

RASD Ricci, Paoli, Grisoni



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RASD

Requirement Analysis and Specification Document

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Authors: Lorenzo Ricci, Matteo Giovanni Paoli, Samuele Grisoni

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1 Document Information

Version	Modification Details
v1.0: 22-12-2024	First version.
v1.1: 09-02-2025	<p>Modifications:</p> <ul style="list-style-type: none"> • Added section 1 for document history details; • Refactor the domain class diagram in section 3.1.2 to include the Auth Provider and ensure more coherent class fields for InternshipOffer, Student, and University. • Corrected the transition label in Figure 2, the Recommendation Process state chart: (from '<i>Student rejects</i>' to '<i>Company rejects</i>'). • Corrected the transition label in Figures 4 and 6, respectively the Interview Process and Selection Process state charts: (from '<i>Recommendation has been accepted</i>' to '<i>Recommendation/Spontaneous Application has been accepted</i>'). • Updated Figure 14, the Registration use case diagram, replacing Email Service with Auth Provider to better represent a realistic scenario where the authentication service directly handles both authentication and user credential confirmation via email. • Corrected typo in Figure 18 and 19, respectively Company and University sign up sequence diagrams: (from '<i>VAC</i>' to '<i>VAT</i>'). • Changed Email Service to Auth Provider in Figure 17, 18, 19 and 20, which respectively represent the Student, Company, and University sign-up and the user login sequence diagrams. This update reflects a more realistic scenario in which the Auth Provider directly handles user validation, registration, and credential confirmation via email. • Refactor section 3.4.2, to include Auth Provider dependency. • Refactor section 4.1.3, to include Auth Provider software interface. • Changed Email Service to Auth Provider in tables 7, 8, 9 and 10, which respectively represent the Student, Company, and University sign-up and the user login use case tables. This update reflects a more realistic scenario in which the Auth Provider directly handles user validation, registration, and credential confirmation via email.

2 Introduction

2.1 Purpose

The purpose of the Student&Company (S&C) Platform is to create a system that allows Students to find Internships to enhance their education and improve their curriculum, while allowing Companies to find suitable candidates for their internship programs. All of this is done in a simple and efficient way by providing a series of tools to help both parties in the process.

S&C will support the entire lifecycle of the Internship process for both Students and Companies. The matchmaking can be done both automatically by the system through a proprietary Recommendation Process or by a Student with a Spontaneous Application to a specific internship offer. The final selection process is done through interviews created and submitted by Companies directly on the platform.

In the meantime, Student&Company will also provide Students and Companies with a series of suggestions to improve their respectively published CVs and internship offers. The platform will also allow Universities whose Students are actually doing an internship to monitor the progress of such activities and handle any Complaints that may arise, even by terminating the internship if no other solution to the problem can be found.

2.1.1 Goals

- [G1] Companies would like to advertise the internships they offer.
- [G2] Students would like to autonomously candidate for available internships.
- [G3] Students would like to be matched with internships they might be interested in.
- [G4] Companies would like to perform interviews with suitable students.
- [G5] Students and companies would like to complain, communicate problems, and provide information about an ongoing internship.
- [G6] Students and companies would like to be provided with suggestions about how to improve their submission
- [G7] Universities would like to handle complaints about ongoing internships.
- [G8] Students would like to choose which internship to attend from among those for which they passed the interview.
- [G9] Companies would like to select students for the internship position among those who passed the interview.

2.2 Scope

This section defines the scope of the S&C platform, highlighting the key features and functionalities that enable interactions among students, companies, and universities. The main features to provide in order to satisfy all the goals are the following:

- **Advertise Internship:**

Companies can publish internship offers that:

- Students can spontaneously apply to;
- Recommendation process consider while looking for matches.

- **Insert CV:**

Students can provide the platform with their CV that Recommendation Process will consider while looking for matches.

- **Spontaneous Application:**

Students can autonomously apply for an available internship offer.

- **Recommendation Process:**

The platform automatically finds matches between available CV and Internships. At the end of the process, provides Students and Companies with a match they can accept or refuse.

- **Interview Process:**

Companies can interview both Student whose Spontaneous Application has been accepted, and Students that accepted a match found by the Recommendation Process the company has accepted too. The outcome of the Interview finalizes the selection process that can lead to a confirmed internship experience.

- **Internship Handling:**

Students and Companies can complain, communicate problems, provide information about a confirmed internship.

University can monitor a confirmed Internship and handle complaints, communicated problems and provided information. Handling a complaint, the University can decide to interrupt the Internship.

- **Suggestion Mechanism:**

The platform provide suggestion to both Students and Companies about the manner they insert respectively their CV and Internships. The suggestion achievement is to allow Students and Companies to perform better in Recommendation Process.

2.2.1 World Phenomena

[WP1] A company wants to advertise its internship.

[WP2] A student wants to apply for an internship.

[WP3] A company wants to accept a suitable recommendation.

[WP4] A company wants to accept a student's spontaneous application.

[WP5] A student wants to accept a suitable recommendation.

[WP6] A company wants to interview a student.

[WP7] A company wants to manage (create, visualize, send, evaluate) its interviews.

[WP8] A student wants to answer questions concerning an interview.

[WP9] A company wants to complain, communicates problem, provide information about an ongoing internship.

[WP10] A student wants to complain, communicates problem, provide information about an ongoing internship.

[WP11] A student wants to receive suggestions on how to improve his CV.

[WP12] A company wants to receive suggestions on how to improve their internship offers.

- [WP13] A university wants to monitor an ongoing internship that involves one of their students.
- [WP14] A university wants to handle complaints about an ongoing internship that involves one of their students.
- [WP15] A university wants to interrupt an ongoing internship that involves one of their students.
- [WP16] A company wants to choose from the students they are interested in the ones to whom they will offer the internship position.
- [WP17] A student wants to choose an internship position offer.

2.2.2 Shared Phenomena

Shared - By World

- [SPW1] A company publish an internship.
- [SPW2] A student insert his CV.
- [SPW3] A company accepts a spontaneous application.
- [SPW4] A student or company monitors his recommendations.
- [SPW5] A student or a company accepts a recommendation.
- [SPW6] A company creates interviews for a specific internship.
- [SPW7] A company sends to a student a previously created interview.
- [SPW8] A company evaluates a previously sent interview that has been answered by the student.
- [SPW9] A student answers questions related to an interview.
- [SPW10] A company sends to a student who passed the interview an internship position offer.
- [SPW11] A student accepts an internship position offer.
- [SPW12] A student or company complains, communicates problems, provides information about an ongoing internship.
- [SPW13] A university answers to complaints about ongoing internships that involves one of their students.
- [SPW14] A university interrupts an internship that involves one of their students.

Shared - By Machine

- [SPM1] The platform shows to students available internships.
- [SPM2] The platform shows to companies available candidates for their internships.
- [SPM3] The platform shows to students and companies information about their recommendations and spontaneous applications.
- [SPM4] The platform asks for feedbacks to improve the recommendation research mechanism.
- [SPM5] The platform notifies students and companies when a suitable recommendation involving them is found.

- [SPM6] The platform shows to companies information about their interviews.
- [SPM7] The platform provides students and companies suggestions about how to formulate better respectively their CV and internship offers.
- [SPM8] The platform shows to universities information about an ongoing internship.
- [SPM9] The platform notifies companies when there is a new spontaneous application regarding one of their internships.
- [SPM10] The platform notifies a student when a company accepts his spontaneous application.
- [SPM11] The platform notifies a student when a company sends to him a new interview.
- [SPM12] The platform notifies a student when a company evaluates an interview he previously sent.
- [SPM13] The platform notifies a student when a company sends him an internship offer.
- [SPM14] The platform notifies a company when a student accepts his internship position offer.
- [SPM15] The platform notifies the involved student and the company when a university terminates their internship.
- [SPM16] The platform notifies the university when there is a new complaint or problem about an ongoing internship regarding one of their students.

2.3 Definitions, Acronyms, Abbreviations

This section offers explanations of terminology to elucidate the terms, acronyms and abbreviations used throughout the document, facilitating easy comprehension and reference for the readers.

2.3.1 Definition

- **University:** A university that is registered on the S&C platform.
- **Company:** A company that is registered on the S&C platform.
- **Student:** A person who is currently enrolled in a University and is registered on the S&C platform.
- **User:** Any registered entity on the S&C platform.
- **Internship Offer:** The offer of an opportunity to enroll in an internship provided by a Company. The offer remains active on the platform indefinitely until the publishing Company removes it
- **Participant:** A Participant is an entity that interacts with the platform for the purpose of finding or offering an Internship Position Offer, like Students and Companies
- **Recommendation Process:** The process of matching a Student with an Internship offered by a Company based on the Student's CV and the Internship's requirements made by the S&C platform.
- **Recommendation/Match:** The result of the Recommendation Process. It is the match between a Student and an Internship.
- **Spontaneous Application:** The process of a Student spontaneously applying for an Internship that was not matched through the Recommendation Process.
- **Interview:** The process of evaluating a Student's application for an Internship done by a Company through the S&C platform.

- **Feedback:** Information provided by Participant to the S&C platform to improve the Recommendation Process.
- **Internship Position Offer:** The formal offer of an internship position presented to a student who has successfully passed the Interview, who can decide to accept or reject it.
- **Suggestion:** Information provided by the S&C platform to Participant to improve their CVs and Internship descriptions.
- **Confirmed Internship:** An Internship that has been accepted by the Student and the offering Company.
- **Ongoing Internship:** A internship that is currently in progress. All Ongoing Internships are Confirmed Internships, but the vice versa is not always true.
- **Complaint:** A report of a problem or issue that a Student or Company has with an Ongoing Internship. It can be published on the platform and handled by the University.
- **Confirmed Match:** A match that has been accepted by both a Student and a Company.
- **Rejected Match:** A match that has been refused by either a Student or a Company.
- **Pending Match:** A match that has been accepted only by a Student or a Company, waiting for a response from the other party.
- **Unaccepted Match:** A match that has been refused by either a Student or a Company.

2.3.2 Acronyms

Acronyms	Definition
RASD	Requirements Analysis & Specification Document
CV	Curriculum vitae

Table 4: Acronyms and Definitions

2.3.3 Abbreviations

Acronyms	Definition
S&C	Students&Companies

Table 5: Abbreviations and Definitions

2.4 Revision History

Revised on	Version	Description
22-12-2024	1.0	Initial release of the document

Table 6: Document Revision History

2.5 Reference Documents

- Assignment RDD AY 2024-2025 [A]
- Software Engineering 2 A.Y. 2024/2025 Slides “CreatingRASD”
- IEEE Software Requirements Specification Template [1]

2.6 Document Structure

1. **Introduction:** This section provides an overview of the document and the system. Here the purpose of the platform is explained, along with the goals and phenomena of the system. Finally, essential definitions are provided.
2. **Overall Description:** In this section, a high-level perspective of the system is provided, describing its overall purpose, functionality, and User interactions. It includes an outline of the intended features of the system, user profiles, and assumptions about the domain.
3. **Specific Requirements:** In this section, we focus on the technical and functional details of the system. Here, the external interfaces are specified as well as the functional and non-functional requirements of the system. Diagrams, such as use cases and sequence diagrams, provide a visual representation of the system’s functionality.
4. **Alloy:** This section presents the code and the generated diagrams created using Alloy, a formal specification language that has been used to ensure the consistency and correctness of some core system’s requirements.
5. **Effort Spent:** This section provides an overview of the time that each group member spent on the project.
6. **References:** This section provides a list of references used in the document.

3 Overall Description

3.1 Product Prospective

This section provides a high-level description of the Student&Company platform, outlining its main features and functionalities through the use of text description such as User Scenarios, and a more in-depth analysis of the system's structure through the use of Class Diagrams and State Charts.

3.1.1 User Scenarios

1. Student Sign-up

Mario Rossi is a student that want to improve his abilities and education by doing an internship before graduating. He opens the SC root page and select “SignUp”. He provides the required personal information such as his name, surname, date of birth, an email, and a password that he will use as login credential. He also select from the list of available university the one he is attending

If the email address has never been used on the site, Mario will receive an email for confirming the mail address and the registration of the account. Once the registration is confirmed by Mario, the account is created. If the email address is already in use, the platform will show an error that ask to insert a new email address.

2. Company Sign-up

FastRedCar SPA, a world-leading car company, aims to launch an internship program to train final-year mechanical engineering students pursuing a Bachelor’s or Master’s degree. To register on the S&C platform, the company accesses the root page and selects “Sign Up,” where they provide the required information, including the company name, headquarters address, VAT number, email address, and a password to be used as login credentials.

If both the VAT number and email address have not been previously used on the platform, FastRedCar SPA will receive a confirmation email to verify the address and complete the account registration. Once the email is confirmed, the account is successfully created.

However, if either the VAT number or email address is already associated with an existing account on S&C, an error message will be displayed, indicating that the company already has a registered account on the platform.

3. University Sign-up

The Technical University of Milan is a prestigious university that wants his students to complete an internship before graduating, believing this experience will enhance their skills and knowledge. The university opens the S&C root page and selects “SignUp” where they provide the required information such as the university name, the university description, the university VAT number, the name of the university office that will manage the internship program and also an email address and a password that will be used as login credential.

If both the VAT number and email address have not been previously used on the platform, the Technical University of Milan will receive an email for confirming the mail address and the registration of the account. Once the registration is confirmed, the account is created. However, if either the VAT number or email address is already associated with an existing account on S&C, an error message will be displayed, indicating that the university already has a registered account on the platform.

4. User Login

A platform user that has already registered an account can log in by providing the email and

password used during the registration. If the email and password are correct, matching an entry in the platform DB, the user is redirected to the platform dashboard page. If the email or password are incorrect, the platform will show an error message indicating that the login credentials are wrong.

5. Student Load Curriculum

Stefano is a student who has already registered an account on S&C and wants to complete his profile by uploading his CV. From the platform's dashboard, he clicks on the "CV" button. He is then redirected to a page where he can enter his curriculum information, including his current level of education, languages he knows, technical skills, and, optionally, details about past work experience along with contact information for previous employers. He also adds a photo of himself, a brief description of his interests and hobbies and, as soon as he clicks on the "Submit CV" button, the platform elaborates it and try to find some matching internship based on the given information. A list of five different internships, to which Stefano has been matched, is shown to the student in the platform's recommendations page where he can decide to apply for one of them, notifying the company. While computing the matching, the platform also provides Stefano with some suggestions on how to improve his CV and matching probability, based on a grammar and lexical analyses and a direct comparison of Stefano's CV with other similar candidate

6. Company Submit an Internship Insertion

AnanasPhone is a major tech company, specialized in the production of smartphones and tablets, that has an account on the S&C site. The company wants to create an internship program aimed at software engineering students in the final year of their Master's degree.

A Human Resource employee open the S&C platform and select "Internship Offers" where a list of all the internship already present on S&C are shown. Here he clicks on "Create Internship" where he provides the required information such as the internship title, the internship description, the start date and duration, the office address, a list of the required skills students need to have in order to be considered for the internship and, possibly, a list of benefits offered to the future intern. Once the internship is created, by clicking on the "Submit Internship" button, the platform will start the recommendation process with the aim to match the internship with all the students that are compatible with such opportunity, based on the given information of both parties.

The platform will also provide AnanasPhone with some suggestions on how to improve the internship description, and matching probability, based on a grammar and lexical analyses and a direct comparing of AnanasPhone's Internship proposal with other similar companies.

7. Company create a structured interview to submit to possible candidate

MacroHard is a world-leading tech company, known for creating its secure and reliable operating system, "Door". The company has an account on the S&C platform and has already set up an internship program for software engineering students pursuing a Master's degree. The company wants to create a structured interview to evaluate the technical skills and motivation of the students who apply for the internship.

MacroHard opens the platform dashboard and, on the page displaying the lists of matched students, clicks on the "Create Interview" button. This option allows the company to create structured interviews that will be submitted to candidates. MacroHard can create multiple interviews for the same internship, allowing to submit them to different students based on factors such as the student's CV, method of application (matched or spontaneous), or other criteria.

For this internship, MacroHard has created two types of interviews: one for matched students to assess their technical skills, and another for spontaneous applicants, which evaluates not only technical skills but also the student's motivation.

8. Student accepts a matched internship

Sara is an economic major student that has already uploaded her CV on the S&C platform, and she is looking for an internship. She has received a notification and, by clicking on it, she sees that a

new internship is available for her.

Sara reads the internship information, and she decides to accept it. A notification is then sent to the company that created the internship informing them of Sara's acceptance of the match. If the company also accepts the match, the platform requires the company to initiate the selection process by creating or assigning a structured interview to Sara, who will be notified about it. To both parties, feedback is requested by the platform to improve the Recommendation Process by asking both to rate the matching generated by S&C

9. Student manually applies for an internship

Marco is a chemistry student that has already uploaded his CV on the S&C platform and is looking for an internship. Unfortunately, the matching internships provided by the platform do not fully satisfy his needs, and he decides to proactively search for another one.

He opens the platform's dashboard page and click on the "Browse all Internships" button. Here he can see all the internships that are available on the platform, and he can filter them by field of study, required skills, location and other parameters. He finds an internship that is not in the matching list provided by the platform, but that is perfect for him, so he clicks on the "Apply" button.

The platform notifies the company that Marco has applied for the internship and will inform the student the company will start the application process by sending him an interview. There is no need for Marco to accept the interview, as a spontaneous application is considered as an implicit acceptance of the match by the student.

10. Student see his application interview status

Stefano is a student who has applied for various internships through the S&C platform. He has submitted applications, both by matching with companies through the platform's automated feature, and by manually applying. He is already in a selection phase with some of them, and he is currently waiting for updates from the different companies.

When Stefano logs into the platform, he navigates to "Interviews". In this section, he can view the status of each of his applications by clicking on each one of them. This includes whether the company has assigned him an interview, whether his interview has been reviewed, and whether he has been accepted or rejected for the position. In the same section, he can also see if the platform is running the recommendation process, matching his profile with all the other possible internship offers.

11. Company see the status of the selection process

CosmoX, a renowned private space company that is specialized in the reuse of rocket, has created an internship on the S&C platform for aspirants Aerospace engineers. It has received multiple manual applications from different students and has been match numerous time. The company has already accepted all worthy manual applications and matches and has assigned structured interviews to everyone. CosmoX is now waiting for the students to complete the interviews.

When a CosmoX employee logs into the platform, he can navigate to the "Interview" section. In this section, he can view the status of each interview and the status of each student, such as: "SENT" if the student has received the interview but not opened yet, "COMPLETED" if the student has completed the interview and "REVIEWED" if the company has started the review process of the interview.

12. Student refuse/accept an internship

Paula is an Art Major that has been matched by S&C with different museums and private art galleries in the city of Florence. She happily accepted all the matches and completed the interviews with all the companies. She did not expect to pass all the interviews, and now she has to choose between the different offers.

Paula open the platform and navigate to the "Interview" section, where she can see all of her interview and the status of each one. To refuse an internship position after successfully passing the

interview, Paula clicks on it and then clicks on the “Refuse” button, and the platform will notify the company about her the decision. By doing the same process, but clicking on the “Accept” button, the platform will notify the company that Paula has accepted the internship and will and block any other interview process informing the respective companies.

By navigating to the “Interview” section, any company can see, between the different possible state of an application, if the internship of a particular student has been accepted or refused.

13. Company publishes a complaint about a student

PlaneHearts is a company famous for its innovative and multi-platform IDE for the development of mobile applications. The company has created an internship on the S&C platform for software engineering students and selected Giovanni, a computer science student, for the internship. However, after the internship started, employees at PlaneHearts noticed that Giovanni was not performing as expected, did not have the required skills, and was not motivated to learn. The company decided to publish a complaint about Giovanni on the platform to inform the student’s university.

For publish the complaint, the person managing PlaneHearts account on S&C, logs into the platform and navigates to the “Complaints” section. Here, he can view all the complaints they have published and can create a new complaint by providing the student’s name, the internship title, and describing the problem that has arisen. Once the complaint is submitted, the platform will notify Giovanni and his university.

14. Student responds to a complaint

Giovanni has received a notification from the S&C platform that a complaint has been published about him by PlaneHearts, the company where he is currently doing an internship. The complaint states that Giovanni is not performing as expected, does not have the required skills, and is not motivated to learn during this experience.

The Student will have the opportunity to respond to the complaint and provide his version of the events by navigating to the “Complaints” section of the platform. Here, he can view all the complaints published about him and can respond to each one by providing a description of the situation from his perspective.

15. University handles a complaint

The University of Rome, a prestigious university that has students enrolled in the S&C platform, has received a complaint about one of their students. The carrier advisor at the university opens the S&C platform and navigate to the “Complaints” section. Here, he can view all the complaints published about his students and can handle each one by reviewing the complaint, contacting the student and the company involved, and taking appropriate actions to resolve the issue. In this particular case, the advisor and the university have decided to interrupt the internship of the student to protect the student and the company from further issues. The university do so by clicking on the “Interrupt Internship” button in the complaint page. The platform will notify the student and the company about the interruption of the internship and will close the complaint.

3.1.2 Class Diagrams

The following UML class diagram describes the domain of our interest with the entities involved in it and the main relations between them. It includes the main attributes and a limited set of methods that represent the core functionalities of the system. These entities capture the essence of the platform’s domain.

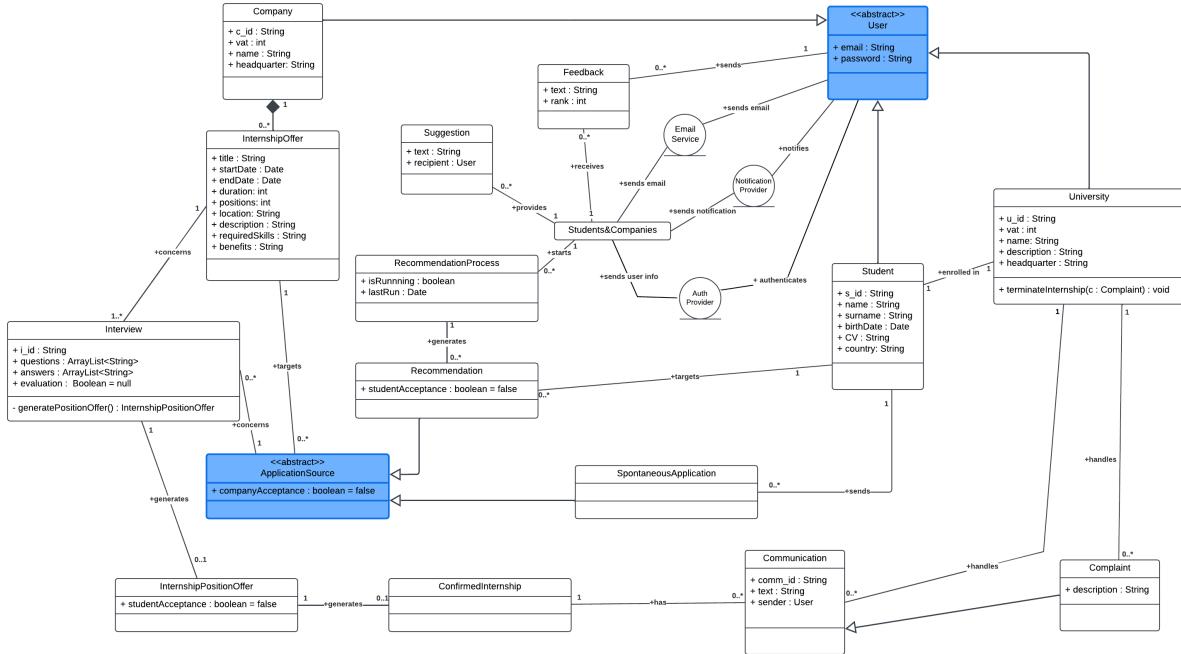


Figure 1: Class Diagram

To clarify the methods signatures:

- Interview: `generatePositionOffer(): InternshipPositionOffer`
generates the `InternshipPositionOffer` if the company wants to provide the student who passed an interview with an Internship Position Offer.
 - University: `terminateinternship(c: Complaint): void`
allows the University to terminate an Internship through a Complaint.

Other methods have been omitted for simplicity, as the relations are sufficient to understand the domain.

3.1.3 State Charts

The following section presents a series of state diagrams illustrating the progression of the main phases of the Student&Company platform. These diagrams include representations of the Recommendation Process and its Spontaneous Application variant, the Interview Process that may result in an Internship Position Offer, and finally, a Selection Process diagram that highlights the relationship between the latter two processes. These diagrams represent the possible states that the object Interview can be in, without detailing all possible outcomes explicitly. For example, the case of the interview accepted or rejected are represented into a single state, InternshipEnded, without loss of generality.

Recommendation Process

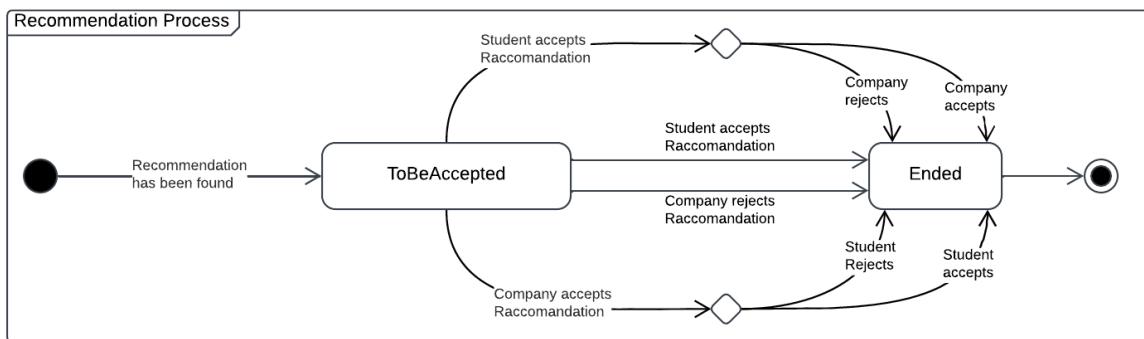


Figure 2: Recommendation State Chart

- The Recommendation Process is the core of the Student&Company platform. It is the process that matches Students with Internships based on the Student's CV and the Internship's requirements. It is initiated by the platform when it detects a potential Match. The process then evolves to a "ToBeAccepted" state, where the system waits for the Student and the Company to accept the Match. If one of the two parties rejects the Match, the process is terminated. If both parties accept the Match, an Interview is initiated, and the process is terminated.

Spontaneous Application Process

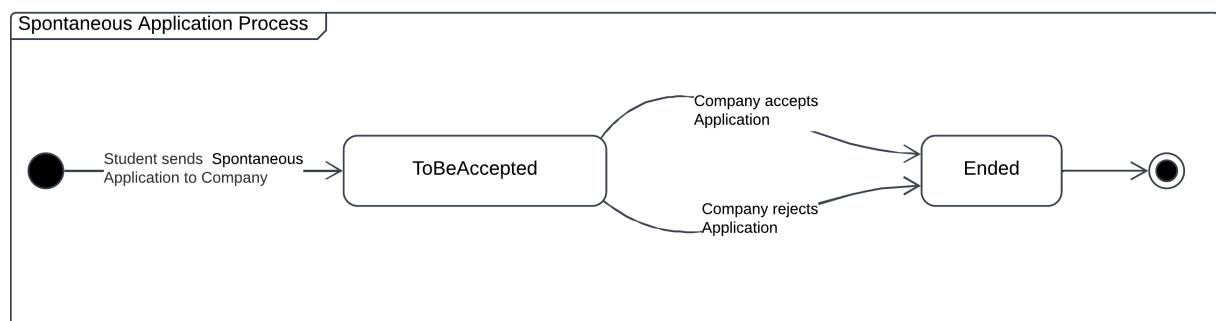


Figure 3: Spontaneous Application State Chart

- Unlike the Recommendation Process, the Spontaneous Application process is initiated by the Student. When a Student submits a Spontaneous Application for an Internship, the process evolves to a "ToBeAccepted" state, where the system waits for the Company to accept the Application.

If the Company rejects the Application, the process is terminated. If the Company accepts the Application, an Interview Process is initiated, and the process is terminated.

Interview Process

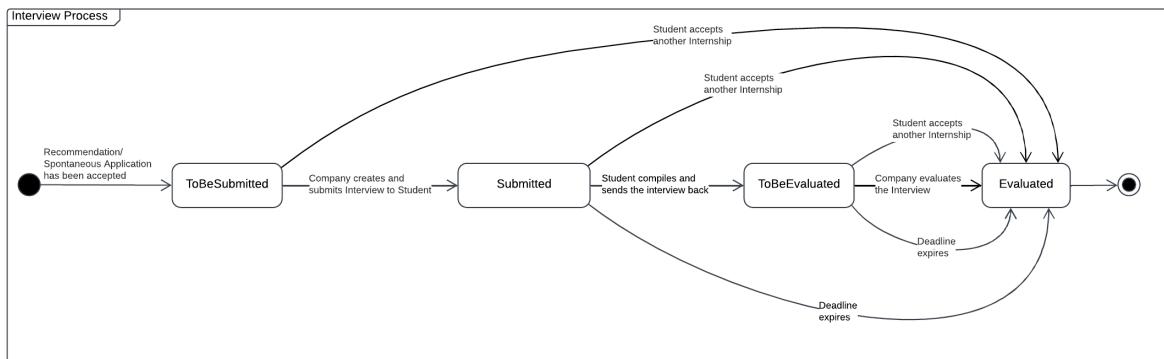


Figure 4: Interview State Chart

- The Interview Process is initiated when a Match is accepted by both the Student and the Company, or when the Company accepts a Spontaneous Application. The process starts in the “ToBeSubmitted” state, where the Company is asked to create and submit an Interview. Here, the Company is required to specify a deadline for the Interview. The Interview process evolves into the “Submitted” state once the Company sends the Interview to the Student, who answers the questions and submits the Interview. If the Student fails to submit the answers within the deadline, he will be considered rejected, and the process is progressed to an “Evaluated” state and terminates. Otherwise, after the Interview has been sent back by the student, the process evolves to a “ToBeEvaluated” state. In this state, the Company can manually evaluate the Student’s answers and mark the interview as accepted or rejected. In case the Student has been rejected, he will be notified of the outcome, and the process is terminated. Otherwise, if the Student has been accepted, an Internship Position Offer process started and the Interview Process is terminated. If anywhere in the process, the Student accepts another Internship, the process terminates and the Student will be considered rejected.

Internship Position Offer process

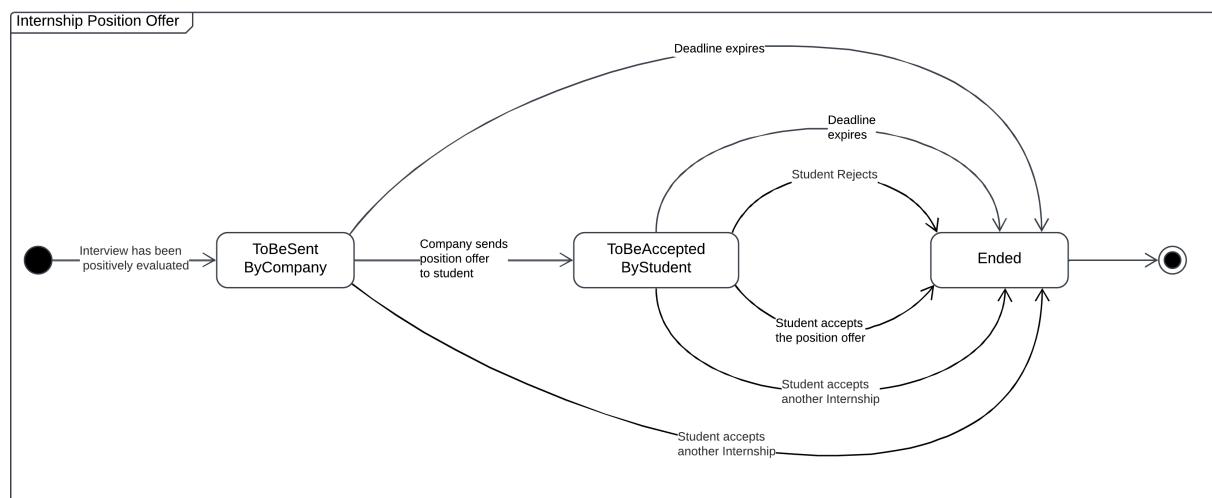


Figure 5: Internship Position Offer State Chart

- The Internship Position Offer process begins when a student successfully completes the Interview Process. Initially, the process enters the “ToBeSentByCompany” state. This state allows companies to evaluate and select the most suitable candidates when more students than required have passed the interview. If the company rejects the student or the deadline expires, the process concludes, and the student will be considered rejected. If the company accepts the student, the process transitions to the “ToBeAcceptedByStudent” state, where the student decides to either accept or reject the offer. If the student rejects the offer or lets the deadline expire, the process concludes, and the student will be considered rejected. If the student accepts the offer, the process concludes, and all the student’s other ongoing interviews are terminated with the student being marked as rejected in those interviews. If anywhere in the process, the Student accepts another Internship, the process is terminated and the Student will be considered rejected.

Selection Process

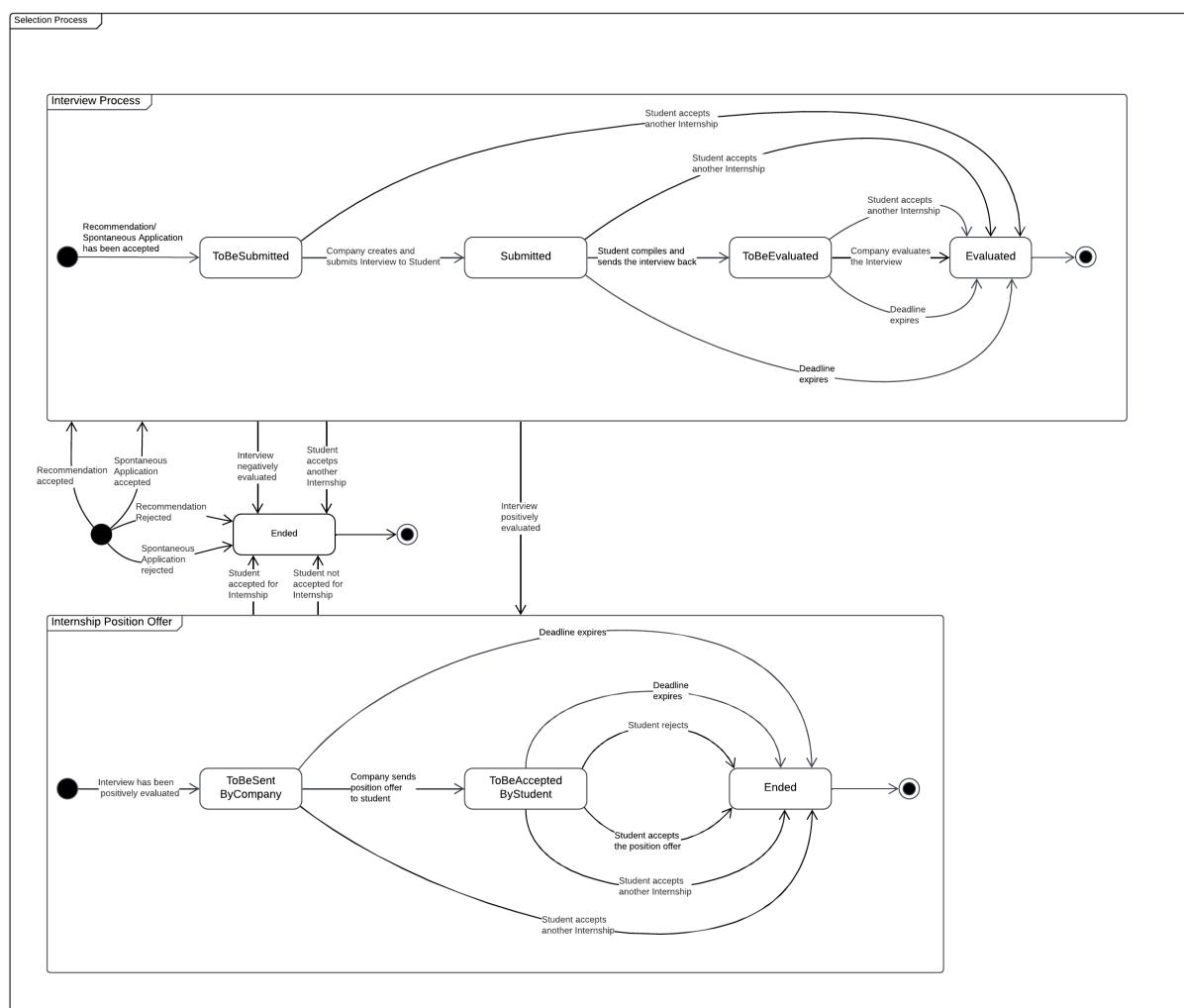


Figure 6: Selection Process State Chart

- The Selection Process diagram illustrates the relationship between the Interview Process and the Internship Position Offer Process. The Selection Process terminates if the Match is rejected, if the Student is rejected during the Interview Process or the Internship Position Offer Process, or if the Student accepts another Internship. If the Student is accepted during the Interview Process, the process transitions to the Internship Position Offer Process. If the Student accepts the Internship

Position Offer, the process also concludes.

3.2 Product Functions

This section outlines the essential functionalities and detailed requirements of the platform, structured to support the key objectives defined in the scope of the product.

1. **User Management:** The platform allows Students, Companies, and Universities to register and log in. It also provides Students with the ability to upload and modify their CVs, and Companies with the ability to view and manage their Internships.
2. **Internship Creation and Management:** Companies can create, publish, and manage Internship offers on the platform. They define details such as job description, requirements, deadlines, and benefits. Companies also have the ability to terminate Internship offers when they are no longer available.
3. **Student Application Process:** Students can browse available Internships and apply to Internships either through automatic matching or by submitting Spontaneous Applications. They can also track the status of their Applications throughout the process.
4. **Automated Recommendations:** The platform matches Students with suitable Internships based on their CVs and the specific requirements set by Companies. Once a match is found, both Students and Companies are notified, and they can accept or decline the Recommendation.
5. **Interview Management:** Companies can create and assign Interviews to Students, which include closed and open questions to assess their suitability for an Internship. Both Students and Companies can track the Interview progress, and Companies can evaluate Student responses. Companies can also select among students who have passed the interview those to whom they will propose an Internship Position Offer.
6. **Feedback and Suggestions for Improvement:** The platform collects Feedback from Students and Companies to improve the Recommendation Process. It also provides Suggestions to Students on how to enhance their CVs and to Companies on how to improve their Internship descriptions.
7. **Complaint Management:** Students and Companies can publish Complaints about Ongoing Internships, which are then handled by Universities. Universities can monitor Complaints and interrupt Ongoing Internships if necessary.
8. **Notification System:** Notifications are sent to Students, Companies, and Universities when relevant events occur, such as new Internships, matched Recommendations, Interview assignments, Internship Position Offers, Sign-up confirmation, Complains or Communications.

3.2.1 Requirements

- [R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.
- [R2] The platform shall allow any companies to register by providing company information.
- [R3] The platform shall allow any universities to register by providing university information.
- [R4] The platform shall allow Users to log in using their email and password.
- [R5] The platform shall send notifications to Users when relevant events occur.
- [R6] The platform shall allow Companies to create and publish Internship offers specifying details.
- [R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.

- [R8] The platform shall provide Students with Matches automatically obtained by the Recommendation Process.
- [R9] The platform shall allow Students to view and navigate all available Internships.
- [R10] The platform shall enable Students to submit Spontaneous Applications to Internships they choose.
- [R11] The platform shall allow Students to submit their CV.
- [R12] The platform shall allow Students to modify their CV.
- [R13] The platform shall allow Students to monitor the status of their Spontaneous Applications.
- [R14] The platform shall allow Students to monitor the status of their Recommendation.
- [R15] The platform shall display to Students all the Internships found by the Recommendation Process.
- [R16] The platform shall display to Companies all the CVs of Matched Students obtained by the Recommendation Process.
- [R17] The platform shall allow Students and Companies to accept a Recommendation.
- [R18] The platform shall allow Companies to accept a Spontaneous Application.
- [R19] The platform shall start a Selection Process only if both the Company and the Student have accepted the Recommendation.
- [R20] The platform shall start a Selection Process only if the Company has accepted the Spontaneous Application.
- [R21] The platform shall allow Companies to create Interviews.
- [R22] The platform shall allow Companies to submit Interviews to Students they have initiated a Selection Process with.
- [R23] The platform shall allow Students to answer Interview questions and submit them.
- [R24] The platform shall allow Companies to manually evaluate Interview submissions.
- [R25] The platform shall allow Students and Companies to monitor the status of their Interviews.
- [R26] The platform shall enable Companies to complete the Interview process by submitting the final outcome to each candidate.
- [R27] The platform shall enable Companies to send an Internship Position Offer to a Student only if he previously passed the relative Interview.
- [R28] The platform shall enable Students to accept or reject an Internship Position Offer sent by a Company only if he previously passed the relative Interview.
- [R29] The platform shall collect Feedback from both Students and Companies regarding the Recommendation Process.
- [R30] The platform shall provide Suggestions to Students on improving their CVs.
- [R31] The platform shall provide Suggestions to Companies on improving Internship descriptions.
- [R32] The platform shall allow registered Universities to access and monitor Internship Communications related to their Students.

[R33] The platform shall provide a dedicated space for Students and Companies to exchange Communications about the current status of an Ongoing Internship.

[R34] The platform shall allow registered Universities to handle Complaints and to interrupt an Internship at their own discretion.

3.3 User Characteristics

Student&Company is designed to be used by three main types of Users: Students, Companies, and Universities. Each User has a specific role and can perform different actions on the platform as described below:

- **Students:**

Students are individuals currently enrolled in a University (which must be registered on the Platform) who are looking for Internship opportunities to enhance their education and their curriculum. They can register on the platform, upload their CVs, and apply for Internships either through the Recommendation Process or by submitting a Spontaneous Applications to an Interview Offer to which they are particularly interested. Students can also monitor the status of their Applications, Interviews, and Internship Position Offers through a dedicated section on the platform and, if necessary, can report problems encountered during an Ongoing Internship to their University by creating a Complaint.

The platform also provides Students with Suggestions on how to improve their CVs and matching probability based on a grammar and lexical analysis and a direct comparison of the Student's CV with others similar candidate. The Student can also improve the platform by providing Feedback on the Recommendation Process once a Confirmed Match is found.

- **Companies:**

Companies are entities that are looking for interns to train and educate in their field of expertise. Each company account is created by a representative of the Company, usually a Human Resource employee or a manager that is in charge of the internship program.

Companies can register on the platform and create, publish, manage and delete different Internship Offers at the same time. They can also view and manage the CVs of Students that have been matched or have sent a Spontaneous Application to such offers, and create and submit Interviews to evaluate them. If a Student passes the Interview, the Company can send an Internship Position Offer to him while monitoring other Interviews and Internship Position Offers and, moreover, each Company can report problems encountered during an Ongoing Internship by creating Complaints. The platform also provides Companies with Suggestions on how to improve their Internship descriptions and matching probability based on a grammar and lexical analysis and a direct comparison of the Company's Internship Offer with other similar companies. They can also help improve the platform by providing Feedback on the Recommendation Process once a Confirmed Match is found.

- **Universities:**

Universities are institutions that are looking to provide their Students with Internship opportunities to enhance their education and curriculum. Each university account is created by a representative of the University, usually a carrier advisor or a professor that is in charge of the internship program. Universities can register on the platform and monitor their Students by receiving Communication both from Student and Companies. Such Communication can be about the acceptance of an Internship Position Offer by a Student or some problem encountered during an Ongoing Internship reported by a party through a Complaint.

The University can handle such Complaints and, eventually, interrupt an Ongoing Internship if no solution to the problem is found to prevent further issues.

While Student&Company is not specifically designed to accommodate users with special needs, the platform implements several basic accessibility features to improve usability for all users. These include different display modes such as dark mode, screen-reader compatible layouts and easily readable fonts. The web interface try to follow WCAG 2.1 Level A guidelines for basic accessibility compliance. However, users requiring specialized assistive technologies may need to rely on their own tools and software to interact with the platform optimally.

3.4 Assumptions, dependencies, and constraints

3.4.1 Domain Assumption

This section outlines the basic assumptions about the environment and behavior of entities that interact with the system. These assumptions simplify the design and implementation by defining expectations about Students, Companies, Universities, and the platform, ensuring the system operates effectively within its intended context.

- [D1] Students and Companies provide the Platform with correct and truthful information.
- [D2] Companies remove published Internships if they are no longer available.
- [D3] The Email Service and Notification Manager services are reliable, and the Users visualize every notification
- [D4] Students, Companies, and Universities have a working internet connection.
- [D5] Universities interrupt an Ongoing Internship only if no solution is found to the Complaints.

3.4.2 Dependencies

The platform relies on only three external actors: the Notification Provider, the Email Service, and the Auth Provider.

- The first is responsible for correctly handling push notifications to ensure they are delivered to users.
- The second is responsible for sending notifications via email.
- The third is responsible for handling user authentication and confirming user credentials via email.

For more details, see section 4.1.3

4 Specific Requirements

4.1 External Interface Requirements

This chapter provides a detailed description of the system's external interfaces such as the User, Hardware, Software, and Communication interfaces.

4.1.1 User Interfaces

The user interface will be designed to improve intuitiveness and simplicity. The platform root page is the Home Page from which every non-registered user can find information about S&C such as the latest news. The Home page is linked to other pages, such as the Dashboard, Contacts, and About page, using an app bar. In the Contacts page, the user can find useful links to get in touch with S&C.

The image shows a screenshot of a mobile application's home screen. At the top, there is a navigation bar with links for "Home", "Dashboard", "About", and "Contacts". On the right side of the bar are "Sign in", "Sign up", and a light/dark mode switch. Below the navigation bar, the main title "Students & Companies" is displayed in a large, bold font. Underneath the title, a subtitle "Stay in the loop with the latest news" is visible. The screen is divided into two main sections, each containing a card with a scenario description and a small image. The left section is titled "UserScenario" and "Student Sign-up". It features an image of a person's hands holding a smartphone displaying a sign-up form. Below the image, the text reads: "Mario Rossi is a student that want to improve his ability and education by doing an internship before graduating. He opens the SC platform and select "Student SignUp...". The right section is titled "UserScenario" and "Company Sign-up". It features an image of a person's hands typing on a laptop keyboard. Below the image, the text reads: "FastRedCar SPA is a world-leading car company that aims to launch an internship program to train new mechanical engineers in their final year of a Bachelor's or...".

Figure 7: UI Home Page: as an example, UI cards containing some user scenarios described in the 3.1.1 are shown

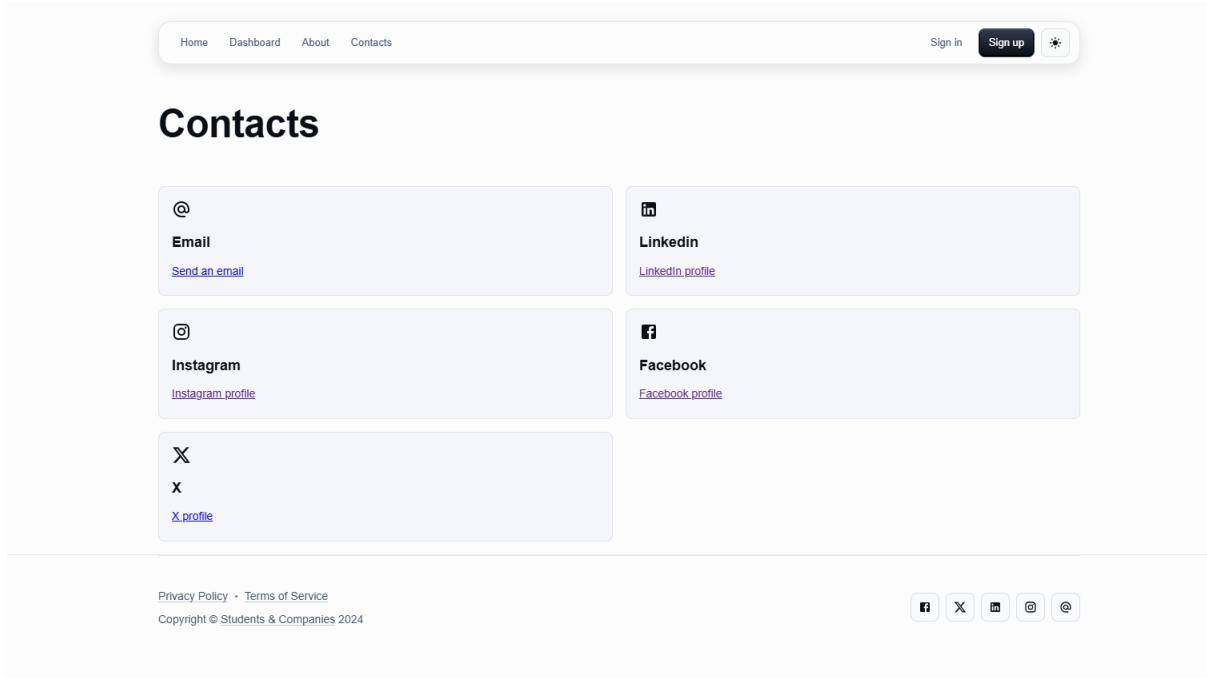


Figure 8: UI Contacts Page

Thanks to the app bar link buttons, users can also reach the Sign-Up and Sign-in pages. The Sign-Up page allows for different types of sign-up according to the new user type. This allows the user to provide the platform with the correct information.

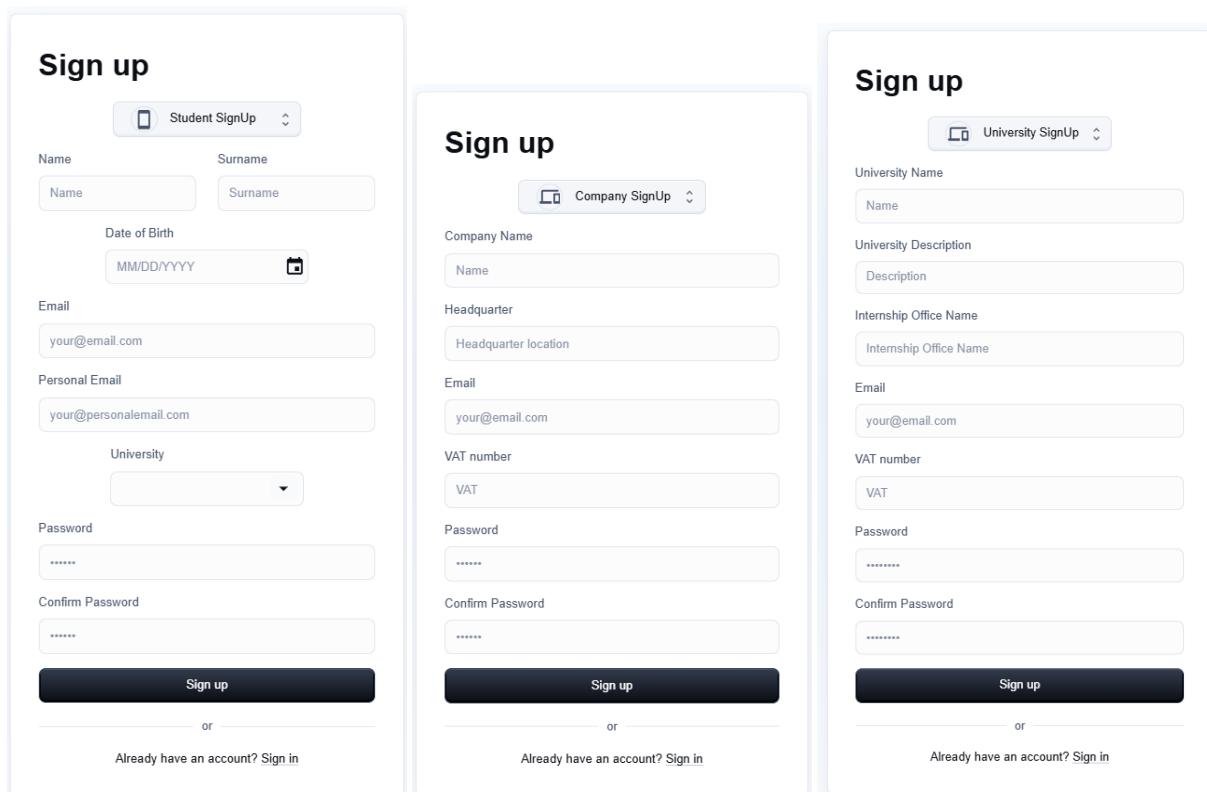


Figure 9: UI Sign-Up Page

To be able to log into the platform, the user shall provide his email and password.

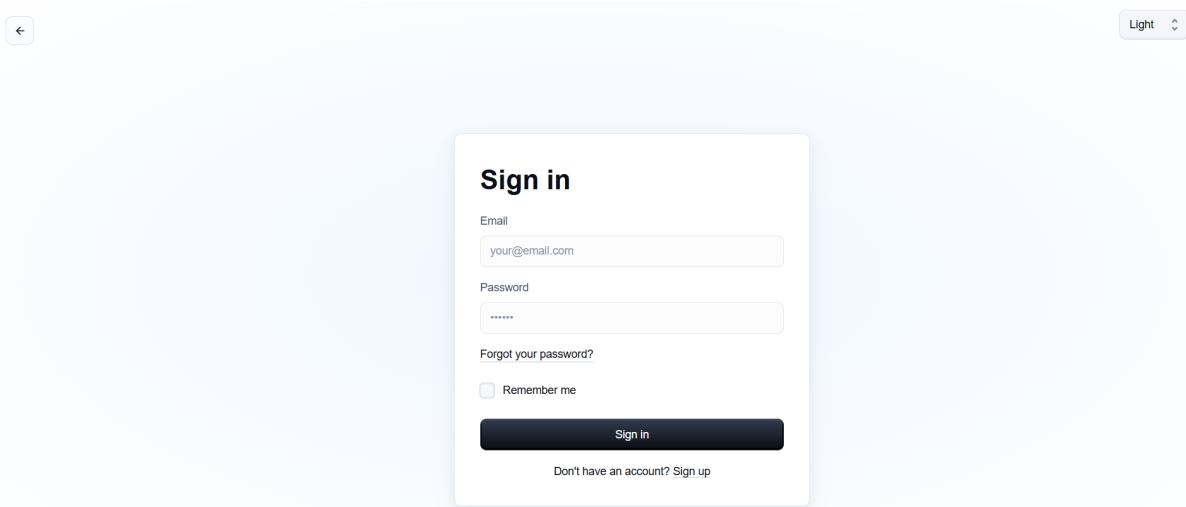


Figure 10: UI Sign-In Page

The Dashboard page will be the central hub for logged-in users. From the left-hand panel of the dashboard, all the pages associated with the core functionalities of the platform are reachable. Therefore, this page is provided after a successful log-in. The side panel contains different elements according to the user needs.

 A screenshot of the UI Company Dashboard Page. On the left is a sidebar with navigation items: Overview, Browse Internship, Internship Offers (selected), Spontaneous Applications, Recommendation Process, Interviews, Confirmed Internship, and Communications. Below these are Profile, S&C H, Account Settings, and a Logout button. The main content area shows a breadcrumb 'Dashboard > Internship Offers' and a '+ Create New Internship Offer' button. It lists several internships in cards:

- Marketing Intern**: Description: Support the marketing team in creating campaigns and analyzing results. Education Level: Undergraduate in Marketing or Business Administration. Languages: English (B2+), Italian (Optional). Duration: 3 months.
- Human Resources Intern**: Description: Assist in recruitment processes and employee engagement initiatives. Education Level: Undergraduate in Human Resources or Psychology. Languages: English (C1), Italian (Optional). Duration: 6 months.
- Event Planning Intern**: Description: Assist in planning and coordinating corporate events. Education Level: Undergraduate in Event Management or Hospitality. Languages: English (B2+), Italian (Optional). Duration: 4 months.
- Environmental Studies Intern**: Description: Support research on sustainable development initiatives. Education Level: Undergraduate in Environmental Science or Sustainability. Languages: English (C1), Italian (Optional). Duration: 5 months.
- Graphic Design Intern**: Description: Collaborate with the creative team to design visual assets for marketing campaigns. Education Level: Undergraduate in Graphic Design or similar. Languages: English (B2+), Italian (Optional). Duration: 4 months.
- Customer Support Intern**: Description: Assist the support team in resolving customer inquiries and improving service processes. Education Level: Undergraduate in Business Administration or similar. Languages: English (C1), Italian (Optional). Duration: 3 months.
- Data Analyst Intern**
- Legal Intern**

Figure 11: UI Company Dashboard Page

The screenshot shows the UI Students Dashboard Page. On the left is a sidebar with navigation links: Overview, Cv, Browse Internships, Spontaneous Applications, Recommendation Process, Interviews, Confirmed Internship, Communications, Settings, S&C Home, and a user profile section with Student Name and email. The main content area is titled 'CV Summary' and contains sections for Personal Information (Name: Mario Rossi, Date of Birth: 12/05/1990, Address: Via Roma, 10, Milano, Italy, Phone: +39 123 456 7890, Email: mario.rossi@example.com), Contacts (LinkedIn: linkedin.com/in/mariorossi, GitHub: github.com/mariorossi, Twitter: @MarioRossi), Education (BSc in Computer Science - Università degli Studi di Milano (2010-2013), MSc in Software Engineering - Politecnico di Milano (2014-2016)), Work Experience (Software Developer - TechCorp (2016-2019), Senior Software Engineer - DevSolutions (2019-2022), Team Lead - Innovatech (2022-Present)), Courses (JavaScript Advanced Course - Codecademy, Full-Stack Web Development - Udemy, AI and Machine Learning - Coursera). At the top right are Profile, Account Settings, Logout, and a help icon.

Figure 12: UI Students Dashboard Page

The screenshot shows the UI University Dashboard Page. The sidebar includes Overview, University, Browse Internship, Recommendations Stats, Interviews Stats, Confirmed Internship, Communications, Settings, S&C Home, and a user profile section with University Name and email. The main content area is titled 'Communications' and features a feed of communication items. Each item has a timestamp, a user icon, a subject, and a brief description. Buttons for 'Create New Communication' and 'Create New Complaint' are at the top. Examples include: 'Request for Additional Information' (5 minutes ago, Student2: Could you please provide more details about the upcoming project tasks? Communication, See Internship), 'Internship Progress Update' (2 hours ago, UniversityAdmin: Please submit your weekly internship progress report by Friday. Communication, See Internship), 'Issue with Submitted Documentation' (1 day ago, CompanyRepresentative: The document submitted by the student is incomplete. Please review and resubmit. Complaint, See Internship), 'Request for Remote Work Options' (10 minutes ago, Student3: Would it be possible to work remotely for the next week? Communication, See Internship), 'New Internship Opportunity' (1 hour ago, CompanyHR: A new internship position in the Marketing department is now available. Communication, See Internship), 'Unclear Task Description' (3 hours ago, Student4: The description for Task 5 is unclear. Could you clarify the expected outcome? Complaint, See Internship), 'Feedback on Your Recent Submission' (4 hours ago, CompanyMentor: Great work on the recent report! Keep it up. Communication, See Internship), and 'Mandatory Internship Meeting' (6 hours ago, UniversityAdmin: All students must attend the internship review meeting on Friday. Communication, See Internship).

Figure 13: UI University Dashboard Page

4.1.2 Hardware Interfaces

The platform is a web application that can be accessed from any device with a web browser and an internet connection like a PC, a tablet, or a smartphone. No specific hardware requirements are needed to interact with the Student&Company platform.

4.1.3 Software Interfaces

The platform uses the Email Service, through its interface, to send general notifications via email. However, the confirmation of user credentials upon registration is handled directly by the Auth Provider. The latter is responsible for properly handling user authentication and session validation while interacting with the platform application. The Notification Provider is responsible for sending notifications to users when relevant events occur. Unlike emails, notifications provide a more immediate and interactive experience without generating spam, which could be perceived as annoying by users. At this stage of development, no other external software interfaces are required.

4.1.4 Communication Interfaces

The platform uses standard internet communication protocols to interact with Users and the backend server. At this stage of development other specific communication interfaces are not defined yet.

4.2 Functional Requirements

This chapter provides a comprehensive overview of the system's use cases, detailing the various interactions between Users and the system. Use Case Diagrams, detailed Use Case Descriptions, Sequence Diagrams and Requirement Mapping are provided for each use case.

4.2.1 Use Case Diagrams

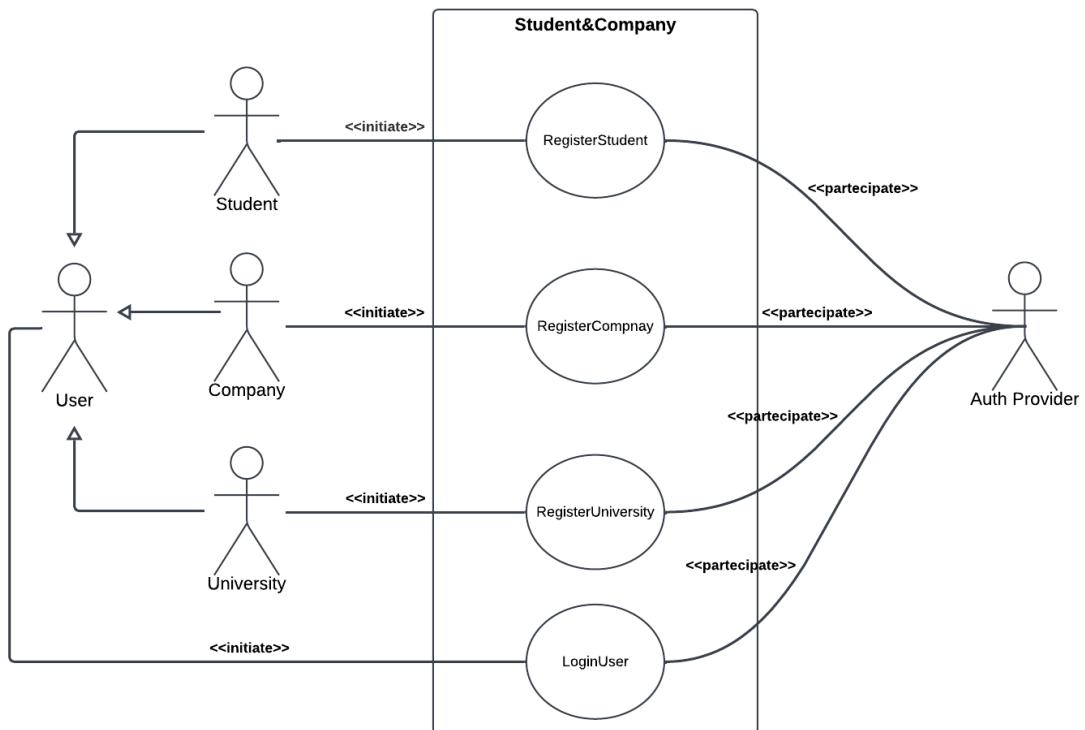


Figure 14: User Registration Use Case Diagram

This diagram illustrates the User Registration and Login process, for all Users. It shows how the different use case for the registration, based on the User type, and how the login process is generic and common for all Users

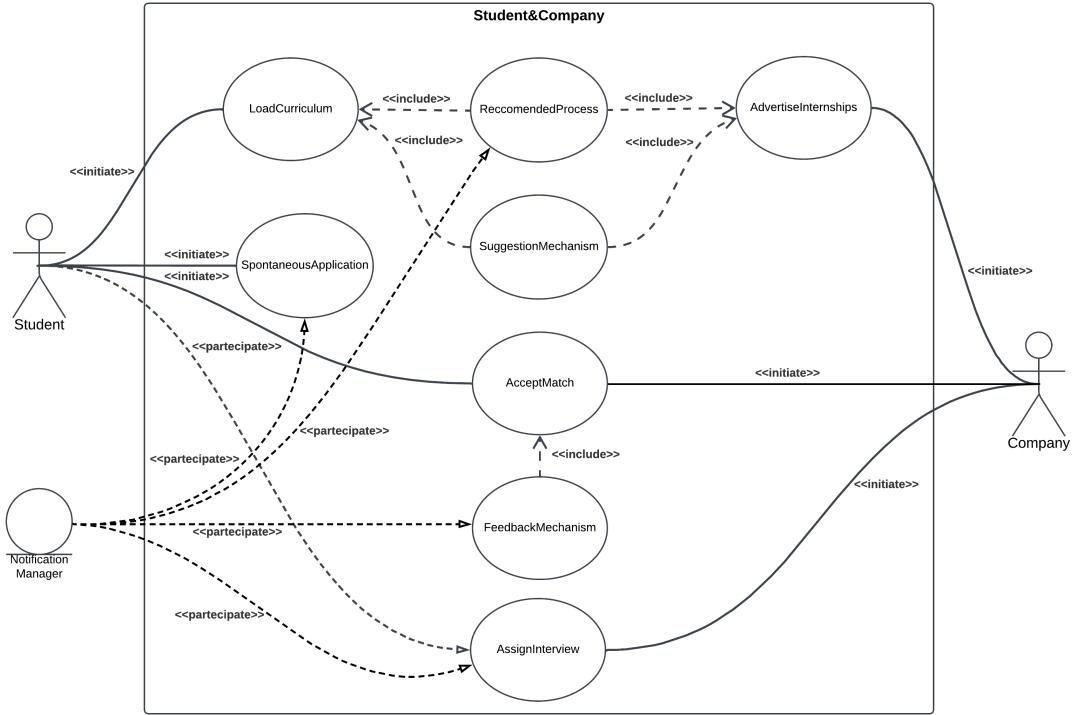


Figure 15: Student and Company Use Case Diagram

This diagram illustrates the main functionalities of the platform, such as the loading of CV or the creation of an Internship Offer.

This diagram both shows the different use cases that are specific to Students or Companies, and the common ones, such as the Acceptance of a Match. In such cases, the use case can be initiated by both actors.

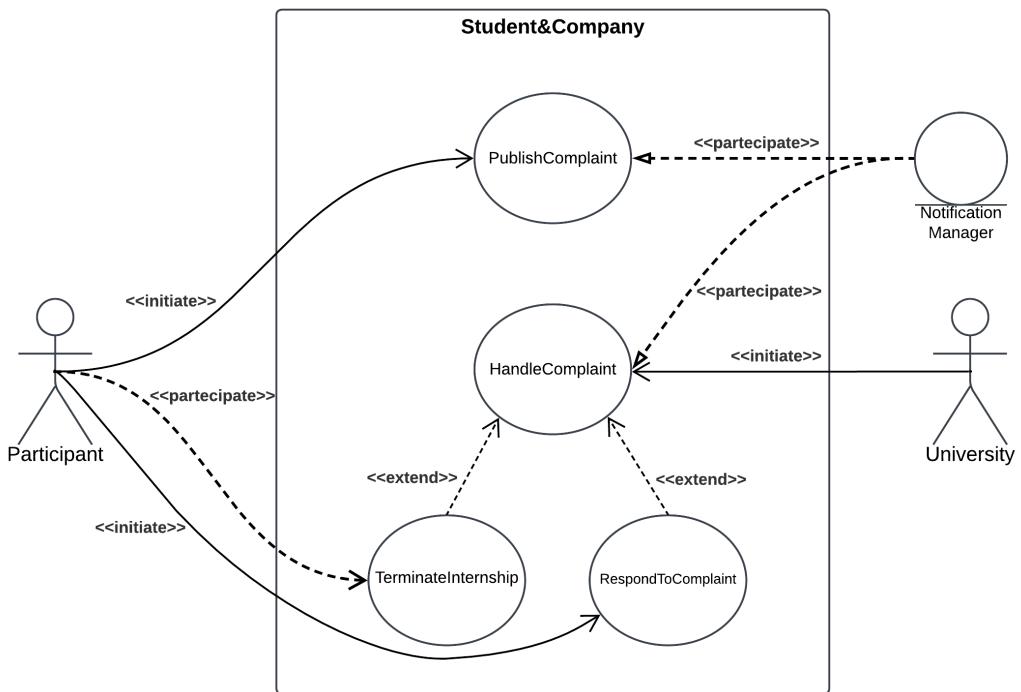


Figure 16: University and Complaint Use Case Diagram

This diagram concentrates on the functionalities offered to Universities. It shows how a Participant can create a Complaint, and how the University can handle it.

More importantly, it shows that a complaint can be handled “as is” by the University, or it can be extended either by the other Participants that respond to such complaint or by the University itself that can interrupt an Ongoing Internship.

4.2.2 Use Cases

RegisterStudent	
Actor	<ul style="list-style-type: none"> • Student • Auth Provider
Entry Condition	The user is not logged in.
Event Flow	<ol style="list-style-type: none"> 1. The Student presses the “Sign up” button situated on the dashboard. 2. The platform opens the sign-up page. 3. The Student selects the “Student” option, provides the required information (name, surname, date of birth, institutional email, optionally personal email, password, University name among those available) and click the “Sign Up” button. 4. The platform validates the email and checks if it is unique. 5. The platform registers the Student and sends a confirmation email to the provided email address through the Auth Provider. 6. The platform shows a message to the Student to confirm the registration. 7. The Student confirms the registration by clicking on the link in the email. 8. The platform confirms the registration and activates the account. 9. The Student is redirected to the platform’s dashboard.
Exit Condition	The Student is registered and logged in.
Exception	<ul style="list-style-type: none"> • The Student provides incorrect information. • The Student does not confirm the registration. • The email is already in use.

Table 7: [UC1]: Student registration use case

RegisterCompany	
Actor	<ul style="list-style-type: none"> • Company • Auth Provider
Entry Condition	The user is not logged in
Event Flow	<ol style="list-style-type: none"> 1. The Company presses the “Sign up” button situated on the dashboard. 2. The platform open the sign-up page. 3. The Company selects the “Company” option, provides the required information (Company name, Company headquarters address, VAT number, email, and password) and click the “Sign Up” button. 4. The platform checks if the VAT number and the email are unique 5. The platform registers the Company and sends a confirmation email to the provided email address through the Auth Provider. 6. The platform shows a message to the Company to confirm the registration. 7. The Company confirms the registration by clicking on the link in the email. 8. The platform confirms the registration and activates the account. 9. The Company is redirected to the platform’s Dashboard.
Exit Condition	The Company is registered and logged in.
Exception	<ul style="list-style-type: none"> • The Company provides incorrect information. • The Company does not confirm the registration. • The VAT number or the email is already in use.

Table 8: [UC2]: Company registration use case

RegisterUniversity	
Actor	<ul style="list-style-type: none"> • University • Auth Provider
Entry Condition	The user is not logged in.
Event Flow	<ol style="list-style-type: none"> 1. The University presses the “Sign up” button situated on the dashboard. 2. The platform open the sign-up page. 3. The University selects the “University” option, provides the required information (University Name, University description, VAT number, email of the University office that will manage the internship program, and password) and click the “Sign Up” button. 4. The platform checks if the VAT number and the email are unique 5. The platform registers the University and sends a confirmation email to the provided email address through the Auth Provider. 6. The platform shows a message to the University to confirm the registration. 7. The University confirms the registration by clicking on the link in the email. 8. The platform confirms the registration and activates the account. 9. The University is redirected to the platform’s Dashboard.
Exit Condition	The University is registered and logged in.
Exceptions	<ul style="list-style-type: none"> • The University provides incorrect information. • The University does not confirm the registration. • The VAT number or the email is already in use.

Table 9: [UC3]: University registration use case

LoginUser	
Actor	<ul style="list-style-type: none"> • User • Auth Provider
Entry Condition	The user is not logged in
Event Flow	<ol style="list-style-type: none"> 1. The User presses the “Sign in” button situated on the dashboard. 2. The platform open the sign-in page. 3. The user provides their email and password. 4. The platform validates the credentials through the Auth Provider. 5. The platform confirms the credentials and logs in the User. 6. The User is redirected to the platform’s Dashboard.
Exit Condition	The User is logged in.
Exceptions	<ul style="list-style-type: none"> • The User provides incorrect email or password.

Table 10: [UC4]: User login use case

LoadCurriculum	
Actor	<ul style="list-style-type: none"> • Student • Notification Manager • Company
Entry Condition	The Student is logged in
Event Flow	<ol style="list-style-type: none"> 1. The Student presses the “CV” menu button situated on the dashboard. 2. The platform opens the Curriculum page. 3. The Student fills the form with the required information (current level of education, known languages, technical skills, a photo of himself, a brief description of his interests and hobbies etc...) and click the “Submit CV” button. 4. The platform publishes the CV. 5. The platform generates a list of matching internships based on the CV. 6. The platform provides feedback and suggestions to improve the CV. 7. The Student is redirected to his account page. 8. The platform notifies the new matching Companies through the Notification Manager.
Exit Condition	The Student’s CV is uploaded.
Exception	<ul style="list-style-type: none"> • The Student provides invalid or partial information.

Table 11: [UC5]: Student uploads Curriculum use case

AdvertiseInternships	
Actor	<ul style="list-style-type: none"> • Company • Notification Manager • Student
Entry Condition	The Company is logged in
Event Flow	<ol style="list-style-type: none"> 1. The Company presses the “Internship Offers” button situated on the dashboard. 2. The Platform opens the Internships page. 3. The Company presses the “Create Internship” button. 4. The platform shows the Internship creation form. 5. The Company fills the form with the required information (Internship title, description, start date and duration, office address, required skills and benefits offered) and click the “Submit Internship” button. 6. The platform publishes the Internship. 7. The platform generates a list of matching Students based on the Internship. 8. The system provides feedback and suggestions to improve the internship description. 9. The Company is redirected to the Internships page. 10. The platform notifies the new matching Students through the Notification Manager.
Exit Condition	The Internship is created and published.
Exception	<ul style="list-style-type: none"> • The Company provides invalid or partial information.

Table 12: [UC6]: Company advertises an Internship use case

SpontaneousApplication	
Actor	<ul style="list-style-type: none"> • Student • Company • Notification Manager
Entry Condition	The Student is logged in and has his CV uploaded.
Event Flow	<ol style="list-style-type: none"> 1. The Student presses the “Browse Internships” button situated on the dashboard. 2. The platform opens the global Internships page. 3. The Student presses the “Apply” button on one of the available Internships. 4. The platform adds the application to the Company and Student list of applications. 5. The platform notifies the Company of the Spontaneous Application through the Notification Manager.
Exit Condition	The application is successfully submitted to the Company.
Exception	<ul style="list-style-type: none"> • Internship is no longer available.

Table 13: [UC7]: Student submits Spontaneous Application use case

AcceptMatch	
Actor	<ul style="list-style-type: none"> • Participant • Notification Manager
Entry Condition	A Match is generated between the Student and the Company's Internship and the Student has his CV uploaded.
Event Flow	<ol style="list-style-type: none"> 1. The Participant presses the “Recommendations Process” button situated on the dashboard. 2. The platform opens the respective Recommendations pages. 3. The Participant accepts the Match. 4. The platform stores the result. 5. If the other party has already accepted the Match, the platform adds the Interview to the Student and the Company's list of Interviews and notifies both parties through the Notification Manager.
Exit Condition	The Match is successfully accepted by the participant.
Exception	<ul style="list-style-type: none"> • None

Table 14: [UC8]: Company or Student accepts Match use case

FeedbackMechanism	
Actor	<ul style="list-style-type: none"> • Participant
Entry Condition	The Participant is logged in.
Event Flow	<ol style="list-style-type: none"> 1. The Participant presses the “Recommendations Process” button situated on the dashboard. 2. The platform opens the respective Recommendations pages. 3. The Participant accept or decline the Match. 4. The platform asks for feedback about the Match. 5. The Participant submits the feedback. 6. The platform stores the feedback.
Exit Condition	Feedback is successfully provided.
Exception	<ul style="list-style-type: none"> • None

Table 15: [UC9]: Feedback is asked upon Match result use case

SuggestionMechanism	
Actor	<ul style="list-style-type: none"> • Participant
Entry Condition	A Student has uploaded his CV or a Company has created an Internship.
Event Flow	<ol style="list-style-type: none"> 1. The platform analyses the Student’s CV or the Company’s Internship. 2. The platform generates a list of suggestions to improve the CV or the Internship description. 3. The platform displays a notification on the Participant’s dashboard page. 4. The Participant open the notification. 5. The platform displays the suggestions.
Exit Condition	Suggestions are successfully provided.
Exception	<ul style="list-style-type: none"> • No valuable suggestions are found.

Table 16: [UC10]: Suggestion mechanism use case

AssignInterview	
Actor	<ul style="list-style-type: none"> • Company • Student • Notification Manager
Entry Condition	A Match is accepted by both parties or the Company has accepted a Spontaneous Application.
Event Flow	<ol style="list-style-type: none"> 1. The Company presses the “Interviews” button situated on the dashboard. 2. The platform opens the Interviews page. 3. The Company selects an Interview in the “ToBeSubmitted” state. 4. The platform shows the Interview creation form. 5. The Company fills the form with the required information (open and closed questions, deadline and additional infos) and click the “Submit Interview” button. 6. The platform sends the form to the Student, updates his Interview status and notifies him thorough the Notification Manager. 7. The Company is redirected to the Interviews page.
Exit Condition	The Interview is created and submitted to the Student.
Exception	<ul style="list-style-type: none"> • None

Table 17: [UC11]: Company assigns Interview to Student use case

PublishComplaint	
Actor	<ul style="list-style-type: none"> • Company • Student • University • Notification Manager
Entry Condition	There is an Ongoing Internship between the relative Company and Student.
Event Flow	<ol style="list-style-type: none"> 1. The Company presses the “Communications” button situated on the dashboard. 2. The platform opens the Communications page. 3. The Company presses the “Create Complaint” button. 4. The platform shows the Complaint creation form. 5. The Company fills the form with the required information (Student’s name, Internship title, description of the problem) and click the “Submit Complaint” button. 6. The platform publishes the Complaint. 7. The platform notifies the Student and the University through the Notification Manager.
Exit Condition	The Complaint is created and published.
Exception	<ul style="list-style-type: none"> • None

Table 18: [UC12]: Company publishes Complaint use case

RespondToComplaint	
Actor	<ul style="list-style-type: none"> • User • Notification Manager
Entry Condition	The User has an active Complaint.
Event Flow	<ol style="list-style-type: none"> 1. The Student or the Company presses the “Communications” button situated on the dashboard. 2. The platform opens the Communications page. 3. The User presses the target complaint. 4. The platform shows the relative Complaint page. 5. The User responds to the Complaint and submits the message. 6. The platform notifies the other Users involved in the Complaint about the response through the Notification Manager.
Exit Condition	The response is successfully published, and involved Users are notified.
Exception	<ul style="list-style-type: none"> • None

Table 19: [UC13]: User responds to a Complaint use case

HandleComplaint	
Actor	<ul style="list-style-type: none"> • University • Student • Company
Entry Condition	There is an active Complaint regarding the Company and a Student of the University.
Event Flow	<ol style="list-style-type: none"> 1. The University presses the “Communications” button situated on the dashboard. 2. The platform opens the Communications page. 3. The University presses the target complaint. 4. The platform shows the relative Complaint page. 5. The University presses the “Close Complaint” button, writes a final message and submits. 6. The platform will close the relative Complaint. 7. The platform notifies the Student and the Company about the resolution of the Complaint through the Notification Manager.
Exit Condition	The Complaint is closed.
Exception	<ul style="list-style-type: none"> • None

Table 20: [UC14]: University handles Complaint use case

TerminateInternship	
Actor	<ul style="list-style-type: none"> • Student • Company • University • Notification Manager
Entry Condition	There is an active Complaint regarding the Company and a Student of the University.
Event Flow	<ol style="list-style-type: none"> 1. The University presses the “Communications” button situated on the dashboard. 2. The platform opens the Communications page. 3. The University presses the target complaint. 4. The platform shows the relative Complaint page. 5. The University presses the “Interrupt Internship” button. 6. The platform will notify the Student and the Company about the interruption of the Internship through the Notification Manager and close the relative Complaint.
Exit Condition	The Internship is interrupted, and the Complaint is closed.
Exception	<ul style="list-style-type: none"> • None

Table 21: [UC15]: University terminates Internship use case

4.2.3 Sequence Diagrams

The functions used in the sequence diagrams follow these conventional meanings:

- **press(Button)**: Represents the action of a user pressing Button.
- **submit(Content)**: Indicates a user uploading Content to the platform.
- **showPage(Page)**: Displays the content of a specific Page.
- **showError(Error)**: Displays an error message indicating an issue that occurred.
- **showMessage(Message)**: Displays a generic message to the user.
- **notify(What, Who)**: Represents a notification forwarded to the NotificationManager regarding What and intended for Who.
- **check()**: Verifies the validity of the information provided by the user.
- **update(Data)**: Refers to internal processes that update database records with Data.

For readability, in all diagrams except the first four, the user login process is omitted. It is assumed that the user is already logged in and navigating the dashboard. Accordingly, the S&C processes are depicted as already in progress.

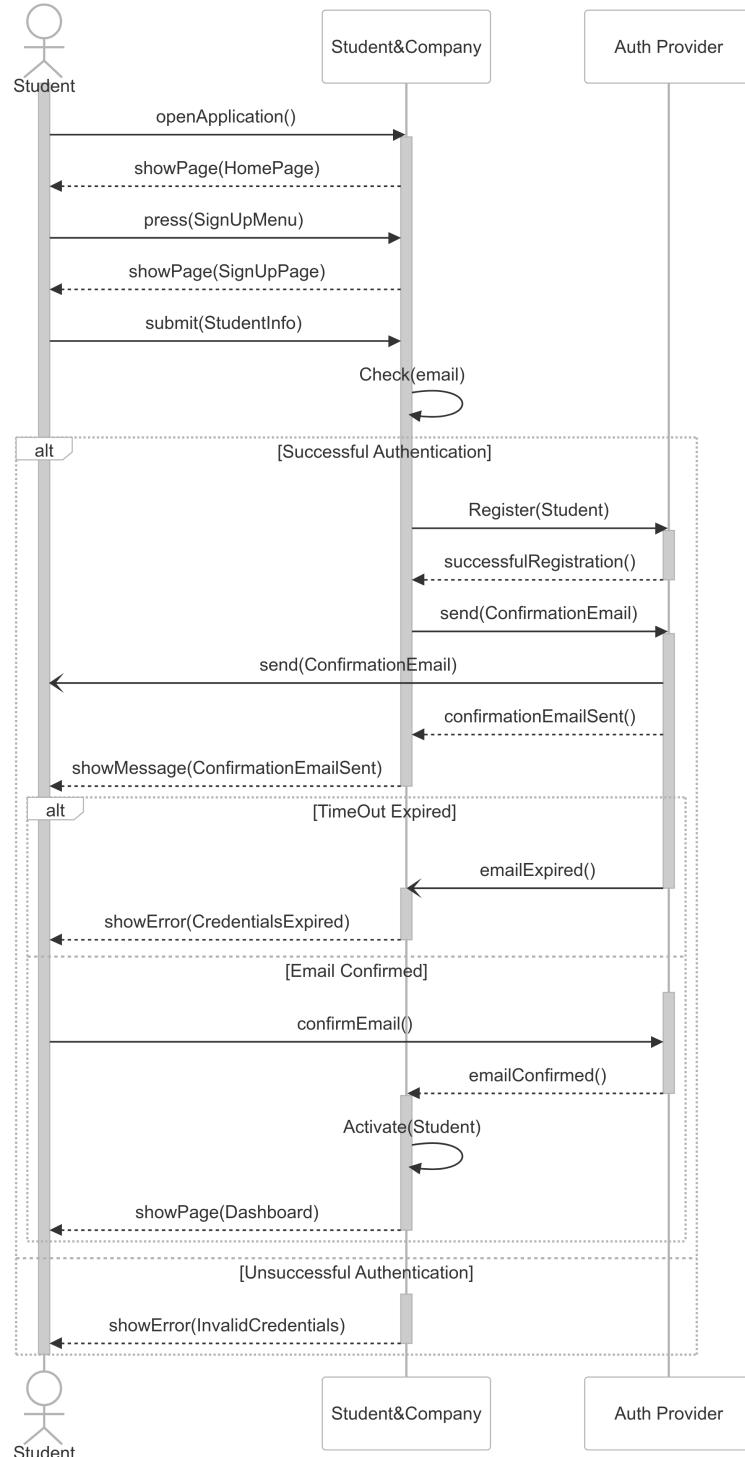


Figure 17: [SD1]: Student sign-up Sequence Diagram

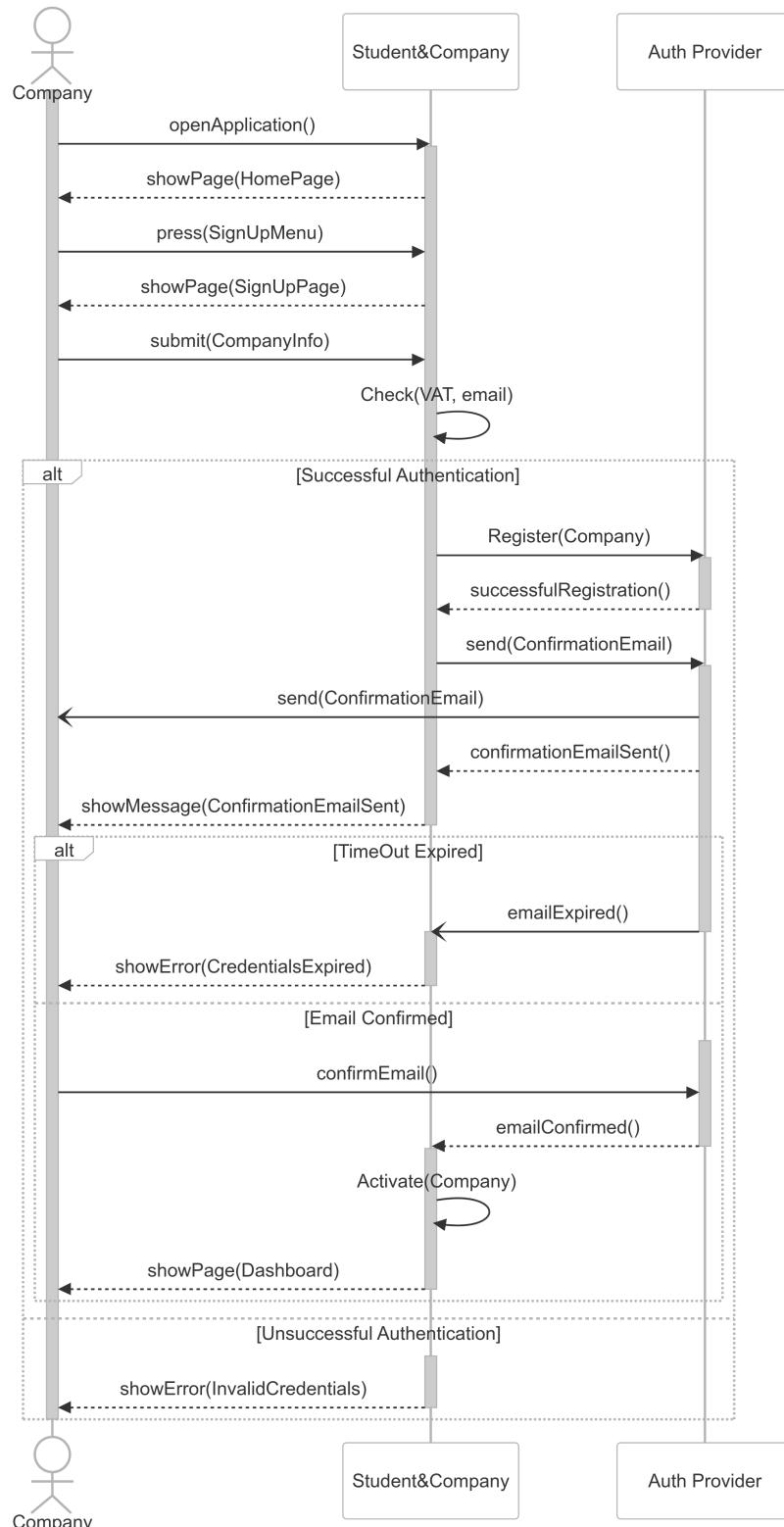


Figure 18: [SD2]: Company sign-up Sequence Diagram

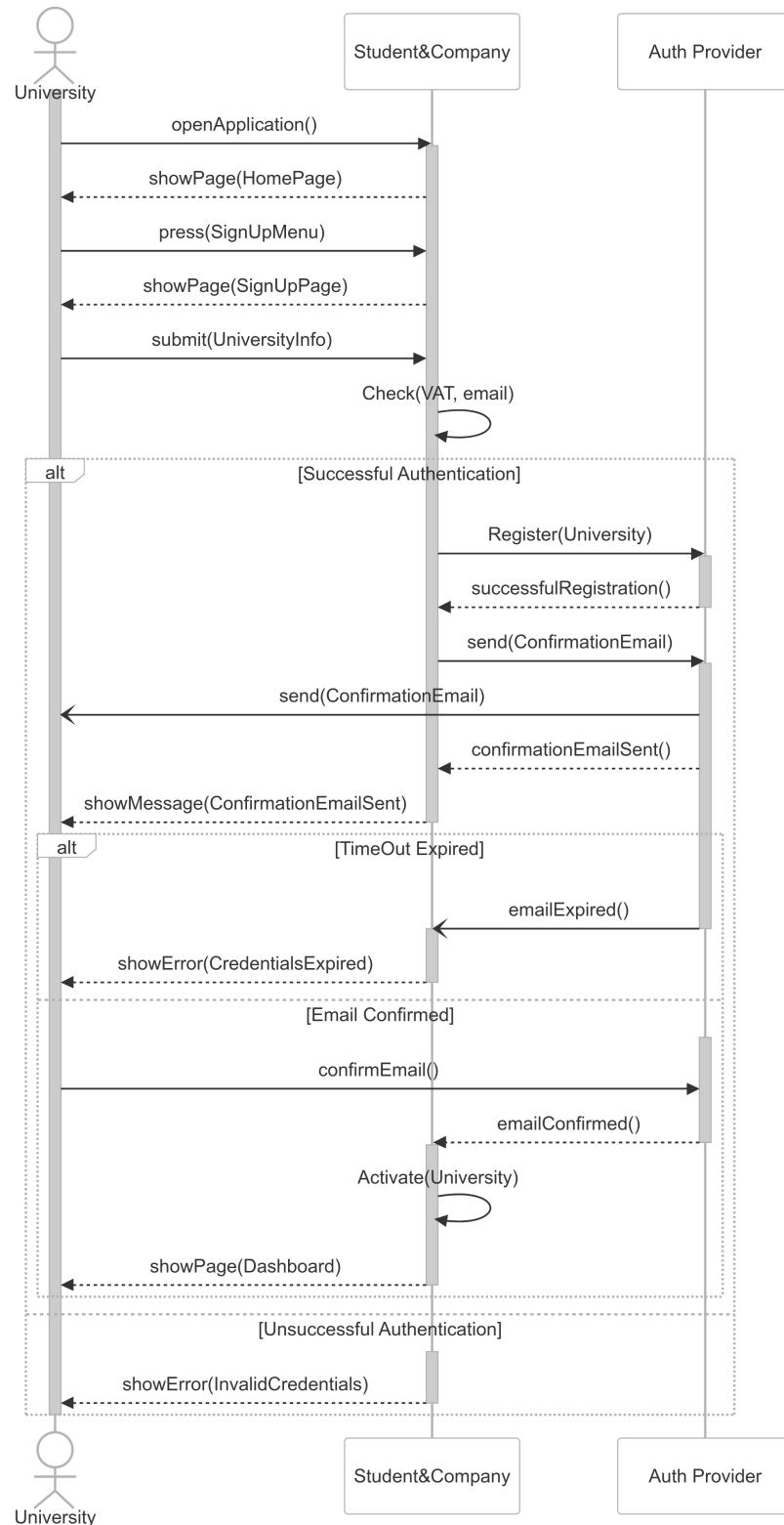


Figure 19: [SD3]: University sign-up Sequence Diagram

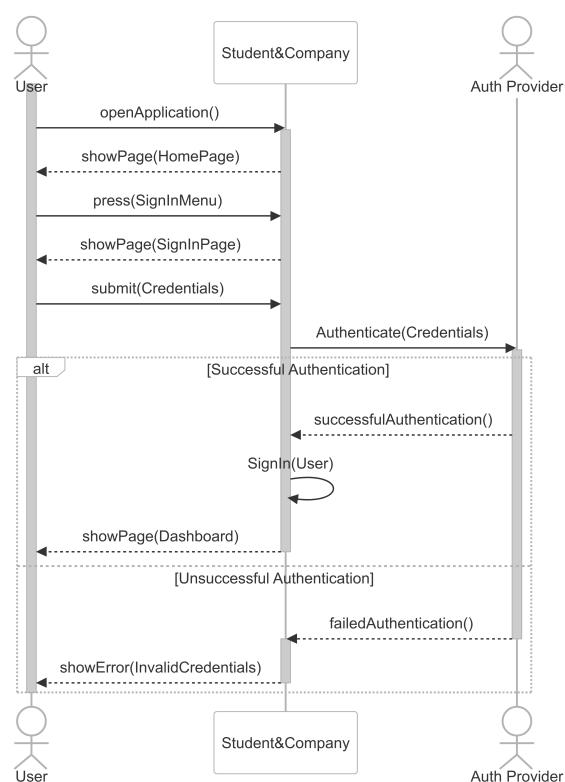


Figure 20: [SD4]: User login Sequence Diagram

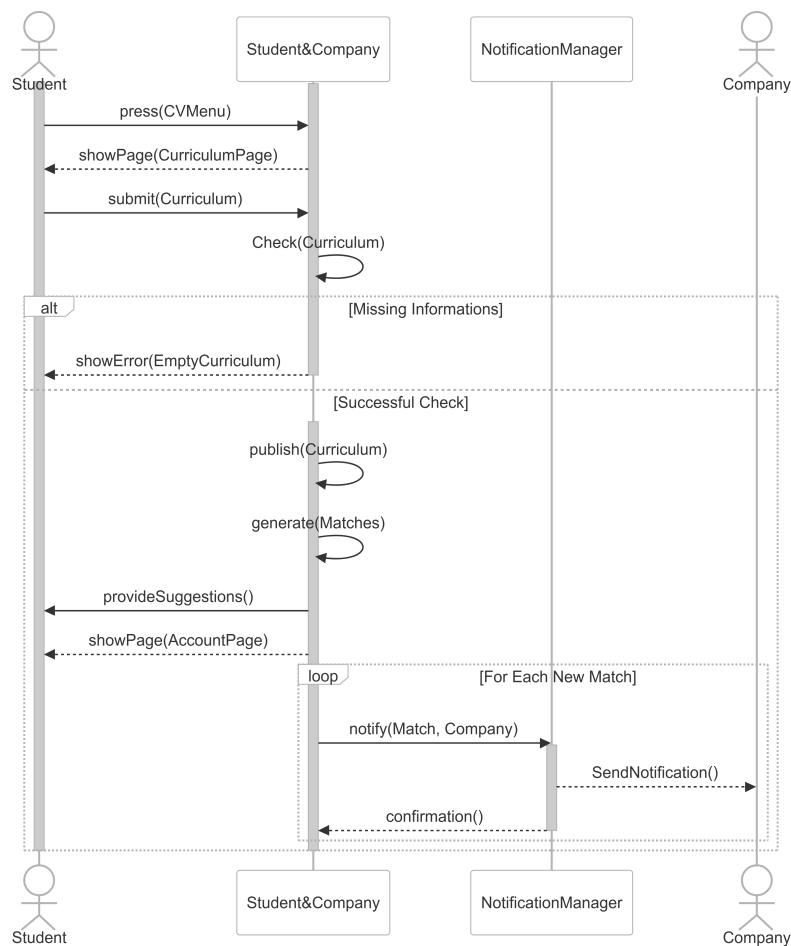


Figure 21: [SD5]: Load Curriculum Sequence Diagram

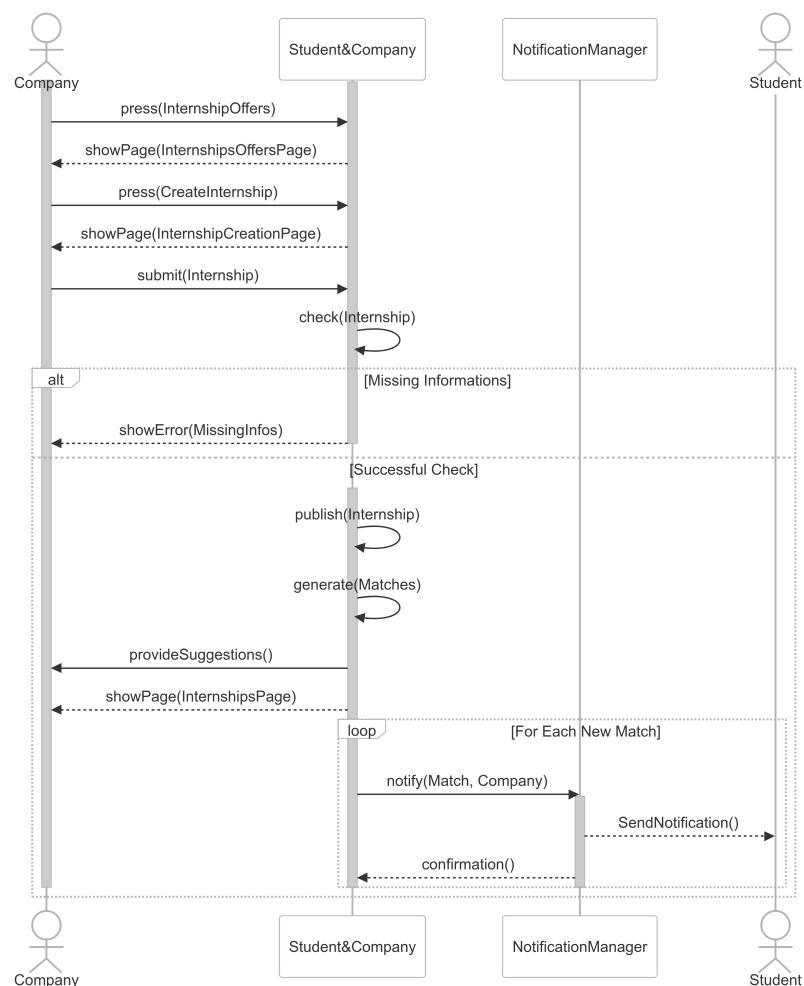


Figure 22: [SD6]: Advertise Internship Sequence Diagram

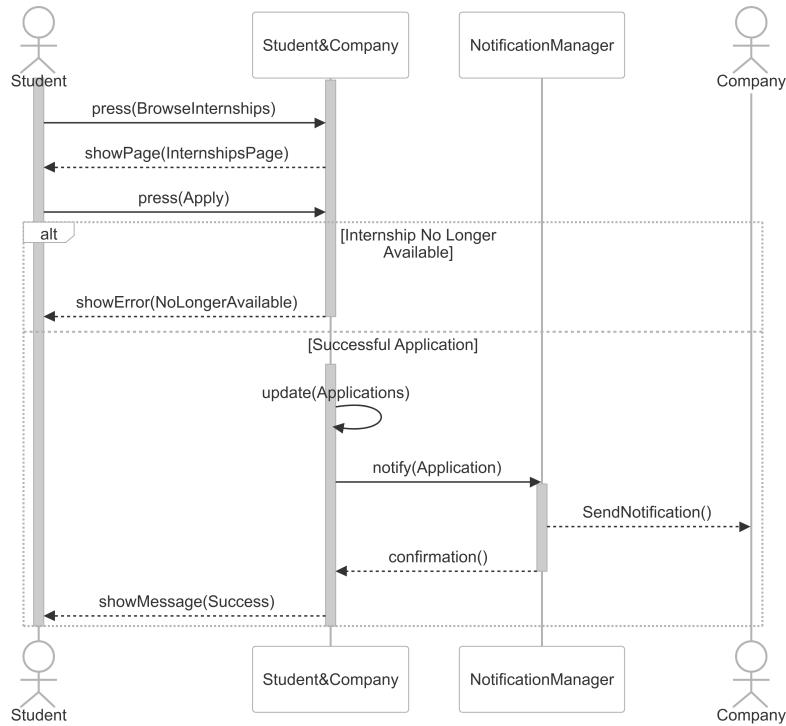


Figure 23: [SD7]: Spontaneous Application Sequence Diagram

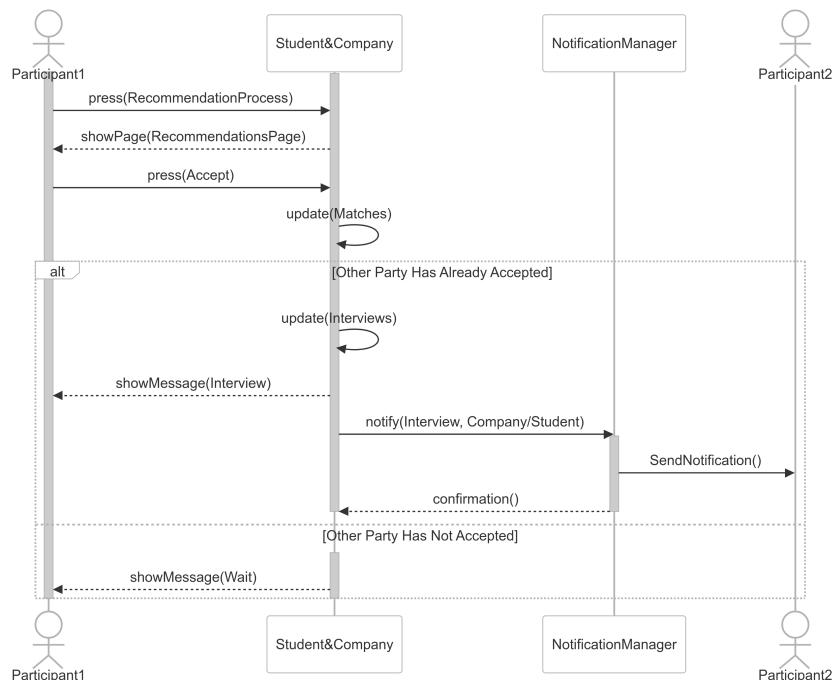


Figure 24: [SD8]: Accept Match Sequence Diagram

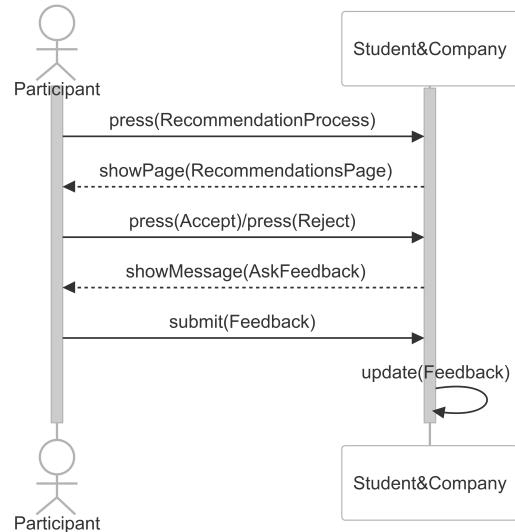


Figure 25: [SD9]: Feedback mechanism Sequence Diagram

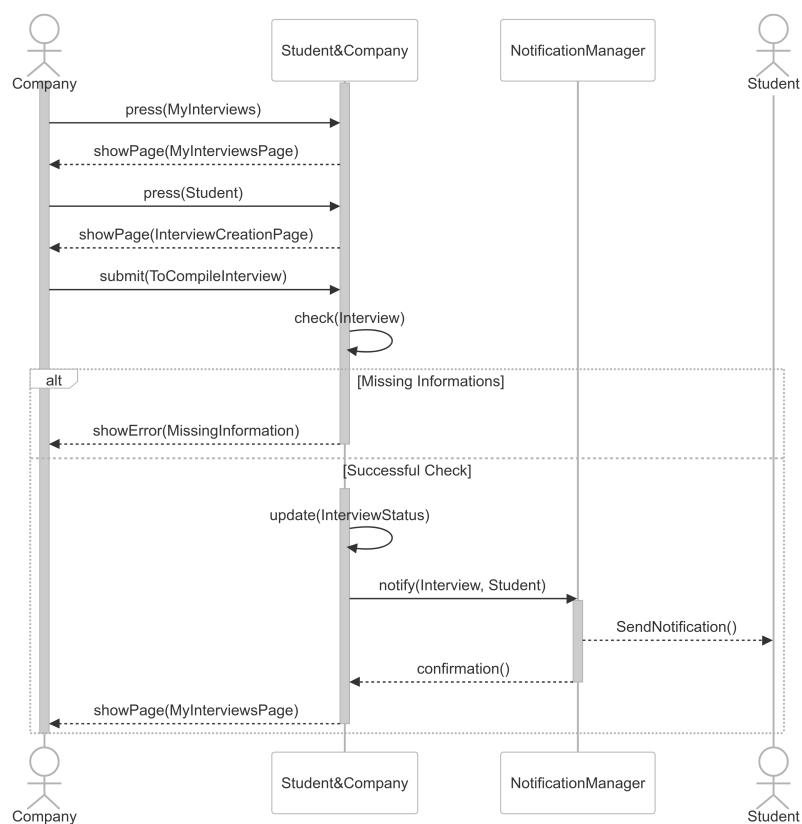


Figure 26: [SD10]: Assign Interview Sequence Diagram

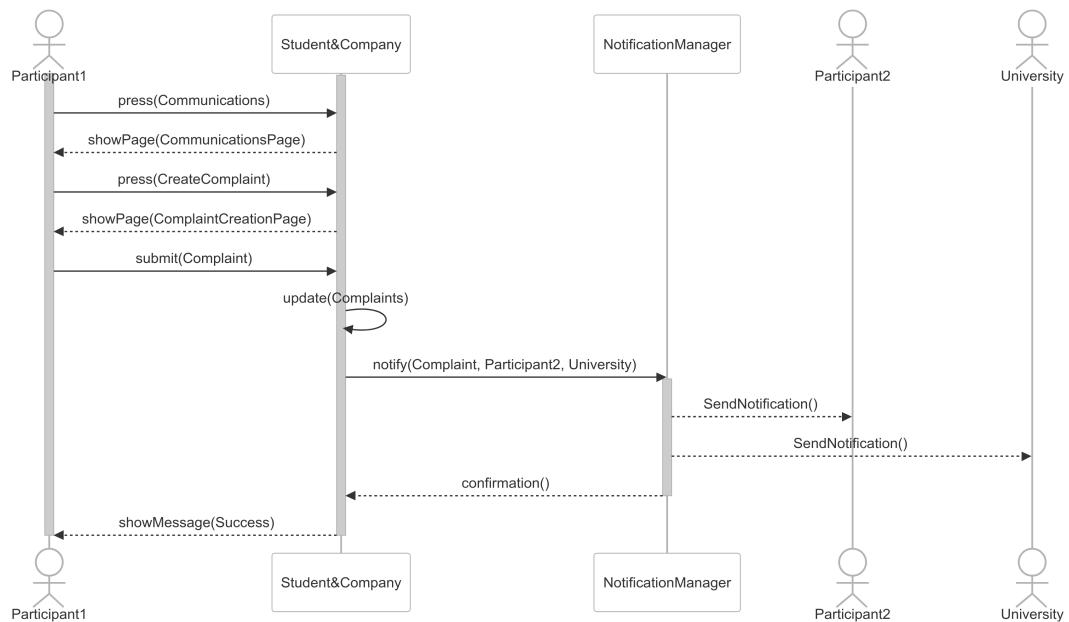


Figure 27: [SD11]: Publish Complaint Sequence Diagram

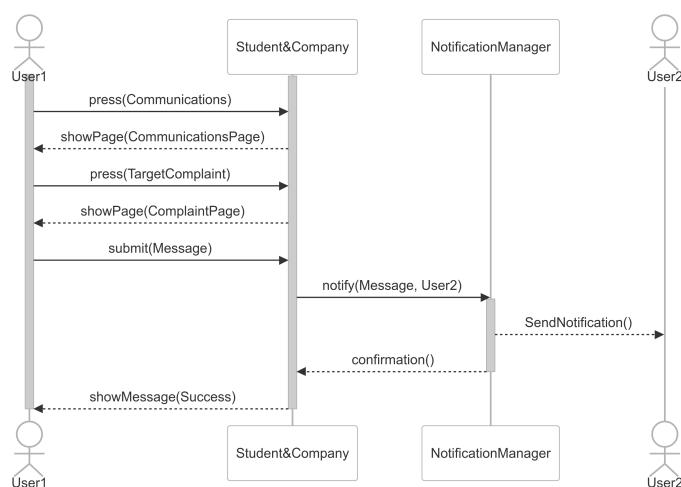


Figure 28: [SD12]: Respond to Complaint Sequence Diagram

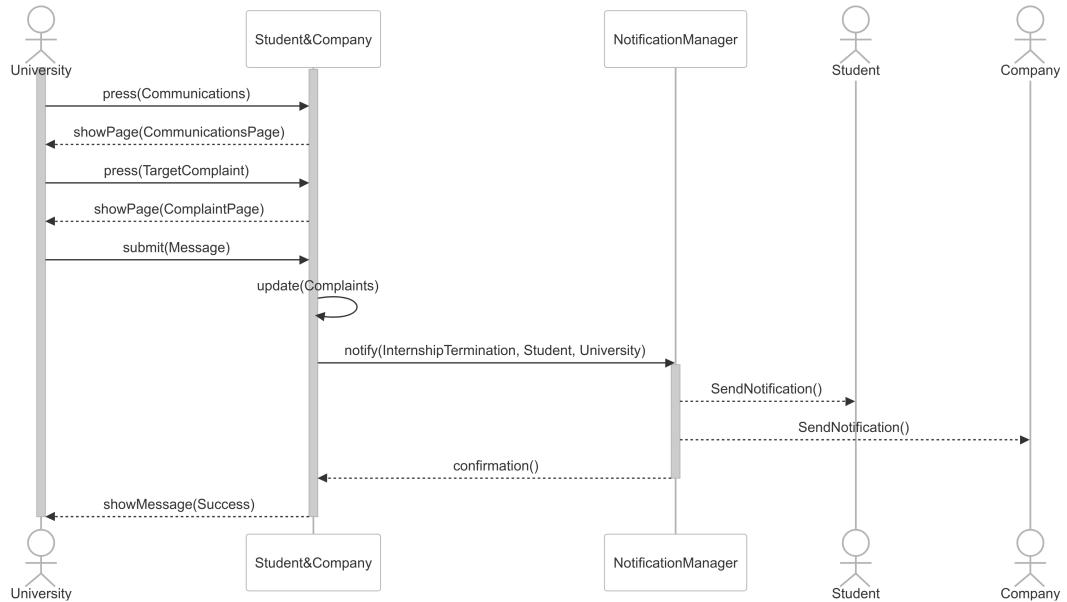


Figure 29: [SD13]: Handle Complaint Sequence Diagram

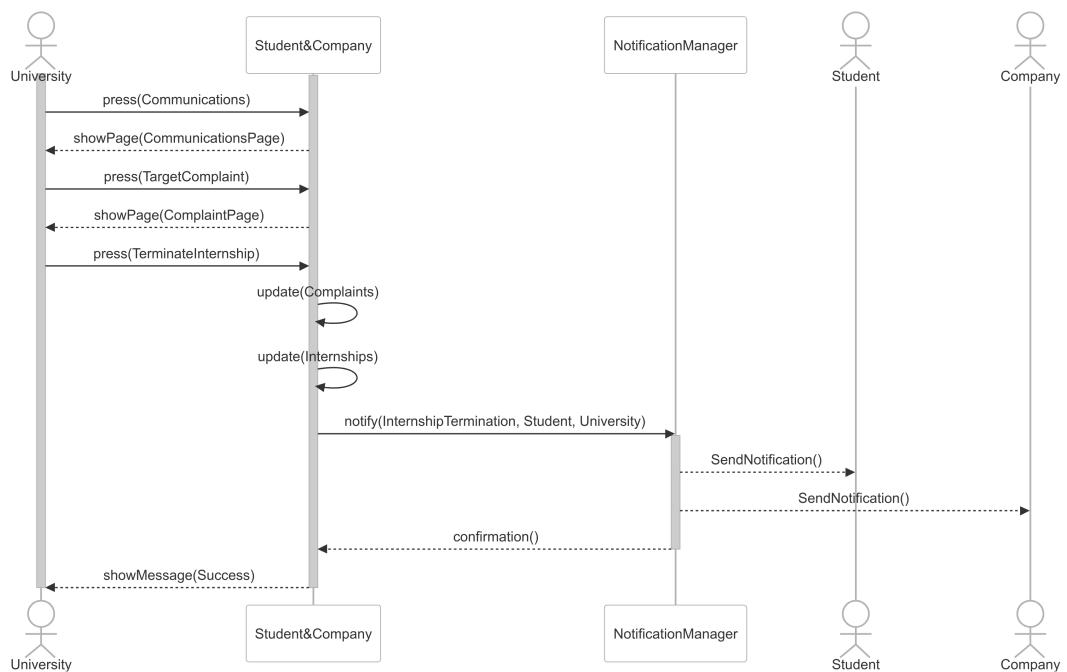


Figure 30: [SD14]: Terminate Internship Sequence Diagram

4.2.4 Requirements Mapping

G1: Companies would like to advertise the internships they offer.
<ul style="list-style-type: none">[D1] Students and Companies provide the Platform with correct and truthful information.[D2] Companies remove published Internship if they are no longer available.[D3] Students, Companies, and Universities receive every notification.[D4] Students, Companies, and Universities have a working internet connection.
<ul style="list-style-type: none">[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.[R2] The platform shall allow any companies to register by providing company information.[R3] The platform shall allow any universities to register by providing university information.[R4] The platform shall allow Users to log in using their email and password.[R5] The platform shall send notifications to Users when relevant events occur.[R6] The platform shall allow Companies to create and publish Internship offers specifying details.[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.[R9] The platform shall allow Students to view and navigate all available Internships.

Table 22: Goal 1 mapping

G2: Students would like to autonomously candidate for available internships.
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p> <p>[D2] Companies remove published Internship if they are no longer available.</p> <p>[D3] Students, Companies, and Universities receive every notification.</p> <p>[D4] Students, Companies, and Universities have a working internet connection.</p> <p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p> <p>[R2] The platform shall allow any companies to register by providing company information.</p> <p>[R3] The platform shall allow any universities to register by providing university information.</p> <p>[R4] The platform shall allow Users to log in using their email and password.</p> <p>[R5] The platform shall send notifications to Users when relevant events occur.</p> <p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p> <p>[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.</p> <p>[R9] The platform shall allow Students to view and navigate all available Internships.</p> <p>[R10] The platform shall enable Students to submit Spontaneous Applications to Internships they choose.</p> <p>[R13] The platform shall allow Students to monitor the status of their Spontaneous Applications.</p> <p>[R18] The platform shall allow Companies to accept a Spontaneous Application.</p>

Table 23: Goal 2 mapping

G3: Students would like to be matched with internships they might be interested in.
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p> <p>[D2] Companies remove published Internship if they are no longer available.</p> <p>[D3] Students, Companies, and Universities receive every notification.</p> <p>[D4] Students, Companies, and Universities have a working internet connection.</p> <p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p> <p>[R2] The platform shall allow any companies to register by providing company information.</p> <p>[R3] The platform shall allow any universities to register by providing university information.</p> <p>[R4] The platform shall allow Users to log in using their email and password.</p> <p>[R5] The platform shall send notifications to Users when relevant events occur.</p> <p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p> <p>[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.</p> <p>[R8] The platform shall provide Students with Matches automatically obtained by the Recommendation Process.</p> <p>[R11] The platform shall allow Students to submit their CV.</p> <p>[R14] The platform shall allow Students to monitor the status of their Recommendation.</p> <p>[R15] The platform shall display to Students all the Internships found by the Recommendation Process.</p> <p>[R16] The platform shall display to Companies all the CVs of Matched Students obtained by the Recommendation Process.</p> <p>[R17] The platform shall allow Students and Companies to accept a Recommendation.</p>

Table 24: Goal 3 mapping

G4: Companies would like to perform interviews with suitable students.
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p> <p>[D2] Companies remove published Internship if they are no longer available.</p> <p>[D3] Students, Companies, and Universities receive every notification.</p> <p>[D4] Students, Companies, and Universities have a working internet connection.</p> <p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p> <p>[R2] The platform shall allow any companies to register by providing company information.</p> <p>[R3] The platform shall allow any universities to register by providing university information.</p> <p>[R4] The platform shall allow Users to log in using their email and password.</p> <p>[R5] The platform shall send notifications to Users when relevant events occur.</p> <p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p> <p>[R17] The platform shall allow Students and Companies to accept a Recommendation.</p> <p>[R18] The platform shall allow Companies to accept a Spontaneous Application.</p> <p>[R19] The platform shall start a Selection Process only if both the Company and the Student have accepted the Recommendation.</p> <p>[R20] The platform shall start a Selection Process only if the Company has accepted the Spontaneous Application.</p> <p>[R21] The platform shall allow Companies to create Interviews.</p> <p>[R22] The platform shall allow Companies to submit Interviews to Students they have initiated a Selection Process with.</p> <p>[R23] The platform shall allow Students to answer Interview questions and submit them.</p> <p>[R24] The platform shall allow Companies to manually evaluate Interview submissions.</p> <p>[R25] The platform shall allow Students and Companies to monitor the status of their Interviews.</p> <p>[R26] The platform shall enable Companies to complete the Interview process by submitting the final outcome to each candidate.</p>

Table 25: Goal 4 mapping

<p>G5: Students and companies would like to complain, communicate problems, provide information about an Ongoing Internship.</p>
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p> <p>[D2] Companies remove published Internship if they are no longer available.</p> <p>[D3] Students, Companies, and Universities receive every notification.</p> <p>[D4] Students, Companies, and Universities have a working internet connection.</p>
<p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p> <p>[R2] The platform shall allow any companies to register by providing company information.</p> <p>[R3] The platform shall allow any universities to register by providing university information.</p> <p>[R4] The platform shall allow Users to log in using their email and password.</p> <p>[R28] The platform shall enable Students to accept or reject an Internship Position Offer sent by a Company only if he previously passed the relative Interview.</p> <p>[R33] The platform shall provide a dedicated space for Students and Companies to exchange Communications about the current status of an Ongoing Internship.</p>

Table 26: Goal 5 mapping

<p>G6: Students and companies would like to be provided with suggestions about how to improve their submission.</p>
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p> <p>[D4] Students, Companies, and Universities have a working internet connection.</p>
<p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p> <p>[R2] The platform shall allow any companies to register by providing company information.</p> <p>[R3] The platform shall allow any universities to register by providing university information.</p> <p>[R4] The platform shall allow Users to log in using their email and password.</p> <p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p> <p>[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.</p> <p>[R12] The platform shall allow Students to modify their CV.</p> <p>[R29] The platform shall collect Feedback from both Students and Companies regarding the Recommendation Process.</p> <p>[R30] The platform shall provide Suggestions to Students on improving their CVs.</p> <p>[R31] The platform shall provide Suggestions to Companies on improving Internship descriptions.</p>

Table 27: Goal 6 mapping

G7: Universities would like to handle complaints about Ongoing Internships.	
[D1]	Students and Companies provide the Platform with correct and truthful information.
[D2]	Companies remove published Internship if they are no longer available.
[D3]	Students, Companies, and Universities receive every notification.
[D4]	Students, Companies, and Universities have a working internet connection.
[D5]	Universities interrupt an Ongoing Internship only if no solution to complaints are found.
[R1]	The platform shall allow any unregistered students to register by providing personal information and selecting their University.
[R2]	The platform shall allow any companies to register by providing company information.
[R3]	The platform shall allow any universities to register by providing university information.
[R4]	The platform shall allow Users to log in using their email and password.
[R5]	The platform shall send notifications to Users when relevant events occur.
[R32]	The platform shall allow registered Universities to access and monitor Internship Communications related to their Students.
[R33]	The platform shall provide a dedicated space for Students and Companies to exchange Communications about the current status of an ongoing Internship.
[R34]	The platform shall allow registered Universities to handle Complaints and to interrupt an Internship at their own discretion.

Table 28: Goal 7 mapping

<p>G8: Students would like to choose which internship to attend from among those for which they passed the interview.</p>
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p>
<p>[D2] Companies remove published Internship if they are no longer available.</p>
<p>[D4] Students, Companies, and Universities have a working internet connection.</p>
<p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p>
<p>[R2] The platform shall allow any companies to register by providing company information.</p>
<p>[R3] The platform shall allow any universities to register by providing university information.</p>
<p>[R4] The platform shall allow Users to log in using their email and password.</p>
<p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p>
<p>[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.</p>
<p>[R17] The platform shall allow Students and Companies to accept a Recommendation.</p>
<p>[R18] The platform shall allow Companies to accept a Spontaneous Application.</p>
<p>[R22] The platform shall allow Companies to submit Interviews to Students they have initiated a Selection Process with.</p>
<p>[R23] The platform shall allow Students to answer Interview questions and submit them.</p>
<p>[R26] The platform shall enable Companies to complete the Interview process by submitting the final outcome to each candidate.</p>
<p>[R28] The platform shall enable Students to accept or reject an Internship Position Offer sent by a Company only if he previously passed the relative Interview.</p>

Table 29: Goal 8 mapping

<p>G9: Companies would like to select students for the internship position among those who passed the interview.</p>
<p>[D1] Students and Companies provide the Platform with correct and truthful information.</p>
<p>[D2] Companies remove published Internship if they are no longer available.</p>
<p>[D4] Students, Companies, and Universities have a working internet connection.</p>
<p>[R1] The platform shall allow any unregistered students to register by providing personal information and selecting their University.</p>
<p>[R2] The platform shall allow any companies to register by providing company information.</p>
<p>[R3] The platform shall allow any universities to register by providing university information.</p>
<p>[R4] The platform shall allow Users to log in using their email and password.</p>
<p>[R6] The platform shall allow Companies to create and publish Internship offers specifying details.</p>
<p>[R7] The platform shall allow Companies to terminate their Internship offers at their own discretion.</p>
<p>[R17] The platform shall allow Students and Companies to accept a Recommendation.</p>
<p>[R18] The platform shall allow Companies to accept a Spontaneous Application.</p>
<p>[R22] The platform shall allow Companies to submit Interviews to Students they have initiated a Selection Process with.</p>
<p>[R23] The platform shall allow Students to answer Interview questions and submit them.</p>
<p>[R26] The platform shall enable Companies to complete the Interview process by submitting the final outcome to each candidate.</p>
<p>[R27] The platform shall enable Companies to send an Internship Position Offer to a Student only if he previously passed the relative Interview.</p>

Table 30: Goal 9 mapping

	G1	G2	G3	G4	G5	G6	G7	G8	G9
D1	x	x	x	x	x	x	x	x	x
D2	x	x	x	x	x		x	x	x
D3	x	x	x	x	x		x		
D4	x	x	x	x	x	x	x	x	x
D5							x		
R1	x	x	x	x	x	x	x	x	x
R2	x	x	x	x	x	x	x	x	x
R3	x	x	x	x	x	x	x	x	x
R4	x	x	x	x	x	x	x	x	x
R5	x	x	x	x	x		x		
R6	x	x	x	x		x		x	x
R7	x	x	x			x		x	x
R8			x						
R9	x	x							
R10		x							
R11			x						
R12						x			
R13		x							
R14			x						
R15			x						
R16			x						
R17			x	x				x	x
R18		x		x				x	x
R19				x					
R20				x					
R21				x					
R22				x				x	x
R23				x				x	x
R24				x					
R25				x					
R26				x				x	x
R27									x
R28					x			x	
R29						x			
R30						x			
R31						x			
R32							x		
R33					x		x		
R34							x		

Table 31: Goals and Requirements Mapping Table

4.3 Performance Requirements

Given the system's non-critical nature, stringent performance criteria are unnecessary. However, to ensure an optimal User experience:

- The system shall notify Users within 2 seconds after an event has occurred
- The system shall respond to User requests within 2 seconds under normal load conditions
- The system shall support at least 1000 concurrent Users
- Database queries shall be completed within 1.5 seconds
- The system shall handle up to 10,000 internship listings simultaneously
- The system shall support up to 100,000 registered Users
- The system shall support up to 1000 registered Companies
- The system shall support up to 100 registered Universities
- The Recommendation Process shall be completed within 300 seconds under normal load conditions
- The Suggestions computed by the platform shall be provided to the User within 180 seconds after the CV or the Internship Offer has been submitted

4.4 Design Constraints

This section explain the different constraints that the platform must respect such as the standard compliance for the data protection and hardware limitations.

4.4.1 Standards Compliance

Student&Company will handle and process highly sensitive data, including but not limited to personal information, Student's CVs and proprietary information of Company and University.

Because of that the Platform must not only be able to comply with the General Data Protection Regulation (GDPR) and any other Data/Privacy Law present in the countries where the Platform will be used (e.g California Consumer Privacy Act "CCPA" or similar law), but also have to be flexible enough to adopt custom policies set by Companies and Universities to protect their data and the data of their own users.

4.4.2 Hardware limitations

The platform is a web application that can be accessed from any device with a web browser and an internet connection. No special hardware is required a part from a device with a network card

4.5 Software System Attributes

This section provides an overview of the system's key attributes such as reliability and availability, security, maintainability, and portability explained in a technical and non-technical way.

4.5.1 Reliability & Availability

The platform is designed to be highly reliable and available to Users, with a target uptime of at least 99.862%. This means that the system should be unreachable for Users for no more than 12 hours in a year. To achieve this, the platform will be hosted on redundant servers with automatic failover capabilities and a load balancer to distribute traffic evenly between the different machines.

Furthermore, to ensure the availability of the platform, scheduled maintenance will be scheduled during low traffic days such as during winter or summer break.

This approach is intended to guarantee that the system remains fully operational at the start of each semester, when the traffic expected to be much higher due to the increase in the number of Students and Companies looking for Internships.

4.5.2 Security

Due to the highly sensitive nature of the data processed by the platform, security is a top priority for S&C. We will implement a multi-layered security approach to protect the data of our Users such as:

- The use of HTTPS protocol to encrypt data exchanged between the User and the Platform
- Strong password requirements and email verification for all users
- Failed login attempts shall be limited to 5 before temporary account lockout
- Password encryption using industry-standard hashing algorithms such as MD5 or SHA-256
- Role-based access control to ensure that Users can only access the data they are authorized to see
- Verification of Companies and Universities profile will be conducted using their VAT numbers, once the official governance API becomes available.

4.5.3 Maintainability

The system should be designed to be easily maintainable and scalable to accommodate future growth. This includes the use of modular code, clear documentation, and a well-defined architecture that allows for easy updates and modifications both on the front and the back end.

The platform should also be designed to be easily scalable to accommodate an increase in the number of Users and Internship Offers and in a way where the need of adding new features or fixing bugs should not require a complete overhaul of the system.

4.5.4 Portability

As a web application, the platform is inherently portable by design, allowing access from any device equipped with a web browser and an internet connection. There are no additional portable constraints on the server-side infrastructure of the platform.

5 Formal Analysis Using Alloy

In this section, we will provide a formal analysis of the system using the Alloy language. Alloy is a lightweight formal specification language that allowed us to model the system's structure and behavior and verify the correctness of the system's design. In particular, we decided to use Alloy to provide a formal analysis of Recommendation and Interview functionalities as they are the most complex part of the system and the one that could benefit the most from a formal correctness verification.

In this section first, we present the code used to generate the model, divided into three main parts: signature, facts, and assertions. Each part will be thoroughly explained through comments included directly in the code. Additionally, we will provide a visual representation of the model generated by the code and its evolution over time, as the model represents a dynamic system. This will be accompanied by a brief textual explanation of the events occurring at each specific step.

5.1 Signatures

The signature part of the code defines the different entities present in the system and their relationships. In this case, we will define the main entities of S&C such as Students, Companies, Universities, InternshipsOffer, Recommendation, and Interview.

```

sig Email, VatNumber, CV{}{
    //No Email, VatNumber or CV can be created without an associated user
    Email = User.userEmail
    VatNumber = (Company.companyVatNumber + University.universityVatNumber)
    CV = Student.cv
}

abstract sig User {
    userEmail: one Email,
}

sig Student extends User {
    enrolledIn: one University,
    cv: lone CV,
    recommendations: set Recommendation,
    spontaneousApplications: set SpontaneousApplication
}

sig University extends User {
    universityVatNumber: one VatNumber,
}

sig Company extends User {
    companyVatNumber: one VatNumber,
    offeredInternshipPosition: set InternshipsOffer,
}

sig InternshipsOffer{
    recommendations: set Recommendation,
    spontaneousApplications: set SpontaneousApplication
}{

    //A InternshipsOffer exists only if a company has offered it
    InternshipsOffer = Company.offeredInternshipPosition
}

/*
Define the possible status of a Recommendation.
- toBeAccepted represents a match by the Platform
- acceptedByStudent and acceptedByCompany are refer in the document as "PendingMatch"
- acceptedMatch and rejectedMatch have the same definition as in the document
*/

```

```

enum recommendationStatus{toBeAccepted , acceptedByStudent , acceptedByCompany ,
    ↪ acceptedMatch , rejectedMatch}

/*
Define the possible status of a SpontaneousApplication.
- toBeEvaluated represents the sending of a spontaneous application that has not been
    ↪ evaluated by the Company yet
- acceptedApplication and rejectedApplication are the possible outcomes of the
    ↪ evaluation of a spontaneous application
*/
enum spontaneousApplicantStatus{toBeEvaluated , acceptedApplication ,
    ↪ rejectedApplication}

/*
Define the possible status of an Interview.
- toBeSubmitted represents the creation of an interview that has not been submitted
    ↪ yet
- submitted represents the submission of the interview
- passed and failed are the possible outcomes of the interview
*/
enum interviewStatus{toBeSubmitted , submitted , passed , failed}

sig Recommendation{
    matchedStudent: one Student ,
    matchedInternship: one InternshipsOffer ,
    var status: one recommendationStatus
}{ 
    //A recommendation exists only if a student and an internship have been matched
    (InternshipsOffer.recommendations & Student.recommendations) = Recommendation
}

sig SpontaneousApplication{
    spontaneousApplicant : one Student ,
    interestedInternshipOffer: one InternshipsOffer ,
    var status: one spontaneousApplicantStatus
}{ 
    //A spontaneous application exists only if a student has sent it
    (SpontaneousApplication & Student.spontaneousApplications) =
        ↪ SpontaneousApplication
}

//The signature Interview is variable as it is created only when a Recommendation or
    ↪ a SpontaneousApplication is accepted
var sig Interview{
    var recommendation: lone Recommendation ,
    var spontaneousApplication: lone SpontaneousApplication ,
    var status: one interviewStatus
}{ 
    //An interview can only be assign to a recommendation or a spontaneous
        ↪ application
    recommendation.status = acceptedMatch iff !spontaneousApplication.status =
        ↪ acceptedApplication
    one recommendation implies no spontaneousApplication
    one spontaneousApplication implies no recommendation
}

```

5.2 Facts

Facts represent the constraints that the system must respect and are always true in the model. For this application we defined numerous facts such as the necessity of a Student to have a CV to be matched with an Internship as well as the various stages of progression for an Internship Offer and Interview.

```

// Two distinct interview cannot share the same recommendation or spontaneous application
fact interviewUniqueness{
    always all i1 , i2: Interview | i1 ≠ i2 implies ((i1.recommendation & i2.
        ↪ recommendation) = none) and ((i1.spontaneousApplication & i2.
        ↪ spontaneousApplication) = none)
}

//Ensure that VatNumbers are unique for Company and University

```

```

fact UniqueVatNumber{
    //The set of VatNumbers for companies and universities should be different from
    //each other
    Company.companyVatNumber & University.universityVatNumber = none
    //Different companies and universities should have different vat numbers
    all c1, c2: Company | c1 ≠ c2 implies c1.companyVatNumber ≠ c2.companyVatNumber
    all u1, u2: University | u1 ≠ u2 implies u1.universityVatNumber ≠ u2.
        ↪ universityVatNumber
}

//Different Users shall have different emails
fact UniqueEmailEndEnrollment{
    all u1, u2: User | u1 ≠ u2 implies u1.userEmail ≠ u2.userEmail
}

//All students shall be enrolled in a university
fact StudentEnrolledInUniversity{
    all s: Student | s.enrolledIn ≠ none
}

//Different students shall have different CVs
fact CurriculumUniqueness{
    all s1, s2: Student | (s1 ≠ s2 and s1.cv ≠ none and s2.cv ≠ none) implies s1.cv ≠
        ↪ s2.cv
}

//Different companies shall have different offeredInternshipPositions
fact UniqueInternshipOffer{
    all c1, c2: Company | (c1 ≠ c2 and c1.offeredInternshipPosition ≠ none and c2.
        ↪ offeredInternshipPosition ≠ none) implies c1.offeredInternshipPosition ≠
        ↪ c2.offeredInternshipPosition
}

//Only a student with a Cv and a Company with an OfferedInternshipPosition can be
//→ matched.
//Only a student with a Cv can send a spontaneous application
fact StudentWithCVInteraction{
    all r: Recommendation | r.matchedStudent.cv ≠ none ∧ r.matchedInternship ≠ none
    all s: SpontaneousApplication | s.spontaneousApplicant.cv ≠ none ∧ s.
        ↪ interestedInternshipOffer ≠ none
}

//Define how one Recommendation differs from another Recommendation and similarly for
//→ SpontaneousApplications
fact SingleApplicationSource{
    all r1, r2: Recommendation | r1 ≠ r2 implies r1.matchedStudent ≠ r2.
        ↪ matchedStudent or r1.matchedInternship ≠ r2.matchedInternship
    all sa1, sa2: SpontaneousApplication | sa1 ≠ sa2 implies sa1.spontaneousApplicant
        ↪ ≠ sa2.spontaneousApplicant or sa1.interestedInternshipOffer ≠ sa2.
        ↪ interestedInternshipOffer
}

//Define the reflexive property Recommendation and SpontaneousApplication
fact ApplicationReflexivity{
    all r: Recommendation, i: InternshipsOffer | r in i.recommendations iff r.
        ↪ matchedInternship = i
    all r: Recommendation, s: Student | r in s.recommendations implies r.
        ↪ matchedStudent = s
    all sa: SpontaneousApplication, i: InternshipsOffer | sa in i.
        ↪ spontaneousApplications iff sa.interestedInternshipOffer = i
    all sa: SpontaneousApplication, s: Student | sa in s.spontaneousApplications
        ↪ implies sa.spontaneousApplicant = s
}

//An Application is unique and cannot be shared between two different Students or
//→ InternshipOffers
fact ApplicationUniqueness{
    all i1, i2: InternshipsOffer | i1 ≠ i2 implies ((i1.recommendations & i2.
        ↪ recommendations) = none)
    all sa1, sa2: SpontaneousApplication | sa1 ≠ sa2 implies ((sa1.
        ↪ interestedInternshipOffer & sa2.interestedInternshipOffer) = none)
}

```

```

//Define the initial status of a Recommendation and a SpontaneousApplication
fact initAcceptance {
    Recommendation.status = toBeAccepted
    SpontaneousApplication.status = toBeEvaluated
}

//Constraints that define the evolution of the status of a Recommendation
fact RecommendationEvolutionRules{
    //A Match need to be accepted by both parties before it can be considered
    ↪ accepted. It can't become accepted in one-step
    all r: Recommendation | always ((r.status = toBeAccepted) implies (r.status' ≠
    ↪ acceptedMatch))
    //A party cannot retract its acceptance of a match. Once accepted, it remains
    ↪ accepted.
    all r: Recommendation | always ((r.status = acceptedByStudent) implies (r.status' =
    ↪ ≠ acceptedByCompany and r.status' ≠ toBeAccepted))
    all r: Recommendation | always ((r.status = acceptedByCompany) implies (r.status' =
    ↪ ≠ acceptedByStudent and r.status' ≠ toBeAccepted))
    //Rejected and accepted matches remain rejected and accepted forever
    all r: Recommendation | always ((r.status = rejectedMatch) implies always (r.
    ↪ status = rejectedMatch))
    all r: Recommendation | always ((r.status = acceptedMatch) implies always (r.
    ↪ status = acceptedMatch))
}

//Constraints that define the evolution of the status of a SpontaneousApplication
fact SpontaneousApplicationEvolutionRules{
    always all sa: SpontaneousApplication | (sa.status = toBeEvaluated) implies ((sa.
    ↪ status' = acceptedApplication) or (sa.status' = rejectedApplication) or (
    ↪ sa.status' = toBeEvaluated))
    //Once a spontaneous application has been accepted or rejected, it cannot change
    ↪ its status
    all sa: SpontaneousApplication | always ((sa.status = acceptedApplication)
    ↪ implies always (sa.status = acceptedApplication))
    all sa: SpontaneousApplication | always ((sa.status = rejectedApplication)
    ↪ implies always (sa.status = rejectedApplication))

}

//Here the Interviews are created and for now the starting status is toBeSubmitted
fact InterviewIFRecommendationAccepted{
    always all r: Recommendation | ((r.status = acceptedMatch) implies (one i:
    ↪ Interview | i.recommendation = r ))
    always all sa: SpontaneousApplication | ((sa.status = acceptedApplication)
    ↪ implies (one i: Interview | i.spontaneousApplication = sa))
    always all i: Interview, r:Recommendation | ((i.recommendation = r) implies
    ↪ always (i.recommendation = r))
    always all i: Interview, r:SpontaneousApplication | ((i.spontaneousApplication =
    ↪ r) implies always (i.spontaneousApplication = r))
    always (all i: Interview | once (i.status = toBeSubmitted))
}

fact InterviewStatusEvolution{
    // If interview is submitted, then sometime in the past it had to be
    ↪ toBeSubmitted
    always all i: Interview | always ((i.status = submitted) implies once (i.status =
    ↪ toBeSubmitted and i.status' = submitted))
    // If interview is failed, then sometime in the past it had to be submitted
    always all i: Interview | always ((i.status = failed) implies once (i.status =
    ↪ submitted and i.status' = failed))
    // If interview is passed, then sometime in the past it had to be submitted
    always all i: Interview | always ((i.status = passed) implies once (i.status =
    ↪ submitted and i.status' = passed))
    always all i: Interview | always ((i.status = submitted) implies after always (i.
    ↪ status ≠ toBeSubmitted))
    always all i: Interview | always ((i.status = passed) implies after always (i.
    ↪ status ≠ submitted))
    always all i: Interview | always ((i.status = failed) implies after always (i.
    ↪ status ≠ submitted))
    always all i: Interview | always ((i.status' ≠ toBeSubmitted) implies once (i.
    ↪ status = toBeSubmitted))
}

```

```
}
```

5.3 Assertions

Assertions are the properties that we want to verify in the model. Such properties must hold to avoid unwanted behavior by the Platform. For this scenario we verified different aspects such as the necessity of both Student and Company to accept a Match before starting an Interview or the fact that only a Student, with a CV uploaded to the Platform, can have completed an interview.

```

//A function that returns the company that has offered a specific InternshipsOffer
fun FindInternshipPositionCompany[i: InternshipsOffer]: lone Company {
    { c: Company | i in c.offeredInternshipPosition }
}

//If a student has no CV, then it cannot be matched with a recommendation or send a
//→ spontaneous application
//If a company has no offeredInternshipPosition, then it cannot be matched with a
//→ recommendation
assert NoInfoProvided{
    all s: Student, r: Recommendation | (s.cv = none) implies (r.matchedStudent ≠ s)
    all s: Student, sa: SpontaneousApplication | (s.cv = none) implies (sa.
        //→ spontaneousApplicant ≠ s)
    all c: Company, r: Recommendation | (c.offeredInternshipPosition = none) implies
        //→ (FindInternshipPositionCompany[r.matchedInternship] ≠ c)
}

//For a recommendation to be accepted, both the student and the company need to
//→ accept it
//For a spontaneous application to be accepted, it needs to be evaluated
assert BothPartyNeedToAct{
    always all r: Recommendation | (r.status' = acceptedMatch) implies (r.status =
        //→ acceptedByStudent or r.status = acceptedByCompany or r.status =
        //→ acceptedMatch)
    always all sa: SpontaneousApplication | (sa.status' = acceptedApplication)
        //→ implies (sa.status = toBeEvaluated or sa.status = acceptedApplication)
}

//If a student has multiple recommendations, then the recommendations are for
//→ different InternshipOffers
//If a InternshipOffer has multiple recommendations, then the students recommended
//→ are different
assert UniqueRecommendation{
    all s: Student, r1, r2: Recommendation | (r1 ≠ r2 and r1.matchedStudent = s and
        //→ r2.matchedStudent = s) implies r1.matchedInternship ≠ r2.matchedInternship
    all i: InternshipsOffer, r1, r2: Recommendation | (r1 ≠ r2 and r1.
        //→ matchedInternship = i and r2.matchedInternship = i) implies r1.
        //→ matchedStudent ≠ r2.matchedStudent
}

//Two companies cannot offer the same InternshipOffer
assert internshipsOfferUniqueness{
    all c1, c2: Company | (c1 ≠ c2 and c1.offeredInternshipPosition ≠ none and c2.
        //→ offeredInternshipPosition ≠ none) implies c1.offeredInternshipPosition ≠
        //→ c2.offeredInternshipPosition
}

//Two students cannot have the same CV
assert CVUniqueness{
    all s1, s2: Student | (s1 ≠ s2 and s1.cv ≠ none and s2.cv ≠ none) implies s1.cv ≠
        //→ s2.cv
}

//An interview can be assigned to a recommendation or a spontaneous application only
//→ if they have been accepted
assert InterviewAssignment{
    always all i: Interview | (i.recommendation.status = acceptedMatch or i.
        //→ spontaneousApplication.status = acceptedApplication)
}

```

```

//An interview can be assigned only to a student with a CV
assert StudentWithInterviewHasCV{
    //( $A$  iff  $\neg B$ ) equivalent to ( $A = \neg B$  and  $B = \neg A$ ) equivalent to ( $A \oplus B$ )
    always all i: Interview | (i.recommendation.matchedStudent.cv ≠ none) iff !(i.
        ↳ spontaneousApplication.spontaneousApplicant.cv ≠ none)
}

```

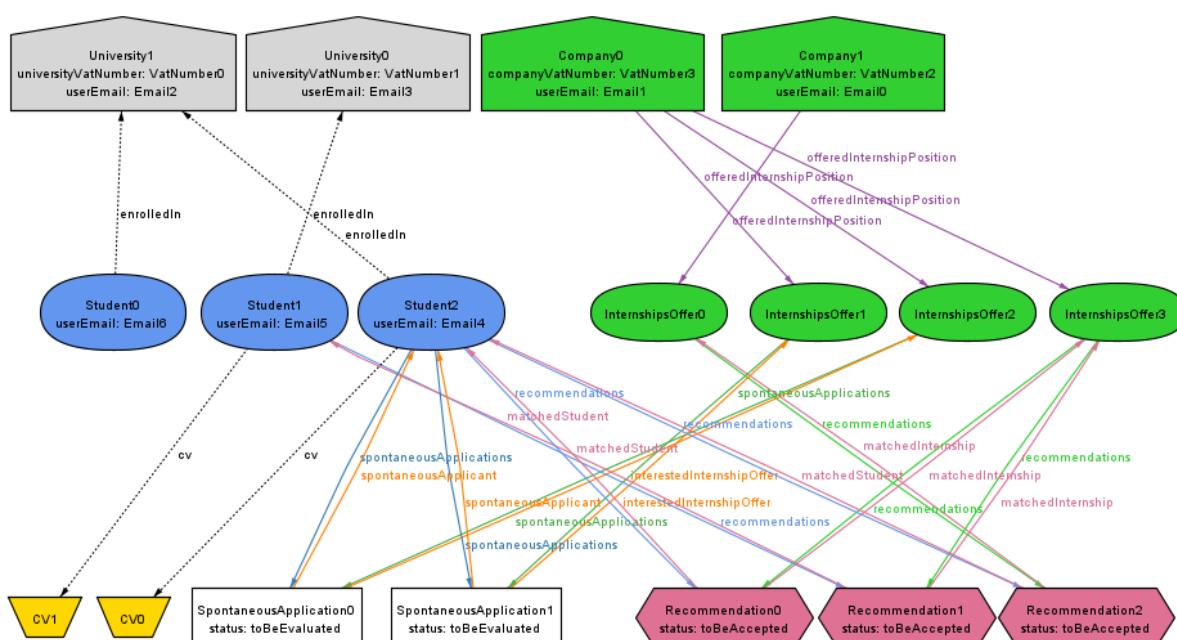
5.4 Model Visualization

The following model was obtained with the following run:

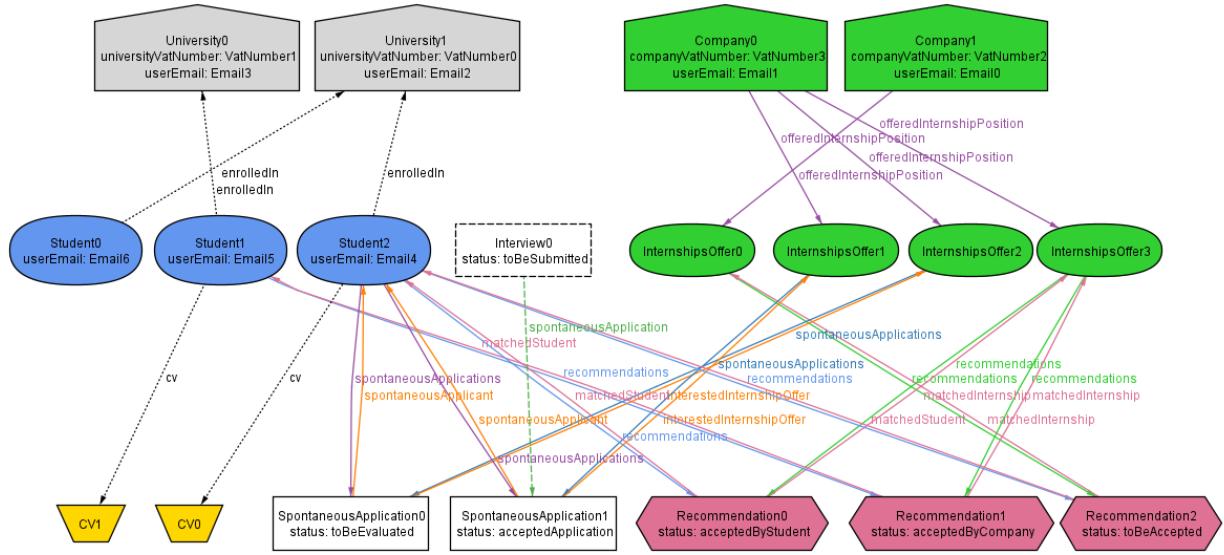
```
run {} for 5 but exactly 3 Recommendation, exactly 2 SpontaneousApplication, exactly  
→ 4 InternshipsOffer, exactly 3 Students, exactly 2 CV, exactly 5 steps
```

and represent a typical evolution of the system. It is possible to see the different entities, their relationships, and the evolution of the status of some of those entities, like Recommendation or Interview, through time.

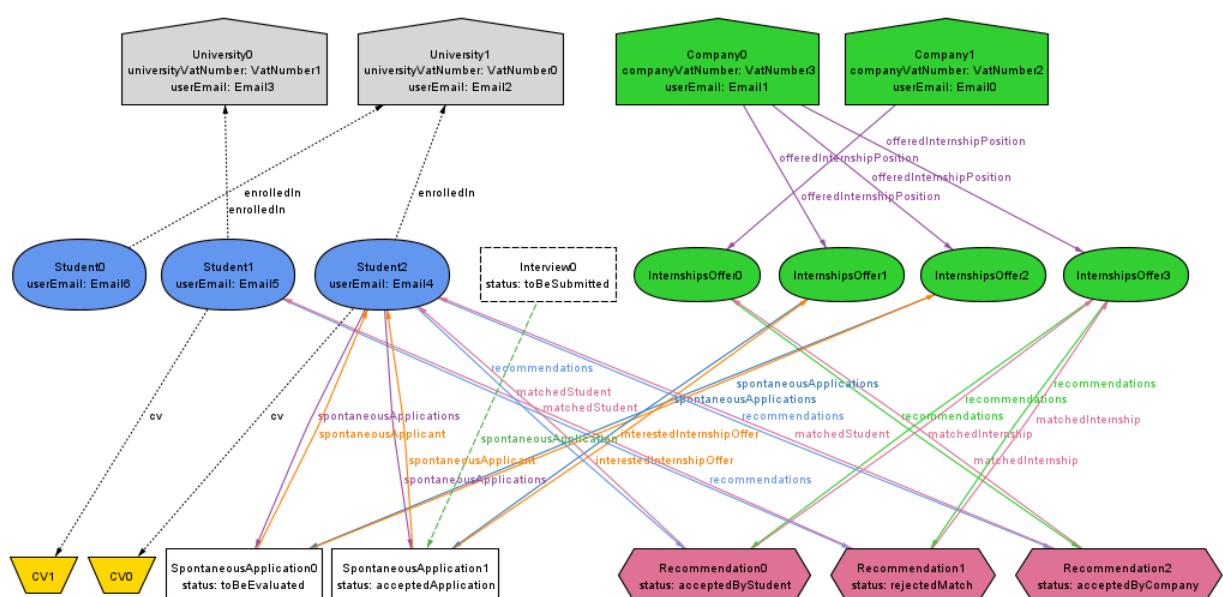
The parameters for the run command were chosen to produce a clear and readable model that is easy for the reader to understand but, they can be easily adjusted to generate a more detailed or more generalized model if a different type of analysis is required.



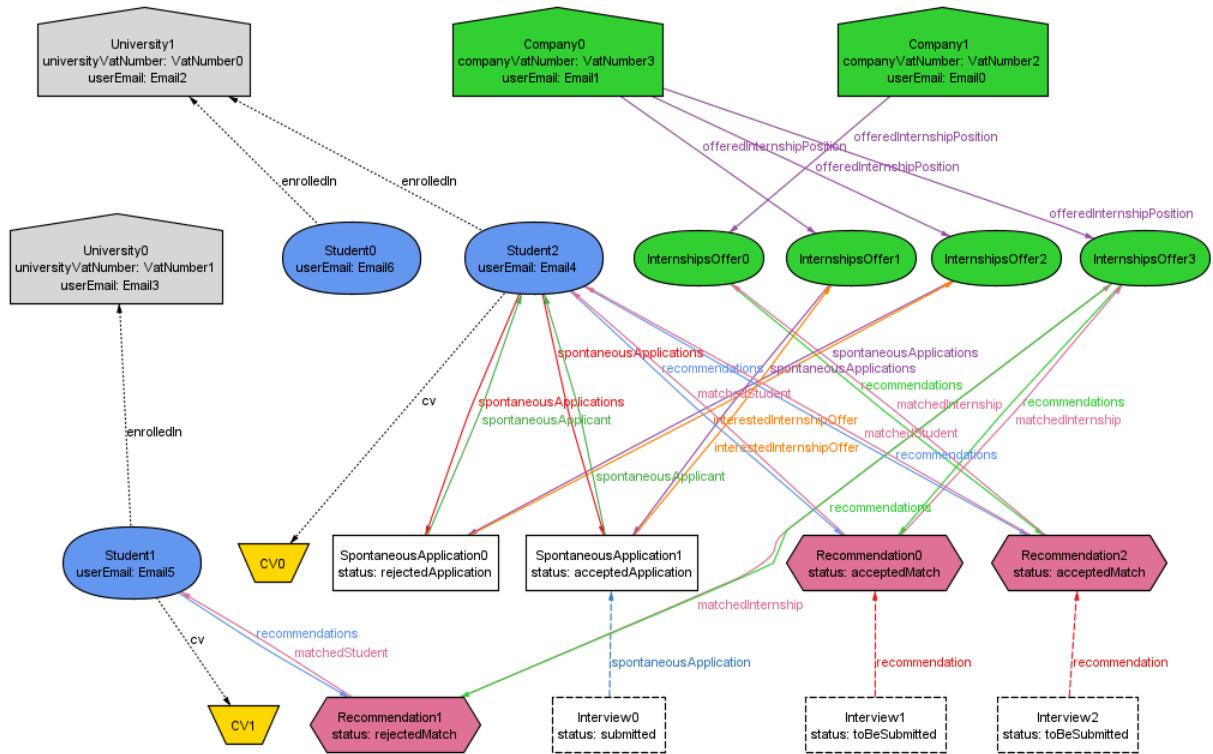
Step 0: All Recommendations and Spontaneous Applications have been sent but have not yet been evaluated. *Student0* has not uploaded a CV yet, so he cannot be matched with any InternshipOffer



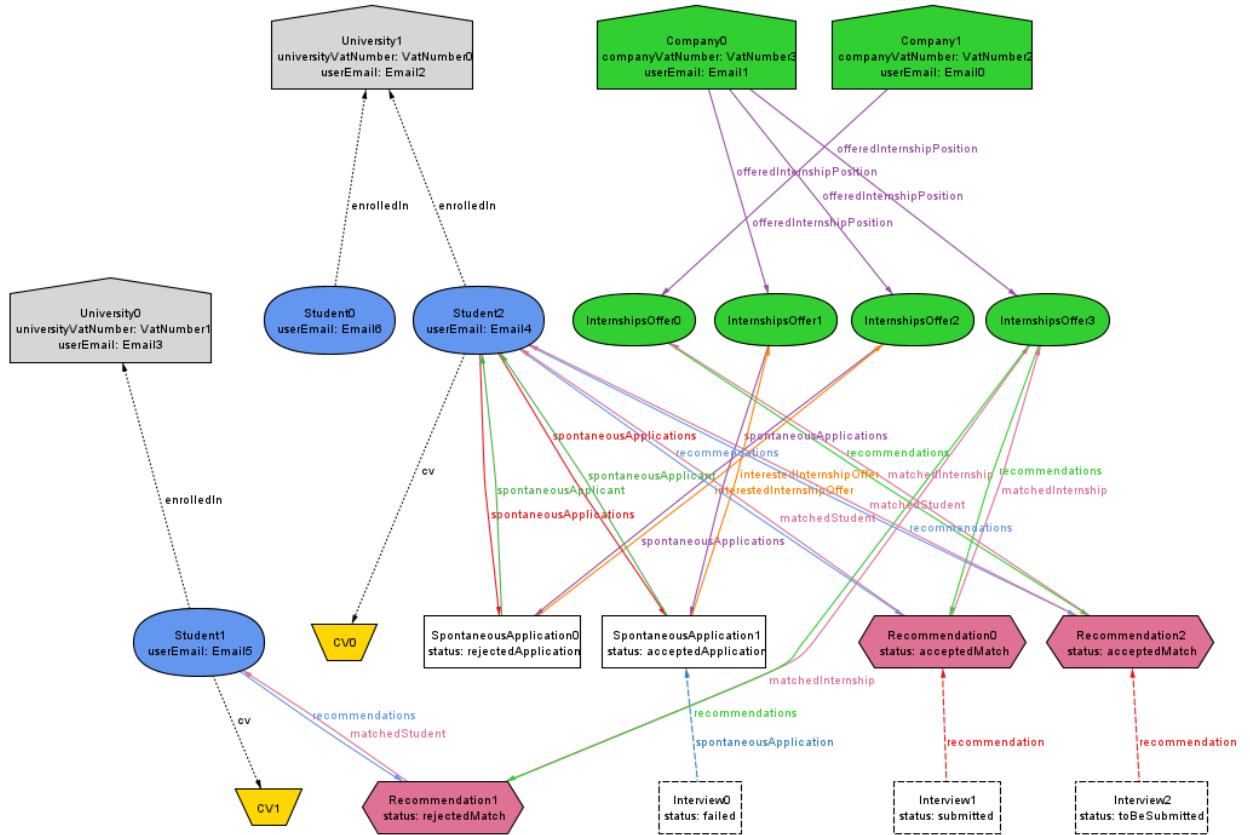
Step 1: A Spontaneous Application (*SpontaneousApplication1*) has been accepted and a Interview (*Interview0*) has been created



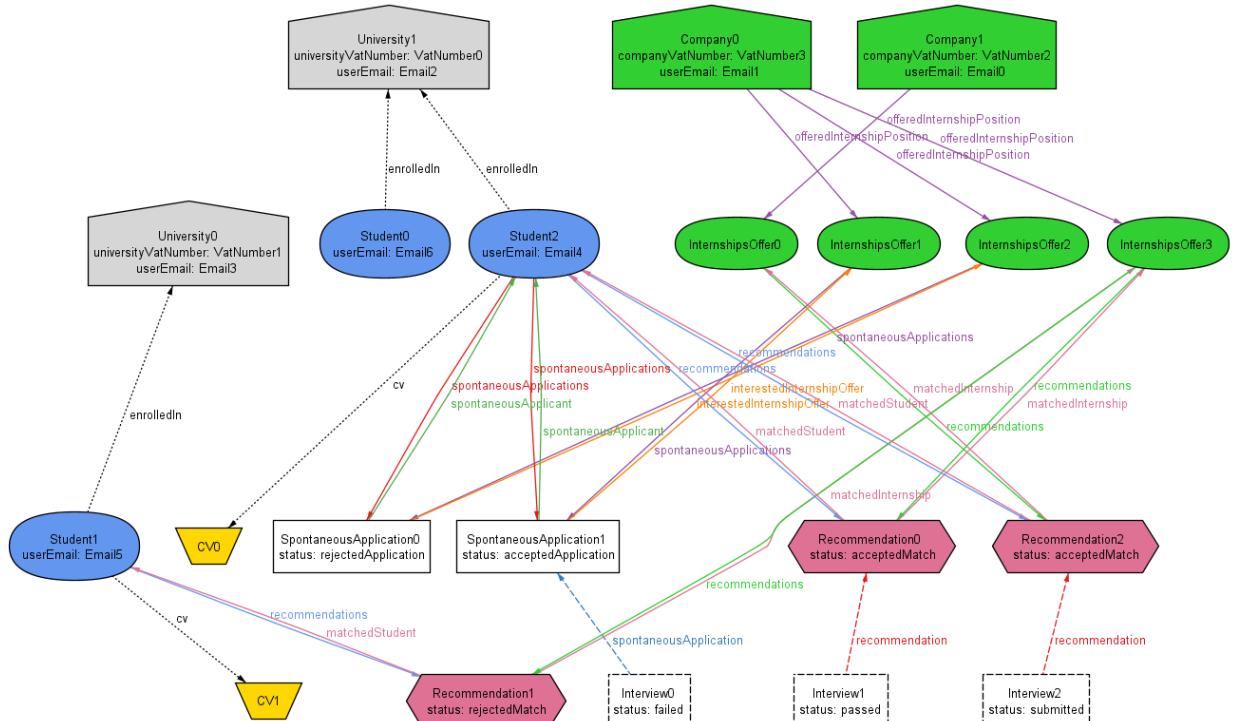
Step 2: A Recommendation (*Recommendation1*) has been rejected by one of the party



Step 3: The other Spontaneous Application (*SpontaneousApplication0*) has been rejected, while *Interview0* has been sent. The two remaining Recommendations have been accepted by the remaining party



Step 4: Interview0 of Student2 was unsucesfull but Interview (Interview1) is sent to him for another Recommendation



Step 5: Interview1 has been passed by Student2, while Company1 has sent him the remaining Interview

6 Effort Spent

Lorenzo Ricci

Section	Hours
Introduction	10
Overall Description	8
Specific Requirements	15
Formal Analysis Using Alloy	10
Misc Activities	24

Table 32: Effort - Lorenzo Ricci

Matteo Giovanni Paoli

Section	Hours
Introduction	7
Overall Description	16
Specific Requirements	22
Formal Analysis Using Alloy	13
Misc Activities	2

Table 33: Effort - Matteo Giovanni Paoli

Samuele Grisoni

Section	Hours
Introduction	11
Overall Description	15
Specific Requirements	9
Formal Analysis Using Alloy	16
Misc Activities	11

Table 34: Effort - Samuele Grisoni

7 References

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A Assignment RDD AY 2024-2025

Students&Companies (S&C) is a platform that helps match university students looking for internships and companies offering them. The platform should ease the matching between students and companies based on:

- the experiences, skills and attitudes of students, as listed in their CVs;
- the projects (application domain, tasks to be performed, relevant adopted technologies-if any etc.) and terms offered by companies (for example, some company might offer paid internships and/or provide both tangible and intangible benefits, such as training, mentorships, etc.).

The platform is used by companies to advertise the internships that they offer, and by students to look for internships. Students can be proactive when they look for internships (i.e., they initiate the process, go through the available internships, etc.). Moreover, the system also has mechanisms to inform students when an internship that might interest them becomes available and can inform companies about the availability of student CVs corresponding to their needs. We refer to this process as “recommendation”. Recommendation in S&C can employ mechanisms of various levels of sophistication to match students with internships, from simple keyword searching, to statistical analyses based on the characteristics of students and internships. When suitable recommendations are identified and accepted by the two parties, a contact is established. After a contact is established, a selection process starts. During this process, companies interview students (and collect answers from them, possibly through structured questionnaires) to gauge their fit with the company and the internship. S&C supports this selection process by helping manage (set up, conduct, etc.) interviews and also finalize the selections. To feed statistical analysis applied during recommendation, S&C collects various kinds of information regarding the internships, for example by asking students and companies to provide feedback and suggestions. Moreover, S&C should be able to provide suggestions both to companies and to students regarding how to make their submissions (project descriptions for companies and CVs for students) more appealing for their counterparts. In general, S&C provides interested parties with mechanisms to keep track and monitor the execution and the outcomes of the matchmaking process and of the subsequent internships from the point of view of all interested parties. For example, it provides spaces where interested parties can complain, communicate problems, and provide information about the current status of the ongoing internship. The platform is used by students at different universities. Universities also need to monitor the situation of internships; in particular, they are responsible for handling complaints, especially ones that might require the interruption of the internship.