



POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE



RASD: Requirement Analysis and Specification Document

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1. INTRODUCTION

1.1. Purpose

The process of identifying suitable internship opportunities has historically represented a significant challenge for university students. Despite their academic training, many students encounter difficulties in applying their knowledge in real-world settings due to a lack of opportunities that align with their skills and career goals. At the same time, companies seeking talented interns often encounter difficulties in identifying candidates who meet their specific requirements, particularly when the matching process relies on manual search and basic criteria.

This gap between students and companies has the effect of limiting career opportunities for students while simultaneously preventing companies from identifying skilled candidates who could contribute to the growth and success of their teams. Consequently, the internship process can become a source of frustration for all parties involved, due to inefficiencies in the manner in which opportunities are identified, candidates are selected, and internships are executed.

The objective of this project is to address these issues by developing a platform, entitled “Students&Companies” (S&C), which aims to enhance the internship matching process. The S&C platform will facilitate the automation of the matching process through the utilization of data-driven algorithms, enabling the identification of optimal internship opportunities for students based on their unique skill sets, experiences, and career aspirations. Additionally, the platform will assist companies in the identification of suitable candidates, aligning them with their specific project requirements and needs.

The platform employs recommendation algorithms to enhance the efficiency of the search and selection process, transcending the limitations of conventional keyword-based searches. Upon uploading their CVs, students will receive automatic suggestions regarding internships that align with their profiles. Similarly, companies will be able to advertise their internship offerings, and the system will recommend students whose CVs align with the company’s specified criteria. This approach will enable both students and companies to spend less time searching and more time focusing on the core objective of creating valuable internship experiences.

Moreover, S&C will facilitate the entirety of the internship process, from the initial matching of candidates to the final evaluation. Students and companies will be able to communicate with one another, schedule interviews, and track progress throughout the duration of the internship. Additionally, the platform will include university coordinators, who will have dedicated accounts created using their institutional email addresses. These university coordinators will play a critical role in approving internships, gaining an overview of ongoing internship details, and serving as points of contact for managing complaints or addressing issues that may arise during the internship process.

Furthermore, the platform will furnish students with the capacity to receive feedback and suggestions regarding the enhancement of their CVs, and will facilitate the improvement of internship descriptions for companies, thereby ensuring that the opportunities are more engaging and aligned with student interests.

In essence, our objective is to establish a unified, streamlined, and transparent system that eliminates obstacles to identifying meaningful internship opportunities for students, facilitates the discovery and nurturing of talent by companies, and incorporates universities as key stakeholders in the process. It is our intention that S&C will enable enhanced collaboration between students, companies, and universities, thereby transforming the internship experience into a mutually beneficial process that enhances professional development and career opportunities for all parties involved.

1.1.1. Goals

The Students&Companies (S&C) project is designed to achieve the following goals:

For Students:

- G1 Enable students to create and manage their accounts, including uploading and updating CVs, saving internships, and tracking application history.
- G2 Allow students to search for internships using advanced filters (e.g., industry, location, salary, required skills, and application domain) and access detailed descriptions of the opportunities.
- G3 Notify students about internship opportunities that match their profiles, preferences, and goals, using personalized recommendations powered by advanced algorithms.
- G4 Provide students with tools to enhance their CVs by offering suggestions on format, content, and alignment with industry standards to improve their appeal to companies.
- G5 Enable students to monitor the status and progress of their applications and internships, track feedback, and report issues or complaints through dedicated communication spaces.

For Companies:

- G6 Enable companies to create and manage accounts for posting internships, reviewing applications, and accessing student profiles.
- G7 Allow companies to advertise internships with comprehensive project descriptions, required qualifications, and details on terms (e.g., compensation, mentorship opportunities, and technologies used).
- G8 Provide companies with tools to browse and filter student CVs, access relevant profiles, and receive notifications about candidates who meet their requirements.
- G9 Offer companies suggestions to optimize their internship postings, including recommendations on language, structure, and benefits to attract the best-suited candidates.
- G10 Notify companies when new student profiles align with their internship needs.

For University Coordinators:

- G11 Allow university coordinators to create and manage accounts using institutional email addresses.
- G12 Enable university coordinators to approve or reject internship proposals submitted by students or companies, ensuring compliance with academic policies and standards.
- G13 Provide university coordinators with access to detailed information on each internship, including descriptions, student progress, and contact details for companies, to maintain an overview of all activities.
- G14 Offer tools for university coordinators to handle complaints and intervene when necessary, including direct communication channels with students and companies.
- G15 Enable university coordinators to access reports and analytics on internship outcomes to improve collaboration and oversight.

1.2. Scope

The Students&Companies (S&C) platform provides a convenient and efficient platform for university students seeking internships and companies offering them to connect. By leveraging user-friendly features and advanced recommendation mechanisms, the S&C platform aims to facilitate a streamlined process, ensuring that students and companies can easily connect, interact, and establish productive collaborations. Additionally, the platform allows universities to monitor internships, address issues, and ensure compliance with academic standards.

1.2.1. World Phenomena

World Phenomena ID	Description
WP01	A student decides to search for an internship to gain experience and improve their skills.
WP02	A company decides to post an internship listing to attract potential candidates.
WP03	A student decides to submit an application for an internship.
WP04	A company reviews internship applications to evaluate potential candidates.
WP05	A university coordinator monitors ongoing internships to address issues or provide support.
WP06	A student provides feedback about their internship experience.
WP07	A company provides feedback about the student's performance during the internship.
WP08	A student or company identifies and reports a problem during an internship.
WP09	A university coordinator intervenes to resolve reported complaints or issues.

Table 1: World Phenomena

1.2.2. Shared Phenomena

Shared Phenomena ID	Description	Control
SP01	A company enters its information to register.	World controlled
SP02	A student enters their information to register.	World controlled
SP03	A company enters its credentials to log in.	World controlled
SP04	A UC enters their information to register.	World controlled
SP05	A student enters their credentials to log in.	World controlled
SP06	A company logs out.	World controlled
SP07	A student logs out.	World controlled
SP08	A UC enters their credentials to log in.	World controlled
SP09	A company creates an internship listing, specifying required details.	World controlled
SP10	A student uploads their CV and enters preferences and skills.	World controlled
SP11	The platform provides personalized internship recommendations to students.	Machine controlled
SP12	A UC logs out.	World controlled
SP13	The platform notifies companies about student profiles matching their needs.	Machine controlled
SP14	A student applies to an internship via the platform.	World controlled
SP15	A company uses the platform to review applications and shortlists candidates.	World controlled
SP16	A UC reviews and approves/rejects an internship listing.	World controlled
SP17	The platform sends notifications about new internships to students.	Machine controlled
SP18	The platform notifies companies about new student applications.	Machine controlled
SP19	The platform schedules interviews between students and companies.	Machine controlled
SP20	A company conducts interviews with students.	World controlled
SP21	The platform collects feedback from students and companies about the process.	Machine controlled
SP22	A student or company reports a complaint via the platform.	World controlled
SP23	The UC intervenes to address a complaint via the platform.	World controlled
SP24	The platform generates analytics and statistics based on outcomes and feedback.	Machine controlled

Table 2: Shared Phenomena

1.2.3. 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	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 3: Definitions

1.2.4. 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 4: Acronyms

1.2.5. Abbreviations

Abbreviation	Description
Id	Identifier

Table 5: Abbreviations

1.3. Revision History

December 22, 2024: version 1.0 (first release)

January 7, 2025: version 2.0 (second release)

- Student recommendation sequence diagram
- Company HR recommendation sequence diagram
- Recommendations use case analysis recommendation

1.4. 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/>
- State Diagrams rules: <https://plantuml.com/state-diagram>
- State Diagrams: <https://www.planttext.com/>
- Sequence Diagrams: <https://plantuml.com/sequence-diagram>
- Mock ups: <https://www.figma.com/>
- Alloy official documentation: <https://alloytools.org/documentation.html>

1.5. Document Structure

This RASD is organized into five chapters:

1. **INTRODUCTION:** This chapter offers a comprehensive overview of the project's objectives, delineating the system's scope through an examination of global and shared phenomena. Additionally, it provides a glossary of abbreviations and acronyms.
2. **OVERALL DESCRIPTION:** This chapter presents an overview of the system's interactions, employing a combination of scenarios, class diagrams, and state diagrams. The chapter concludes with a list of domain assumptions and a description of the characteristics of the intended users.
3. **SPECIFIC REQUIREMENTS:** This is the core of the document, providing detailed descriptions of all aspects needed by the development team. It includes hardware and software interfaces, functional requirements represented with UML diagrams, performance requirements, and design constraints.
4. **FORMAL ANALYSIS USING ALLOY:** This chapter contains a formal description of the software product using the Alloy language, accompanied by comments to clarify each part of the modeling.
5. **EFFORT SPENT:** This section details the amount of time each team member spent on each section of the document.

2. OVERALL DESCRIPTION

2.1. Product Perspective

2.1.1. Scenarios

1. **A new student wants to register on S&C:**

Giulia is a university student looking for an internship. She decides to register on the S&C platform after hearing about it from a friend. She clicks the “Register” button and selects the “Student” option. The system prompts Giulia to fill in her personal information, including her name, email, password, university, and additional information (e.g., study

field, key skills, and previous experiences). After completing the form, she submits it and receives a confirmation email. Giulia clicks the link in the email to activate her account, and the system confirms that the registration is complete.

2. A new company wants to register on S&C:

Hololimb is a growing startup looking to attract talented interns. Anna, the HR manager, visits the S&C platform to create a company profile. She clicks the “Register” button and selects “Company” as the registration type. The system requests details such as the company name, email, and password. After completing the form, Anna submits it and receives a confirmation email. She verifies her account by clicking the link provided, and the system confirms successful registration.

3. A new university coordinator registers on S&C:

Sarah, an internship coordinator for the Polytechnic of Milan, logs into the platform to register as a University Coordinator. She clicks “Register” and selects “University Coordinator” as the registration type. The system asks her to provide her institutional email address and sends a verification email. Sarah confirms her account by clicking the link, and the system allows her to access the dashboard where she can approve internships and monitor student progress.

4. A company posts a new internship:

Hololimb, a VR/XR startup, wants to hire an intern for a software development role. Lisa, the HR manager, logs into her company profile and clicks on “Post Internship.” She fills in the details, including the job title, required skills, application domain, compensation, and other benefits. Lisa submits the internship, and the system notifies her that the posting is live and visible to students.

5. A student applies for an internship:

Giulia is a student looking for an internship in data science. While browsing the platform, she finds an internship posted by Hololimb that matches her skills. She clicks on the internship posting to view the details and then clicks “Apply.” The system prompts Giulia to upload her CV and, optionally, write a brief cover letter. She submits her application, and the system notifies her that her application has been sent to the company.

6. A company reviews student applications:

Hololimb receives applications for its data science internship. Lisa logs into the platform and opens the internship dashboard. She sees a list of applicants, including Giulia, and reviews her CV and eventual cover letter. Lisa shortlists Giulia for an interview, and the system sends Giulia a notification about the interview invitation.

7. A student receives a recommendation:

Tom is a student with skills in machine learning. One day, he receives a notification from S&C suggesting an internship at AIWorks, a company looking for interns with his exact skill set. Tom clicks on the link in the notification, views the internship details, and decides to apply directly through the platform.

8. A company receives a recommendation:

DataCorp posts an internship for web developers. The platform automatically identifies three students whose profiles match the internship requirements and sends a recommendation to DataCorp. The HR manager reviews the student profiles and invites them to apply for the internship.

9. A company conducts an interview:

After a match is accepted, Hololimb schedules an interview with Giulia through the S&C platform. Giulia receives the details and joins via the platform's video conferencing feature or in person. After the interview, they finalize the evaluation and notify Giulia of the next steps.

10. A university coordinator approves or rejects an internship:

Sarah, the internship coordinator for the Polytechnic of Milan, receives a notification that Giulia, one of her students, has been matched with an internship opportunity at Hololimb. She logs into the S&C platform to review the details of the internship, including the company's offer, Giulia's application, and any additional notes from the company. After reviewing all the information, Sarah decides to approve the internship. The platform notifies Giulia and Hololimb that the internship has been approved, and they can proceed with the next steps. If Sarah had concerns or found issues with the internship, she could reject it and provide feedback or suggest changes to ensure the internship meets university requirements.

11. A university coordinator monitors internship progress:

Sarah, the UC for the Polytechnic of Milan, logs into the S&C platform to monitor the progress of students' internships. She reviews the status of active internships, examines reports submitted by students and companies, and intervenes if there are any unresolved complaints.

12. A complaint is filed during an internship:

Laura is an intern at Hololimb but is experiencing issues with the working conditions. She uses the S&C platform to file a formal complaint. Sarah, the UC, reviews the complaint, contacts both parties, and mediates the situation. If necessary, the university terminates the internship agreement.

13. A student completes an internship and provides feedback:

Giulia completes her internship at Hololimb. The platform prompts her to provide feedback about the experience. Giulia rates the internship, mentions her satisfaction with the mentorship, and suggests improvements for future internships. This feedback is used to enhance the platform's recommendation system.

2.1.2. Class Diagram

The UML diagram represents the conceptual model for the S&C platform.

The **Student** class is central to the system, representing students who interact with other entities. Each student provides various details during registration, including their CV, university, field of study, and a list of skills. Students can create multiple **Applications** to apply for

available internships, and for each application, they must re-attach their CV file. Additionally, students can provide **Feedback** to evaluate the internships or companies they have collaborated with. They can also give **Complaints** about a particular internship or company.

The **Company HR** class represents company representatives who manage and publish internships through the **Internship** class. HR representatives review applications submitted by students, and the application's status updates accordingly (e.g., *Submitted*, *UnderReview*, *Shortlisted*, *Rejected*, *Accepted*). HR can also provide **Feedback** to evaluate their experience with interns or file **Complaints** about a student's performance during an internship.

The **Internship** class contains details such as `internshipID`, `title`, `description`, `requirements`, `location`, `salary`, `duration`, and its current status (e.g., *Open*, *Applied*, *Accepted*, *Ongoing*, *Closed*). Internships are created and posted by companies and are linked to multiple student applications.

The **University Coordinator (UC)** class represents university staff responsible for overseeing complaints. UCs do not directly manage internships but are tasked with handling **Complaints** to resolve conflicts or issues reported during internships. **Complaints** can have one of three statuses: *Open, InProgress, or Resolved*.

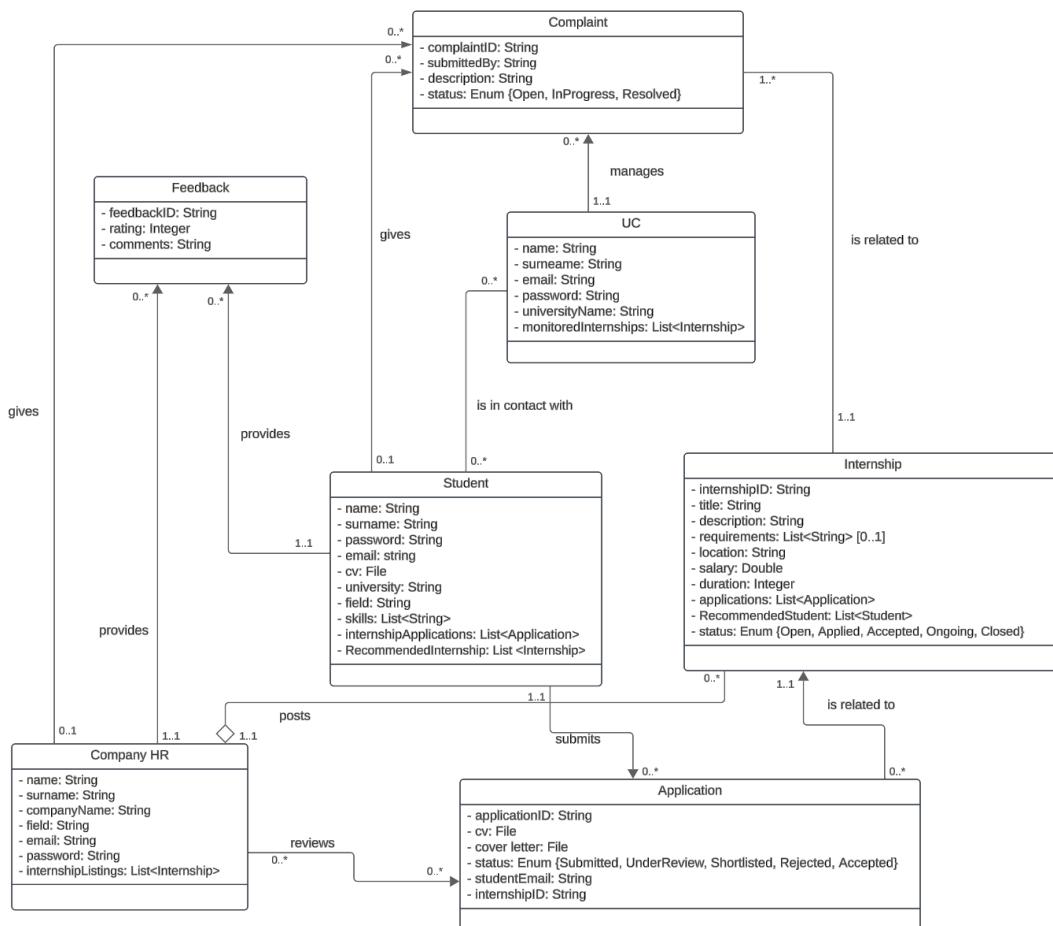


Figure 1: Class Diagram

2.1.3. State Diagram

Internship State Diagram:

In this diagram, we illustrate the life cycle of an internship on the S&C platform. When a company creates a new internship offer, it enters the “*Created*” state. At this point, the offer is visible to students.

Once a student applies and the system matches the student’s profile with the internship’s requirements (such as skills and experience), the internship moves to the “*Matched*” state.

The company proceeds to contact the student to schedule an interview and the internship moves to the “*Under Evaluation*” state. During this phase, the company evaluates the student’s fit for the role through interviews or assessments. If the company decides not to proceed with the internship, it enters the “*Rejected*” state.

If the company decides to proceed with the internship, the internship moves to the “*Accepted*” state.

The internship then enters the “*Awaiting Approval*” state, where the UC reviews and approves it. Once the internship is validated by the UC, it reaches the “*Approved*” state, and the internship officially begins. Otherwise, the internship is rejected, and both parties are notified.

This process ensures that all internships are thoroughly evaluated by both the company and the UC before being confirmed and started.

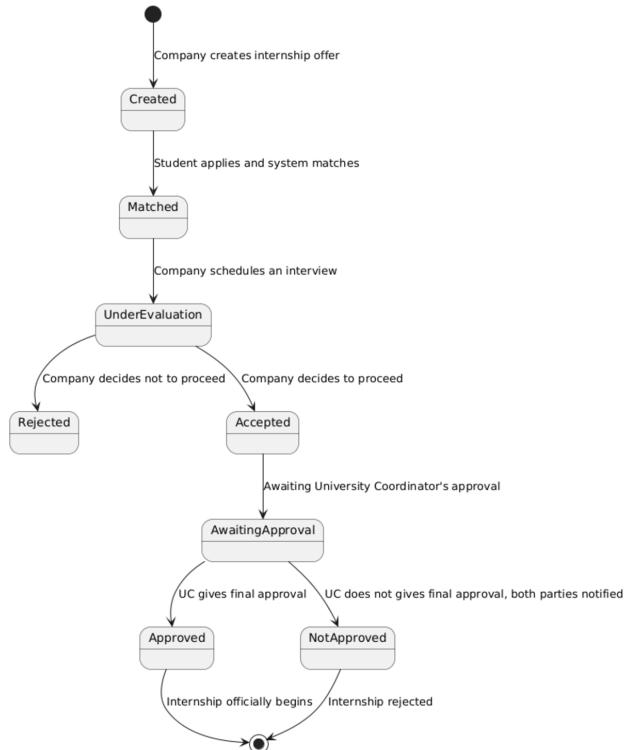


Figure 2: Internship state diagram

2.1.4. Internship Recommendation State Diagram

This diagram illustrates the recommendation process within the S&C platform, which matches university students with internships based on their profiles.

After a student registers and uploads their CV, the system transitions to the *Analyzing* state, where it processes the student's skills, experiences, and preferences against the available internships. This analysis leverages algorithms such as keyword searching and statistical analysis to find potential matches.

If the system identifies suitable matches, it transitions to the *Recommended* state, where a tailored list of internship opportunities is presented to the student. This list highlights the internships that best align with the student's profile.

If no matches are found during the analysis, the system transitions to the *No Matches Found* state. In this state, the platform prompts the student to update their profile or wait for new opportunities to become available.

From the *Recommended* state:

- If the student applies to an internship, the system transitions to the *Applied* state, where the application process continues.
- If the student decides not to pursue any of the suggested internships and closes the recommendations list, the system transitions to the *Not Interested* state, ending the process for this cycle.

The platform collects data from student and company interactions to refine the recommendation process continuously. This includes actionable insights, such as suggestions to improve student CVs, to enhance the quality of future matches.

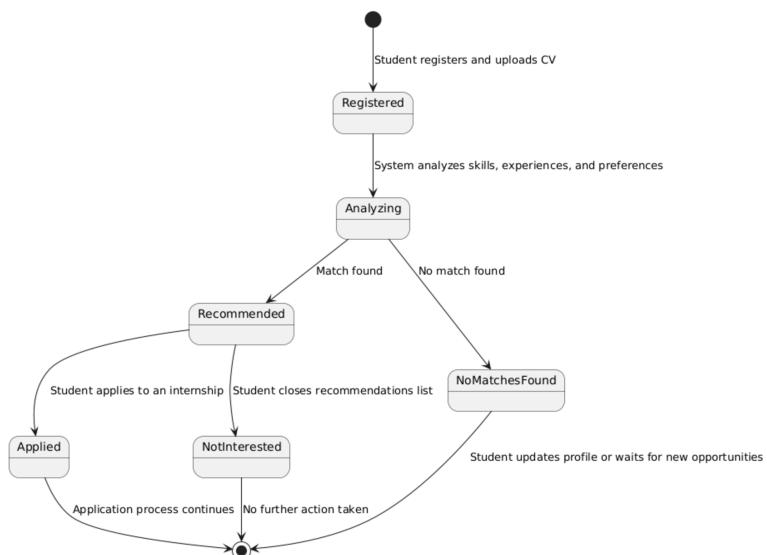


Figure 3: Internship Recommendation state diagram

2.1.5. Candidates Recommendation State Diagram

After a company publishes an internship offer, the platform analyzes the profiles of applicants when the company views the list of applicants. Using algorithms such as keyword matching and statistical analysis, the platform identifies candidates whose skills, experiences, and qualifications best match the internship requirements.

If suitable matches are found, the system transitions to the *Recommended Candidates* state, presenting a prioritized list to the company. This list highlights candidates who are the best fit for the internship based on the analysis.

If no applicants are found, the system transitions to the *No Applicants* state, where the platform provides actionable suggestions to improve the internship posting. These suggestions may include adjusting skill requirements, refining the job description, or emphasizing benefits like mentorships or paid opportunities.

From the *Recommended Candidates* state:

- The company can contact suggested candidates to proceed with further application steps.
- If the company does not act on the recommendations, the process ends for that internship cycle.

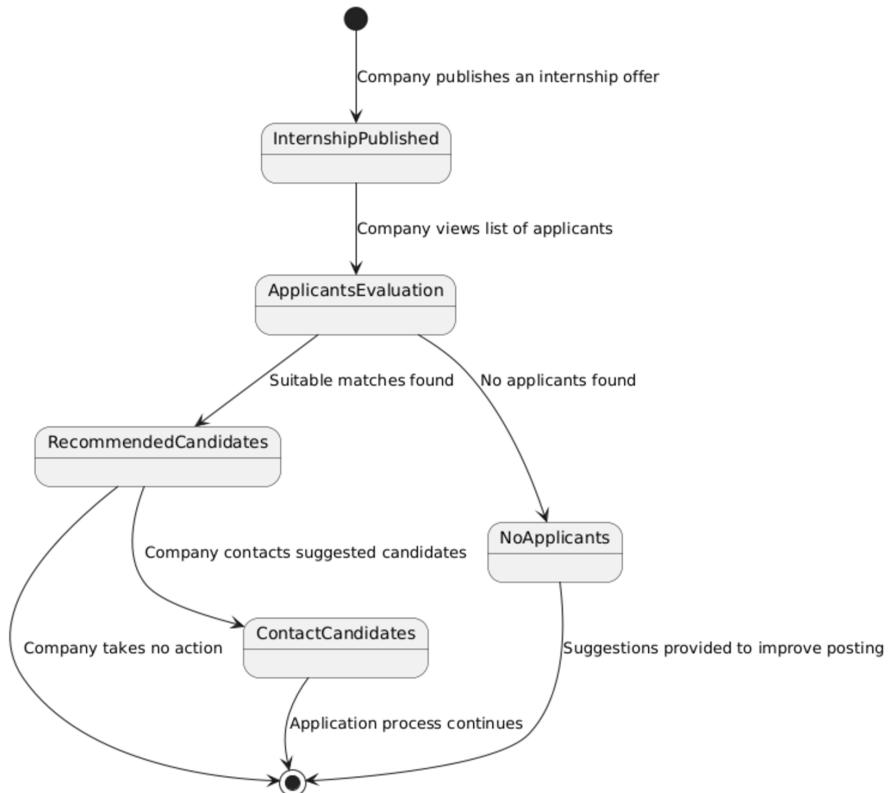


Figure 4: Candidates Recommendation state diagram

2.1.6. Feedback State Diagram

After an internship is marked as completed, the platform prompts both the student and the company to provide feedback. At this point, the system transitions to the *Awaiting Feedback* state, where both parties are invited to submit their ratings and comments regarding their experience.

If one party submits feedback, the system transitions to the *Register Feedback* state to record the feedback provided by that party. The system then returns to the *Awaiting Feedback* state, waiting for the other party's feedback.

Once both parties have submitted their feedback, the system transitions to the *Feedback Complete* state, where the feedback is finalized, and the process ends successfully.

If neither party or only one party submits feedback within the given timeframe, the system transitions to the *Feedback Not Complete* state. In this case, the process ends without complete feedback, but any submitted feedback is retained.

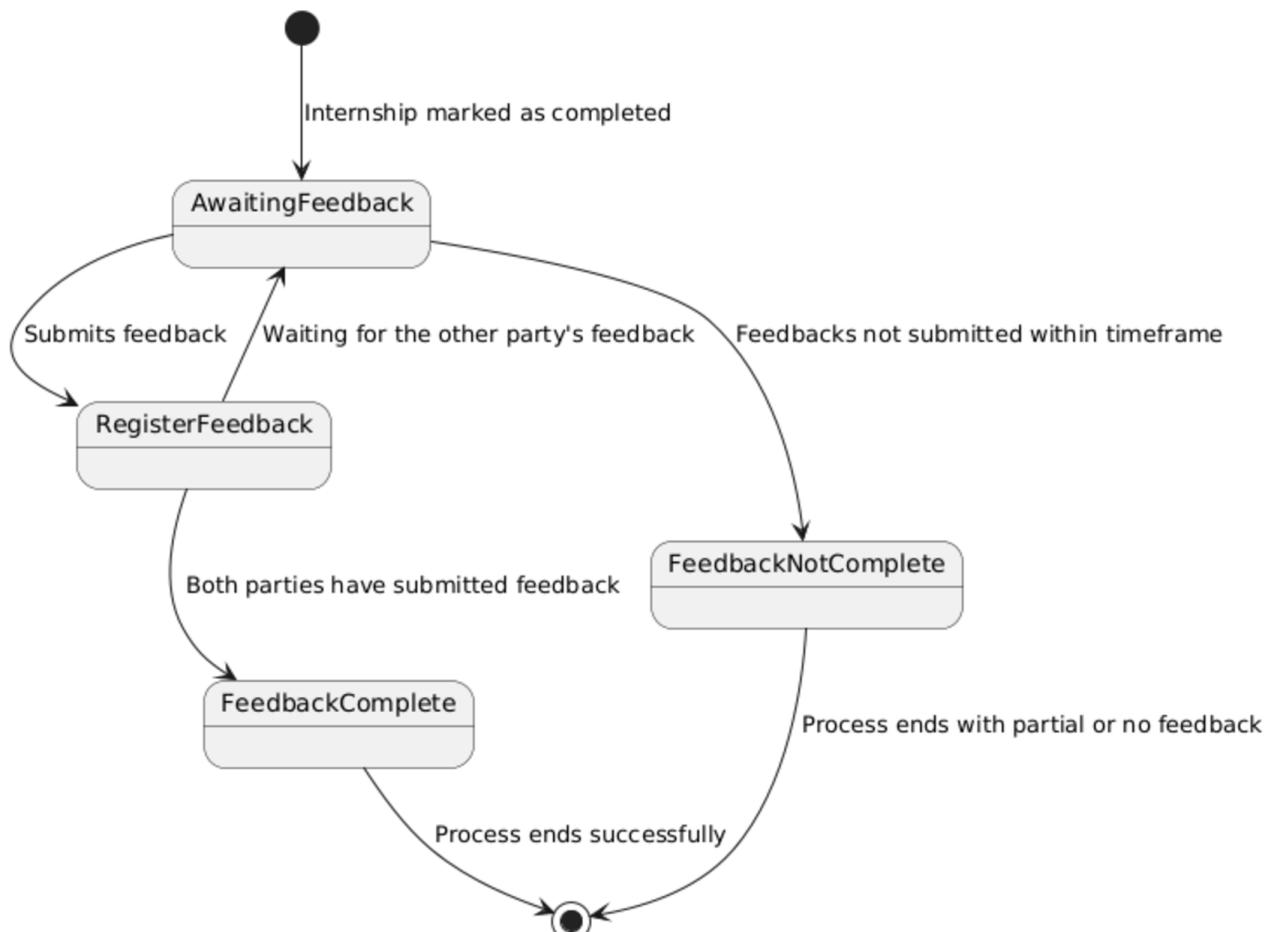


Figure 5: Feedback state diagram

2.1.7. University Monitoring State Diagram

The monitoring phase begins as soon as the internship starts and continues throughout its duration. During this phase, students, companies, and universities can report issues related to the internship.

If no complaints are reported, the internship transitions directly to the *Completed* state once it concludes successfully.

If a complaint is reported, the internship transitions to the *Under Investigation* state. In this state, the UC is responsible for addressing the issue. If the complaint is resolved satisfactorily, the internship transitions back to the *Monitoring* state, allowing it to continue as planned.

If the complaint cannot be resolved or the issue requires the internship to be terminated, it transitions to the *Terminated* state, ending the process.

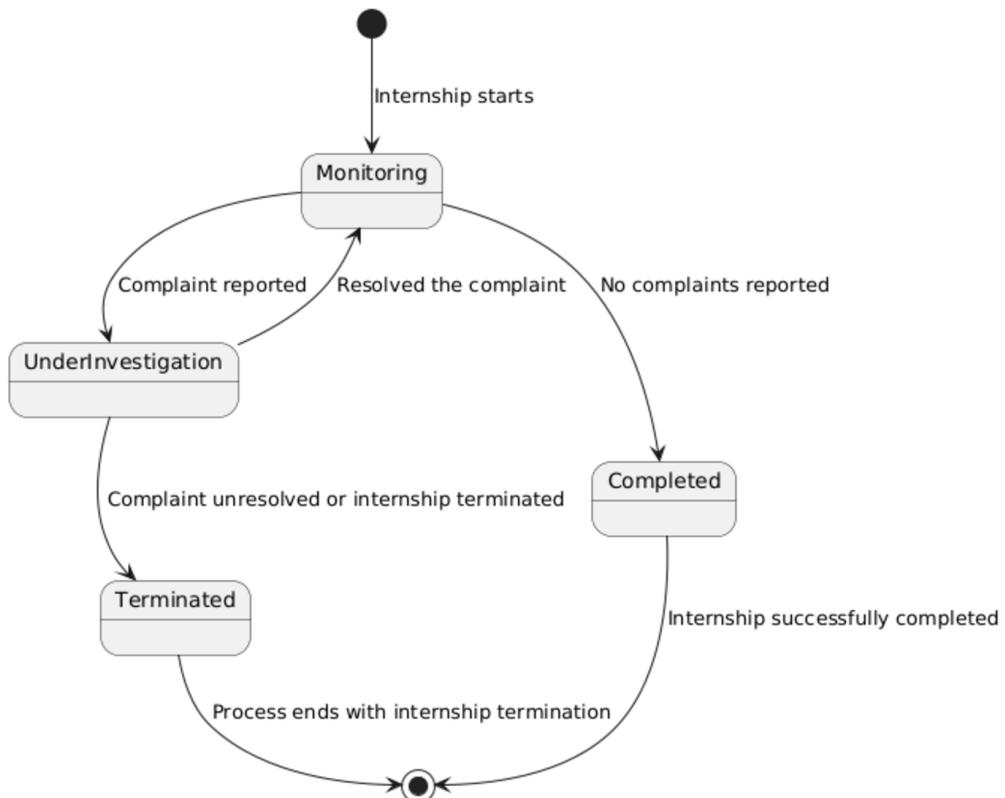


Figure 6: University Monitoring State Diagram

2.2. Product Functions

2.2.1. Student's Product Functions

Registration: To access the web application, all users must complete the registration process. Students are required to provide their email, password, and full name. The email must be unique across all user categories (student, company, university coordinator). Additionally, students must accept the platform's terms and conditions before submitting the registration form. Upon successful submission, the system redirects the user to a page that instructs them to finalize their registration by clicking a verification link sent to the provided email address.

Account Management and CV: Students can manage their accounts by navigating to their user profile, where they can add or update personal information, contact details, education, experiences, skills, and career goals. The platform enables them to upload CVs, which can be updated or edited at any time. A CV improvement feature offers tailored suggestions to enhance their profiles by identifying missing or unclear information, ensuring a professional and attractive representation for potential employers.

Proactively Search for Internships: Students can proactively search for internships through the application using advanced filters such as industry, location, salary, required skills, and application domain. Detailed descriptions of each opportunity help students find internships that align with their preferences and career goals. When ready, they can apply for internships directly through the platform, with their CV automatically included as part of their profile (they can even attach an updated CV as part of the application).

Receive Internship Recommendations: The system identifies and recommends internships tailored to a student's profile, skills, and preferences. Recommendations are generated through methods ranging from basic keyword matching to advanced statistical analysis. Notifications are prominently displayed on the dashboard and sent via email, ensuring students are informed about relevant opportunities.

Monitoring Applications and Feedback: The platform provides students with a dedicated dashboard to monitor the status and progress of their internship applications. This includes real-time updates on the application process, such as "Under Review," "Shortlisted," or "Rejected." Students can view detailed information about the progress of each internship application, ensuring that they are informed about the current status of their applications. In addition, students can track feedback from companies related to their applications and performance during the internship.

Provide Feedback: Upon completing an internship, students are prompted to share comprehensive feedback about their experience through the platform. This feedback includes evaluations of various aspects of the internship, such as the relevance and clarity of the tasks assigned, the quality of mentorship provided, the work environment, and the overall learning experience. Students can rate specific areas of their internship, such as task variety, skill development, and support from the company. Additionally, they can offer suggestions for improvement in the

internship program, such as recommendations on how the company could enhance onboarding, communication, or internship training programs.

2.2.2. Companies' Product Functions

Registration: To access the web application, all users must complete the registration process. Company representatives are required to provide their email, password, and full name. The email must be unique across all user categories (student, company, university coordinator). Additionally, company representatives must accept the platform's terms and conditions before submitting the registration form. Upon successful submission, the system redirects the user to a page that instructs them to finalize their registration by clicking a verification link sent to the provided email address.

Account Management: Companies can manage their profiles by updating details such as company name/description, contact information, and industry focus. They can also customize notification preferences to stay updated on internship-related activities.

Internship and Application Management: Companies can publish internships by creating postings that include information such as: project title, responsibilities, required qualifications, technologies, compensation, and mentorship opportunities. The platform provides editing tools and recommendations for optimizing internship descriptions to attract the best candidates. Once applications are submitted, companies can review a student's profile and CV. An integrated application dashboard allows company HRs to track and update the status of applications, such as "Under Review," "Shortlisted," or "Rejected."

Student Search: Companies can actively search for students through the application using advanced filters such as skills, education, location, and availability to help narrow down search results. Companies can view student profiles and directly invite candidates who match their requirements to apply for specific internships. Suggestions for relevant student profiles are also generated automatically based on the internship descriptions posted by the company.

Notifications: The platform ensures that companies stay updated by sending real-time notifications. Companies are notified when new student profiles align with their internship requirements, when applications are received, and when students accept or decline interview invitations. Additionally, the system provides reminders for upcoming interviews or deadlines related to their listed internships. Notifications are accessible through both the platform dashboard and emails.

2.2.3. University Coordinators' Product Functions

Registration: To access the web application, all users must complete the registration process using their institutional email address. They are required to provide their email, password, and full name. The email must be unique across all user categories (student, company, university coordinator). Coordinators must accept the platform's terms and conditions before submitting the registration form. Upon successful submission, the system redirects the user to a page that

instructs them to finalize their registration by clicking a verification link sent to the provided institutional email address.

Account Management: University coordinators can manage their accounts by updating personal and institutional information such as department, title, and contact details. They can also customize notification preferences to stay updated on internship-related activities.

Internship Proposal Review and Approval: University coordinators can view internship proposals submitted by students or companies through a dedicated dashboard. Proposals are presented with comprehensive details, including project descriptions, timelines, required skills, and compliance with academic policies. Coordinators can approve or reject proposals, providing detailed feedback or additional requirements when necessary. Notifications are sent to students and companies to inform them of the decision.

Internship Monitoring: Coordinators have access to detailed information on ongoing internships, including project descriptions, student progress reports, and company contact details. A centralized dashboard enables them to track all activities, ensuring academic compliance and identifying any potential issues. Coordinators can sort and filter internships by status, student, or company for efficient oversight.

Complaint and Issue Resolution: The platform includes tools for university coordinators to handle complaints submitted by students or companies. Coordinators can view and respond to complaints directly through the system. A built-in communication channel enables direct messaging with the involved parties to address concerns. Logs of complaint resolutions are maintained for future reference.

Reports and Analytics: University coordinators can access detailed reports and analytics on internship outcomes, including information such as completion rates, student satisfaction, and company feedback.

Notifications: Coordinators receive real-time notifications about key activities, such as new internship proposals, changes in internship statuses, and unresolved complaints. Alerts also remind coordinators about upcoming deadlines or approvals. Notifications are accessible through both the platform dashboard and emails.

2.3. User Characteristics

The actors of the application are the following:

Unregistered User: An individual who has not yet registered on the platform but is eligible to sign up or register as a Student, Company HR, or University Coordinator.

Student: A university student who has registered on the platform. Students can create profiles, upload CVs, search for internships, receive recommendations, apply for opportunities, and participate in selection processes.

Company HR: An organization representative registered on the platform to offer internships. Companies can post internship opportunities, search for student profiles, receive recommendations, and manage the selection process.

University Coordinator: A registered user affiliated with a university. University Coordinators monitor and approve internships and address complaints raised by students or companies.

2.4. Assumptions and Dependencies

2.4.1. Domain Assumptions

Domain Assumption ID	Description
D1	All users have an internet connection.
D2	All notifications arrive correctly and on time to all users.
D3	When a company publishes an internship, it is uploaded correctly.
D4	Each university coordinator has an institutional email.
D5	Students using the platform are actively enrolled in a university program.
D6	Companies registering on the platform are legitimate and capable of providing internships.
D7	Students input accurate and truthful information in their profiles and CVs.
D8	Companies input accurate and detailed descriptions of internships.
D9	Companies and students understand the terms and criteria used in matching.
D10	Students look for internships and update their profiles.
D11	The platform correctly identifies matches between students and companies.
D12	Companies and students submit truthful and constructive feedback.
D13	Students, businesses, and coordinators can use the system simultaneously without issues.
D14	Students, companies, and coordinators have the technical skills to navigate the platform.

Table 6: Domain Assumptions

2.4.2. Dependencies

The web application relies on all users having an active internet connection and an updated browser for surfing the web.

3. SPECIFIC REQUIREMENTS

3.1. External Interface Requirements

3.1.1. User Interfaces

The Students&Companies (S&C) platform is accessible through a web interface tailored for its three types of users: students, company HR, and university coordinators. Each role has distinct functionalities and interfaces, but some pages are shared among all users. The following sections describe the common user interfaces, followed by the specific interfaces for each user type.

Common User Interfaces

User Log-In: The log-in page is shared by all users. Each user enters their registered email and password. Upon clicking the “Login” button, the system validates the credentials and redirects the user to their role-specific dashboard.

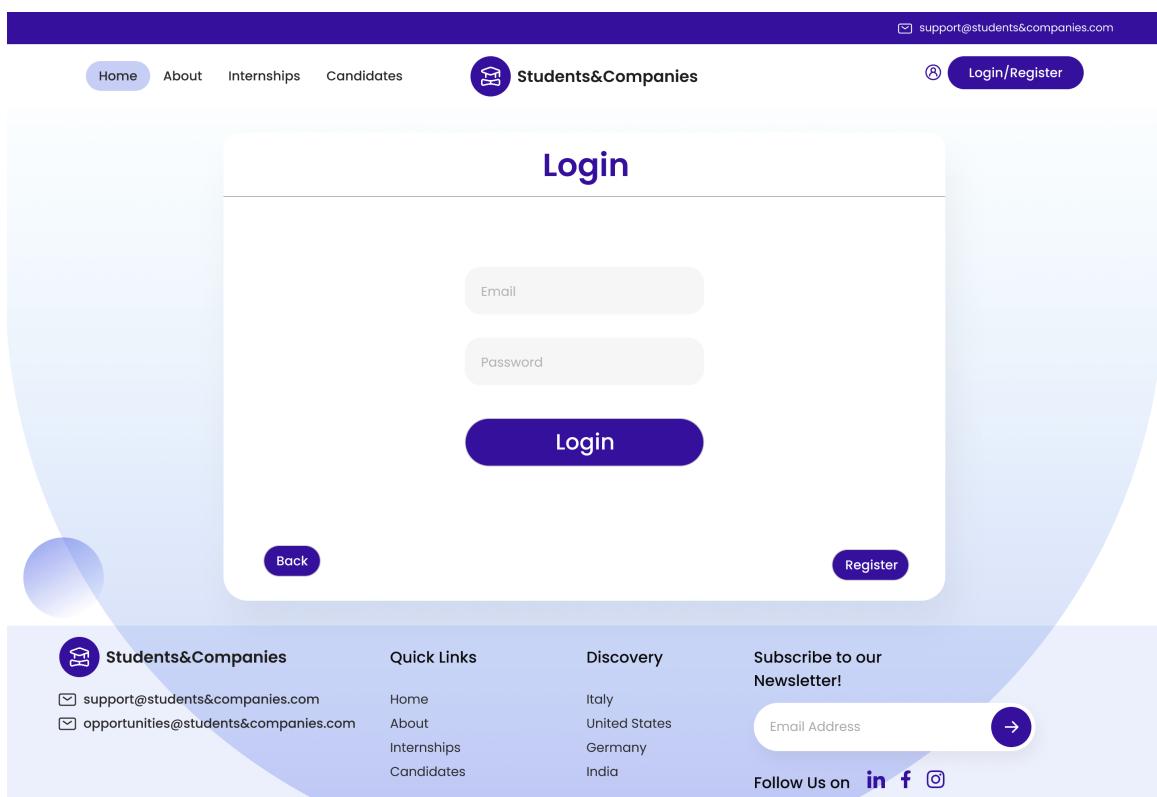


Figure 7: User Log-In

New User Sign-Up: This page allows all types of users to register on the platform.

- **Students:** Enter information such as name, surname, academic email, password, university, study field, skills, and upload a CV.

- **Company HR:** Enter name, surname, work email, password, and company name.
- **University Coordinator (UC):** Enter name, surname, work email, password, and university name.

After filling out the form, a verification email is sent to finalize the process.

The screenshot shows the 'Student Registration' page. At the top, there is a navigation bar with links for Home, About, Internships, Candidates, and a logo for 'Students&Companies'. On the right side of the navigation bar are icons for support (support@students&companies.com) and login/register. The main content area is titled 'Student Registration' and contains fields for Name, Surname, Academic Email, Password, University, Study Field, Add Skills, and Upload CV. Below these fields are two buttons: 'Back' and a large purple 'Register' button. At the bottom of the page, there is a footer with links for support and opportunities, quick links (Home, About, Internships, Candidates), discovery options (Italy, United States, Germany, India), a newsletter sign-up section, and social media links for LinkedIn, Facebook, and Instagram.

Figure 8: New User Sign-Up (1)

Company HR Registration

Name

Surname

Work Email

Password

Company

Register

Back

Students&Companies

support@students&companies.com

opportunities@students&companies.com

Quick Links

- [Home](#)
- [About](#)
- [Internships](#)
- [Candidates](#)

Discovery

- [Italy](#)
- [United States](#)
- [Germany](#)
- [India](#)

Subscribe to our Newsletter!

Email Address

Follow Us on

Figure 9: New User Sign-Up (2)

University Coordinator Registration

Name

Surname

Work Email

Password

University

Register

Back

Students&Companies

support@students&companies.com

opportunities@students&companies.com

Quick Links

- [Home](#)
- [About](#)
- [Internships](#)
- [Candidates](#)

Discovery

- [Italy](#)
- [United States](#)
- [Germany](#)
- [India](#)

Subscribe to our Newsletter!

Email Address

Follow Us on

Figure 10: New User Sign-Up (3)

3.1.2. Student-Specific User Interfaces

Student My account: The “My Account” page allows students to manage their profiles and activities on the platform. It includes sections for updating account settings, viewing their applications, tracking internships, and accessing the complaints section.

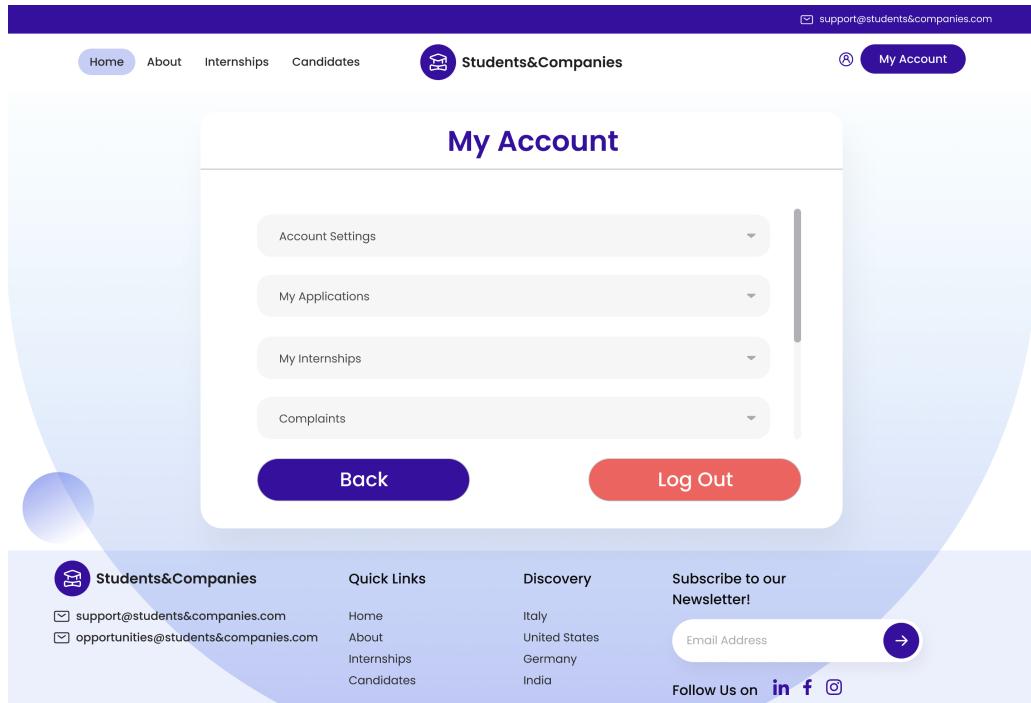


Figure 11: Student My Account

Internships Available Page: This interface displays a list of available internships with details like title, company, and location (e.g., “Data Science Intern at Hololimb, Milan”). Students can expand each entry for more information, such as duration and requirements. The search panel on the left allows filtering by parameters such as location, industry focus, and internship type. An Advanced Search option provides additional customization for refining the results.

The screenshot shows the 'Internships Available' page. At the top, there's a navigation bar with links for Home, About, Internship (which is highlighted in blue), Candidates, and a support email (support@students&companies.com). The main header is 'Internships Available'. On the left, there's a sidebar with filters: 'Milan, San Francisco, etc.', 'Select Industry Focus', 'Select Type', and an 'Advance Search' button. Below the sidebar is a large purple 'Search' button. The main content area lists several internships: 'Hololimb - Data Science Intern Position - Milan', 'Amazon - Junior data analyst - Legnano', 'Google - Data Engineer Intern - Legnano', 'Google - ML Engineer Intern - Legnano', and 'Hololimb - VR Developer Intern Position - Milan'. Each listing has a small downward arrow icon. At the bottom of the page, there's a footer with the 'Students&Companies' logo, contact info (support@students&companies.com, opportunities@students&companies.com), quick links (Home, About, Internships, Candidates), discovery links (Italy, United States, Germany, India), a newsletter sign-up form, and social media links for LinkedIn, Facebook, and Instagram.

Figure 12: Internships Available Page

My Applications Page: This page allows students to monitor the status of their internship applications. It displays a list of all internships to which the student has applied, with the following details: the name of the position, company name, and the status of the current progress of the application, such as “Waiting for results,” “Interview Scheduled,” etc.

Each application entry includes an expandable dropdown for additional information about the application or relevant actions.

The screenshot shows the 'My Applications' page. At the top, there is a navigation bar with links for Home, About, Internships, Candidates, and a logo for Students&Companies. On the right side of the navigation bar are links for support@students&companies.com and My Account. Below the navigation bar, the main content area is titled 'My Applications'. It lists three application entries, each with a dropdown menu: 1. Hololimb - Data Science Intern Position - Status: waiting for applications results. 2. Amazon - Junior data analyst - Status: interview scheduled. 3. Google - Data Engineer Intern - Status: on interviews. At the bottom of the page is a 'Back' button. The footer contains links for support and opportunities, quick links for Home, About, Internships, Candidates, Discovery links for Italy, United States, Germany, and India, a newsletter subscription form, and social media links for LinkedIn, Facebook, and Instagram.

Figure 13: My Applications Page

Application Details Page: This interface displays detailed information about a specific internship application selected from the My Applications list. The page provides key details such as the internship title, type (e.g., full-time), duration, salary range, and location, along with the current status of the application (e.g., “Waiting for application results”) or additional information. A Withdraw button allows the student to cancel their application.

The screenshot shows the 'Hololimb - Data Science Intern Position' application details. At the top, there's a blue header bar with the company logo and name 'Students&Companies'. Below it is a navigation bar with links for Home, About, Internships, Candidates, and a support email 'support@students&companies.com'. On the right is a 'My Account' button. The main content area has a light gray background. It displays the application status as 'waiting for applications results' in a blue box. To the left, there's a summary of the application: 'Data Science Intern Position', 'Full-time, March-May', 'Salary: \$20k-30k', and 'Milan, Italy'. Below this is a note: 'CV Uploaded'. To the right, there's a detailed description of the position: 'Exciting opportunity for a Data Science Intern at a leading VR/XR company! Collaborate on immersive projects, analyze data to enhance user experiences, and develop innovative solutions. Ideal for creative problem-solvers with a passion for data-driven insights and emerging technologies. Join us today!'. At the bottom of the main content area are two buttons: 'Back' (blue) and 'Withdraw' (red). The footer is white with a blue shadow. It contains the company logo and name again, along with contact emails: 'support@students&companies.com' and 'opportunities@students&companies.com'. It also lists 'Quick Links' (Home, About, Internships, Candidates) and 'Discovery' (Italy, United States, Germany, India). There's a 'Subscribe to our Newsletter!' section with an input field for 'Email Address' and a red '→' button. Finally, there's a 'Follow Us on' section with icons for LinkedIn (in), Facebook (f), and Instagram (i).

Figure 14: Application Details Page

My Internships Page: This page enables students to review all internships they are currently undertaking or have completed. For each internship, the interface provides key details, including the role title, company name, and the current status (e.g., “Started,” “In Progress,” “Completed”).

The screenshot shows the 'My Internships' page. At the top, there's a navigation bar with links for Home, About, Internships, Candidates, and a support email (support@students&companies.com). The main header is 'My Internships'. Below it, a dropdown menu shows 'Hololimb - Data Science Intern Position - Status: started'. A large blue button labeled 'Back' is centered. At the bottom, there's a footer with the company logo, contact emails (support@students&companies.com, opportunities@students&companies.com), quick links (Home, About, Internships, Candidates), discovery options (Italy, United States, Germany, India), a newsletter sign-up form, and social media links (LinkedIn, Facebook, Twitter).

Figure 15: My Internships Page

My Internship Details Page: This interface provides students with detailed information about a specific internship they are currently undertaking. The page displays the internship's title, position type, duration, salary range, and location, alongside the current status. The user can report a problem and the system will notify the UC responsible.

The screenshot shows a web application interface for managing internships. At the top, there is a dark blue header bar with the company logo 'Students&Companies' and navigation links for 'Home', 'About', 'Internships', 'Candidates', 'support@students&companies.com', and 'My Account'. Below the header, the main content area has a light blue background. It displays a job listing for a 'Data Science Intern Position' at 'Hololimb'. The listing includes details like 'Full-time, March-May', 'Salary: \$20k-30k', and 'Milan, Italy'. There is also a note indicating 'CV Uploaded'. To the right of the listing is a descriptive paragraph about the role. Below the listing are two buttons: 'Back' and 'Report'. At the bottom of the page, there is a footer section with the company logo, contact emails ('support@students&companies.com', 'opportunities@students&companies.com'), quick links ('Home', 'About', 'Internships', 'Candidates'), discovery options ('Italy', 'United States', 'Germany', 'India'), a newsletter sign-up form ('Subscribe to our Newsletter!', 'Email Address', 'Follow Us on' with icons for LinkedIn, Facebook, and Instagram), and social media links ('Follow Us on' with icons for LinkedIn, Facebook, and Instagram).

Figure 16: My Internship Details Page

3.1.3. Company HR-Specific User Interfaces

Company HR My Account: The “My Account” page allows Company HR to manage their profiles and activities on the platform. It includes sections for updating account settings, viewing their job offers, tracking internships, and accessing the complaints section.

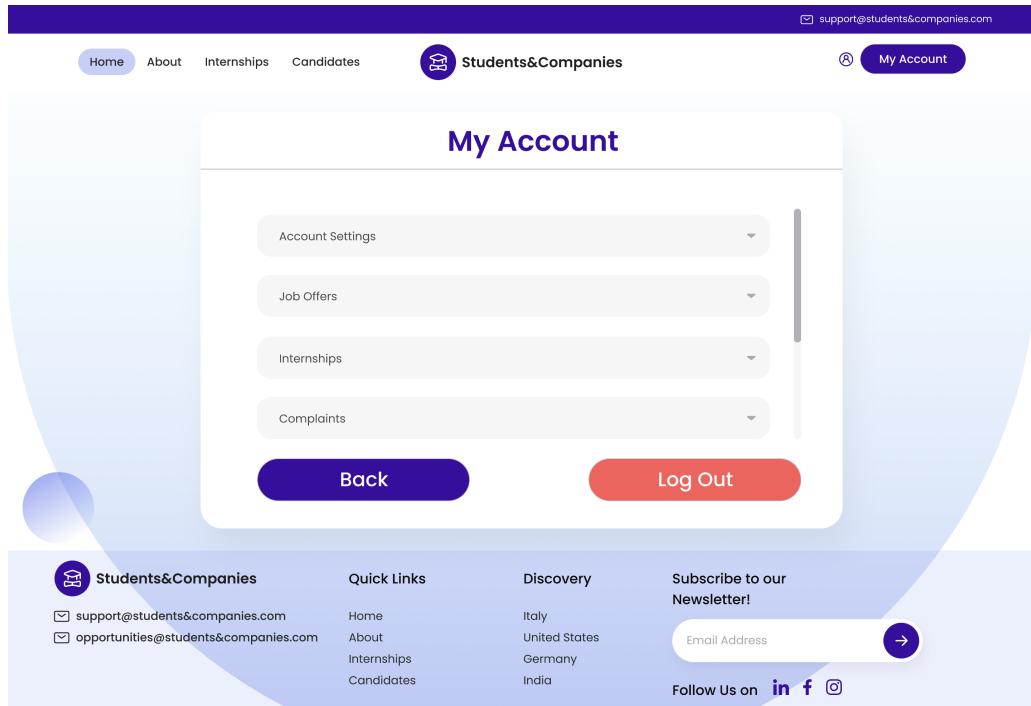


Figure 17: Company HR My Account

Job Offers Page: This interface provides an overview of all job offers created by the HR user. Each entry displays the position title, number of applicants, and scheduled interviews (if applicable). The user can expand each entry to view detailed information or manage candidates. There is a "New" button to create a new job offer.

The screenshot shows the 'Job Offers' section of the website. At the top, there is a navigation bar with links for Home, About, Internships, Candidates, and My Account. The main content area is titled 'Job Offers' and lists three job positions from 'Hololimb': 'Data Science Intern Position - Applicants: 198', 'Junior Data Engineer - Applicants: 35, Scheduled Interviews: 3', and 'Web Developer - Applicants: 3'. Below this is a 'Back' button and a prominent green 'New' button. The footer contains the company logo, contact information (support@students&companies.com, opportunities@students&companies.com), quick links (Home, About, Internships, Candidates), discovery options (Italy, United States, Germany, India), a newsletter sign-up form, and social media links for LinkedIn, Facebook, and Twitter.

Figure 18: Job Offers Page

Applicants List for Job Offer: This interface displays a detailed list of applicants for a specific job offer. The HR user can view the applicant names, their universities, and fields of study. By clicking on an applicant's name, the HR user can access their full application details, including their CV and additional information.

Figure 19: Applicants List for Job Offer

Applicant Details Page: This interface provides a detailed overview of an individual applicant's profile for a specific job offer. It displays the applicant's name, academic background, university, location, and degree level. Additionally, it includes a button to access the CV uploaded and a section for their optional cover letter or application message, highlighting their motivation and alignment with the job role.

The screenshot shows the 'Hololimb - Data Science Intern Position' page. At the top, there are navigation links for Home, About, Internships, Candidates, and a logo for Students&Companies. On the right, there are links for support@students&companies.com and My Account. The main content area displays the candidate's information: Name: Giulia - Surname: Ye, Computer Science Engineering [Master Degree] from Politecnico di Milano in Milan, Italy, and a CV uploaded. A cover letter message is present, and a 'Back' button is visible. The footer includes links for quick navigation, discovery in various countries, and newsletter subscription.

Figure 20: Applicant Details Page

Internships Page: This interface displays all internships currently managed by the company. Each entry shows the internship position, its current status (e.g., “Started,” “In Progress,” “Completed”), and the assigned intern’s name.

The screenshot shows the 'Internships' page of the Students&Companies website. At the top, there is a navigation bar with links for Home, About, Internships, Candidates, and a support email address (support@students&companies.com). The main title 'Internships' is centered above a list of internships. A specific entry for 'Hololimb - Data Science Intern Position ~ Status: started ~ Intern: Ye Giulia' is highlighted. Below the list is a 'Back' button. At the bottom, there is a footer section with the company logo, contact emails (support@students&companies.com, opportunities@students&companies.com), quick links (Home, About, Internships, Candidates), discovery options (Italy, United States, Germany, India), a newsletter sign-up form, and social media links (Follow Us on LinkedIn, Facebook, Instagram).

Figure 21: Internships Page

Intern Details Page: This interface provides the HR user with a comprehensive overview of the intern currently engaged in a specific internship position. It displays the intern's name, academic background, university details, and degree level. Additionally, it shows the internship's start and expected finish dates, and the CV is available for review.

The screenshot shows the 'Hololimb - Data Science Intern Position' page. At the top, there are navigation links: Home, About, Internships, Candidates, support@students&companies.com, and My Account. Below the header, the intern's name is listed as 'Name: Giulia - Surname: Ye' with a status of 'Started'. To the right, there is a search icon. Underneath, the intern's details are displayed: 'Computer Science Engineering [Master Degree]', 'Politecnico di Milano', 'Milan, Italy', 'Start Date: 17 December 2024', 'Expected Finish Date: 16 May 2024', and a 'CV Uploaded' button. A large blue 'Back' button is centered at the bottom of the main content area. At the very bottom, there is a footer with links to 'Students&Companies', email addresses (support@students&companies.com, opportunities@students&companies.com), quick links (Home, About, Internships, Candidates), discovery options (Italy, United States, Germany, India), a newsletter sign-up form, social media links (Follow Us on LinkedIn, Facebook, Instagram), and a copyright notice (© 2024 Students&Companies).

Figure 22: Intern Details Page

3.2. University Coordinator-Specific User Interfaces

Complaints Overview Page: This interface allows the University Coordinator to view and manage complaints related to internships. Each complaint is listed with the student's name, associated company, and the current resolution status (e.g., Resolved or Unresolved). The UC can click on each complaint to view detailed information or take further action. There are also chats available to communicate directly with single or multiple parties at once.

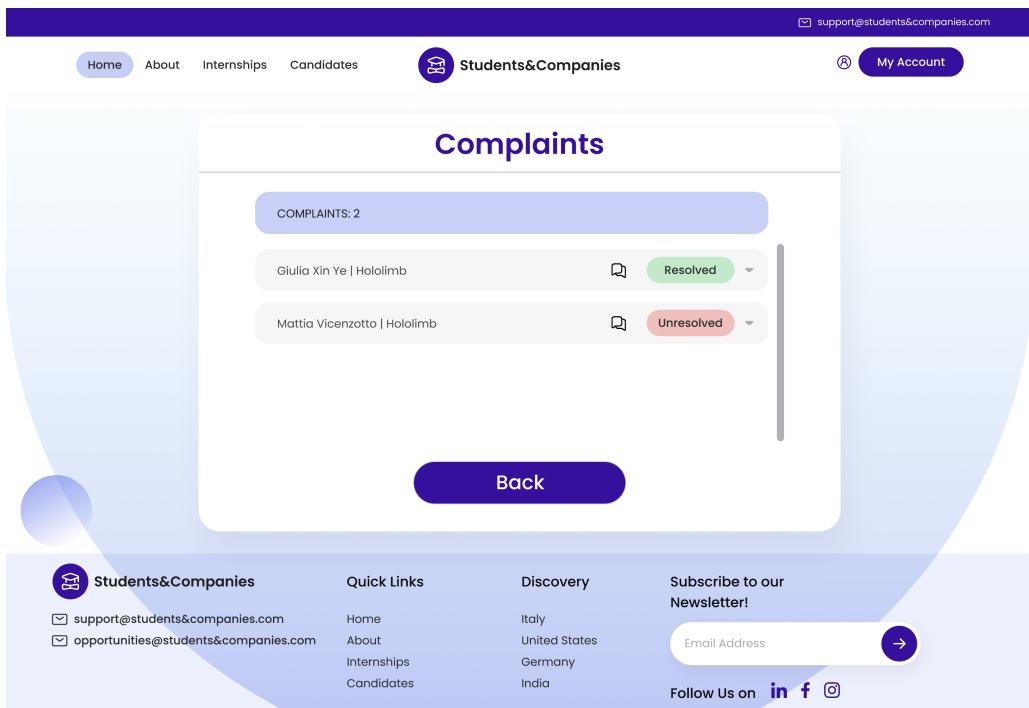


Figure 23: Complaints Overview Page

3.2.1. Hardware Interfaces

All users of the S&C platform, including students, company HR representatives, and university coordinators, require an internet-enabled digital device. The platform is accessible via desktop computers, laptops, tablets, or mobile devices through a standard web browser. The system does not rely on specialized or dedicated hardware, ensuring broad accessibility and usability across various devices.

3.2.2. Software Interfaces

Users can access the S&C platform via any modern web browser, without the need for additional software installation. The platform uses the following software interfaces to provide its functionalities:

- **Recommendation System APIs:** These APIs support advanced matching between students and internships by analyzing CVs, internship descriptions, and user preferences. They employ algorithms such as keyword searching and statistical analyses to generate

personalized recommendations.

- **Notification System APIs:** The platform uses notification services to inform students about new matching opportunities, updates on their applications, and interview schedules. Similarly, companies receive notifications about new candidate profiles and application updates.
- **Data Analytics APIs:** The platform integrates analytics tools to process internship data, user activity, and feedback, generating actionable insights for refining recommendations and enhancing platform usability.
- **Third-Party Verification APIs:** These APIs verify institutional or email addresses during user registration, ensuring the authenticity of university coordinators and companies.

3.2.3. Communication Interfaces

The S&C platform requires a stable internet connection to ensure proper functionality and up-to-date information for all users. The platform is accessible via web browsers for students, company HRs, and university coordinators, utilizing standard HTTP/HTTPS protocols for communication. HTTPS is used to secure all data transmission, including personal details, CVs, internship descriptions, and feedback.

The system also integrates APIs for advanced functionalities, such as recommendation generation, notifications, and authentication. These APIs communicate using RESTful protocols with JSON as the data format for requests and responses.

Details of all communication protocols and interfaces will be further elaborated in the DD (Design Document).

3.3. Functional Requirements

3.3.1. List of Requirements

Students' Requirements

Requirements	Description
R1.1	The system allows students to register by filling out a registration form and verifying their email address.
R1.2	The system allows students to log in using their email and password.
R1.3	The system allows students to log out of their accounts.
R1.4	The system allows students to edit their personal profiles, including updating personal information, skills, and uploading a CV.
R1.5	The system allows students to browse available internships, filtering by criteria such as location, industry, role, compensation, and internship type.

R1.6	The system provides personalized recommendations for internships based on the student's profile, including skills, experiences, and preferences.
R1.7	The system notifies students when internships matching their preferences or skills become available.
R1.8	The system allows students to view detailed descriptions of internships, including required qualifications if any, type, location, salary.
R1.9	The system allows students to apply for internships by submitting their CVs and optional cover letters.
R1.10	The system notifies students upon successful submission of their internship applications.
R1.11	The system allows students to track the status of their internship applications, including updates such as waiting for application results, interview invitations, or rejection.
R1.12	The system facilitates communication between students and companies during the selection process, such as scheduling interviews or responding to queries.
R1.13	The system allows students to monitor the status of ongoing internships, including updates from the company or university.
R1.14	The system allows students to submit feedback on completed internships, rating their experience and suggesting improvements.
R1.15	The system uses feedback submitted by students to refine the recommendation process and improve future matches.
R1.16	The system allows students to file complaints about internships through a structured form, specifying details like the issue and parties involved.
R1.17	The system notifies the appropriate university coordinator when a student submits a complaint related to their internship.
R1.18	The system provides suggestions to students for improving their CVs, such as aligning content with industry standards or highlighting relevant experiences.
R1.19	The system allows students to view a history of their previous applications and internships, including feedback and outcomes.

Table 7: Students' Functional Requirements

Company HR's Requirements

Requirements	Description
R2.1	The system allows Company HR to register by filling out a registration form and verifying their email address.
R2.2	The system allows Company HR to log in using their email and password.
R2.3	The system allows Company HR to log out of their accounts.

R2.4	The system allows Company HR to manage their profiles, including updating company information and adding contact details.
R2.5	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.
R2.6	The system allows Company HR to edit their internship listings.
R2.7	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).
R2.8	The system notifies Company HR when new student profiles match their internship requirements.
R2.9	The system allows Company HR to browse and search for student profiles using filters such as education, location, and skills.
R2.10	The system allows Company HR to view detailed student profiles, including uploaded CVs and other relevant information.
R2.11	The system prioritizes recommended candidates based on their fit with the internship requirements.
R2.12	The system allows Company HR to schedule and manage interviews for further evaluation.
R2.13	The system facilitates communication between Company HR and students, such as scheduling interviews or requesting additional information.
R2.14	The system allows Company HR to track the status of applications for their internship postings (e.g., under review, shortlisted, or rejected).
R2.15	The system allows Company HR to manage ongoing internships, including providing progress updates and addressing any issues reported by students or university coordinators.
R2.16	The system allows Company HR to submit feedback on completed internships, rating the student's performance and suggesting improvements.
R2.17	The system uses feedback provided by Company HR to refine the recommendation process and improve future student matches.
R2.18	The system notifies Company HR of critical updates, such as new applications, upcoming interview schedules, or changes in internship status.
R2.19	The system provides analytics and reports for Company HR, such as application statistics, internship outcomes, and feedback trends.

Table 8: Company HR Functional Requirements

University Coordinator's Requirements

Requirements	Description
R3.1	The system allows University Coordinators to register by filling out a registration form and verifying their email address.
R3.2	The system allows University Coordinators to log in using their email and password.
R3.3	The system allows University Coordinators to log out of their accounts.
R3.4	The system allows University Coordinators to manage their profiles, including updating their department, title, and contact details.
R3.5	The system provides University Coordinators with a dashboard to view and monitor all internships involving students under their supervision.
R3.6	The system allows University Coordinators to review and approve or reject internship proposals submitted by students or companies.
R3.7	The system notifies University Coordinators of new internship proposals that require their review and approval.
R3.8	The system allows University Coordinators to view detailed information about each internship, including project descriptions, timelines, and required qualifications.
R3.9	The system provides tools for University Coordinators to monitor the progress of ongoing internships, including reviewing updates from students and companies.
R3.10	The system allows University Coordinators to view and respond to complaints filed by students or companies with a built-in communication channel.
R3.11	The system allows University Coordinators to terminate an internship if a complaint cannot be resolved.
R3.12	The system notifies University Coordinators of unresolved complaints and any changes in internship statuses.
R3.13	The system allows University Coordinators to access detailed reports and analytics on internship outcomes, including student satisfaction and feedback trends.
R3.14	The system allows University Coordinators to track the history of all internships involving students from their university.
R3.15	The system provides University Coordinators with notifications about deadlines for internship approvals and other critical activities.

Table 9: University Coordinator Functional Requirements

3.3.2. Mapping Requirements and Domain Assumptions on Goals

G1: Enable students to create and manage their accounts, including uploading and updating CVs, saving internships, and tracking application history.

Requirements	Description
R1.1	The system allows students to register by filling out a registration form and verifying their email address.
R1.2	The system allows students to log in using their email and password.
R1.3	The system allows students to log out of their accounts.
R1.4	The system allows students to edit their personal profiles, including updating personal information, skills, and uploading a CV.
R1.19	The system allows students to view a history of their previous applications and internships, including feedback and outcomes.
Domain Assumptions	
D1	All users have an internet connection.
D2	All notifications arrive correctly and on time to all users.
D14	Students, companies, and coordinators have the technical skills to navigate the platform.

Table 10: Mapping for Goal G1

G2: Allow students to search for internships using advanced filters and access detailed descriptions of the opportunities.

Requirements	Description
R1.5	The system allows students to browse available internships, filtering by criteria such as location, industry, role, compensation, and internship type.
R1.8	The system allows students to view detailed descriptions of internships, including required qualifications, type, location, and salary.
Domain Assumptions	
D1	All users have an internet connection.
D10	Students look for internships and update their profiles.

Table 11: Mapping for Goal G2

G3: Notify students about internship opportunities that match their profiles.

Requirements	Description
R1.6	The system provides personalized recommendations for internships based on the student's profile.
R1.7	The system notifies students when internships matching their preferences or skills become available.
Domain Assumptions	
D2	All notifications arrive correctly and on time to all users.
D11	The platform correctly identifies matches between students and companies.

Table 12: Mapping for Goal G3

G4: Provide students with tools to enhance their CVs.

Requirements	Description
R1.18	The system provides suggestions to students for improving their CVs.
Domain Assumptions	
D7	Students input accurate and truthful information in their profiles and CVs.

Table 13: Mapping for Goal G4

G5: Enable students to monitor applications and report issues.

Requirements	Description
R1.11	The system allows students to track the status of their internship applications.
R1.13	The system allows students to monitor the status of ongoing internships.
R1.14	The system allows students to submit feedback on completed internships.
R1.16	The system allows students to file complaints about internships.
R1.17	The system notifies the appropriate university coordinator when a student submits a complaint.
Domain Assumptions	
D2	All notifications arrive correctly and on time to all users.

D5	Students using the platform are actively enrolled in a university program.
D12	Companies and students submit truthful and constructive feedback.

Table 14: Mapping for Goal G5

G6: Enable companies to create and manage accounts for posting internships, reviewing applications, and accessing student profiles.

Requirements	Description
R2.1	The system allows Company HR to register by filling out a registration form and verifying their email address.
R2.2	The system allows Company HR to log in using their email and password.
R2.3	The system allows Company HR to log out of their accounts.
R2.4	The system allows Company HR to manage their profiles, including updating company information, uploading a logo, and adding contact details.
Domain Assumptions	
D6	Companies registering on the platform are legitimate and capable of providing internships.

Table 15: Mapping for Goal G6

G7: Allow companies to advertise internships with comprehensive project descriptions, required qualifications, and details on terms (e.g., compensation, mentorship opportunities, and technologies used).

Requirements	Description
R2.5	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.
R2.6	The system allows Company HR to edit their internship listings.
Domain Assumptions	
D3	When a company publishes an internship, it is uploaded correctly.
D8	Companies input accurate and detailed descriptions of internships.

Table 16: Mapping for Goal G7

G8: Provide companies with tools to browse and filter student CVs, access relevant profiles, and receive notifications about candidates who meet their requirements.

Requirements	Description
R2.8	The system notifies Company HR when new student profiles match their internship requirements.
R2.9	The system allows Company HR to browse and search for student profiles using filters such as education, location, and skills.
R2.10	The system allows Company HR to view detailed student profiles, including uploaded CVs and other relevant information.
Domain Assumptions	
D2	All notifications arrive correctly and on time to all users.
D11	The platform correctly identifies matches between students and companies.

Table 17: Mapping for Goal G8

G9: Offer companies suggestions to optimize their internship postings, including recommendations on language, structure, and benefits to attract the best-suited candidates.

Requirements	Description
R2.7	The system provides suggestions to Company HR on how to optimize their internship postings to attract suitable candidates.
Domain Assumptions	
D9	Companies and students understand the terms and criteria used in matching.

Table 18: Mapping for Goal G9

G10: Notify companies when new student profiles align with their internship needs.

Requirements	Description
R2.8	The system notifies Company HR when new student profiles match their internship requirements.
Domain Assumptions	
D2	All notifications arrive correctly and on time to all users.

Table 19: Mapping for Goal G10

G11: Allow university coordinators to create and manage accounts using institutional email addresses.

Requirements	Description
R3.1	The system allows University Coordinators to register by filling out a registration form and verifying their email address.
R3.2	The system allows University Coordinators to log in using their email and password.
R3.3	The system allows University Coordinators to log out of their accounts.
Domain Assumptions	
D4	Each university coordinator has an institutional email.

Table 20: Mapping for Goal G11

G12: Enable university coordinators to approve or reject internship proposals submitted by students or companies.

Requirements	Description
R3.6	The system allows University Coordinators to review and approve or reject internship proposals submitted by students or companies.
R3.7	The system notifies University Coordinators of new internship proposals that require their review and approval.
Domain Assumptions	
D3	When a company publishes an internship, it is uploaded correctly.

Table 21: Mapping for Goal G12

G13: Provide university coordinators with access to detailed information on each internship, including descriptions, student progress, and contact details for companies, to maintain an overview of all activities.

Requirements	Description
R3.5	The system provides University Coordinators with a dashboard to view and monitor all internships involving students under their supervision.
R3.8	The system allows University Coordinators to view detailed information about each internship, including project descriptions, timelines, and required qualifications.
Domain Assumptions	
D13	Students, businesses, and coordinators can use the system simultaneously without issues.

Table 22: Mapping for Goal G13

G14: Offer tools for university coordinators to handle complaints and intervene when necessary, including direct communication channels with students and companies.

Requirements	Description
R3.10	The system allows University Coordinators to view and respond to complaints filed by students or companies with a built-in communication channel.
R3.11	The system allows University Coordinators to terminate an internship if a complaint cannot be resolved.
Domain Assumptions	
D2	All notifications arrive correctly and on time to all users.

Table 23: Mapping for Goal G14

G15: Enable university coordinators to access reports and analytics on internship outcomes to improve collaboration and oversight.

Requirements	Description
R3.13	The system allows University Coordinators to access detailed reports and analytics on internship outcomes, including student satisfaction and feedback trends.
R3.14	The system allows University Coordinators to track the history of all internships involving students from their university.
Domain Assumptions	
D12	Companies and students submit truthful and constructive feedback.

Table 24: Mapping for Goal G15

3.3.3. Use Case Diagrams

Student's use case diagram

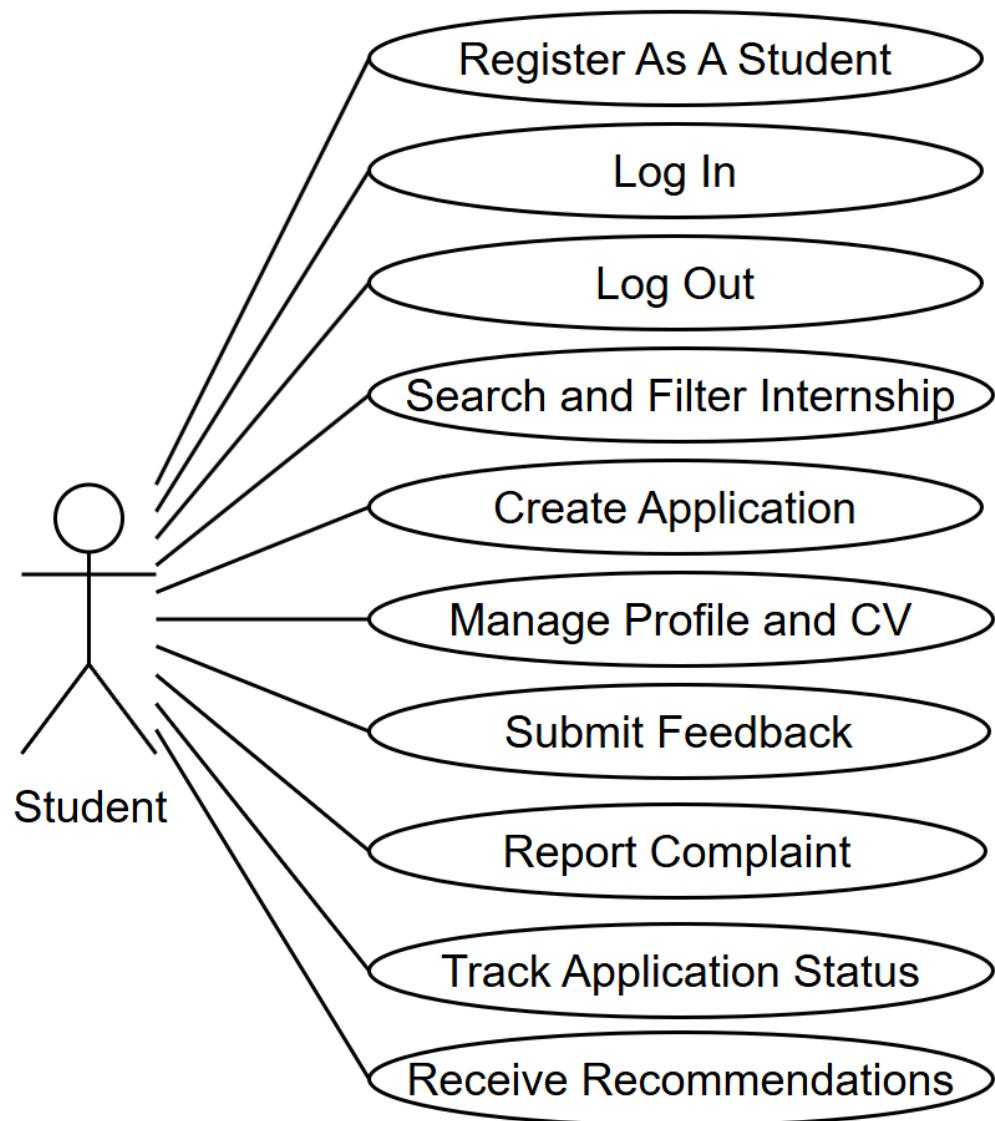


Figure 24: Student's use case diagram

Company's use case diagram

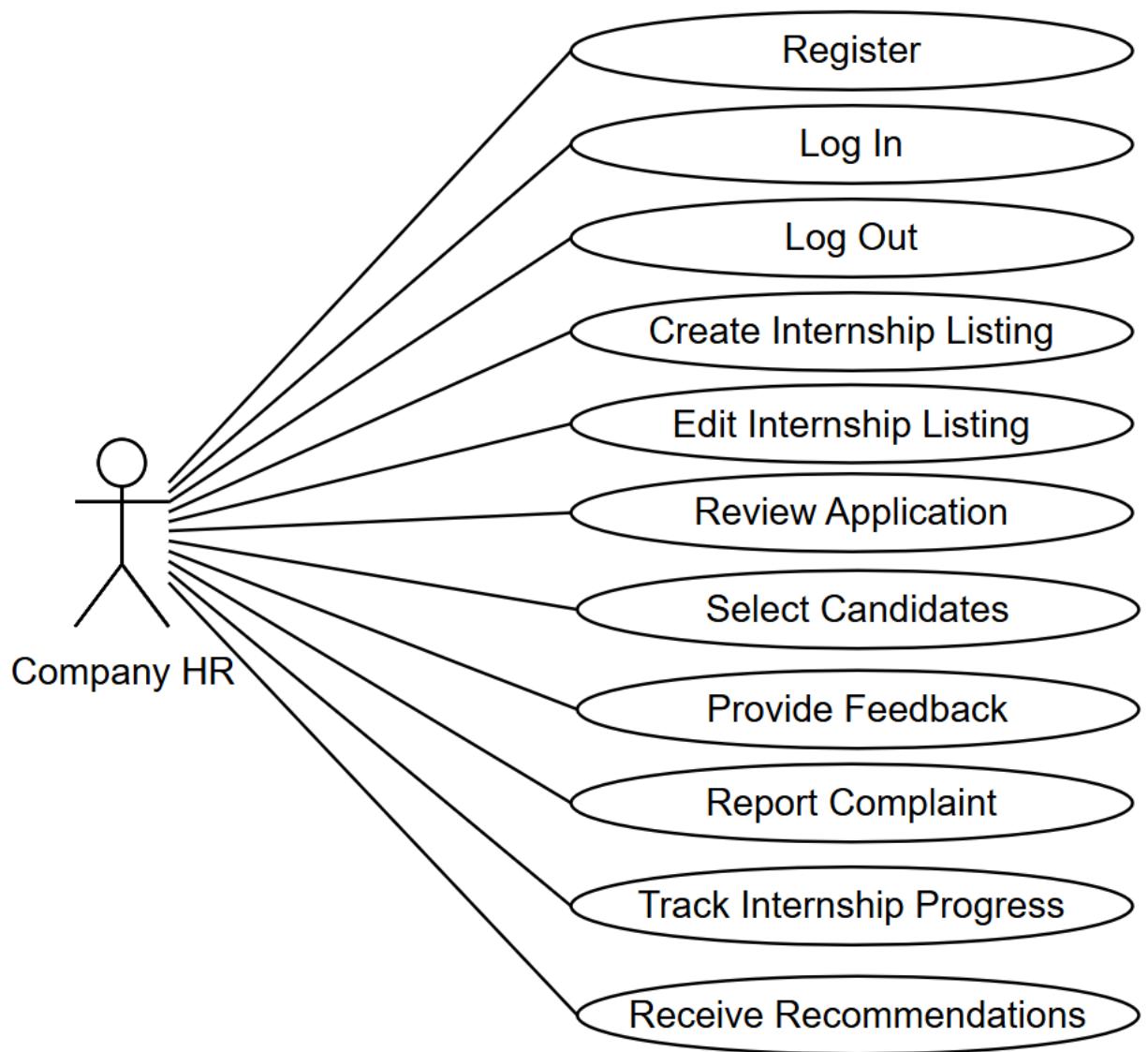


Figure 25: Company's use case diagram

UC's use case diagram

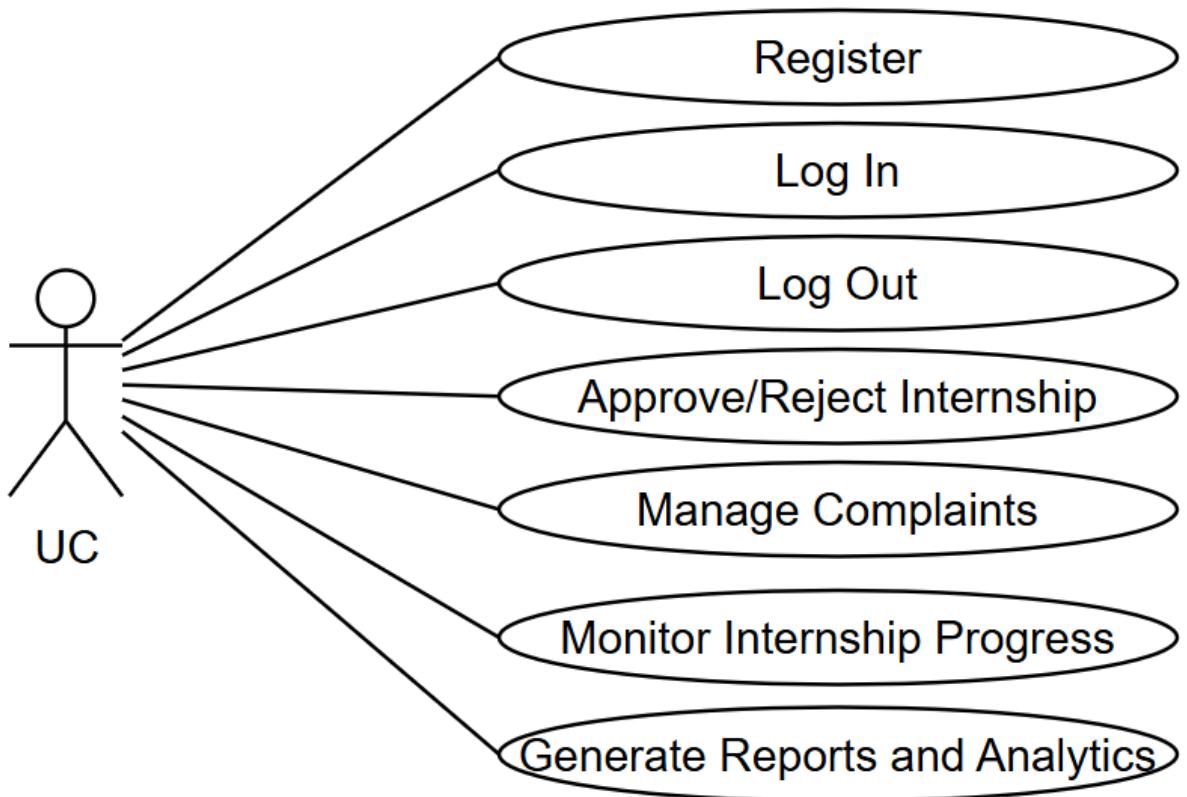


Figure 26: UC's use case diagram

3.3.4. Student's Use Case Analysis

1. Register as a Student

- **Name:** Register as a Student
- **Actor:** Unregistered Student
- **Entry Conditions:** The student is not registered on the platform and navigates to the registration page.
- **Input:** Name, surname, email, password, CV, university, field of study, skills.
- **Event Flow:**
 - The student selects the “Register” option.
 - The system displays the registration form.
 - The student fills out the required fields.
 - The system validates the input.
 - A confirmation email is sent to the student’s provided email.
 - The student clicks the confirmation link to complete the registration.
- **Exit Conditions:** The student account is successfully created and activated.
- **Exceptions:**
 - The email is already registered.
 - Invalid or incomplete data is provided.
 - The confirmation link is not accessed within a specific timeframe.

2. Log In

- **Name:** Log In
- **Actor:** Registered Student
- **Entry Conditions:** The student has already registered and navigates to the login page.
- **Input:** Email and password.
- **Event Flow:**
 - The student enters their email and password.

- The system validates the credentials.
 - Upon successful validation, the student is redirected to their dashboard.
- **Exit Conditions:** The student successfully accesses the platform.
 - **Exceptions:**
 - Incorrect email or password.
 - The account has not been activated.

3. Log Out

- **Name:** Log Out
- **Actor:** Logged-in Student
- **Entry Conditions:** The student is logged into the platform.
- **Input:** None.
- **Event Flow:**
 - The student selects the “My Account” option from the homepage.
 - The student scrolls to the bottom of the page and selects the “Log Out” option.
 - The system terminates the session.
 - The student is redirected to the login page or homepage.
- **Exit Conditions:** The student is logged out of the platform.
- **Exceptions:** None.

4. Search and Filter Internship

- **Name:** Search and Filter Internship
- **Actor:** Logged-in Student
- **Entry Conditions:** The student is authenticated and accesses the search page.
- **Input:** Search filters selected through the interface (e.g., location, skills, industry, or salary).
- **Event Flow:**
 - The student navigates to the internship search section.

- Enters search filters or keywords.
 - The system processes the input and retrieves matching internships.
 - The student reviews the results.
- **Exit Conditions:** The student identifies internships of interest.
 - **Exceptions:**
 - No internships match the selected criteria.

5. Create Application

- **Name:** Create Internship Application
- **Actor:** Logged-in Student
- **Entry Conditions:** The student has identified an internship of interest.
- **Input:** CV and optional cover letter.
- **Event Flow:**
 - The student selects an internship and clicks “Apply”.
 - Uploads a CV or selects an existing one.
 - Optionally, adds a cover letter.
 - Confirms and submits the application.
 - The system records the application and notifies the company.
- **Exit Conditions:** The internship application is submitted successfully.
- **Exceptions:**
 - The internship is no longer available.
 - The CV upload fails.

6. Manage Profile and CV

- **Name:** Manage Profile and CV
- **Actor:** Logged-in Student
- **Entry Conditions:** The student is logged in and accesses their profile.

- **Input:** Updated personal data or CV file.

- **Event Flow:**

- The student navigates to the “Manage Profile” section.
- Updates personal details or uploads a new CV.
- Saves the changes.
- The system validates and updates the profile information.

- **Exit Conditions:** The profile and CV are successfully updated.

- **Exceptions:**

- Invalid CV file format.
- Incomplete profile data.

7. Submit Feedback

- **Name:** Submit Feedback

- **Actor:** Logged-in Student

- **Entry Conditions:**

The internship is completed.

- **Input:**

Ratings and comments.

- **Event Flow:**

- The system prompts the student to provide feedback.
- The student navigates to the feedback section.
- Enters ratings and comments about the internship experience.
- The system records the feedback and updates the internship records.

- **Exit Conditions:**

The feedback is successfully submitted.

- **Exceptions:**

- Feedback submission timeout.
- Incomplete feedback data.

8. Report Complaint

- **Name:** Report Complaint

- **Actor:** Logged-in Student

- **Entry Conditions:**

The student encounters an issue during the internship.

- **Input:**

Description of the complaint.

- **Event Flow:**

- The student accesses the complaints section.
- Describes the issue and submits the complaint.
- The system forwards the complaint to the UC for resolution.

- **Exit Conditions:**

The complaint is successfully submitted to the UC.

- **Exceptions:**

- The description is incomplete or invalid.

9. Track Application Status

- **Name:** Track Application Status

- **Actor:** Logged-in Student

- **Entry Conditions:**

The student has submitted one or more applications.

- **Input:**

None.

- **Event Flow:**

- The student navigates to their application dashboard.
- Clicking on the application, the system displays the status of each application (e.g., "Under Review," "Shortlisted").
- The student views details or updates related to their applications.

- **Exit Conditions:**

The student is informed of the application statuses.

- **Exceptions:**
 - No applications submitted.

10. Receive Recommendations

- **Name:** Receive Internship Recommendations
- **Actors:** Logged-in CompanyHR, Student
- **Entry Conditions:**
 - The CompanyHR has posted a new internship opportunity.
 - Students have completed their profiles and uploaded their CVs.
- **Input:**
 - Internship details posted by the CompanyHR.
- **Event Flow:**
 - The system analyzes student profiles, CVs, and preferences to find matches for the newly posted internship.
 - If matches are found: The system notifies each matched student via in-app notifications and/or email.
 - If no matches are found: The system informs the CompanyHR that no matches are available for the internship.
- **Exit Conditions:**
 - Matched students are notified about the new internship opportunity.
 - The CompanyHR is informed about the result of the matching process.
- **Exceptions:**
 - No matching students are found, and no notifications are sent to students.

3.3.5. Company's Use Case Analysis

1. Register as a Company HR

- **Name:** Register as a Company HR
- **Actor:** Unregistered Company HR
- **Entry Conditions:**

The company representative is not yet registered on the platform.

- **Input:**

Name, surname, company name, email, password, and field of expertise.

- **Event Flow:**

- The company HR selects the "Register" option.
- Fills in the required fields in the registration form.
- The system validates the provided information.
- A confirmation email is sent to the provided email address.
- The HR clicks the confirmation link to complete the registration process.

- **Exit Conditions:**

The HR account is successfully created and activated.

- **Exceptions:**

- Email already registered.
- Missing or invalid information.
- Confirmation link not accessed within the specified timeframe.

2. Log In

- **Name:** Log In as a Company HR

- **Actor:** Registered Company HR

- **Entry Conditions:**

The HR is registered on the platform and navigates to the login page.

- **Input:**

Email and password.

- **Event Flow:**

- The HR enters their email and password on the login page.
- The system validates the credentials.
- Upon successful validation, the HR is redirected to the company dashboard.

- **Exit Conditions:**

The HR successfully accesses their dashboard.

- **Exceptions:**

- Incorrect credentials.
- Account not activated.

3. Log Out

- **Name:** Log Out

- **Actor:** Logged-in Company HR

- **Entry Conditions:**

The HR is logged into the platform.

- **Input:**

None.

- **Event Flow:**

- The HR selects the "My Account" option from the homepage.
- The HR scrolls to the bottom of the page and selects the "Log Out" option.
- The system terminates the session and redirects to the login page.

- **Exit Conditions:**

The HR is logged out of the platform.

- **Exceptions:**

None.

4. Create Internship Listing

- **Name:** Create Internship Listing

- **Actor:** Logged-in Company HR

- **Entry Conditions:**

The company wants to publish a new internship.

- **Input:**

Internship title, description, required skills (optional), location, salary, duration, and other details.

- **Event Flow:**

- The HR navigates to the "Create Internship" section.
- Fills in the required details in the form.

- The system validates the information.
 - The internship listing is published and becomes visible to students.
- **Exit Conditions:**
The internship is successfully published on the platform.
 - **Exceptions:**
 - Missing or invalid data.
 - Validation errors.

5. Edit Internship Listing

- **Name:** Edit Internship Listing
- **Actor:** Logged-in Company HR
- **Entry Conditions:**
The company has an existing internship listing that requires updates.
- **Input:**
Updated details such as title, description, or requirements.
- **Event Flow:**
 - The HR navigates to the list of existing internship listings.
 - Selects the internship to edit.
 - Updates the necessary fields.
 - The system validates the changes and saves the updates.
- **Exit Conditions:**
The internship listing is updated successfully.
- **Exceptions:**
 - Invalid or incomplete data.
 - Errors during the update process.

6. Review Application

- **Name:** Review Internship Applications
- **Actor:** Logged-in Company HR

- **Entry Conditions:**

At least one application has been received for a published internship.

- **Input:**

None.

- **Event Flow:**

- The HR navigates to the applications section for a specific internship.
- Views the list of applicants along with their CVs and optional cover letters.
- Shortlists, rejects, or keeps applications under review.

- **Exit Conditions:**

Applications are reviewed and updated accordingly.

- **Exceptions:**

- No applications have been received.

7. Select Candidates

- **Name:** Select Candidates

- **Actor:** Logged-in Company HR

- **Entry Conditions:**

At least one application has been reviewed, and the HR has identified candidates for further consideration.

- **Input:**

Selection of candidate(s) from the list and decision (send notification, schedule an interview, or update application status).

- **Event Flow:**

- The HR accesses the reviewed applications in the dashboard.
- Selects one or more candidates from the list.
- Sends a notification or interview invitation to the selected candidate(s).
- Updates the application status to "Shortlisted" or other appropriate status.

- **Exit Conditions:**

The selected candidate(s) are notified, and their application statuses are updated in the system.

- **Exceptions:**

- Candidate does not respond: The candidate fails to respond to the invitation within the specified timeframe.
- Candidate declines the invitation: The candidate explicitly communicates their disinterest in proceeding with the application process.

8. Provide Feedback

- **Name:** Provide Feedback

- **Actor:** Logged-in Company HR

- **Entry Conditions:**

The internship has been completed, and feedback is required.

- **Input:**

Ratings and comments regarding the intern's performance.

- **Event Flow:**

- The HR navigates to the feedback section for completed internships.
- Completes the feedback form with ratings and comments.
- The system records the feedback and makes it visible to the UC or intern.

- **Exit Conditions:**

Feedback is successfully recorded and stored in the system.

- **Exceptions:**

- Feedback form submission fails or times out.

9. Report Complaint

- **Name:** Report Complaint

- **Actor:** Logged-in Company HR

- **Entry Conditions:**

The company has identified an issue during the internship process.

- **Input:**

Complaint details.

- **Event Flow:**

- The HR accesses the "Report Complaint" section.

- Describes the issue and submits the complaint.
 - The system forwards the complaint to the University Coordinator.
- **Exit Conditions:**
The complaint is successfully submitted for review.
 - **Exceptions:**
 - Insufficient or invalid complaint details.

10. Track Internship Progress

- **Name:** Track Internship Progress
- **Actor:** Logged-in Company HR
- **Entry Conditions:**
An internship is active, and the HR wants to monitor its progress.
- **Input:**
None.
- **Event Flow:**
 - The HR navigates to the "Internship Progress" section.
 - Views progress reports or updates submitted by the intern or UC.
 - Takes action or provides feedback if necessary.
- **Exit Conditions:**
The HR is informed about the internship's current status.
- **Exceptions:**
 - No updates or reports are available.

11. Receive Recommendations

- **Name:** Receive Candidate Recommendations
- **Actors:** Student, Company HR
- **Entry Conditions:**
 - The student has updated their profile, including their CV and preferences.
 - The company has published at least one internship listing.

- **Input:**

- Student profile updates.

- **Event Flow:**

- The student updates their profile on the platform.
 - The platform analyzes the student's updated profile and preferences against published internship listings.
 - If matches are found: For each matching internship, the platform notifies the Company HR about the matching candidate via in-app notifications or email.
 - If no matches are found: The platform notifies the student that no matches are currently available.

- **Exit Conditions:**

- The Company HR is notified about the matching candidates for their internships.
 - The student is informed about the status of potential matches.

- **Exceptions:**

- No internships match the student's updated profile, and no notifications are sent to the Company HR.

3.3.6. University Coordinator's Use Case Analysis

1. Register as a UC

- **Name:** Register as a UC

- **Actor:** Unregistered University Coordinator

- **Entry Conditions:**

The UC is not yet registered on the platform.

- **Input:**

Name, surname, institutional email, and password.

- **Event Flow:**

- The UC selects the "Register" option.
 - Completes the registration form with the required fields.

- The system validates the input.
 - A confirmation email is sent to the institutional email address.
 - The UC clicks the confirmation link to complete the registration process.
- **Exit Conditions:**
The UC account is successfully created and activated.
 - **Exceptions:**
 - The email is already registered.
 - Missing or invalid information.
 - Confirmation link not accessed within the specified timeframe.

2. Log In

- **Name:** Log In as a UC
- **Actor:** Registered University Coordinator
- **Entry Conditions:**
The UC is registered on the platform and navigates to the login page.
- **Input:**
Email and password.
- **Event Flow:**
 - The UC enters their email and password on the login page.
 - The system validates the credentials.
 - Upon successful validation, the UC is redirected to their dashboard.
- **Exit Conditions:**
The UC successfully accesses the platform.
- **Exceptions:**
 - Incorrect email or password.
 - The account is not activated.

3. Log Out

- **Name:** Log Out

- **Actor:** Logged-in UC
- **Entry Conditions:**
The UC is logged into the platform.
- **Input:**
None.
- **Event Flow:**
 - The UC selects the "My Account" option from the homepage.
 - The UC scrolls to the bottom of the page and selects the "Log Out" option.
 - The system terminates the session and redirects to the login page.
- **Exit Conditions:**
The UC is logged out of the platform.
- **Exceptions:**
None.

4. Approve or Reject Internship

- **Name:** Approve or Reject Internship
- **Actor:** Logged-in UC
- **Entry Conditions:**
An internship proposal is submitted by a company or student and requires review.
- **Input:**
Review decision (approve or reject) and optional feedback or comments.
- **Event Flow:**
 - The UC navigates to the "Internship Approval" section.
 - Reviews the details of the submitted internship proposal.
 - Provides a decision (approve/reject) with optional comments.
 - The system records the decision and notifies the relevant parties (company or student).
- **Exit Conditions:**
The internship is either approved or rejected with feedback provided.
- **Exceptions:**

- Missing or incomplete proposal details.

5. Manage Complaints

- **Name:** Manage Complaints
- **Actor:** Logged-in UC
- **Entry Conditions:**
A complaint is submitted by a student or company and requires resolution.
- **Input:**
Complaint details and resolution decision.
- **Event Flow:**
 - The UC navigates to the "Complaints" section.
 - Reviews the submitted complaint details.
 - Communicates with the involved parties to investigate the issue.
 - Resolves the complaint and, if deemed necessary, decides to terminate the internship.
 - Records the resolution decision and notifies the parties involved.
- **Exit Conditions:**
The complaint is resolved and logged in the system.
- **Exceptions:**
 - Insufficient details to investigate or resolve the complaint.

6. Monitor Internship Progress

- **Name:** Monitor Internship Progress
- **Actor:** Logged-in UC
- **Entry Conditions:**
At least one internship is active and requires monitoring.
- **Input:**
None.
- **Event Flow:**
 - The UC navigates to the "Internship Monitoring" section.

- Reviews updates or reports submitted by students or companies.
 - Identifies and addresses any issues or potential concerns.
 - Provides feedback or suggestions to improve the internship process if needed.
- **Exit Conditions:**
The UC is informed about the progress of active internships and intervenes if necessary.
 - **Exceptions:**
 - No updates or reports are available.

7. Generate Reports and Analytics

- **Name:** Generate Reports and Analytics
- **Actor:** Logged-in UC
- **Entry Conditions:**
The UC requires detailed insights or reports about internships.
- **Input:**
Filters or parameters for generating reports (e.g., time range, internship status).
- **Event Flow:**
 - The UC navigates to the "Reports and Analytics" section.
 - Specifies the parameters for the report (e.g., date range, type of report).
 - The system processes the input and generates the requested report.
 - The UC views the report on the platform or downloads it as a file.
- **Exit Conditions:**
The UC successfully generates and accesses the required report.
- **Exceptions:**
 - No data available for the specified parameters.

3.3.7. Student's Sequence Diagram

Sign up

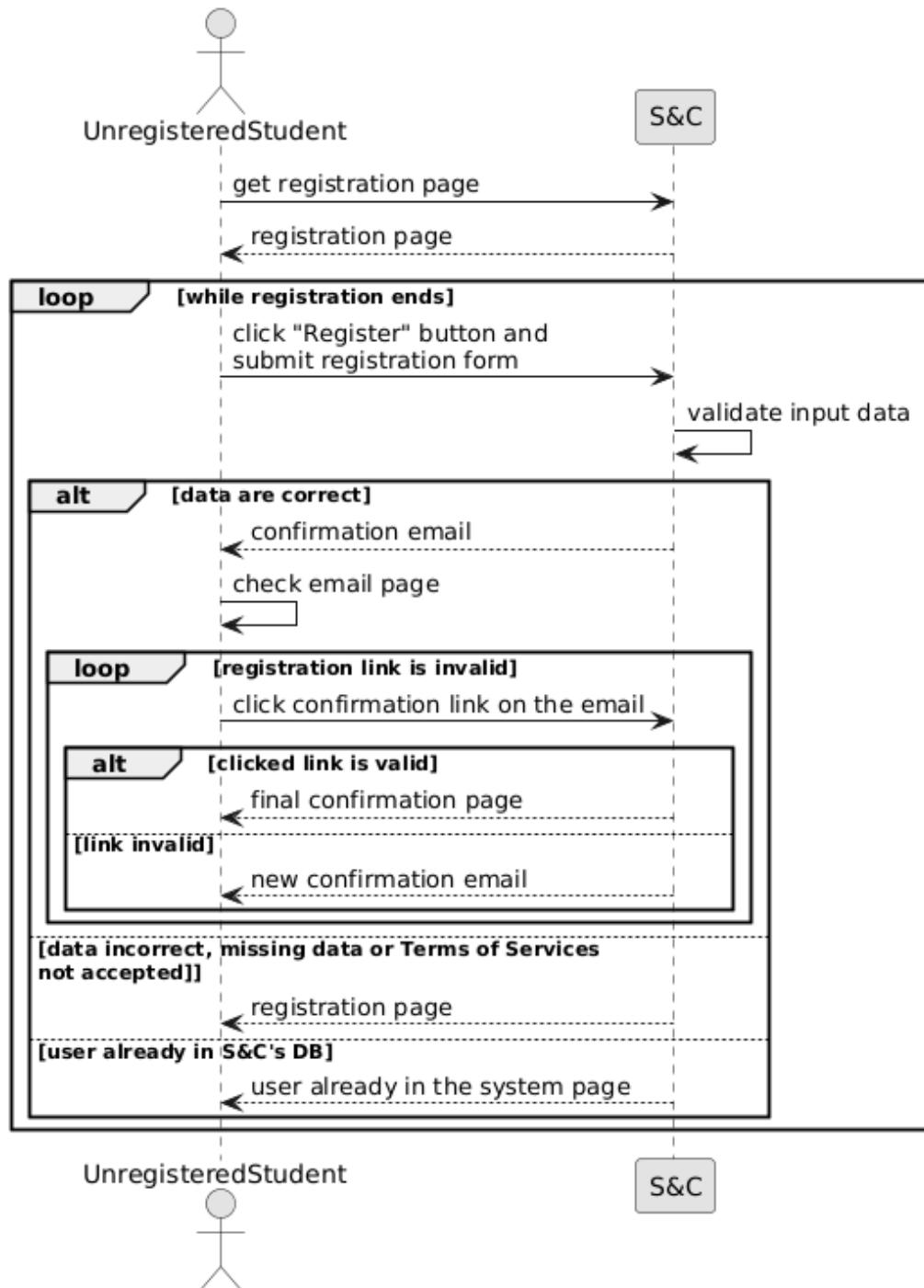


Figure 27: Sign up - Sequence Diagram

Log in

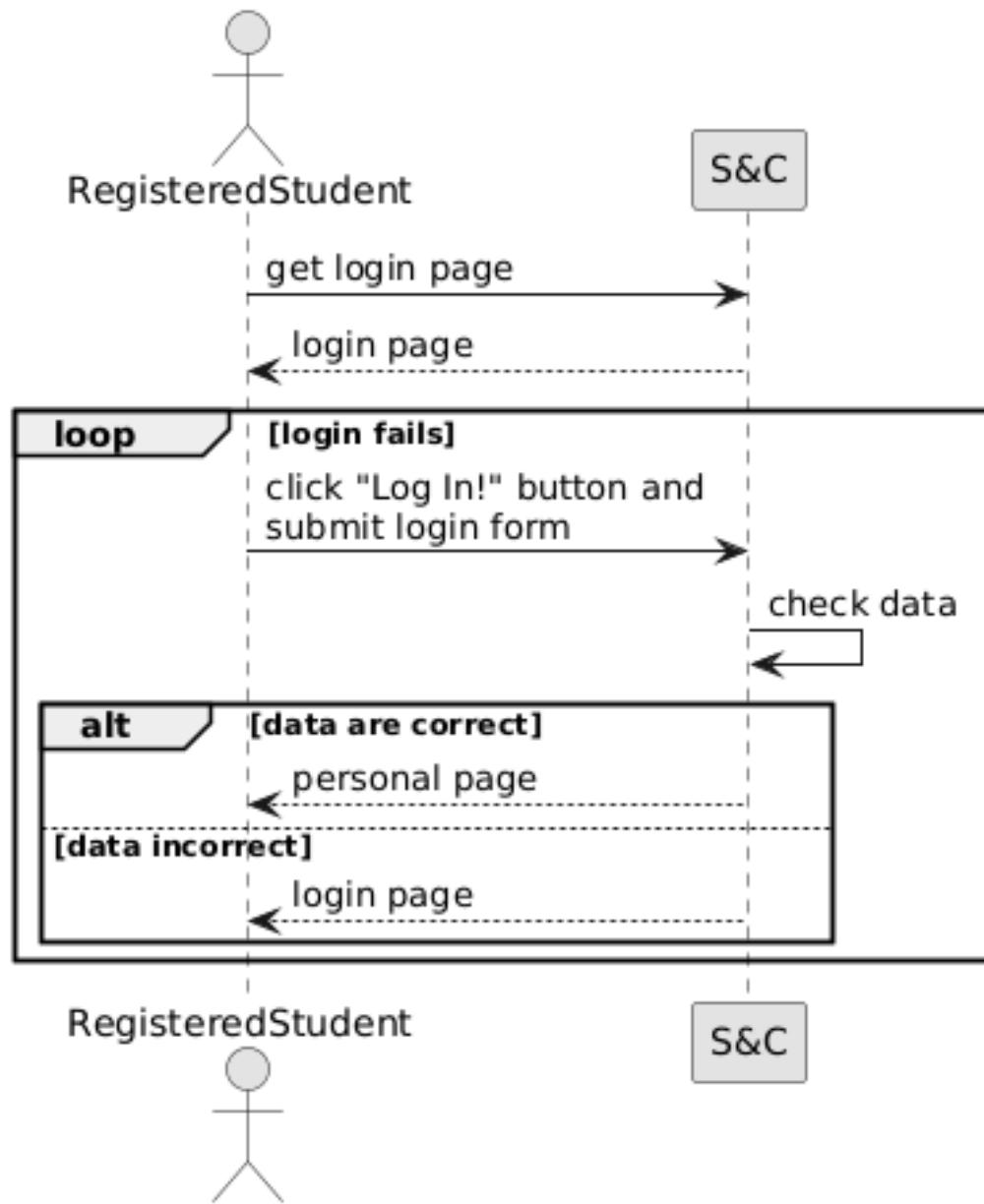


Figure 28: Log in - Sequence Diagram

Log out

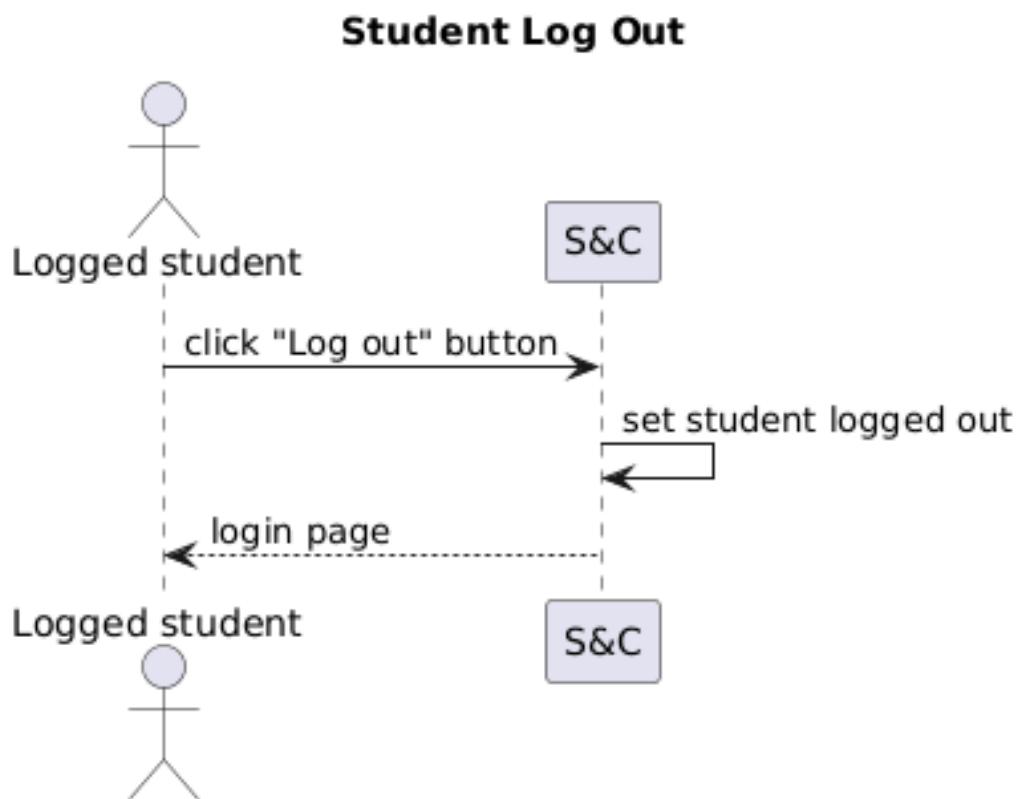


Figure 29: Log out - Sequence Diagram

Show internship information

Student show internship's information

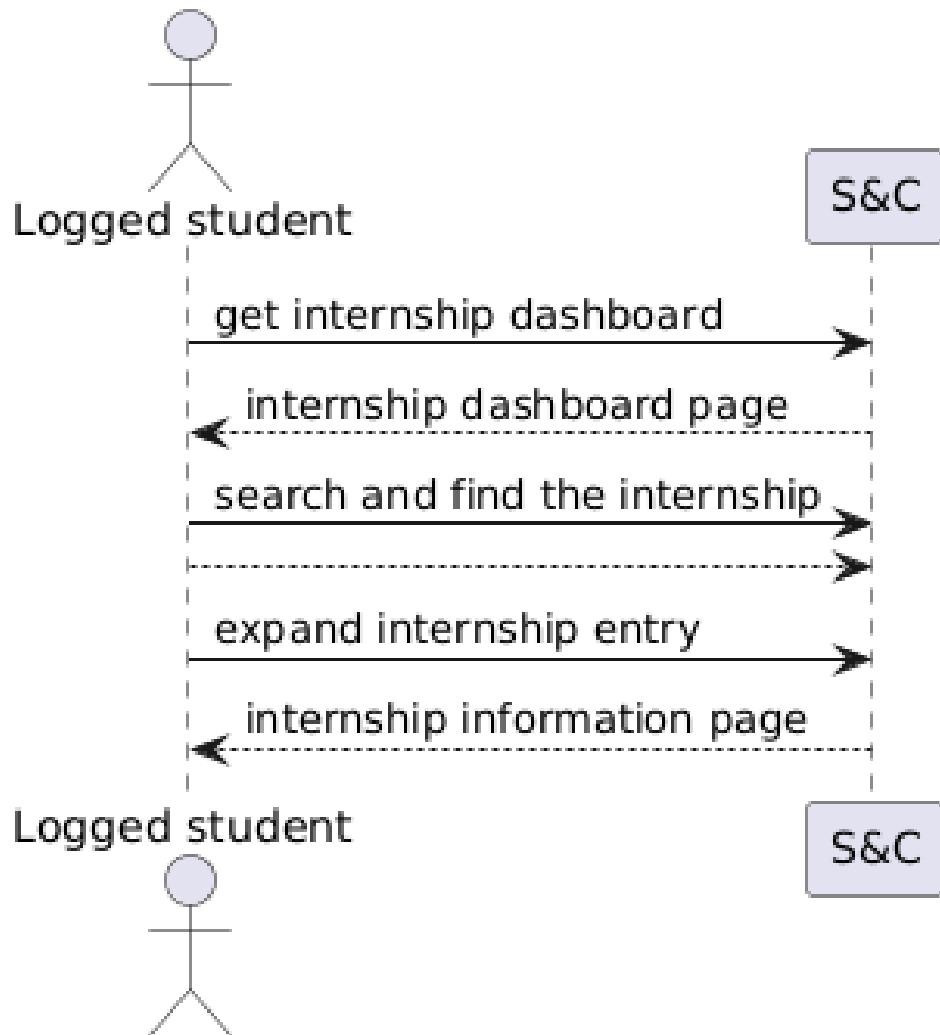


Figure 30: Show Internship Information - Sequence Diagram

Apply to an internship

Student applies to an internship opportunity

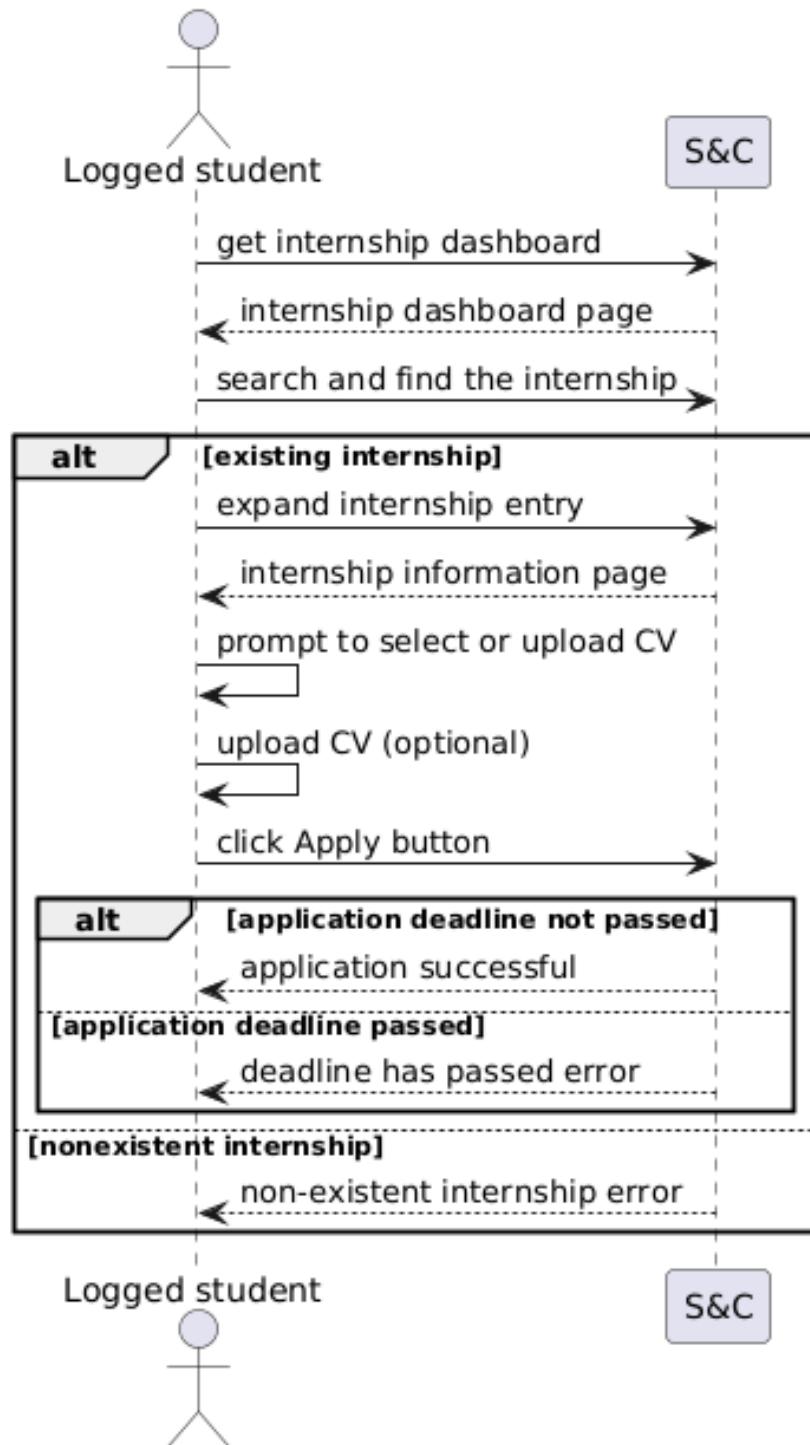


Figure 31: Apply to an Internship - Sequence Diagram

Manage Profile

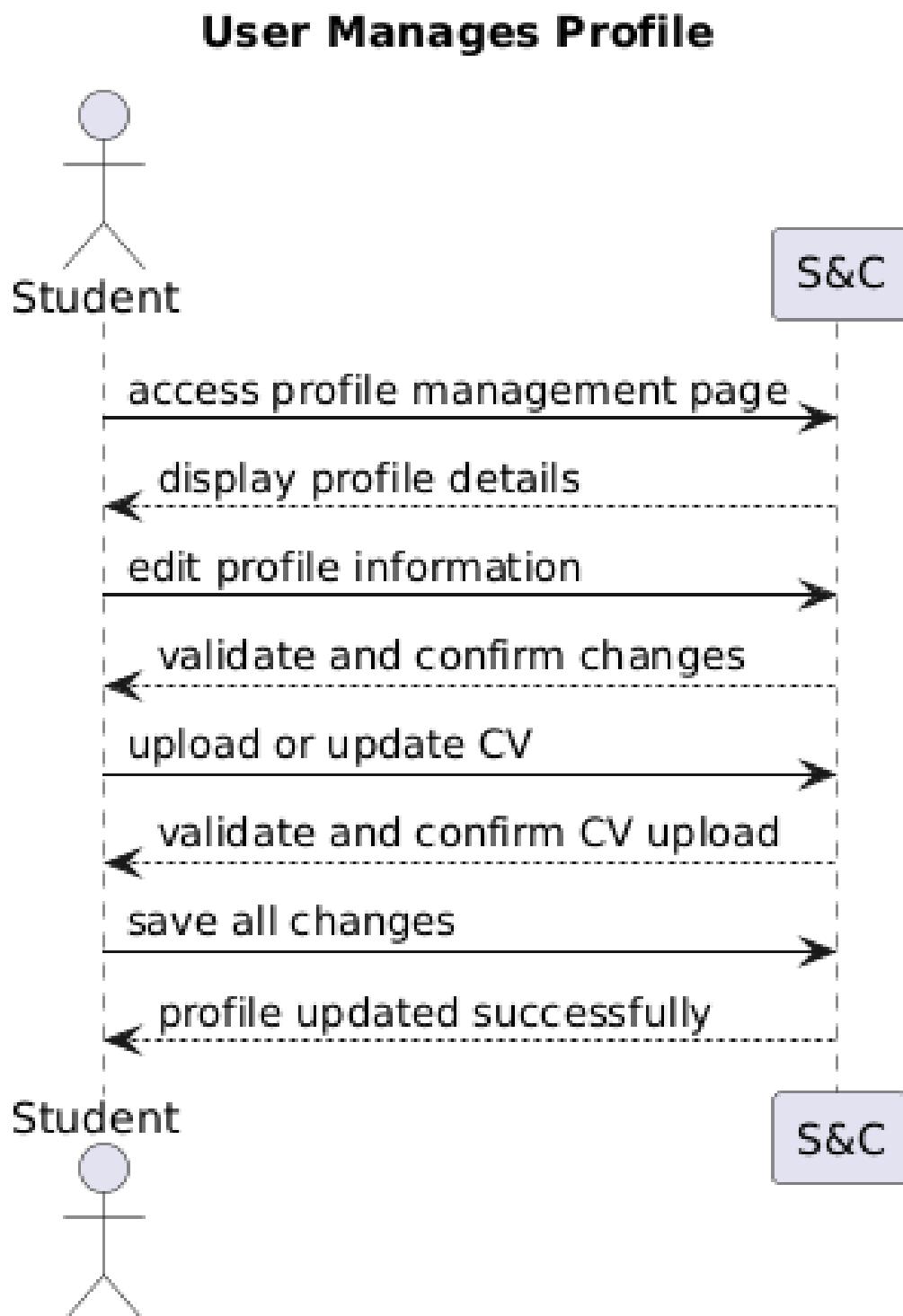


Figure 32: Manage Profile - Sequence Diagram

Submit Feedback

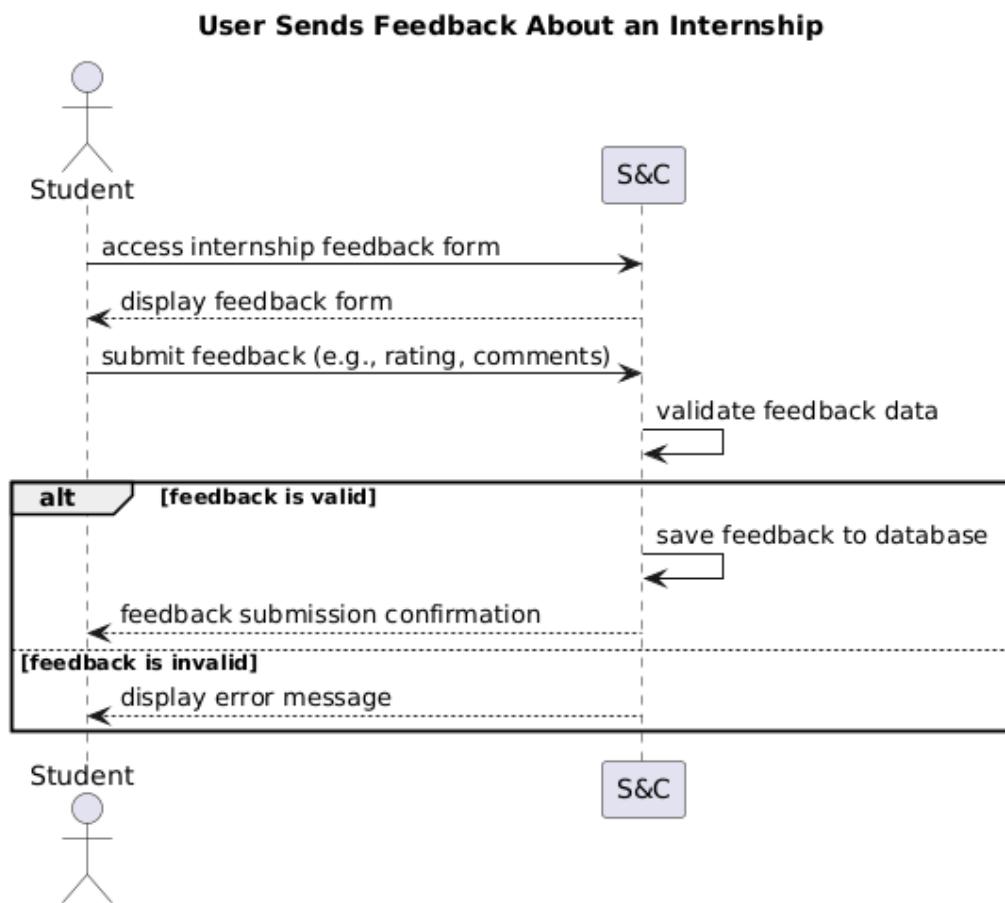


Figure 33: Submit Feedback - Sequence Diagram

Report a Complaint

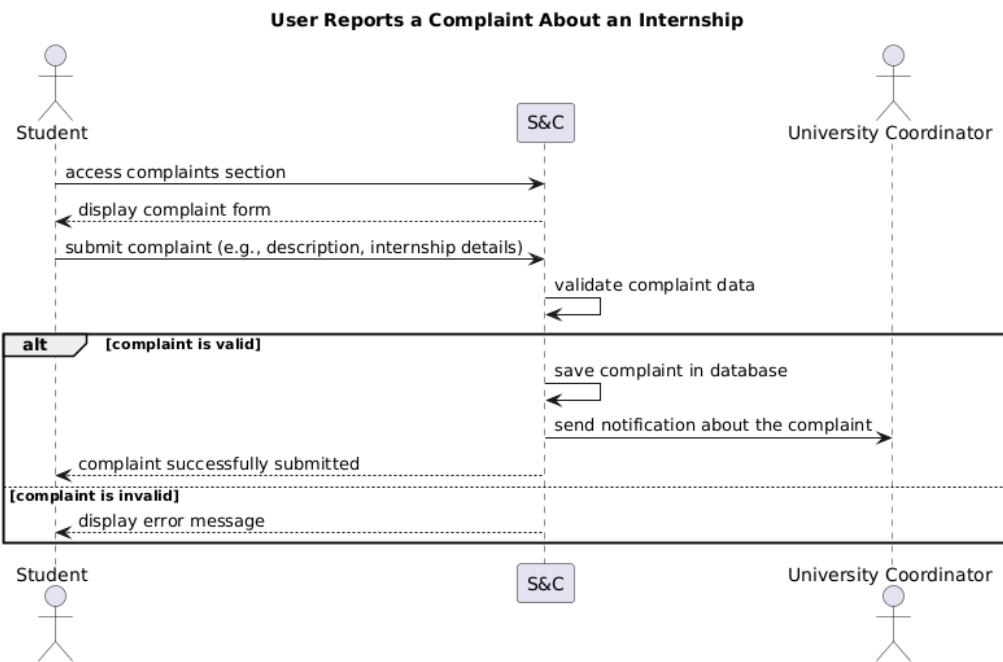


Figure 34: Report a Complaint - Sequence Diagram

Track Application Status

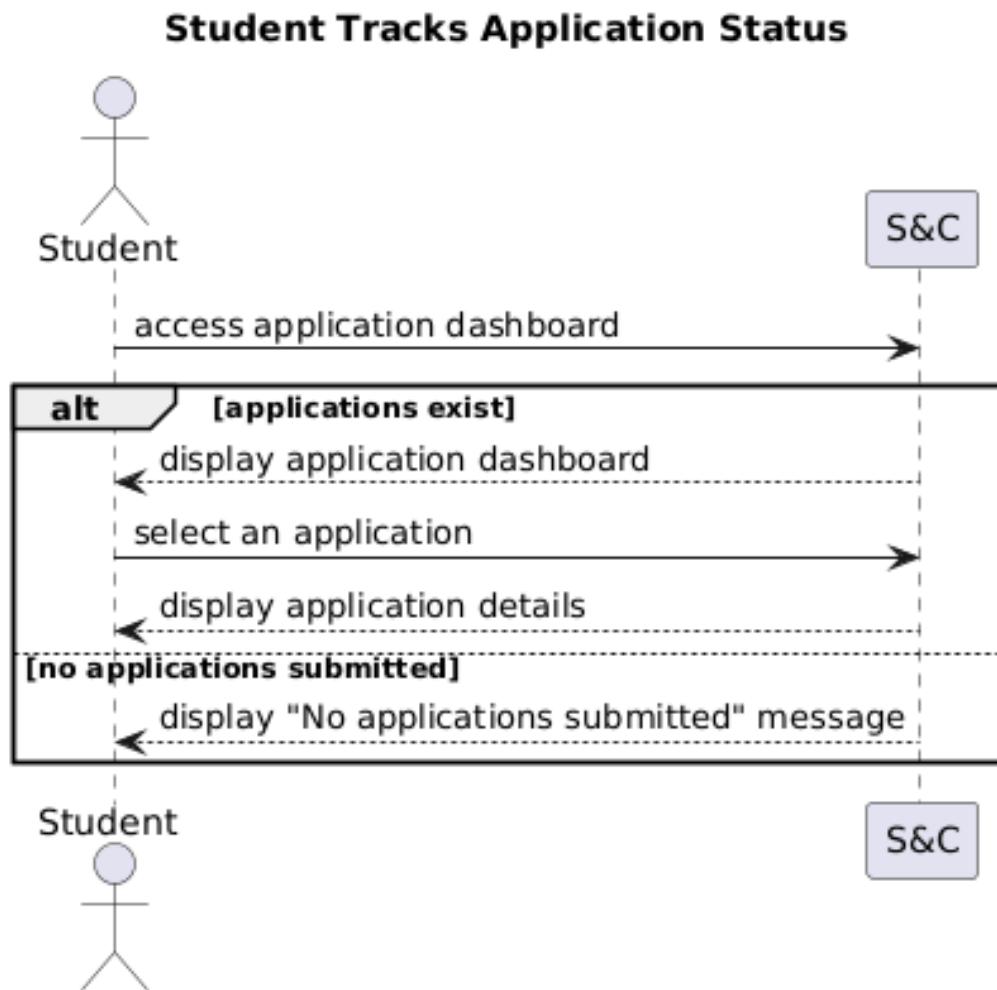


Figure 35: Track Application Status - Sequence Diagram

Student Gets Internship Recommendations

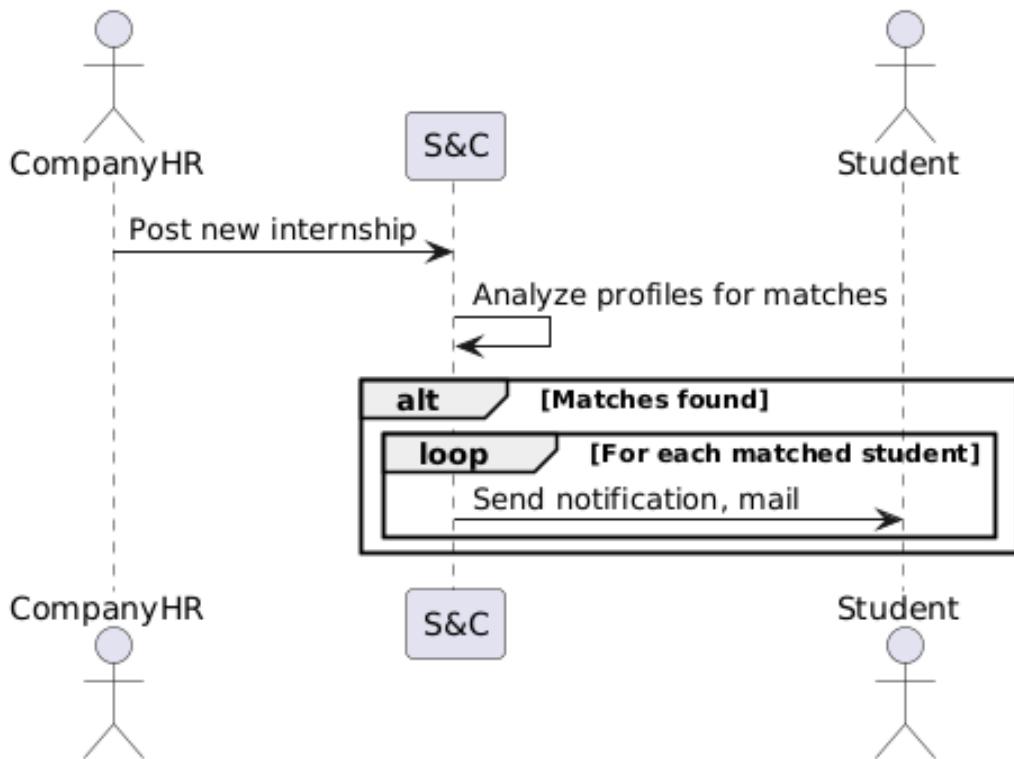
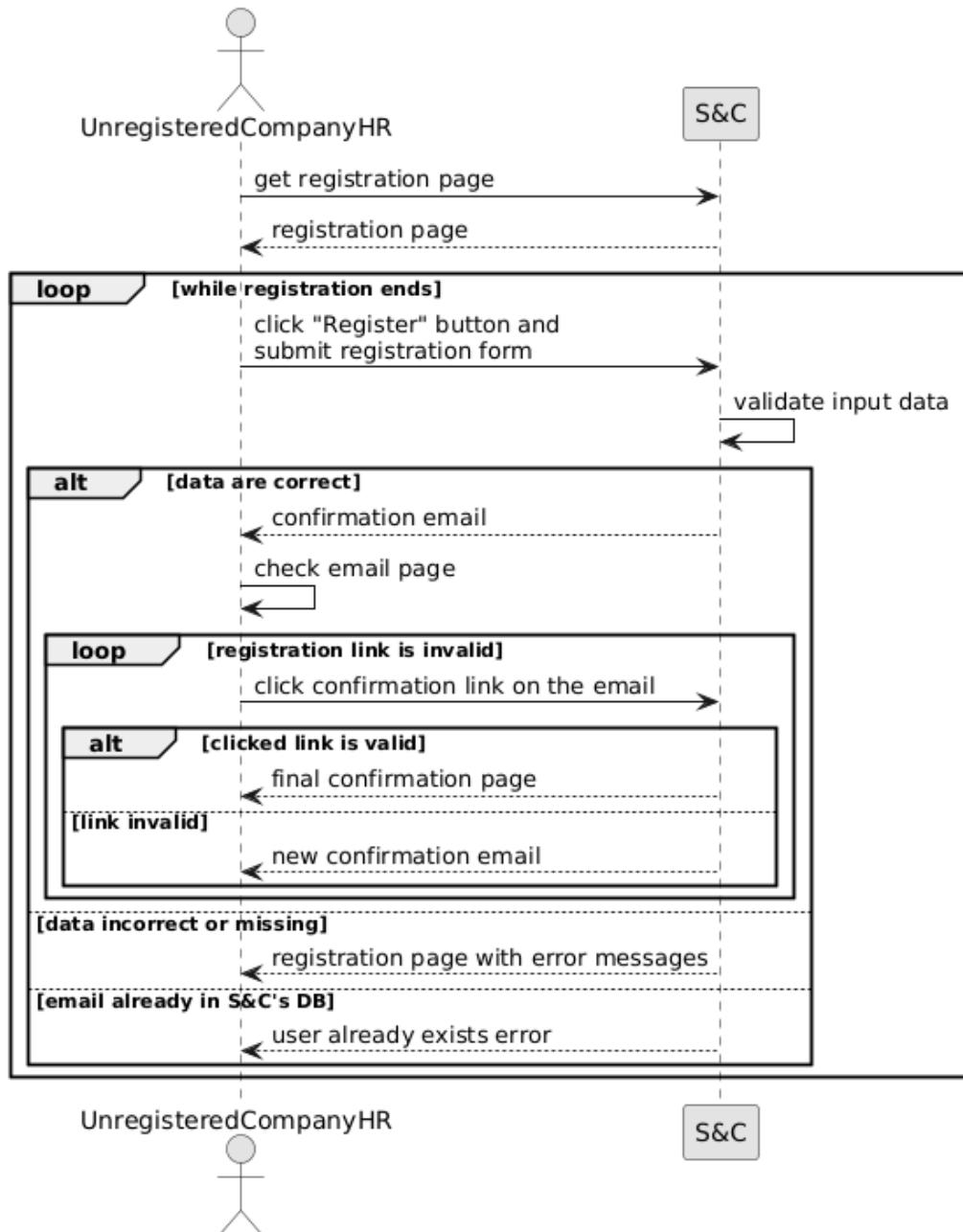


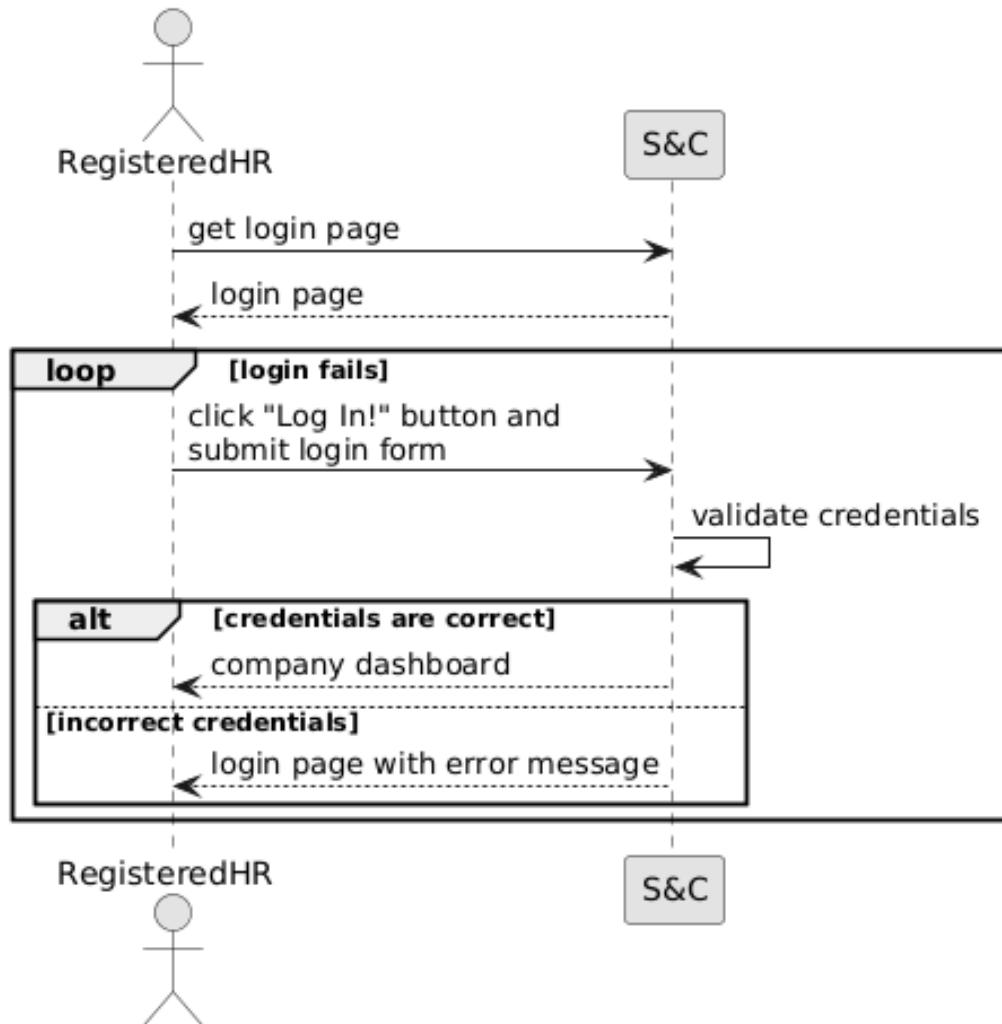
Figure 36: Student Gets Internship Recommendations - Sequence Diagram

3.3.8. Company Sequence Diagram

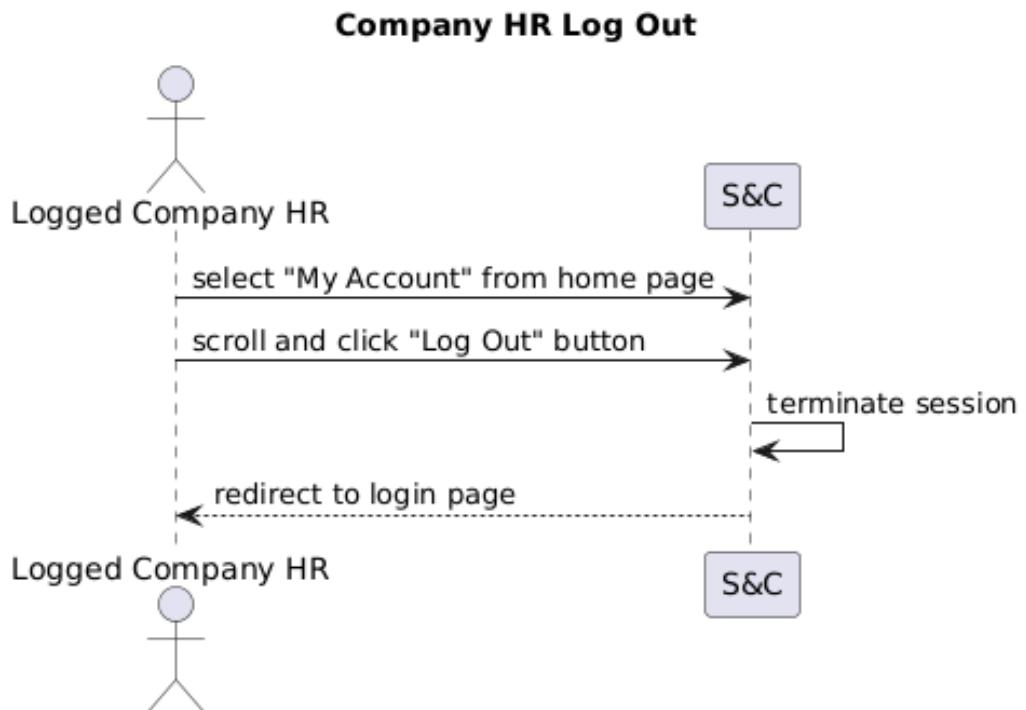
Company HR Registration



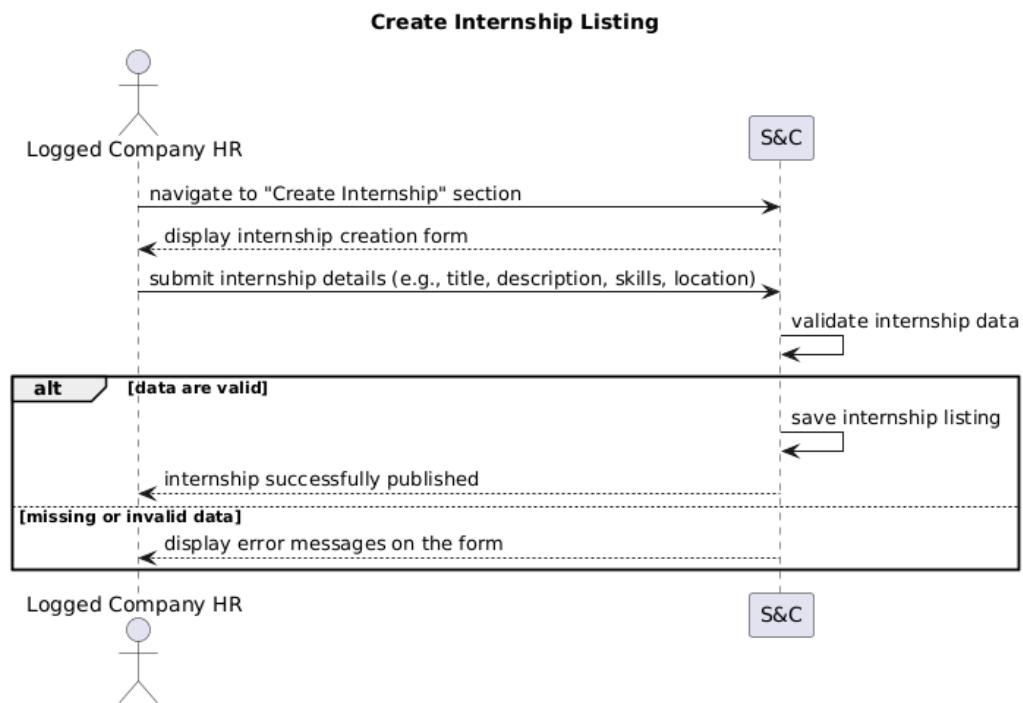
Company HR Login



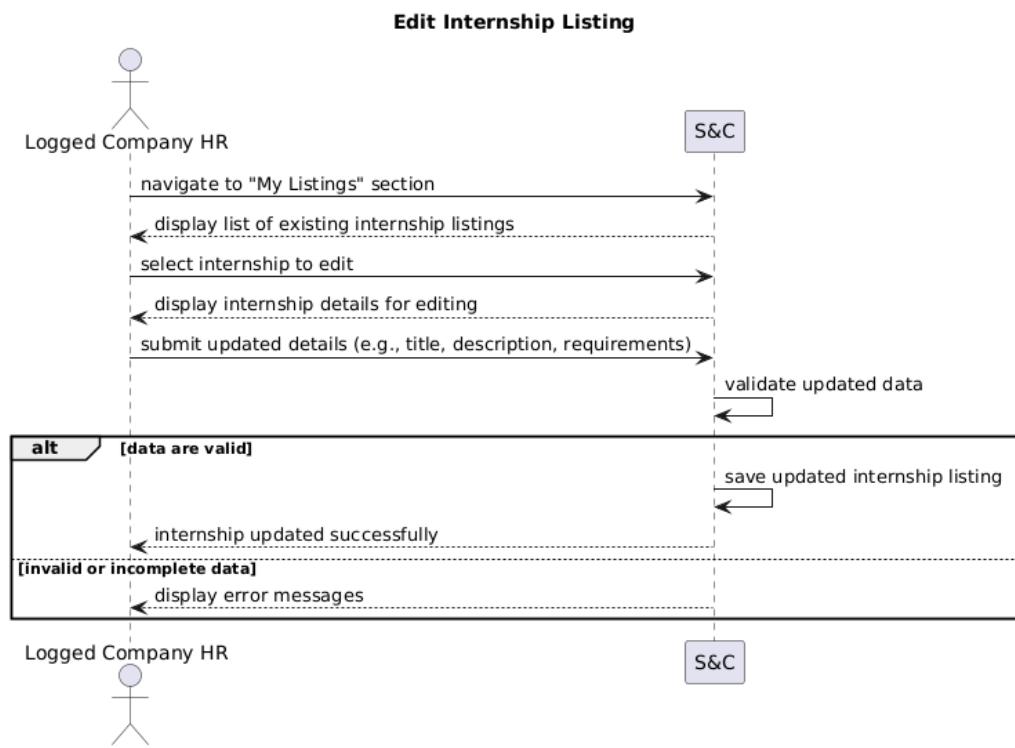
Company HR Logout



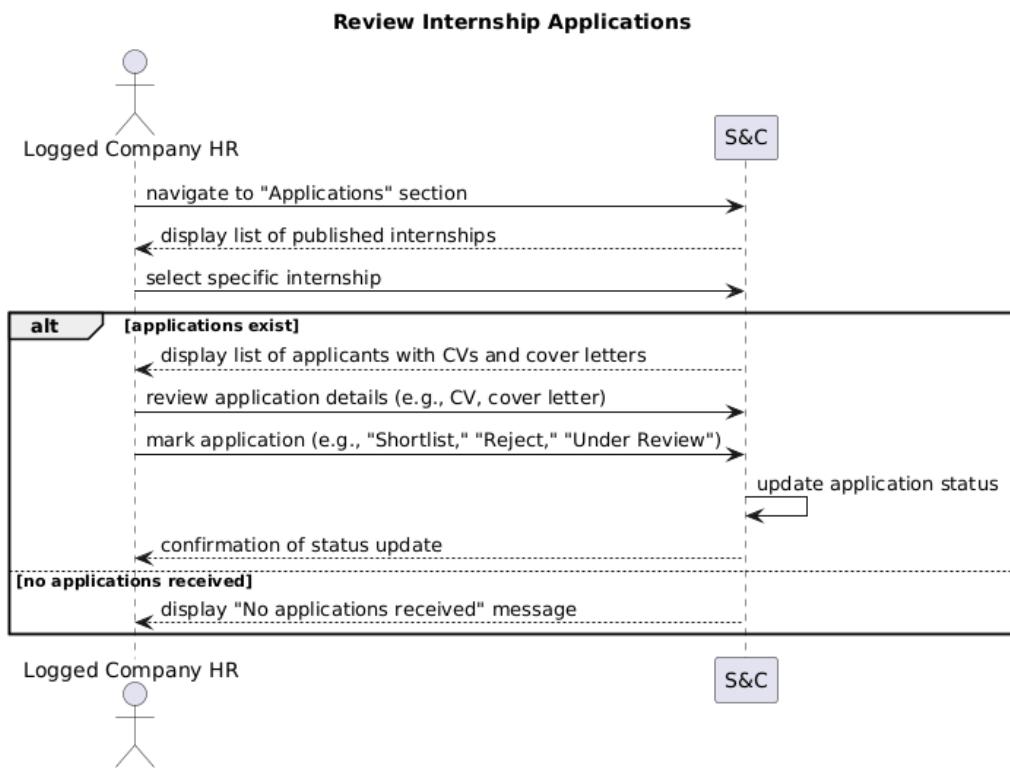
Company HR create internship listing



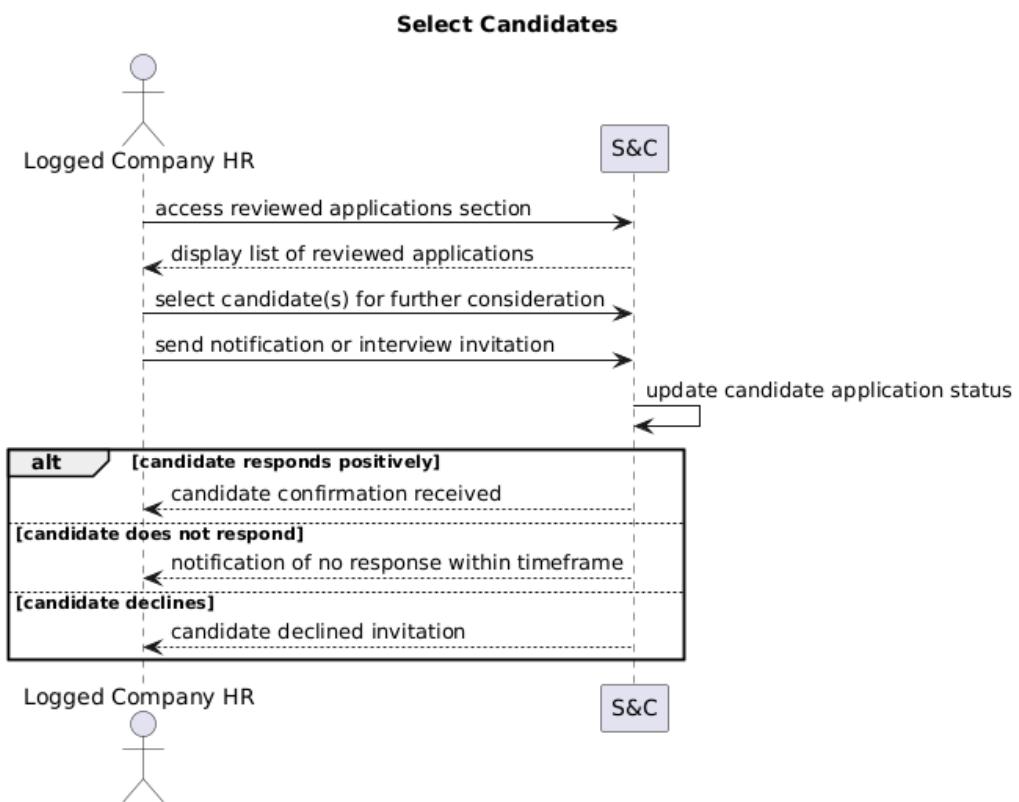
Company HR Modify Internship



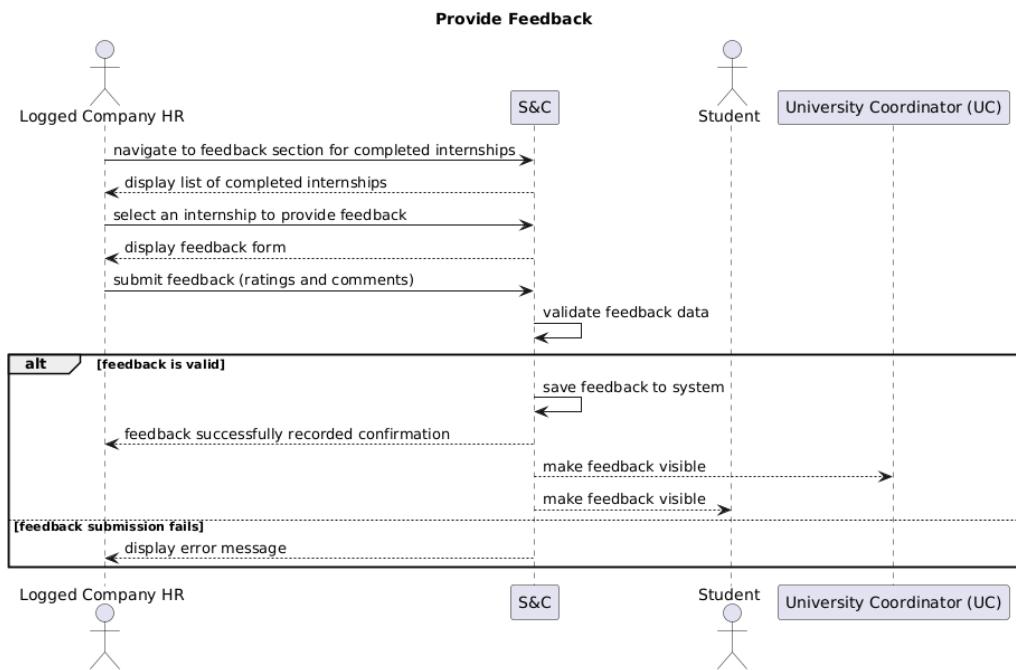
Company HR review application



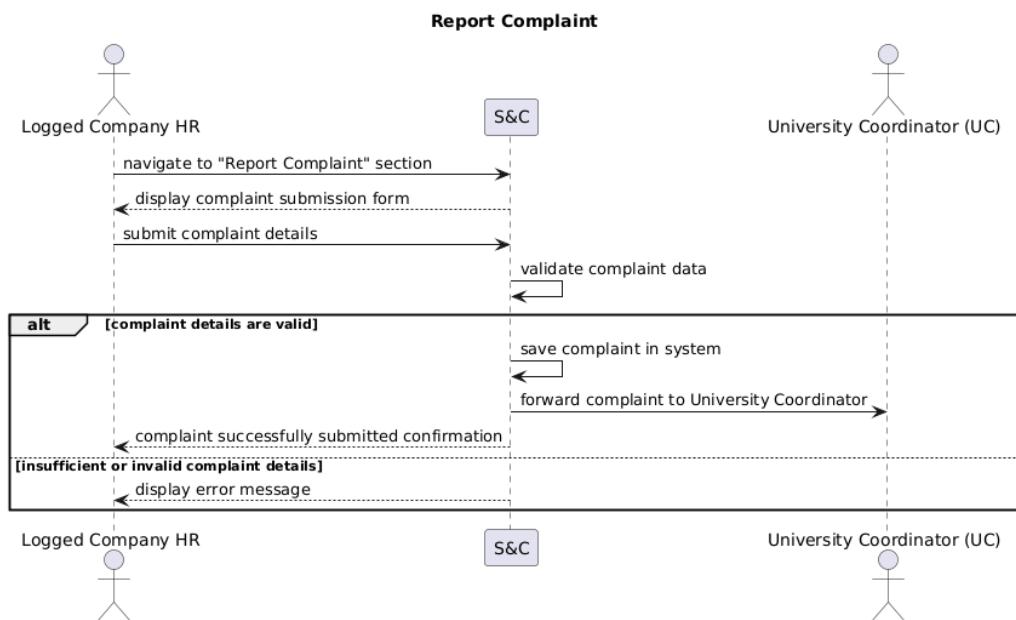
Company HR select candidate



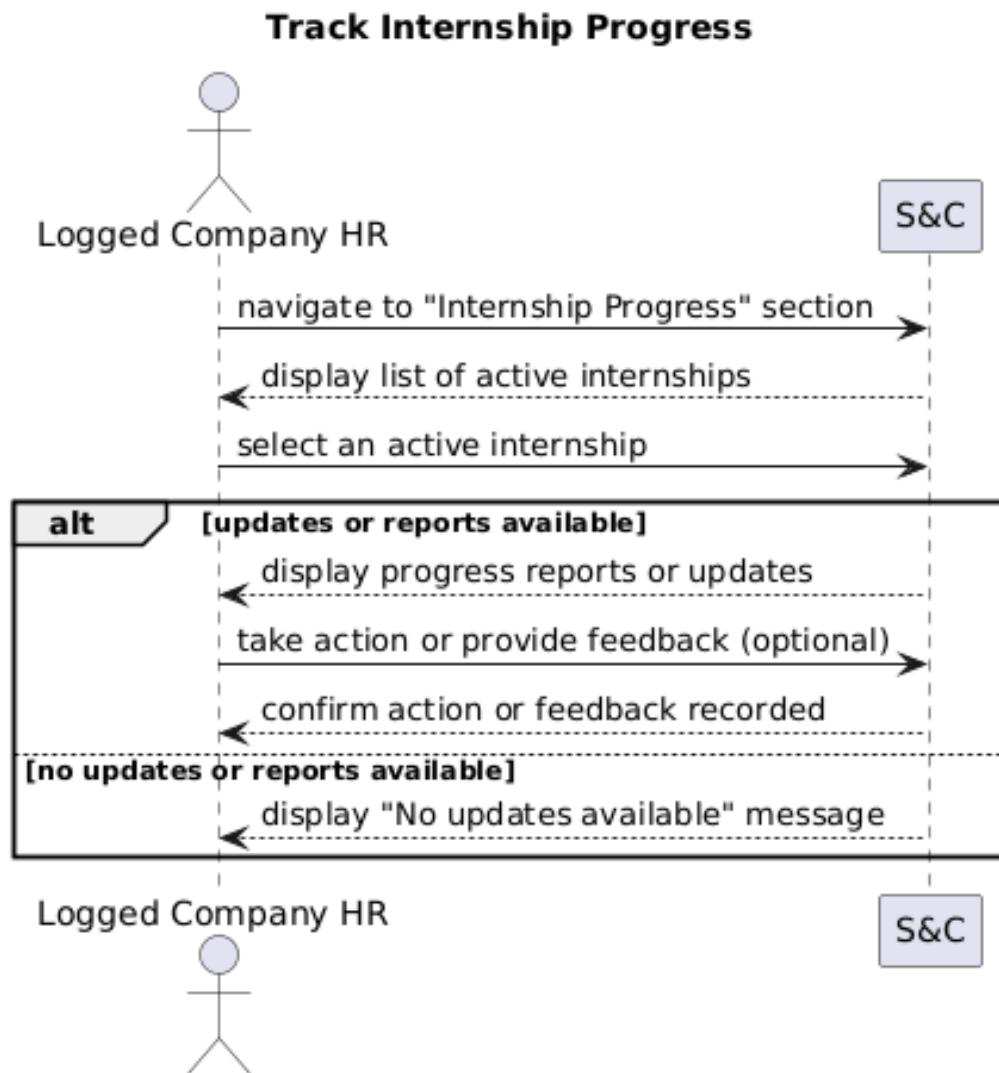
Company HR provide feedback



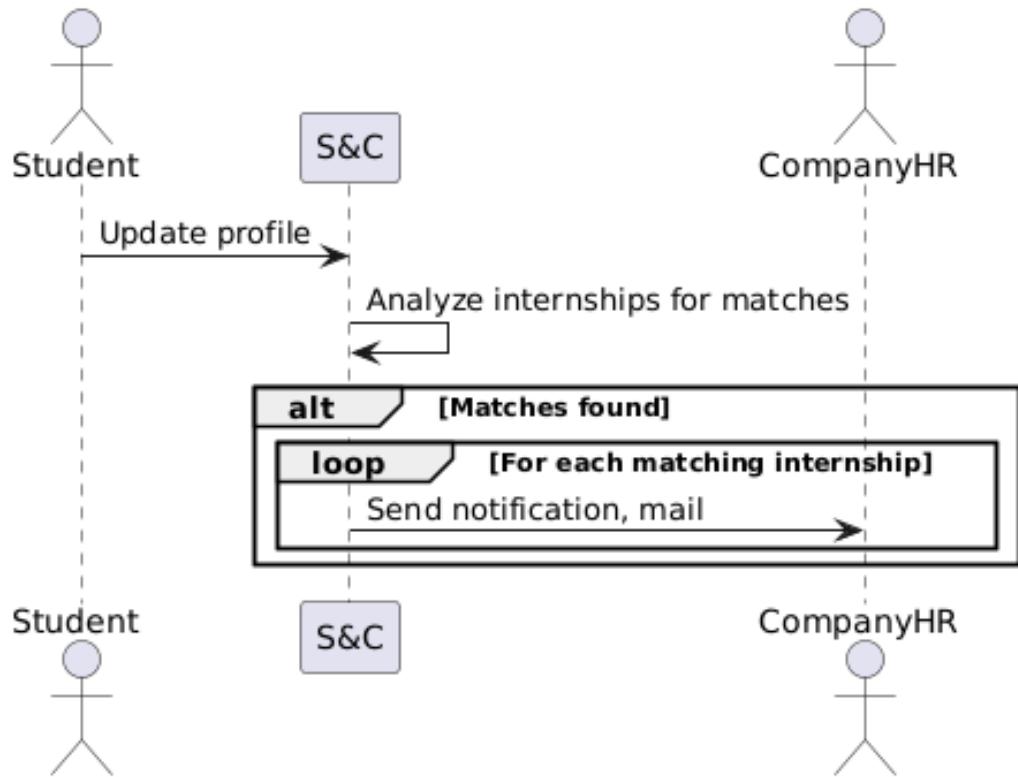
Company HR report complaint



Company HR track internship

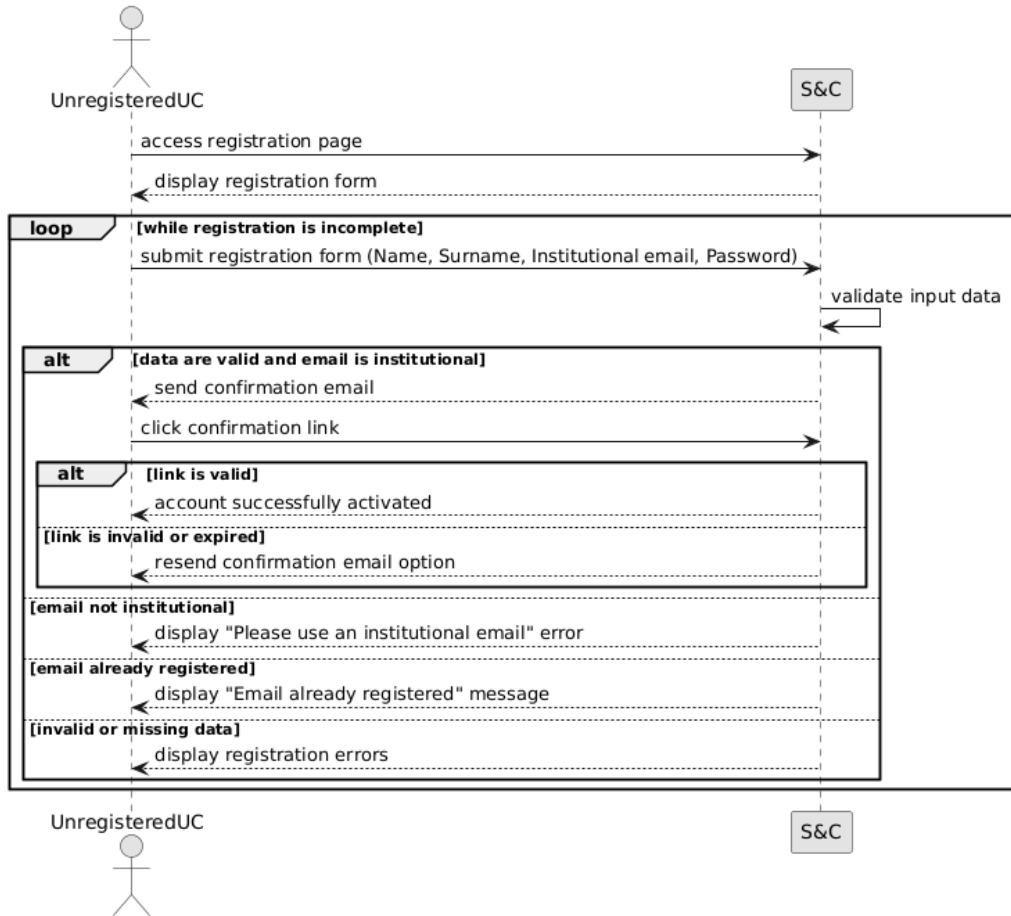


Company HR Receive Recommendations

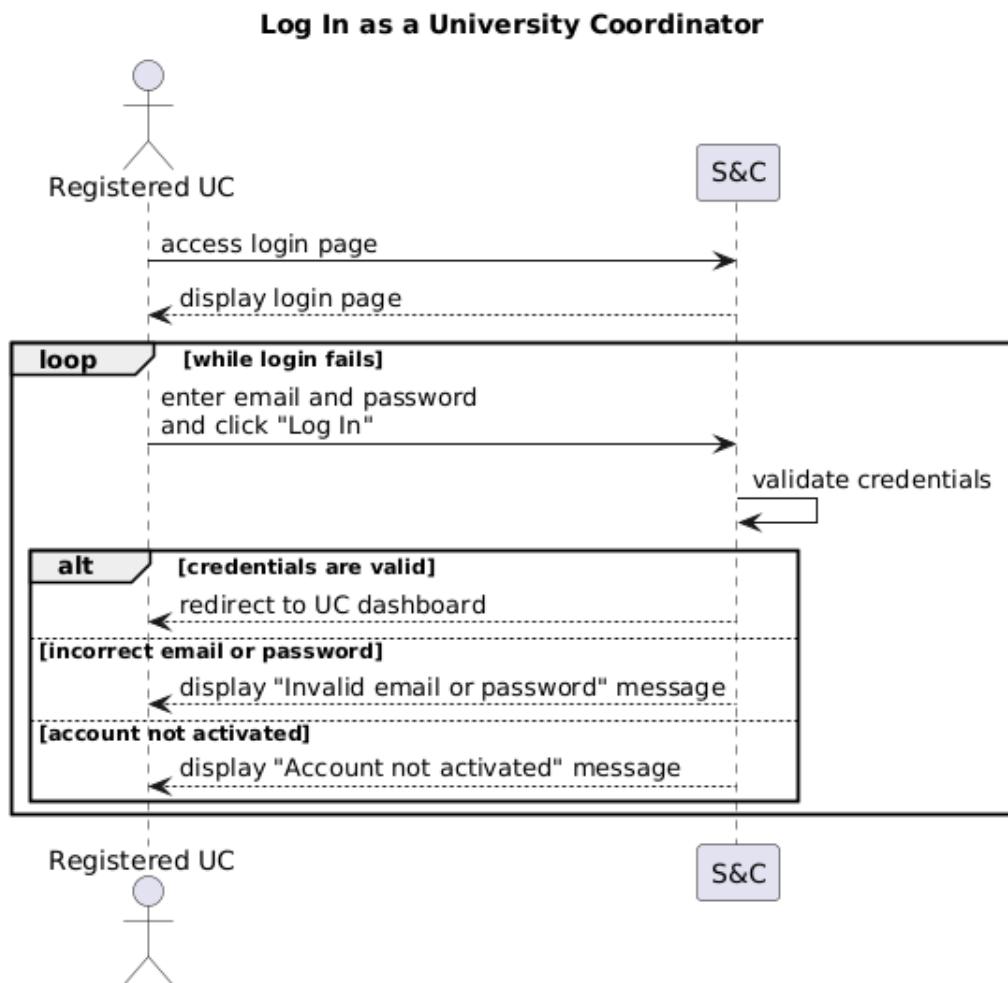


3.3.9. UC Sequence Diagram

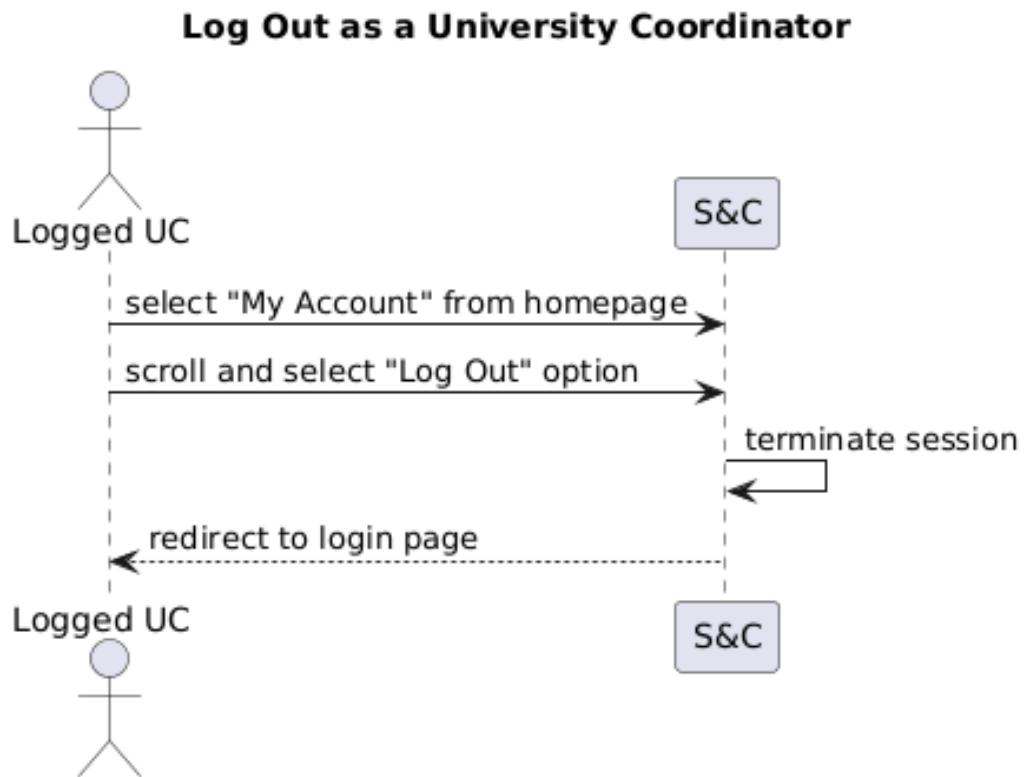
UC Registration



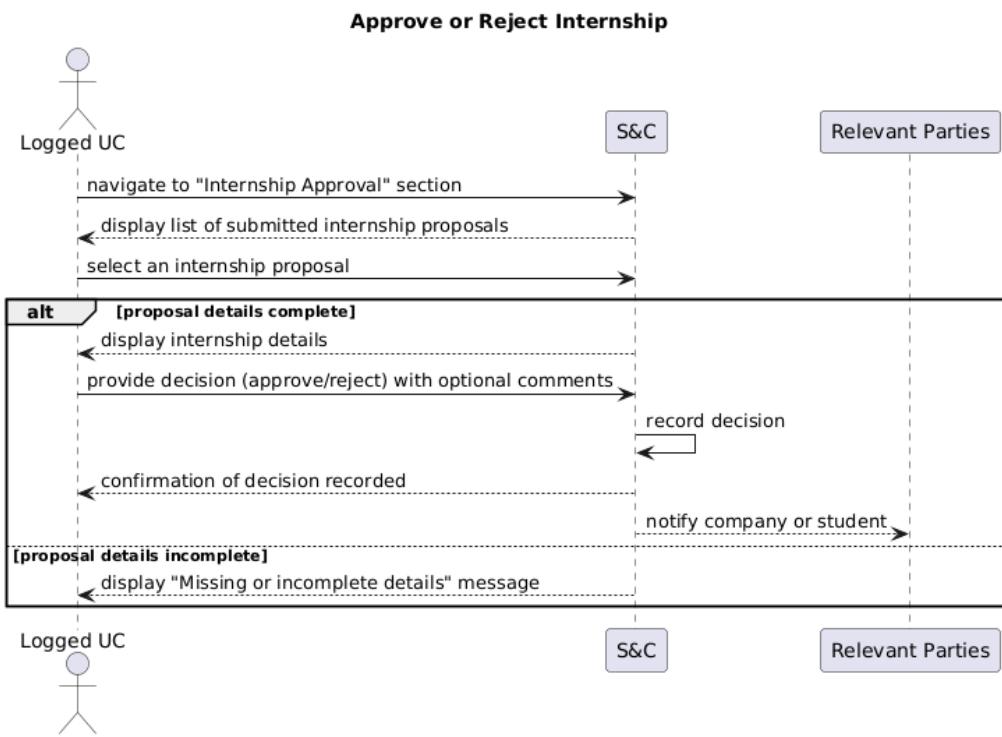
UC Login



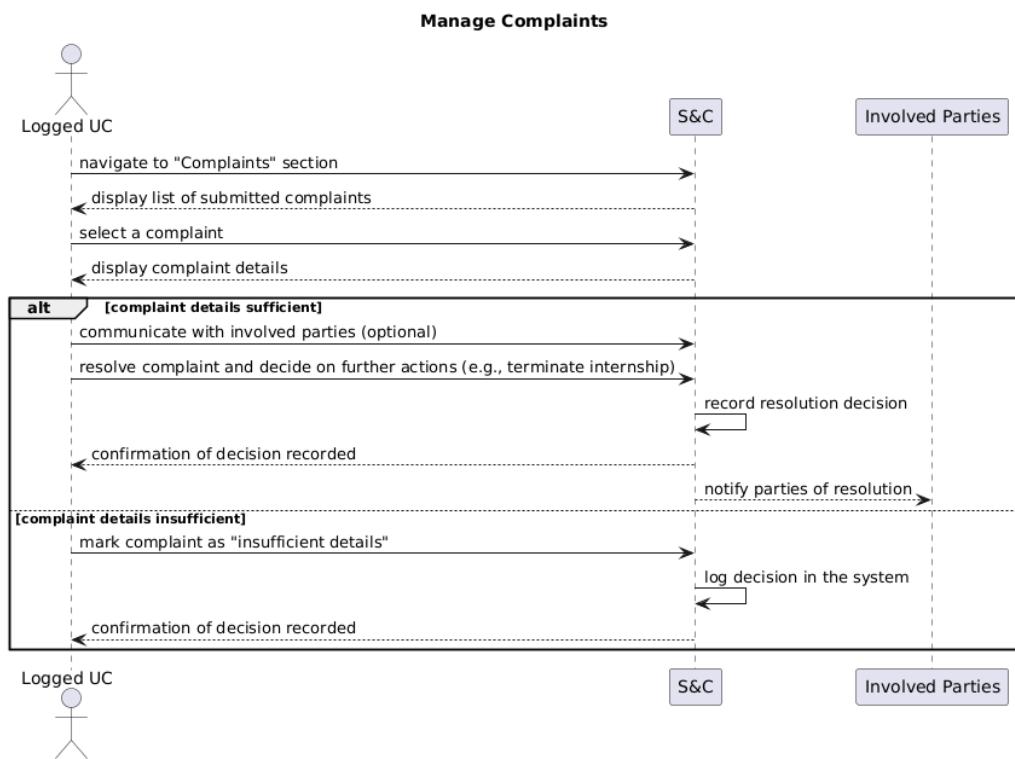
UC Logout



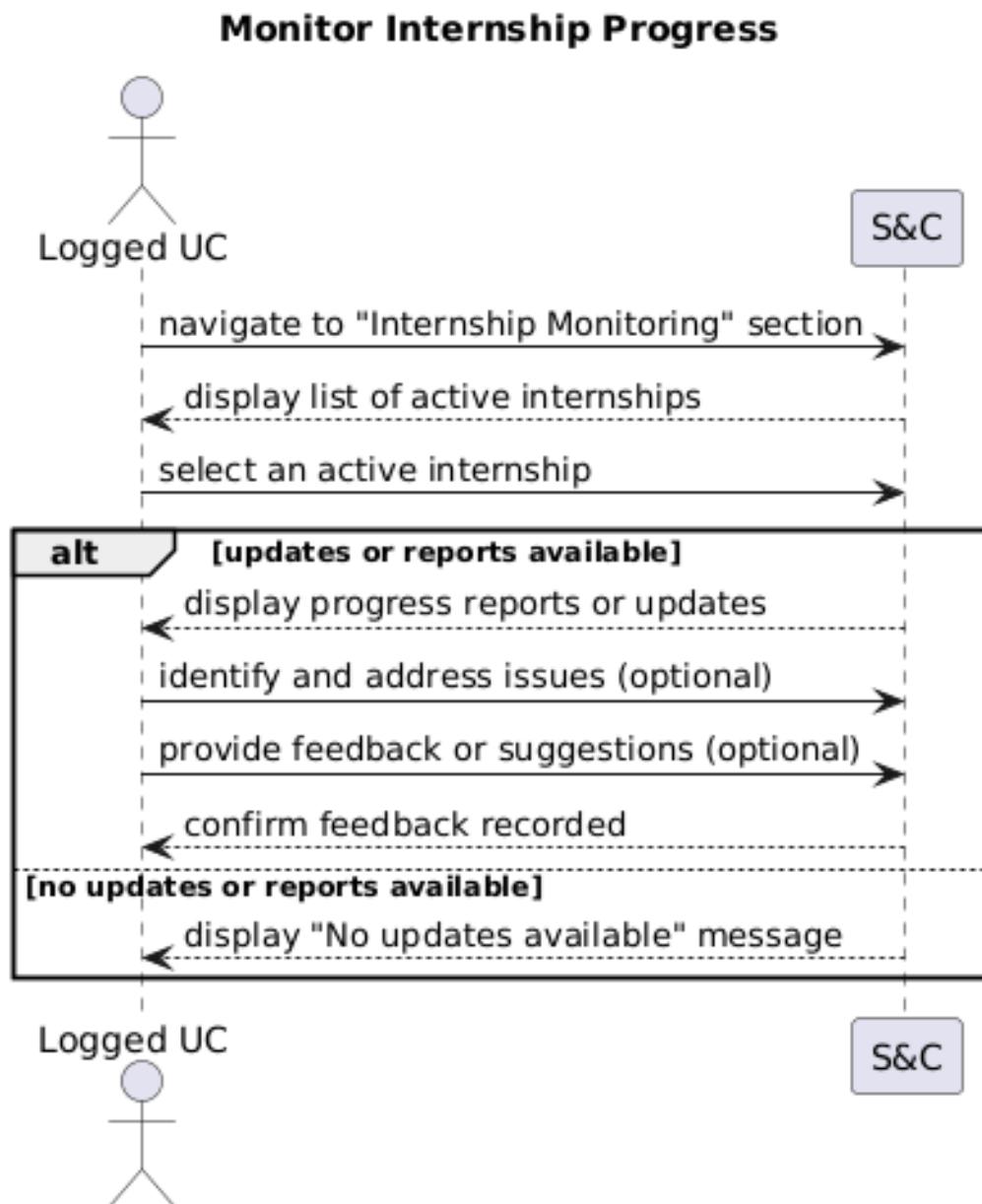
UC Approve/Reject Internship



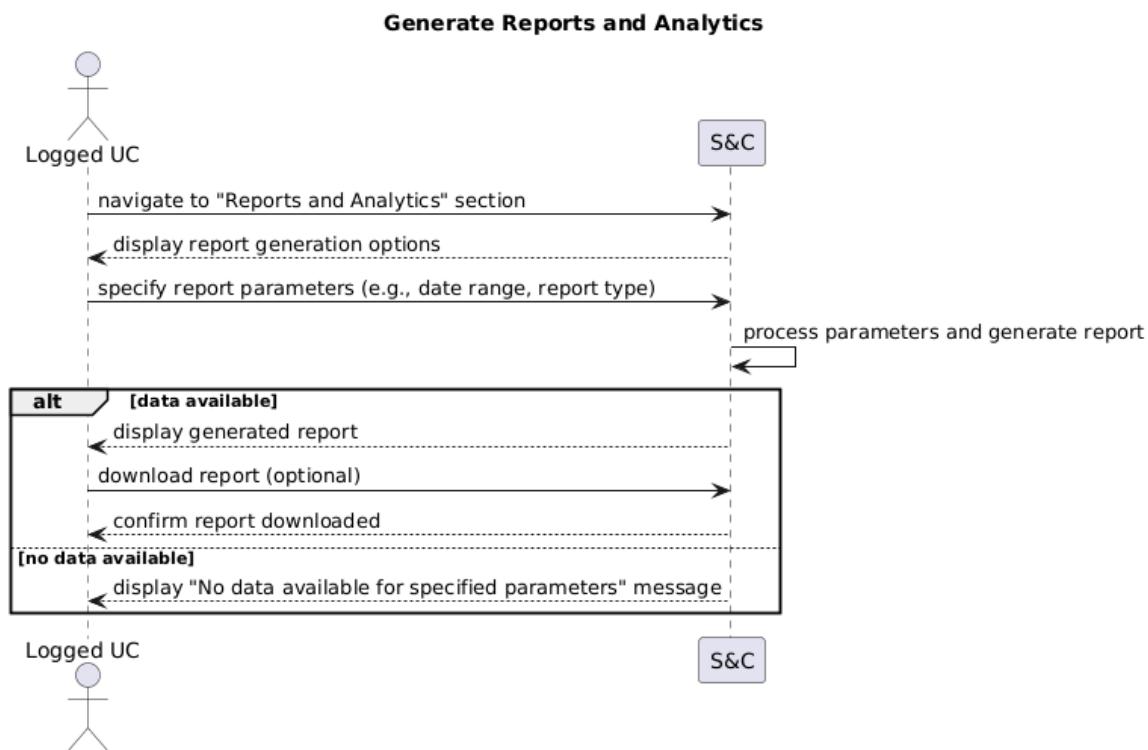
UC manage complaints



UC monitor internship



UC Generate Report and Analytics



4. Alloy

This section uses the Alloy language to formally model the core concepts, constraints, and relationships within the Students & Companies (S&C) platform. Alloy provides a declarative approach to specify the main entities, their properties, and their interactions while ensuring logical consistency. Through the Alloy Analyzer, the model can be validated to identify potential inconsistencies and confirm that it aligns with the system's requirements and objectives.

The model focuses on attributes that are directly relevant to the system's logic and behavior, such as extitskills, extitfield, and extituniversity, while excluding personal details like extitname, extitsurname, or extitpassword, as these do not significantly impact the modeling or verification process. The metamodel, shown in the following figure, provides a clear overview of all the components involved in the system. To enhance clarity, non-essential attributes have been omitted while preserving the model's ability to represent the functionality of the system. For example:

- Human agents are abstracted as entities like `Student` and `CompanyHR`, with only their essential relationships and actions included, such as submitting applications or providing feedback.
- Details like internship descriptions or application specifics have been excluded to prioritize the focus on relationships and constraints, which are central to the platform's operations.

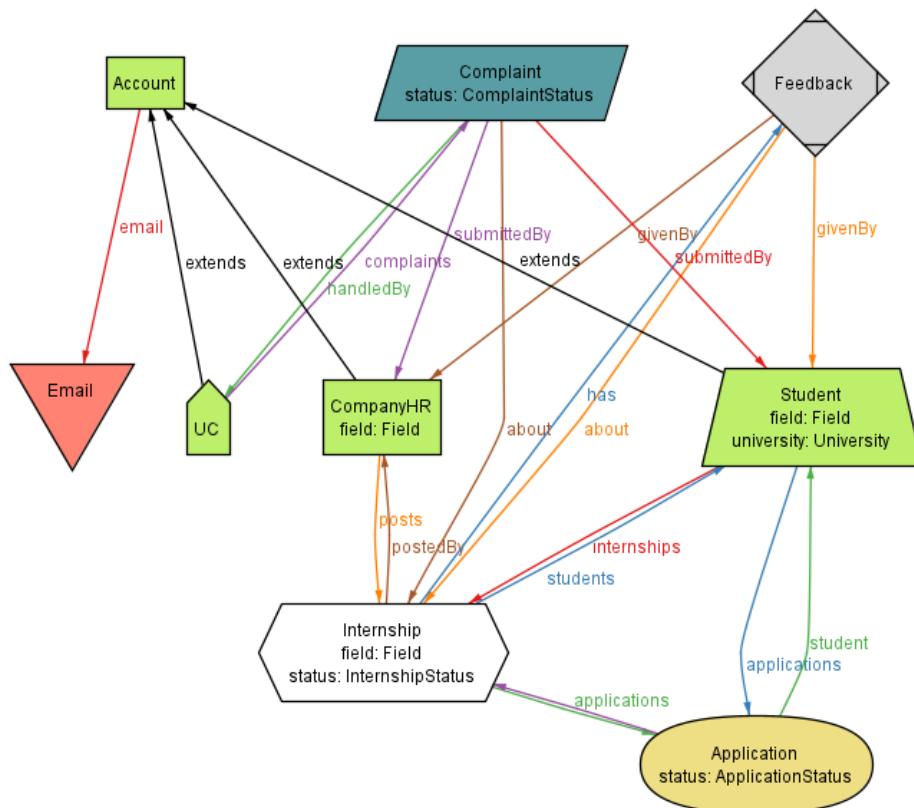


Figure 37: Metamodel

```

// Signatures

abstract sig InternshipStatus {}
one sig InternshipOpen, InternshipApplied, InternshipAccepted,
    InternshipOngoing, InternshipClosed extends InternshipStatus {}

abstract sig ApplicationStatus {}
one sig ApplicationSubmitted, ApplicationAccepted, ApplicationRejected
    extends ApplicationStatus {}

abstract sig ComplaintStatus {}
one sig ComplaintOpen, ComplaintUnderReview, ComplaintResolved,
    ComplaintRejected extends ComplaintStatus {}

abstract sig University {}
one sig Unia, UniB, UniC extends University {}

abstract sig Field {}
one sig Engineering, Law, Medicine, ComputerScience extends Field {}

sig Email {}

// Abstract account for common properties
abstract sig Account {
    email: one Email
}

// Student inherits from Account
sig Student extends Account {
    university: one University,
    field: one Field,
    applications: set Application,
    internships: set Internship
}

// CompanyHR inherits from Account
sig CompanyHR extends Account {
    field: one Field,
    posts: set Internship
}

// UC inherits from Account
sig UC extends Account {
    complaints: set Complaint
}

```

```

sig Internship {
    field: one Field,
    applications: set Application,
    has: set Feedback,
    status: one InternshipStatus,
    students: set Student,
    postedBy: one CompanyHR
}

sig Application {
    student: one Student,
    internship: one Internship,
    status: one ApplicationStatus
}

sig Feedback {
    givenBy: lone (Student + CompanyHR),
    about: one Internship
}

sig Complaint {
    submittedBy: lone (Student + CompanyHR),
    handledBy: one UC,
    status: one ComplaintStatus,
    about: one Internship
}

// FACT

// Facts for Students & Companies (S&C) Platform

// -- Account:

// Ensures that each account (Student, CompanyHR, UC) has a unique email.
fact AccountUniqueEmails {
    no disj a1, a2 : Account | a1.email = a2.email
}

// Ensures that the applications of a student are consistent with the
// application-student relationship
fact studentApplicationConsistency {
    all s: Student, a: Application |
        (a.student = s) iff (a in s.applications)
}

// Ensures that the internships associated with a student are correctly

```

```

//derived from the applications submitted by the student.
fact StudentInternshipLinkage {
    all s: Student |
        s.internships = { i: Internship | some a: Application |
            a.student = s and a.internship = i }
}

// -- Internship:

// Ensures that no two internships are identical.
fact InternshipNoDuplicates {
    no disj i1, i2 : Internship | i1 = i2
}

// Ensures that every internship is posted by exactly one CompanyHR
//or none at all.
fact InternshipPostedByCompanyHR {
    all i: Internship | lone c: CompanyHR | i in c.posts
}

// Ensures that every internship has an associated poster (a CompanyHR).
fact EveryInternshipHasPoster {
    all i: Internship | some c: CompanyHR | i in c.posts
}

// Ensures internships only have valid statuses
// (Open, Applied, Accepted, Ongoing, Closed).
fact InternshipValidStatuses {
    all i: Internship | i.status in InternshipOpen + InternshipApplied +
        InternshipAccepted + InternshipOngoing + InternshipClosed
}

// An internship can be "Applied" only if it has at least one application.
fact InternshipTransitionToApplied {
    all i: Internship | i.status = InternshipApplied iff some i.applications
}

// An internship can be "Ongoing" only if it has at least one accepted
//application.
fact InternshipTransitionToOngoing {
    all i: Internship | i.status = InternshipOngoing implies some
        a: i.applications | a.status = ApplicationAccepted
}

// A closed internship cannot have pending applications.
fact InternshipClosed {

```

```

    all i: Internship | i.status = InternshipClosed implies no
        a: i.applications | a.status = ApplicationSubmitted
}

// Ensures the internship status is consistent with the status
//of its applications
fact internshipStatusConsistency {
    all i: Internship |
        (all a: i.applications | a.status = ApplicationRejected) implies
            i.status != InternshipApplied
}

// Ensures that students accepted to an internship are correctly linked
//to that internship.
fact AcceptedStudentsLinkedToInternship {
    all i: Internship |
        i.students = {s: Student | some a: Application | a.student = s and
            a.internship = i and a.status = ApplicationAccepted}
}

// Ensures that feedback is linked to the internship it is about and
//given by a valid entity (Student or CompanyHR).
fact FeedbackLinkage {
    all f: Feedback |
        ((f.givenBy in Student) => f.about in f.givenBy.internships)
        and
        ((f.givenBy in CompanyHR) => f.about in f.givenBy.posts)
}

// Ensures that complaints are linked to the internships they are
//about and submitted by valid entities.
fact ComplaintLinkage {
    all c: Complaint |
        ((c.submittedBy in Student) => c.about in c.submittedBy.internships)
        and
        ((c.submittedBy in CompanyHR) => c.about in c.submittedBy.posts)
}

// Ensures that internships in the "Accepted" status have at least
//one accepted application.
fact InternshipAcceptedCondition {
    all i: Internship |
        (i.status = InternshipAccepted) =>
            some a: i.applications | a.status = ApplicationAccepted
}

```

```

// Ensures that each internship is correctly listed as a post of
// the CompanyHR who posted it.
fact InternshipPostedByHR {
    all i: Internship | i in i.postedBy.posts
}

// Ensures that internships with feedback or complaints must have
// at least one application.
fact InternshipWithFeedbackOrComplaintHasApplications {
    all i: Internship |
        ((some i.has) or (some c: Complaint | c.about = i)) implies
        some i.applications
}

// -- Application:

// Ensures that no two applications are identical.
fact ApplicationNoDuplicates {
    no disj a1, a2 : Application | a1 = a2
}

// Ensures applications only have valid statuses (Submitted, Accepted, Rejected).
fact ApplicationValidStatuses {
    all a: Application | a.status in ApplicationSubmitted +
        ApplicationAccepted + ApplicationRejected
}

// Ensures each application is linked to one internship and is
// in the internship's applications set.
fact ApplicationBelongingToInternship {
    all a: Application | a in a.internship.applications
}

// Ensures that an Application can belong to only one Internship
fact applicationBelongsToSingleInternship {
    all a: Application |
        lone i: Internship | a in i.applications
}

// -- Feedback:

// Ensures that feedback is provided by either a student or a
// company HR, but not both.
fact FeedbackOwnership {
    all f: Feedback | some f.givenBy and f.givenBy in (Student + CompanyHR)
}

```

```

// Ensures that feedback is linked to one internship and is
// included in the internship's feedback set.
fact FeedbackBelongingToInternship {
    all f: Feedback | f in f.about.has
}

// -- Complaint:

// Ensures that no two complaints are identical.
fact ComplaintNoDuplicates {
    no disj c1, c2 : Complaint | c1 = c2
}

// Ensures complaints only have valid statuses
// (Open, UnderReview, Resolved, Rejected).
fact ComplaintValidStatuses {
    all c: Complaint | c.status in ComplaintOpen +
        ComplaintUnderReview + ComplaintResolved + ComplaintRejected
}

// Ensures every complaint is submitted by either a student or a company HR.
fact ComplaintSubmittedByValidEntity {
    all c: Complaint | c.submittedBy in (Student + CompanyHR)
}

// Ensures that an open complaint is not yet assigned to a UC,
// and when assigned, it becomes UnderReview.
fact complaintStateAndAssignment {
    all c: Complaint |
        (c.status = ComplaintOpen implies no c.handledBy) and
        (some c.handledBy implies c.status = ComplaintUnderReview)
}

// -- Status Transitions:

// Ensures internships follow logical lifecycle transitions:
// Open → Applied → Accepted → Ongoing → Closed.
fact InternshipLifecycle {
    all i: Internship |
        (i.status = InternshipApplied implies some i.applications) and
        (i.status = InternshipOngoing implies some a: i.applications |
            a.status = ApplicationAccepted) and
        (i.status = InternshipClosed implies no i.applications)
}

```

```

// Ensures applications follow logical lifecycle transitions:
// Submitted → Accepted/Rejected.
fact ApplicationLifecycle {
    all a: Application |
        (a.status = ApplicationSubmitted or
         a.status = ApplicationAccepted or
         a.status = ApplicationRejected)
}

// Ensures complaints follow logical lifecycle transitions.
fact ComplaintLifecycle {
    all c: Complaint |
        (c.status = ComplaintOpen or
         (c.status = ComplaintUnderReview and some c.handledBy) or
         c.status = ComplaintResolved or
         c.status = ComplaintRejected)
}

// Assertions and Predicates for Students & Companies (S&C) Platform

// -- Assertions:

// Ensures that all applications are associated with an internship,
// and the application exists in the internship's set of applications.
assert validApplications {
    all a: Application | a.internship in Internship and
        a in a.internship.applications
}
check validApplications

// Ensures that all feedback entries are linked to an internship,
// and that the internship includes them in its feedback set.
assert validFeedback {
    all f: Feedback | f.about in Internship and f in f.about.has
}
check validFeedback

// Ensures that all complaints are handled by a university coordinator.
assert complaintsHandledByUC {
    all c: Complaint | some c.handledBy
}
check complaintsHandledByUC

// Ensures that internships transition between valid statuses
// based on the conditions defined in the facts.
assert internshipLifecycleValid {

```

```

all i: Internship |
  (i.status = InternshipApplied implies some i.applications) and
  (i.status = InternshipOngoing implies some a: Application |
  a in i.applications and a.status = ApplicationAccepted) and
  (i.status = InternshipClosed implies
    no a: Application | a in i.applications)
}
check internshipLifecycleValid

// Ensures that applications transition between valid statuses
// (Submitted → Accepted/Rejected).
assert applicationLifecycleValid {
  all a: Application |
    (a.status = ApplicationSubmitted or
     a.status = ApplicationAccepted or
     a.status = ApplicationRejected)
}
check applicationLifecycleValid

// Ensures that all feedback is provided by either a student or a company HR,
// but not both.
assert feedbackGivenByValidEntities {
  all f: Feedback | some f.givenBy and f.givenBy in (Student + CompanyHR)
}
check feedbackGivenByValidEntities

// Ensures that complaints transition between valid statuses
// (Open → UnderReview → Resolved/Rejected).
assert complaintLifecycleValid {
  all c: Complaint |
    (c.status = ComplaintOpen or
     (c.status = ComplaintUnderReview and some c.handledBy) or
     c.status = ComplaintResolved or
     c.status = ComplaintRejected)
}
check complaintLifecycleValid

// Ensures that no applications can be submitted to an internship
// if its status is Closed.
assert noApplicationToClosedInternship {
  all i: Internship |
    (i.status = InternshipClosed implies no a: Application |
     a.internship = i and a.status = ApplicationSubmitted)
}
check noApplicationToClosedInternship

```

```

// Ensures complaints cannot be Resolved or Rejected unless
// they have been UnderReview.
assert complaintResolutionAfterReview {
    all c: Complaint |
        (c.status = ComplaintResolved or c.status = ComplaintRejected) implies
        (c.status = ComplaintUnderReview or c.status = ComplaintOpen)
}

// Ensures that open complaints are unassigned and assigned
// complaints are UnderReview.
assert complaintOpenOrUnderReview {
    all c: Complaint |
        (c.status = ComplaintOpen implies no c.handledBy) and
        (some c.handledBy implies c.status = ComplaintUnderReview)
}
check complaintOpenOrUnderReview

//All the feedbacks are connected to an Internship
assert allFeedbackLinkedToInternships {
    all f: Feedback | some f.about
}
check allFeedbackLinkedToInternships

// Ensures that internships follow lifecycle status conditions.
assert internshipOpenCondition {
    all i: Internship |
        (i.status = InternshipOpen) =>
        (no i.applications or all a: i.applications |
            a.status = ApplicationRejected)
}
check internshipOpenCondition

// Ensures that internships in the "Accepted" status have at least one
//accepted application.
assert internshipAcceptedCondition {
    all i: Internship |
        (i.status = InternshipAccepted) =>
        (some a: i.applications | a.status = ApplicationAccepted)
}
check internshipAcceptedCondition

// Ensures that internships in the "Ongoing" status have at least one
//accepted application.
assert internshipOngoingCondition {
    all i: Internship |
        (i.status = InternshipOngoing) =>

```

```

        some a: i.applications | a.status = ApplicationAccepted
    }
check internshipOngoingCondition

// Ensures that internships in the "Closed" status have no pending applications.
assert internshipClosedCondition {
    all i: Internship |
        (i.status = InternshipClosed) =>
        no a: i.applications | a.status = ApplicationSubmitted
}
check internshipClosedCondition

// -- Predicates:

// Generates a complete world with multiple students, companies,
//internships, applications, feedback, and complaints.
pred completeWorld {
    some s: Student, c: CompanyHR, i: Internship, a: Application, f: Feedback,
    comp: Complaint, uc: UC |
        a.student = s and
        a.internship = i and
        i in c.posts and
        f.about = i and
        comp.handledBy = uc
}
run completeWorld for 5

```

22 commands were executed. The results are:

- #1: No counterexample found. validApplications may be valid.
- #2: No counterexample found. validFeedback may be valid.
- #3: No counterexample found. complaintsHandledByUC may be valid.
- #4: No counterexample found. internshipLifecycleValid may be valid.
- #5: No counterexample found. applicationLifecycleValid may be valid.
- #6: No counterexample found. feedbackGivenByValidEntities may be valid.
- #7: No counterexample found. complaintLifecycleValid may be valid.
- #8: No counterexample found. noApplicationToClosedInternship may be valid.
- #9: No counterexample found. allComplaintsHandled may be valid.
- #10: No counterexample found. feedbackGivenByValidAccount may be valid.
- #11: No counterexample found. ongoingInternshipsHaveAcceptedApplications may be valid.
- #12: No counterexample found. openComplaintUnassigned may be valid.
- #13: No counterexample found. underReviewComplaintAssigned may be valid.
- #14: No counterexample found. noRejectionAfterAcceptance may be valid.
- #15: No counterexample found. feedbackLinkedToValidEntities may be valid.
- #16: No counterexample found. complaintOpenOrUnderReview may be valid.
- #17: No counterexample found. allFeedbackLinkedToInternships may be valid.
- #18: No counterexample found. internshipOpenCondition may be valid.
- #19: No counterexample found. internshipAcceptedCondition may be valid.
- #20: No counterexample found. internshipOngoingCondition may be valid.
- #21: No counterexample found. internshipClosedCondition may be valid.
- #22: **Instance found.** completeWorld is consistent.

Examples

In this section we present two different instances of the completeWorld predicate to illustrate the behaviour of the system under different conditions. The first instance, SimpleWorld, represents a minimal configuration with a limited number of entities and interactions, designed to highlight the core relationships and constraints of the model in a simple context. The second instance, ComplexWorld, introduces a more complicated scenario with a richer set of entities, applications and relationships, demonstrating the model's ability to handle complex behaviours and lifecycle transitions.

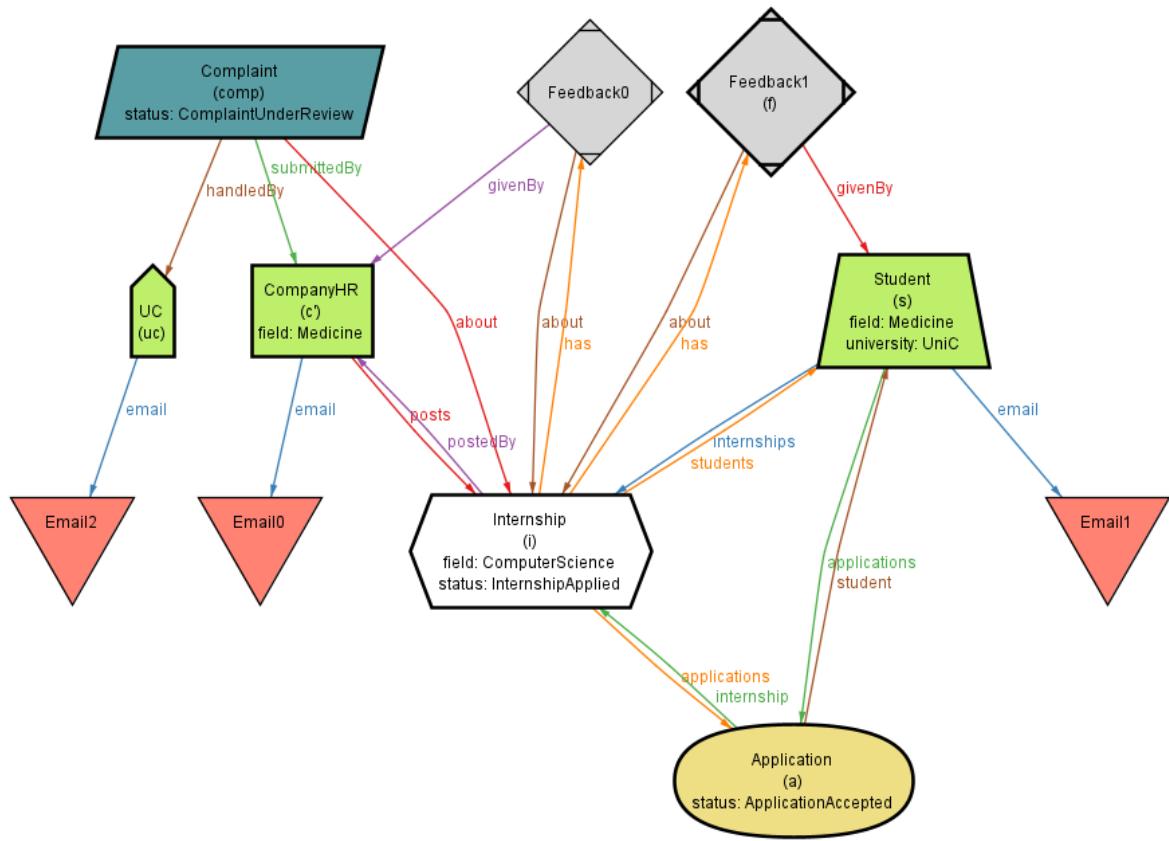


Figure 38: Example of a simple world

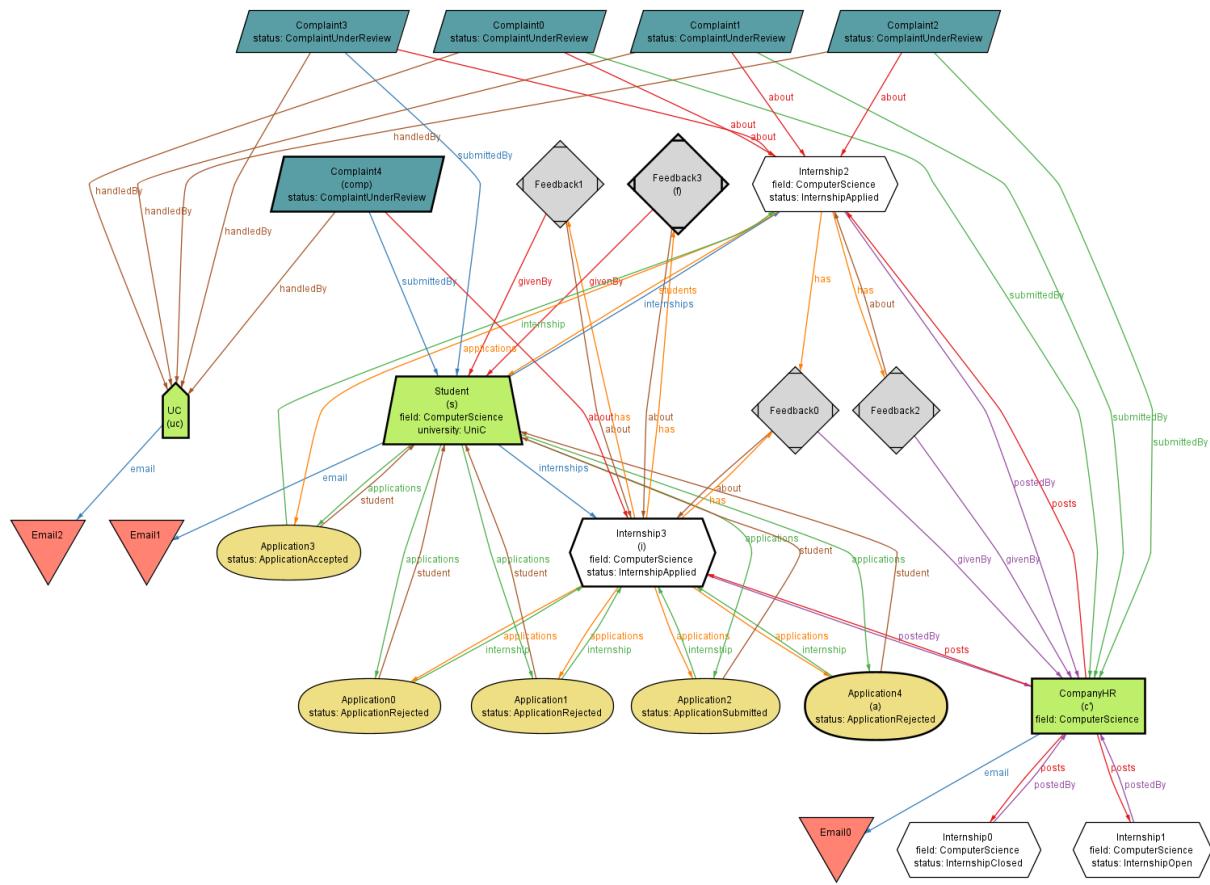


Figure 39: Example of a more complex world

5. Effort Spent

5.1. Xin Ye

Task	Hours
Introduction	5.30
Goals and phenomena	3
User characteristics	0.30
Requirements and Domain Assumptions	3
Mapping	3.30
Alloy Model	9.30
Use Cases Tables	5
Use Cases Diagrams	2
Mock-ups	9
Document revision	6.3

Table 25: Effort spent by Xin Ye

5.2. Matteo Civitillo

Task	Hours
Goals and phenomena	3
Requirements and Domain Assumptions	2
Alloy Model	15
Use Cases Tables	1.30
Use Case Analysis	5
State Diagrams	2.30
Specific Requirements section	5.30
Class Diagram	5
Product Functions	4
Document revision	5

Table 26: Effort spent by Matteo Civitillo

5.3. Mattia Vicenzotto

Task	Hours
Goals and phenomena	2
Product Prospective	5
Requirements and Domain Assumptions	5
Alloy Model	7.30
Use Cases Tables	3.30
Use Cases Diagrams	8
Product Functions	3.30
Document revision	10

Table 27: Effort spent by Mattia Vicenzotto