



**POLITECNICO**  
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE  
E DELL'INFORMAZIONE



# DD: Design Document

Authors: **Xin Ye - Matteo Civitillo - Mattia Vicenzotto**

Advisor: Elisabetta Di Nitto  
Academic Year: 2024-2025

# 1. INTRODUCTION

## 1.1. Purpose

This document provides a detailed overview of the architectural design for the Students&Companies (S&C) platform, building upon the requirements and specifications defined in the RASD document. All design choices will be documented and explained, providing adequate justifications for each decision taken. The document will focus on the design of the system's architecture and user interface design while also providing a general implementation, integration and testing plan.

## 1.2. Scope

As stated in the RASD document, the Students & Companies (S&C) platform aims to simplify the internship process by connecting university students with companies through an intuitive and efficient platform. The platform leverages advanced recommendation algorithms to match students' profiles with suitable opportunities and provides tools for seamless communication and collaboration between all parties involved.

The actors are Students, who can create and manage their profiles, search for internships, receive recommendations, and track their applications. Companies are another key actor, enabling them to post internships, review applications, and find suitable candidates through the platform. Finally, University Coordinators ensure academic standards are upheld, monitor internships, and address any arising issues.

### 1.3. Definitions, Acronyms, Abbreviations

#### 1.3.1. Definitions

Definition	Description
Student	A user registered on the platform who seeks internships to gain experience and enhance their skills. Students can create profiles, upload CVs, search for internships, receive recommendations, apply for opportunities, and track application statuses.
Company HR	A user registered on the platform representing an organization offering internships. Companies can post listings, browse student profiles, receive candidate recommendations, and manage the selection process.
University Coordinator	A representative of a university with a dedicated account on the platform, created with their institutional email account. University Coordinators are responsible for approving internships, reviewing details, and serving as points of contact for resolving complaints or other concerns during the internship process.
CV	A document listing a student's skills, experiences, and preferences, used for matching with internships.
Internship	A professional opportunity offered by a company for students to gain practical experience. Each internship specifies tasks, required skills, application domain, and terms, such as compensation, mentorship opportunities, and potential benefits (both tangible and intangible).
Recommendation	Automated suggestions provided by the platform to connect students and companies.
Complaint	A report submitted to address issues during the internship process, reviewed and managed by University Coordinators in collaboration with companies and students.
Feedback	Information provided by students or companies to improve recommendations or the internship process.
Notification	Alerts sent by the platform about matches, applications, or status updates.

Table 1: Definitions

### 1.3.2. Acronyms

Acronym	Description
S&C	Students & Companies
UC	University Coordinator
Company HR	Company representative (Human Resources)
CV	Curriculum Vitae
API	Application Programming Interface
UI	User Interface
DB	Database
NFR	Non-Functional Requirements
RASD	Requirements Analysis and Specification Document
DD	Design Document
UML	Unified Modeling Language
WP	World Phenomena
SP	Shared Phenomena
G	Goal
D	Domain Assumption
R	Requirement

Table 2: Acronyms

### 1.3.3. Abbreviations

Abbreviation	Description
Id	Identifier

Table 3: Abbreviations

## 1.4. Revision History

January 7, 2024: version 1.0 (first release)

## 1.5. Reference Documents

- Specification document: “Assignment RDD AY 2024-2025”
- UML official specification: <https://www.omg.org/spec/UML/>
- Class diagram: <https://www.lucidchart.com/pages/>
- Mock ups: <https://www.figma.com/>
- Sequence Diagrams: <https://plantuml.com/sequence-diagram>

## 1.6. Document Structure

The DD is structured in the following seven chapters:

- **INTRODUCTION:** This section provides a brief description of the document's purpose, scope, and overall content. It introduces the S&C platform and outlines what the document aims to explain.
- **ARCHITECTURAL DESIGN:** This chapter details the architectural choices made to design the S&C platform, including an overview of its main components and their interactions. Deployment considerations are also discussed in this section.
- **USER INTERFACE DESIGN:** This chapter presents mock-ups of the web-based UIs for the primary actors: Students, Company HR, and University Coordinators, showcasing their interaction with the platform.
- **REQUIREMENT TRACEABILITY:** This section explains how the requirements specified in the RASD are addressed through the design choices presented in the DD, ensuring coherence and alignment.
- **IMPLEMENTATION, INTEGRATION, AND TEST PLAN:** This chapter outlines the implementation approach, the order in which components and subcomponents are integrated, and the testing strategies to validate the system.
- **EFFORT SPENT:** This section summarizes the effort spent by team members, including a detailed table of hours dedicated to the realization of this document.
- **REFERENCES:** A list of all relevant references to external sources, documentation, or tools that were used to develop this document.

## 2. Architectural Design

### 2.1. Overview

The Students & Companies (S&C) platform adopts a three-tier distributed architecture to provide flexibility, scalability, and maintainability. This architecture ensures a clear separation of responsibilities and supports the system's requirements for reliable and efficient operations. The three layers include:

- **Presentation Layer:** This layer manages user interaction and the graphical user interface (GUI). It ensures students, company HR, and university coordinators can intuitively access the platform's features, such as searching internships, posting offers, and monitoring activities. The GUI is web-based, focusing on accessibility and usability.
- **Application Layer:** This layer handles the business logic, processing user requests, matching internships with student profiles, managing feedback, and generating recommendations. It serves as the core of the platform, enabling secure and efficient communication between users and the system.

cation between the Presentation and Data layers.

- **Data Layer:** Responsible for storing and retrieving data, such as user profiles, internship postings, and feedback. A clustered Database Management System (DBMS) is employed to ensure scalability, fault tolerance, and data integrity.

This separation not only organizes the system logically but also determines its physical deployment. Each layer can operate on different machines or clusters, enhancing modularity and scalability.

To improve performance and reliability:

- A **load balancer** distributes incoming requests across multiple instances of the application layer to prevent bottlenecks and ensure high availability.
- **Firewalls** are implemented to safeguard sensitive data, ensuring secure communication and protecting against unauthorized access.

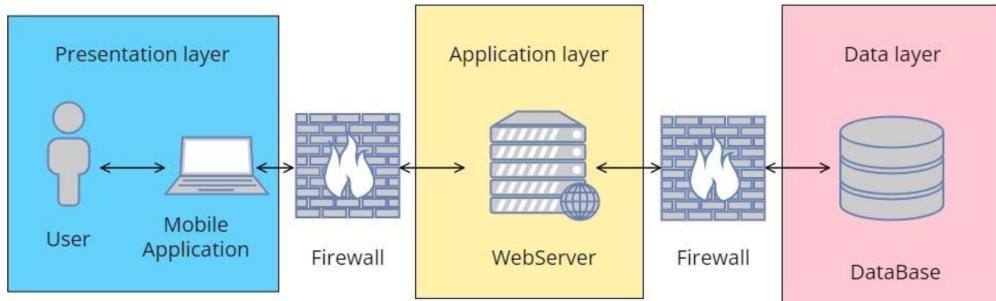


Figure 2.1.1: Three tier architecture

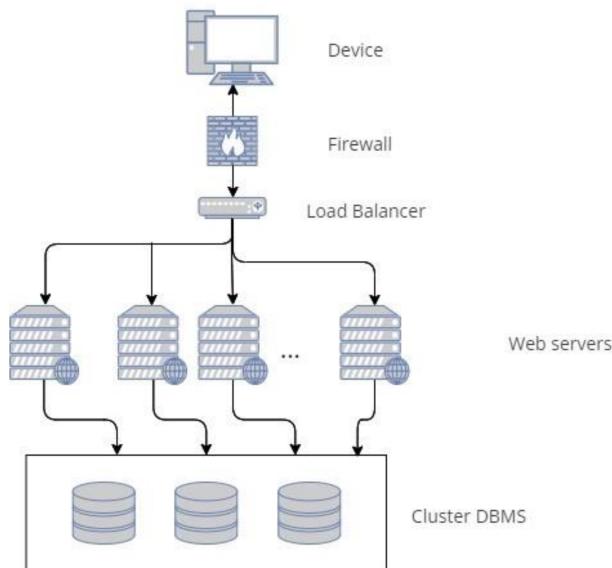


Figure 2.1.2: System topology

### 2.1.1. Class Diagram

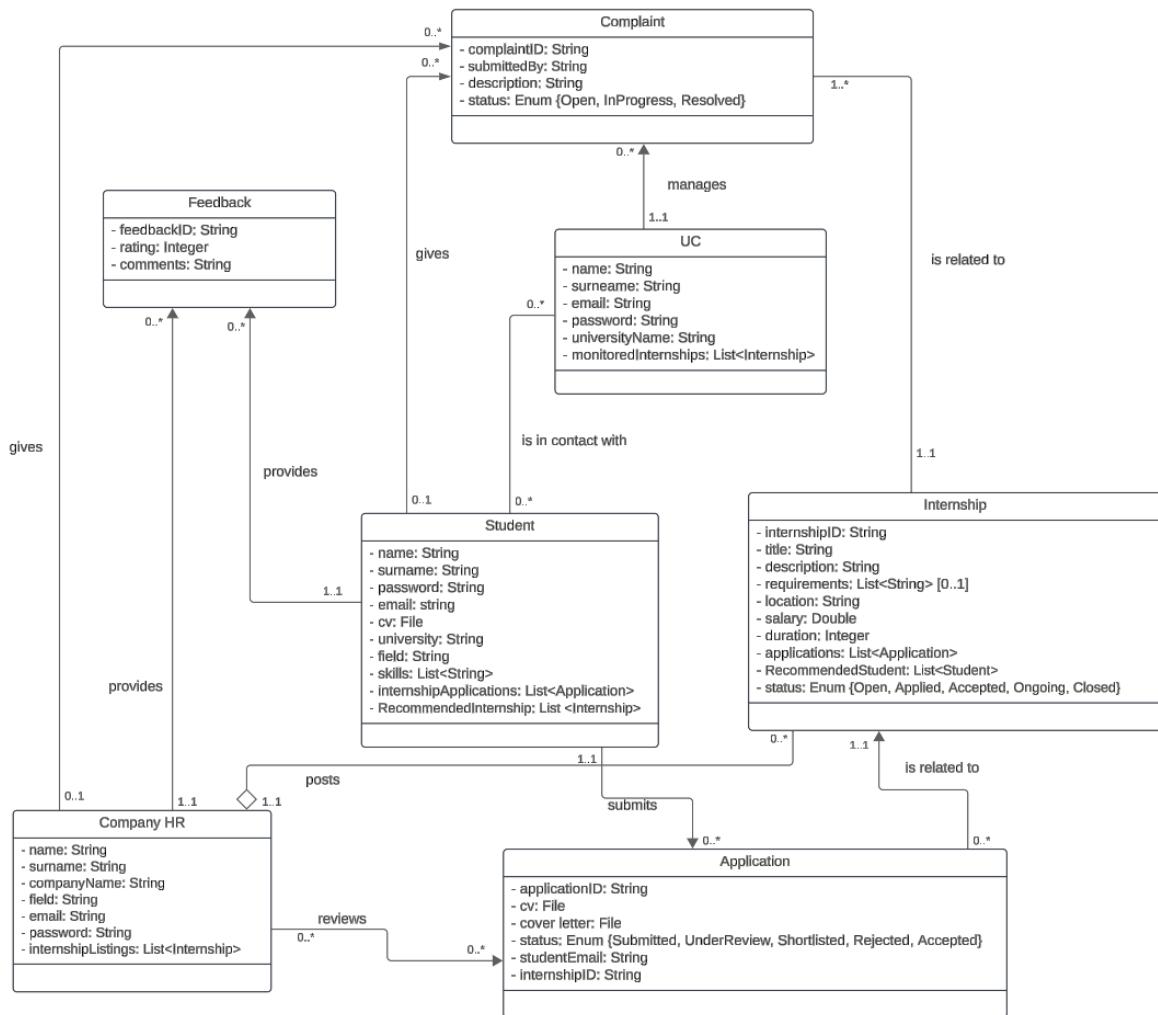


Figure 2.1.3: Class Diagram

## 2.2. Component View

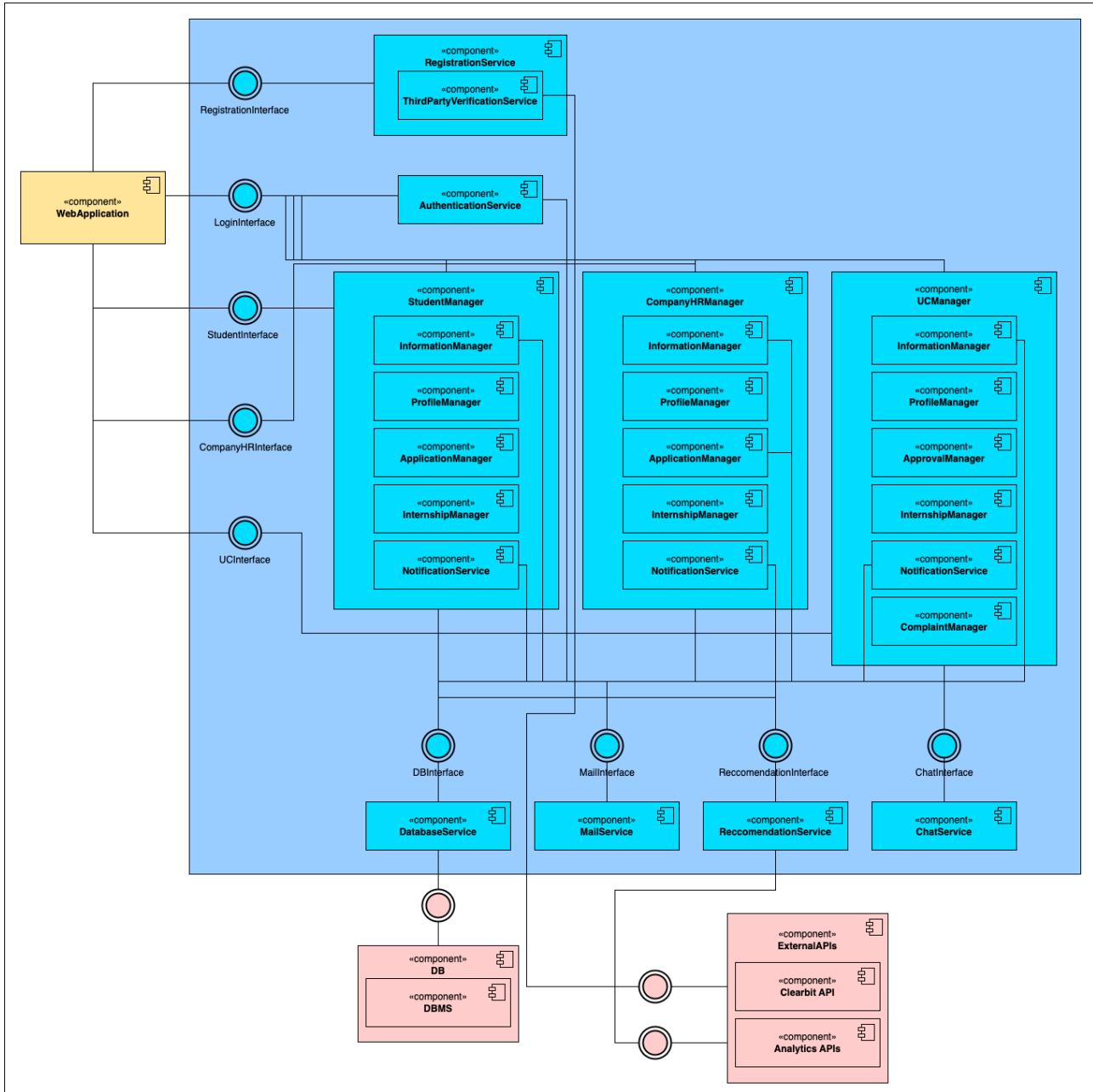


Figure 2.2.1: Component Diagram

### Web Application

The main interface for students, company HR, and university coordinators to access the S&C platform. It allows users to manage their accounts, browse internships, submit applications, approve proposals, and monitor internship statuses.

### Mail Service

Responsible for sending emails to all users. Such as:

- **Confirmation Emails:** Sent during the registration process to validate user email addresses.
- **Notifications:** Sent to inform users of new matches, application updates, interview schedules or other important informations and updates.

## Registration Service

Manages the user registration process and stores user data in the database by interacting with the Database Service. It also works with the Mail Service to send verification links.

- **Third-Party Verification Service:** ensures company HR and university coordinators register with authentic email addresses, interacting with external APIs like Clearbit.

## Authentication Service

Handles login functionality by verifying user credentials. It interacts with the Database Service to access user data and validate login attempts.

## Student Manager

Manages the functionalities related to students:

- **Information Manager:** provides students with curated internship listings and in-depth company information, helping them evaluate opportunities that match their profile.
- **Profile Manager:** allows students to view and update personal details, maintain CVs, and track their application history.
- **Application Manager:** oversees the application lifecycle, from submission to status updates, ensuring students can manage and follow their internship applications effectively.
- **Internship Manager:** enables students to track and maintain details of ongoing internships, submit feedback, or send complaints if issues arise.
- **Notification Service:** sends alerts about relevant information such as internship matches, application progress or complaints, keeping students informed of any important changes.

## CompanyHR Manager

Manages the functionalities related to company HR representatives:

- **Information Manager:** offers company-specific resources to optimize internship postings and manage applicant tracking.
- **Profile Manager:** allows companies to maintain their organizational profile, update contact information, and keep track of past internships.

- **Application Manager:** manages the application and candidate-selection lifecycle, enabling HR to browse profiles, shortlist candidates, and schedule interviews.
- **Internship Manager:** facilitates the creation, editing, and management of internship postings. It handles both feedback and complaints.
- **Notification Service:** alerts companies about new matching student profiles, status changes or complaints, keeping company HR informed of any important changes.

## **UC Manager**

Manages the functionalities related to university coordinators:

- **Information Manager:** supplies an overview of internships, approval processes, and complaint resolution.
- **Profile Manager:** enables coordinators to manage their related information, view internship or complaint histories.
- **Approval Manager:** allows coordinators to approve or reject internship proposals.
- **Internship Manager:** provides oversight of ongoing internships, including status checks and relevant documentation.
- **Notification Service:** notifies UC about pending approvals, unresolved issues, important updates on internships, keeping UC informed of any important changes.
- **Complaint Manager:** focuses on receiving and resolving formal complaints, ensuring timely intervention when problems arise during an internship.

## **Chat Service**

Handles real-time communication among students, company HR representatives, and university coordinators, primarily to address complaints and disputes arising during the internship process.

## **Recommendation Service**

The core engine for personalized matching between students and companies. It analyzes student CVs, internship descriptions, and user preferences to suggest optimal matches. Employs advanced algorithms, including keyword searches and statistical analyses.

## **Notification Service**

Handles system-wide notifications for all user actions, ensuring timely updates about matches, applications, and other critical events. Integrates with the Mail Service for email-based alerts.

## **Database (DB)**

Stores and manages all data related to the platform, including user profiles, internship listings,

applications, feedback, recommendations and complaints.

- **Database Service:** acts as the interface for other components to interact with the database.

## External APIs

Provides additional functionalities by integrating third-party services:

- **Clearbit API:** verifies institutional and company emails during registration.
- **Analytics APIs:** processes data for generating insights and refining recommendations.

### 2.3. Deployment View

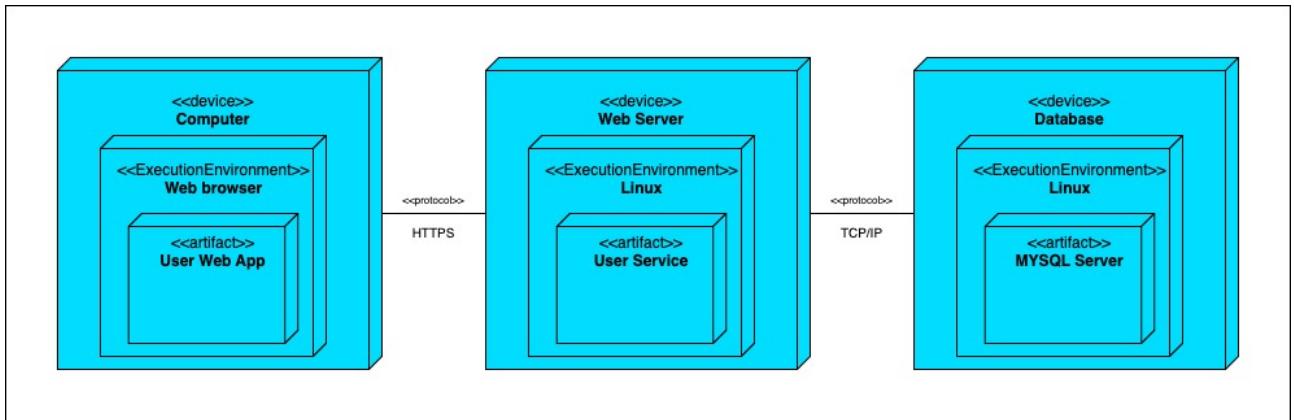


Figure 2.3.1: Deployment View

This section outlines the deployment strategy for the S&C platform, focusing on the integration of hardware and software components for efficient and secure operation. The deployment strategy utilizes a **three-tier architecture**, where each layer is deployed on separate machines (or sets of machines) to enhance scalability, maintainability, and reliability. This setup ensures clear separation of concerns and flexibility for future system growth.

#### 2.3.1. Deployment Tiers

- **Presentation Tier:** users (students, company HR, and UC) interact with the S&C platform through this tier via their devices, such as laptops, desktops, tablets, or smartphones. The **Web Server** hosts the S&C Web Application, providing an intuitive user interface for managing accounts, internships, proposals, and notifications. Communication with the Middle Tier is secured via HTTPS, ensuring data confidentiality and integrity.
- **Middle Tier:** consists of a single application server that both hosts the **Web Application** and handles all incoming **requests** from users' browsers. Communication between

the clients and this server is secured via HTTPS, ensuring data integrity and confidentiality. In this setup, there is no strict need to separate the Web Server from the Application Server, so both roles are combined for simplicity. Whenever data retrieval or updates are required, the application server interacts with the database, effectively managing all business logic and core functionalities of the S&C platform.

- **Data Tier:** is responsible for ensuring the reliable storage and management of all persistent data required by the platform. A **Database** server serves as a centralized repository for a multitude of data types, including user profiles, internship listings, applications, feedback, and other pertinent information. Communication between the Middle Tier and the aforementioned components is facilitated via the TCP/IP protocol.

### 2.3.2. Additional Components

- **Load Balancer:** is necessary to facilitate the distribution of processing loads among replication nodes. This is achieved by introducing a load balancing system between the presentation tier and the middle tier. The implementation of such a system will reduce the time required to process all requests, leading to enhanced response times and improved reliability.
- **Firewall:** is a combination of hardware and/or software components designed to facilitate the interconnection of a trusted network with untrusted networks. By enforcing the implementation of appropriate security policies, it monitors and regulates the traffic entering and exiting the secure network, thereby preventing, detecting, and blocking any unauthorized access or malicious activity. These components are situated between the presentation tier and the middle tier, as well as between the middle tier and the data tier.

In the figure load balancer and firewall are omitted.

## 2.4. Runtime View

In the following sequence diagrams, we are going to represent the behaviour of the most important components of the S&C platform. The diagrams show just a high-level representation of the interaction between the various components.

## 2.4.1. Student's Sequence Diagrams

### Student sign up

When a student accesses the S&C platform for the first time, the web application takes them to the registration page. After filling in the required fields (first name, last name, email, password, CV, university, field of study and skills) and submitting the form, the data is sent to the Registration Service. The Registration Service validates the submitted information. If validation fails (for example, mandatory fields are missing or the email format is invalid), an error message is sent back to the web application, prompting the student to correct the input. If validation succeeds, the Registration Service forwards the data to the Database Service to store the student's details in the Database. The database assigns a unique userID to the new student record and confirms the successful temporary creation of the account. The Registration Service then calls the Mail Service to send a verification email to the student containing a link to verify the student's email address. To complete the registration process, the student must click the verification link in the email. This triggers a request to the Registration Service, which updates the student's account status to "Verified" in the Database via the Database Service. Once verified, the student's account is fully activated. The web application then notifies the student that their account has been successfully created and verified. The student is redirected to the login page where they can access their newly created account.



Figure 2.4.1: Sign up - Sequence Diagram

## Student log in

When a Student attempts to log in to the S&C platform, they first access the login page through the web application, which displays the login form. The Student enters their email and password and submits the credentials. The web application forwards these credentials to the authentication service for validation. If the credentials are valid, the authentication service confirms success, and the Student is redirected to their dashboard. If the credentials are incorrect, the system returns an "Invalid email or password" error message and prompts the Student to try again. In addition, if the Student's account does not exist, the system informs them with an "Account does not exist" message. The process continues in a loop until the Student either successfully logs in or decides to stop trying.

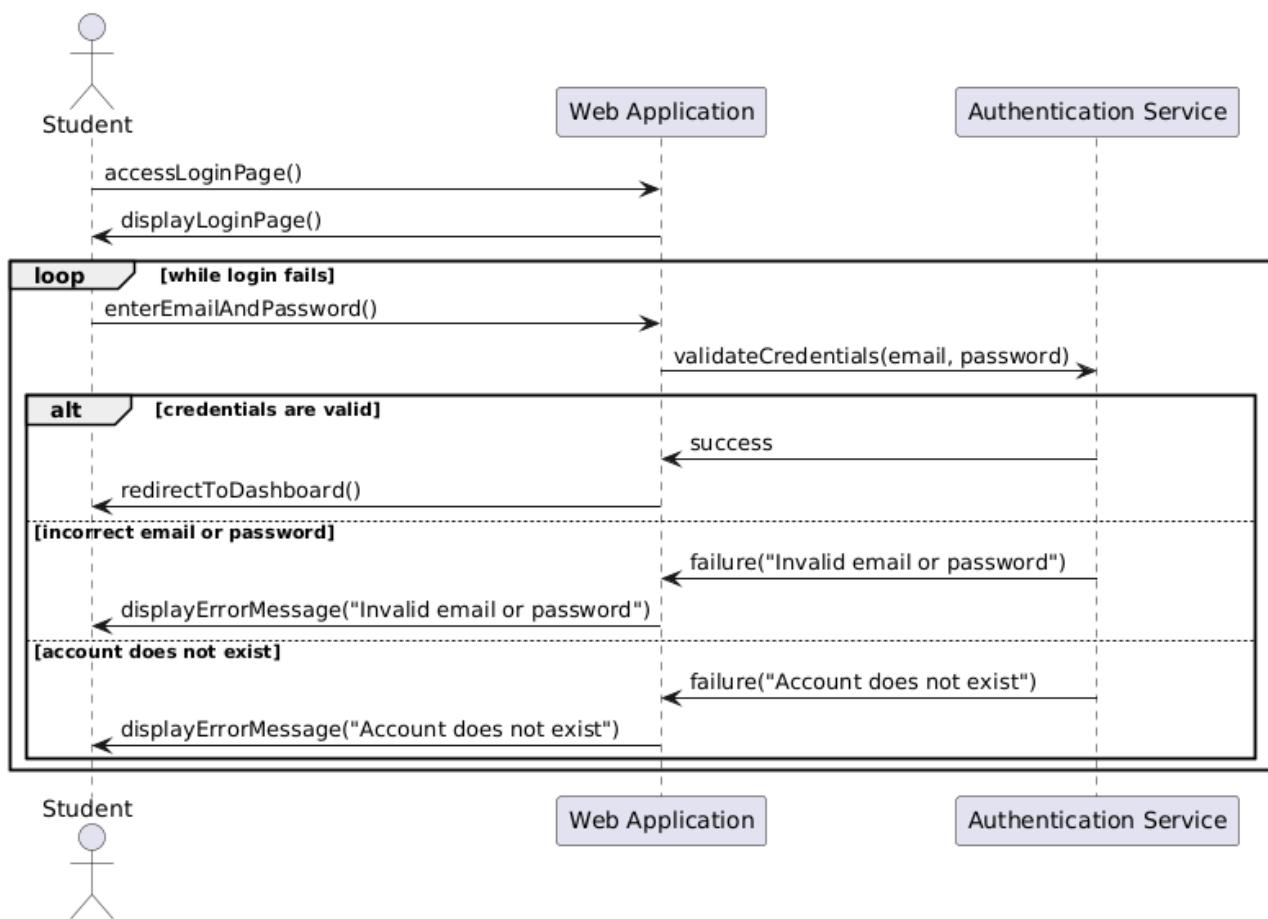


Figure 2.4.2: Log in - Sequence Diagram

### Student log out

When a Student logs out of the S&C platform, they first select the "My Account" option from the home page of the web application, which displays the account management options, including the logout button. The user clicks the logout button to initiate the logout process. The web application triggers the notification service to send a logout confirmation message to the user, ensuring that the user is notified of the successful logout. The web application then terminates the user's session to prevent any further activity without re-authentication. Finally, the user is redirected to the login page, completing the logout process.

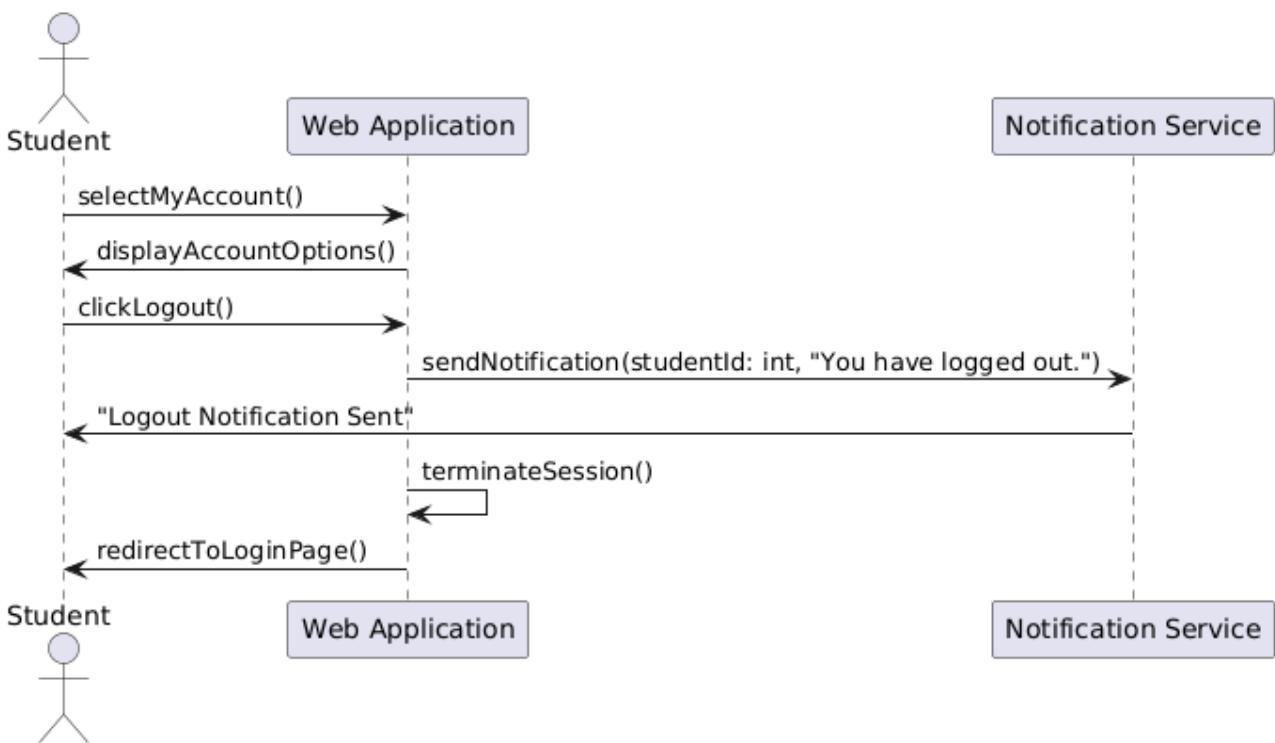


Figure 2.4.3: Log out - Sequence Diagram

## Student show internship information

When a logged-in student navigates to the Internship Dashboard, the system displays a list of available internships. The student can search for internships using specific criteria, such as keywords or filters. The web application retrieves the relevant internships from the Information Manager, which queries the database for matching records. After viewing the search results, the student can select and expand a specific internship record to view detailed information such as the description, requirements, location, and duration. The detailed internship data is retrieved from the Information Manager and displayed to the student on the Internship Information page.

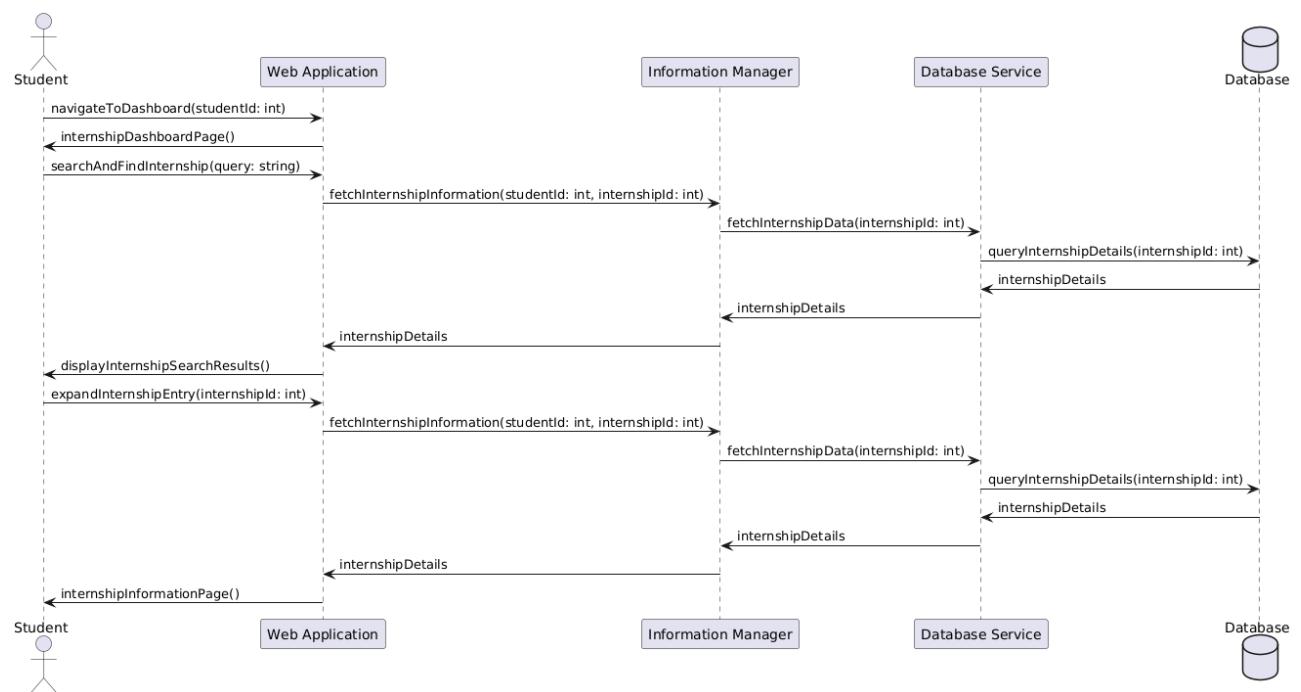


Figure 2.4.4: Show Internship Information - Sequence Diagram

## Student applies to an internship

When a logged-in student wants to apply for an internship, they first navigate to the Internship Dashboard. The system displays a list of internships based on the student's search criteria. The student can select and expand a specific internship record to view its details. Once the internship details are displayed, the student is prompted to upload their resume (optional) and click the Apply button. The web application forwards the application request to the Internship Manager, which processes the application. The Internship Manager checks to see if the application deadline has passed. If the application deadline has not passed, the application is successfully stored in the database and the student is redirected to an application confirmation page. If the application deadline has passed, an error message is displayed, informing the student that he or she can no longer apply for the internship. If the internship does not exist, the student receives an error message. This process ensures that only valid applications are submitted and saved, and that students receive immediate feedback on the status of their application.

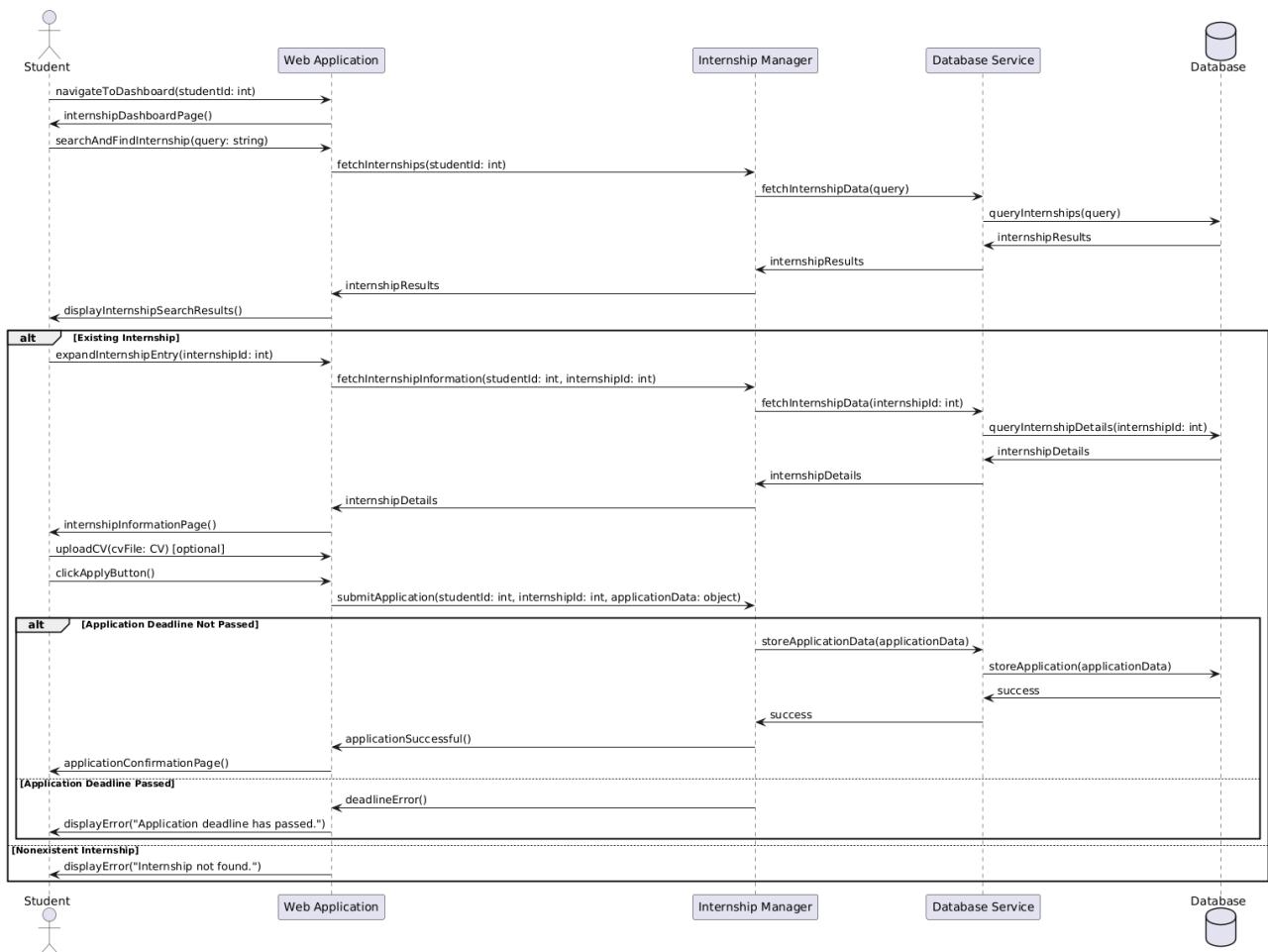


Figure 2.4.5: Apply to an Internship - Sequence Diagram

## Student manages profile

When a student wants to manage their profile on the S&C platform, they first access the profile management page through the web application. The system retrieves the student's current profile data by querying the Student Manager, which retrieves the data from the database via the Database Service. The profile details are displayed to the student. The student can then edit his or her profile information, such as personal details, skills or CV. Once the changes are submitted, the web application sends the updated data to the Student Manager, which validates the information and updates it in the database. A confirmation is displayed when the updates are successfully saved. In addition, the student has the option to upload or update his or her resume. The resume is sent to the Student Manager, which stores it in the database using the Database Service. After validating the upload, the system confirms the success of the operation. When all changes are complete, the student saves the updates. The system provides feedback that the profile has been successfully updated and the interaction is complete. This process ensures that the student's profile remains current and accurately reflects their qualifications.

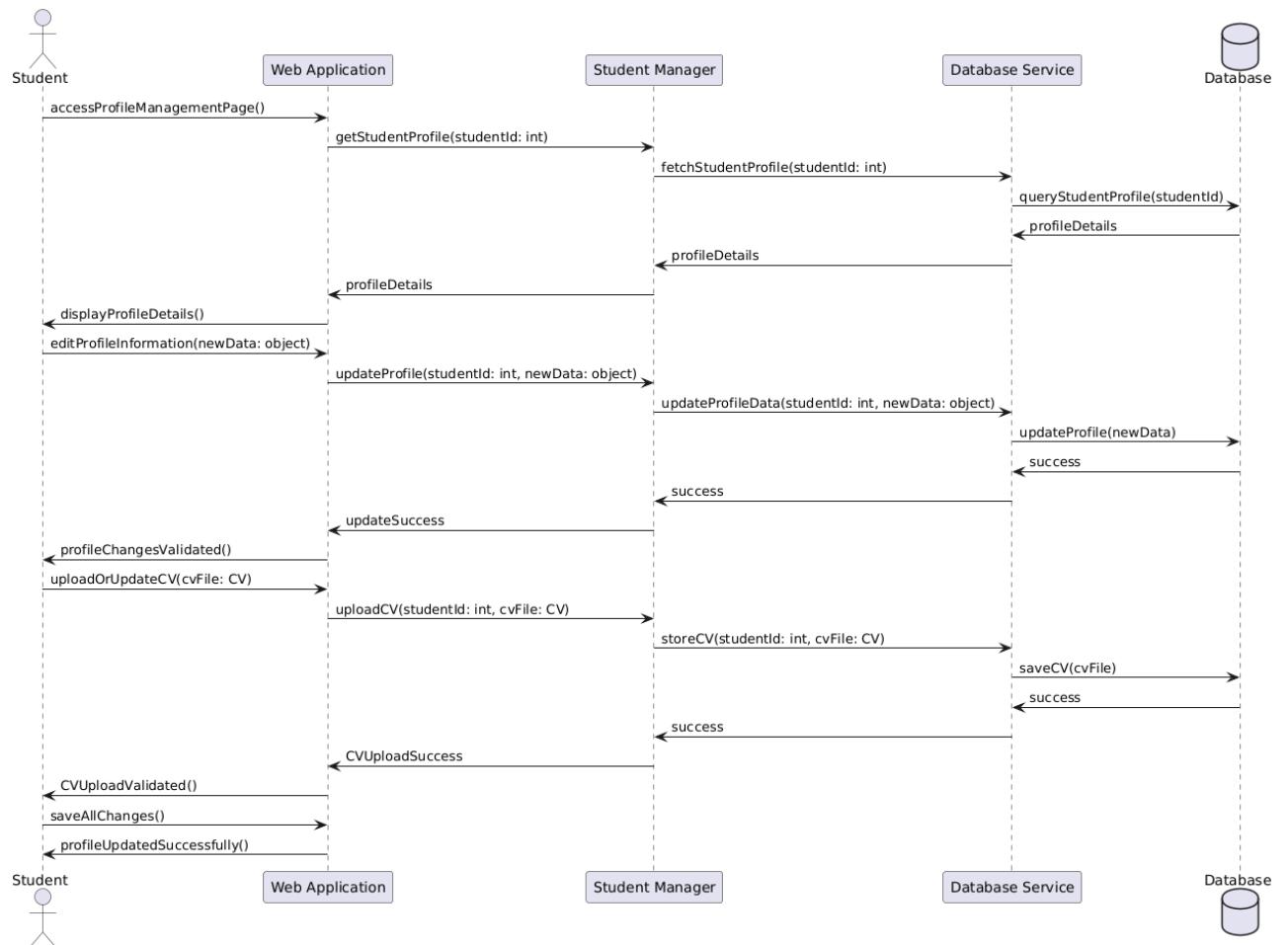


Figure 2.4.6: Manage Profile - Sequence Diagram

## Student submits feedback

When a student wants to provide feedback on an internship, they access the feedback form through the web application. The system displays the form and allows the student to enter details such as a rating and comments. After submitting the feedback, the web application forwards the data to the Student Manager, who validates the input. If the feedback is valid, the Student Manager sends the data to the Database Service, which stores it in the database. The system confirms the successful submission and the student receives a confirmation message. If the feedback is invalid, the Student Manager returns an error to the web application, notifying the student that the feedback submission failed. This process ensures that only valid feedback is stored in the database, while providing immediate feedback to the student about the success or failure of their submission.

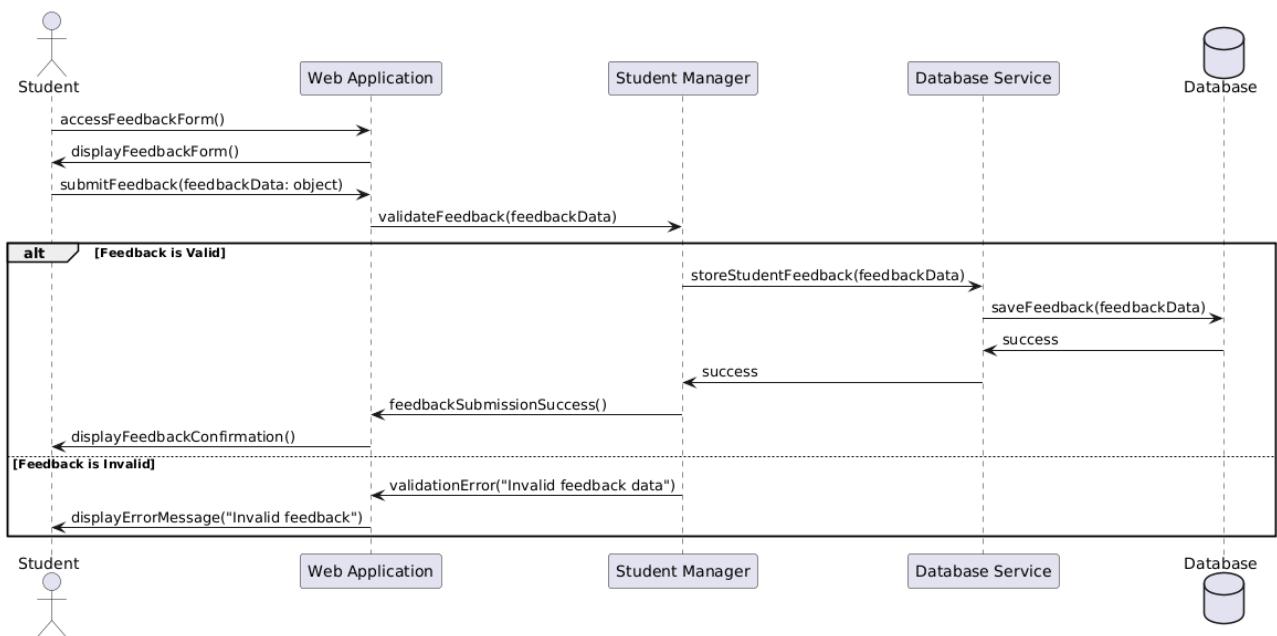


Figure 2.4.7: Submit Feedback - Sequence Diagram

## Student reports complaint

When a student wants to report a complaint about an internship, they access the complaints section through the web application, which displays a form for submitting complaint details. The student fills in the form with relevant information, such as a description of the problem and details of the internship, and submits it. The web application forwards the complaint data to the Student Manager, who validates the input. If the complaint is valid, the Student Manager sends the data to the Database Service, which stores it in the database. Once the complaint is saved, the Notification Service notifies the University Coordinator about the new complaint. The student then receives a confirmation message indicating that the complaint has been successfully submitted. If the complaint is invalid, the Student Manager returns an error to the web application and the student is notified that the submission failed with an error message.

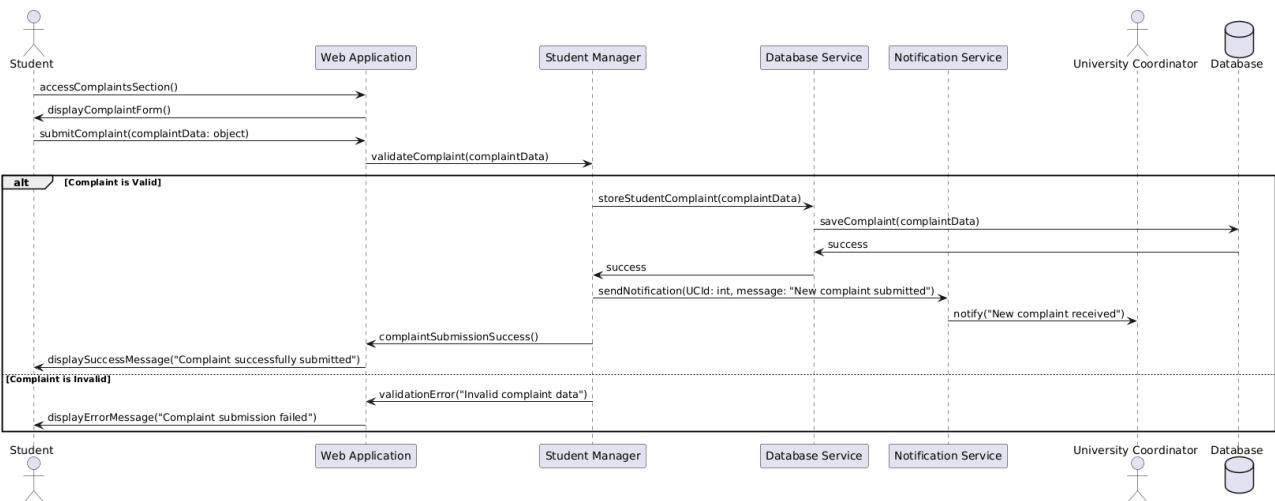


Figure 2.4.8: Report a Complaint - Sequence Diagram

## Student tracks application status

When a student wants to track the status of his or her internship applications, he or she accesses the Application Dashboard through the web application. The system retrieves the student's applications by requesting the data from the Application Manager, which retrieves it from the database via the Database Service. If applications exist, the system displays a dashboard that lists all submitted applications. The student can select an application to view detailed information such as its current status, feedback, or updates. The system retrieves and displays these details by querying the database. If no applications have been submitted, the system displays a message informing the student that no applications are available.

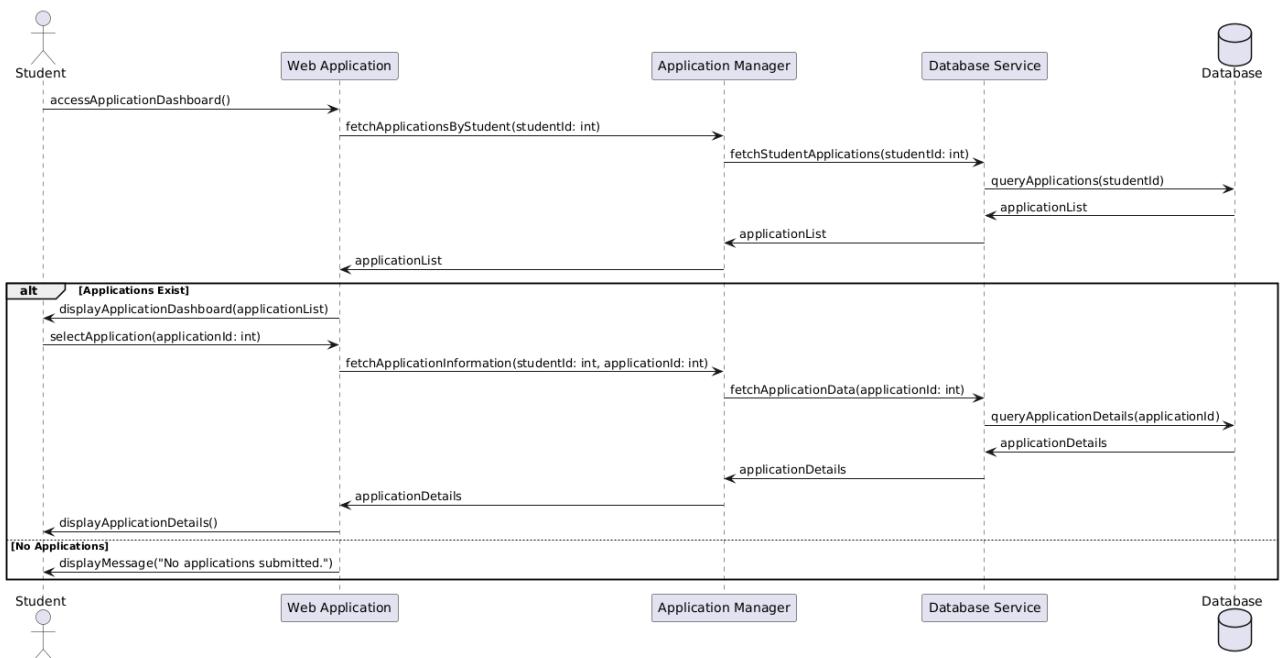


Figure 2.4.9: Track Application Status - Sequence Diagram

## Student receives internship recommendations

When a Company HR posts a new internship on the S&C platform, the system processes the internship data to identify students whose profiles match the posted opportunity. The web application sends the internship details to the recommendation service, which analyzes the registered students' profiles and generates a list of potential matches. For each matched student, the system sends an in-app notification via the notification service to inform the student of the new recommendation. This notification appears directly on the student's dashboard. In addition, the system sends an email notification using the mail service to ensure that the student receives detailed information about the recommended internship in their inbox.

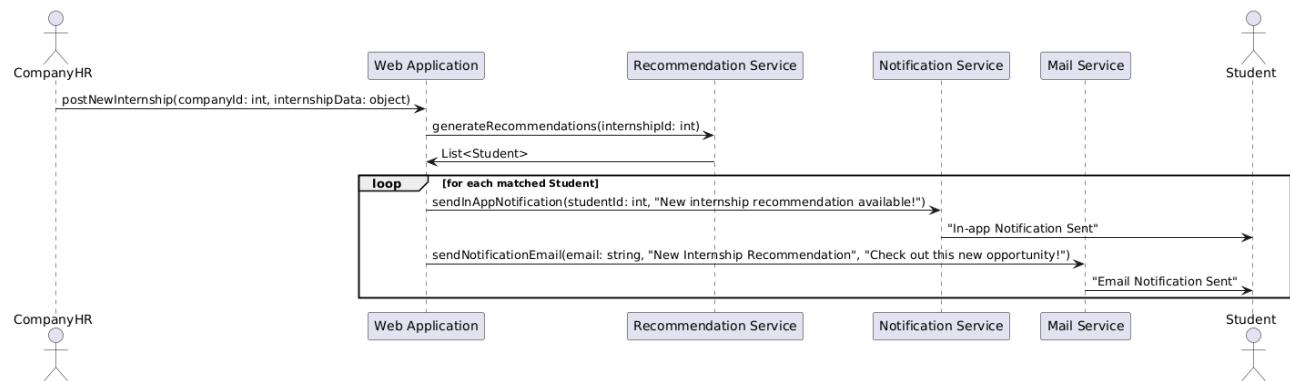


Figure 2.4.10: Student Gets Internship Recommendations - Sequence Diagram

## 2.4.2. Company HR's Sequence Diagrams

### Company HR sign up

When a company HR attempts to sign up on the S&C platform, they first access the registration page through the web application, which displays the required form. The user enters their company details, including their email, and submits the registration form. The web application sends the data to the registration service, which validates the input. If the data is correct, the registration service stores the information in the database via the database service. A confirmation e-mail is sent to the user via the Mail Service. The user must click on the confirmation link in the e-mail: If the link is valid, the account is activated and the user is redirected to a confirmation page. If the link is invalid, the system sends a new confirmation email to the user. If the data is incorrect or missing, the system displays error messages and prompts the user to correct the issues and resubmit the form. If the email is already registered, the system notifies the user that the email is already in use.

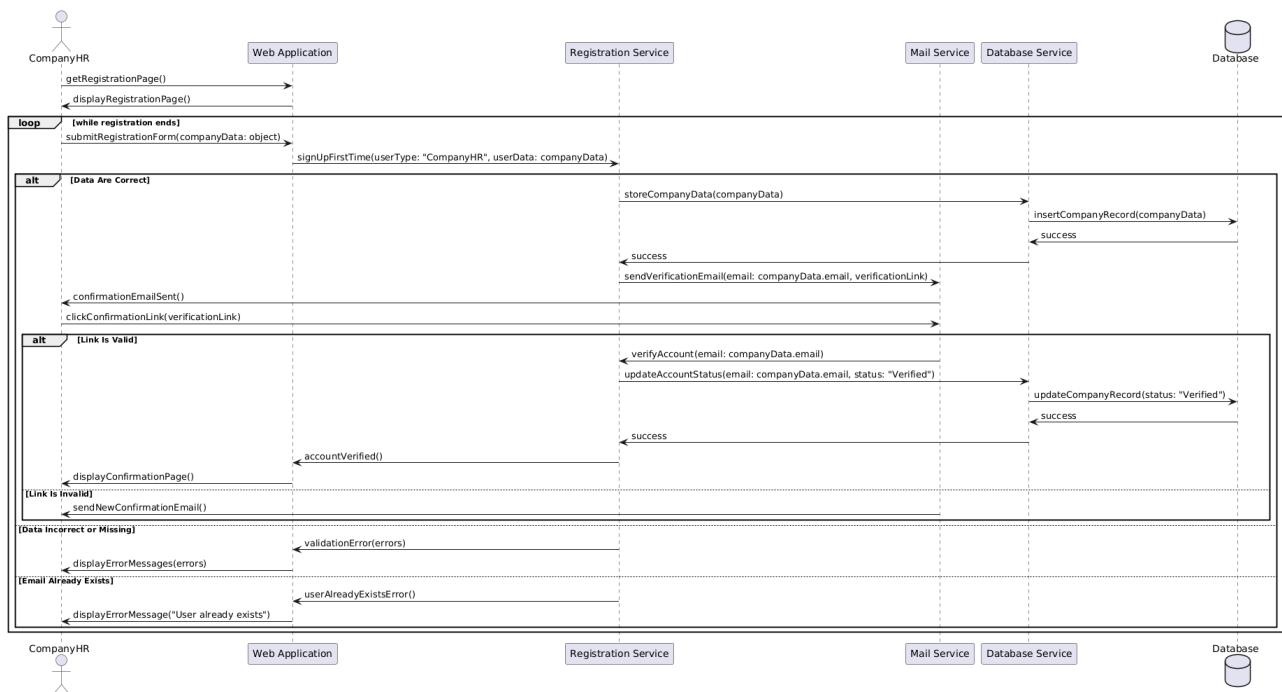


Figure 2.4.11: Company HR sign up - Sequence Diagram

## Company HR Login

When a Company HR attempts to log in to the S&C platform, they first access the login page through the web application, which displays the login form. The Company HR enters their email and password and submits the credentials. The web application forwards these credentials to the authentication service for validation. If the credentials are valid, the authentication service confirms success, and the Company HR is redirected to their dashboard. If the credentials are incorrect, the system returns an "Invalid email or password" error message and prompts the Company HR to try again. In addition, if the Company HR's account does not exist, the system informs them with an "Account does not exist" message. The process continues in a loop until the Company HR either successfully logs in or decides to stop trying.

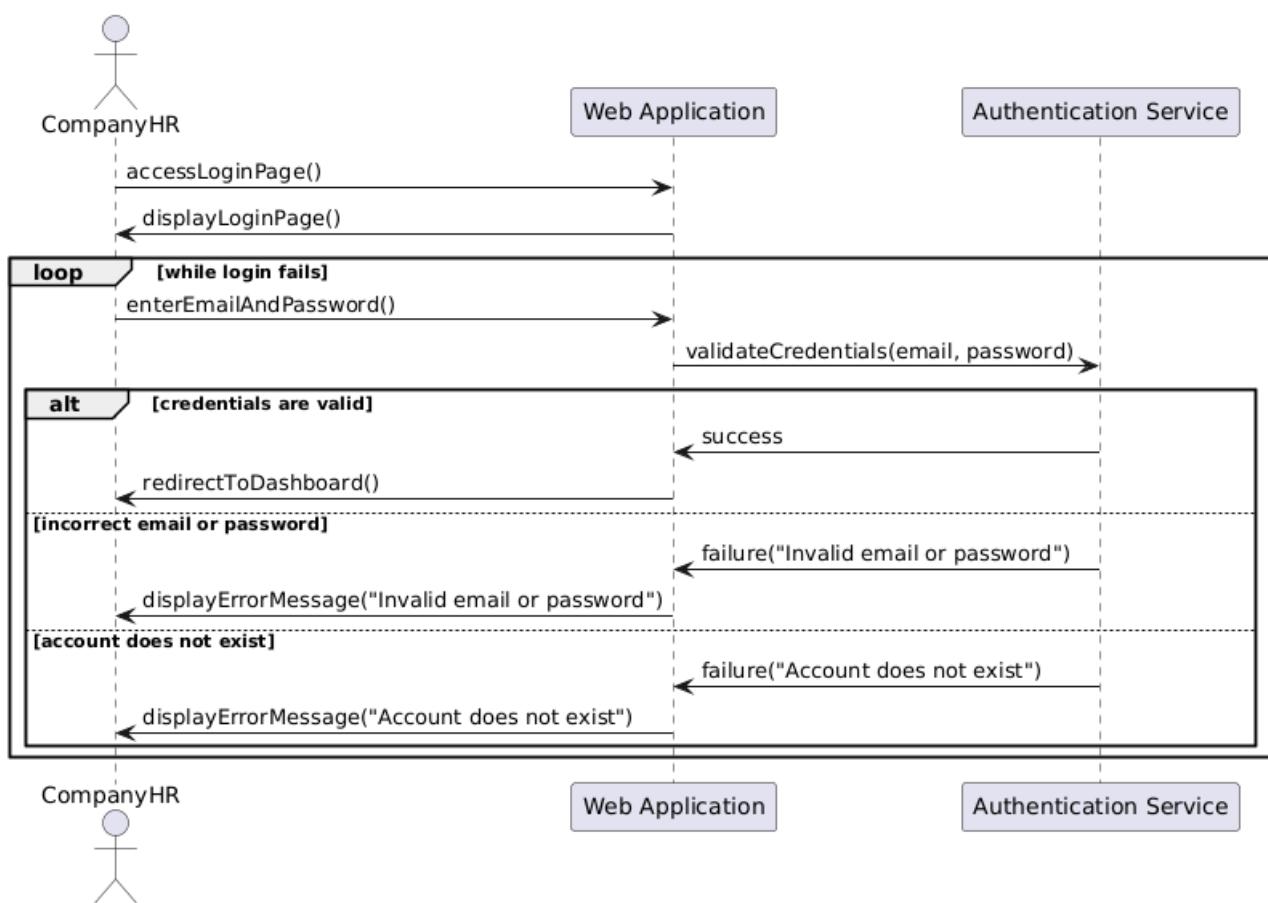


Figure 2.4.12: Company HR Login - Sequence Diagram

## Company HR Logout

When a Company HR logs out of the S&C platform, they first select the "My Account" option from the home page of the web application, which displays the account management options, including the logout button. The user clicks the logout button to initiate the logout process. The web application triggers the notification service to send a logout confirmation message to the user, ensuring that the user is notified of the successful logout. The web application then terminates the user's session to prevent any further activity without re-authentication. Finally, the user is redirected to the login page, completing the logout process.

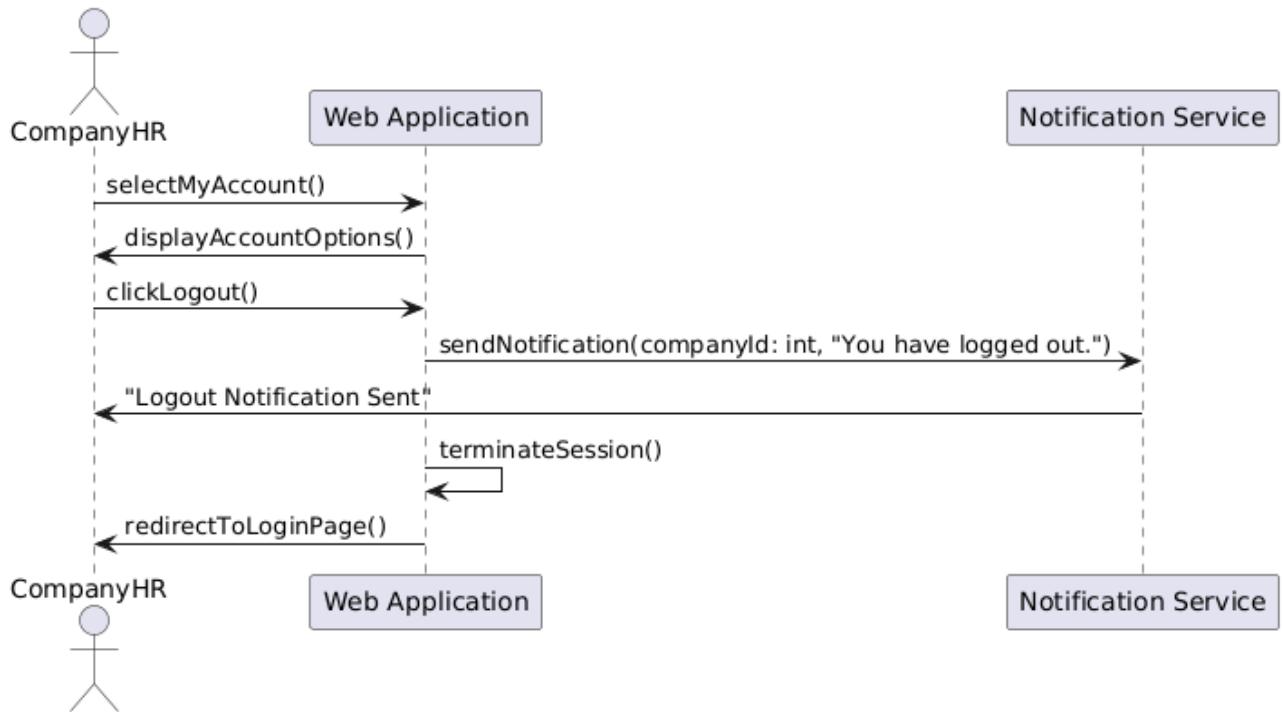


Figure 2.4.13: Company HR Logout - Sequence Diagram

## Company HR creates internship

When a company HR wants to create an internship listing, the user navigates through the web application to the "Create Internship" section, which displays the internship creation form. The user fills in the required fields, such as the internship title, description, required skills, and location, and submits the form. The web application forwards the submitted data to the Internship Manager, which validates the input. If the data is valid, the Internship Manager saves the internship listing to the database via the Database Service. If the data is successfully saved, the user receives a confirmation message that the internship has been successfully published. If the data is invalid or missing, the Internship Manager returns validation errors to the web application, which displays the error messages to the user. The user can then correct the data and resubmit the form.

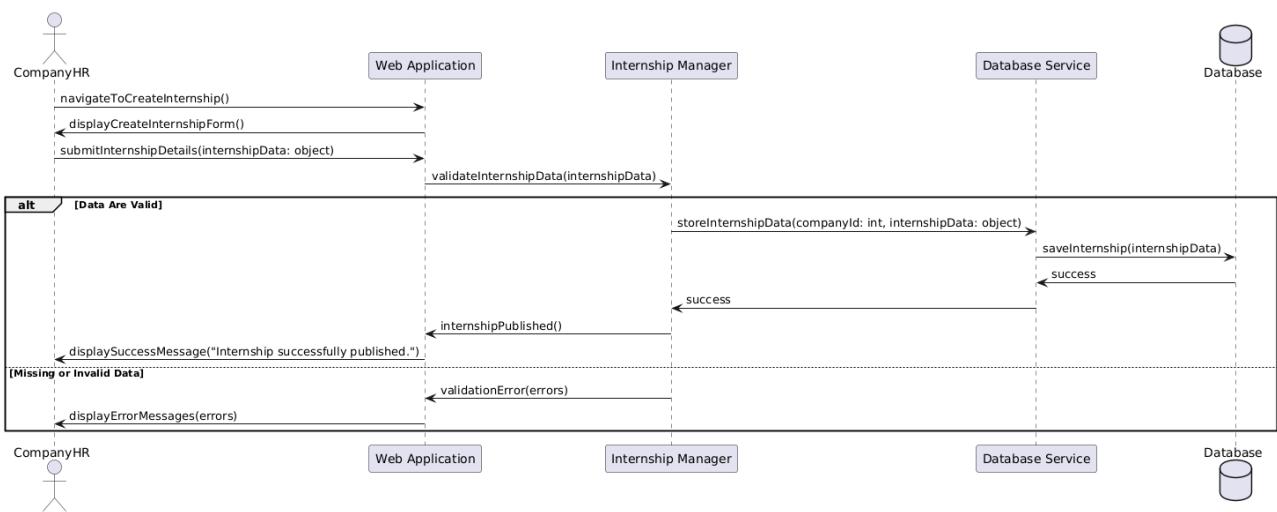


Figure 2.4.14: Company HR creates internship - Sequence Diagram

## Company HR modifies internship

When a company HR needs to update an internship listing, they first navigate to the "My Listings" section of the web application. The system displays a list of existing internship listings associated with the user. The company HR selects an internship to edit, and the current details of the internship are retrieved from the database and displayed for editing. The user modifies the required details, such as the title, description, or requirements, and submits the updated information. The web application forwards the updated details to the Internship Manager for validation. If the data is valid, the Internship Manager updates the internship listing in the database via the Database Service, and the user receives a success message. If the data is invalid or incomplete, the system returns validation errors that are displayed to the user for correction.

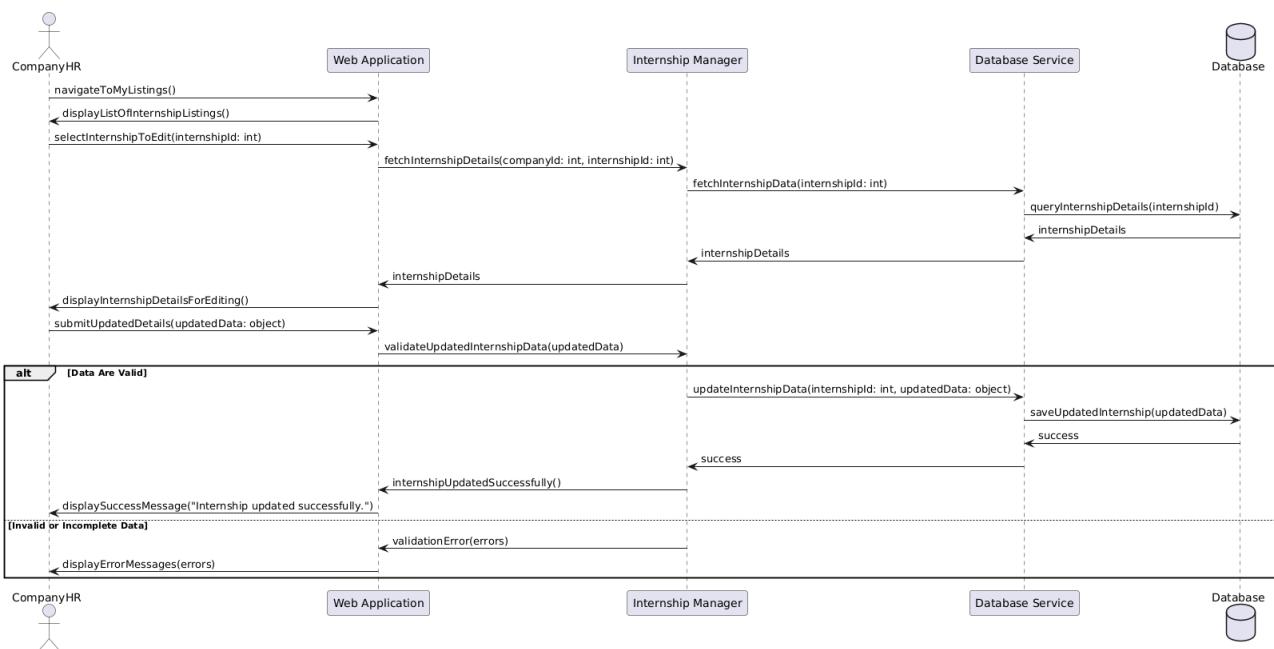


Figure 2.4.15: Company HR modifies internship - Sequence Diagram

## Company HR reviews applications

When a company HR wants to review applications for an internship, the user navigates through the web application to the Applications section, which displays a list of posted internships. The user selects a specific internship to review the applications associated with it. The web application requests the list of applications from the Application Manager, which retrieves the relevant data from the database via the Database Service. If applications exist, the system displays the list of applicants, including their resumes and cover letters. The Company HR can view the details of a specific application by selecting it. The system retrieves the application details and displays them to the user. After reviewing, the user can update the status of the application (for example, "Shortlisted," "Rejected," or "Under Review"). The updated status is saved in the database and a confirmation message is displayed. If no applications exist, the system notifies the user with a message indicating that no applications have been received.

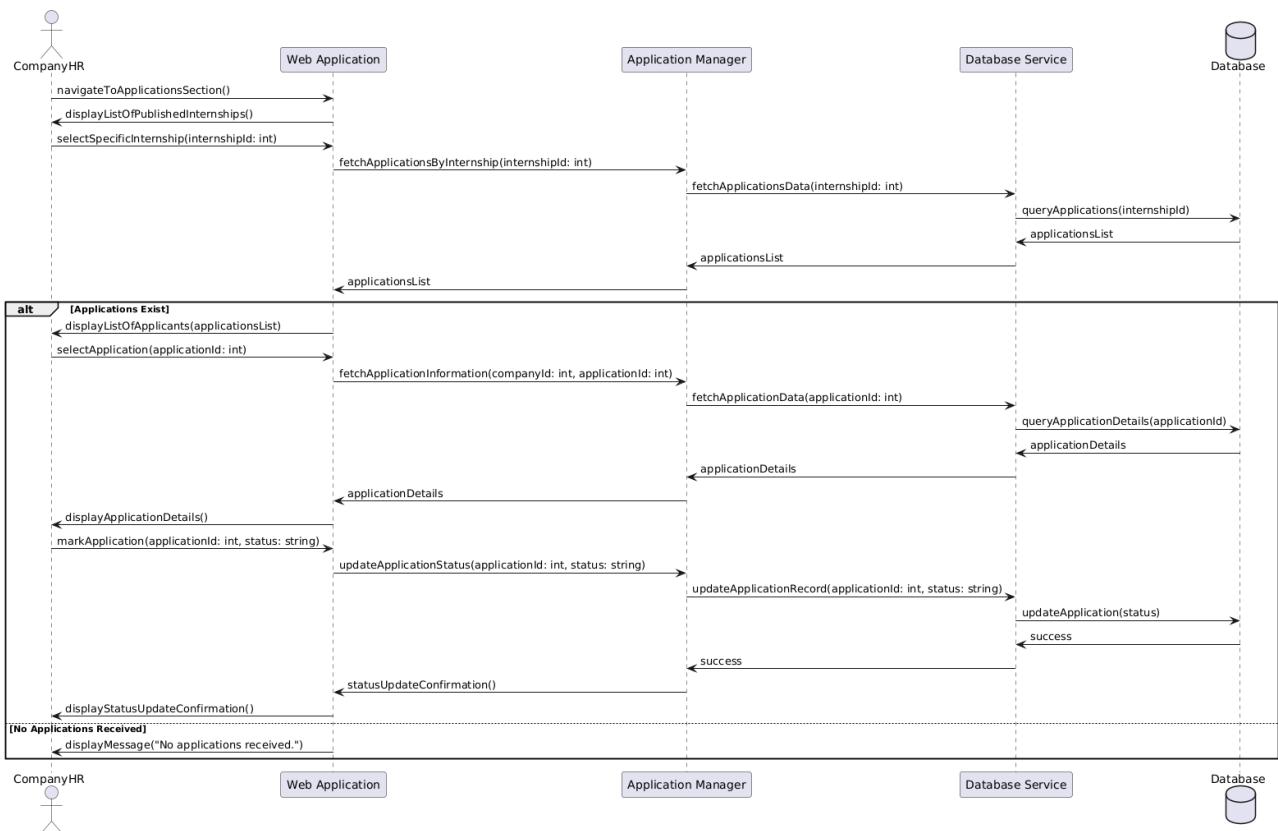


Figure 2.4.16: Company HR reviews applications - Sequence Diagram

## Company HR selects candidate

When a company HR wants to select a candidate for further consideration or interview, he or she first accesses the screened applications section through the web application. The system retrieves a list of screened applications by querying the database through the Application Manager and displays the results to the user. The company HR selects a specific candidate from the list. The web application triggers the Notification Service to send a notification to the candidate, informing him/her of the selection or inviting him/her for an interview. At the same time, the Application Manager updates the application status in the database to reflect the selection process. If the candidate responds positively, the system updates the status to confirm the candidate's participation and notifies the company HR. If the candidate does not respond within the specified timeframe, the system notifies the company HR of the lack of response. If the candidate declines the invitation, the system updates the status and notifies the company HR of the candidate's decision.

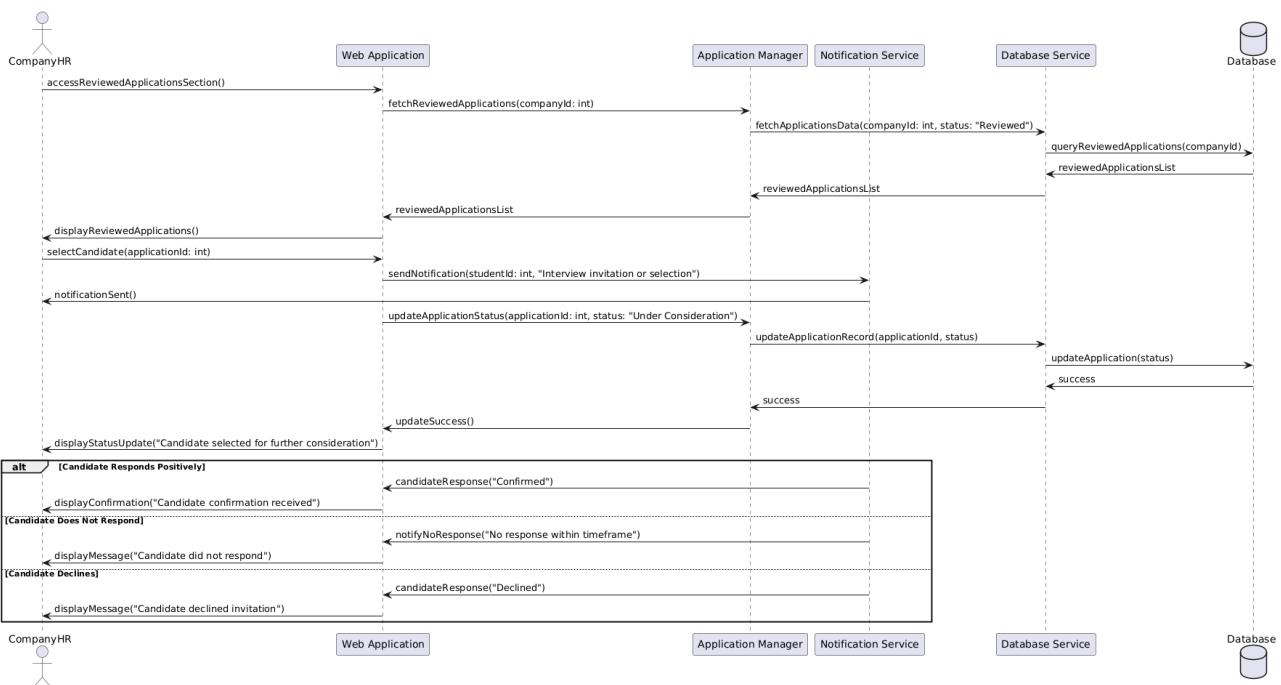


Figure 2.4.17: Company HR selects candidate - Sequence Diagram

## Company HR provides feedback

When a company HR wants to provide feedback on a completed internship, they navigate to the feedback section through the web application, which retrieves a history of feedback and completed internships using the CompanyHR Manager component. The CompanyHR Manager queries the database using the Database Service to retrieve feedback records and internship details, which are then displayed to the company HR. The user selects a specific internship from the list and is presented with a feedback form. After filling in the required fields (e.g. ratings, comments), the user submits the feedback via the web application. The manager validates the feedback and stores it in the database using the Database Service. If the feedback is valid, the system saves the feedback and the company HR receives a success message. The feedback is then made visible to the relevant student and UC. If the feedback submission fails (for example, due to missing or invalid data), the system notifies the company HR of the error and prompts the user to correct the input.

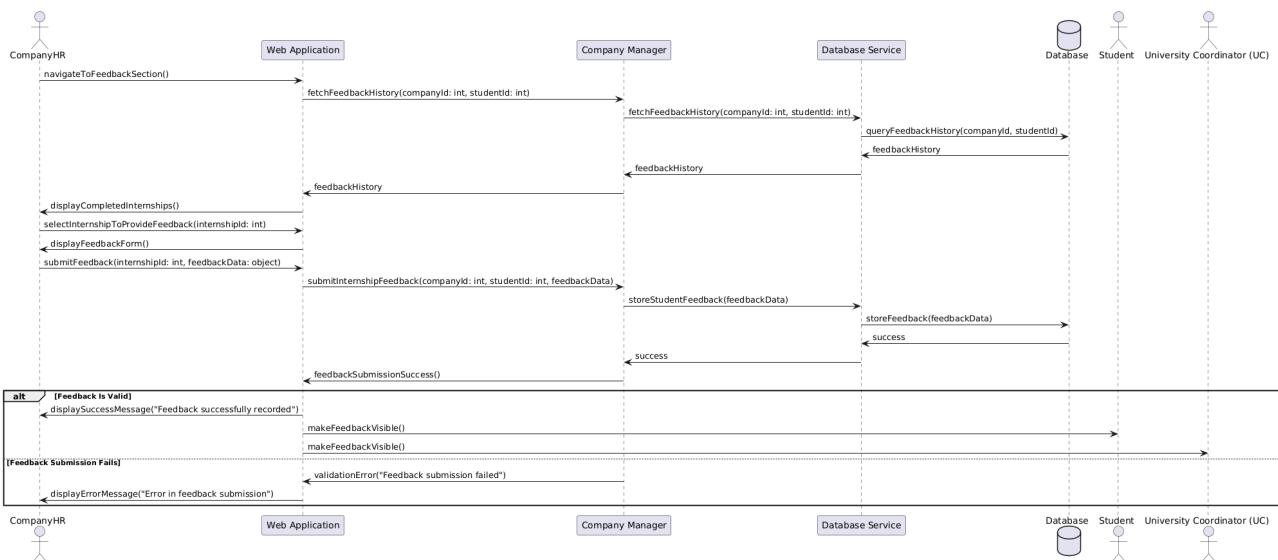


Figure 2.4.18: Company HR provides feedback - Sequence Diagram

## Company HR reports a complaint

When a company HR user needs to report a complaint, they navigate through the web application to the "Report Complaint" section, where the system displays a complaint submission form. The user fills in the complaint details, such as a description and associated internship or student details, and submits the form. The web application forwards the complaint data to the CompanyHR Manager, who validates the input. If the complaint details are valid, the CompanyHR Manager saves the complaint to the database via the Database Service. Upon successful saving, the system displays a confirmation message to the company HR. The grievance is then forwarded to the UC for further processing. If the complaint details are invalid or incomplete, the CompanyHR Manager returns an error to the web application, which displays an error message prompting the user to correct the input.

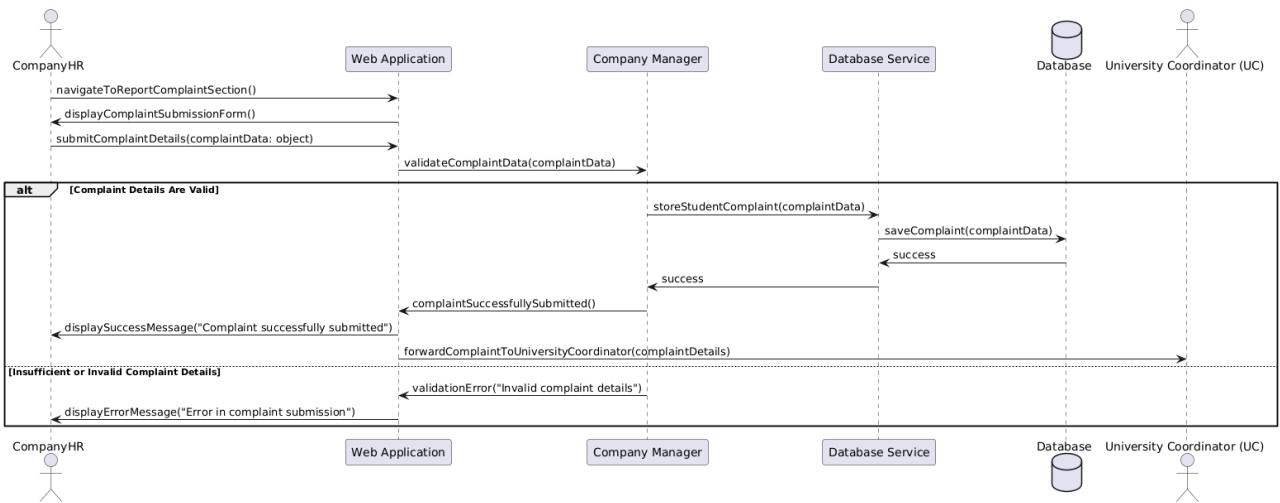


Figure 2.4.19: Company HR reports a complaint - Sequence Diagram

## Company HR tracks internship

When a company HR user wants to monitor the progress of ongoing internships, he navigates through the web application to the internships section. The system retrieves a list of active internships associated with the company HR by querying the database through the Information Manager. The list of internships is then displayed to the user. The company HR user selects a specific internship to view detailed progress and updates. The Information Manager retrieves the relevant internship information from the database, including any available progress reports or updates. If updates or reports are available, the system displays them to the user. The company HR can take actions, such as providing feedback or recording observations, which are stored in the database through the Information Manager. A confirmation message is displayed when the action or feedback is successfully recorded. If no updates or reports are available, the system notifies the user with a message indicating that no updates are currently available.

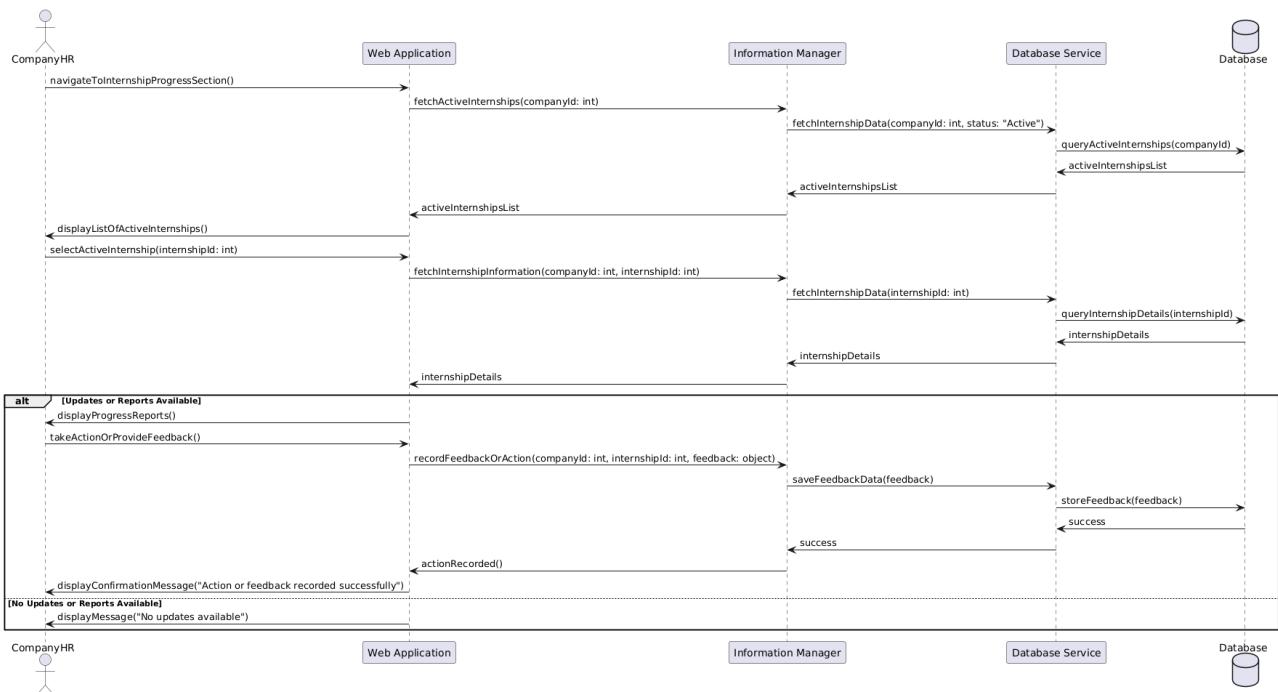


Figure 2.4.20: Company HR tracks internship - Sequence Diagram

## Company HR receives recommendations

When a student updates their profile on the S&C platform via the web application, the profile data is sent to the Student Manager, which processes the update. The Student Manager then calls the Recommendation Service to generate internship recommendations based on the updated profile. If the recommendation service finds internships that match the student's profile, the web application receives a list of matching internships. For each matching internship, the web application sends an in-app notification via the Notification Service to the company HR, informing them of the potential candidate. In addition, an email notification is sent via the Mail Service to ensure that the company HR is aware of the recommendation. If no matches are found, the Recommendation Service informs the Web application and no notifications or emails are sent.

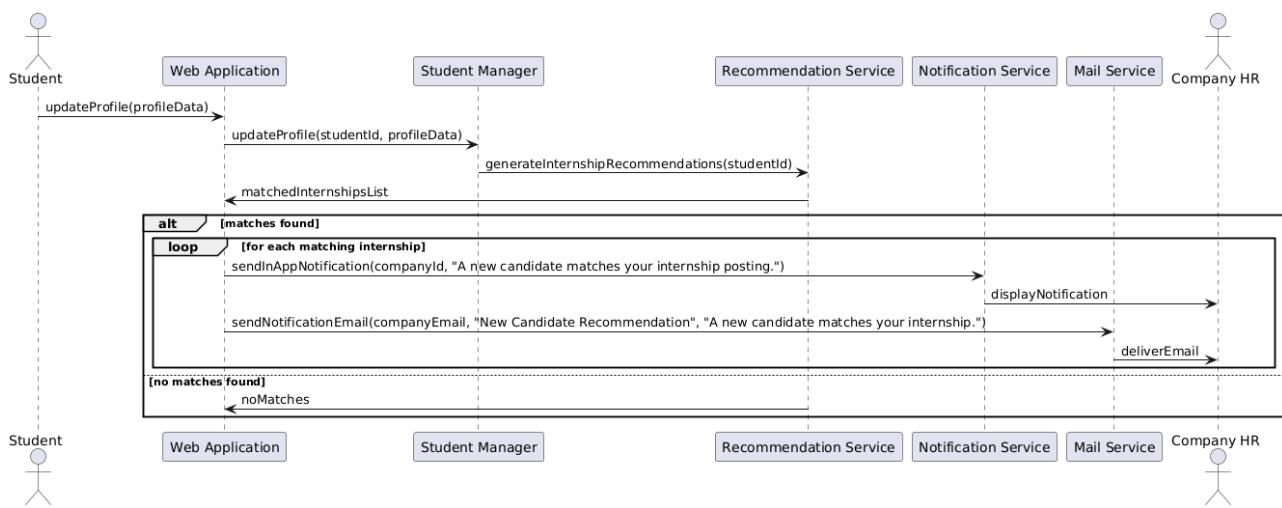


Figure 2.4.21: Company HR receives recommendations - Sequence Diagram

## 2.4.3. University Coordinator's Sequence Diagrams

### UC sign up

When a UC attempts to sign up on the S&C platform for the first time, they first navigate through the web application to the registration page, which displays the registration form. The UC enters their information, such as name, institutional email, and password, and submits the form. This action triggers the registration service to validate the information provided. If the data is valid and the email is institutional, a confirmation email is sent via the mail service. The UC clicks the confirmation link in the email; if the link is valid, the account is activated, the UC's information is stored in the database, and a success message is displayed. If the link is invalid or expired, the UC is given the option to resend the confirmation email. If the email is not institutional, an error message is displayed and the UC is prompted to use an appropriate email address. Similarly, if the email is already registered, the UC is informed that its email is in use, or if the data is incomplete or invalid, the system displays the errors and prompts the UC to make corrections. After successful activation, the UC is logged in and can continue to use the platform.

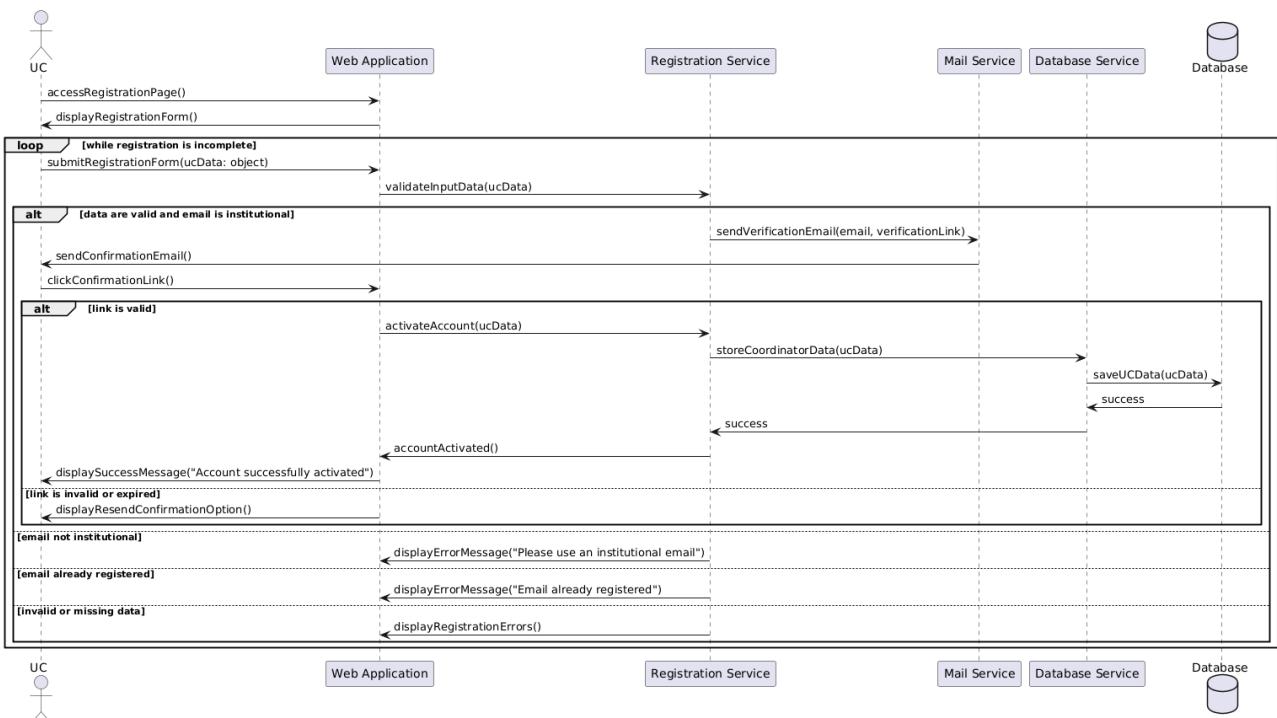


Figure 2.4.22: UC sign up - Sequence Diagram

## UC login

When a UC attempts to log in to the S&C platform, they first access the login page through the web application, which displays the login form. The UC enters its email and password and submits the credentials. The web application forwards these credentials to the authentication service for validation. If the credentials are valid, the authentication service confirms success and the UC is redirected to their dashboard. If the credentials are incorrect, the system returns an "Invalid email or password" error message and prompts the UC to try again. In addition, if the UC's account does not exist, the system informs them with an "Account does not exist" message. The process continues in a loop until the UC either successfully logs in or decides to stop trying.

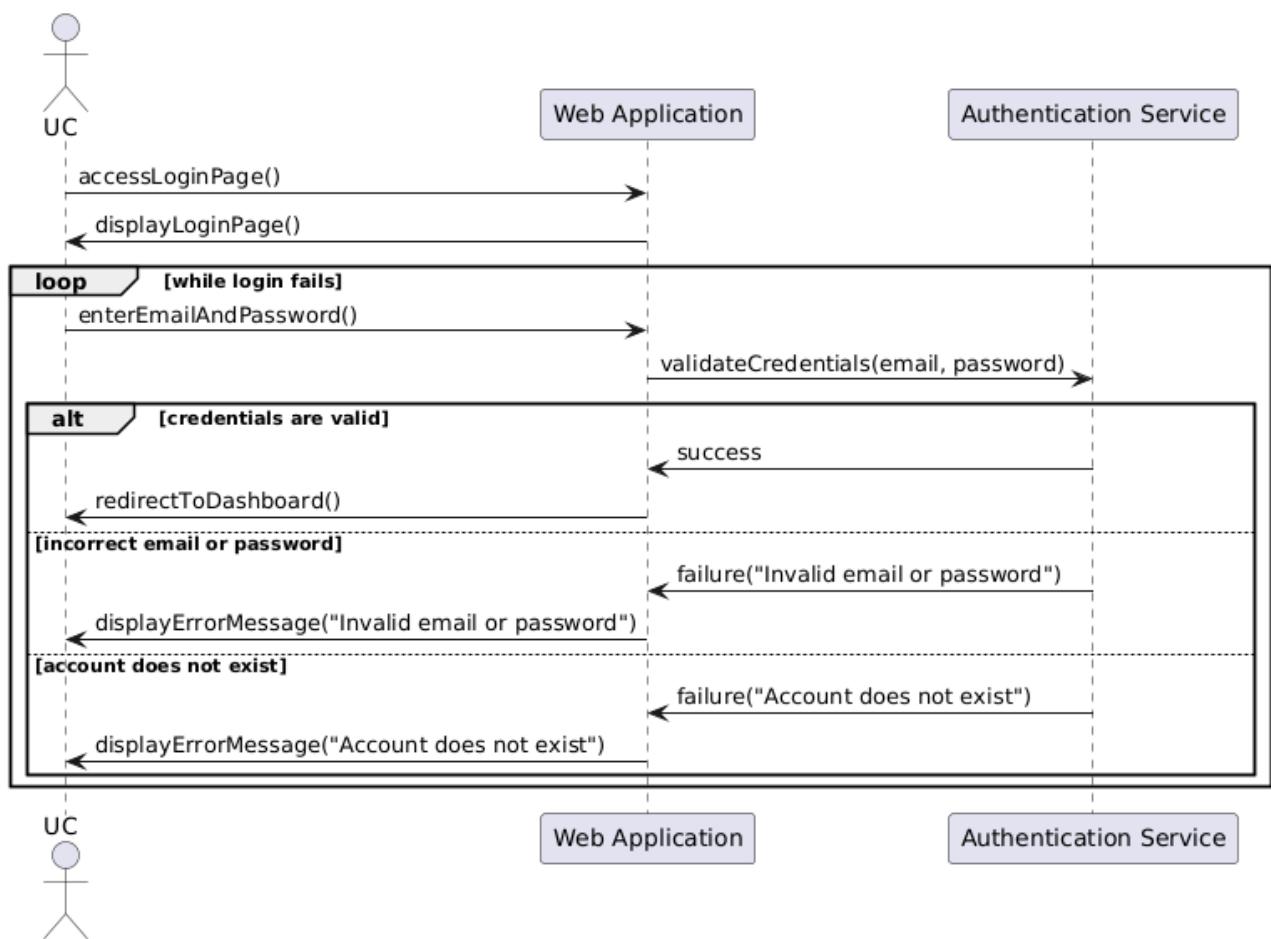


Figure 2.4.23: UC login - Sequence Diagram

## UC logout

When a UC decides to log out of the S&C platform, it navigates through the web application from the home page to the "My Account" section. From there, the UC selects the "Log Out" option, which prompts the web Application to terminate the active session. After terminating the session, the web application sends a logoff notification to the notification service, which ensures that the UC is informed of the successful logoff. The notification service then returns a "You have successfully logged out" confirmation message to the UC. Finally, the web application redirects the UC to the login page, completing the logout process.

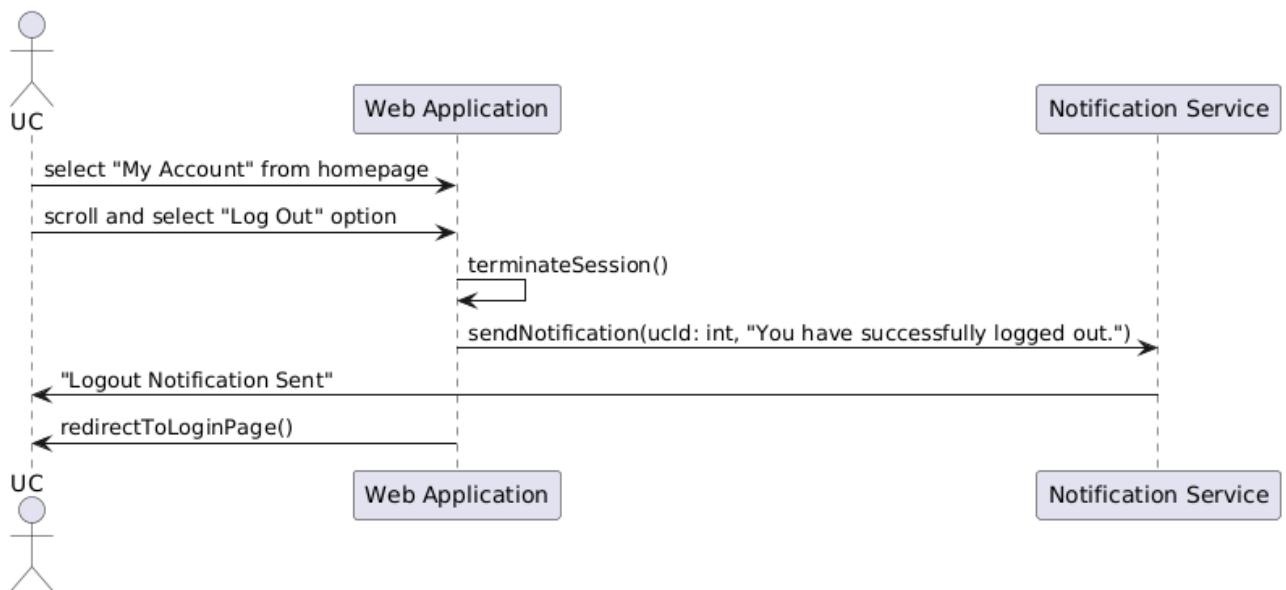


Figure 2.4.24: UC logout - Sequence Diagram

### UC approves/rejects internship

When a UC wants to approve or reject an internship proposal, they first log in to the S&C platform and navigate to the dashboard. The web application displays a list of internship proposals submitted for review. The UC selects a specific internship proposal for review and makes a decision to either approve or reject it. If the proposal details are complete, the web application forwards the approval request to the system, which processes the decision. A confirmation message is then sent to the UC and relevant parties to notify them of the approval. The UC receives a confirmation message indicating that the internship has been successfully approved. If the proposal details are incomplete, the web application identifies the problem and displays an error message informing the UC that the internship proposal cannot be approved due to missing or incomplete information.

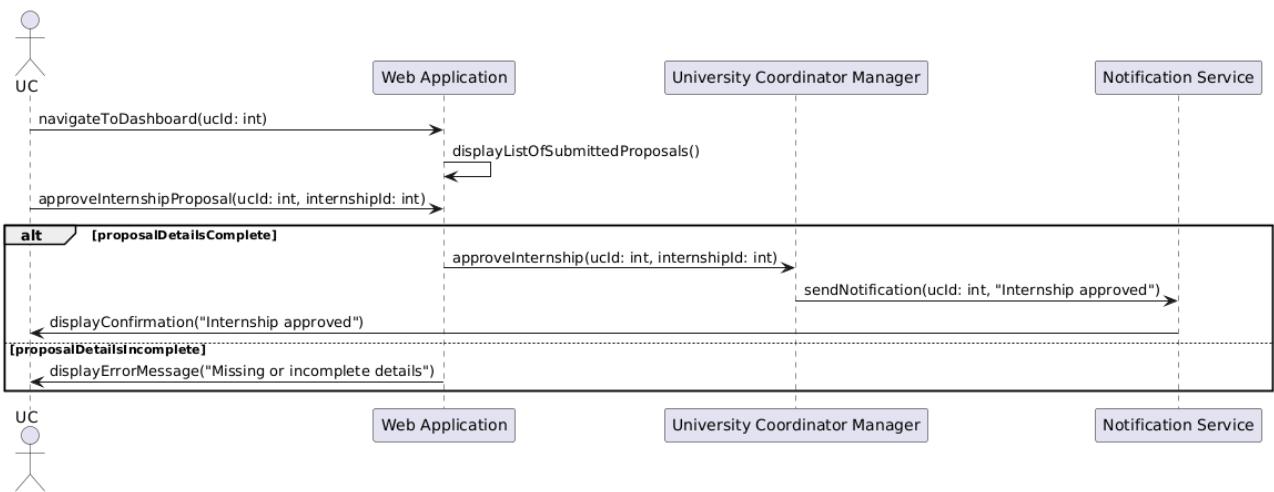


Figure 2.4.25: UC approves/rejects internship - Sequence Diagram

## UC manages complaints

The Manage Complaints interaction begins with the UC navigating to the complaints section of the system via the dashboard. The web application displays a list of submitted complaints. The UC selects a specific complaint from the list, prompting the web application to retrieve the complaint details using the Complaint Manager. The retrieved details are displayed to the UC. If the complaint details are deemed sufficient, the UC resolves the complaint by providing a resolution and any necessary action, such as terminating an internship. The Complaint Manager records the resolution decision, and the Notification Service sends notifications of the resolution to the parties involved. The system then confirms the resolution to the UC. Alternatively, if the complaint details are deemed insufficient, the UC marks the complaint as having insufficient details. This decision is logged in the system by the Complaint Manager and the web application informs the UC that the complaint cannot be resolved due to insufficient information.

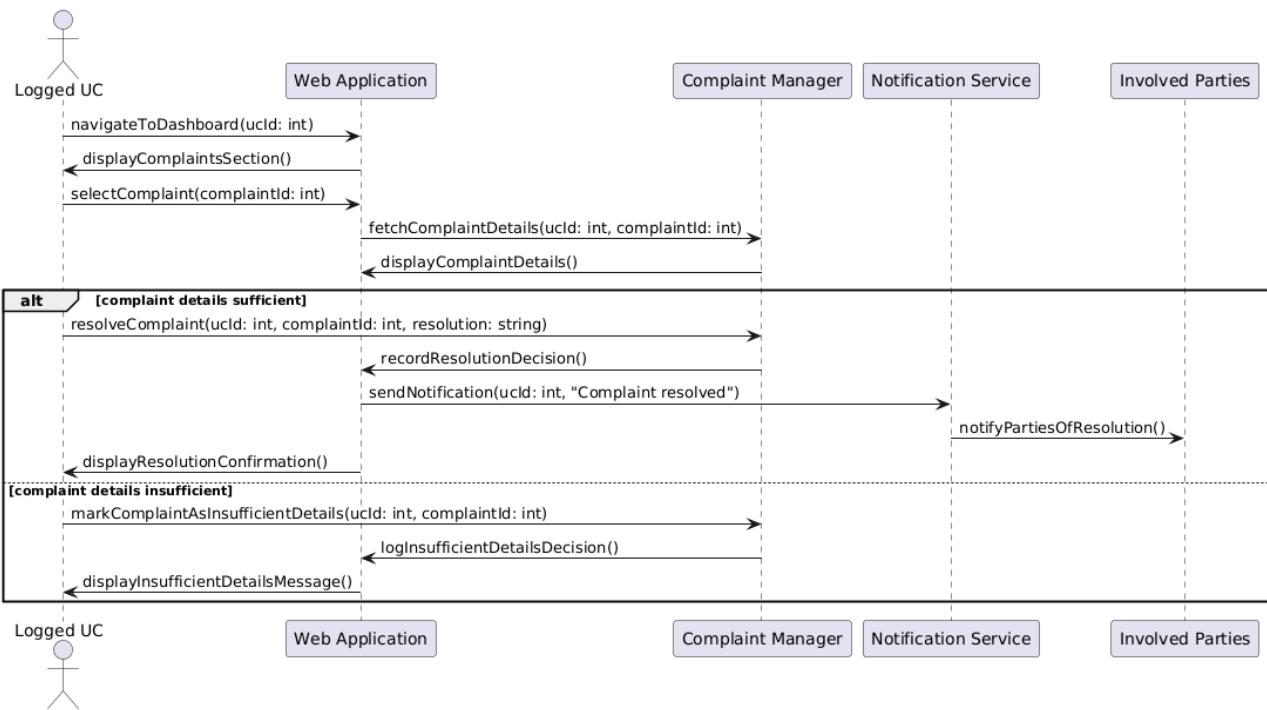


Figure 2.4.26: UC manages complaints - Sequence Diagram

## UC monitors internship

The "Monitor Internship Progress" interaction begins with the UC navigating to their dashboard in the S&C platform. The web application displays the options available to the UC, who then selects the "Monitor Internship Progress" section. The web application communicates with the UC Manager to retrieve a list of active internships associated with the UC. The UC Manager in turn uses the Information Manager to query the database for detailed internship information, which is returned to the web application and displayed to the UC. The UC selects a specific active internship from the displayed list. The web application sends a request to the Information Manager to retrieve progress reports or updates related to the selected internship. The Information Manager queries the database for these reports and returns the results to the web application. If updates or reports are available, the web application displays them to the UC, who can optionally provide feedback or suggestions regarding the progress. The feedback is recorded by the UC Manager and stored in the database, with a confirmation message displayed to the UC. If no updates or reports are available, the web application informs the UC with a "No updates available" message.

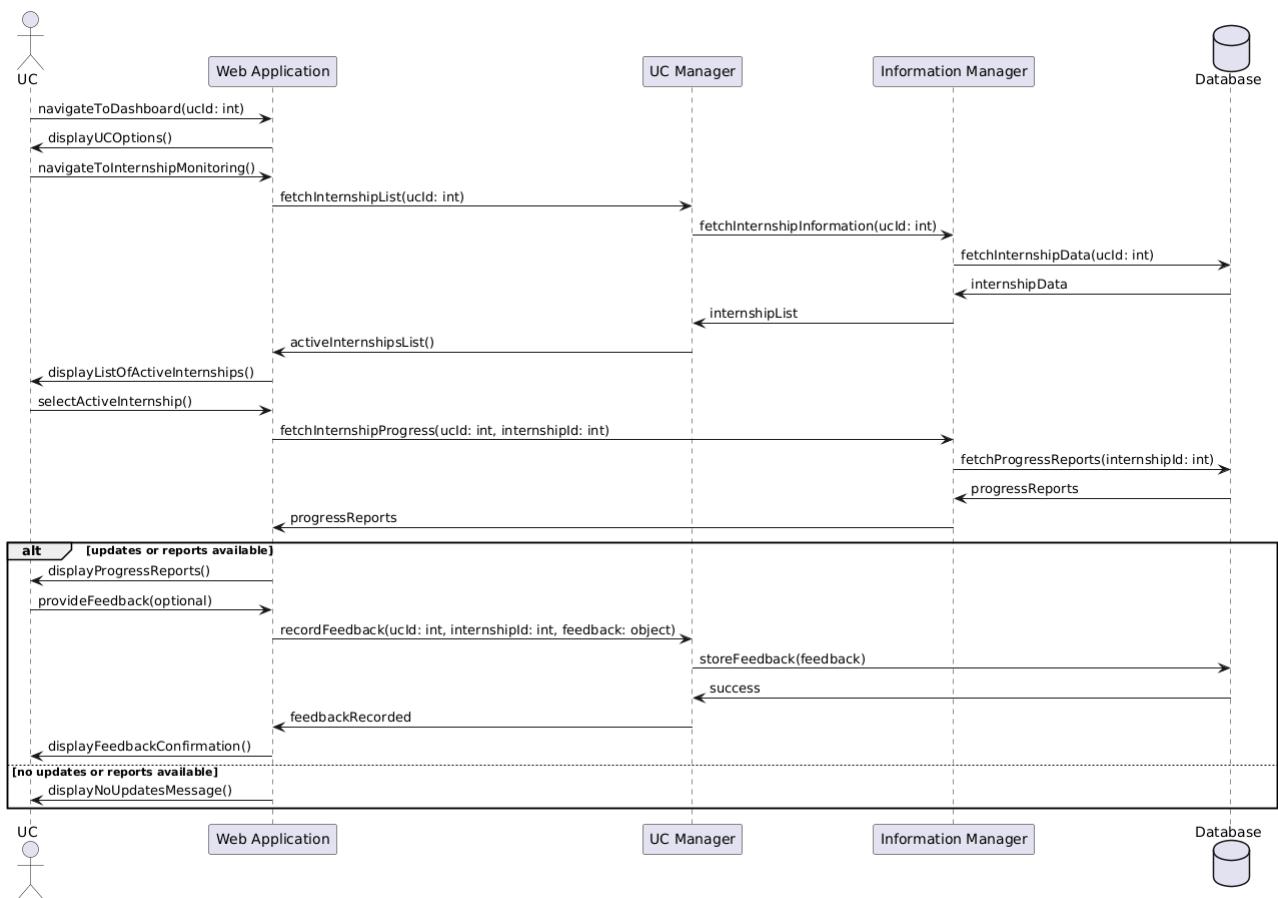


Figure 2.4.27: UC monitors internship - Sequence Diagram

## UC generate report and analytics

The Generate Reports and Analytics interaction allows a UC to generate and analyze reports based on specified parameters. The UC begins by navigating to the Reports and Analytics section of the web application. The application responds by displaying available report generation options. The UC specifies the parameters for the report, such as date range, report type, or filters. These parameters are sent to the University Coordinator Manager, which processes the request by querying the Information Manager. The Information Manager accesses the database to retrieve the relevant analytical data based on the specified parameters. The data is then returned to the Web application through the Information Manager and the University Coordinator Manager. If data matching the parameters is available, the generated report is displayed to the UC. The UC can choose to download the report, and upon completion, the application confirms the download. If no data is available for the specified parameters, the web application notifies the UC with a message indicating the lack of matching data.

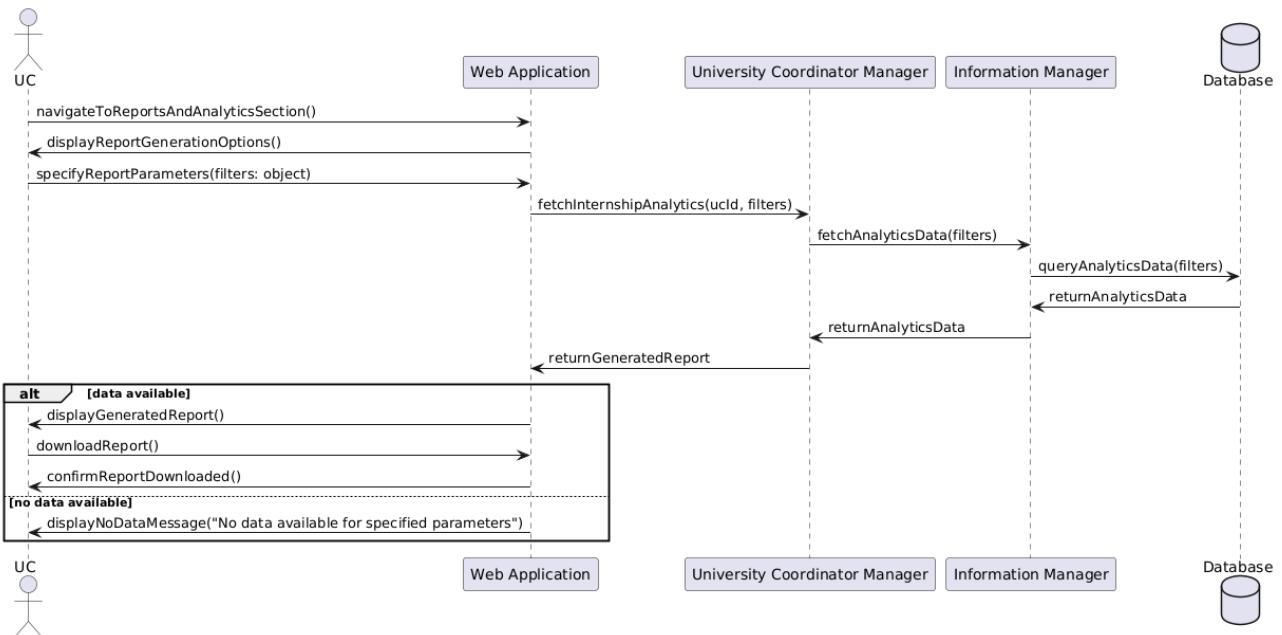


Figure 2.4.28: UC Generate Report and Analytics - Sequence Diagram

## 2.5. Component Interfaces

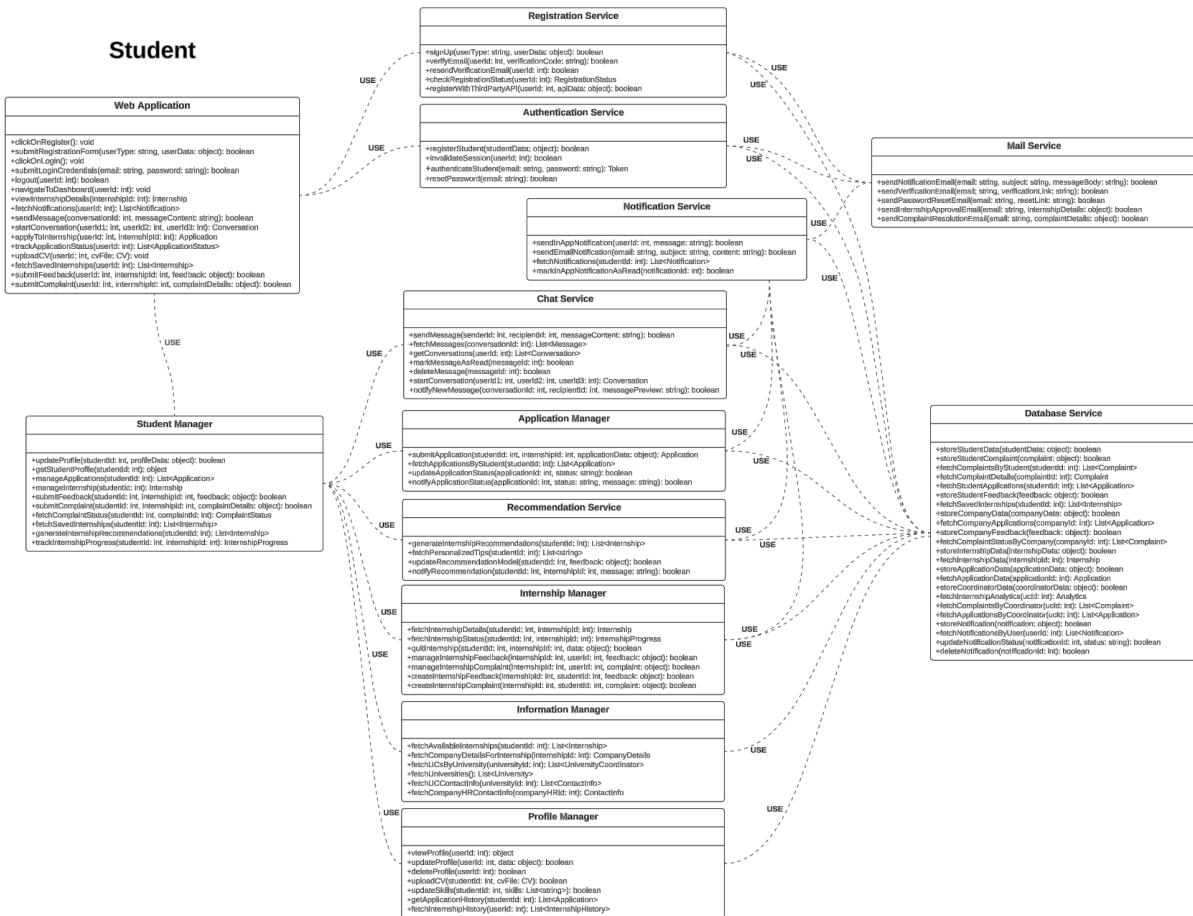


Figure 2.5.1: Student Component Interfaces

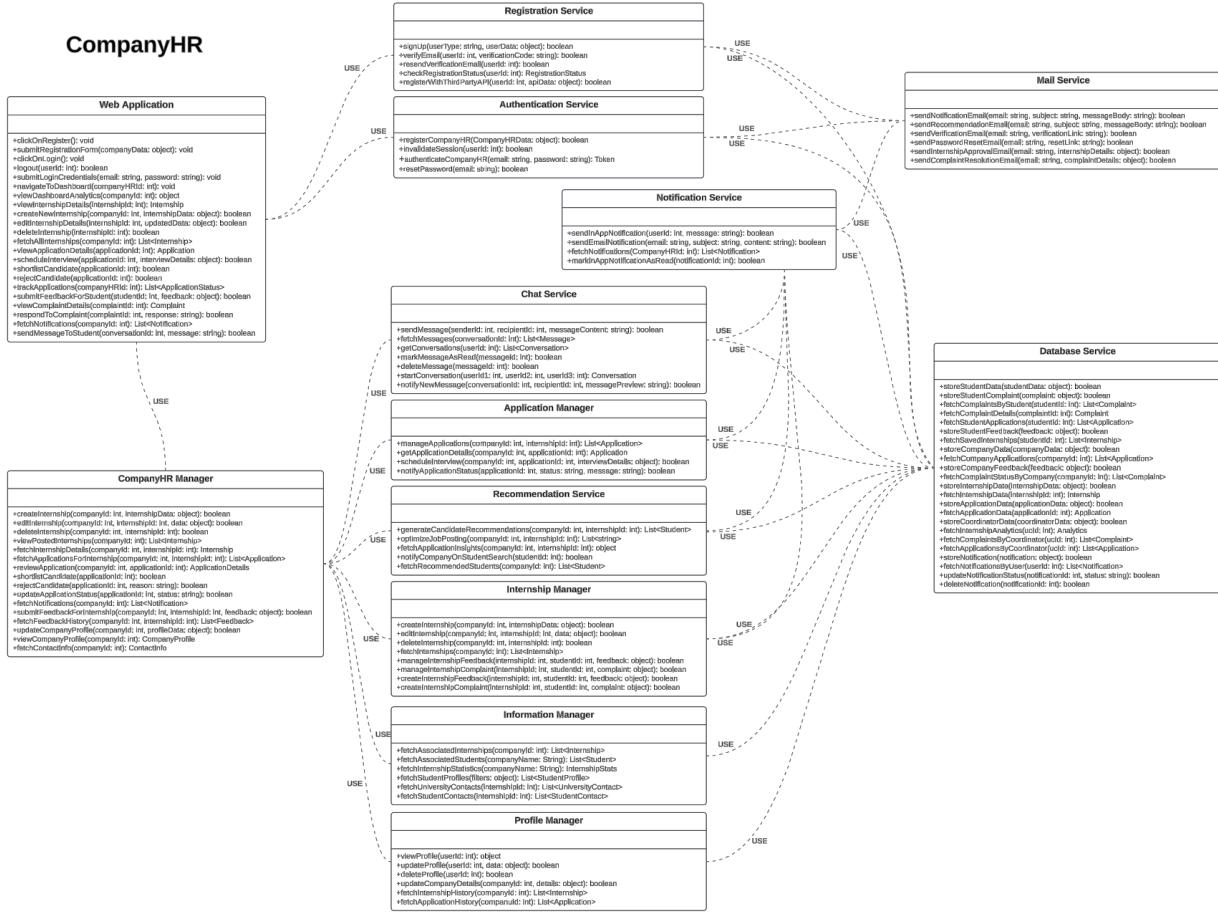


Figure 2.5.2: CompanyHR Component Interfaces

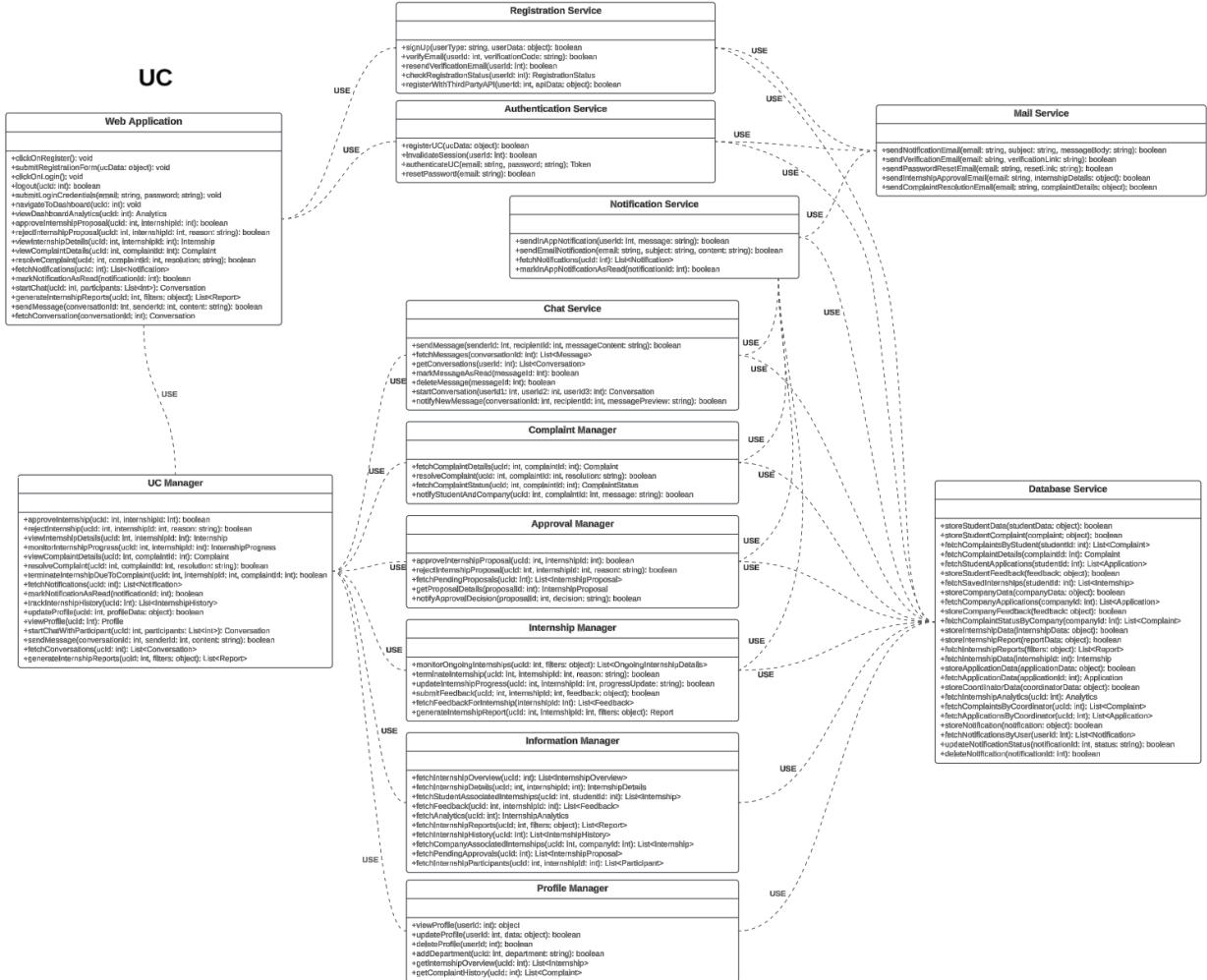


Figure 2.5.3: UC Component Interfaces

## 2.6. Selected Architectural Styles and Patterns

- **Client-Server Architecture:** the Students&Companies platform uses a client-server model that separates clients (students, company HR, and UC) that make requests from the server that processes and responds to these requests. This architecture supports distributed deployment and efficient management of user interactions, using HTTP/HTTPS for secure communication.
- **Three-Tier Architecture:** the platform is built on a three-tier architecture comprising the Presentation Layer, Application Layer, and Data Layer. This approach ensures clear separation of responsibilities:
  - **Presentation Layer:** manages user interaction through a web-based interface.
  - **Application Layer:** handles business logic, such as matching internships to student profiles and validating user actions.

- **Data Layer:** responsible for data persistence and retrieval, ensuring integrity and scalability.

This structure enhances maintainability, modularity, and scalability, allowing independent updates to each tier without disrupting the entire system.

- **Model-View-Controller Pattern (MVC):** the MVC design pattern is applied to separate the user interface, application logic, and data management:

- **Model:** encapsulates the core business logic, such as algorithms for recommendation and internship management.
- **View:** renders the user interface and presents real-time data to the users.
- **Controller:** acts as an intermediary between the model and view, handling user input and updating the system state.

This pattern ensures modularity and improves system testability, making the platform more robust and easier to extend.

- **Observer Pattern:** notifications (e.g., application updates or internship recommendations) are managed using the Observer pattern, where components subscribe to specific events and receive updates automatically. This ensures efficient communication without tight coupling between components.

- **Factory Pattern:** the Factory Pattern is employed to streamline the creation of complex objects, such as `Application`. By encapsulating the logic for object creation within a dedicated factory class, this pattern simplifies the process for other components and ensures uniformity across the platform. Key benefits include:

- Simplified Object Creation: developers do not need to handle the intricacies of object construction repeatedly.
- Consistency: ensures all `Application` objects conform to the same initialization logic, reducing potential errors.
- Enhanced Maintainability: centralizing the creation logic makes it easier to update or modify the initialization process without affecting multiple parts of the codebase.
- Scalability: supports adding new object types or creation rules with minimal changes to the existing system.

## 2.7. Other Design Decisions

- **Clearbit API Integration:** the platform uses Clearbit API to verify institutional email addresses during registration, ensuring the authenticity of users such as students, companies, and university coordinators.

- **Data Exchange Format:** JSON is employed as the standard format for data exchange across components. Its lightweight nature and compatibility with modern web technologies make it ideal for seamless communication.
- **RESTful Services:** RESTful APIs are used for interactions between the client and server. This design ensures stateless communication, scalability, and ease of integration with external services.
- **Recommendation Algorithms:** the recommendation system leverages advanced techniques, including machine learning-based matching and keyword analysis, to connect students with suitable internships and companies with potential candidates.
- **Quality Assurance:** to maintain a consistent coding style and secure codebase, the platform employs:
  - **Linting/Formatting Tools:** enforces coding conventions and helps catch common errors early.
  - **Automated Vulnerability Scanning:** identifies security flaws in both custom code and third-party dependencies.
- **Scalability and Reliability:** horizontal and vertical scaling strategies ensure the platform can handle fluctuating loads:
  - **Load Balancers:** distribute incoming traffic efficiently across servers.
  - **Containerization (e.g., using Docker):** allows for modular deployments and quick recovery from failures.
  - **CI/CD Pipelines (e.g., Jenkins or GitHub Actions):** automate builds, tests, and deployments to deliver updates rapidly and consistently.
- **Security Measures:** data security is ensured using HTTPS for encrypted communication and OAuth2 for secure authentication. The platform also employs firewalls and intrusion detection systems to protect against unauthorized access.

### 3. User Interface Design

Some of the web application's user interfaces have already been introduced in the previous sections of this RASD. In the following figures, we will present flow graphs that illustrate how the key interfaces of the Students&Companies (S&C) platform are organized and interconnected, focusing on the three main user roles: students, company HR and university coordinators.

To avoid unnecessary repetition, certain common interfaces, such as the login and sign-up pages, which are shared across all user roles, have not been included in the flow graphs.

These generic pages have already been described in detail in the RASD document.

Instead, the diagrams emphasize the role-specific sections of the platform, providing a clearer understanding of how each type of user engages with the system's core functionalities and

navigates through its features.

## Student interfaces

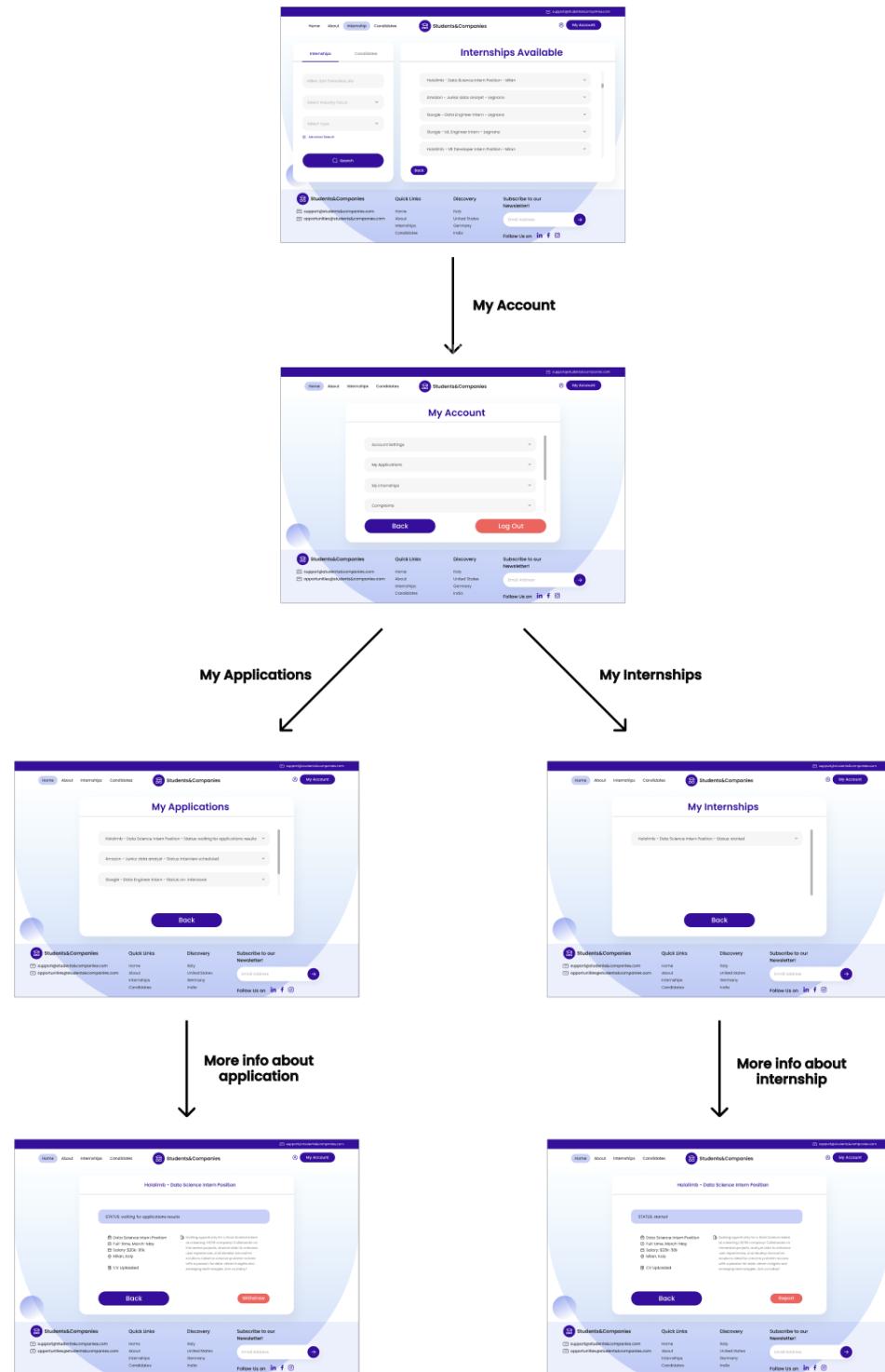


Figure 3.0.1: Student Interfaces

## Company HR interfaces

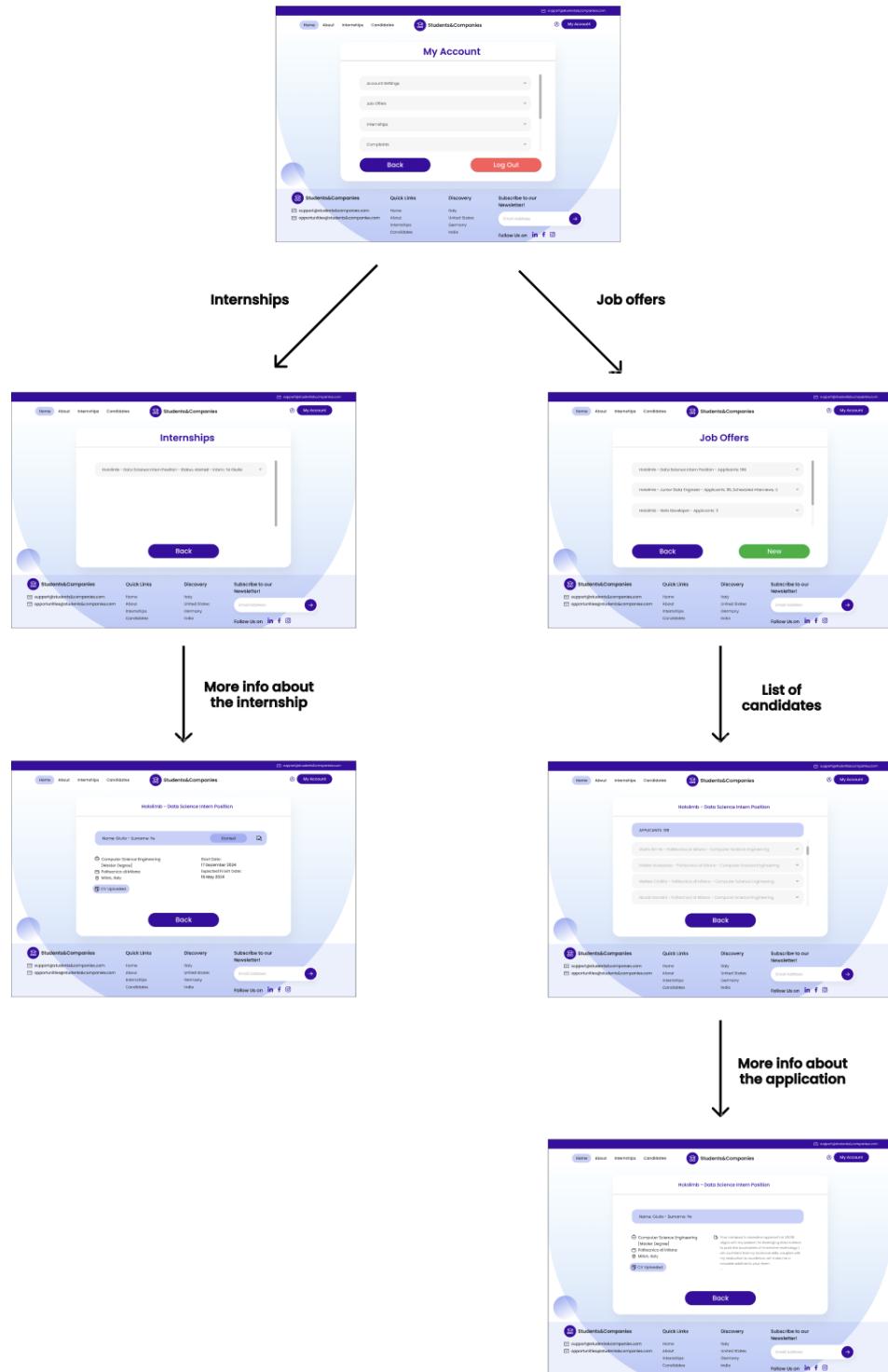


Figure 3.0.2: Company HR Interfaces

## University Coordinator interfaces

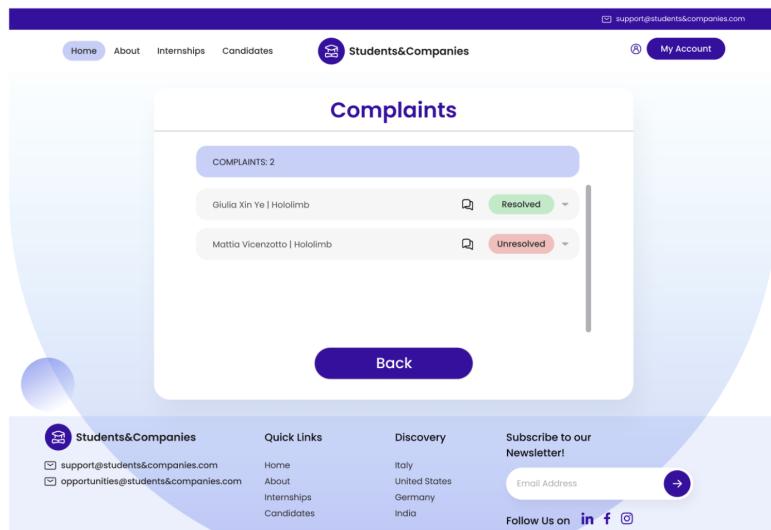


Figure 3.0.3: University Coordinator Interfaces

## 4. Requirements Traceability

This section establishes a clear link between the requirements defined in the RASD and the design decisions documented in the DD, ensuring that every requirement is addressed effectively in the system's implementation. The traceability matrix below outlines how each functional and non-functional requirement is fulfilled within the architectural, interface, and component designs of the Students&Companies (S&C) platform.

### 4.1. Traceability Matrix

The traceability matrix organizes the information as follows:

- **Requirement ID:** Identifies the specific requirement from the RASD.
- **Component:** Identifies the components involved in fulfilling the requirement.

To enhance clarity, requirements that utilize the same group of components have been grouped together to avoid redundancy and highlight shared dependencies.

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.1:</b> The system allows students to register by filling out a registration form and verifying their email address.</li> <li>• <b>R2.1:</b> The system allows Company HR to register by filling out a registration form and verifying their email address.</li> <li>• <b>R3.1:</b> The system allows University Coordinators to register by filling out a registration form and verifying their email address.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Registration Service,</li> <li>• Authentication Service,</li> <li>• Mail Service,</li> <li>• Database Service.</li> </ul>

Table 4: Traceability for R1.1, R2.1, R3.1

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.2:</b> The system allows students to log in using their email and password.</li> <li>• <b>R2.2:</b> The system allows Company HR to log in using their email and password.</li> <li>• <b>R3.2:</b> The system allows University Coordinators to log in using their email and password.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Authentication Service,</li> <li>• Database Service.</li> </ul>

Table 5: Traceability for R1.2, R2.2, R3.2

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.3:</b> The system allows students to log out of their accounts.</li> <li>• <b>R2.3:</b> The system allows Company HR to log out of their accounts.</li> <li>• <b>R3.3:</b> The system allows University Coordinators to log out of their accounts.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Authentication Service.</li> </ul>

Table 6: Traceability for R1.3, R2.3, R3.3

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.4:</b> The system allows students to edit their personal profiles, including updating personal information, skills, and uploading a CV.</li> <li>• <b>R1.5:</b> The system allows students to browse available internships, filtering by criteria such as location, industry, role, compensation, and internship type.</li> <li>• <b>R1.19:</b> The system allows students to view a history of their previous applications and internships, including feedback and outcomes.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Profile Manager,</li> <li>• Information Manager,</li> <li>• Database Service.</li> </ul>

Table 7: Traceability for R1.4, R1.5, R1.19

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.6:</b> The system provides personalized recommendations for internships based on the student's profile, including skills, experiences, and preferences.</li> <li>• <b>R1.7:</b> The system notifies students when internships matching their preferences or skills become available.</li> <li>• <b>R1.18:</b> The system provides suggestions to students for improving their CVs, such as aligning content with industry standards or highlighting relevant experiences.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Recommendation Service,</li> <li>• Notification Service,</li> <li>• Mail Service,</li> <li>• Database Service.</li> </ul>

Table 8: Traceability for R1.6, R1.7, R1.18

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.8:</b> The system allows students to view detailed descriptions of internships, including required qualifications if any, type, location, and salary.</li> <li>• <b>R1.13:</b> The system allows students to monitor the status of ongoing internships, including updates from the company or university.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Profile Manager,</li> <li>• Internship Manager,</li> <li>• Database Service.</li> </ul>

Table 9: Traceability for R1.8, R1.13

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.9:</b> The system allows students to apply for internships by submitting their CVs and optional cover letters.</li> <li>• <b>R1.10:</b> The system notifies students upon successful submission of their internship applications.</li> <li>• <b>R1.11:</b> The system allows students to track the status of their internship applications, including updates such as waiting for application results, interview invitations, or rejection.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Profile Manager,</li> <li>• Application Manager,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 10: Traceability for R1.9, R1.10, R1.11

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.12:</b> The system facilitates communication between students and companies during the selection process, such as scheduling interviews or responding to queries.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Chat Service,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 11: Traceability for R1.12

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.14:</b> The system allows students to submit feedback on completed internships, rating their experience and suggesting improvements.</li> <li>• <b>R1.16:</b> The system allows students to file complaints about internships through a structured form, specifying details like the issue and parties involved.</li> <li>• <b>R1.17:</b> The system notifies the appropriate university coordinator when a student submits a complaint related to their internship.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Internship Manager,</li> <li>• Notification Service,</li> <li>• Mail Service,</li> <li>• Database Service.</li> </ul>

Table 12: Traceability for R1.14, R1.16, R1.17

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R1.15:</b> The system uses feedback submitted by students to refine the recommendation process and improve future matches.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Student Manager,</li> <li>• Internship Manager,</li> <li>• Recommendation Service,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 13: Traceability for R1.15

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.4:</b> The system allows Company HR to manage their profiles, including updating company information and adding contact details.</li> <li>• <b>R2.9:</b> The system allows Company HR to browse and search for student profiles using filters such as education, location, and skills.</li> <li>• <b>R2.10:</b> The system allows Company HR to view detailed student profiles, including uploaded CVs and other relevant information.</li> <li>• <b>R2.19:</b> The system provides analytics and reports for Company HR, such as application statistics, internship outcomes, and feedback trends.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• CompanyHR Manager,</li> <li>• Profile Manager,</li> <li>• Information Manager,</li> <li>• Database Service.</li> </ul>

Table 14: Traceability for R2.4, R2.9, R2.10, R2.19

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.5:</b> The system allows Company HR to create and post internship listings by providing information such as job title, required skills (if any), compensation, and location.</li> <li>• <b>R2.6:</b> The system allows Company HR to edit their internship listings.</li> <li>• <b>R2.16:</b> The system allows Company HR to submit feedback on completed internships, rating the student's performance and suggesting improvements.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• CompanyHR Manager,</li> <li>• Profile Manager,</li> <li>• Internship Manager,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 15: Traceability for R2.5, R2.6, R2.16

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.7:</b> The system provides suggestions to Company HR on how to optimize their internship postings to attract suitable candidates (e.g., improving descriptions or adding benefits).</li> <li>• <b>R2.8:</b> The system notifies Company HR when new student profiles match their internship requirements.</li> <li>• <b>R2.11:</b> The system prioritizes recommended candidates based on their fit with the internship requirements.</li> <li>• <b>R2.17:</b> The system uses feedback provided by Company HR to refine the recommendation process and improve future student matches.</li> <li>• <b>R2.18:</b> The system notifies Company HR of critical updates, such as new applications, upcoming interview schedules, or changes in internship status.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• CompanyHR Manager,</li> <li>• Recommendation Service,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 16: Traceability for R2.7, R2.8, R2.11, R2.17, R2.18

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.12:</b> The system allows Company HR to schedule and manage interviews for further evaluation.</li> <li>• <b>R2.13:</b> The system facilitates communication between Company HR and students, such as scheduling interviews or requesting additional information.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• CompanyHR Manager,</li> <li>• Application Manager,</li> <li>• Chat Service,</li> <li>• Notification Service,</li> <li>• Mail Service.</li> </ul>

Table 17: Traceability for R2.12, R2.13

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.14:</b> The system allows Company HR to track the status of applications for their internship postings (e.g., under review, shortlisted, or rejected).</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Company Manager,</li> <li>• Profile Manager,</li> <li>• Application Manager,</li> <li>• Database Service.</li> </ul>

Table 18: Traceability for R2.14

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R2.15:</b> The system allows Company HR to manage ongoing internships, including providing progress updates and addressing any issues reported by students or university coordinators.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• Company Manager,</li> <li>• Profile Manager,</li> <li>• Internship Manager,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 19: Traceability for R2.15

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.4:</b> The system allows University Coordinators to manage their profiles, including updating their department, title, and contact details.</li> <li>• <b>R3.5:</b> The system provides University Coordinators with a dashboard to view and monitor all internships involving students under their supervision.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Profile Manager,</li> <li>• Information Manager,</li> <li>• Database Service.</li> </ul>

Table 20: Traceability for R3.4, R3.5

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.8:</b> The system allows University Coordinators to view detailed information about each internship, including project descriptions, timelines, and required qualifications.</li> <li>• <b>R3.13:</b> The system allows University Coordinators to access detailed reports and analytics on internship outcomes, including student satisfaction and feedback trends.</li> <li>• <b>R3.14:</b> The system allows University Coordinators to track the history of all internships involving students from their university.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Information Manager,</li> <li>• Database Service.</li> </ul>

Table 21: Traceability for R3.8, R3.13, R3.14

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.6:</b> The system allows University Coordinators to review and approve or reject internship proposals submitted by students or companies.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Approval Manager,</li> <li>• Notification Service,</li> <li>• Database Service.</li> </ul>

Table 22: Traceability for R3.6

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.9:</b> The system provides tools for University Coordinators to monitor the progress of ongoing internships, including reviewing updates from students and companies.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Internship Manager,</li> <li>• Database Service.</li> </ul>

Table 23: Traceability for R3.9

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.7:</b> The system notifies University Coordinators of new internship proposals that require their review and approval.</li> <li>• <b>R3.12:</b> The system notifies University Coordinators of unresolved complaints and any changes in internship statuses.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Notification Service,</li> <li>• Mail Service,</li> <li>• Database Service.</li> </ul>

Table 24: Traceability for R3.7, R3.12

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.10:</b> The system allows University Coordinators to view and respond to complaints filed by students or companies with a built-in communication channel.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Complaint Manager,</li> <li>• Chat Service,</li> <li>• Database Service.</li> </ul>

Table 25: Traceability for R3.10

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.11:</b> The system allows University Coordinators to terminate an internship if a complaint cannot be resolved.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Complaint Manager,</li> <li>• Internship Manager,</li> <li>• Database Service.</li> </ul>

Table 26: Traceability for R3.11

<b>Requirements:</b>	<ul style="list-style-type: none"> <li>• <b>R3.15:</b> The system provides University Coordinators with notifications about deadlines for internship approvals and other critical activities.</li> </ul>
<b>Components:</b>	<ul style="list-style-type: none"> <li>• Web Application,</li> <li>• UC Manager,</li> <li>• Approval Manager,</li> <li>• Notification Service,</li> <li>• Mail Service.</li> </ul>

Table 27: Traceability for R3.15

## 5. Implementation, Integration and Test Plan

This section presents the detailed implementation, integration, and testing plan for the Students & Companies (S&C) platform. It describes the approach for implementing system components, their integration order, and the testing strategies that will be applied to ensure the robustness and reliability of the platform.

### 5.1. Implementation Plan

When selecting an implementation strategy, the two main approaches considered are Bottom-Up and Top-Down.

The chosen implementation plan for the S&C platform is **Bottom-Up**. This approach allows the development team to:

- Develop, integrate, and test individual components first.
- Validate components independently before focusing on their interactions.
- Simplify testing and interpretation of results.
- Facilitate future extension of the system with minimal effort.

The development order is determined based on dependencies between components, ensuring foundational services are implemented first. External components such as third-party APIs and infrastructure services (e.g., mail, database) are treated as reliable.

#### Development Order of Components:

1. Database Service
2. Mail Service
3. Registration Service
4. Authentication Service
5. Notification Manager
6. Information Manager
7. Profile Manager
8. Application Manager
9. Approval Manager
10. Internship Manager

11. Complaint Manager
12. Student Manager
13. CompanyHR Manager
14. UC Manager
15. Recommendation Service
16. Chat Service
17. External Components Integration
18. Web Application

## 5.2. Integration and Test Plan

This section delineates the system's integration plan and the sequence for testing interactions between components. Each component will undergo **unit testing** during the development process, ensuring its individual functionality, while **integration tests** will focus on communication and interaction between components. A bottom-up approach will be adopted, starting with lower-level components such as the Database Service and Mail Service.

Drivers will be used to simulate top-level components not yet implemented, allowing comprehensive testing of lower-level components. For instance, testing the Database Service will require a Driver to provide input and invoke its methods to verify behavior before integrating higher-level components.

Additionally, the implementation of the **Chat Service** and **Recommendation Service** will be postponed until after the implementation of the **Student Manager** and **CompanyHR Manager**, as these services are auxiliary and require complete instances of student and company data for proper testing and functionality validation.

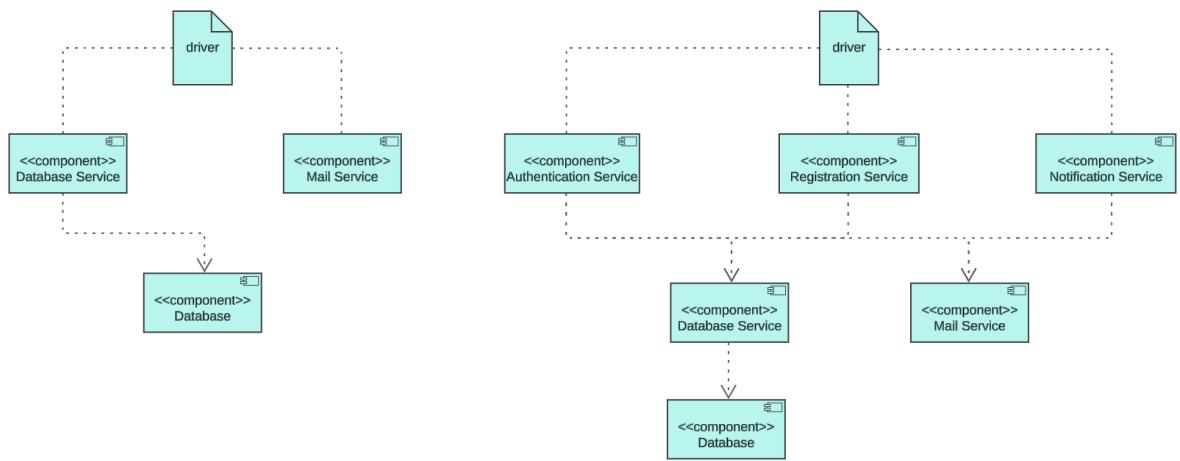


Figure 5.2.1: Integration of foundational services

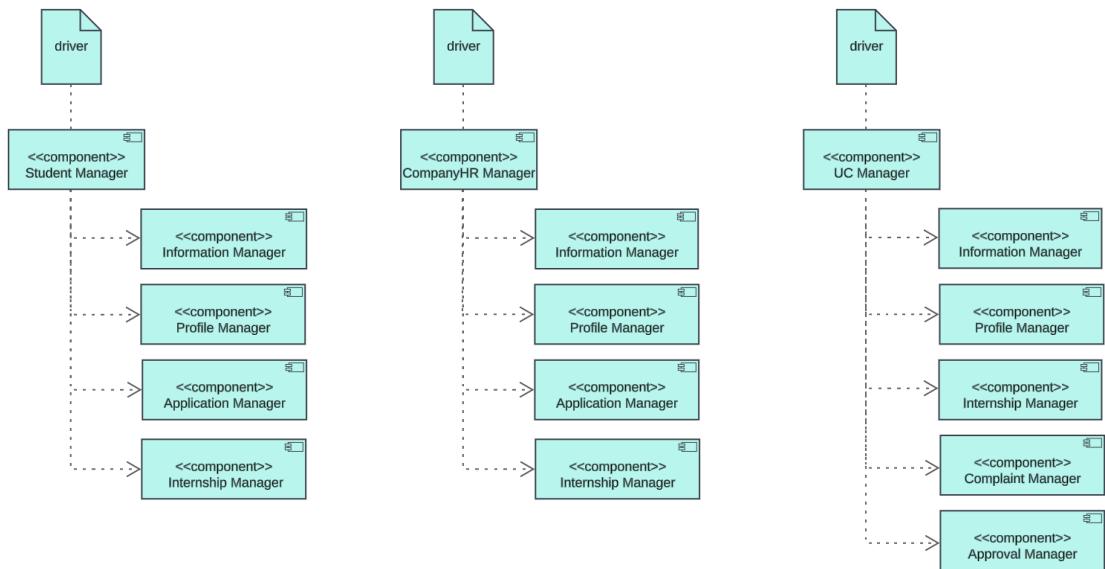


Figure 5.2.2: Manager component dependencies

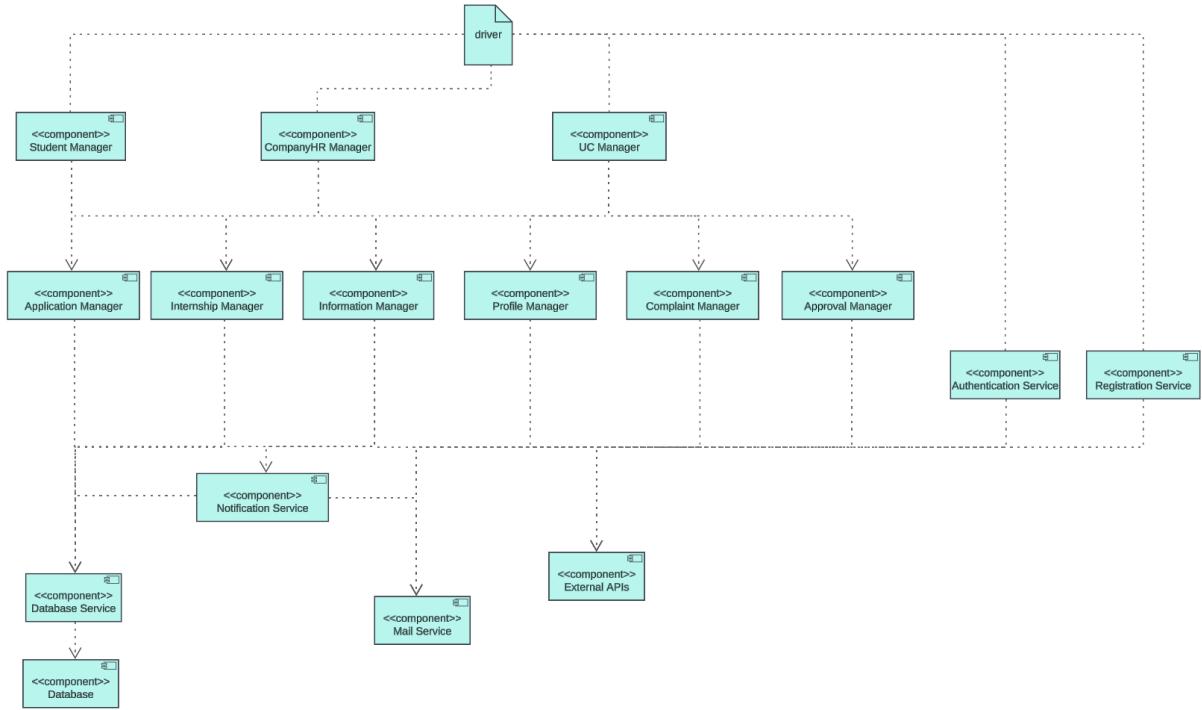


Figure 5.2.3: High-level component integration

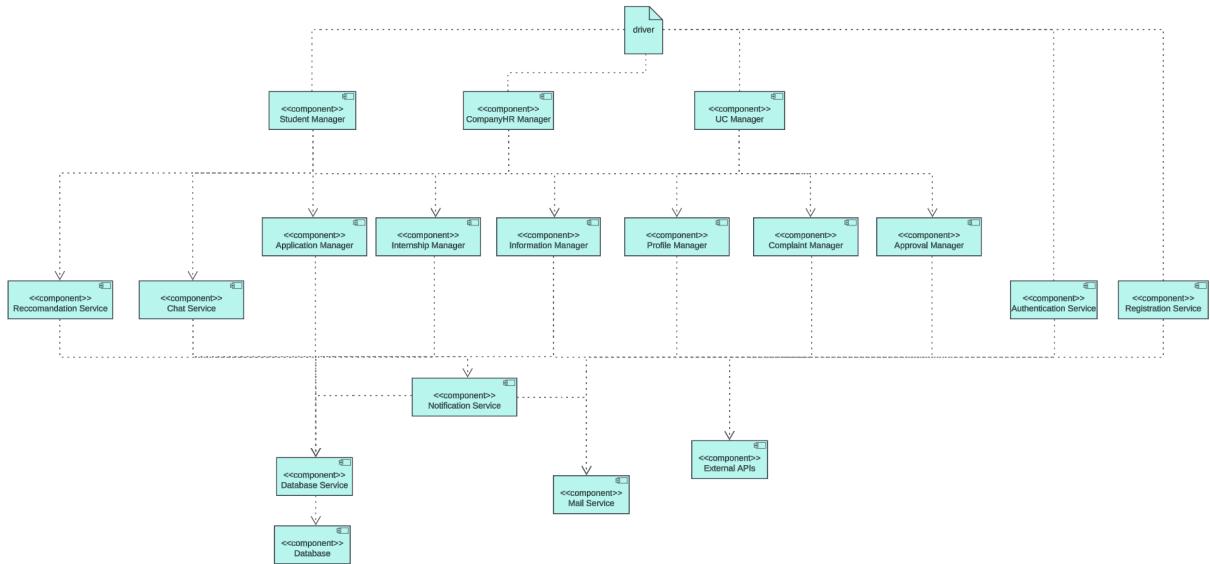


Figure 5.2.4: Complete system integration

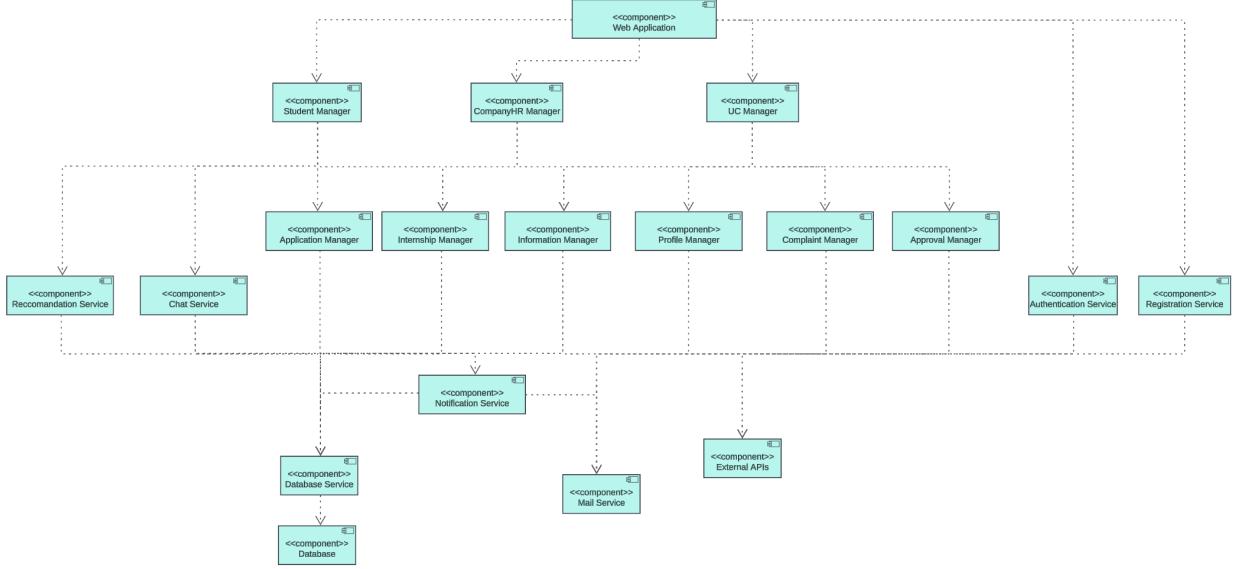


Figure 5.2.5: Web application final integration

### 5.3. External API Usage and System Tests

We use external APIs to show how some system parts need to work with outside services to make sure everything works properly. For example:

- The **Mail Service** uses external APIs to send verification and notification emails.
- The **Recommendation Service** might use advanced machine learning algorithms on external platforms to provide personalized suggestions.
- Services such as checking the authenticity of registered users' emails through third-party providers ensure that institutional email verification is done properly.

In addition to integration testing, the following system tests will be conducted to ensure the platform meets all functional and non-functional requirements:

- **Load Testing:** Gradually increases the load on the system to identify potential scalability issues, memory leaks, or performance degradation. This helps determine the system's maximum capacity and behavior under high-demand conditions.
- **Performance Testing:** Focuses on identifying bottlenecks and establishing a baseline for the platform's response times, throughput, and overall efficiency.
- **Functional Testing:** Ensures that all requirements and functionalities defined in the RASD are fully implemented and behave as expected under normal operating conditions.
- **Usability Testing:** Evaluates the user-friendliness of the platform, ensuring the Presentation Layer offers intuitive and accessible interfaces for all user roles.

- **Stress Testing:** Subjects the system to extreme conditions, such as high resource demand or simulated failures, to assess its stability and recovery mechanisms.

## 6. Effort Spent

### 6.1. Xin Ye

Task	Hours
Introduction	2
Component Diagram	3
Overview, Class Diagram, Component View, Deployment View, Selected Architectural Styles and Patterns, Other Design Decisions	8
Sequence Diagrams	7.30
Mock-ups	7
Requirements Traceability	3
Document Revision	2

Table 28: Effort spent by Xin Ye

### 6.2. Matteo Civitillo

Task	Hours
Component Diagram	3
Component Interfaces	11
Document Revision	5
Sequence Diagrams	7
Implementation, Integration, and Test Plan	7

Table 29: Effort spent by Matteo Civitillo

### 6.3. Mattia Vicenzotto

Task	Hours
Component Diagram	2.30
Sequence Diagrams	15
Component Interfaces	5
Document Revision	7
User Interface Design	2

Table 30: Effort spent by Mattia Vicenzotto