Requirements Analysis and Specification Document

Students&Companies

Elia Falzoni - 10763955
Andrea Toffoli - 10725294
Andrea Torti - 10730470

Release Date: 07/01/2025

Version 2.0

Contents

1 Introduction **4**

1.1 Purpose . . . 4

1.1.1 Goals . . . 4

1.2 Scope . . . 4

1.2.1 World Phenomena . . . 5

1.2.2 Shared Phenomena . . . 5

1.3 Acronyms and Abbreviations . . . 6

1.3.1 Acronyms . . . 6

1.3.2 Abbreviations . . . 6

1.4 Revision History . . . 6

1.5 Reference Documents . . . 6

1.6 Document Structure . . . 6

2 Overall Description **8**

2.1 Product Perspective . . . 8

2.1.1 Scenarios . . . 8

2.1.2 Class Diagram . . . 11

2.2 Product Functions . . . 11

2.3 User Characteristics . . . 12

2.4 Assumptions, Dependencies and Constraints . . . 12

2.4.1 Domain Assumptions . . . 12

3 Specific Requirements **13**

3.1 External Interface Requirements . . . 13

3.1.1 User interfaces . . . 13

3.1.2 Hardware interfaces . . . 13

3.1.3 Software interfaces . . . 13

3.1.4 Communication interfaces . . . 13

3.2 Functional Requirements . . . 13

3.2.1 Requirements Mapping . . . 15

3.2.2 Use case Diagrams . . . 16

3.2.3 Use cases and related Sequence Diagrams . . . 17

3.3 Performance Requirements . . . 42

3.4 Design Constraints . . . 42

3.4.1 Standards Compliance 42
3.4.2 Hardware Limitations 42
3.5 Software System Attributes 42
3.5.1 Reliability 42
3.5.2 Availability 42
3.5.3 Security 42
3.5.4 Maintainability 43
3.5.5 Portability 43

4 Formal Analysis Using Alloy **44**

5 Effort Spent **51**

6 References **51**
6.1 References 51
6.2 Used Tools 51

1 Introduction

1.1 Purpose

In a world where the need for students to connect with the job market has become increasingly essential for career development, the Students&Companies (from now on S&C) platform mediates the link between students from different universities and companies by allowing the latter to advertise their internship offers and students to consult them and subsequently apply.

S&C offers functionality for both proactive and automated participation: Students can actively browse and apply for internships, while the system can also notify them of new opportunities that align with their profile. Companies, similarly, are notified when potential candidates meet their requirements, through a process called "recommendation".

At the end of the process, a contact is established and the selection process begins, which consists of an interview. The platform also helps companies create engaging project descriptions and students improve their resumes, as well as monitoring the communication between the parties involved.

1.1.1 Goals

[G1] Allow students to find internships that match their profiles.

[G2] Allow companies to find suitable candidates for their open internships.

[G3] Provides students and companies with automatic recommendations for compatible counterparts.

[G4] Ensures matching quality by crunching all available data and asking students and companies for feedback.

[G5] Helps students and companies during the interview and selection processes.

[G6] Helps students and companies to be more appealing to their counterparts.

[G7] Allows complaints to be filed by students and companies and to be handled by universities.

1.2 Scope

S&C has two types of main users: students, which look for internships, and companies, which look for suitable candidates. Universities are a secondary user that will use S&C to monitor internships and handle eventual complaints.

Students upload their CVs to the system and describe their previous experiences, skills, projects and internships terms preferences.

Companies advertise their open internship positions, providing information as salary and intangible benefits offered, and they can withdraw them at anytime.

Students can proactively look for open positions or accept system recommendations, while companies can only do the latter: if both of them accept a match, a contact is established,

so, they can start communicating. In particular, companies can interview students and collect information from them, for example, through questionnaires. Companies can select the best candidates among the ones that applied for a particular position. Both parties can also provide feedback and suggestions about the internship. If necessary, both companies and students are able to submit a complaint about the counterpart.

Universities are able to monitor internships status and handle eventual complaints, especially the ones that might require the interruption of the internship.

1.2.1 World Phenomena

[WP1] Students write their CVs

[WP2] Companies create new internship opportunities for students

[WP3] Students and companies decide to accept a system's recommendation

[WP4] Students and companies participate in interviews

[WP5] Students and companies agree to start an internship

1.2.2 Shared Phenomena

World controlled

[SP1] Students create a personal account

[SP2] Companies create a business account

[SP3] Companies submit an internship position to the system

[SP4] Companies withdraw an internship position from the system

[SP5] Students submit their CVs

[SP6] Students remove their CVs

[SP7] Students proactively search for internship positions

[SP8] Students accept systems' recommendations

[SP9] Companies accept systems' recommendations

[SP10] Companies interview and collect information from students

[SP11] Companies or students file complaints during an internship

Machine controlled

[SP1] The system notifies students when an internship that matches their interests and skills becomes available

[SP2] The system notifies companies about the availability of student's profile corresponding to their needs

[SP3] The system provides the possibility for companies to collect students' answers through structured questionnaires

1.3 Acronyms and Abbreviations

1.3.1 Acronyms

- S&C: Students&Companies

- UML: Unified Modeling Language

1.3.2 Abbreviations

- WP: World Phenomena

- SP: Shared Phenomena

1.4 Revision History

- Version 1.0 (22/12/2024)

- Version 1.1 (23/12/2024): added table of contents (index), added alloy screenshots.

- Version 2.0 (07/01/2025): minor formal and stylistic edits, uploaded Figure 16.

1.5 Reference Documents

- The Requirement Engineering and Design Project specification document A.Y. 2024–2025
- https://github.com/Benels/Software-Engineering-2-project-2023-2024-RASD-DD
- https://github.com/Angtrim/alloy-latex-highlighting
- Software Engineering 2 PoliMi course materials

1.6 Document Structure

1. **Introduction**: provides a brief description of the system focusing on goals, phenomena and purpose of its development. Also, it specifies details about the RASD document itself, like versioning, references and structure.

2. **Overall Description**: offers an in-depth exploration of the problem. It thoroughly examines the domain and its intricacies, outlines various scenarios, and provides a detailed discussion of product and user attributes. Additionally, it addresses underlying assumptions, key dependencies, and notable constraints.

3. **Specific Requirements**: focuses on a thorough analysis of the specific requirements. It provides comprehensive insights into external interface requirements, functional requirements, and performance requirements, ensuring a detailed understanding of each aspect.

4. **Formal Analysis**: shows the process of formal analysis using Alloy. Its primary objective is to validate the accuracy and consistency of the model described in the earlier sections. This chapter emphasizes presenting the outcomes of the conducted checks and highlighting meaningful assertions derived from the analysis.

5. **Effort Spent**: details the individual contributions made by each group member in the creation of this document.

6. **References**: functions as a bibliography, providing a comprehensive list of references and supplementary resources utilized in the development of this document.

2 Overall Description

2.1 Product Perspective

2.1.1 Scenarios

Scenario 1 - Unregistered student creates a personal account: Francesco Totti, a university student, wants to look for an internship program and happens to stumble across the S&C website. He clicks on the "Create account" button and chooses the "I'm a student" option. Then, he proceeds to insert his name, surname, institutional e-mail address, home and residence addresses and, eventually, he chooses a password. Now, by clicking on the "Register" button and then clicking on the sign-up confirmation link, received on the provided e-mail address, he is registered to S&C.

Scenario 2 - Unregistered company creates a business account: Svoltastudenti, a company, wants to find suitable candidates for its internship position and runs into the S&C website. The operator proceeds to click on the "Create account" button and then chooses the "I'm a company" option. The operator needs to insert company name, tax ID Number, office/headquarters address, the company's e-mail address and choose password. Now, by clicking on the "Register" button and then clicking on the sign-up confirmation link, received on the provided e-mail address, the company is registered to S&C.

Scenario 3 - Student uploads/updates his CV and receives suggestions about improving it: Paola Squalo, a registered student, wants to upload/update her CV on S&C platform. So, she clicks on the "Profile" button, then, the "Upload CV" button. She can now choose her CV between her files and upload it. Then, S&C suggests how Paola's CVs can be improved by displaying, in this page, AI generated hints.

Scenario 4 - Company opens a new internship position and receives suggestions about improving the offer: AS Roma, a registered company, wants to open a new internship position on the S&C platform. So, the company operator clicks on the "Profile" button, then, on the "New internship" button. Now, the operator inserts the new internship position information and terms: application domain, tasks to be performed, relevant adopted technologies (if present), salary (if offered), workplace, tangible and non-tangible benefits offered, candidates-expected skills and characteristics. In this page, S&C displays AI generated hints in order to improving the internship offer. Finally, the operator clicks on the "Save" button.

Scenario 5 - Company edits/deletes/closes/re-opens an internship position: Politecnico di Milano, a registered company, wants to edit/delete/close/re-open an internship position. So, the company operator clicks on the "Profile" button, then, on the "Edit internships" button. Now, the operator is presented with the list of internships and has 3 buttons available for each one: edit, delete, close (if open) or open (if closed). Clicking close/open/delete performs the requested operation immediately, while clicking "edit" will open a new page with the internship information fields made writable. In this last case, when the changes have been made, the information can be saved by clicking the "Save" button.

Scenario 6 - Student or Company logs into the S&C platform: Gennaro Sapio, a student, or Francesco Pio Valentino, a company operator, wants to log into their personal or business S&C account. The user clicks the "Login" button in the website's homepage,

then, proceeds to insert e-mail and password and clicks the "Login" button.

Scenario 7 - Student or Company operator resets the account forgotten password: Mattia Perfumo, a student, or Alessandro Mellone, a company operator, wants to reset the password associated to their personal or business account. The user clicks the "Login" button in the website's homepage, then, after inserting the account e-mail address, clicks the "Reset password" button. A password-reset link is sent to the e-mail address associated to the account and, by clicking it, it's possible to choose a new password. Then, by clicking on "Confirm", the process is completed.

Scenario 8 - Students proactively search for an internship: Giovanni Pertile, a student, wants to look for an internship suitable to his particular skills. Once logged in, he clicks on the "Search for internship" button on the website homepage and he is presented with a new page containing the appropriate filters that allow him to tailor his search to his specific needs. Applying the filters will reduce the list of internships presented to him, then allowing him to click on one of them to have more information. Finally, the student can click the "Like" button to initiate a match with said project or click "Back" to go back to the list.

Scenario 9 - A student or a company receives a recommendation: Luca Dignatici, a student, or Andrea Ragioni, a company operator, can find a list of recommended internships or candidates in the S&C homepage, and click on any of them to view more details. They find a button to accept or decline the system recommendation for each one. Clicking "Accept" or "Decline", S&C returns to recommendations list, this time not showing the previous recommendation, while clicking on "Back" just returns to the recommendations list.

Scenario 10 - A company interviews a candidate: Once a student and a company match each other, a chat between them is opened, which can be found in the profile's match list section, which can be reached by clicking the "See matches" on the home page. So, the parties can communicate by text and the companies are able to submit questionnaires to candidates: in particular, the operator can build one by clicking on the "New questionnaire" button in the chat window, where an online page with the tools and options made available by S&C appears, then click the "Send" button. Users are also able to start a video call, by clicking on the "camera" icon, which prompts the page to show a window with the options to select an already known contact.

Scenario 11 - Selection: In order to complete the selection process, each company can see, through a section in their home page, the list of names of all students who have completed the interview, alongside with an icon of a paper for each student row, representing a link to the questionnaires they have answered. If clicked, the full document opens showing both questions and the given answers. Next to this option, the operator finds a green check icon that once clicked sends a notification to the concerned students, notifying the confirmation of selection. At the same time, a red "X" icon serves the purpose of notifying the student of the rejection of their candidacy. Both these options trigger a pre-compiled email with a proper text for the two cases.

Scenario 12 - A student or a company wants to file a complaint about an ongoing internship: A student or a company operator wants to file a complaint about an ongoing internship: the user clicks the "Manage internships" button in S&C home page, selects the relevant internship for which they want to find the complaint, then click on the "File a complaint" button. There, he can fill a text field stating notes and

problems, and eventually he can select a clickable box made solely to express the desire to end the internship. In this latter case, the user fills up another text field. Finally, the operation is concluded by clicking on the "Send" button.

Scenario 13 - A university operator logs into the S&C website: Roberto Scardia, a university operator, is in the list of authorized operators for the Tate University. He clicks on the "Login" button in the S&C homepage, and inserts his institutional email in the provided text field. He then clicks on the "Send OTP" button. He'll receive an OTP code on that email shortly and he pastes it in the new available text field, then he clicks "Confirm OTP" to login.

Scenario 14 - Any registered user chats: Mario Castoro, a student, wants to chat with Pear S.P.A, the company that provided the internship he is currently enrolled in. To do so, he accesses the home page where he finds the chat list button to open the chat interface. At the same time, all companies can perform the same action and start chatting with any of their enrolled students. Cinzia Berrietto, an authorized university operator, can view a list of active chats with students and companies on her S&C home page. The chats are displayed in reverse chronological order based on the last message sent (similar to WhatsApp). Clicking on a student or company opens a new page showing the chat history and the relevant details of the internship involving the selected student, company, and any other active participants. Cinzia Berrietto, as a mediator, also has to forward complaints between students and companies. All users can view active chats or click a "Start chat" button to initiate a new conversation. Once the appropriate chat is selected or created, they can simply write and send the message.

Scenario 15 - Students and companies monitor the execution and outcomes of the matchmaking process: A student or a company operator wants more information about the performance of their curriculum or projects: so, the user clicks on the "Profile" button on the S&C home page, then, on the "Analytics" button. Here, the list of pending matches, data and analytics about performance are displayed.

Scenario 16 - Students and companies provide feedback about matchmaking performance and/or internship experience: Students and companies are able to provide feedback about matchmaking performance and/or internship experience compiling questionnaires, which are sent via email by S&C: the user clicks on the link attached to the email, so, compiles the questionnaire. Then, he clicks on the "Send" button.

2.1.2 Class Diagram

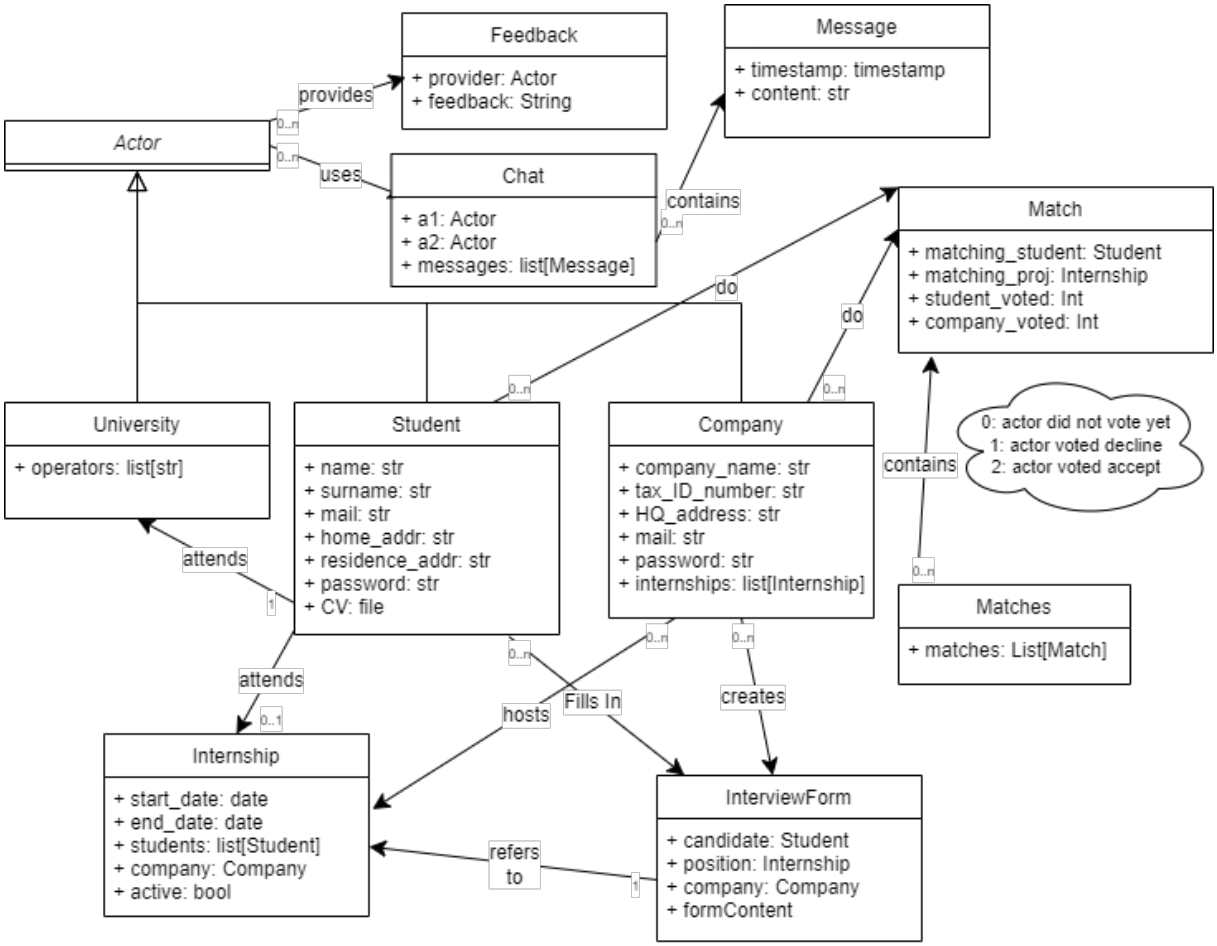

Figure 1: High Level UML Diagram

2.2 Product Functions

Sign up and log in The platform gives the possibility to both students and companies to create accounts. Companies need to provide their name, field of activity, registered office and contacts, while students will be asked about their name, last name, date of birth, university and degree course. Once the profile is created, the system allows for a log in with the respective credentials.

Companies profile update The platform must provide, for every registered company, a section to create and update internships and various requirements. In particular, giving way to insert internship title and description, number of available positions, required degree, technical knowledge and experiences. All these updates will be openly visible once the changes are saved.

Students profile update At the same, students must be able to upload their CVs, specifically stating the projects accomplished, field of work and technologies employed. Just like with companies, the changes will be visible once saved.

Recommendation system This function helps students companies in finding the most suitable internship based on their skills and preferences, and companies in receiving rec-

ommendations for students who might be a good fit for their internships.

Communication support After a match is made between students and companies, the platform facilitates initial communication by providing tools to schedule interviews and structured questionnaires.

Monitoring and report Universities can monitor ongoing internships and handle complaints and issues, while the system offers a tracking of the internship lifecycle. In particular, universities must be able to visualize the state of the apprenticeships of their students along with the respective project details and start/end date.

2.3 User Characteristics

In S&C there are three main users that interact with the system: students, companies operators and universities operators.

Student A student is a member of a certain university who applies for an internship position. The search will be based on personal preferences, technical characteristics, experiences and attitudes. They rely on the platform to perform tasks such as creating and updating profiles, uploading resumes, and browsing through available internships.

Company A company, which can be of various sizes and have specific needs and expectations, looks for suitable students to fill internship positions. To achieve this, companies use the platform to create and update detailed internship postings, specifying requirements such as educational background, technical skills, and work experience.

Universities Universities play a supervisory role in the system, monitoring the ongoing internships, addressing issues and forwarding complaints that may arise from both the other parties.

2.4 Assumptions, Dependencies and Constraints

2.4.1 Domain Assumptions

Domain Assumptions

- Both students and companies need to input real and valid credentials
- All users have access to the technology required to use S&C: web browser, internet connection
- The platform's recommendation and tracking mechanisms depend on consistent and accurate data inputs from users.
- Students and companies are willing to provide sufficient details about their qualifications and requirements, respectively, for the system to generate effective matches.

3 Specific Requirements

3.1 External Interface Requirements

3.1.1 User interfaces

The system is available only by accessing a website, so through any device that can run a web browser, desktop or mobile, with an internet connection.

3.1.2 Hardware interfaces

The system is web-based and designed to be lightweight and accessible on standard hardware configurations, making it usable for a wide range of devices.

3.1.3 Software interfaces

The system uses the mailing system to notify students about their internship application response and to allow university operators to login via OTPs.

3.1.4 Communication interfaces

S&C only needs HTTPS protocol to ensure secure connections on the website and SMTP/IMAP protocols for emailing.

3.2 Functional Requirements

[R1] S&C allows unregistered students and companies to sign up to the platform.

[R2] S&C allows registered students and companies to log in.

[R3] S&C allows students to upload/update their CV.

[R4] S&C allows registered companies to create, delete, activate or disable internships.

[R5] S&C allows registered students to proactively search for internships through appropriate filters.

[R6] S&C recommends internships to students based on their skills and interests.

[R7] S&C recommends candidates to companies based on students' skills and interests.

[R8] S&C allows students and companies to accept or decline system recommendations.

[R9] S&C automatically crunches all available data to provide better recommendations.

[R10] S&C collects feedback from students and companies.

[R11] S&C provides companies with guided tools to interview candidates.

[R12] S&C presents all data relevant to potential candidates to the companies.

[R13] S&C allows students or companies to file a complaint during internships.

[R14] S&C allows university operators to monitor internships and mediate complaints.

[R15] S&C provides students suggestions about how to improve their CVs so as to be more appealing to companies.

[R16] S&C provides companies suggestions on how to improve project descriptions to be more appealing to students.

[R17] S&C allows a user who has lost his password to recover it via traditional email-link recovery.

[R18] S&C allows users to view their profile.

[R19] S&C allows students to view internships details.

[R20] S&C allows students and companies to view their matches.

[R21] S&C allows students, companies and university operators to chat with/video-call each other.

[R22] S&C allows companies to view all students who completed the interview process.

[R23] S&C allows companies to select students to start an internship.

[R24] S&C allows companies to reject students from their selection process.

[R25] S&C allows university operators to log-in using an OTP mechanism.

[R26] S&C allows university operators to start a new chat with students or companies, in order to handle complaints.

[R27] S&C must provide students suggestions in order to improve their CVs.

[R28] S&C must provide companies suggestions in order to improve their internship offers.

[R29] S&C allows students and companies to monitor the execution and the outcomes of the matchmaking process.

[R30] S&C must send questionnaires to students and companies about matchmaking performance and/or internship experience.

3.2.1 Requirements Mapping

Requirements	G1	G2	G3	G4	G5	G6	G7
R1	✓	✓					
R2	✓	✓					
R3	✓						
R4		✓					
R5	✓						
R6			✓				
R7			✓				
R8			✓				
R9				✓			
R10				✓			
R11					✓		
R12		✓					
R13							✓
R14							✓
R15						✓	
R16						✓	
R17	✓	✓					
R18	✓	✓					
R19	✓	✓					
R20	✓	✓					
R21					✓		
R22					✓		
R23					✓		
R24					✓		
R25							✓
R26							✓
R27						✓	
R28						✓	
R29	✓	✓					
R30				✓			

Table 1: Traceability Matrix for Goals and Requirements

3.2.2 Use case Diagrams

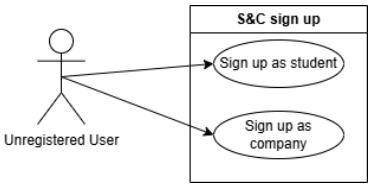

Figure 2: Unregistered user use case

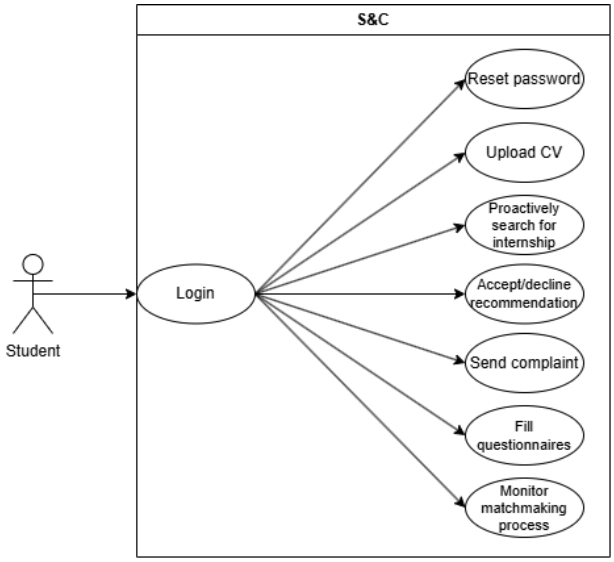

Figure 3: Students Use Cases

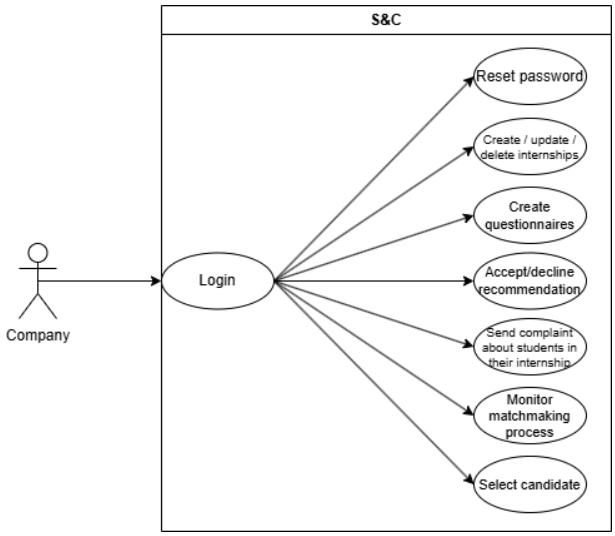

Figure 4: Companies use cases

3.2.3 Use cases and related Sequence Diagrams

Actor	Student
Entry conditions	The student is not registered to the platform yet.
Event Flow	1 - The student reaches the S&C page. 2 - S&C shows the home page. 3 - The student clicks on “create an account” button. 4 - S&C shows the sign up form. 5 - The Student clicks on ”I’m a student” button. 6 - The platform shows a credentials form page. 7 - The student inserts the required information. 8 - S&C checks the validity of the inserted information. 9 - If the credentials are valid, S&C sends a confirmation email to the provided address. 10 - The student clicks on the link in the email and confirms their registration. 11 - S&C registers the new student to the platform.
Exit condition	S&C allows the student to access the platform with the newly created account.
Exceptions	• The email address is already linked to an account. In this case an error message is shown and the student is redirected to the profile creation settings. • Invalid password if it is shorter than 8 characters, if it doesn’t have at least 1 number and/or 1 capital letter and/or a special character. In this case an error message is shown and the student is redirected to the profile creation settings.

Table 2: Sign up as student

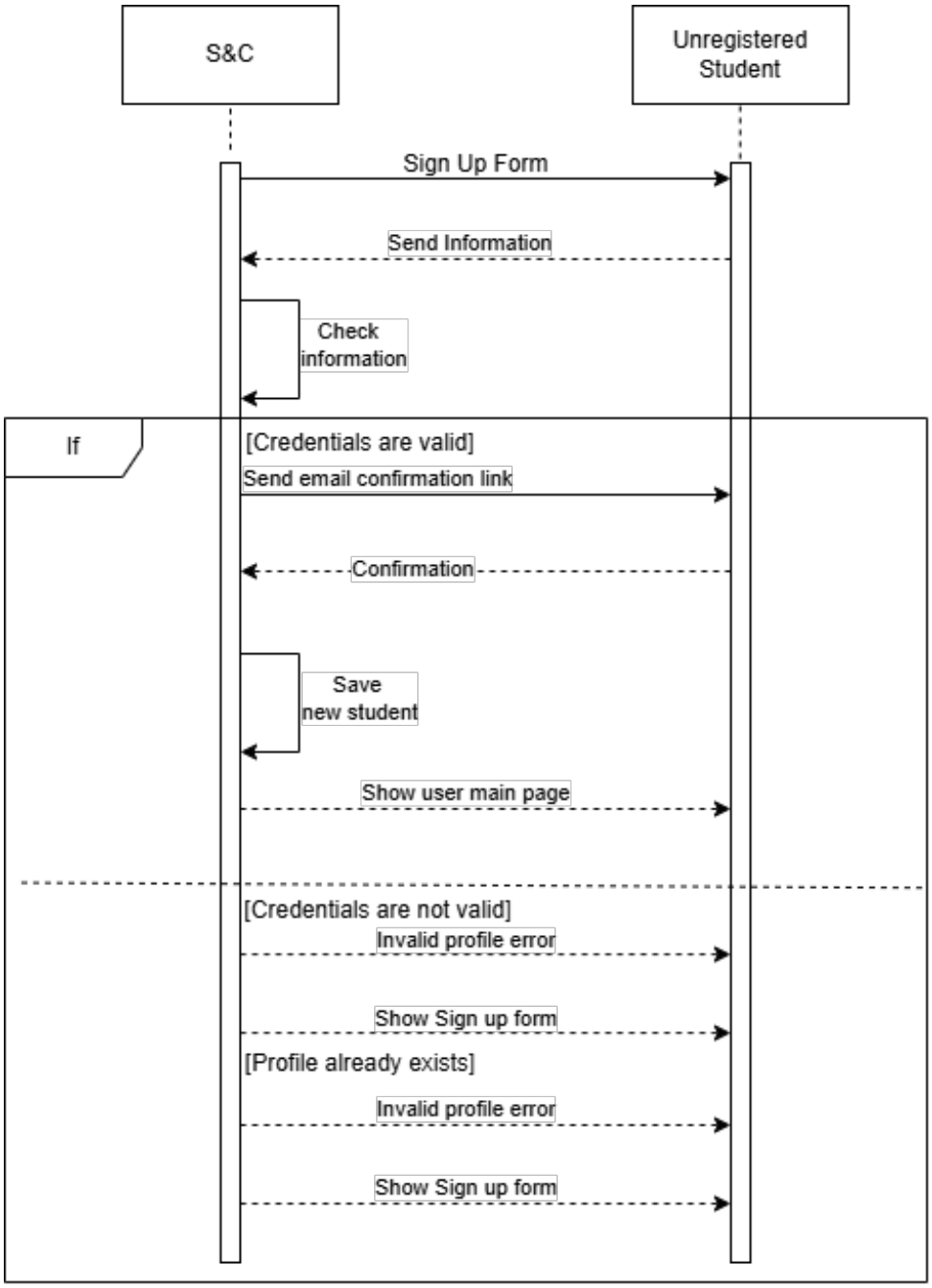

Figure 5: Student signs up

Actor	Company
Entry conditions	The company is not registered to the platform yet.
Event Flow	1 - The company reaches the S&C page. 2 - S&C shows the home page. 3 - The student clicks on “create an account” button. 4 - S&C shows the sign up form. 5 - The Student clicks on ”I’m a company” button. 6 - The platform shows a credentials form page. 7 - The company inserts the required information. 8 - S&C checks the validity of the inserted information. 9 - If the credentials are valid, S&C sends a confirmation email to the provided address. 10 - The company clicks on the link in the email and confirms their registration. 11 - S&C registers the new student to the platform.
Exit condition	S&C allows the company to access the platform with the newly created account.
Exceptions	• The email address is already linked to an account. In this case an error message is shown and the company is redirected to the profile creation settings. • Invalid password if it is shorter than 8 characters, if it doesn’t have at least one number and/or one capital letter and/or a special character. In this case an error message is shown and the company is redirected to the profile creation settings.

Table 3: Sign up as company

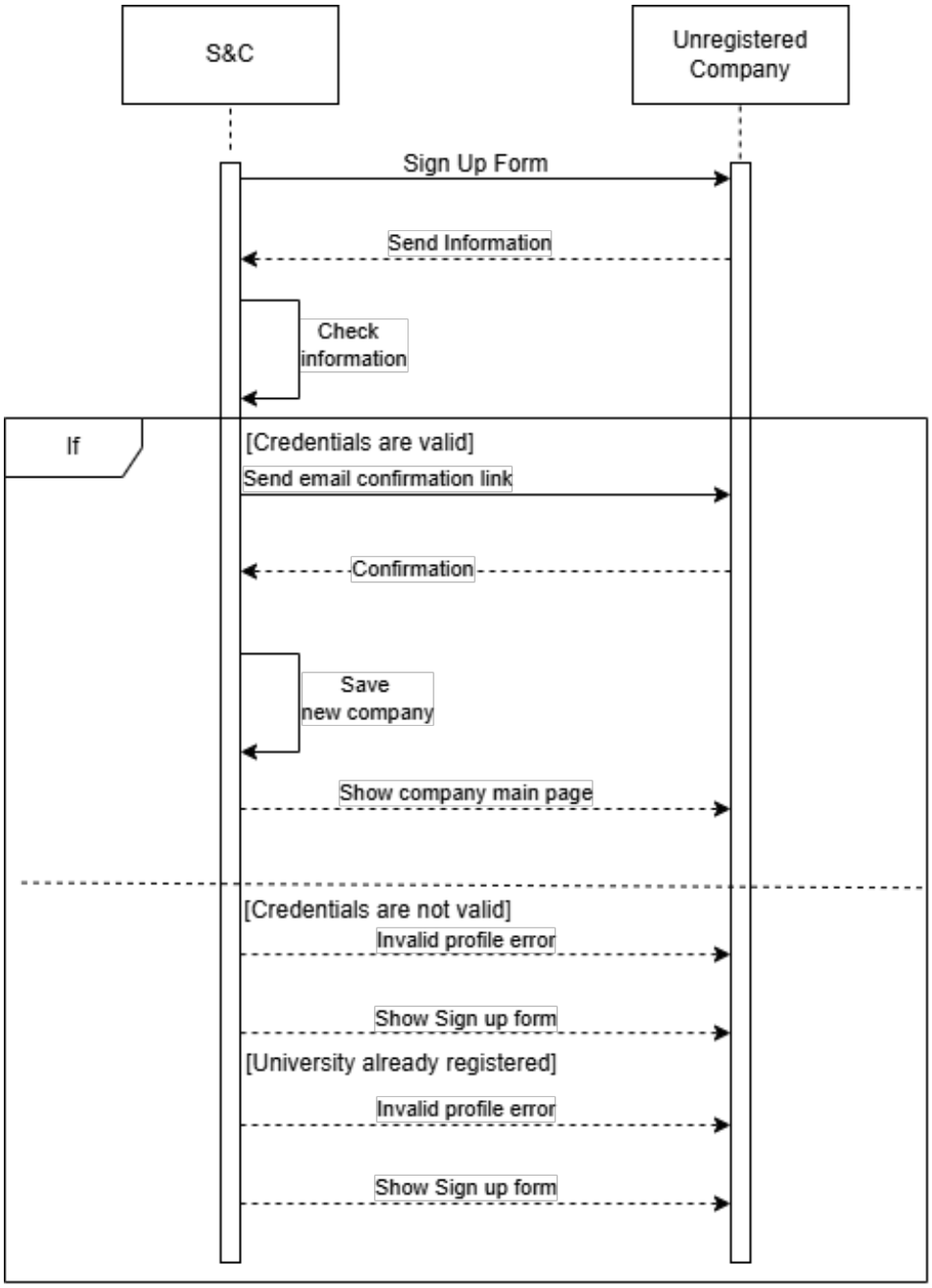

Figure 6: Company signs up

Actor	Student
Entry conditions	Student is registered in S&C, not logged into S&C, and needs to reset their account's password.
Event Flow	1 - The student reaches the S&C home page. 2 - The student clicks on the "Login" button. 3 - The student inserts their account's associated email. 4 - The student clicks on the "Reset password" button. 5 - S&C sends a password-reset link to the account's associated email. 6 - The student clicks on the password-reset link sent by email. 7 - The student types in the new password. 8 - The student clicks on the "Confirm" button.
Exit condition	The student's account password information is updated.
Exceptions	• Invalid password if it is shorter than 8 characters, if it doesn't have at least one number and/or one capital letter and/or a special character. Moreover, the new password cannot be the same as the previous one. In this case an error message is shown and the student is redirected to the profile creation settings. • If an account associated to the specified email address doesn't exist, the email with the password-reset link isn't sent and the student is redirected to the profile creation page.

Table 4: Student resets their account's password

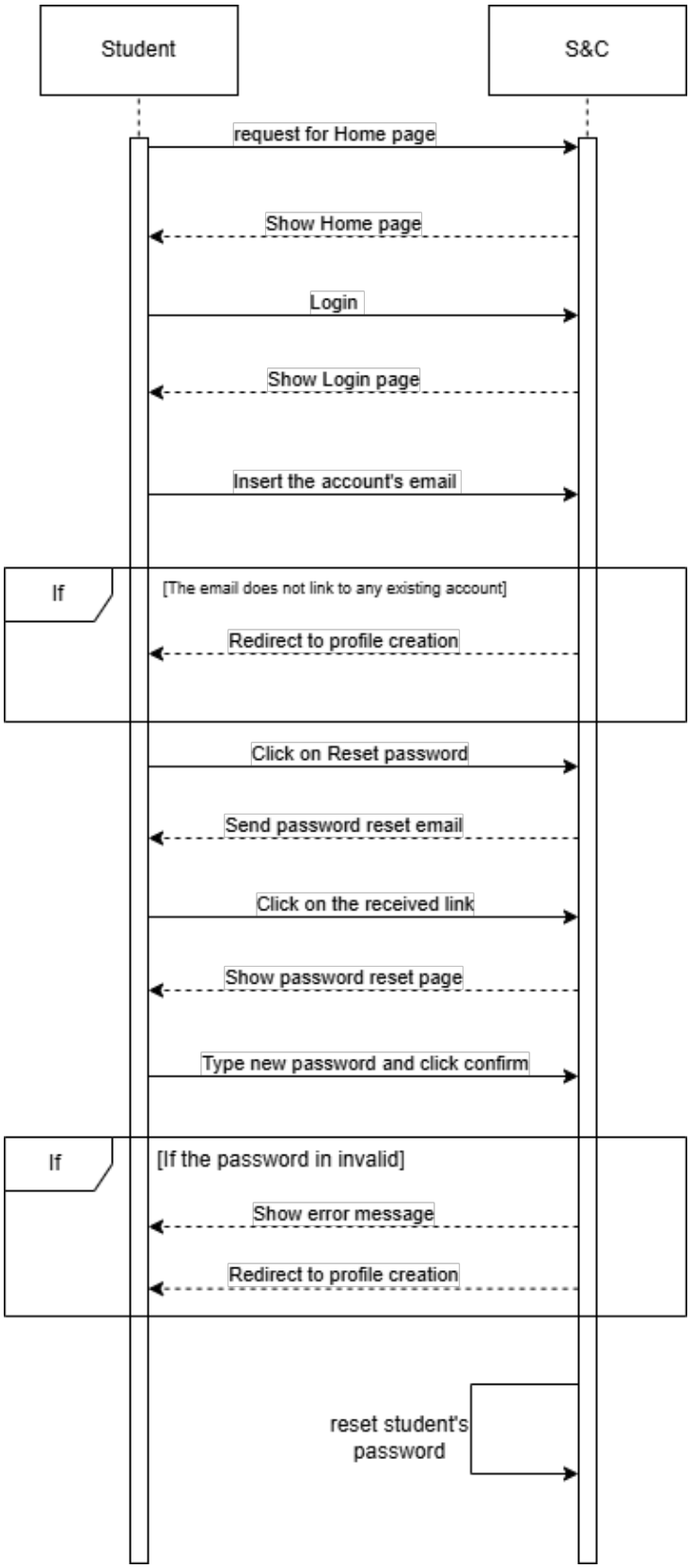

Figure 7: Student resets their account's password

Actor	Student
Entry conditions	Student is registered in S&C and is logged into their account and has accessed their personal page.
Event Flow	1 - The student clicks on "Upload CV" button. 2 - The student uploads the CV choosing it from their own machine. 3 - S&C saves the uploaded file.
Exit condition	S&C now shows the new version of the CV once the student logs into their account.
Exceptions	• The updated CV file is empty, so, S&C shows an error message.

Table 5: Student uploads CV

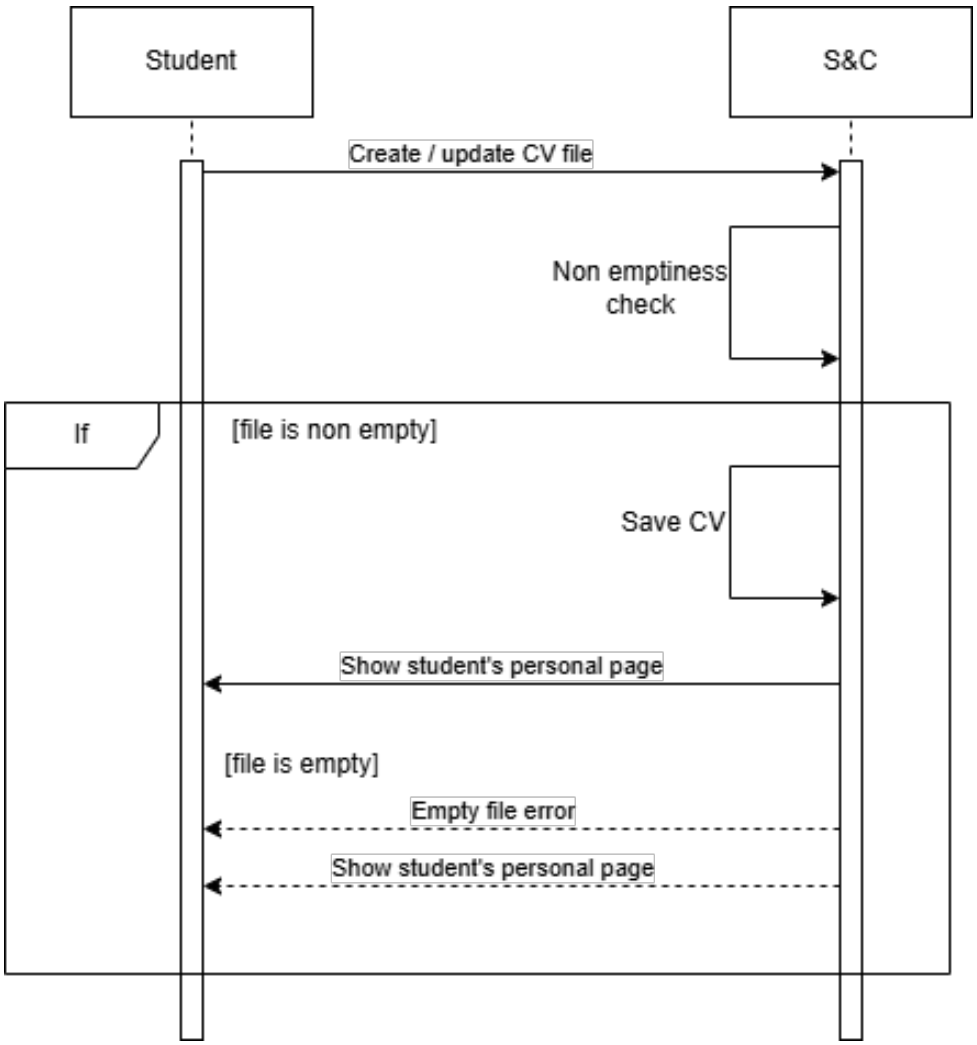

Figure 8: Student uploads CV

Actor	Student
Entry conditions	Student is registered to S&C and is logged into their account and has already uploaded a CV.
Event Flow	1 - The student clicks on the "Search for internships" button. 2 - S&C shows a new page with a set of filters the student can select. 3 - The student selects the filters and sends the request. 4 - S&C shows the list of appropriately filtered internships. 5 - The student can select an internship to have additional information. 6 - S&C shows the internship's information. 7 - The student can go back to the home page or click on the "like" button.
Exit condition	If the student actively liked an internship, they can see it on their personal page.

Table 6: Student proactively looks for an internship

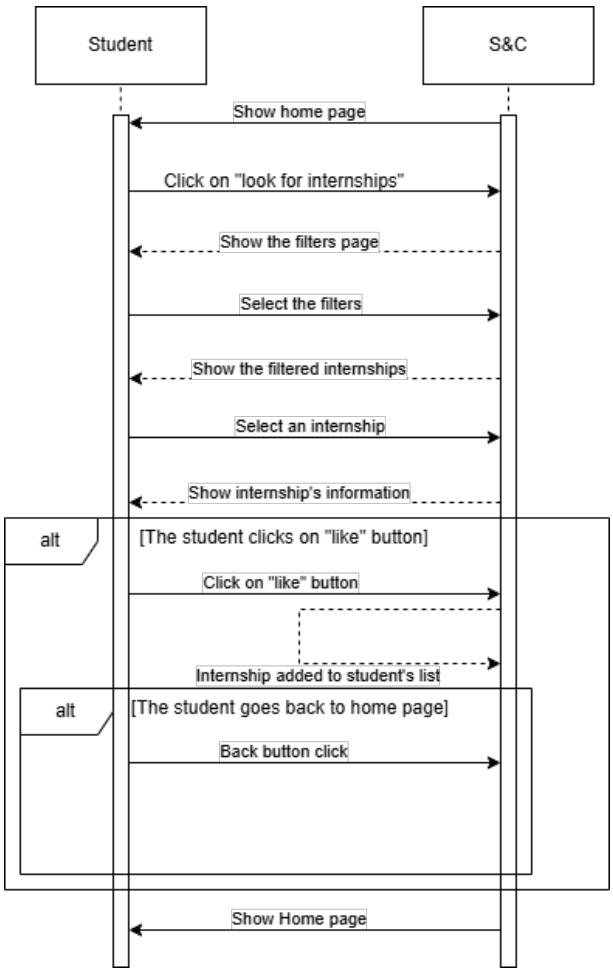

Figure 9: Student proactively looks for internship

Actor	Student
Entry conditions	Student is registered to S&C and is logged into their account.
Event Flow	1 - The student accesses their profile page. 2 - S&C shows the student's personal page. 3 - The student selects the "Analytics" button. 4 - S&C shows the list of liked internships and how many companies liked their profile.

Table 7: Student looks at analytics

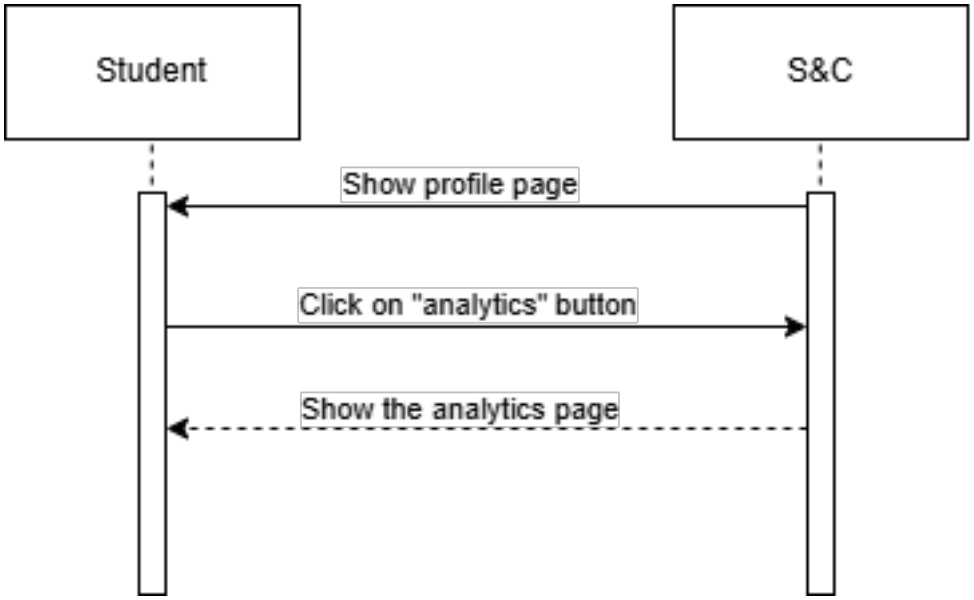

Figure 10: Student looks at analytics

Actor	Company
Entry conditions	Company is registered and company operator is logged into S&C
Event Flow	1 - The company operator accesses the company's profile page. 2 - S&C shows the company's profile page. 3 - The company operator clicks on the "analytics" button. 4 - S&C shows lists of liked candidates for each internship position, along with the number of students liking each internship position, with statistics about them.

Table 8: Company operator looks at analytics

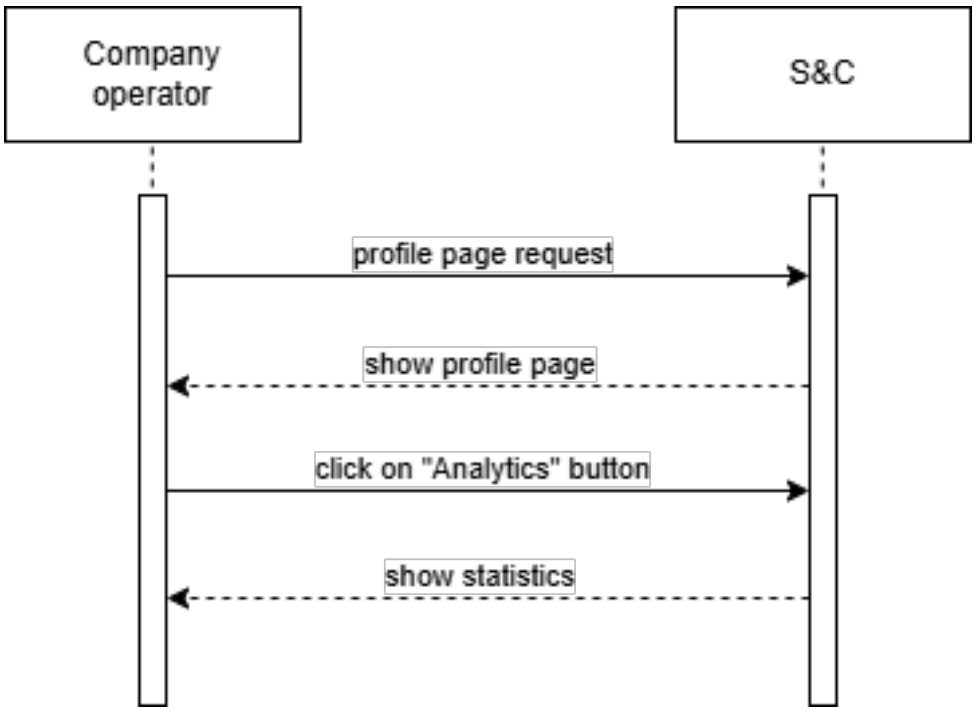

Figure 11: Company operator looks at analytics

Actor	Student
Entry conditions	Student is registered to S&C and is logged into their account.
Event Flow	1 - The student accesses the home page. 2 - S&C shows the home page, containing the list of system recommendations compatible with the student's characteristics. 3 - The student clicks on any of the recommendations. 4 - S&C shows more information about the selected internship, along with the "Accept", "Decline" and "Back" buttons. 5 - If the student clicked on accept, S&C adds the internship to the student's liked proposals. 5 - If the student clicked on decline, S&C adds the internship to the student's disliked proposals. 5 - If the student clicked on back, S&C shows the recommendations list without performing any additional action.

Table 9: Student accepts/refuses system recommendations

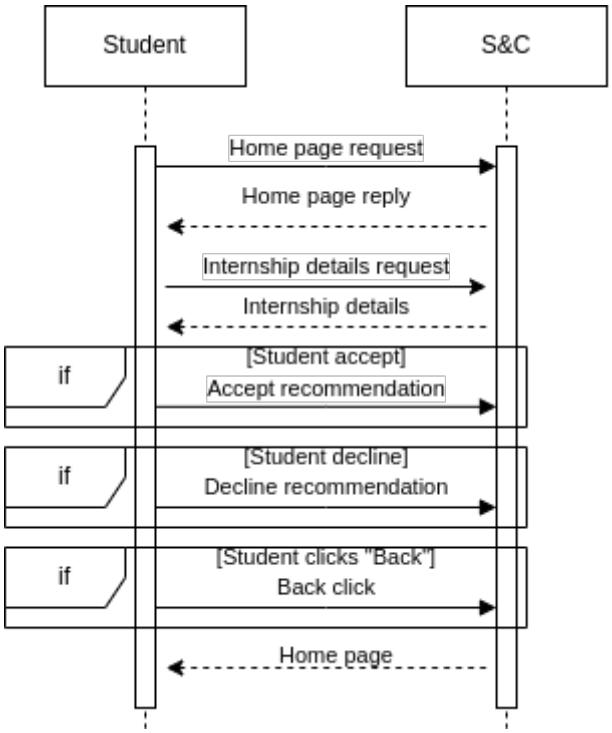

Figure 12: Student accepts/refuses system recommendations

Actor	Student
Entry conditions	Student is registered in S&C and is logged into their account.
Event Flow	1 - The student accesses the home page and selects the "Manage internship" button. 2 - S&C shows the new page where the user will be able to complain 3 - The student writes the complaints in a text field and can check the box related to the desire to end the internship. 4 - Should the box be selected, the student is required to complete an additional text field pertaining to their intention to conclude the internship. 5 - The student clicks on the "Send" button.
Exit condition	S&C is notified about the student's complaints.
Exceptions	• If the student doesn't fill in all the necessary fields in the complaint filing form, S&C shows an error message.

Table 10: Student files a complaint

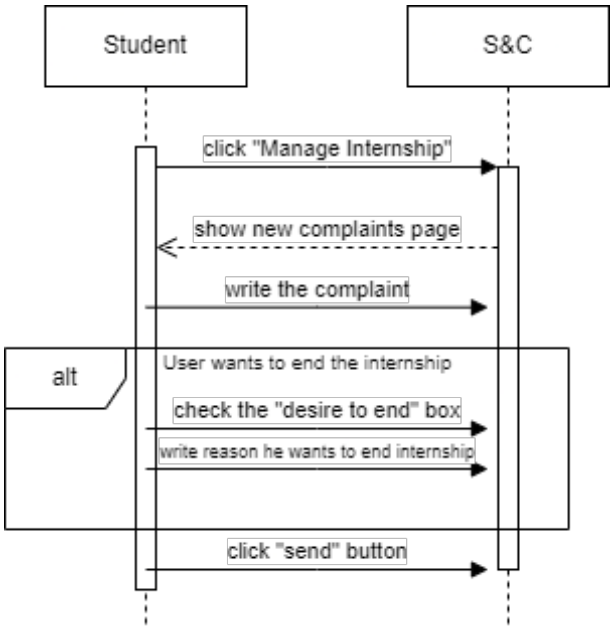

Figure 13: Student files a complaint

Actor	Company operator
Entry conditions	Company operator is logged into S&C and enabled to operate on behalf of his company.
Event Flow	1 - The company operator accesses the home page and selects the "Manage internships" button. 2 - S&C shows the internships list. 3 - The company operator selects the internship they are interested in and clicks on "File a complaint" button. 4 - The company operator writes the complaints in a text field and can check the box related to the desire to kick the student from the internship. 5 - If the box was clicked, the company operator fills another text field with reasoning about the wish to kick the student. 6 - The company operator clicks on "Send" button.
Exit condition	S&C is notified about the company's complaints.
Exceptions	• If the company operator doesn't fill in all the necessary fields in the form, S&C shows an error message.

Table 11: Company operator files a complaint

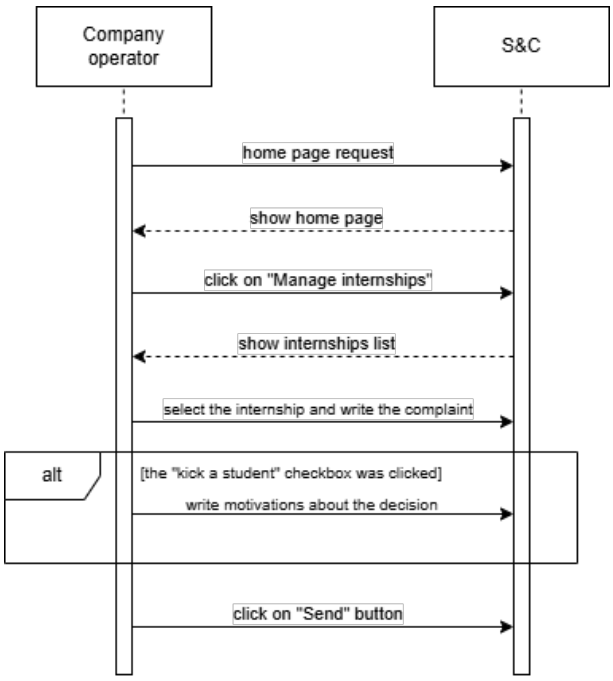

Figure 14: Company operator files a complaint

Actor	Student
Entry conditions	Student is registered in S&C and may be enrolled in an internship or is looking for one.
Event Flow	1 - S&C sends an email to the student with a questionnaire attached to it. 2 - The student fills the questionnaires. 3 - The student clicks on "Send" button. 4 - S&C receives and process the questionnaire.
Exit condition	S&C keeps the file in memory for further analysis.
Exceptions	• If the student doesn't reply to all the mandatory fields of the questionnaire, S&C shows an error message.

Table 12: Student fills in a feedback questionnaire

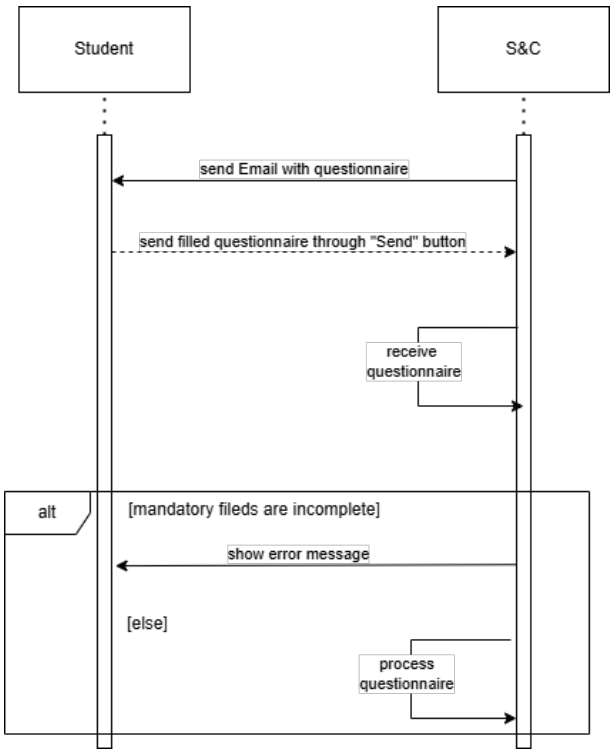

Figure 15: Student fills in a feedback questionnaire

Actor	Student
Entry conditions	Student is registered to S&C and has matched with a company.
Event Flow	1 - S&C prompts the company operator to create an interview form. 2 - The company operator builds the questionnaire. 3 - The company operator clicks on them "Confirm" button. 4 - S&C notifies the student that the form is available to be filled in. 5 - The student enters the "See matches" section from S&C homepage. 6 - The student and the company operator may call via the video-call function in the chat window.
Exit condition	The student is added to the list of candidates for the position.
Exceptions	• If the student doesn't reply to all the mandatory fields of the questionnaire, S&C shows an error message.

Table 13: Company interviews a candidate

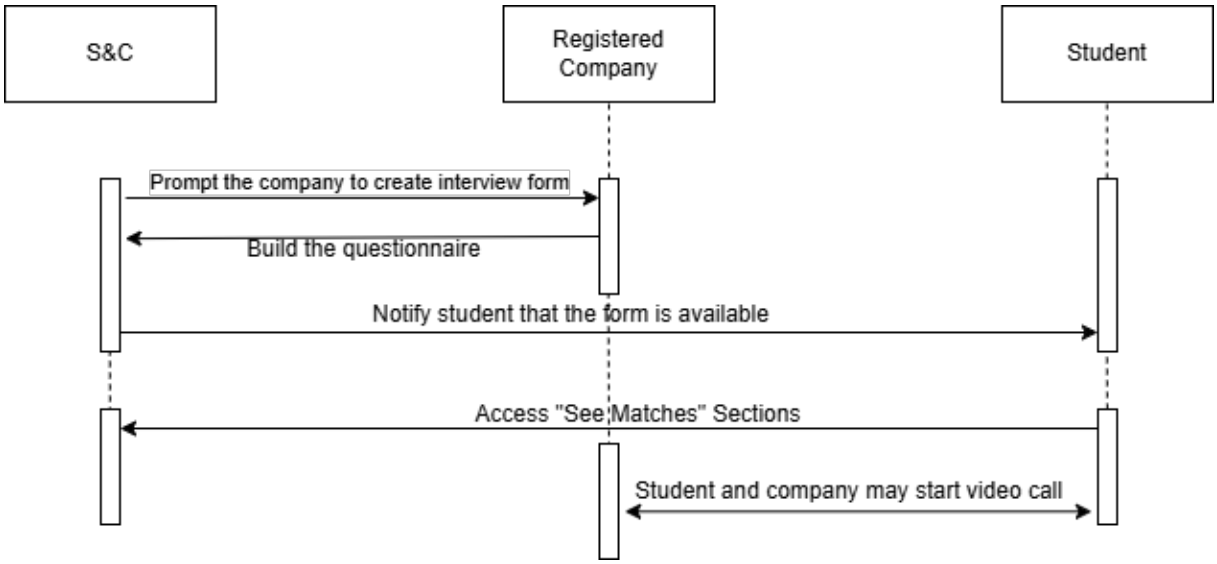

Figure 16: Company interviews a candidate

Actor	Company operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - The company operator clicks on "Profile" button. 2 - The company operator clicks on the "New internship" button. 3 - The company operator inserts the new internship position and terms. 4 - S&C displays some AI generated hints to improve the internship offer. 5 - The company operator click on the "Save" button.
Exit condition	S&C stores the internship position.
Exceptions	• The company operator misses some mandatory fields in the internship position, so, S&C displays an error message.

Table 14: Company creates a new internship

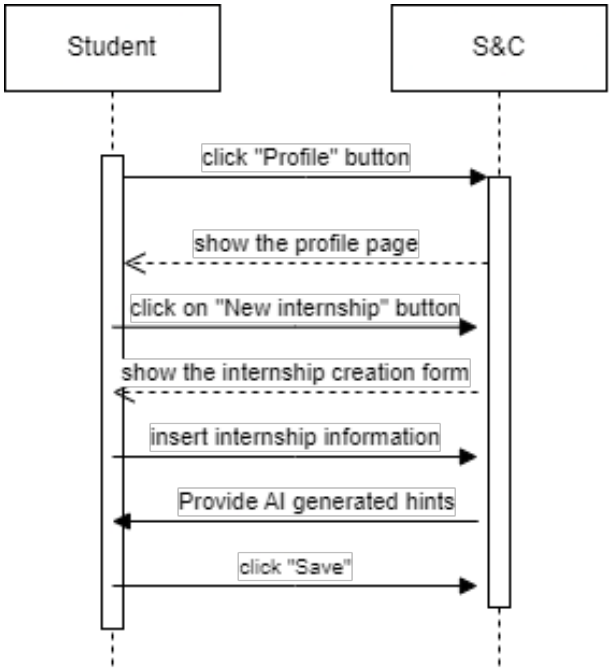

Figure 17: Company operator creates new internship

Actor	Company operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - The company operator clicks on "Profile" button. 2 - The company operator clicks on the "Edit internships" button. 3 - If there are any internships, the system shows the list of them along with 3 buttons available for each one: edit, delete, close/open. 4 - If the company clicks on "Delete", the internship is immediately deleted. 4 - If the company clicks on "Open" on a closed internship, it is immediately opened. 4 - If the company clicks on "Edit" on an internship, S&C shows a new page with the internship information fields made writable. 5 - If changes have been made, the company operator clicks on "Save" button.
Exit condition	S&C updates the internship accordingly.

Table 15: Company edits/deletes/closes an internship

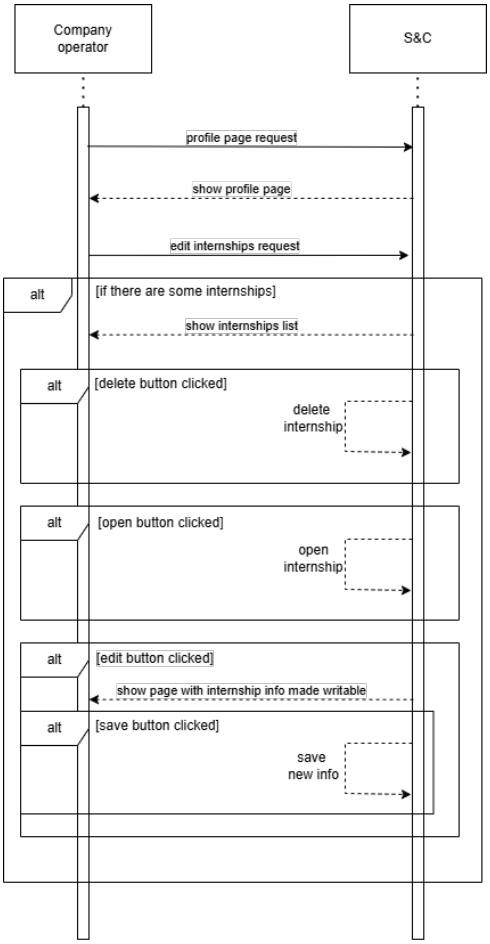

Figure 18: Company operator updates internship

Actor	Company operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - S&C sends an email to the company with a questionnaire attached to it. 2 - The company fills the questionnaire. 3 - The company clicks on "Send" button.
Exit condition	S&C keeps the file in memory for further analysis.
Exceptions	• If the company operator doesn't fill in all the mandatory fields of the questionnaire, S&C shows an error message.

Table 16: Company fills in a feedback questionnaire

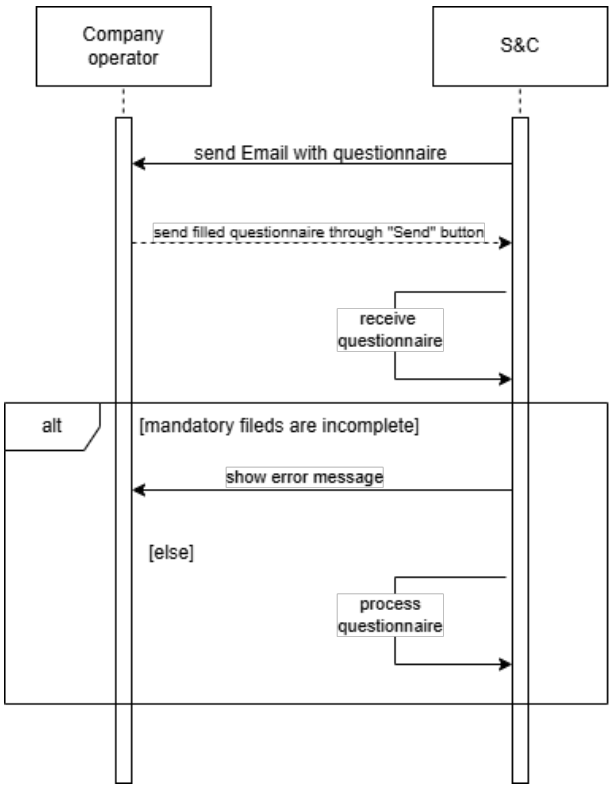

Figure 19: Company operator updates internship

Actor	University operator
Entry conditions	The university operator is enabled to operate on S&C on behalf of the university and is already on the S&C homepage, logged in.
Event Flow	1 - The university operator clicks on a student or company's corresponding chat from the list present on the homepage or clicks on the "Start New Chat" button. 2 - If The university operator clicked on the "Start New Chat" button, S&C shows a new page with a search bar for possible interlocutors. 3 - The university operator looks for and selects the correct interlocutor. 4 - S&C shows the chat with the chosen actor, along with details about the involved actors in his internship(s). 5 - The university operator writes the new message. 6 - The university operator clicks "Send".
Exit condition	The chat history is updated.
Exceptions	• The university operator tries to send an empty message. • The university operator looks for a non-existing interlocutor.

Table 17: University operator chats with students and companies

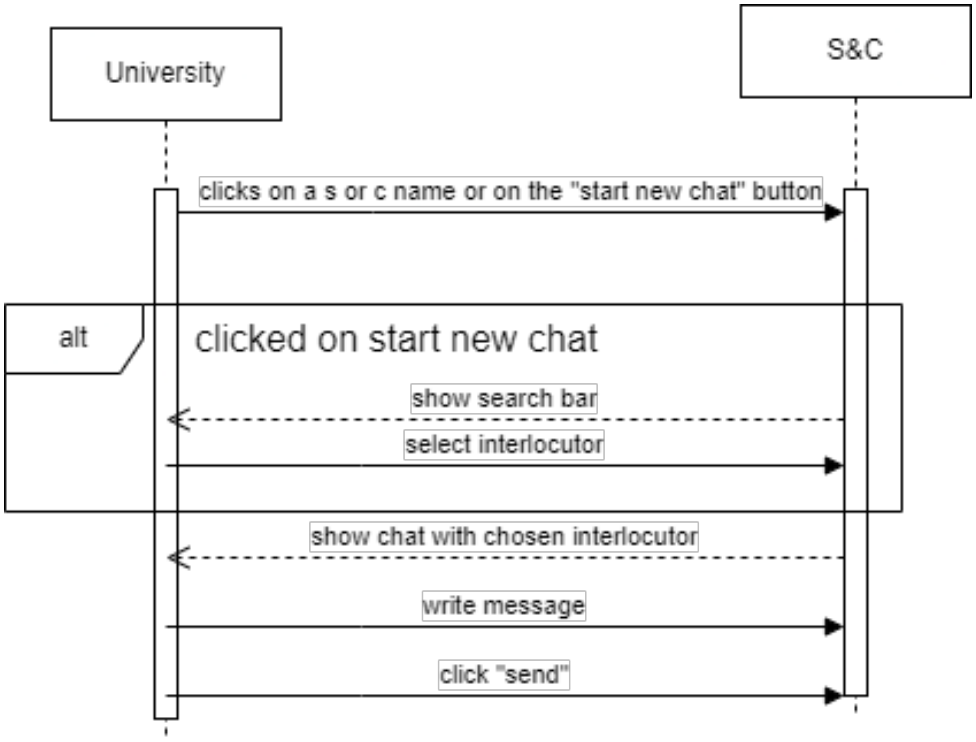

Figure 20: University operator chats with students and companies

Actor	University operator
Entry conditions	University operator is present in the list of authorized operators.
Event Flow	1 - The university operator accesses the S&C login page. 2 - S&C prompts the user to input their institutional email. 3 - The university operator enters their institutional email and clicks on "Send OTP". 4 - S&C shows a new page prompting the user to input OTP code. 5 - The university operator enters the received OTP code. 5 - If the OTP code is correct, S&C shows the university operator home page with the chats.
Exit condition	S&C is notified about the student's complaints.
Exceptions	• If the OTP is not valid, S&C displays the message "Incorrect OTP!" and lets the user re-insert it.

Table 18: University operator logs into S&C

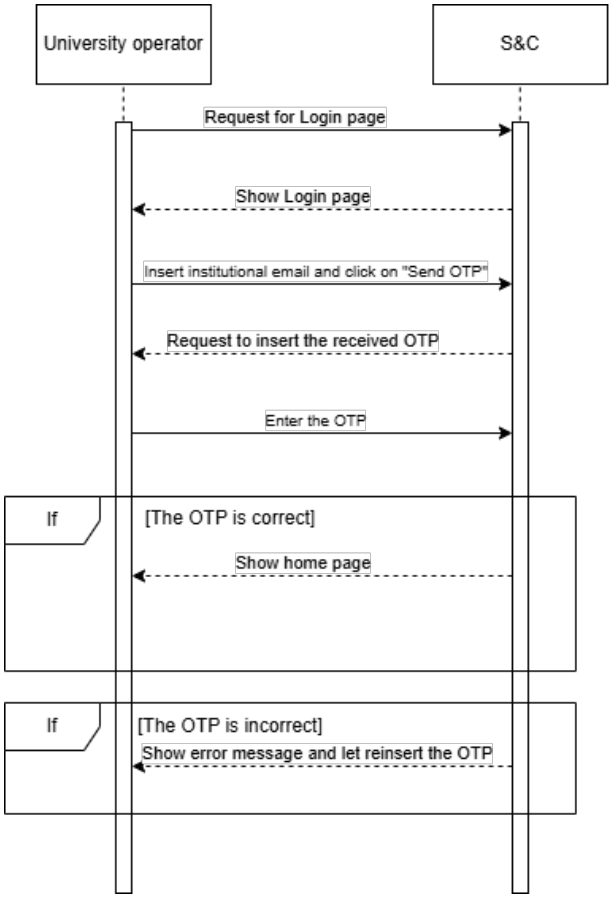

Figure 21: University operator logs into S&C

Actor	Company operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - The company operator accesses the home page. 2 - S&C shows the home page, containing the list of system recommendations compatible with the company's characteristics. 3 - The company operator clicks on any of the recommendations. 4 - S&C shows more information about the selected internship, along with the "Accept", "Decline" and "Back" buttons. 5 - The company operator may click on any of the three buttons. 6 - If the company operator clicks on accept, S&C adds the internship to the company's liked proposals. 7 - If the company operator clicks on decline, S&C adds the internship to the company's disliked proposals. 8 - If the company operator clicks on back, S&C shows the recommendations list without performing any additional action.
Exit condition	S&C will no longer show that internship proposal to the company.

Table 19: Company accepts/refuses system recommendations

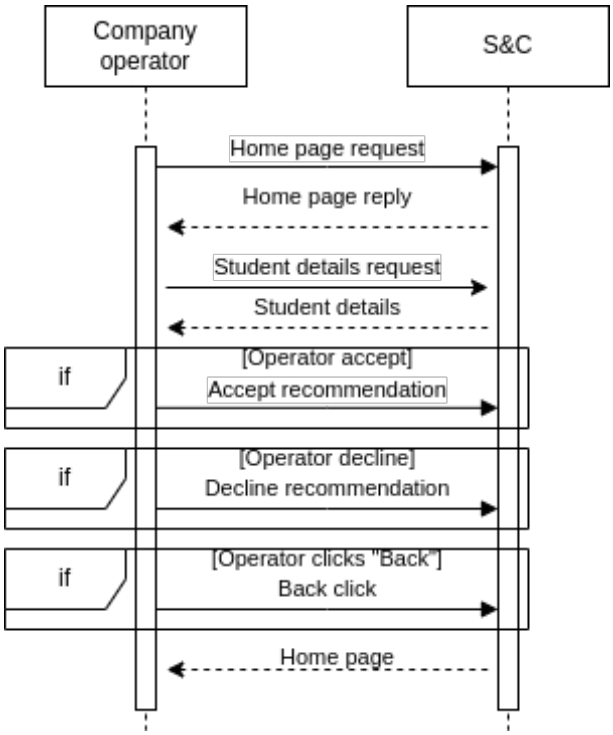

Figure 22: Company accepts/refuses system recommendations

Actor	Student
Entry conditions	Student is registered to S&C.
Event Flow	1 - The student reaches the S&C home page. 2 - The student clicks on the "Login" button. 3 - The student inserts email and password he registered with in the dedicated fields. 4 - The student clicks on the "Login" button.
Exit condition	The student is logged into S&C.
Exceptions	• If email or password inserted is not valid or incorrect, S&C displays the message "Incorrect email or password!".

Table 20: Student logs into S&C

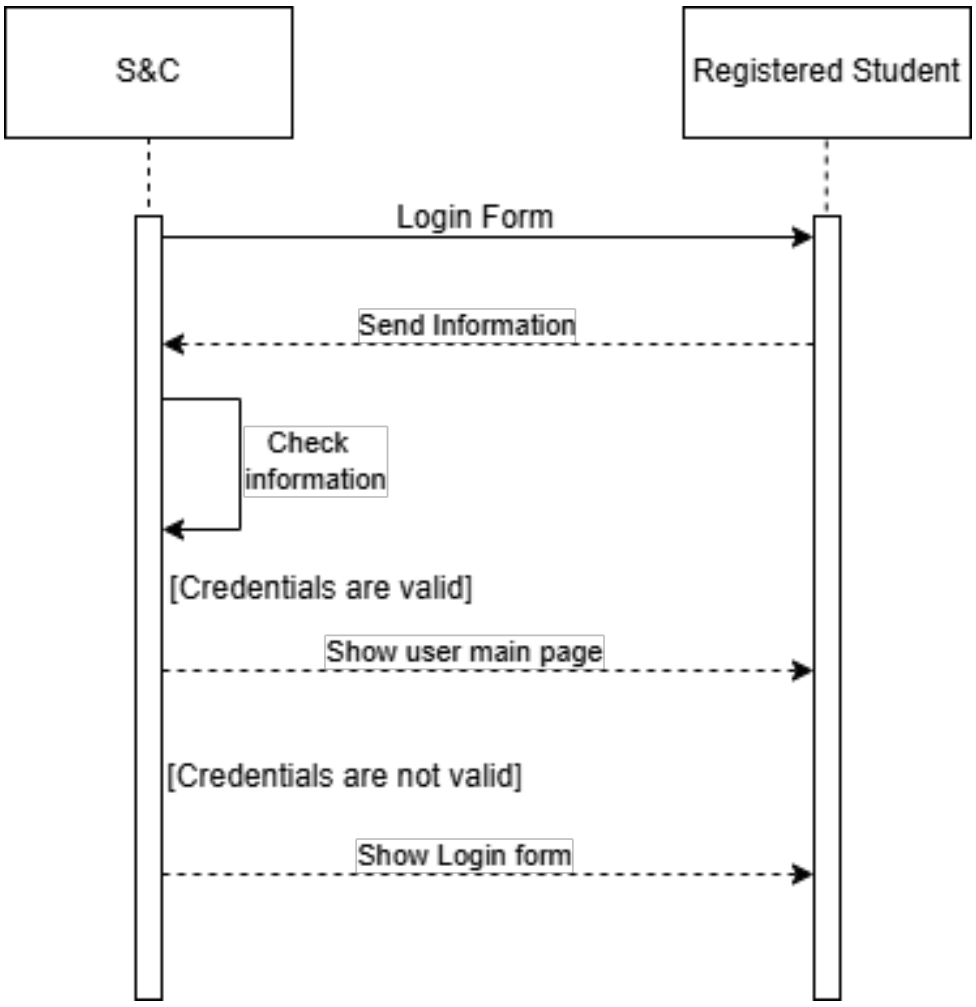

Figure 23: Student logs in

Actor	Company Operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - The company operator reaches the S&C home page. 2 - The company operator clicks on the "Login" button. 3 - The company operator inserts email and password he registered with in the dedicated fields. 4 - The company operator clicks on the "Login" button.
Exit condition	The company operator is logged into S&C.
Exceptions	• If email or password inserted is not valid or incorrect, S&C displays the message "Incorrect email or password!".

Table 21: Company operator logs into S&C

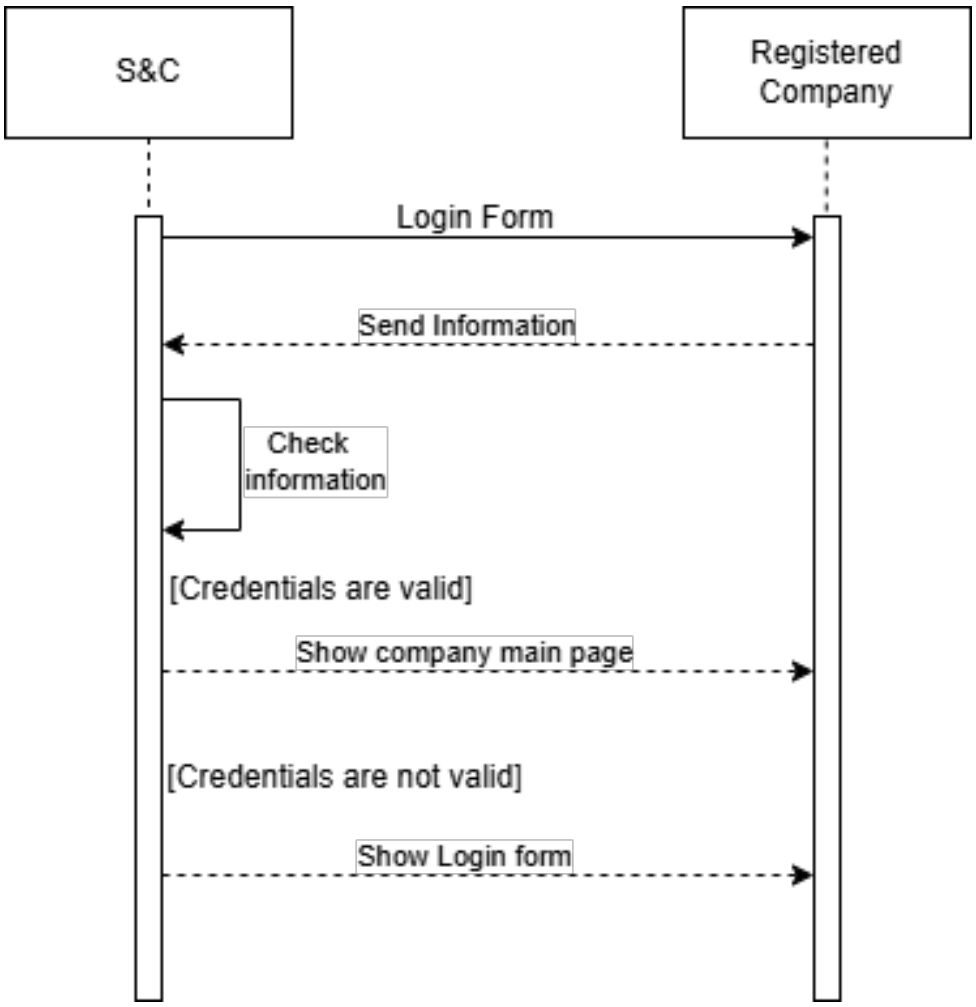

Figure 24: Company operator logs in

Actor	Company Operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company.
Event Flow	1 - The company operator clicks on the "Login" button in the website homepage 2 - S&C shows the login page, along with the "reset password" button. 3 - The company operator fills in the company email address and clicks on the "reset password" button 4 - S&C sends a password reset link to the entered email address 5 - The company operator clicks on the received link. 6 - The company operator types in the new password. 7 - The company operator clicks on the "Confirm" button.
Exit condition	Company account's password is updated.
Exceptions	• If the new password chosen is empty, S&C shows an error message.

Table 22: Company operator resets password

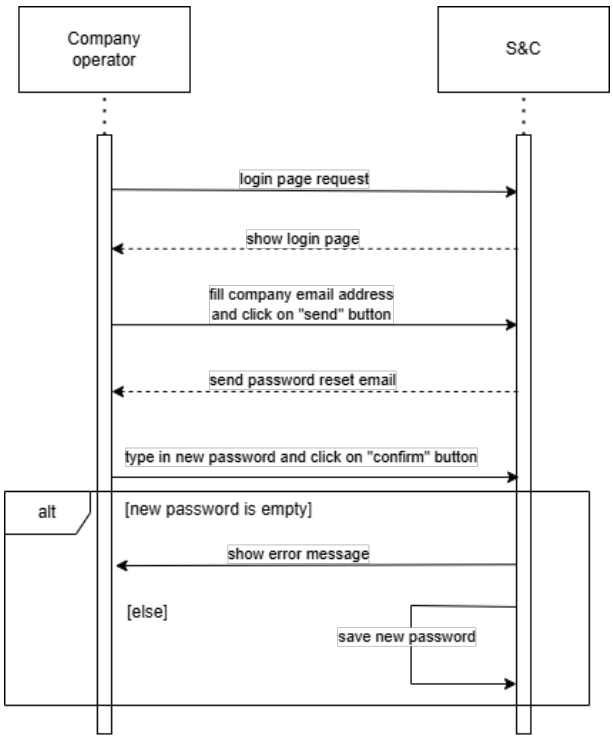

Figure 25: Company operator resets password

Actor	Company Operator
Entry conditions	The company operator is enabled to operate on S&C on behalf of the company, which has open internships.
Event Flow	1 - The company operator accesses the home page. 2 - S&C shows the home page, containing the list of students who have completed the interviews. 3 - The company operator selects the green check or the 'X' icon next to the paper icon related to the concerned students. 4 - If the company operator selects the green check, an email is sent to the student notifying their admission. 5 - If the company operator selects the 'X' icon, an email is sent to the student notifying their rejection.
Exit condition	The student may be added to the internship. The page will refresh, this time without the affected student.

Table 23: Company operator selects/rejects candidates

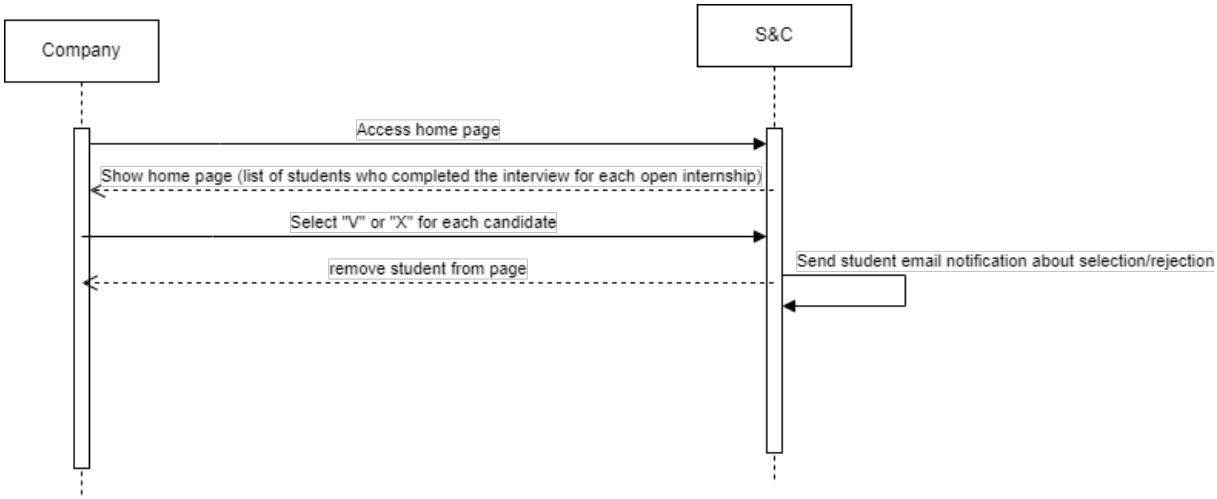

Figure 26: Company operator selects/rejects candidates

3.3 Performance Requirements

Website Responsiveness: the S&C website has to respond in less than 0.5 seconds after each user interaction in order to provide a satisfying experience to every user.

Data Storage: the S&C system will store lots of data in order to feed it to the recommendation engine, so a lot of disk space is needed.

Concurrent users: S&C will employ a scalable structure, and will need to scale to work with the maximum of 30 million concurrent users (estimated students in their last year of university in the whole world, plus some company and university operator).

3.4 Design Constraints

3.4.1 Standards Compliance

The system must adhere to the EU's GDPR (General Data Protection Regulation), in order to guarantee the safeguarding of personal data, privacy, and security of EU citizens.

3.4.2 Hardware Limitations

The only hardware requirements are support for a stable internet connection and a web browser.

3.5 Software System Attributes

3.5.1 Reliability

The system must ensure fault-tolerance and guarantee users an uninterrupted website experience.

3.5.2 Availability

The system must maintain high availability, with a minimum uptime of 99.9%, equating to a maximum of 8.76 hours of downtime per year. Maintenance breaks should be minimized and, if necessary, scheduled primarily during nighttime hours to reduce disruption.

3.5.3 Security

The system must manage user access rights by providing authentication to verify user identities during login and authorization to validate the permissions of logged-in users for specific actions. Robust database protection measures will be implemented, including defenses against SQL injection attacks, encryption of passwords, and encryption of users' personal data.

3.5.4 Maintainability

The system must be designed using scalable and reusable models to facilitate the addition of future features with minimal effort. Regular maintenance should be scheduled during nighttime hours to ensure service availability during peak user traffic times.

3.5.5 Portability

The system must be accessible to users through any type of web browser, with no specific portability requirements on the server side.

4 Formal Analysis Using Alloy

```
var abstract sig Actor {
    var chatsWith: set Actor -- open chats
} {
    always chatsWith in chatsWith' -- chats do not close
    not this in chatsWith -- no reflexive chats
}

sig Skill, Experience, Field, Password {}

var sig CV {
    var skills: set Skill,
    var experiences: set Experience,
    var preferredFields: some Field
} {
    -- a cv fields are fixed
    skills = skills' and experiences = experiences' and
        ↪ preferredFields = preferredFields'
}

-- no floating cvs
fact {
    always all cvt: CV | some s: Student | cvt = s.cv
}

-- all chats are symmetric
fact {
    always(all disj a1, a2: Actor | a2 in a1.chatsWith and
    a1 in a2.chatsWith)
}

var sig Student extends Actor {
    var attends: one University,
    var internship: lone Internship,
    var appliesForInternship: set Internship,
    var cv: lone CV,
    var receiveRecommendation: set Internship,
    var complaint: lone Complaint,
    var likesInternship: set Internship,
    var password : Password
} {
    attends = attends' -- uni does never change, always is
        ↪ implicit
    #(internship & appliesForInternship) = 0 -- cannot apply to
        ↪ current internship
    complaint ≠ none implies complaint.aboutInternship =
        ↪ internship -- students can complain only if they belong
        ↪ to the concerned internship
}

```

```
45 -- need to apply to get in internship
46 fact {
47    always all i: Internship, s: Student | i in s.internship
      ↪ implies
48       once i in s.appliesForInternship
49 }
50
51 -- students don't disappear
52 fact {
53    always Student in Student'
54 }
55
56 -- students have unique CVs
57 fact {
58    always all disj s1, s2: Student | s1.cv ≠ s2.cv
59 }
60
61 -- student can chat with company iff they like each other through
   ↪  at least one internship
62 fact {
63    always(all s: Student, c: Company | c in s.chatsWith implies
64    some i: Internship | i in s.likesInternship and
65    i in c.offers and
66    s in i.likedBy)
67 }
68
69 -- student are recommended internships based on their CV
70 fact {
71    always all i: Internship, s: Student | (i.relatedToSkills in s
      ↪ .cv.skills and
72       i.inField in s.cv.preferredFields) implies
73          i in s.receiveRecommendation
74 }
75
76 -- relation between student and internship is symmetric
77 fact {
78    always(all s: Student | s.internship ≠ none implies
79    s in s.internship.students)
80 }
81
82 -- no student can belong to two internships at the same time
83 fact {
84    always(all disj i1, i2: Internship | i1.students & i2.students
      ↪  = none)
85 }
86
87
88 -- all students who belong to an internship have been interviewed
   ↪  by the company
89 fact {
```

```
90      always(all s: Student, c: Company | s.internship in c.offers
            ↪ implies
91      s in c.hasInterviewed)
92  }
93
94  -- no student belongs to inactive internship
95  fact {
96      always(all i: Internship | always (i.status = Inactive implies
97      i.students = none))
98  }
99
100 pred changePasswordStudent {
101     some s: Student | s.password' ≠ s.password
102 }
103 run changePasswordStudent
104
105 pred newStudentAppears {
106     #(Student') > #(Student)
107 }
108 run newStudentAppears
109
110 var sig Company extends Actor {
111     var offers: set Internship,
112     var hasInterviewed: set Student,
113     var complaint: set Complaint,
114     var password: Password
115 }
116
117 -- companies do not disappear
118 fact {
119     always Company in Company'
120 }
121
122 -- companies can complain only if the internship is active
123 fact {
124     always all c: Company | c.complaint ≠ none implies
125         c.complaint.aboutInternship.status = Active
126 }
127
128 -- no internship offered by two companies
129 fact {
130     always all disj c1, c2: Company | #(c1.offers & c2.offers) = 0
131 }
132
133 pred changePasswordCompany [c : Company]
134 {
135     c.password' ≠ c.password
136 }
137 run changePasswordCompany
138
139 enum complaintStatus {Open, Closed}
```

```
140
141 var sig Complaint {
142     var aboutInternship: one Internship,
143     var status : one complaintStatus
144 } {
145     one s: Student | this in s.complaint or
146     one c: Company | this in c.complaint -- complaints are either
        ↪ by students or companies
147 }
148
149 -- no floating complaints
150 fact {
151     always all cp: Complaint | some s: Student | some c: Company |
152         cp in s.complaint or cp in c.complaint
153 }
154
155 pred openComplaint [c : Complaint]
156 {
157     c.status = Open
158     all c1 : Complaint - c | not c1.aboutInternship = c.
        ↪ aboutInternship
159     all s : Student | s.internship = c.aboutInternship implies (s.
        ↪ complaint = none and s.complaint' = c)
160     all comp : Company | c.aboutInternship in comp.offers implies
        ↪ comp.complaint' = comp.complaint + c
161 }
162 run openComplaint
163
164 pred closeComplaint [c : Complaint]
165 {
166     c.status = Open
167     c.status' = Closed
168     all s : Student | s.internship = c.aboutInternship implies s.
        ↪ complaint' = none
169 }
170 run closeComplaint
171
172 -- returns set of internships that match student's CV
173 fun recommendation [s: Student] : set Internship{
174     {  i: Internship | i.inField in s.cv.preferredFields and
175         i.relatedToSkills in s.cv.skills and
176         i.requiresExperiences in s.cv.experiences }
177 }
178
179 sig University {
180     var listOfComplaints: set Complaint,
181     var students: some Student
182 }
183
184 -- students dont change universities as assumption
185 fact {
```

```
186     always all u: University | u.students = u.students'
187 }
188
189 -- student and university relation
190 fact {
191     always all u: University, s: Student | u = s.attends and s in
        ↪ u.students
192 }
193
194 -- student complaints end up in uni box
195 fact {
196     always all cp: Complaint, s: Student, u: University | (s.
        ↪ attends = u and cp in s.complaint)
197         implies (cp in u.listOfComplaints)
198 }
199
200 -- if exist company so that complaint of company is in uni
    ↪ complaint list,
201 -- company must host some internship whose student is of that uni
202 fact {
203     always all cp: Complaint, c: Company, u: University | (cp in u
        ↪ .listOfComplaints and cp in c.complaint)
204         implies (some i: Internship | i in c.offers and i.students.
            ↪ attends = u and i.status = Active)
205 }
206
207 enum Status { Active, Inactive }
208
209 var sig Internship {
210     var status: one Status,
211     var students: set Student,
212     var company: one Company,
213     var relatedToSkills: some Skill,
214     var requiresExperiences: set Experience,
215     var inField: one Field,
216     var likedBy: set Student
217 } {
218     one c: Company | this in c.offers -- no floating internships
219     all disj s1, s2 : Student | s1.internship ≠ s2.internship
220 }
221
222 pred editInternship [i : Internship]
223 {
224     i.status' = i.status
225     i.students' = i.students
226     i.company' = i.company
227     i.likedBy' = i.likedBy
228     i.relatedToSkills' ≠ i.relatedToSkills or i.
        ↪ requiresExperiences' ≠ i.requiresExperiences or i.inField
        ↪ ' ≠ i.inField
229 }
```

```
run editInternship

pred closeInternship [i : Internship]
{
    i.status = Active
    i.status' = Inactive
    i.students' = i.students
    i.company' = i.company
    i.likedBy' = i.likedBy
    i.relatedToSkills' = i.relatedToSkills
    i.requiresExperiences' = i.requiresExperiences
    i.inField' = i.inField
}
run closeInternship

pred reopenInternship [i : Internship]
{
    i.status = Inactive
    i.status' = Active
    i.students' = i.students
    i.company' = i.company
    i.likedBy' = i.likedBy
    i.relatedToSkills' = i.relatedToSkills
    i.requiresExperiences' = i.requiresExperiences
    i.inField' = i.inField
}
run reopenInternship

pred deleteInternship [i : Internship]
{
    i.company.offers' = i.company.offers - i
    all s : Student | s.internship ≠ i
    all s : Student | i in s.appliesForInternship implies s.
      ↪ appliesForInternship' = s.appliesForInternship - i
    all s : Student | i in s.likesInternship implies s.
      ↪ likesInternship' = s.likesInternship - i
}
run deleteInternship

pred updateCV {
    some s: Student | s.cv' ≠ s.cv
}
run updateCV

pred internships {
    some s: Student | s.internship ≠ none
}
run internships

pred showRecomm {
    some s: Student | recommendation[s] ≠ none
```

```
}
run showRecomm

pred checkInterviews {
    all s: Student, c: Company | s.internship in c.offers implies
    s in c.hasInterviewed
}
run checkInterviews

pred checkRecomm {
    all s: Student | s.internship ≠ none implies
    s.receiveRecommendation ≠ none
}
run checkRecomm
```

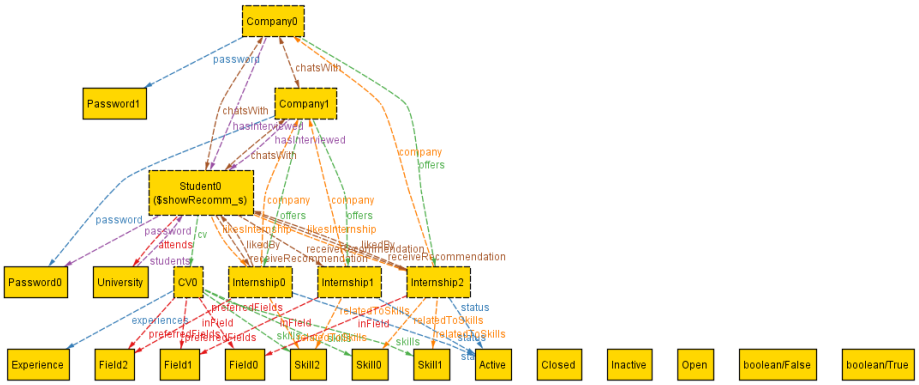

Figure 27: An example of a Recommendation

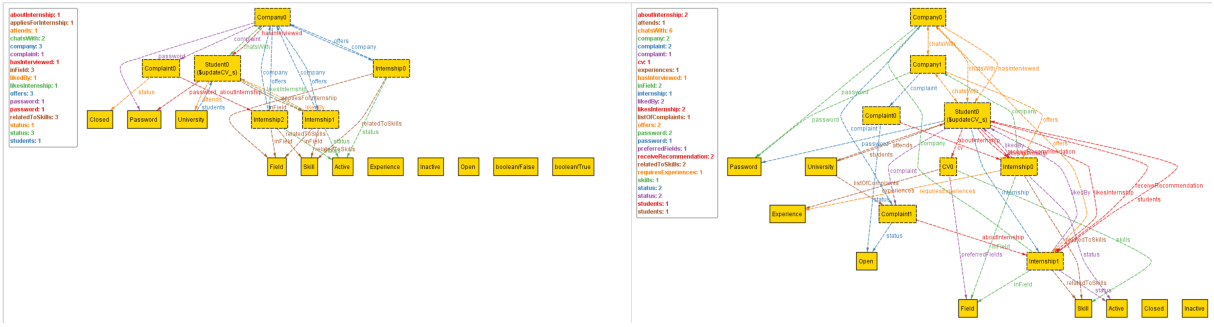

Figure 28: An example of a student uploading his CV

5 Effort Spent

Member of group	Effort spent	
Falzoni Elia	Introduction	4h
	Overall Description	8h
	Specific Requirements	12h
	Formal Analysis	6h
	Reasoning	5h
Toffoli Andrea	Introduction	2h
	Overall Description	7h
	Specific Requirements	15h
	Formal Analysis	6h
	Reasoning	5h
Torti Andrea	Introduction	3h
	Overall Description	6h
	Specific Requirements	20h
	Formal Analysis	3h
	Reasoning	3h

Table 24: Effort spent (in hours) by each member of the group.

6 References

6.1 References

The Requirement Engineering and Design Project specification document A.Y. 2024/2025.

6.2 Used Tools

- GitHub for project versioning and sharing.
- LaTeX and *Overleaf.com* as editor to work on this project.
- *Draw.io* for the other diagrams' design.
- *Alloy* for formal analysis.
- *Google Documents* for collaborative writing, roadmap schedule and progress tracking.

List of Figures

1 High Level UML Diagram . . . 11
2 Unregistered user use case . . . 16
3 Students Use Cases . . . 16
4 Companies use cases . . . 16
5 Student signs up . . . 18
6 Company signs up . . . 20
7 Student resets their account's password . . . 22
8 Student uploads CV . . . 23
9 Student proactively looks for internship . . . 24
10 Student looks at analytics . . . 25
11 Company operator looks at analytics . . . 26
12 Student accepts/refuses system recommendations . . . 27
13 Student files a complaint . . . 28
14 Company operator files a complaint . . . 29
15 Student fills in a feedback questionnaire . . . 30
16 Company interviews a candidate . . . 31
17 Company operator creates new internship . . . 32
18 Company operator updates internship . . . 33
19 Company operator updates internship . . . 34
20 University operator chats with students and companies . . . 35
21 University operator logs into S&C . . . 36
22 Company accepts/refuses system recommendations . . . 37
23 Student logs in . . . 38
24 Company operator logs in . . . 39
25 Company operator resets password . . . 40
26 Company operator selects/rejects candidates . . . 41
27 An example of a Recommendation . . . 50
28 An example of a student uploading his CV . . . 50

List of Tables

1 Traceability Matrix for Goals and Requirements 15
2 Sign up as student 17
3 Sign up as company 19
4 Student resets their account's password 21
5 Student uploads CV 23
6 Student proactively looks for an internship 24
7 Student looks at analytics 25
8 Company operator looks at analytics 26
9 Student accepts/refuses system recommendations 27
10 Student files a complaint 28
11 Company operator files a complaint 29
12 Student fills in a feedback questionnaire 30
13 Company interviews a candidate 31
14 Company creates a new internship 32
15 Company edits/deletes/closes an internship 33
16 Company fills in a feedback questionnaire 34
17 University operator chats with students and companies 35
18 University operator logs into S&C 36
19 Company accepts/refuses system recommendations 37
20 Student logs into S&C 38
21 Company operator logs into S&C 39
22 Company operator resets password 40
23 Company operator selects/rejects candidates 41
24 Effort spent (in hours) by each member of the group. 51