Yarmouk University

Information Technology and Computer Science
Information Systems (IS)

University Course Recommendation System Using Data Mining on Student Academic Data

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1. INTRODUCTION

PURPOSE OF THE SYSTEM:

In each semester, students must decide what courses they should register in their schedules according to the faculty course table and the previously registered courses in each students' register. However, the students are not given proper guidance on what to take in detail and it is very difficult to match the students' needs with the offered courses in the faculty course table. Our system will assist the students in deciding what to take and how to build their schedule for the coming semester.

1.2 PROJECT DESCRIPTION:

The system will use past student data to determine the best possible schedules, customized to each students' needs based on what courses they have already taken and other possible variables such as GPA (this is for students in their second year and above). As for the first-year students in their first semester, the system will give them a default set of possible courses since there is no personal student course history that we can build on. Thus, the system shall provide an advisory schedule specifically set for the first term of the first year that they may follow.

1.3 OBJECTIVES AND SUCCESS CRITERIA OF THE PROJECT:

The system mainly aims to achieve the following:

❖ Ease the registration process for the students.

❖ Help students score better in their overall courses per semester, and in turn raising their GPA.

❖ Raise the overall average of student marks per course.

❖ Offering guidance to the students about the general contents of each course.

❖ Ensure that students are able to finish in the recommended 4-year period by organizing their courses and credit hours in a proper sequence.

1.4 TARGETED AUDIENCE:

The system will serve both the newly-registered students and the students who are already part of the faculty. The Guidance Counselor will also be using the system to help the student.

1.5 LITERATURE REVIEW:

It all starts with the exponential growth of data in the past decade, where almost all details in our daily lives from motion sensor readings to user interactions with technology are being recorded. This produces a giant collection of data known as big data, that can be mined and analyzed to extract beneficial knowledge.

Recommender systems predict the preference of the user for these items, which could be in form of a rating or response. When more data becomes available for a customer profile, the recommendations become more accurate.

There are a variety of applications for recommendations including movies (e.g., Netflix), consumer products (e.g., Amazon or similar on-line retailers), music (e.g., Spotify), or news, social media and advertising [3].

Degree Compass [15]:

This system was created by Austin Peay State University (APSU), to help students with their course choices for each semester. As the authors mentioned in their article, even with the help of a guidance counselor, it is still difficult to choose courses in a way that is most suitable and beneficial to the students. It was inspired by the recommendation systems of companies such as Netflix, Amazon and pandora.

Amazon Product Recommendation System [12]:

Although Amazon's System has both a different target audience and recommended object, it was the main inspiration behind our system. The way that amazon will recommend customers items based on the customer's preferences and product's relevancy to those preferences is very similar to how our system operates. Amazon takes into perspective the customer's preferences, while we take the student's circumstances and give them a schedule that fits those circumstances. Amazon will rate the relevancy of products to a certain customer's specific needs based on both the customer's needs and the product's reviews/Ratings and descriptions and how much they match, while our system gives the student certain options with compromises that the student can match to their own needs based on their personal priorities.

Netflix Movie Recommendations [11]:

Netflix offers its customers recommendations of movies they might like. These recommendations are based on ratings provided by users. The importance of predicting ratings accurately is so high, that Netflix offered a prize of one million dollars for the first algorithm that could beat its own recommendation system by 10%.1 The prize was finally won in 2009, by a team of researchers called "Bellkor's Pragmatic Chaos," after over three years of competition

2. REQUIREMENTS PHASE (SYSTEM DESCRIPTION):

2.1 LIST OF FUNCTIONAL REQUIREMENTS

Our system will serve (4) types of users, specified as follows:

2.1.1 GUEST [18]:

- ❖ View descriptions of all department specializations.
- ❖ Book appointment with guidance counselor.

2.1.1 STUDENTS:

- ❖ Enter the system with log-in credentials (username and password).
- ❖ View Course Descriptions Section.
- ❖ Request Course recommendations.
- ❖ Book meeting with Guidance Counselor.

2.1.2 GUIDANCE COUNSELOR:

- ❖ Enter the system with log-in credentials (username and password).
- ❖ View Course Descriptions Section.
- ❖ Edit descriptions section.
- ❖ View generated student schedules.
- ❖ Access student profile information.
- ❖ Book meeting with a student.

2.1.3 SYSTEM ADMINISTRATOR [19]:

- ❖ Create user accounts for both students and guidance counselors.
- ❖ Access and Change user account settings.
- ❖ Add new Department Schedule.
- ❖ Add new Course Section.
- ❖ Edit Course Section.
- ❖ Delete Course Section.
- ❖ Delete User accounts.

2.2 LIST OF NON-FUNCTIONAL REQUIREMENTS [1]:

2.2.1 RELIABILITY, AVAILABILITY, MAINTAINABILITY:

The system shall be implemented on the university server and shall therefore be available at all the times in which the university server is working, it shall also rely on the server's proneness to failures. Maintenance of the system shall be handled by university tech support and shall be made to match the original university website structure to set a standard.

2.2.2 PERFORMANCE, SCALABILITY:

The system shall be able to handle a large set of input data (student data), number of outputs (suggestions) and a large number of users (students from different batches) without negatively affecting performance. The system shall have a multi-user environment and shall therefore have appropriately quick responses and minimal lag.

2.2.3 SECURITY:

The system shall be secure so that student data and information is encrypted and secure. User authentication shall be implemented by using log-in credentials (username and password) and the system shall not allow access if the user fails to provide correct log-in credentials. In addition to the data encryption, only the authorized Guidance Counselor shall be allowed direct access to the system database to maintain the integrity of data.

2.2.4 USABILITY:

As the system shall be similar to the university website, it shall be familiar and maintain a user-friendly UI. The main actions of the website shall be simple and straightforward with little room for usage errors.

2.2.5 TESTABILITY:

The system shall have a clearly defined user base and testing can be limited only to samples of the student community, making the system easy to test across several testing samples which in turn shall cover a bigger area of possible errors.

2.2.6 REUSABILITY:

The current target of our system shall be limited to the Faculty of Computer Science and Information Technology, but with enough time and student data it can be expanded across the faculties of the university.

3. ANALYSIS PHASE (USE CASE DIAGRAMS):

3.1 USE CASE DIAGRAM [2], [13], [14]

A Use Case Diagram is used to help provide a higher-level view of the system. It has been said before that "Use case diagrams are the blueprints for your system" [4]. Essentially used to depict user's possible interactions with the system graphically to stakeholders [20]. A Use Case Diagram typically consists of Actors [21] and Use Cases.
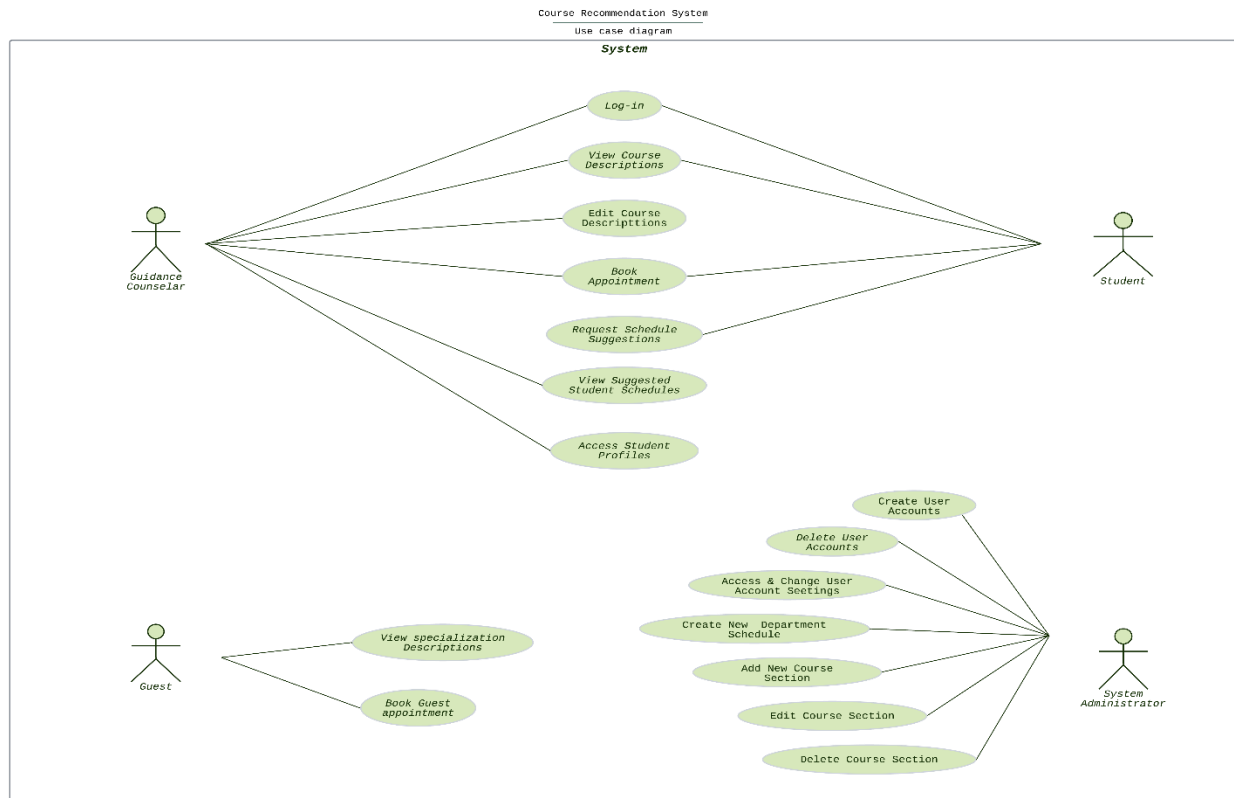
Figure 1 Recommendation System Use Case Diagram

→ Use Case Diagram Summary:

The system has 4 types of Actors (Administrator, Guidance Counselor, Student and Guest).

Admin can create and delete accounts for both students and guidance counselors. Admin can also access and change user information and add the faculty's course schedule to the system.

Student must log-in to the system using their university ID number and password for the student's e-learning system. Student can book appointment with guidance counselor and view course descriptions. Student can request course recommendation schedule from system.

Guidance counselor can login to system, access student information, view and edit course description, and view suggested students' schedules.

Guest can view public version of system without login and view specialization descriptions, and book appointment with guidance counselor.

3.2 USE CASE SPECIFICATIONS

Table 1 Create User Accounts Use Case UC-1

ID:	UC-1
Title:	Create User Account
Description:	Administrator may create accounts to system users (Guidance Counselor and Student).
Primary Actor:	System Administrator
Preconditions:	The Student Credentials must be verified beforehand by the university. As for Guidance Counselor, each time a teacher is appointed Counselor by the University, the teacher must be added to system as Guidance Counselor. The Administrator obtains the data of students and counselors from the Admission and Registration Department.
Postconditions:	New User will exist in the system database and will have access.
Main Success Scenario:	1. The Administrator obtains the data of students and counselors from the Admission and Registration Department. 2. The Administrator add this data to the system database.
Extensions:	If User already exists, system will display error message.
Owner:	Aseel

Table 2 Delete User Account Use Case UC-2

ID:	UC-2
Title:	Delete User Account
Description:	Administrator may delete user accounts
Primary Actor:	System Administrator
Preconditions:	User must be an existing user.
Postconditions:	User Account is deleted
Main Success Scenario:	1. Administrator clicks on "User Settings" page in Navigation. 2. Administrator clicks on the account that needs to be deleted from the list of existing accounts and clicks "Delete Account". 3. System asks the administrator to confirm the deletion of the user account.
Extensions:	The system displays an error message "User Not Found" if the specified User ID does not exist.
Owner:	Aseel

Table 3 Access & Change User Account Settings Use Case UC-3

ID:	UC-3
Title:	Access and Change User Account Settings
Description:	The Administrator has Access to all User account controls and can change and edit them.
Primary Actor:	System Administrator
Preconditions:	Administrator must be logged into the system and have administrative rights.
Postconditions	Administrator successfully configures any changes to Student / Guidance Counselor account settings.
Main Success Scenario:	1. Administrator clicks on "User Settings" page in Navigation. 2. Administrator clicks on the account that requires changes from the list of existing accounts and clicks "Edit Privileges". 3. System displays account information and privileges to Administrator. 4. Administrator will fill in any changes necessary then click "Save Changes".
Extensions:	4.a Administrator does not click "Save Changes", No changes will be made to the account.
Owner:	Dima

Table 4 Create New Department Schedule Use Case UC-4

ID:	UC-4
Title:	Create New Department Schedule
Description:	The system Administrator is responsible for managing and configuring the schedules for all departments included in the system and can create new schedules that reflect the schedules set by the departments.
Primary Actor:	System Administrator
Preconditions:	System must be up and running to be able to access or make any changes to the system database.
Postconditions	A new department schedule will be added to database (schedule is empty by default).
Main Success Scenario:	1. Administrator clicks on "Manage Schedule" page link in Admin Homepage navigation. 2. System displays "Current Schedules" report, and the admin will choose "Create New Schedule" button. 3. Administrator fills in the new schedule details such as "Faculty", "Department", "Semester". 4. Once finished, Administrator will click "Save New Schedule".
Extensions:	2.a If it is not currently a registration period in the university, the system will give an error alert "Schedule creation not possible at the moment". 3.a if the schedule for a specific department already exists, Administrator will be asked to either replace the older instance of the schedule or cancel, as only one schedule exists for each department per semester.
Owner:	Lana

Table 5 Add New Course Section Use Case UC-5

ID:	UC-5
Title:	Add New Course Section
Description:	The system Administrator is responsible for managing and configuring the schedules for all departments included in the system and can add new course sections that reflect the schedules set by the departments.
Primary Actor:	System Administrator
Preconditions:	System must be up and running to be able to access or make any changes to the system database.
Postconditions	After the administrator does all required changes, the saved schedule must be up to date with the current schedule details.
Main Success Scenario:	1. Administrator clicks on "Manage Schedule" page link in Admin Homepage navigation. 2. System displays "Current Schedules" report, and the admin will click on the department that the newly added course section belongs to. 3. System will forward Administrator to the selected department schedule page and shows a "Add New Course Section" button at the bottom that the administrator clicks on. 4. Administrator fills in the new course section details such as "Course Code", "Section Number", "Time Slot" and other attributes. 5. Once finished, Administrator will click "Save New Section".
Extensions:	4.a If new section already matches an existing section in these two attributes (Course Time Slot, Section Teacher), then an error message displays "section Teacher already has an existing section at given time" and the "Save New Section" Button will be deactivated.
Owner:	Lana

Table 6 Edit Course Section Use Case UC-6

ID:	UC-6
Title:	Edit Course Section
Description:	The system Administrator is responsible for managing and configuring the schedules for all departments included in the system and can edit existing course sections that reflect the schedules set by the departments.
Primary Actor:	System Administrator
Preconditions:	System must be up and running to be able to access or make any changes to the system database.
Postconditions	After the administrator does all required changes, the saved schedule must be up to date with the current schedule details.
Main Success Scenario:	1. Administrator clicks on "Manage Schedule" page link in Admin Homepage navigation. 2. System displays "Current Schedules" report, and the admin will click on the department that the existing course section belongs to. 3. System will forward Administrator to the selected department schedule page and shows a "Edit Course Section" button next to the section that the administrator clicks on. 4. All Course section details will become input textboxes that the Administrator can edit. 5. Once finished, Administrator will click "Update Section".
Extensions:	4.a If the new section details already match another existing section in these two attributes (Course Time Slot, Section Teacher), then an error message displays "section Teacher already has an existing section at given time" and the "Update Section" Button will be deactivated.
Owner:	Lana

Table 7 Delete Course Section Use Case UC-7

ID:	UC-7
Title:	Delete Course Section
Description:	The system Administrator is responsible for managing and configuring the schedules for all departments included in the system and can delete Course Sections to reflect the schedules set by the departments.
Primary Actor:	System Administrator
Preconditions:	System must be up and running to be able to access or make any changes to the system database.
Postconditions	After the administrator does all required changes, the database must be up to date with the current schedule details.
Main Success Scenario:	1. Administrator clicks on "Manage Schedule" page link in Admin Homepage navigation. 2. System displays "Current Schedules" report, and the admin will click on the department that the existing course section belongs to. 3. System will forward Administrator to the selected department schedule page and shows a "Delete Course Section" button next to the section that the administrator clicks on. 4. An alert prompt displays "Confirm Deletion ?" and the Administrator clicks "Yes". 5. An alert is sent to students that have the sections in their schedules that the section has been removed and system suggests an alternative.
Extensions:	4.a If administrator clicks "No", the deletion operation is cancelled.
Owner:	Lana

Table 8 Log-In Use Case UC-8

ID:	UC-8
Title:	Log-In
Description:	The User shall access the system by entering the correct username and password
Primary Actor:	Guidance Counselor, Student
Preconditions:	The User must have an account.
Postconditions	The User successfully Logs in to their account.
Main Success Scenario:	1. User clicks over to Log-in. 2. User enters their username and password. 3. User clicks Log-In button. 4. System shall check whether the username and password are correct or not, and if they match. 5. The website shall display the system view belonging to the user.
Extensions:	4.a If username or password is incorrect, an error prompt will display the message "Incorrect Username/Password, please try again". 5.a If the user is a student that has already graduated, access is denied and an error prompt will display the message "Student has already graduated, access to website has been revoked".
Owner:	Dima

Table 9 View Course Descriptions Use Case UC-9

ID:	UC-9
Title:	View Course Descriptions
Description:	Both the Guidance Counselor and Student can view the course descriptions of any course registered on the system.
Primary Actor:	Guidance Counselor, Student
Preconditions:	User must be logged in.
Postconditions	The system displays the description.
Main Success Scenario:	1. User clicks over to "View Descriptions". 2. System Displays the descriptions.
Extensions:	No course description exists for selected course.
Owner:	Aseel

Table 10 Book Appointment (as User) Use Case UC-10

ID:	UC-10
Title:	Book Appointment (as User)
Description:	Both Guidance Counselor and Student can Book Counseling appointments. In students' case, appointment will be made to ask Counselor for help, in Guidance Counselor's case the appointment will be made with a specific student to discuss schedule details.
Primary Actor:	Guidance Counselor, Student
Preconditions:	System must have already given the student schedules suggestions and the Guidance Counselor will have viewed them.
Postconditions	A new appointment will be created and added to the User's list of "Upcoming Appointments".
Main Success Scenario:	1. Student / Guidance Counselor clicks on "Book Appointment" in the Navigation Bar. 2. System will forward Student / Guidance Counselor to the "Book Appointment" page. 3. Student / Guidance Counselor may choose one of the displayed dates in the calendar and then one of the available time slots. 4. Student / Guidance Counselor then fills in other appointment details such as "Reason for Meeting" (will be decided in later stages of implementation). 5. Student / Guidance Counselor clicks "Confirm Appointment". 6. System saves Appointment details into database and alerts the other person of the meeting.
Extensions:	None
Owner:	Lana

Table 11 Request Schedule Suggestions Use Case UC-11

ID:	UC-11
Title:	Request Schedule Suggestions
Description:	This is the main function and purpose of our system, a Student may request schedule suggestions based on available data and their own preferences.
Primary Actor:	Student
Preconditions:	Student must be already logged into the system.
Postconditions	A generated course schedule will be given to the Student.
Main Success Scenario:	1. Student clicks on "Schedule" in the Navigation Bar. 2. System forwards Student to the course suggestion page. 3. System displays controls that allow student to specify the number of credit hours to be taken and the preferred time intervals of the lectures (the actual workings of the controls will be decided during implementation, either input textboxes or other interactive methods). 4. System retrieves all courses the student is allowed to take based on their plan, and only displays the courses that are currently offered in this semester's schedule. 5. Student may then choose which courses they prefer to take. 6. System will then display the available sections for each course separately, while highlighting the suggested schedule by the system. 7. Student may then choose to click on "Confirm Selection". 8. System will display the generated schedule with the options to "Print" or "Send Schedule to Counselor" as buttons on the side that the student may utilize.

Extensions:	7.a Student may choose "Edit Selection" and pick sections that overlap:
	     7.a.1 System will display hint message "This section overlaps with section (x) of course (a), to proceed please confirm that you wish to drop section (x) of course (a)", Student may then choose "Confirm".
	     7.a.2 If student chooses "Cancel", the selection stays unedited.
	
	 7.b Student may choose "Edit Selection" and pick sections that match with no overlapping, then choose "Save Changes", then "Confirm Selection".

Owner:	Lana

Table 12 Access Student Profiles Use Case UC-12

ID:	UC-12
Title:	Access Student Profiles
Description:	Counselor is allowed to access Student profiles that follow the plan the counselor is responsible of.
Primary Actor:	Guidance Counselor
Preconditions:	Guidance Counselor must be already logged into the system, and authorized.
Postconditions	View Student information.
Main Success Scenario:	1. The guidance counselor will click over to "Students". 2. The guidance counselor enters the Student ID in the search bar. 3. The system retrieves and displays the student profile.
Extensions:	2.a The system displays an error message "Student Not Found" if the specified Student ID does not exist.
Owner:	Aseel

Table 13 Edit Course Descriptions Use Case UC-13

ID:	UC-13
Title:	Edit Course Descriptions
Description:	Guidance Counselor can edit and configure course descriptions.
Primary Actor:	Guidance Counselor
Preconditions:	Guidance Counselor must be already logged into the system.
Postconditions	Course descriptions will be up to date.
Main Success Scenario:	1. Guidance Counselor will click over to "Course Descriptions" in Navigation bar. 2. System will display list departments. 3. Counselor will click over the department that offers the course that needs to be edited. 4. Counselor will click on the course that needs to be edited from the list of courses the system displays. 5. Counselor will perform any changes to the course attributes. 6. Counselor will click "Save Changes"
Extensions:	None
Owner:	Lana

Table 14 View Suggested Schedules Use Case UC-14

ID:	UC-14
Title:	View Suggested Student Schedules
Description:	Guidance Counselor can view the suggested student schedules of any student that follows the plan the Counselor is responsible for.
Primary Actor:	Guidance Counselor.
Preconditions:	Student must have already requested a schedule and the system has generated it for the new semester.
Postconditions	Guidance Counselor will have seen the suggested schedule.
Main Success Scenario:	1. Guidance Counselor will click over to "Students". 2. The guidance counselor enters the Student ID in the search bar. 3. The system retrieves and displays the student profile. 4. From the available student information, Counselor picks "View Schedule Suggestions".
Extensions:	None
Owner:	Lana

Table 15 Book Appointment (as Guest) Use Case UC-15

ID:	UC-15
Title:	Book Appointment (as Guest)
Description:	Guest can make an appointment with a guidance counselor upon availability.
Primary Actor:	Guest
Preconditions:	Access System website online.
Postconditions:	Appointment booked, waiting for Guidance Counselor approval.
Main Success Scenario:	1. Guest clicks on "Contact Counselor" in Navigation bar. 2. System forwards Guest to "Book Appointment" page. 3. Guest selects date and time slot. 4. Guest fills in their details and contact method. 5. Guest clicks "Request Meeting". 6. System sends alert to Guidance Counselor.
Extensions:	4.a if the Guest cannot write their information, an error message is displayed. 6.a The Guidance has another meeting.
Owner:	Aseel

Table 16 View Specializations Description Use Case UC-16

ID:	UC-16
Title:	View Specialization Description
Description:	A description of the majors in the faculty of Information Technology will be available publicly on the website, so others may refer to it in deciding which field to enter.
Primary Actor:	Guest
Preconditions:	Access System website online.
Postconditions:	Descriptions of faculty majors as well as their specialties will be displayed.
Main Success Scenario:	1. Guest clicks on "View Specializations" in Navigation bar. 2. System will display the major specializations webpage.
Extensions:	None
Owner:	Dima

3.3 ACTIVITY DIAGRAMS (COMPLICATED BEHAVIORS)

An Activity Diagram is a graphical representation of workflows, stepwise activities and actions with support for choice, iteration and concurrency [5] . It shows the exact steps of an activity that occurs within the system.
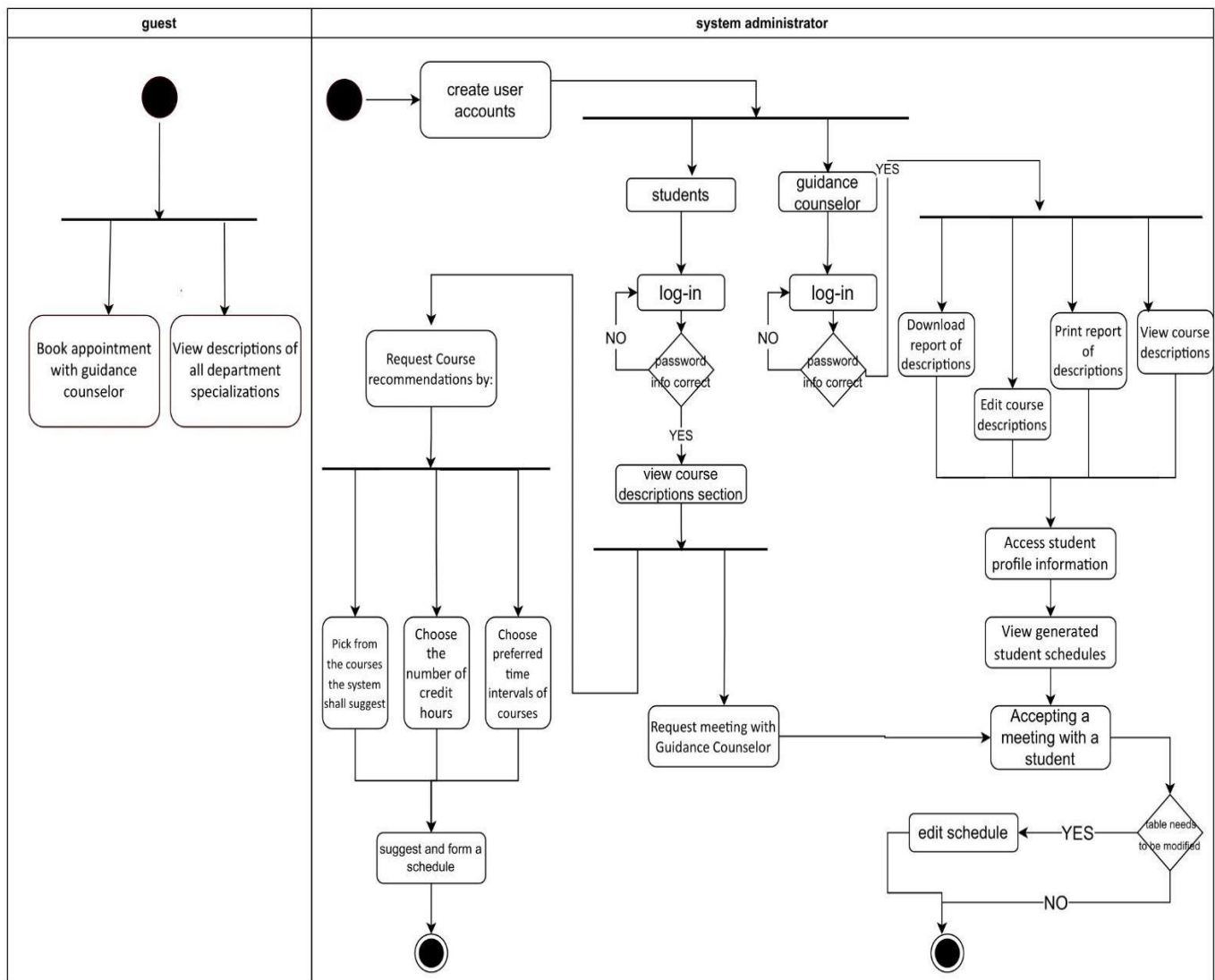
3.3.1 ACTVITY DIGRAM – GENERAL SYSTEM FLOW:

Figure 2 Activity Diagram of the Overall Workflow of System

→ Activity Diagram Summary:

System has Administrator that can create accounts for Students and Guidance Counselors, Student can log-in to website if password and username are correct. If password or username is incorrect, Student can re-enter them. Both Users can view the descriptions of courses and request meetings. Student may request schedule recommendations and must choose preferred time intervals of courses, number of credit hours. Then student may pick from the courses that system shall suggest to form a schedule.

As for the Guidance Counselor, they can log-in to website if password and username are correct. If password or username is incorrect, Counselor can re-enter them. Guidance Counselor can download and print report of descriptions and edit and view those descriptions. Guidance Counselor has access to student profiles and can also view generated student schedules. Counselor may accept a meeting with a student to edit schedule If there is a need for it and accept guest appointments.

Last actor, Guest, can book appointment with guidance counselor and View descriptions of all department specializations.
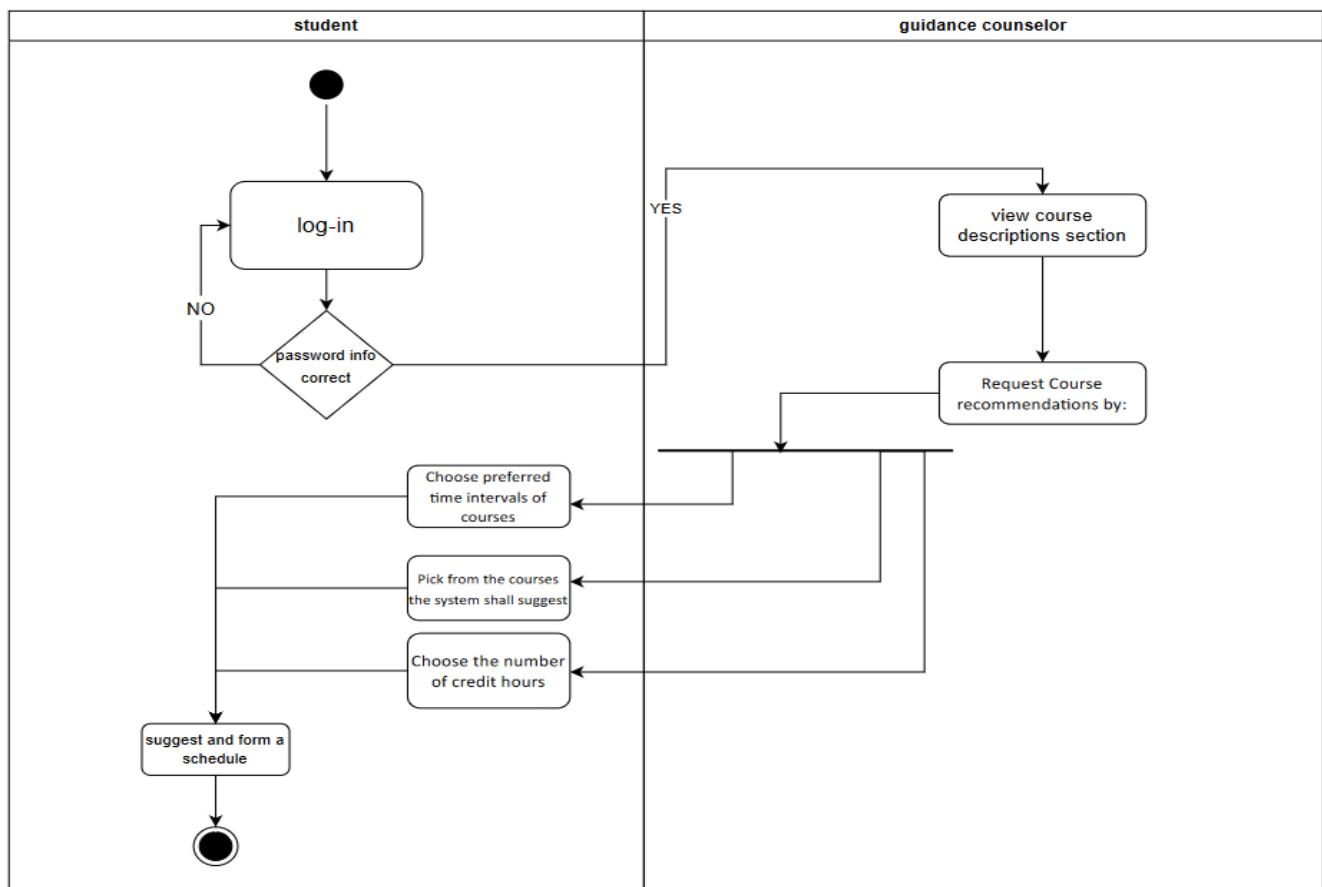
Figure 3 Activity Diagram of Course Recommendation Request

→ Activity Diagram Summary – Request Schedule:

This Activity Diagram Depicts the steps of a student requesting a schedule suggestion. Student can log-in to website if the password and username are correct. If password or username is incorrect, Student must re-enter them. The Student may view the descriptions of courses to understand their schedule better. Student may request schedule recommendations and must choose preferred time intervals of courses, number of credit hours. Then student may pick from the courses that system shall suggest to form a schedule.
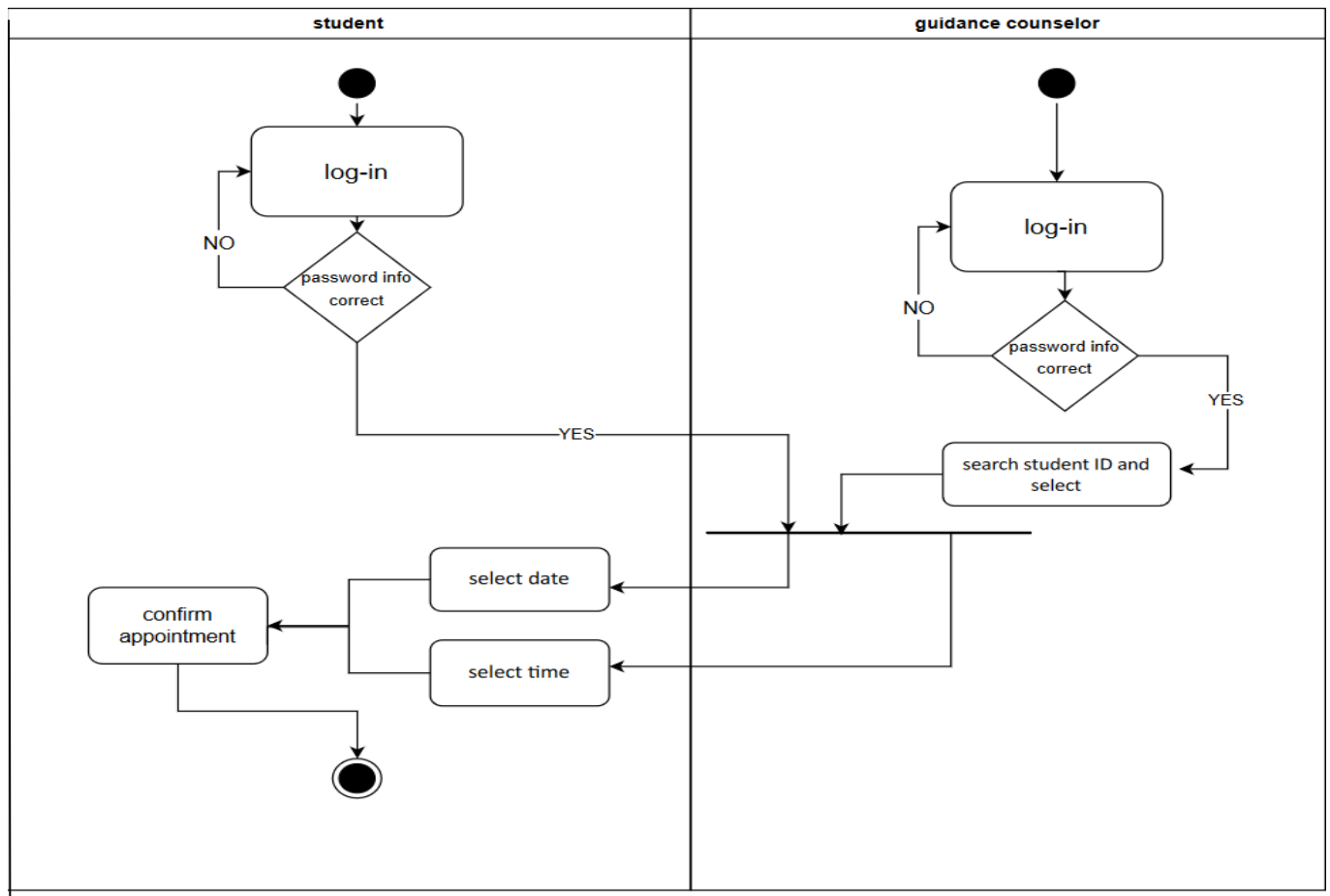
Figure 4 Activity Diagram of Book Appointments

→ Activity Diagram Summary – Book Appointment:

This Activity Diagram Depicts the steps of a student / Guidance Counselor booking an appointment. Student can log-in to website if the password and username are correct. If password or username is incorrect, Student must re-enter them. Same with Counselor, they can log-in to website if password and username are correct. If password or username is incorrect, Counselor can re-enter them. The guidance counselor can search for a certain student through their student ID and then both the student and counselor can select date and time, then confirm.

4. DESIGN PHASE - APPLICATION ARCHITECTURE DESIGN

This Context Diagram has been given to show the data flow between the system (in our case, website) and the system user.
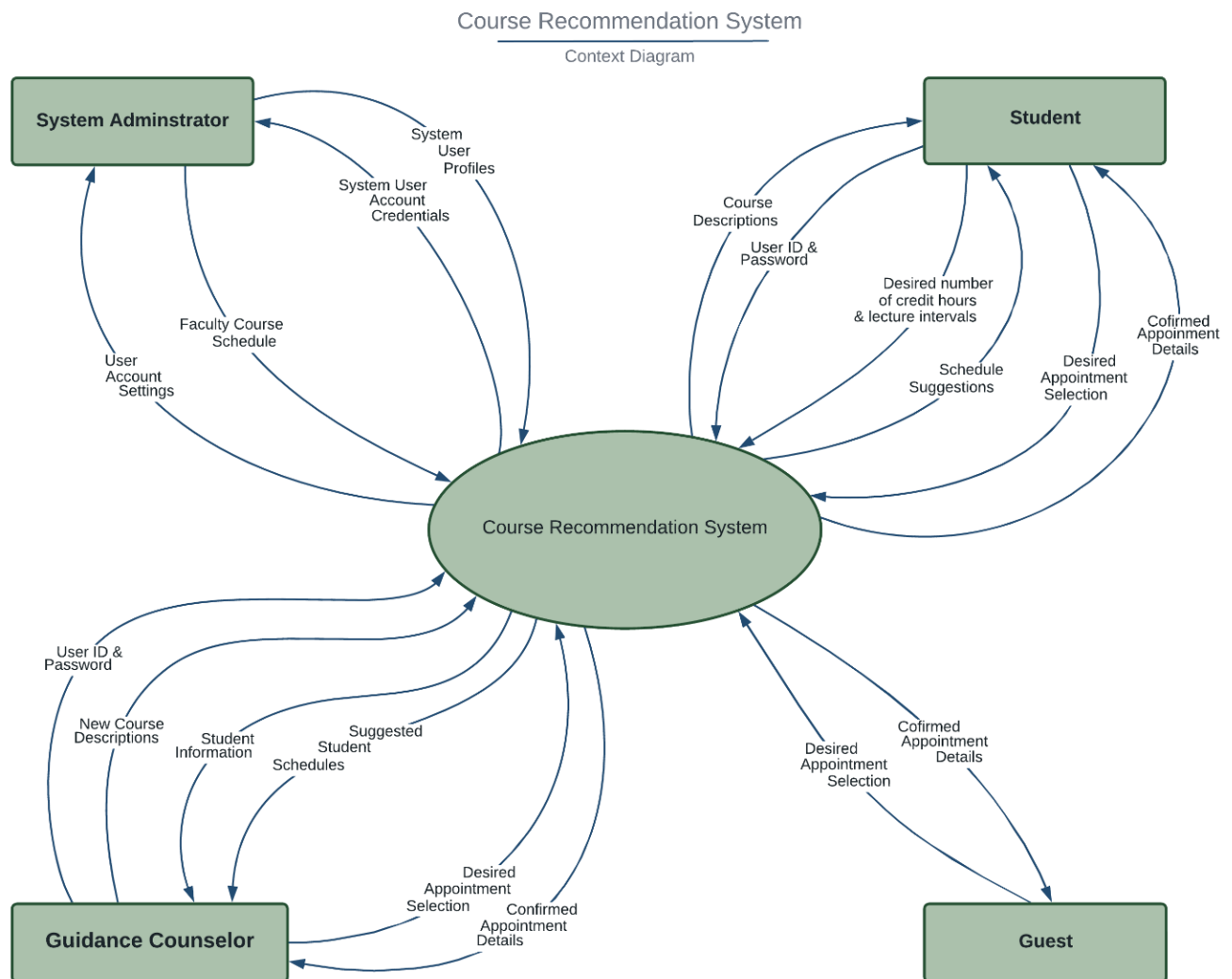
→ Context Diagram Summary:

The system users depicted here are the following :

Guest : Any person that accesses the system publicly, can book appointment with Guidance Counselor (with the assumption that new-coming students to the university who are contemplating registering in the IT faculty might require assistance).

Student : A registered user, can enter system with their log-in credentials, to either request a schedule recommendation or book an appointment with their Guidance Counselor.

Guidance Counselor : a member of the faculty that guides students and has normal user functions, same as student. But with access to student Information and schedules.

System Administrator : Person in-charge of the technical aspects of the system and can thus access all user information and change their account settings.

5. DESIGN PHASE - DATA ARCHITECTURE DESIGN

5.1 CONCEPTUAL DESIGN (ER DIAGRAM) [8], [9], [16]:

ER Diagram stands for (Entity Relationship Diagram), also known as ERD. It is a diagram that displays the relationship of entity sets stored in a database. In other words, ER diagrams help to explain the logical structure of databases [6].
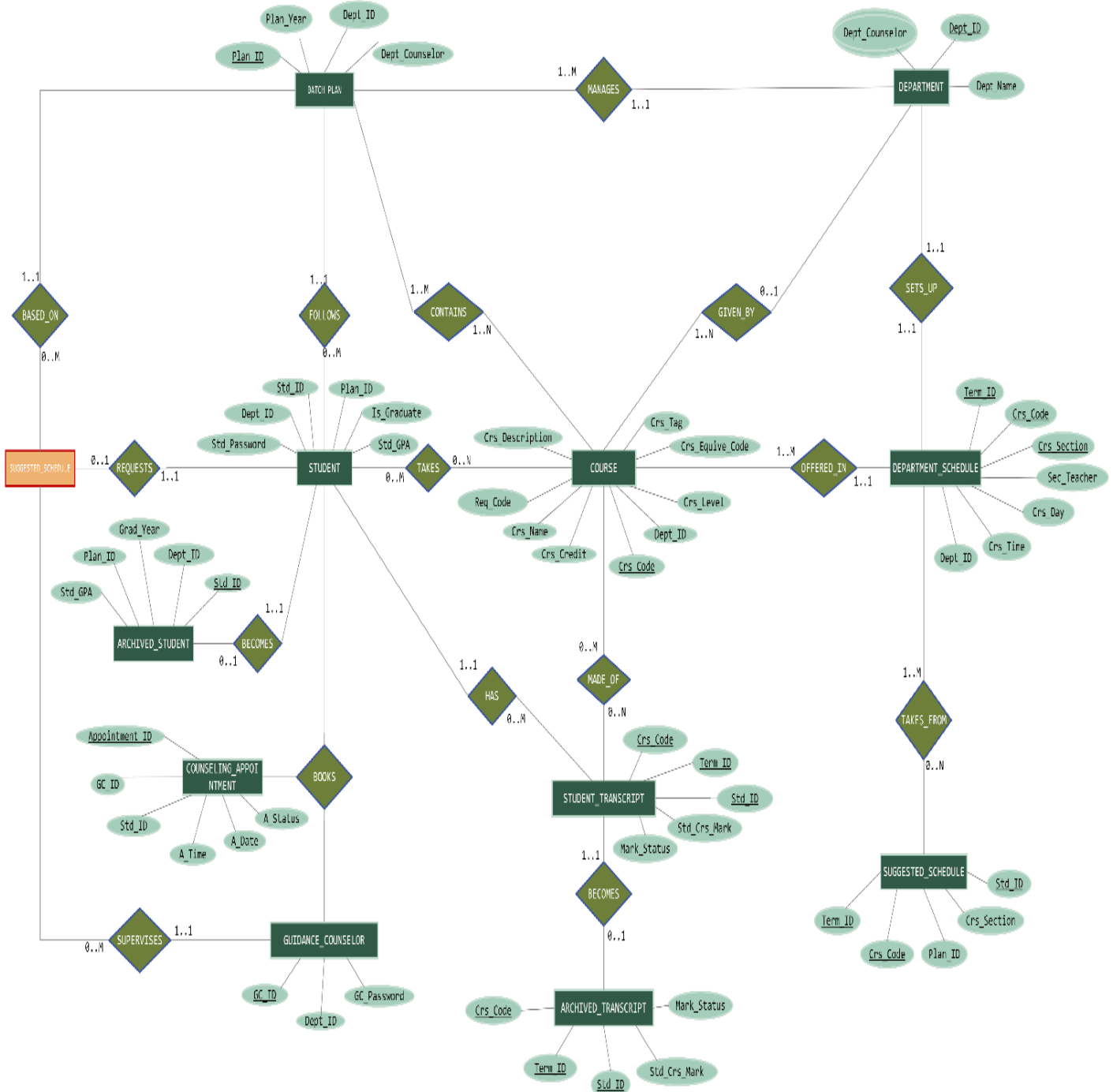

Figure 6 Entity - Relation Diagram

→ Entity Relationship Diagram Summary:

The ER diagram depicts all real-life entities (both physical and logical) of the system database. A DEPARTMENT has STUDENT and GUIDANCE COUNSELOR that *belong* to it (This is not shown here for lack of space in the diagram but is included in the schema) and is identified by Dept_ID.

Each DEPARTMENT *manages* their own BATCH_PLAN (identified by Plan_ID) Which *contains* COURSES (identified by Crs_ID) and *is_followed* by STUDENT (identified by Std_ID) through their academic career. Each DEPARTMENT *sets_up* their DEPARTMENT_SCHEDULE (identified by a composite key; Crs_code, Crs_section, Term_ID) for each term. This DEPARTMENT_SCHEDULE *offers* COURSE that is *given_by* DEPARTMENT and *taken_by* STUDENT.

The STUDENT *requests* SUGGESTED_SCHEDULE (Identified by a composite key; Crs_Code, Term_ID). A STUDENT has a STUDENT_TRANSCRIPT that is *made_of* COURSES that the STUDENT has already taken.

Each STUDENT *becomes* an ARCHIVED_STUDENT once they graduate along with their respective ARCHIVED_TRANSCRIPT.

There exists GUIDANCE_COUNSELOR (identified by GC_ID) that can *supervise* the SUGGESTED_SCHEDULES. Both the GUIDANCE_COUNSELOR and STUDENT can *book* COUNSELING_APPOINTMENT (identified by Appointment_ID)

5.2 CONCEPTUAL DESIGN (RELATIONAL SCHEMA) [8], [9], [16]:

A relational schema is a blueprint used in database design to represent the data to be entered into the database and describe how that data is structured in tables (called relations in relational schemas) [7].
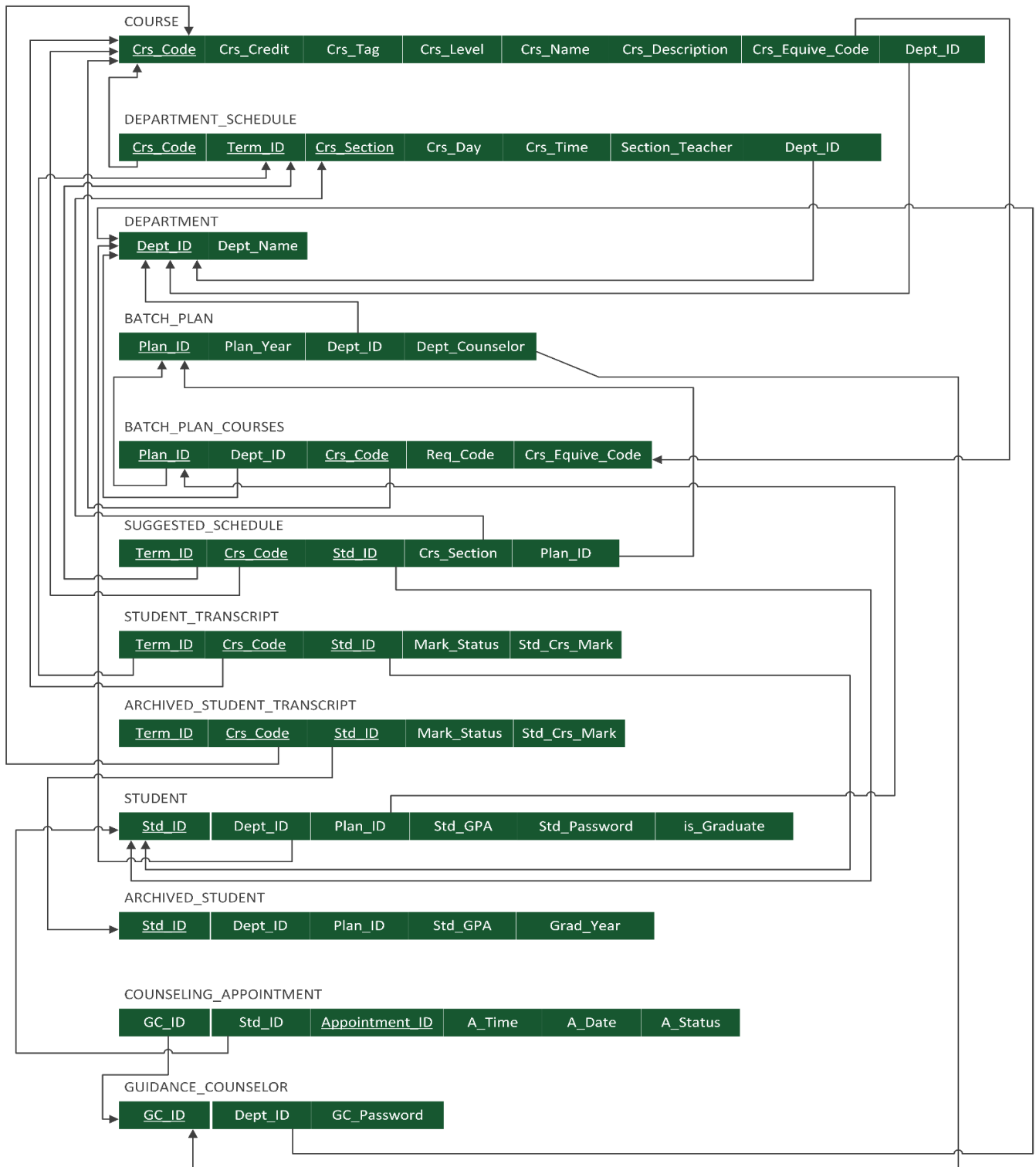
Figure 7 Relational Schema

6. IMPLEMENTATION PHASE

6.1 LANGUAGES USED:

→ Interface : html, css

→ Backend : php

→ Database : MySql

6.2 TOOLS USED:

→ IDE : VSCODE

→ Server : XAMPP Server Package.

→ DBMS : MariaDB, PHPMyAdmin.

6.3 TEMPLATES USED:

→ CSS Framework : Bootstrap.

6.4 WEBSITE SCREENSHOTS :
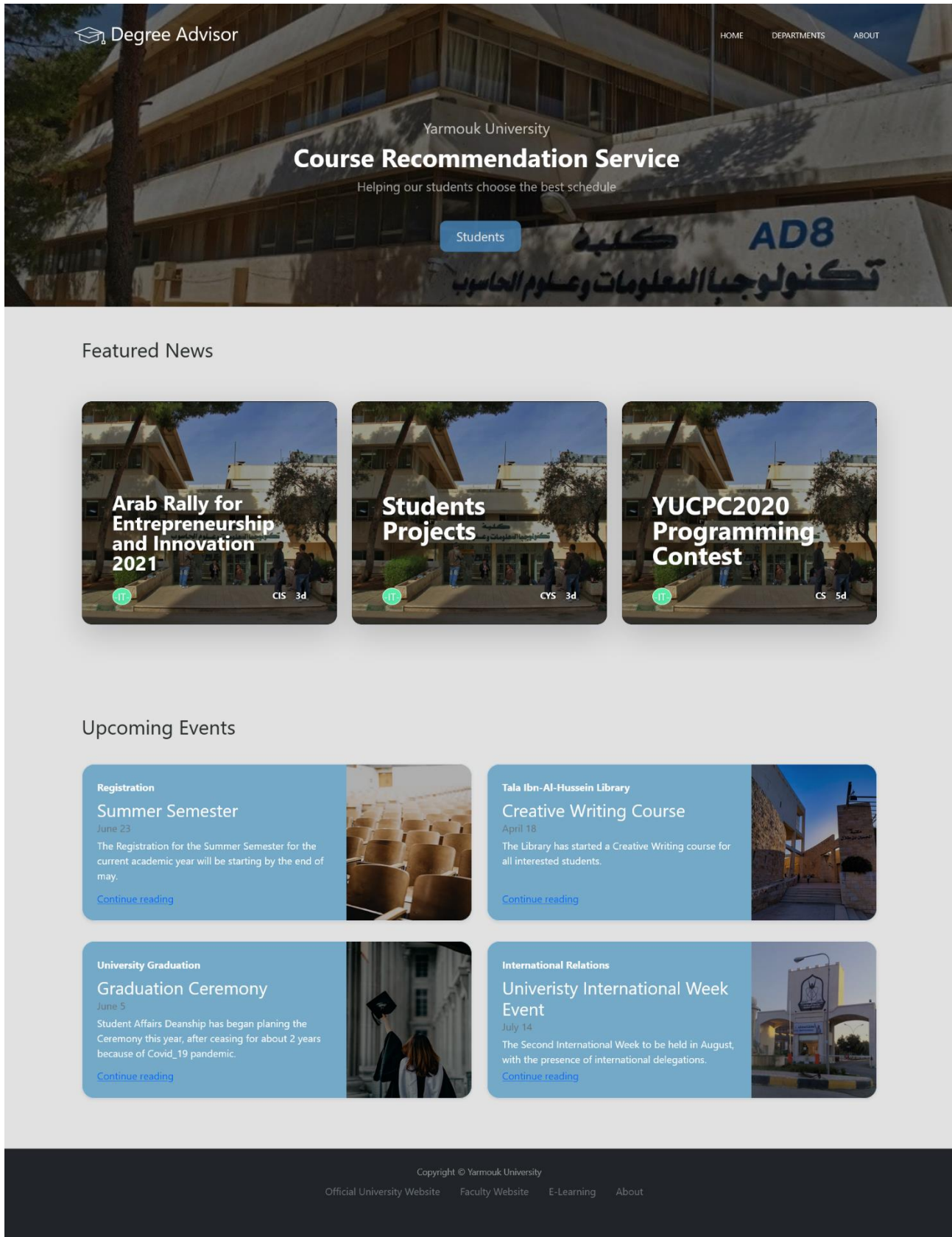
Figure 8 Homepage
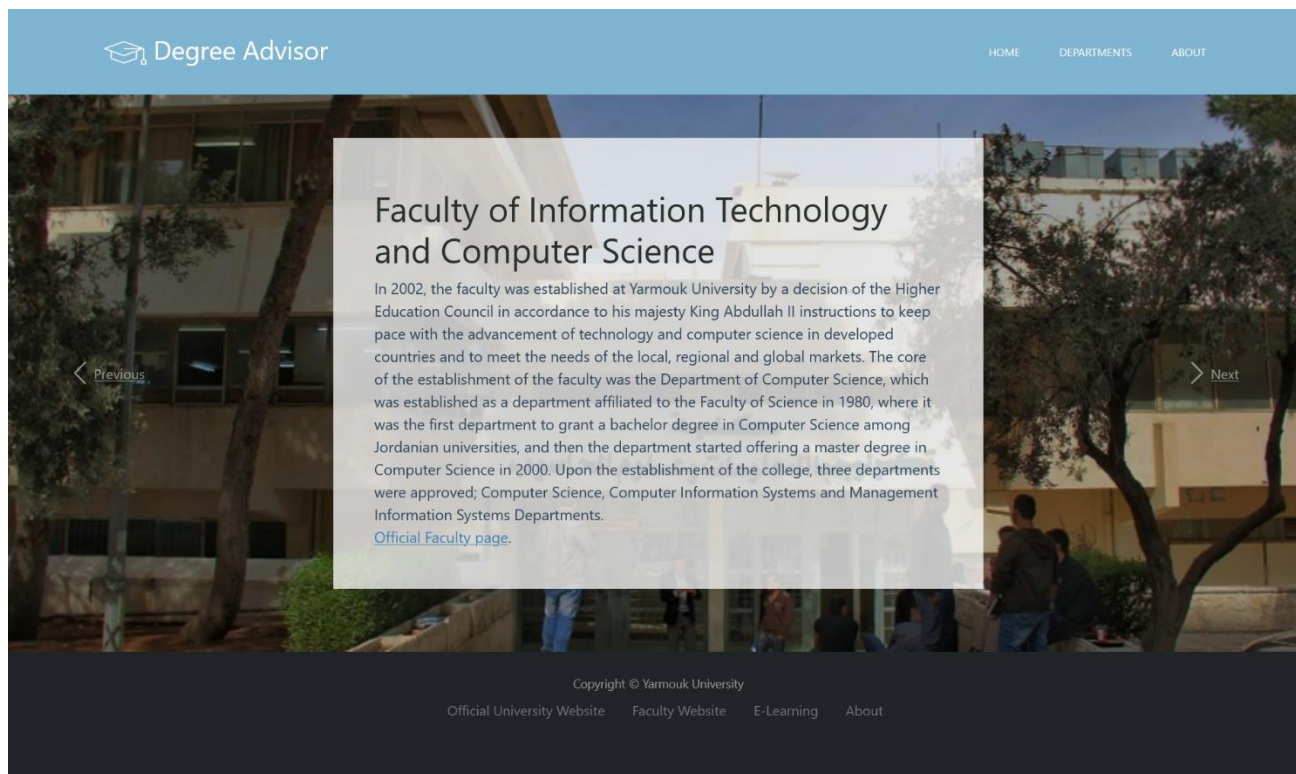
Figure 9 Departments Page : Faculty
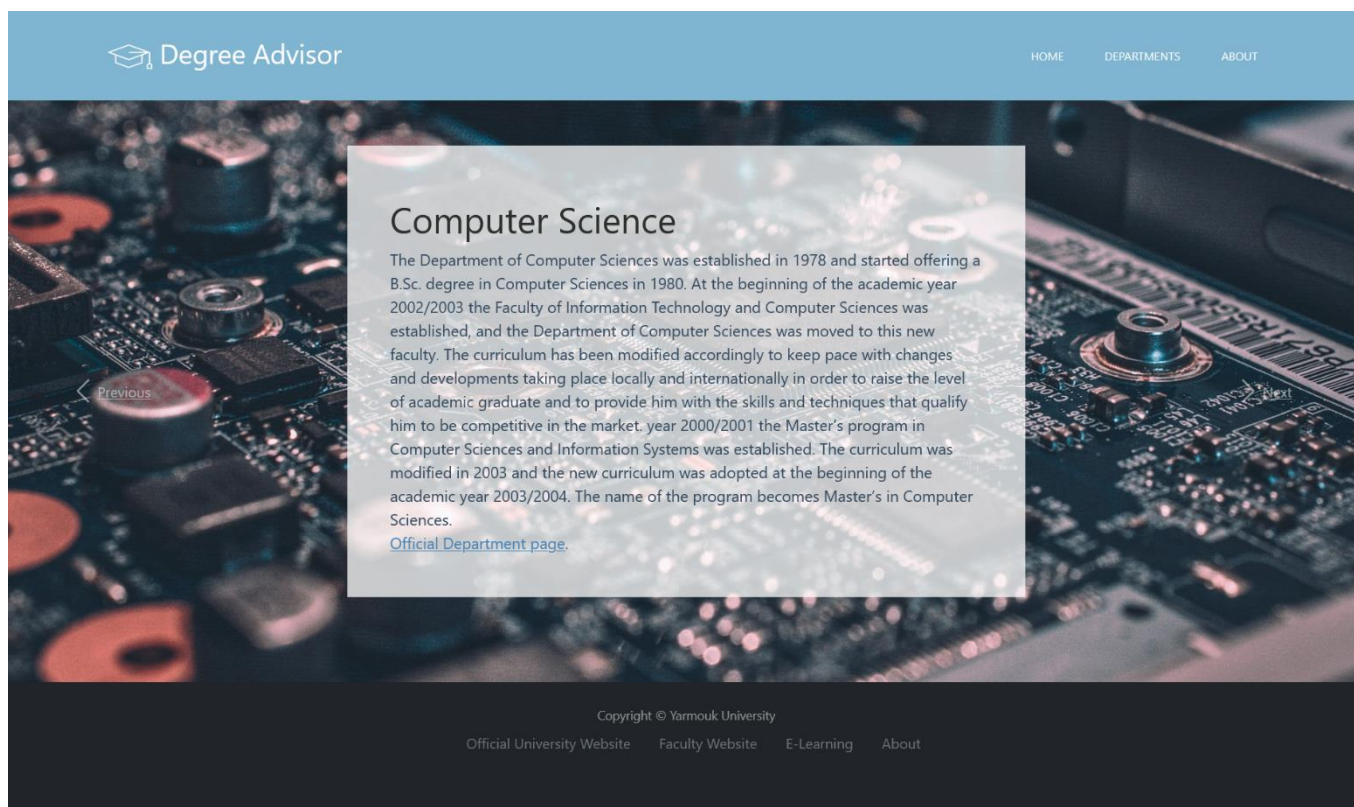
Figure 10 Departments Page : Computer Science
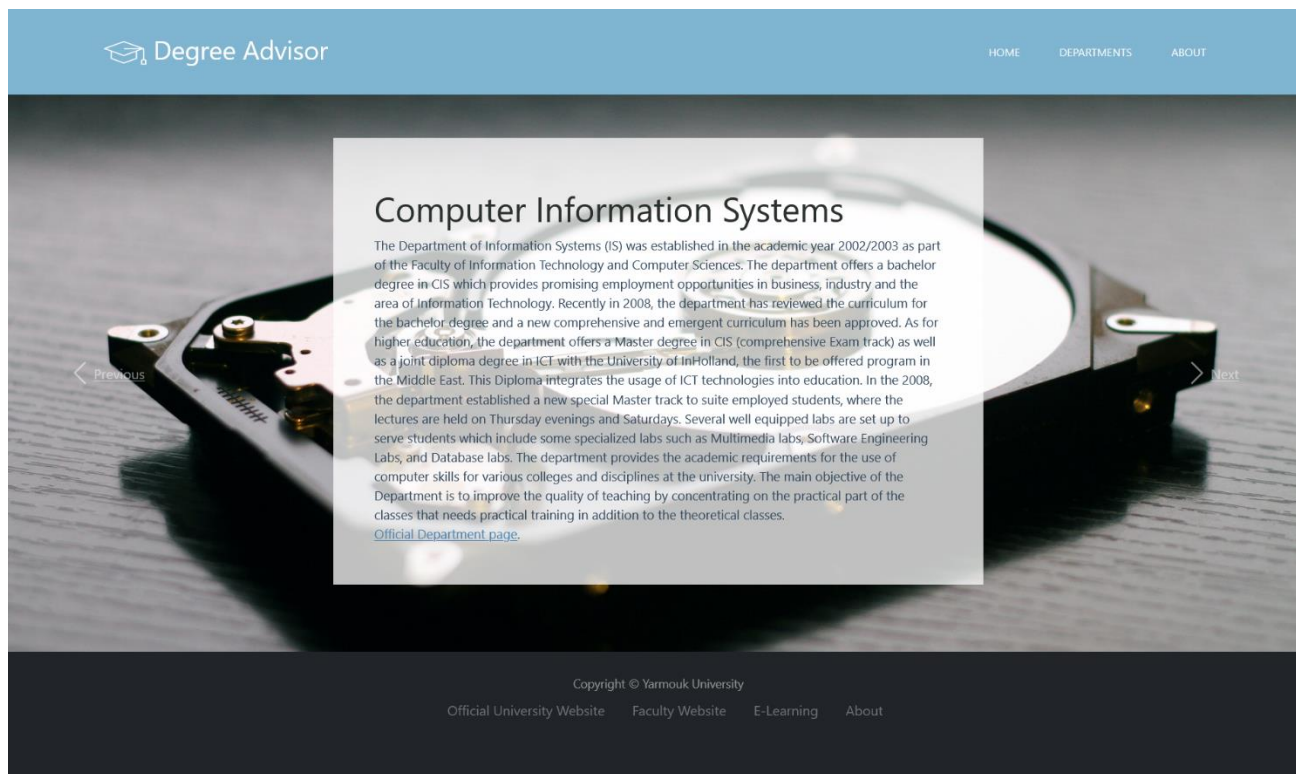
Figure 11 Departments Page : Computer Information Systems
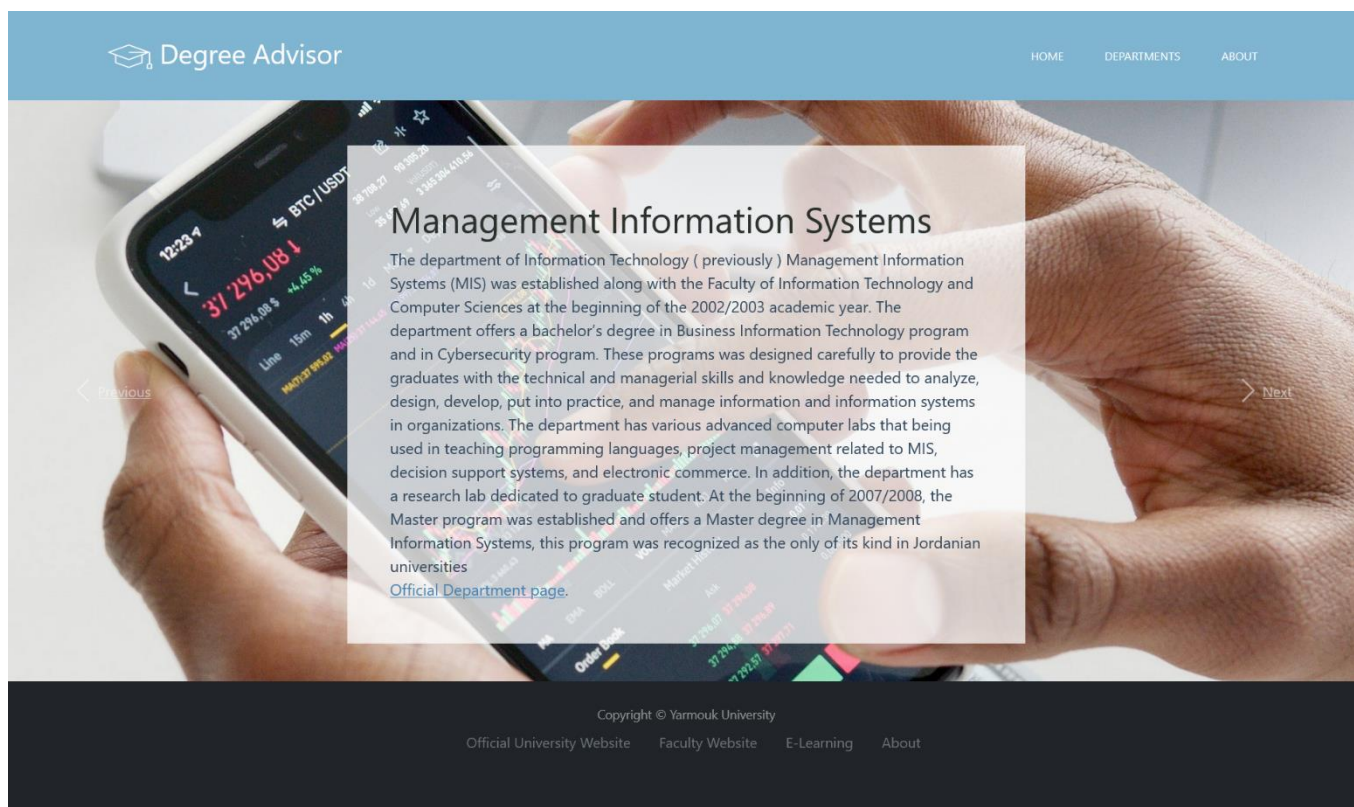
Figure 12 Departments Page : Business Information Technology
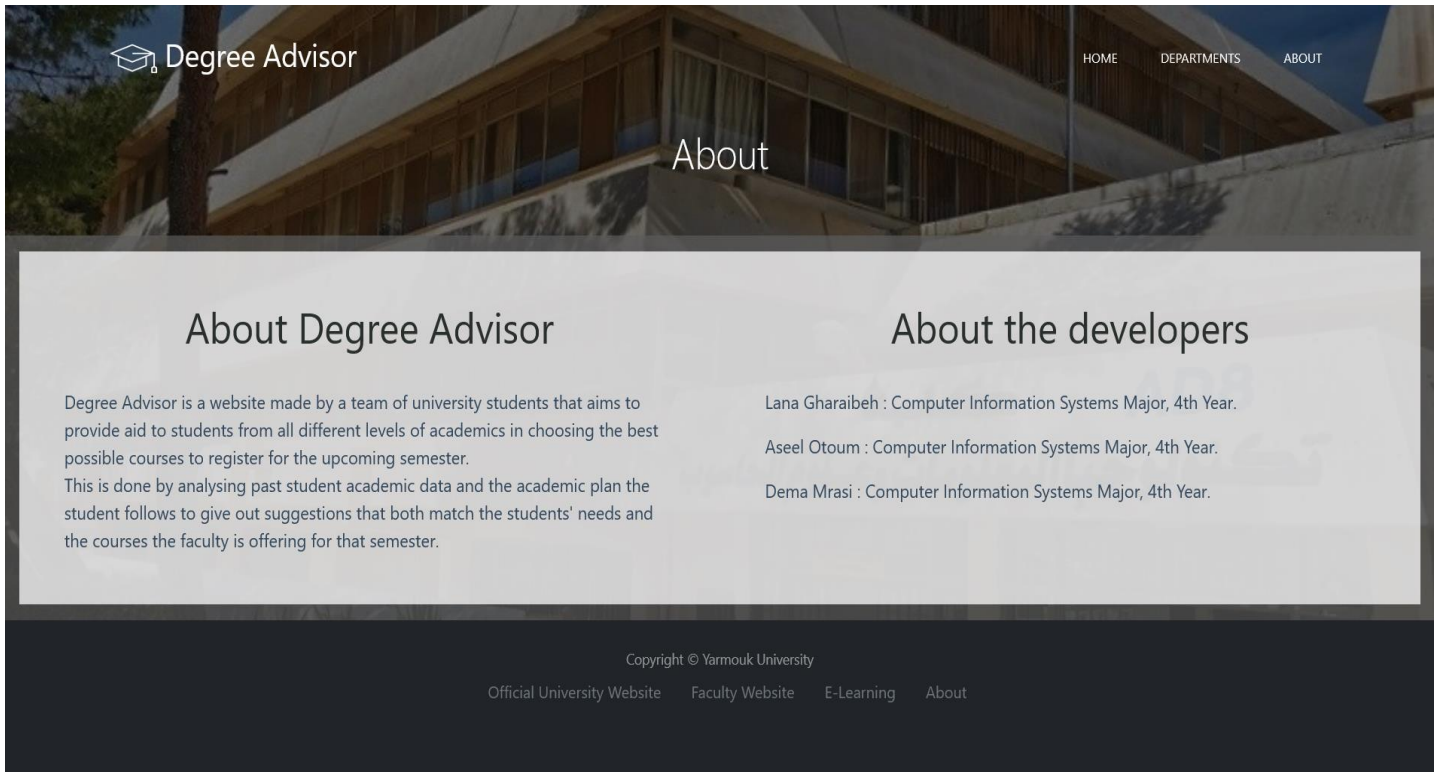
Figure 13 About Page
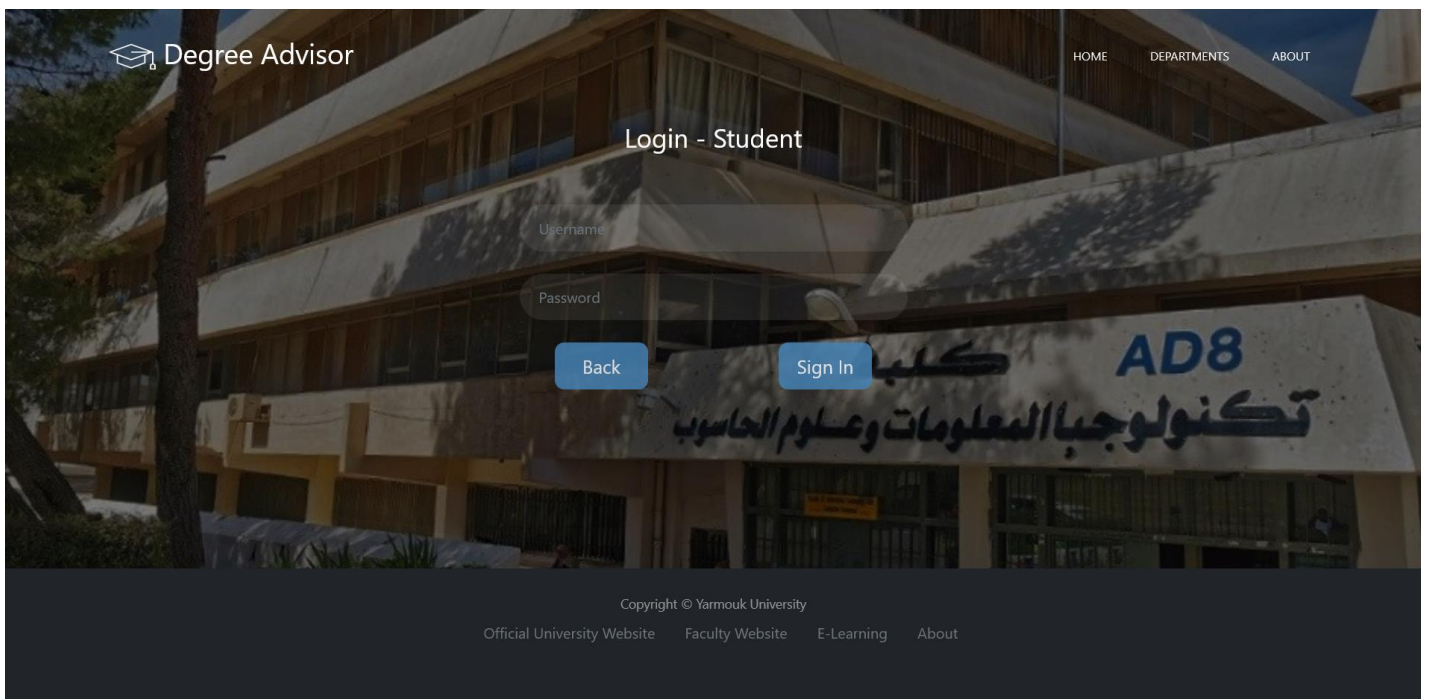
Figure 14 Login Page
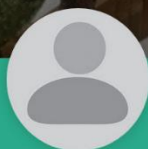
Degree Advisor

Student : 2018902186
Department of Computer Information Systems
Faculty of Computer Science & Information Technology.

Profile

Academic Plan

Schedules

Suggestions

Profile Information

- Student ID Number : 2018902186
- E-mail : 2018902186@ses.yu.ed
- Major : Computer Information Systems
- First Name : Lana
- Last Name : Loai
- Plan Number : 202102
- Student GPA : 80.5

Term : 202001

| Course	Mark	Mark Status
CIS101	PASS	83
MATH101	PASS	50
MILT100A	PASS	0
PS102	PASS	60

Term : 202002

Course	Mark	Mark Status
CS111	PASS	90
CS111L	PASS	98
CS130	PASS	76
HUM117	PASS	90
HUM118	PASS	85
HUM119	PASS	91
STAT111	PASS	58

Term : 202003

Course	Mark	Mark Status
CIS214	PASS	72
CIS240	PASS	83
HUM120	PASS	91

Term : 202101

Course	Mark	Mark Status
BA101	PASS	91
CS142	PASS	62
CS210	PASS	97
CS210L	PASS	95
HUM121	PASS	92

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Figure 15 Student Profile Page

Degree Advisor

Student : 2018902186
Department of Computer Information Systems
Faculty of Computer Science & Information Technology.

Profile

Academic Plan

Schedules

Suggestions

Plan Courses

- Department : Computer Information Systems
- Plan Number : 202102

Group : University Compulsory

| Course Code	Course Name	Course Credit	Course Pre-Requisite
HUM117	Pioneering and Creativity	1	None
HUM118	Leadership and Society	1	None
HUM119	Life Skills	1	None
HUM120	Communication Skills (English Language)	3	None
HUM121	Communicaation Skills (Arabic Language)	3	None
MILT100A	Military Sciences and Citizenship	3	None
PS102	Civil Education	3	None

Group : Faculty Compulsory

Course Code	Course Name	Course Credit	Course Pre-Requisite
CS111	Programming in a Selected Language	3	None
CS111L	Programming in a Selected Language Lab	1	CS111L
CIS101	Introduction to Information Systems	3	None
CIS260	Database Systems	3	CS210,CIS101
BIT221	Legal Issues in Information Technology	3	CYS230
BIT381	Web Applications Development (1)	3	CIS260
MATH101	Calculus (1)	3	None
STAT111	Introduction to Probability (1)	3	None

Group : Department Compulsory

Course Code	Course Name	Course Credit	Course Pre-Requisite
CIS214	Visual Programming	3	CS210 ,CIS101
CIS240	Introduction to Software Engineering	3	CS210 ,CIS102
CIS260L	Database Systems Lab	1	CIS260
CIS265	Database Management System	3	CIS260
CIS340	Object Oriented Analysis & Design	3	CIS240
CIS340L	Object Oriented Analysis & Design Lab	1	CIS340
CIS342	System Analysis & Design	3	CIS240 ,CIS260
CIS360	Developing Database Applications	3	CIS260
CIS367	Data Warehousing	3	CIS260
CIS382	Cloud Computing	3	CIS260, CS332
CIS440	Software Testing & Validation	3	CIS340L
CIS464	Information Retrieval Systems	3	CIS260
CIS467A	Data Mining	3	CIS260
CIS468	Big Data Management	3	CIS467A , CIS360
CIS499	Graduation Project	3	Complete 98 CHs

Group : Department Elective Group 1

Course Code	Course Name	Course Credit	Course Pre-Requisite
CIS227	Human Computer Interaction	3	CS210L
CIS241	Software Documentation	3	CIS240
CIS256	Files Structures	3	CS250
CIS370	Intelligent Systems & Internet Of Things	3	CS210, CS332
CIS380	Information System Applications	3	CS360
CIS472	Applied Data Mining	3	CIS467A
CIS480	Distributed Systems Applications	3	CS332, BIT381
CIS492	Special Topics	3	CIS360
CIS497	Training Certificate	3	None
CIS498	Practical Training	3	98

Group : Department Elective Group 2

Course Code	Course Name	Course Credit	Course Pre-Requisite
CS281	Multimedia Systems	3	CS101, CS210
CS367	Artificial Intelligence	3	CS351
BIT222	Entrepnuership in IT	3	CS101
BIT481	Web Applications Development (2)	3	BIT381

Group : Department Elective Group 3

Course Code	Course Name	Course Credit	Course Pre-Requisite
MATH241	Linear Algebra (1)	3	MATH101
STAT101	Introduction to Statistics (1)	3	None
BA101	Management Principles	3	None

Figure 16 Student Batch Plan Page

Student : 2018902186
Department of Computer Information Systems
Faculty of Computer Science & Information Technology.

Profile

Academic Plan

Schedules

Suggestions

Faculty Offered Courses
The Courses the faculty offers this semester.

Deparment : Computer Science

Course Code	Course Name	Course Section	Day	Time	Course Credit
CS111	Programming in a Selected Language	2	Monday - Wednesday	10:00:00	3
CS111L	Programming in a Selected Language Lab	1	Monday - Wednesday	11:00:00	1
CS111L	Programming in a Selected Language Lab	2	Monday - Wednesday	13:00:00	1
CS130	Operating Systems Fundamentals	1	Monday - Wednesday	08:00:00	3
CS142	Discrete Structures	1	Monday - Wednesday	08:00:00	3
CS142	Discrete Structures	2	Monday - Wednesday	11:00:00	3
CS210	Object-Oriented Programming	1	Monday - Wednesday	11:00:00	3
CS210	Object-Oriented Programming	2	Monday - Wednesday	09:00:00	3
CS210L	Object-Oriented Programming Lab	1	Monday - Wednesday	08:00:00	1
CS210L	Object-Oriented Programming Lab	2	Monday - Wednesday	09:00:00	1
CS220	Logic Design	1	Monday - Wednesday	11:00:00	3
CS225	Computer Organization Lab	1	Monday - Wednesday	11:00:00	1
CS225	Computer Organization Lab	2	Monday - Wednesday	12:00:00	1
CS250	Data Structures	1	Monday - Wednesday	17:00:00	3
CS250	Data Structures	2	Monday - Wednesday	16:00:00	3
CS281	Multimedia Systems	1	Monday - Wednesday	12:00:00	3
CS281	Multimedia Systems	2	Monday - Wednesday	13:00:00	3
CS310	4 Programming	1	Monday - Wednesday	10:00:00	3
CS310	4 Programming	2	Monday - Wednesday	12:00:00	3
CS332	Data Communications and Networks	1	Monday - Wednesday	13:00:00	3
CS332	Data Communications and Networks	2	Monday - Wednesday	10:00:00	3
CS332L	Data Communications and Networks Lab	1	Monday - Wednesday	08:00:00	1
CS332L	Data Communications and Networks Lab	2	Monday - Wednesday	11:00:00	1
CS342	Theroy of Computation	1	Monday - Wednesday	12:00:00	3
CS351	Analysis and Design of Algorithms	1	Monday - Wednesday	09:00:00	3
CS351	Analysis and Design of Algorithms	2	Monday - Wednesday	12:00:00	3
CS360	Wireless Networks	1	Monday - Wednesday	10:00:00	3
CS411	Smart Phones Applications Development	1	Monday - Wednesday	11:00:00	3
CS411	Smart Phones Applications Development	2	Monday - Wednesday	13:00:00	3
CS432	Computer Architecture	1	Monday - Wednesday	17:00:00	3
CS480	Image Processing	1	Monday - Wednesday	09:00:00	3
CS480	Image Processing	2	Monday - Wednesday	08:00:00	3
CS498	Practical Training	1	Monday - Wednesday	08:00:00	3
CS499A	Gradutaion Project A	1	Monday - Wednesday	00:00:00	3
CS499B	Gradutaion Project B	1	Monday - Wednesday	14:00:00	3
CS499B	Gradutaion Project B	2	Monday - Wednesday	14:00:00	3

Deparment : Computer Information Systems

Course Code	Course Name	Course Section	Day	Time	Course Credit
CIS101	Introduction to Information Systems	1	Monday - Wednesday	16:00:00	3
CIS101	Introduction to Information Systems	2	Monday - Wednesday	18:00:00	3
CIS214	Visual Programming	1	Monday - Wednesday	10:00:00	3
CIS214	Visual Programming	2	Monday - Wednesday	13:00:00	3
CIS214	Visual Programming	3	Monday - Wednesday	08:00:00	3
CIS227	Human Computer Interaction	1	Monday - Wednesday	10:00:00	3
CIS240	Introduction to Software Engineering	1	Monday - Wednesday	10:00:00	3
CIS240	Introduction to Software Engineering	2	Monday - Wednesday	08:00:00	3
CIS240	Introduction to Software Engineering	3	Monday - Wednesday	11:00:00	3
CIS256	Files Structures	1	Monday - Wednesday	09:00:00	3
CIS260	Database Systems	1	Monday - Wednesday	11:00:00	3
CIS260	Database Systems	2	Monday - Wednesday	12:00:00	3
CIS260	Database Systems	3	Monday - Wednesday	09:00:00	3
CIS260L	Database Systems Lab	1	Monday - Wednesday	11:00:00	1
CIS260L	Database Systems Lab	2	Monday - Wednesday	12:00:00	1
CIS265	Database Management System	1	Monday - Wednesday	08:00:00	3
CIS265	Database Management System	2	Monday - Wednesday	09:00:00	3
CIS265	Database Management System	3	Monday - Wednesday	11:00:00	3
CIS340	Object Oriented Analysis & Design	1	Monday - Wednesday	17:00:00	3
CIS340L	Object Oriented Analysis & Design Lab	1	Monday - Wednesday	08:00:00	1
CIS342	System Analysis & Design	1	Monday - Wednesday	08:00:00	3
CIS342	System Analysis & Design	2	Monday - Wednesday	10:00:00	3
CIS360	Developing Database Applications	1	Monday - Wednesday	10:00:00	3
CIS360	Developing Database Applications	2	Monday - Wednesday	12:00:00	3
CIS367	Data Warehousing	1	Monday - Wednesday	09:00:00	3
CIS380	Information System Applications	1	Monday - Wednesday	08:00:00	3
CIS382	Cloud Computing	1	Monday - Wednesday	08:00:00	3
CIS492	Special Topics	1	Monday - Wednesday	09:00:00	3
CIS498	Practical Training	1	Monday - Wednesday	08:00:00	3
CIS499	Graduation Project	1	Monday - Wednesday	12:00:00	3
CIS499	Graduation Project	2	Monday - Wednesday	12:00:00	3

Figure 17 Department Schedules Page

HOME   DEPARTMENTS   ABOUT

Student : 2018902186
Department of Computer Information Systems
Faculty of Computer Science & Information Technology.

Profile

Academic Plan

Schedules

Suggestions

Degree Advisor Schedule Suggestions

- Student Department : Computer Information Systems
- Student Plan Number : 202102

Course Suggestions :

Course Code	Course Name	Course Section	Day	Time	Course Credit
CIS260L	Database Systems Lab	1	Monday - Wednesday	11:00:00	1
CIS260L	Database Systems Lab	2	Monday - Wednesday	12:00:00	1
CIS265	Database Management System	1	Monday - Wednesday	08:00:00	3
CIS265	Database Management System	2	Monday - Wednesday	09:00:00	3
CIS265	Database Management System	3	Monday - Wednesday	11:00:00	3
CIS340	Object Oriented Analysis & Design	1	Monday - Wednesday	17:00:00	3
CIS340L	Object Oriented Analysis & Design Lab	1	Monday - Wednesday	08:00:00	1
CIS360	Developing Database Applications	1	Monday - Wednesday	10:00:00	3
CIS360	Developing Database Applications	2	Monday - Wednesday	12:00:00	3
CIS367	Data Warehousing	1	Monday - Wednesday	09:00:00	3

Figure 18 Suggested Schedule By the Website

6.5 WEBSITE SCENARIO :

Essentially, the core of the system is to suggest a schedule for the student that suits them, this is done using the following attributes :

 1. The courses the student has already taken.

 2. The courses from their plan that have no pre-req but are of the level appropriate to the student.

 3. The courses that have been recently opened to the student to take, because they have taken the pre-requisite.

 4. The courses that best match the difficulty of the overall selection.

These attributes that do not belong to the student must also be taken into consideration :

    A. Is the course offered by the faculty for this term ?

    B. The courses that are selected must not overlap.

```php
1   //First, match courses the student has taken with their plan and get the courses they have NOT taken yet,
2    //and give priority to the courses that appear in the 'pre_req' column, store all these into the suggestd table
3
4    //GET ALL Courses that are (NOT TAKEN + IN THE PLAN + ARE OPENED
5    $get_course_options = "SELECT * FROM plan_course WHERE plan_id = $std_plan AND crs_code
6           NOT IN (SELECT crs_code FROM transcript WHERE std_id = $std_id)
7           AND crs_code IN (
8             SELECT crs_code FROM plan_course WHERE req_code = 'null'
9            OR req_code IN (
10             SELECT crs_code FROM plan_course WHERE crs_code IN (
11              SELECT crs_code FROM course_requirements WHERE req_code IN (
12               SELECT crs_code FROM transcript WHERE std_id = $std_id
13                      )
14                   )
15               )
16            ); ";
17
18  $get_course_options_query = mysqli_query($conn, $get_course_options);
19  while ($row = mysqli_fetch_array($get_course_options_query, MYSQLI_ASSOC)){
20    $crs_code = $row['crs_code'];
```

```php
1    //Check if course is offered in the faculty schedules
2    $check_if_offered = "SELECT * FROM dept_schedule WHERE crs_code = '$crs_code'";
3    $check_if_offered_query = mysqli_query($conn, $check_if_offered);
4    while ($row2 = mysqli_fetch_array($check_if_offered_query, MYSQLI_ASSOC)){
5      $crs_code = $row2['crs_code'];
6      $crs_section = $row2['crs_section'];
7      $insert_into_suggested = "INSERT INTO suggested(std_id, term_id, `crs_code`, crs_section, wanted_credit, priority , difficulty)
8      VALUES ($std_id, 202102,'$crs_code', $crs_section , 1 , 1 , 1 )";
9      $insert_into_suggested_query = mysqli_query($conn, $insert_into_suggested);
10    }
11  }
12  ?>
```

7. DEFINITIONS:

[18] Guest: anyone without an account can access the public portion of the system.

[19] System Administrator: person responsible for the technical aspects of the system such as installing it on the university servers and keeping up with maintenance.

[20] Stakeholders : a person who has a say in the business decisions of a situation.

[21] Actor : represents real life objects that interact with each other and the system.

8. REFERENCES:

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[1] *Non-Functional Requirements: Examples, Types, How to Approach.* (2019, November). Altexsoft. Retrieved March 2022, from https://www.altexsoft.com/blog/non-functional-requirements/

[2] *UML Use Case Diagram Example: Registration System.* (n.d.). ConceptDraw. Retrieved April 9, 2022, from https://www.conceptdraw.com/examples/use-case-diagram

[3] Gray, K., & Farzindar, A. F. (n.d.). Recommender Systems in a Nutshell. KDnuggets. Retrieved April 12, 2022, from https://www.kdnuggets.com/2020/07/recommender-systems-nutshell.html

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[7] Nalimov, C. (2021, January). Diagram maker for developers. Gleek_. Retrieved April 12, 2022, from https://www.gleek.io/blog/relational-schema.html

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[9] Elmasri, R., & Navathe, S. (2015). *Fundamentals of Database Systems (7th ed).* Hoboken, N.J: Pearson.

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Chapter 9 - Recommendation Systems

REFERENCED WORKS & DIAGRAMS:

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[13] Abdulmonim, D.A. (2019, May). *Student Registration System: Use Case Diagram*. ResearchGate. Retrieved April 9, 2022, from https://www.researchgate.net/figure/The-use-case-diagram-for-the-student-registration-system_fig1_331316022

[14] Jaime, A. P.-M. (2008, January). *The Use Case Diagram of the University Application.* ResearchGate. Retrieved April 9, 2022, from https://www.researchgate.net/figure/The-Use-Case-Diagram-of-the-University-Application_fig6_45588178.

[15] Denley, T. (2013, September). *Degree Compass: A Course Recommendation System*. EduCase. Retrieved April 9, 2022, from https://er.educause.edu/articles/2013/9/degree-compass-a-course-recommendation-system

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WEBSITES/TOOLS USED FOR DIAGRAMS:

Lucidchart, https://www.lucidchart.com/

Microsoft Visio, https://www.office.com/launch/visio

Draw io, https://drawio-app.com/

ErdPlus, https://erdplus.com/