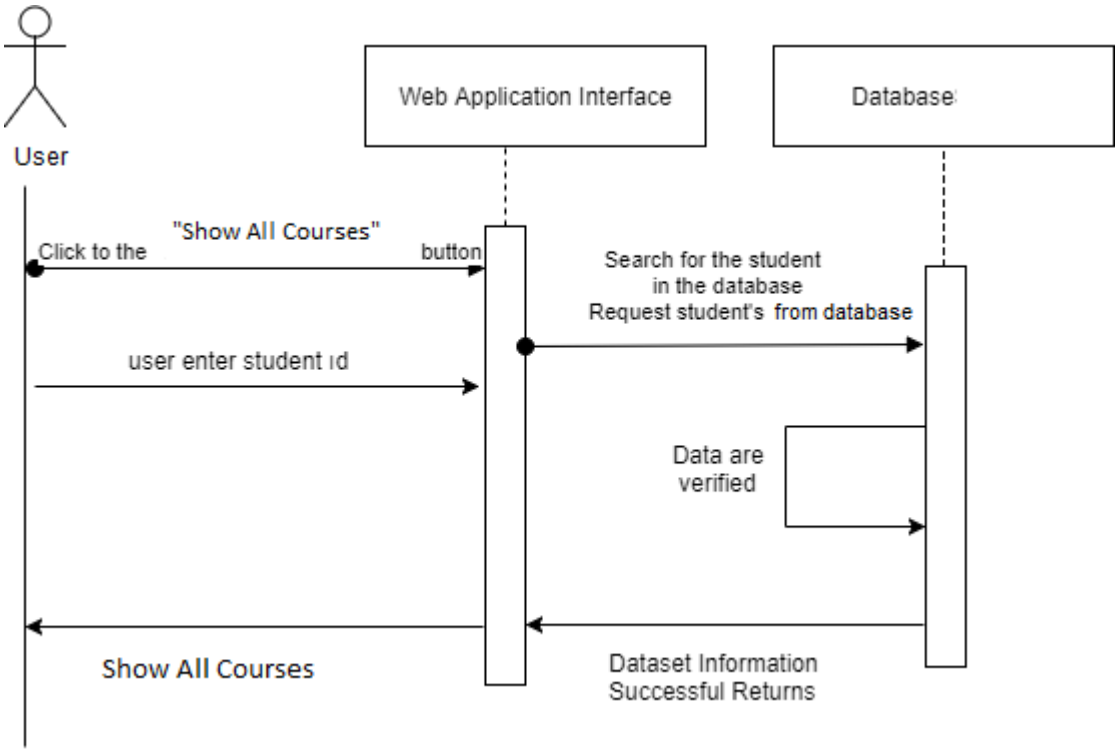


Figure 29 Show all courses Diagram

The user click the “Show all courses” button in student page and necessary informations are displayed by the system.

4.2.1.3.3 Report

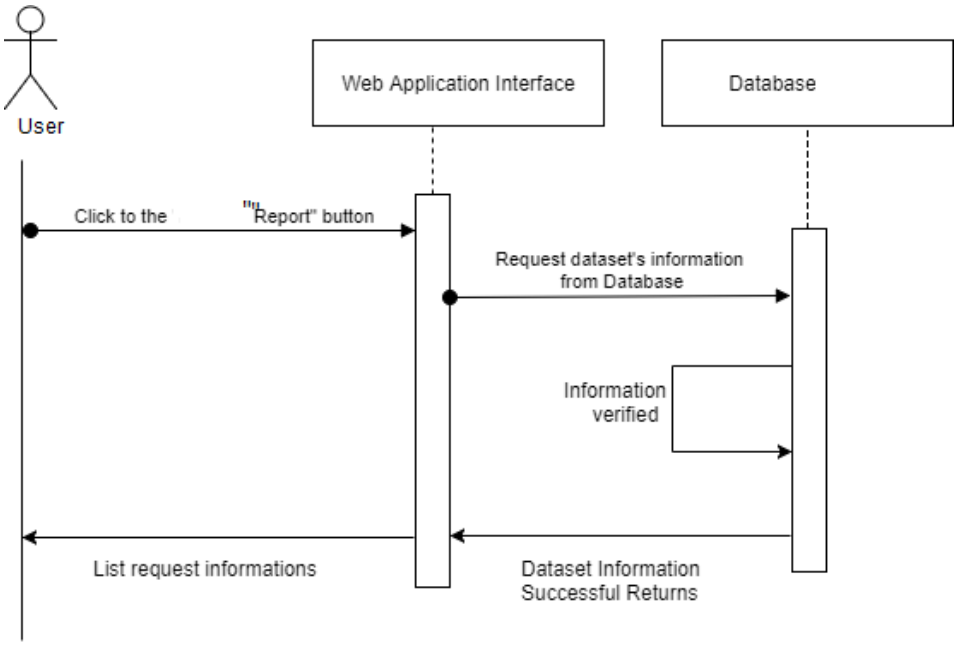


Figure 29 Report

The user click the “Report” button in homepage and selects a report topic. Related reports are displayed by the system. User can change type of report graph such as graph, bar, line.

4.2.1.3.4 GPA Prediction

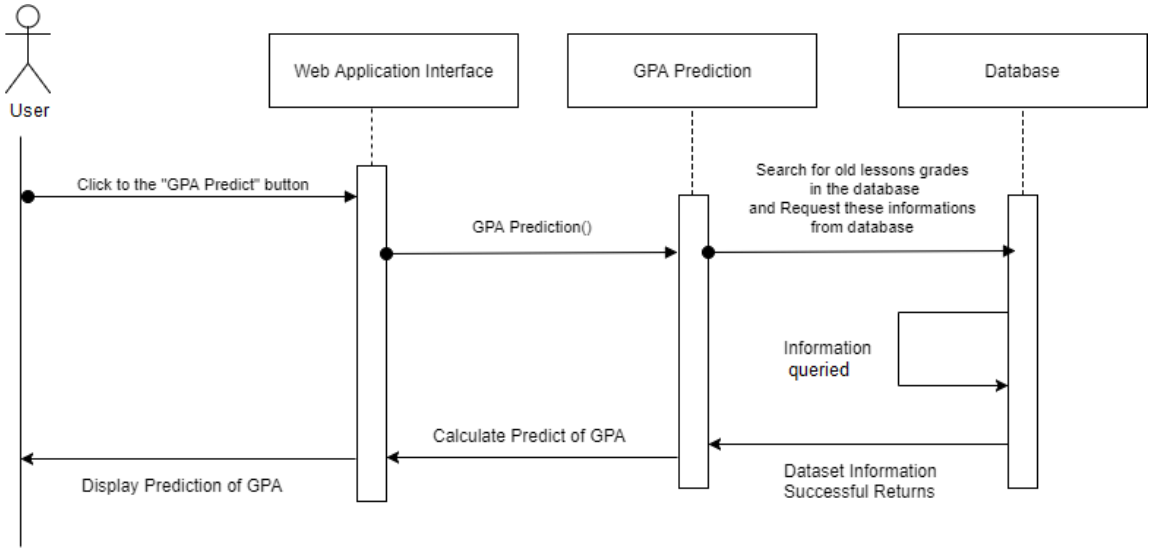


Figure 30 GPA Prediction Diagram

The user click the “Predict” button in GPA Prediction page and GPA value is displayed by the system.

4.2.1.3.5 Length of Study Prediction

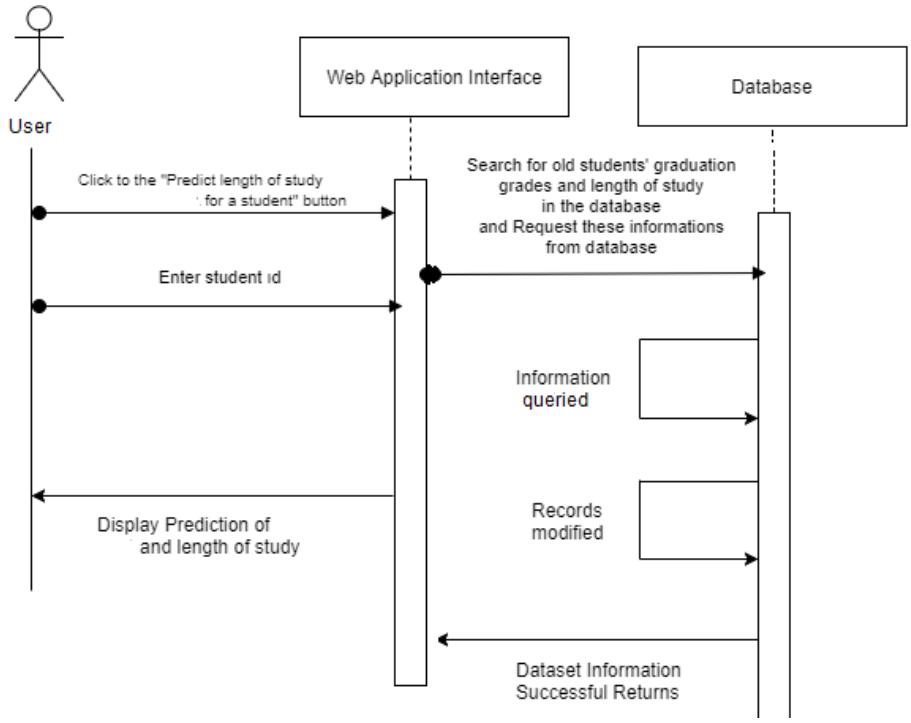


Figure 31 Length of Study Prediction Diagram

The user click the “Predict” button in predict length of study page and length of study value is displayed by the system.

4.2.1.3.6 Course Grade Prediction

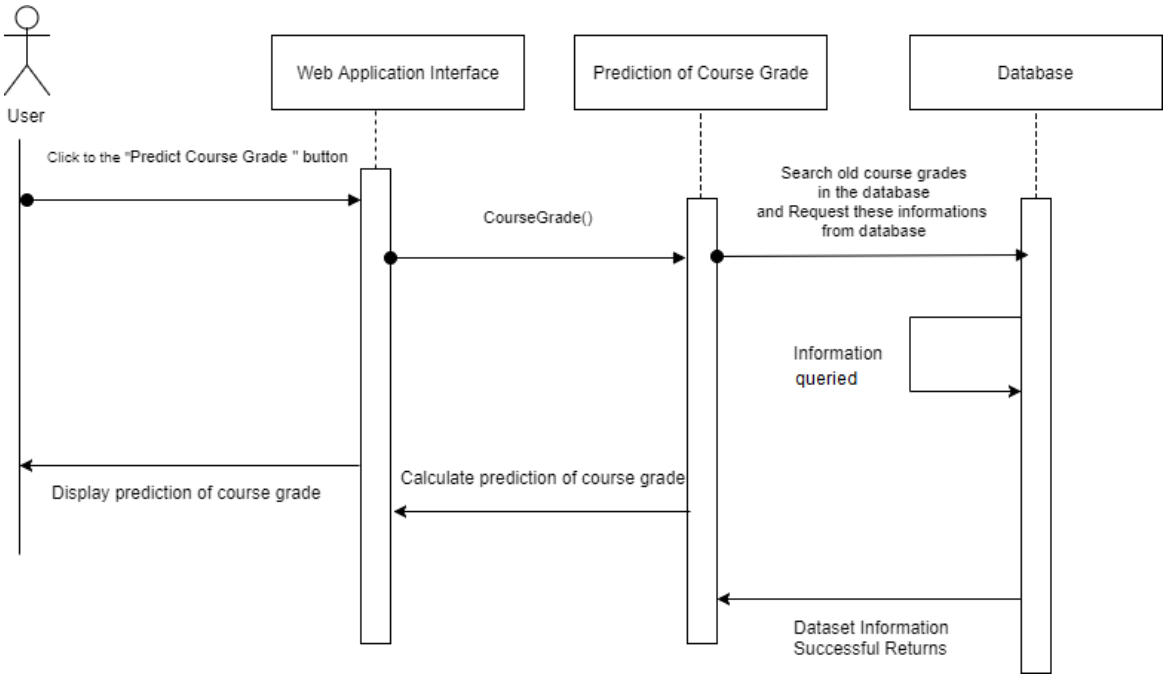


Figure 32 Course Grade Prediction Diagram

The user click the “Predict” button in predict course grade page and course grade is displayed by the system.

4.2.1.3.7 Dropout Prediction

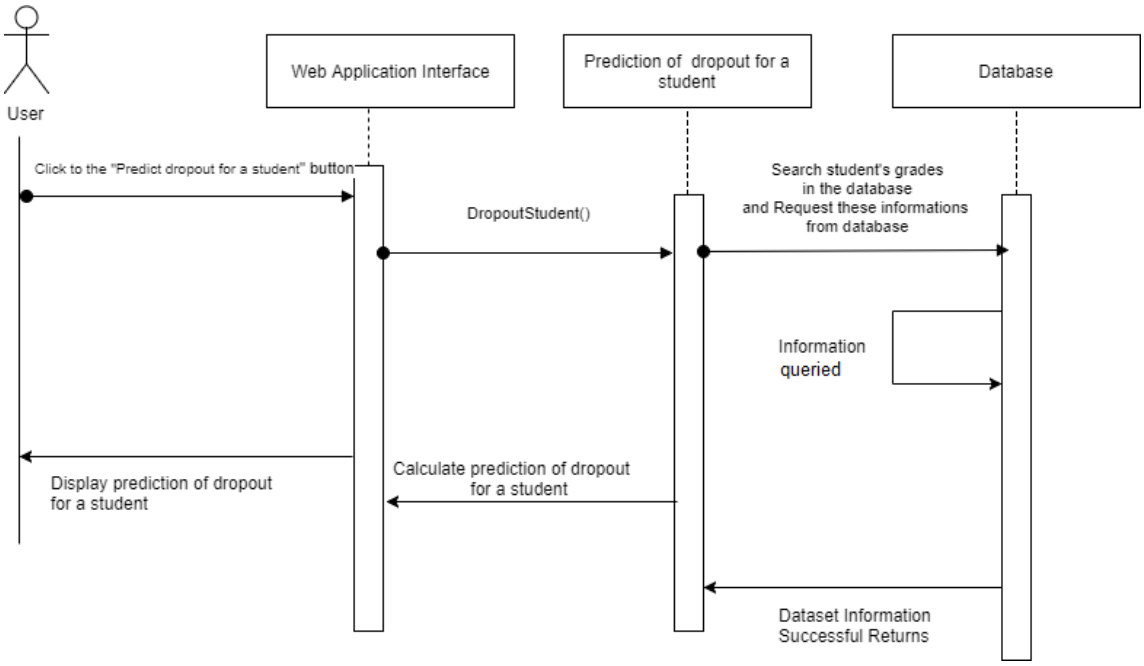


Figure 33 Dropout Prediction Diagram

The user click the “Predict” button in predict course page and dropout value is displayed by the system.

4.2.1.3.8 Create Model

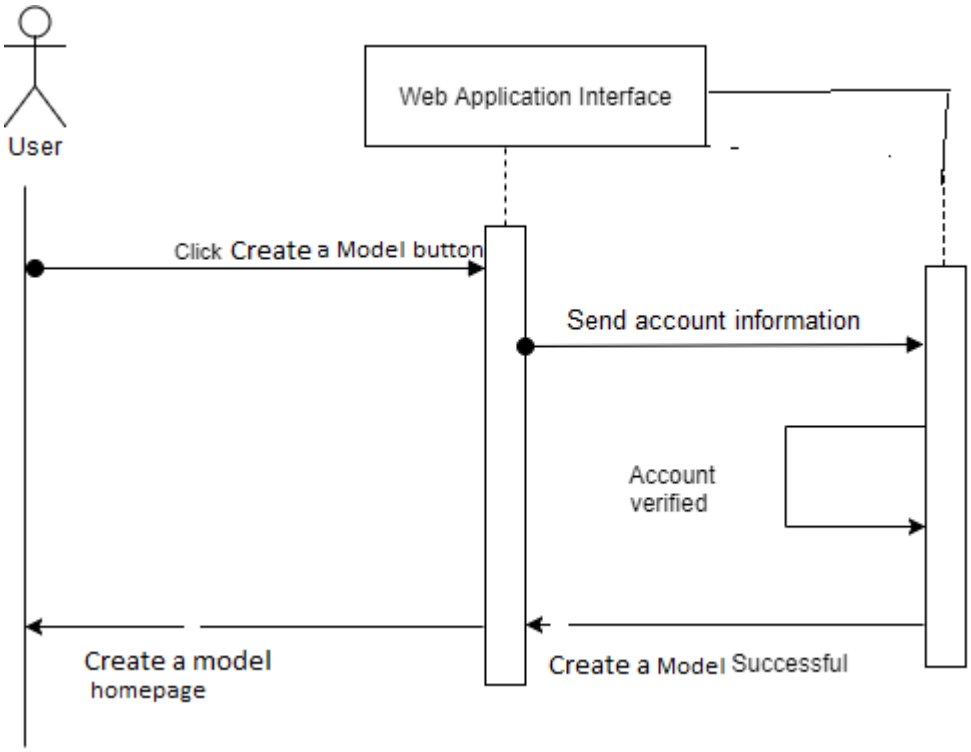
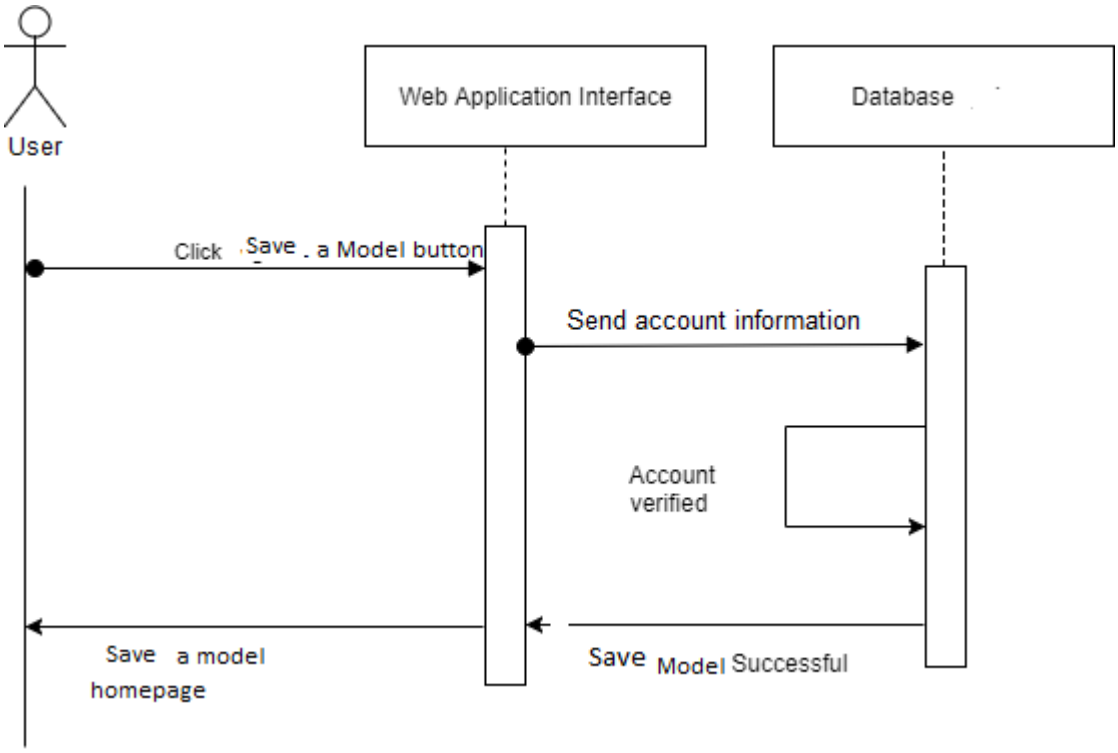


Figure 34 Create a Model Diagram

Creating machine learning model for prediction. To create model, user should be in any machine learning create model page. User be able to fill parameters of machine learning algorithm if he/she wants. Otherwise, default paramaters will be used. After click “Create Model” button, created model information shows up in bottom of the page.

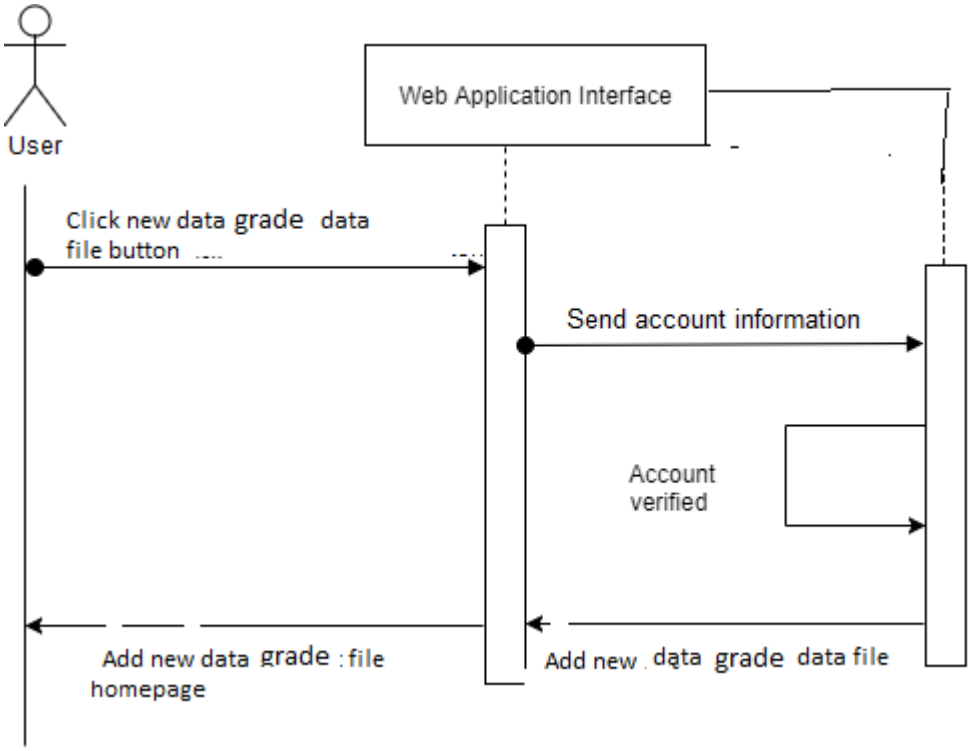
4.2.1.3.9 Save Model



User can save a model as default or not after create model. If model is saved as default then related prediction function will use that default model.

Figure 35 Save Model Diagram

4.2.1.3.10 Add New Grade File



The user clicks ‘Add New Grade’ button in homepage. User selects which data file to add. The system add data file and show calculations for that file.

Figure 36 Add New Grade File Diagram

4.2.1.3.11 Add New Student File

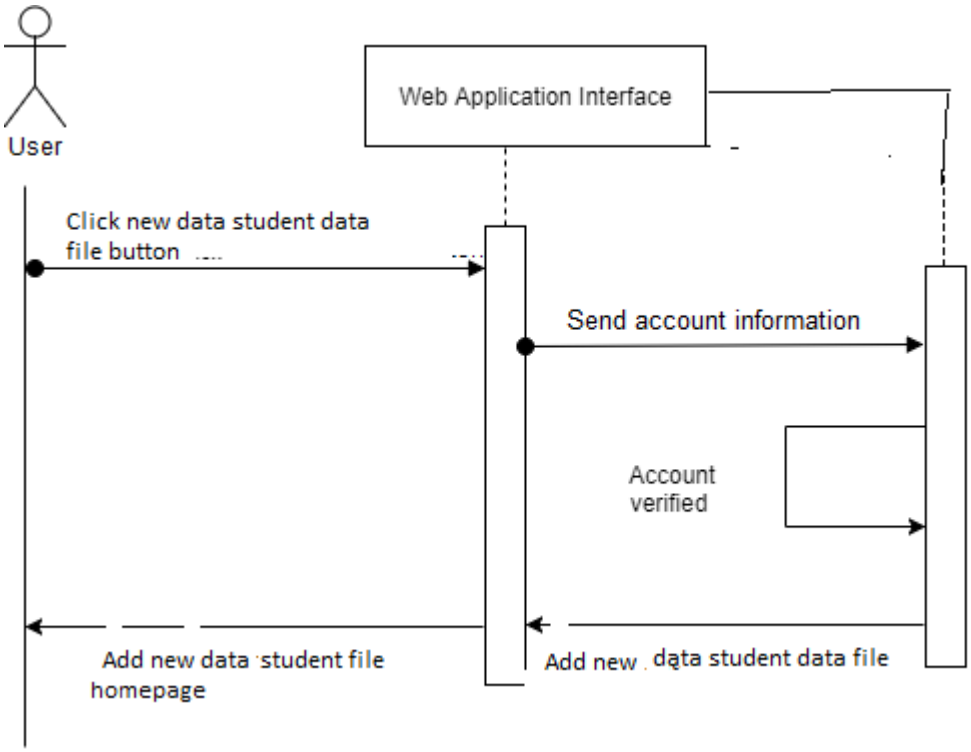


Figure 37 Add New Student File Diagram

The user clicks ‘Add New Student’ button in homepage. User selects which data file to add. The system add data file and show calculations for that file.

4.2.1.3.12 Edit Courses

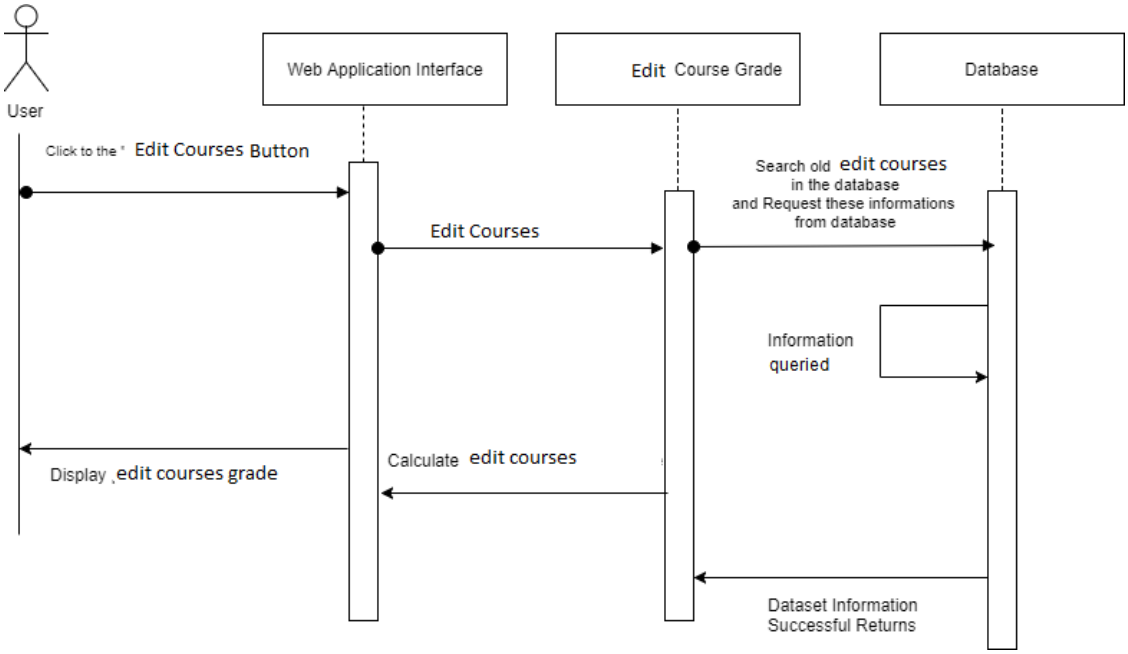


Figure 38 Edit Courses Diagram

The user click the "Edit courses" button in show all courses page and change value of a course grade, course name and semester.

4.2.2 Architecture Design of System

4.2.2.1 Profile Management

Summary: This system is used by students, professors, department head, faculty head and rector. Users can login and exit from the system.

Actor: Professors, Rector, Faculty Head, Department Head

Precondition: User must enter the website.

Basic Sequence:

1. All participants should start system with login.
2. All participant login using university mail as username and password.
3. All users can exit from system by selecting logout button.

Exception: Database connection can be failed.

Post Conditions: Participant should be enrolled in system.

Priority: Low

4.2.2.2 Mutual Home Page

Summary: This page is used by all users except students. This page provides add new data file for grades and student, view reports and create machine learning model page.

Actor: Professor, Rector, Faculty Head, Department Head

Prediction: All users must be logged in the system.

Basic Sequence:

1. User can select any page such as report, create model and data from menu.
2. Users can exit from the system by selection exit button.

Exception: None

Post Conditions: All users should be enrolled in Çankaya University system.

Priority: High

4.2.2.3 Report Page

Summary: This page is used by all users except students. There are three main report section in the page: course, student and department reports. Each of them contains subreports that can be shown as graph, line, bar.

-Grade distributions: by course/year, course/program/year, department/year, faculty/year, university/year, professor/year, gender/year

-Graduation distributions: by length/dept/year, length/univ/year

-Course success distributions: fail/pass /year

-Dropout distributions: by department/year

-Average GPA distributions: by dept/year,

Actor: Professor, Rector, Faculty Head, Department Head

Prediction: All users must be logged in the system.

Basic Sequence:

1. User should choose which type of report they want to see.
2. Users can get any report by selection the desired report type. For doing this, they can select report button and select report's type from mutual home page menu.
3. Users can continue the system by selecting detailed report button from mutual home page menu.
4. Users can exit from the system by selection exit button.

Exception: None

Post Conditions: All users should be enrolled in Çankaya University system.

Priority: High

4.2.2.4 Create Model Page

Summary: Users except students be able to create machine learning models in create model page.

Actor: Professor, Rector, Faculty Head, Department Head

Precondition: User must be logged in the system.

Basic Sequence:

1. User can fill parameter for machine learning algorithm. Otherwise, default algorithms will use.
2. Click create model button after fill parameters.
3. Users can exit from the system by selection exit button.

Exception: None

Post Conditions: User except student should be enrolled in system.

Priority: Medium

4.2.2.5 Student Home Page Menu

Summary: Student be able to enter prediction page and course managament page. Show all courses page includes add, edit or delete courses.

Actor: Student

Precondition: Student must be logged in the system.

Basic Sequence:

1. Student can open prediction page for gpa, course grade, dropout and length of the study.
2. Student can add, edit or delete course in show all courses page.
3. Student can exit from the system by selection exit button.

Exception: None

Post Conditions: Student should be enrolled in Cankaya University system.

Priority: Medium

4.2.2.6 Prediction Home Page

Summary: Student be able to predict gpa, course grade, dropout and length of study.

Actor: Student

Precondition: Student must be logged in the system.

Basic Sequence:

1. Student can learn value of predicted gpa, course grade, dropout or length of study after click to predict button in related pages.
2. Student can exit from the system by selection exit button.

Exception: None

Post Conditions: Studentshould be enrolled in system.

Priority: High

4.2.3Activity Diagram

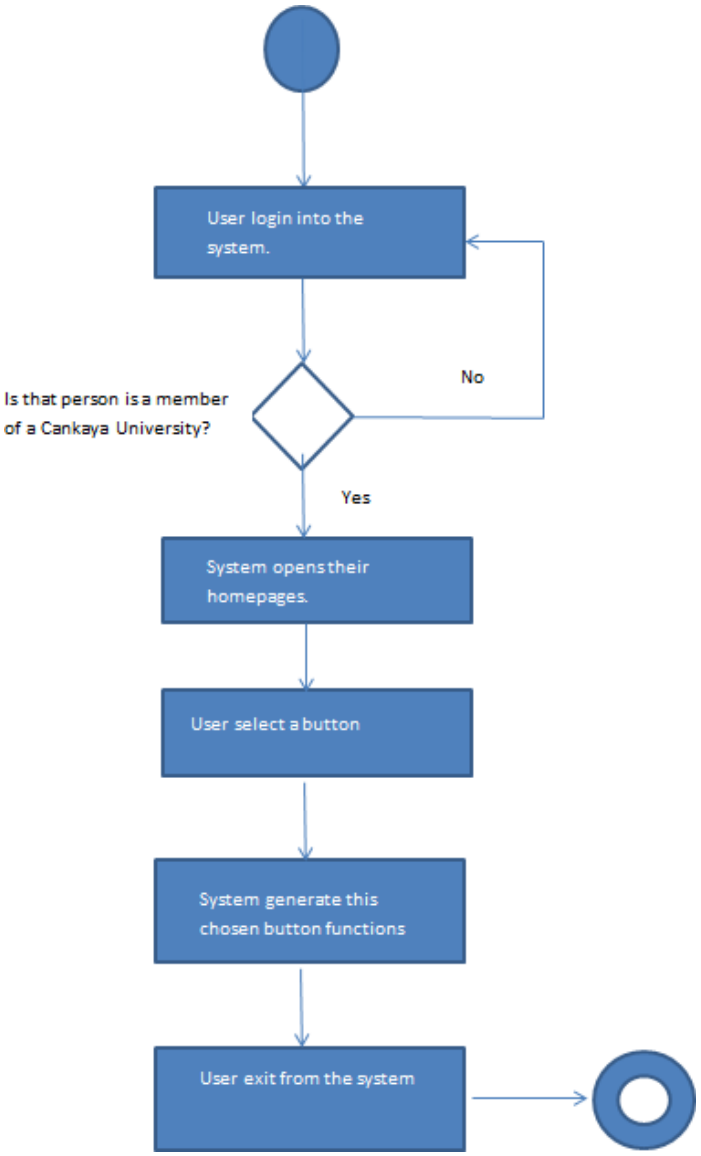


Figure 39 Activity Diagram

Figure 39 shows that how the scenario generation works as an activity diagram. When the user login to the system, it controls whether the user is a member of Cankaya University or not. If the user is a member, system opens user's home page with all buttons. User selects a button which he/she wants and then system generate this buttons functions. When he/she finished their request to the system, they can exit from the system.

4.3. Use Case Realizations

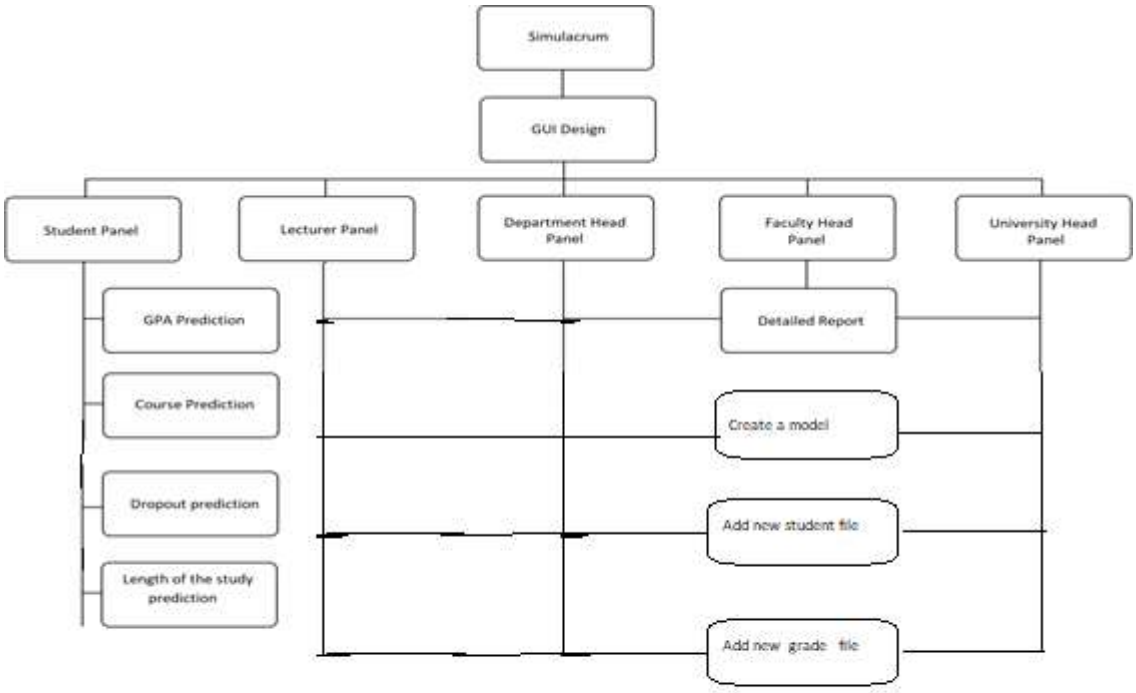


Figure 40 Block Diagram

4.3.1 Brief Description of Figure 40

In figure 40, all designed system is displayed in block diagram. Diagram includes five main component and their sub-systems.

4.3.1.1 Student Panel Design

In student panel, student is able to interact with system. System has own student main page and it contains three sub-system; prediction, add courses, show all courses. There are three buttons in main page that shows each sub-system. Every button directs students to related page. In prediction home page, there are four buttons which names are GPA prediction, Dropout prediction, Course grade prediction, Length of study prediction. Every button directs students to related page. GPA prediction is responsible for making a prediction of a GPA. Left sides of the all prediction pages include tables to show student's previous added lessons. Below the tables there are buttons for predictions. After student clicks the buttons, predicted value are displayed by in each page. On the other hand, course prediction makes an estimate for a certain course. Student must enter which course grade want to predict. In add courses page, student must enter

his/her available past semesters, course grades and course names. To do so, student must fill all three textboxes. Left side of the show all courses page includes tables to show student's previous added lessons. Below the table there is a button for edit courses. If students want to edit these courses, they can delete or editing courses.

4.3.1.2 Professor/Rector/Faculty Head/Department Head Panel Design

In mutual head panel users can interact with system. Main page includes four sub-system which are create model, add new student data file, add new grade data file and report. There are four buttons in main page that shows each sub-system. Every button directs users to related page. In create model page, users can create new models for predictions so that way every new predicted value can be calculated these default models. Left side of the page includes text boxes and dropdown lists to assign parameter models to values. Rest of the page displays new created models' accuracy and loss value. In Add new student data file or new grade date file pages, users can add new data files which include our university students and grades information's. Left side of the page includes dropdown list to show previous added files. In detailed report page, users can choose which type of report they want to see. Report page includes three sub-system which are student reports, course reports and department reports. Every button directs users to related page. Many different reports will be available in detailed report page such as failure rates by course, grade distributions by course and exc. Left side of the page includes textboxes or dropdown lists to choosing which student, department or course information are reported by the system. Rest of the page displays related report information, graphs and lists.

5. Test Plan

5.1. Introduction

5.1.1 Version Control

Version No	Description of Changes	Date
1.0	First Version	May 8, 2018

5.1.2 Overview

The use case of What Will My Gpa Be? System users namely participant and admin which had been determined in SRS document will be tested.

5.1.3 Scope

This document encapsulates the test plan of the use cases, test design specifications and the test cases correspond to test plan.

5.1.4 Terminology

Acronym	Definition
MWPM	Main Web Page Menu
SWP	Student Web Page Menu
MWP	Department Head / Faculty Head / University Head Web Page Menu

5.2.Features to be tested

5.2.1 Main Web Page Menu

In our project, web site components are used. The web site is divided into 6 parts which are Main Menu, Student Menu, Department Head Menu, Faculty Head Menu, Lecturer Menu and University Head Menu. Every part of the menus' also includes smaller functions. Main Web Page Menu includes testing of the functions of Main Menu components which are used in the project such as button, panel, text, etc.

5.2.2 Student Web Page Menu

This part includes test cases and test plan of Student Web Page Menu. Student Web Page Menu includes Precdictions panel, Show all courses panel and add courses panel. In predictions panel have four subsystems such as GPA Prediction, Prediction of Course Grade, Dropout prediction and length of the study prediction. All related calculation of values shall be displayed to the student. Testing of the stated requirements will occur in this document.

5.2.3 Department Head / Faculty Head / University Head / Professor Web Page Menu

This part includes test cases and test plan of Mutual Home Page Menu. Home Page Menu includes add new student data file, add new grade data file, create model and report. This section includes the test situation and test plan of the Head of Department / Head of Faculty / University

President Web Page. All related functions are available for four users.Testing of the stated requirements will occur in this document.

5.3.Item Pass/Fail Criteria

5.3.1 Exit Criteria

1. 100% of the test cases are executed
2. 95% of the test cases passed
3. All High Priority test cases passed

5.4.References

[1] GitHub. (2018). SRS. [online] Available at: https://github.com/CankayaUniversity/ceng-407-408-project-what-will-my-gpa-be/wiki/Software-Requirements-Specification [Accessed 12 Mar. 2018].

[2] GitHub. (2018). SDD. [online] Available at: https://github.com/CankayaUniversity/ceng-407-408-project-what-will-my-gpa-be/wiki/Software-Design-Document [Accessed 12 Mar. 2018].

5.5.Test Design Specifications

5.5.1 Main Web Page Menu (MWPM)

5.5.1.1 Subfeatures to be tested

5.5.1.1.1 Login (MWPM.PLG)

Participants can login to the system by entering their own emails and passwords for being able to use system.

5.5.1.1.2 Exit (MWPM.PXT)

Participants can logout to the system by selecting “Exit” button.

5.5.1.2 Test Cases

TC_ID	Requirements	Priority	Scenario Description
MWPM.PLG.01	3.2.1	H	Enter a valid username and password

MWPM.PLG.02	3.2.1	H	Enter a invalid username and password
MWPM.PLG.03	3.2.1	H	Enter a valid username and password
MWPM.PLG.04	3.2.1	H	Enter a valid username and password
MWPM.PLG.05	3.2.1	H	Enter a blank username and password

TC_ID	Requirements	Priority	Scenario Description
MWPM.PXT.01	3.2.1	H	Select “Logout” button. After selecting, the user logout for the system.

5.5.2 Student Web Page Menu (SWP)

5.5.2.1 Subfeatures to be tested

5.5.2.1.1 GPA Prediction (SWP.GPR)
Students can display the predicted GPA value which is related to their own previous grades.

5.5.2.1.2 Course Grade Prediction (SWP.CGPR)
Students can display the predicted course final grade value.

5.5.2.1.3 Dropout Prediction (SWP.DPR)
Students can display the predicted dropout value which is related to their own previous grades.

5.5.2.1.4 Length of study Prediction (SWP.LPR)
Students can display the predicted length of study grade value.

5.5.2.1.5 Edit Courses (SWP.ECS)
Students can edit or delete one’s course, semester, grade.

5.5.2.2 Test Cases

TC_ID	Requirements	Priority	Scenario Description

SWP.GPR.01	3.2.2	H	If the student enter courses, the predicted value will be displayed.
SWP.GPR.01	3.2.2	H	If the student no entered any course, then display error message.

TC_ID	Requirements	Priority	Scenario Description
SWP.CGPR.01	3.2.3	H	If the student select invalid course, then display error message.
SWP.CGPR.02	3.2.3	H	After selecting Prediction of course grade button, the predicted value will be displayed.

TC_ID	Requirements	Priority	Scenario Description
SWP.DPR.01	3.2.9	H	If the student enter courses, the predicted value will be displayed.
SWP.DPR.02	3.2.9	H	If the student no entered invalid course, then display error message.

TC_ID	Requirements	Priority	Scenario Description
SWP.LPR.01	3.2.6	H	If the student enter courses, the predicted value will be displayed.
SWP.LPR.02	3.2.6	H	If the student no entered invalid course, then display error message.

TC_ID	Requirements	Priority	Scenario Description
SWP.ECS.01	3.2.10	M	If the student enter valid courses,grades or semsters, courses are edited.

SWP.ECS.02	3.2.10	M	If the student enter invalid courses,grades or semsters, then display error message.

5.5.3 Mutual Home Page Menu(MWP)

5.5.3.1 Subfeatures to be tested

5.5.3.1.1 Create Model (MWP.CM)
Users can create machine learning model and save it.

5.5.3.1.2 Report(MWP.RP)
Users can get report about previous informations from added data files.

5.5.3.2 Test Cases

TC_ID	Requirements	Priority	Scenario Description
MWP.CM.01	3.2.3	H	If users give valid parameters to machine learning algorithms, model is created and save button is enabled.
MWP.CM.02	3.2.3	H	If users give invalid parameters to machine learning algorithms, then display error message.

TC_ID	Requirements	Priority	Scenario Description
MWP.RP.01	3.2.11	M	If users give valid parameters to report, then display reports with graph,bar or lines.
MWP.RP.02	3.2.11	M	If users give invalid parameters to report, then display error message.

5.6. Detailed Test Cases

5.6.1 MWPM.PLG.01

TC_ID	MWPM.PLG.01
Purpose	Enter a valid username and password
Requirements	3.2.1
Priority	High.
Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.
Setup	A user should be a member of Cankaya University.
Procedure	[A01] Go to login page.
	[A02] Enter a valid user university email.
	[A03] Enter the valid password for this user.
	[A04] Click on the “Login” button.
	[V01] Observe that the login is successful and the user main page appears.
Cleanup	Exit

5.6.2 MWPM.PLG.02

TC_ID	MWPM.PLG.02
Purpose	Enter a invalid username and password

Requirements	3.2.1
Priority	High.
Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.
Setup	Login button is scripted.
Procedure	[A01] Go to login page.
	[A02] Enter a invalid user university email.
	[A03] Enter the valid password for this user.
	[A04] Click on the “Login” button.
	[V01] Observe that “Email is invalid” error message is displayed
Cleanup	Close Main Page

5.6.3 MWPM.PLG.03

TC_ID	MWPM.PLG.03
Purpose	Enter a valid username and password
Requirements	3.2.1
Priority	High.

Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.
Setup	Login button is scripted.
Procedure	[A01] Go to login page.
	[A02] Enter a valid user university email.
	[A03] Enter the invalid password for this user.
	[A04] Click on the “Login” button.
	[V01] Observe that “Password is invalid” error message is displayed
Cleanup	Close Main Page

5.6.4 MWPM.PLG.04

TC_ID	MWPM.PLG.04
Purpose	Enter a valid user username and blank password
Requirements	3.2.1
Priority	High.
Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.

Setup	Login button is scripted.
Procedure	[A01] Go to login page.
	[A02] Enter a valid user university email.
	[A03] Click on the “Login” button
	[V01] Observe that “Password is empty” error message is displayed
Cleanup	Close Main Page

6.5.5 MWPM.PLG.05

TC_ID	MWPM.PLG.02
Purpose	Enter a valid username and blank password
Requirements	3.2.1
Priority	High.
Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.
Setup	Login button is scripted.
Procedure	[A01] Go to login page.
	[A02] Click on the “Login” button.

	[V01] Observe that “Email and password is empty” error message is displayed
Cleanup	Close Main Page

5.6.6 MWP.PXT.01

TC_ID	MWPM.PLG.02
Purpose	Exit from the system.
Requirements	3.2.1
Priority	High.
Estimated Time Needed	5 Minutes
Dependency	Web Page should be opened.
Setup	Exit button is scripted.
Procedure	[A01] Select “Exit” button.
	[A02] Click on the “Login” button.
	[V01] Verify that user is logout from the system.
Cleanup	Logout

5.6.7 SWP.GPR.01

TC_ID	SWP.GPR.01
Purpose	If the student enter courses, the predicted value will be displayed.
Requirements	3.2.2
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	If there is no course for that student, Add Courses page should be opened.
Setup	Add Courses button is scripted.
Procedure	[A01] Go to Home page.
	[A02] Go to GPA Prediction page.
	[A03] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that the value of prediction is displayed.
Cleanup	Close GPA Prediction Page

5.6.8 SWP.GPR.02

TC_ID	SWP.GPR.02
Purpose	If the student no entered any course, then display error message.

Requirements	3.2.2
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	GPA Predict page should be opened.
Setup	Predict button is scripted.
Procedure	[A01] Go to GPA Predict page.
	[A02] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that “You can not calculate prediction of GPA. Please add new courses.” error message is displayed.
Cleanup	Close GPA Prediction Page

5.6.9 SWP.CGPR.01

TC_ID	SWP.CGPR.01
Purpose	If the student select invalid course, then display error message.
Requirements	3.2.3
Priority	High.

Estimated Time Needed	3 Minutes
Dependency	Course Grade Predict page should be opened.
Setup	Show Course Grade" button is scripted.
Procedure	[A01] Go to Course Grade Predict page.
	[A02] Click on the "Predict" button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that "You are selected invalid course." error message is displayed.
Cleanup	Close Course Grade Prediction Page

5.6.10 SWP.CGPR.02

TC_ID	SWP.CGPR.02
Purpose	After selecting Prediction of course grade button, the predicted value will be displayed
Requirements	3.2.3
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Course Grade Predict page should be opened.

Setup	Show Course Grade” button is scripted.
Procedure	[A01] Go to Course Grade Predict page.
	[A02] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that the value of prediction is displayed.
Cleanup	Close Course Grade Prediction Page

5.6.11 SWP.DPR.01

TC_ID	SWP.DPR.01
Purpose	If the student enter courses, the predicted value will be displayed
Requirements	3.2.9
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Dropout Prediction page should be opened.
Setup	“Predict” button is scripted.
Procedure	[A01] Go to Dropout Prediction page.
	[A02] Click on the “Predict” button.

	[V01] Observe the value of prediction is displayed.
Cleanup	Course Dropout Prediction page

5.6.12 SWP.DPR.02

TC_ID	SWP.DPR.02
Purpose	If the student no entered any course, then display error message.
Requirements	3.2.9
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Dropout Prediction page should be opened.
Setup	“Predict” button is scripted.
Procedure	[A01] Go to Dropout Prediction page.
	[A02] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe the value of prediction is displayed.
Cleanup	Close Dropout Prediction page

5.6.13 SWP.LPR.01

TC_ID	SWP.LPR.01
Purpose	If the student enter courses, the predicted value will be displayed.
Requirements	3.2.6
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Length of study prediction page should be opened.
Setup	“Predict” button is scripted.
Procedure	[A01] Go to Length of study prediction page.
	[A02] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe the value of prediction is displayed.
Cleanup	Close Length of study prediction page

5.6.14 SWP.LPR.02

TC_ID	SWP.LPR.02
Purpose	If the student no entered any course, then display error message
Requirements	3.2.6

Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Length of study prediction page should be opened.
Setup	“Predict” button is scripted.
Procedure	[A01] Go to Length of study prediction page.
	[A02] Click on the “Predict” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that “You are selected invalid course.” error message is displayed.
Cleanup	Close Length of study prediction page

5.6.15 SWP.ECS.01

TC_ID	SWP.ECS.01
Purpose	If the student enter valid courses,grades or semsters, courses are edited
Requirements	3.2.10
Priority	Medium.
Estimated Time Needed	3 Minutes

Dependency	Show all course page should be opened and then select Edit courses button.
Setup	“Edit courses” button is scripted.
Procedure	[A01] Go to Show all course page.
	[A02] Click on the “Edit courses” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that courses are edited in the database.
Cleanup	Close Edit Courses page

5.6.16 SWP.ECS.02

TC_ID	SWP.ECS.02
Purpose	If the student enter invalid courses,grades or semsters, then display error message.
Requirements	3.2.10
Priority	Medium.
Estimated Time Needed	3 Minutes
Dependency	Show all course page should be opened and then select Edit courses button.
Setup	“Edit courses” button is scripted.

Procedure	[A01] Go to Show all course page.
	[A02] Click on the “Edit courses” button.
	[V01] Verify that student has courses in the database.
	[V02] Observe that “You are entered invalid course.” error message is displayed.
Cleanup	Close Edit Courses page

5.6.17 MWP.CM.01

TC_ID	MWP.CM.01
Purpose	If users give valid parameters to machine learning algorithms, model is created and save button is enabled.
Requirements	3.2.3
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Create Model page should be opened.
Setup	“Create Model” button is scripted.
Procedure	[A01] Go to Create Model page.
	[A02] Click on the “Create Model” button.

	[V01] Verify that parameters are valid.
	[V02] Observe that models are created and save model button is enabled.
Cleanup	Close Edit Courses page

5.6.18 MWP.CM.02

TC_ID	MWP.CM.02
Purpose	If users give invalid parameters to machine learning algorithms, then display error message.
Requirements	3.2.3
Priority	High.
Estimated Time Needed	3 Minutes
Dependency	Create Model page should be opened.
Setup	“Create Model” button is scripted.
Procedure	[A01] Go to Create Model page.
	[A02] Click on the “Create Model” button.
	[V01] Verify that parameters are invalid.
	[V02] Observe that “You are entered invalid parameters.” error message is displayed.

Cleanup	Close Edit Courses page

5.6.19 MWP.RP.01

TC_ID	MWP.RP.01
Purpose	If users give valid parameters to report, then display reports with graph,bar or lines.
Requirements	3.2.11
Priority	Medium.
Estimated Time Needed	3 Minutes
Dependency	Report page should be opened.
Setup	“See Report” button is scripted.
Procedure	[A01] Go to Report page.
	[A02] Set parameters to reports.
	[A03] Click on the “See Report” button.
	[V01] Verify that parameters are invalid.
	[V02] Observe that reports are created and displayed by the system.
Cleanup	Close Edit Courses page

6.Test Results

6.1 Individual Test Results

TC ID	Priority	Date Run	Run By	Result	Explanation
MWPM.PLG.01	H	01.05.2018	Meltem Daşdemir	Pass	Enter a valid username and password
MWPM.PLG.02	H	01.05.2018	Meltem Daşdemir	Pass	Enter a invalid username and password
MWPM.PLG.03	H	01.05.2018	Meltem Daşdemir	Pass	Enter a valid username and password
MWPM.PLG.04	H	01.05.2018	Meltem Daşdemir	Pass	Enter a valid user username and blank password
MWPM.PLG.05	H	01.05.2018	Meltem Daşdemir	Pass	Enter a valid username and blank password
MWPM.PXT.01	H	01.05.2018	Meltem Daşdemir	Pass	Exit from the system.
SWP.GPR.01	H	03.05.2018	Sergen İspir	Pass	If the student enter courses, the predicted value will be displayed.
SWP.GPR.02	H	03.05.2018	Sergen İspir	Pass	If the student no entered any course, then display error message.
SWP.CGPR.01	H	03.05.2018	Sergen İspir	Pass	If the student select invalid course, then display error message.

SWP.CGPR.02	H	03.05.2018	Sergen İspir	Pass	After selecting Prediction of course grade button, the predicted value will be displayed.
SWP.DPR.01	H	05.05.2018	Sergen İspir	Pass	If the student enter courses, the predicted value will be displayed.
SWP.DPR.02	H	05.05.2018	Sergen İspir	Pass	If the student no entered invalid course, then display error message.
SWP.LPR.01	H	05.05.2018	Sergen İspir	Pass	If the student enter courses, the predicted value will be displayed.
SWP.LPR.02	H	05.05.2018	Sergen İspir	Pass	If the student no entered invalid course, then display error message.
SWP.ECS.01	M	05.05.2018	Sergen İspir	Pass	If the student enter valid courses,grades or semsters, courses are edited.
SWP.ECS.02	M	05.05.2018	Sergen İspir	Pass	If the student enter invalid courses,grades or semsters, then display error message.
MWP.CM.01	H	05.05.2018	Efnan Gülkanat	Pass	If users give valid parameters to machine learning algorithms, model is created and save button is enabled.
MWP.CM.02	H	05.05.2018	Efnan Gülkanat	Pass	If users give invalid parameters to machine learning algorithms, then display error message.

MWP.RP.01	M	05.05.2018	Efnan Gülkanat	Pass	If users give valid parameters to report, then display reports with graph,bar or lines.
MWP.RP.02	M	05.05.2018	Efnan Gülkanat	Pass	If users give invalid parameters to report, then display error message.

6.2 Summary of Test Results

Priority	Number of TCs	Executed	Passed
H	16	16	16
M	4	4	4
L	0	0	0
Total	20	20	20

6.3 Exit Criteria

We have executed all test cases and 100% of test cases are passed. Also, 100% of high and medium priority test cases are passed. Software development activities are completed within the anticipated cost. Software development activities are completed within the anticipated timeline. Exit criteria is met.

Criteria	Met or Not
100% of the test cases are executed	M
100% of the test cases passed	M

100% of High and Medium Priority test cases passed	M
No high priority or severe bugs are left outstanding.	M
Verify if software development activities are completed within the projected cost.	M
Verify if software development activities are completed within the projected timelines.	M

6.4 Conclusion

This section includes the test results of the project “Student Performance Evaluation System”. The test cases are implemented and 100% of the test cases are completed successfully. Software development activities are completed within the anticipated cost. Current stage of the project is available to use. Failed test cases will be solved in time in order to increase the quality.

7.Conclusion

In this project our goal was to make a web application to help and increase student success using machine learning methods and student/lecturer/course data. System is responsible to make a prediction for related functions. Output of the functions indicates how student improve oneself according to results, what critical situation should handle or warn to student for bad results for his/her academic life. In addition, these functions not only usable for students but academic staff as well. Most academic staff be able to access and use these functions. Also, some of the academic staff has different type of prediction function. Furthermore, every academic staff can have detailed report according to their duties.

To begin with, we have made a literature research to find related projects and figured out how they have been made. Thus, we’ve gained different perspective for our project and have learned how can we use this knowledge to perform project. We found what kind of tools we should use such as python as programming language Flask for visualize the data and our web site. Our next step was to prepare software requirement specification (SRS) to determine the requirements of the project. Documentation contains a general structure of project, use cases and development methodologies. Finally, software design document has prepared to create a generic design for application and given guidance of software architecture.

As a result, we obtained big detailed documentations for make an application to help and enhance student success and indirectly university success. Both student and academic staff have big advantage through using this application. Of course system has a disadvantage which is about updating prediction functions. Machine learning algorithms uses big data and this data needs preprocess and maintenance. System should update machine learning models after each semester.

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