POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

Software Engineering 2 Requirements Analysis and Specification Document

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Contents

1 Introduction

1.1. Purpose

Students&Companies (S&C) is a platform design to facilate university students' entry into the job market and help companies promote internships and job opportunities. The platform adresses market needs by filling the gap between academic skills and industry demands, improving the matching process between young talent and businesses, and creating an ecosystem that values education and practical experience.

1.1.1. Goals

In this section, there are defined the goals that the system has to achieve:

Internships Publication and Search

[G1] Companies should advertise their internships by inserting their project details.

[G2] Students should insert their CVs.

[G3] Students should search for internships.

Recommendations

[G4] Recommendations should be identified by the system through at least the use of:

- **[G4.1]** simple keyword searching.
- **[G4.2]** statistical analyses on students and companies.

[G5] Students should receive recommendations about internships.

[G6] Companies should receive recommendations about students matching their preferences.

[G7] Both students and companies should handle the recommendations they receive:

- **[G7.1]** by accepting them.
- **[G7.2]** by refusing them.

Selection Process

[G8] Both students and companies should be put in contact after they accept a recommendation.

[G9] Companies should be supported in the selection process aimed at evaluating candidates:

[G9.1] in setting up interviews.

[G9.2] in conducting interviews.

[G9.3] in collecting answers from the students.

[G9.4] in finalizing the selections.

Submission Suggestions

[G10] Students should receive suggestions about how to make their CVs more appealing.

[G11] Companies should receive suggestions about how to make their internships descriptions more appealing.

Monitoring

[G12] Both students and companies should provide feedback and suggestions regarding the internships.

[G13] Both students and companies should monitor the evolution of the matchmaking process.

[G14] Students, companies and universities should monitor the evolution of the internships.

[G15] Both students and companies should report information about the ongoing internships:

[G15.1] regarding its status.

[G15.2] regarding eventual complaints and problems.

[G16] Universities should handle complaints about the internships of their students.

1.2. Scope

Students&Companies (S&C) is a platform that acts as an intermediary system facilitating the internship matching process between students and companies. It allows companies to advertise internships and students to search, receive customized recommendations, and initiate contact.

The platform defines **Recommendation** as the automated process of identifying suitable internship opportunities for students and potential candidates for companies. Following this, a

Contact represents the phase in which students and companies communicate via the platform to conduct the selection process, including interviews and candidate selection.

The system automates key activities such as generating recommendations using various mechanisms, coordinating interviews, and collecting feedback to improve its algorithms. Additionally, it provides tools to monitor the progress of contacts and internships, manage issues through communication features, and enable universities to supervise the status of internships, ensuring compliance and resolving possible complaints effectively.

1.2.1. World Phenomena

[WP1] Companies make new internship positions available.

[WP2] Students decide to take on an internship. (?)

[WP3] Companies select the student candidates who fit the most based on the outcomes of their interviews.

[WP4] Students carry on their internships at their companies. (?)

[WP5] Students redact their CV.

[WP6] Universities interrupt internships.

1.2.2. Shared Phenomena

World Controlled

[SP1] Students and companies sign up to the platform. (?)

[SP2] Companies provide information about their internship positions to the system.

[SP3] Students search for open suitable internship positions.

[SP4] Students proactively contact companies to propose themselves for an open internship position.

[SP5] Students accept recommendations for internships.

[SP6] Students decline recommendations for internships.

[SP7] Companies accept recommended candidates for internships.

[SP8] Companies discard recommended candidates for internships.

[SP9] Companies contact accepted students to set up an interview with them.

[SP10] Companies submit questions to students.

[SP11] Students compile required info by companies during the interview.

[SP12] Companies finalize the selection process.

[SP13] Students track the outcomes of the interviews they have participated in.

[SP14] Students and companies report about ongoing internships.

[SP15] Students and companies report complaints and problems about ongoing internships.

[SP16] Students and companies provide feedback and suggestions about internships.

[SP17] Students, companies and universities monitor an ongoing internship.

Machine Controlled

[SP18] The system provides suggestions to students' CVs.

[SP19] The system provides suggestions to companies' internship descriptions.

[SP20] The system notifies students and companies when a recommendation is generated. (split?)

[SP21] The system notifies students and companies when a contact is established.

[SP22] The system forwards the submitted questions from companies to students (?)

[SP23] The system forwards the submitted answers from students to companies, which collect them (?)

[SP24] The system notifies the candidate students when they are selected by companies after the selection process.

[SP25] The system forwards information about the ongoing internships to students, companies and universities.

[SP26] The system asks for feedback during the internship to improve its recommendation algorithms.

1.3. Definition, Acronyms, Abbreviations

"upload a CV": fill all the required fields in a user's profile in the CV section (NOT file uploading in order to enforce a standard format and to facilitate the system in collecting and processing information)

When the terms "University" or "Company" are referenced as performing an action, it is to be understood that the action is executed by a representative acting on behalf of the respective entity.

"notification": "banner" on the user's profile, not actual notification on a device or via email

"accuracy" and "F1" for the recommendations mechanisms

"2FA"

maybe add a "TBDDD" for "to be defined during design"?

Acronyms	Definition
RASD	Requirements Analysis & Specification Document
API	Application Programming Interface

Table 1.1: Acronyms used in the document.

Abbreviations	Definition
ST	Student
CO	Company
GX	Goal X
DAX	Domain Assumption X
WPX	World Phenomena X
SPX	Shared Phenomena X
RX	Requirement X

Table 1.2: Abbreviations used in the document.

1.4. Revision history

Revised on	Version	Description
xx/xx/xxxx	1.0	Initial Release of the document
xx/xx/xxxx	2.0	xxxxxxxxxxxxxxxxxxxxx

Table 1.3: Revision history

1.5. Reference Documents

- [1] Di Nitto, Rossi, Camilli, *"A.Y. 2024-2025 Software Engineering 2 Requirement Engineering and Design Project"*, 2024.
- [2] ISO/IEC/IEEE 29148:2018, *"Systems and Software Engineering — Life Cycle Processes — Requirements Engineering," International Organization for Standardization, International Electrotechnical Commission, and Institute of Electrical and Electronics Engineers*, 2018.

1.6. Document Structure

This document is composed of six sections:

- 1st Chapter (Introduction):
- 2nd Chapter (Overall Description):
- 3rd Chapter (Specific Requirements):
- 4th Chapter (Formal Analysis Using Alloy):
- 5th Chapter (Effort Spent):
- 6th Chapter (References):

2 | Overall Description

2.1. Product Perspective

2.1.1. Scenarios

- **1st Scenario: Sign Up and Profile Creation Performed by a Student**
  Marco Stella, a student at Politecnico di Milano, wants to find a suitable summer internship to put in practice the knowledge gained during his bachelor degree in Computer Science. He has discovered the opportunity offered by the S&C platform and decides to sign up in order to browse the internships. He is required to provide the necessary information in order to subscribe, such as their educational email, password, and other personal details. Once the account verification process has been completed, he is able to navigate his personal dashboard. Marco is now asked to upload his CV and potentially add other relevant details about his background, skills and attitudes. Once these information are inserted into the platform, he is now able to use all the functionalities provided by S&C and can start his searching process.

- **2nd Scenario: Sign Up and Profile Creation Performed by a Company**
  BrightFuture, a company specializing in AI solutions, is looking to recruit talented interns to support its upcoming projects. The company has heard about the opportunities provided by the S&C platform and decides to register in order to post internship offers and connect with potential candidates. To begin, a representative from BrightFuture Technologies signs up by providing the necessary company details, such as the corporate email address, password, and additional contact information about the organization. Once the account registration is complete, the system sends a confirmation email for verification. After confirming the email, the company can access its personalized dashboard. The representative is then prompted to create a company profile. This involves adding essential details, such as a description of the organization, its mission, and the fields it operates in. They can also upload the company logo and other branding elements to enhance the profile's appeal to prospective interns. With the profile fully set up, BrightFuture Technologies can now access all the features of the S&C platform.

- **3rd Scenario: Publication of an Internship Offer by a Company**
  TechFuture, a company specializing in the development of innovative software solutions, decides to use the S&C platform to post an internship opportunity for students interested in the tech industry. After logging into their corporate account using their credentials, a representative selects the "Create New Offer" option from the main menu. The platform prompts the company to provide all the necessary details for the internship: the application domain, the tasks to be performed, the required skills, the duration of the internship, the application deadline and the compensation terms. The representative carefully completes all the required fields, reviews the information for accuracy, and submits the offer. The system performs an automatic preliminary verification of the provided details to ensure the offer complies with the platform's policies and standards. Once the review is completed, the internship offer is published on the platform, making it accessible to students who can now apply and explore the opportunity further.

- **4th Scenario: Internship Search by a Student**
  Davide Bianchi, a second-year Mechanical Engineering student at Politecnico di Milano, is eager to find an internship that aligns with his academic background and career aspirations. He logs into the S&C platform using his credentials and navigates to the "Search Offers" section. Here, the platform presents him with a search interface, allowing him to apply filters to narrow down the opportunities based on his preferences. Davide specifies his criteria: internships related to mechanical design, located in Italy, with a duration of at least three months. Confident in his choices, he submits the search. Within moments, the system displays a list of internship offers that match Davide's selected criteria. Browsing through the options, he identifies a position posted by Innovex Solutions, a company known for its innovative mechanical systems. The platform confirms that the internship has been successfully added to his application list, ensuring Davide can easily track and review it later. Encouraged by this seamless process, he continues exploring other opportunities to further expand his options.

- **5th Scenario: Automatic Internship Recommendation**
  Luca Rossi, a second-year Electrical Engineering student at Politecnico di Milano, has recently completed his profile on the S&C platform. His profile includes details about his academic background, skills, and interests, which he hopes will help him find an ideal internship opportunity. As part of its functionality, the S&C platform automatically analyzes Luca's profile. It leverages the information he has provided - such as his field of study, technical skills, and career aspirations - to compare it with the internship offers available on the platform. Using a recommendation algorithm, the system identifies the internships that best align with Luca's qualifications and professional goals. Once the

analysis is complete, the platform compiles a list of recommended internships. Luca receives a notification informing him about the new recommendations. He navigates to the "Recommendation" section, where he can review the suggested opportunities and start applying for positions that match his interests and attitudes.

- **6th Scenario: Automatic Student Recommendation**
  GreenSpark Energy, a company specializing in renewable energy solutions, has recently posted an internship offer on the S&C platform. The offer outlines the required skills, academic background, and other criteria for the ideal candidate. Once the offer is published, the platform's recommendation system begins its analysis. The system retrieves the details of the internship, such as the field of study, necessary qualifications, required skills, and desired attributes. Using these parameters, it compares the offer against the profiles of students registered on the platform. Leveraging its recommendation algorithm, the system identifies a list of students whose profiles closely align with the internship requirements. Once the analysis is complete, the platform compiles a list of recommended candidates. The system notifies GreenSpark Energy and provides access to the list of students, allowing the company to review their profiles and directly invite them to apply for the internship.

- **7th Scenario: Managing an Interview between a Company and a Student**
  Innovex Solutions, a company specializing in innovative mechanical systems, is reviewing applications for a recently posted internship position. Among the candidates, they identify Davide Bianchi, a promising Mechanical Engineering student at Politecnico di Milano, whose profile aligns closely with their requirements. The company decides to invite him for an interview. Through the S&C platform, Innovex Solutions sends an interview invitation to Davide, including the date, time, and format (video call or in-person). Shortly after, Davide receives a notification about the interview and logs into the platform to review the details. Finding the schedule convenient, he accepts the invitation and confirms his availability. On the agreed date, the interview is conducted as planned. During the session, Davide discusses his qualifications, skills, and aspirations, while the company representative provides more information about the role and evaluates his suitability. After the interview, Innovex Solutions uses the platform to provide feedback on Davide's performance, assessing his strengths and areas for improvement. They also post the results of the interview, informing Davide whether he has progressed to the next stage of the selection process or been offered the internship. The system records the feedback and updates Davide's status in the selection process, ensuring he remains informed about the outcome.

- **8th Scenario: Reporting and Handling Problems during an Internship**
  Giulia Moretti, a Civil Engineering student at the Politecnico di Milano, is excited to begin her internship at Skyline, a company specializing in urban infrastructure projects. On her first day, Giulia is welcomed by her supervisor, who outlines her responsibilities and assigns her to work on a sustainability-focused bridge design project. The initial weeks of her internship are productive, with Giulia learning new skills and gaining hands-on experience. Throughout the internship, Giulia and her supervisor at Skyline regularly update the S&C platform with progress details. Giulia logs her completed tasks, acquired skills, and challenges faced. These updates help both the university and Skyline monitor the alignment between Giulia's work and her learning objectives. However, midway through the internship, Giulia encounters a significant issue: the tools and resources promised by Skyline for her project, including access to specific engineering software, are unavailable. This lack of resources makes it difficult for Giulia to complete her assigned tasks effectively. After attempting to resolve the issue internally with her supervisor without success, Giulia decides to report the problem to her university. Using the S&C platform, Giulia navigates to the "Report Problems" section and submits a detailed description of the issue. She explains the nature of the problem, its impact on her project, and the steps she has already taken to address it. The platform immediately makes Giulia's report available to her university's internship coordinator. Upon receiving the report, the university's coordinator reviews the details and contacts both Giulia and Skyline to discuss the issue. During a scheduled meeting, the coordinator gathers additional information from both parties and assesses the situation. After evaluating the options, the university decides to address the issue by coordinating with Skyline to speed up the software licensing process. The problem is resolved within a week, and Giulia is able to continue her internship with minimal disruptions. As the internship progresses, Giulia continues to log her tasks and achievements on the S&C platform. Finally, the internship reaches its scheduled conclusion. Giulia submits a final report summarizing her work, the skills she has developed, and her overall experience. Skyline also provides formal feedback through the platform, highlighting Giulia's strengths and suggesting areas for further improvement. Both the student's and the company's feedback is stored in the system and fed to the recommendation mechanisms, allowing the evaluation of the quality of internships offered by Skyline and the improvement of future recommendations.
- **9th Scenario: Profile Optimization Suggestions for Students**
  Alessandro Romano, a second-year Computer Science student at Politecnico di Milano, logs into the S&C platform to ensure his profile is fully optimized for attracting internship opportunities. Navigating to his profile page, he notices a notification prompting him

to review suggestions for improvement. The system automatically analyzes Alessandro's profile, considering his academic background, skills, and documents such as his CV. Based on the analysis, the platform generates a list of personalized suggestions. These include adding programming languages that are in high demand, updating his project portfolio, and providing a more detailed description of his certifications. Alessandro reviews the suggestions carefully and starts implementing the changes directly through the platform.

- **10th Scenario: Profile Optimization Suggestions for Companies**
  BlueHorizon Robotics, a company specializing in autonomous systems and AI integration, logs into the S&C platform to ensure their profile is effectively attracting top candidates for their internship programs. A representative navigates to the company profile page and notices a prompt indicating available optimization suggestions. The platform's system analyzes the company's profile, including details about past internship postings, descriptions of ongoing projects, and the clarity of their technical requirements. Based on the analysis, the platform generates actionable suggestions, such as refining job descriptions to better outline the scope of responsibilities or specifying advanced technical skills required for certain roles. The representative carefully reviews the suggestions and begins updating the profile to align with the recommendations.

2.1.2. Domain-level Class Diagram

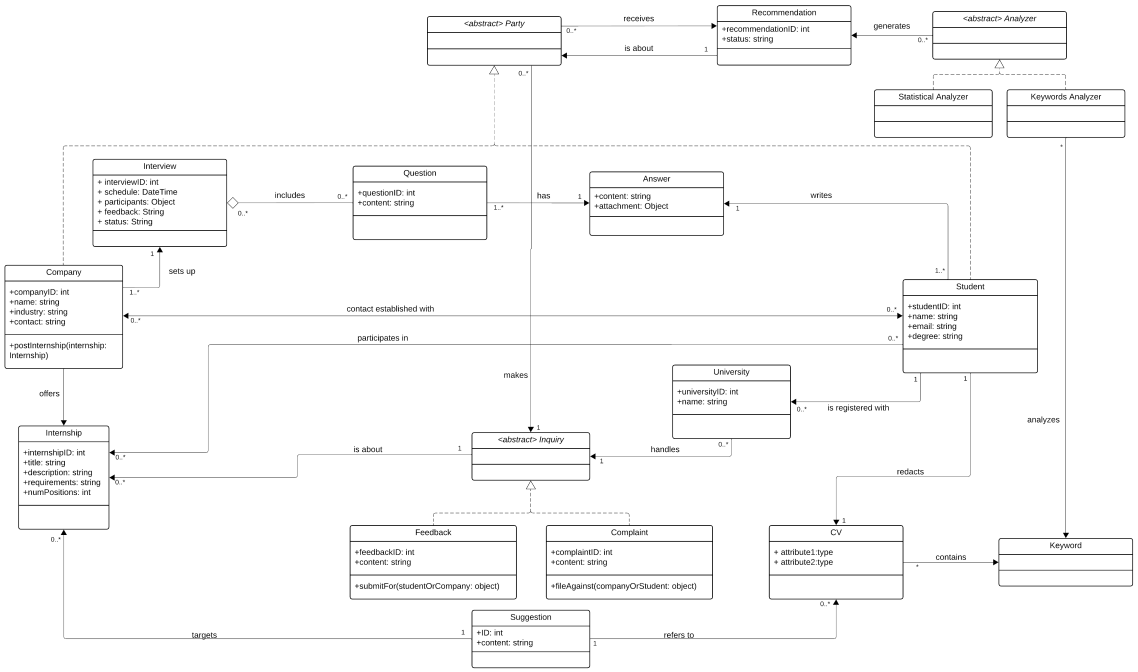

Figure 2.1: Domain-Level Class Diagram.

The core of the system revolves around the concept of connecting students with internship opportunities. This is reflected in the relationships between the Student, Company, and Internship entities, which interact guided by the recommendation generator or by initiative of the students. The Student entity encapsulates candidate data such as personal details and educational background, which combined with the CV class, are essential to matching students with adequate internship opportunities. Companies can publish detailed internship opportunities that students can eventually search and apply for.

The Recommendation entity acts as a bridge between CVs and Internships, enabling the system to suggest the most relevant opportunities to students and suitable candidates to companies. (The process is asymmetric ... A single internship can be tied to multiple rec, same for CVs.. etc blah blah) This process is driven by the different Analyzers, which enhance the recommendation accuracy applying techniques like keyword matching and statistical analyses. A student is always considered eligible for new recommendations by the system, even if it's already enrolled in another internship, since he could be interested in applying for others in future times.

The interview process is modeled through the Interview class, which provides a structured framework for evaluating candidates. Each interview is an aggregation of multiple Question, which are designed to be reusable across different interviews. This approach promotes modu-

larity, allowing companies to build evaluation processes reusable in multiple interviews. The Answer class captures the responses provided by candidates during the interviews.

A key feature of the platform is the facilitation of feedback and communication. The Feedback class allows students and companies to provide insights on their experiences, which the system can use to refine the recommendations. The Complaint class adds another layer of oversight, enabling parties to report and address issues related to internships or interactions. These mechanisms are monitored and supervised by the University entity, ensuring that internships comply with established agreements and resolving disputes when necessary. Feedback and complaints are tied to the specific party accountable for them, in order to provide traceability.

2.1.3. State Diagrams

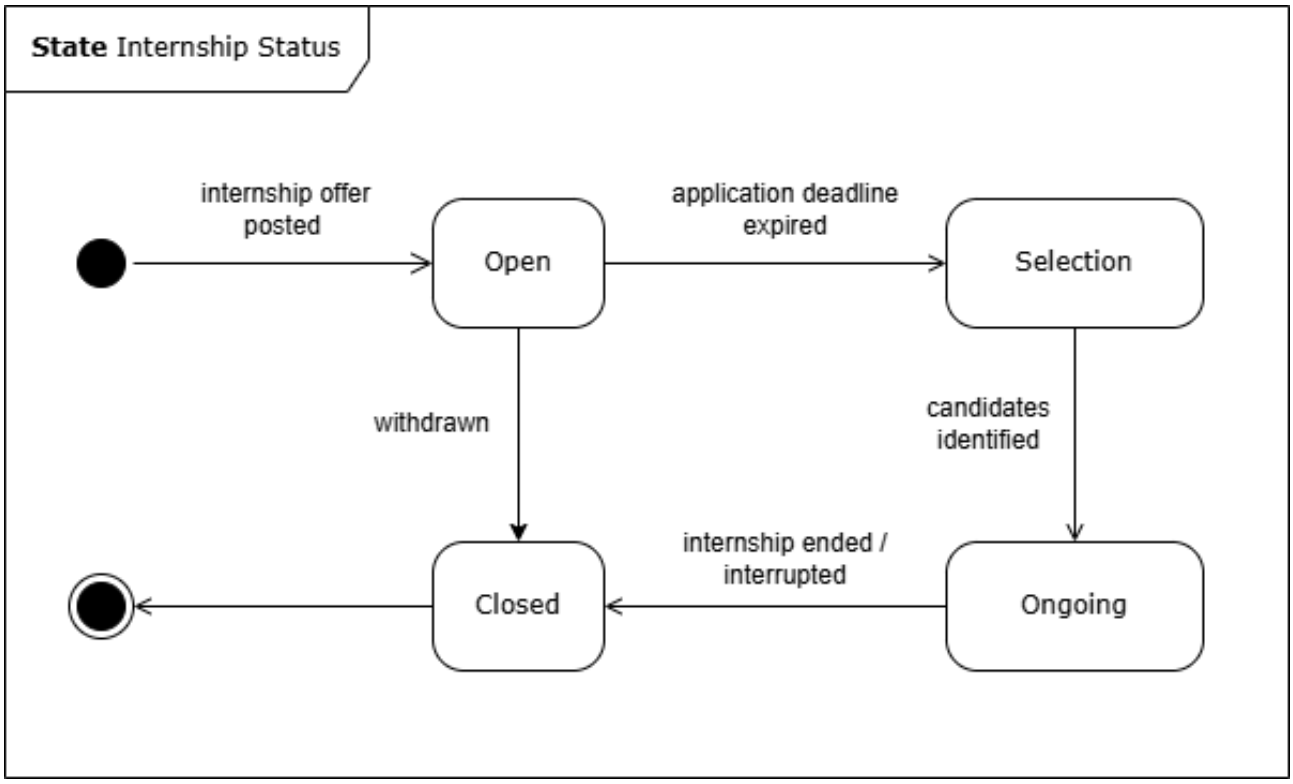

Figure 2.2: Internship Status State Diagram.

This state diagram illustrates the lifecycle of an internship offer on the platform. It begins when an offer is posted, transitioning into the Open state, where the internship is available for applications. The offer remains open until either the application deadline expires, leading to the Selection phase, or the company withdraws it, moving directly to Closed. In the Selection state, candidates are evaluated, and if suitable candidates are identified, the process progresses to the Ongoing state, where the internship is actively taking place. Finally, upon completion

or interruption of the internship, the offer transitions to the Closed state and it remains stored in the system.

2.1.4. Activity Diagrams

TODO

2.2. Product Functions

The S&C platform is designed to streamline the internship matching and selection phase by providing functionalities that support every stage of the process. Key features include internship publication, automated recommendations, and monitoring tools. By integrating feedback mechanisms, the platform ensures an effective internship experience for all the stakeholders.

- **Sign Up and Profile Creation**
  Users, including students, companies, and universities, must sign up to the platform to access its functionalities. During the registration process, they create profiles by providing required personal and professional details. For students, details include uploading a CV and filling out additional information such as experiences, skills, and attitudes, enabling the platform to generate accurate recommendations. For companies, it includes a description, the mission, the fields in which they operate and eventually their branding elements.

- **Internship Publication**
  The platform enables companies to publish detailed and descriptive internship opportunities. Relevant information includes the application domain of the project along with the tasks that the student will be required to perform with the adopted technologies, if applicable. Furthermore, the details include the terms offered by companies: paid internship, training period or other benefits. These details are essential for allowing students to make informed decisions and to improve the recommendation algorithm. Companies are allowed to withdrawn internship offers before the application deadline expires.

- **Internship Search**
  Students can search for internship opportunities using filtering options based on standardized information required by the platform while posting an internship offer. This functionality ensures a user-friendly browsing experience, allowing students to efficiently find internships aligned with their preferences.

- **Generation of Recommendations**
  The platform automatically generates recommendations for students based on their pro-

files, and suggests suitable candidates to companies. The system employs keyword matching and statistical analyses to provide accurate and relevant suggestions. Both parties can evaluate the received recommendations and decide to accept or decline them based on their interests.

- **Support in the Selection Process**
  The platform facilitates the selection process by enabling companies to contact the candidates, schedule interviews and collect responses from students for evaluation. In the end, it notifies students about the outcomes of their interviews.
- **Personalized Suggestions**
  The platform assists users by providing personalized suggestions to produce more appealing descriptions. In particular, it provides suggestions to students for improving their CVs and it offers guidance to companies on how to optimize their internship descriptions.
- **Communication Functionalities and Monitoring**
  The platform supports communication between students and companies, allowing them to provide updates about the status and progress of their ongoing internships and monitor them. Communication of problems and complaints is made possible through private spaces. Universities can monitor internships to handle complaints and issue them when possible, interrupting internships if necessary.
- **Collecting Feedback**
  To improve its recommendation system, the platform gathers feedback from students and companies both during and after internships. This feedback loop allows a continuous refinement, to better address the interests of both parties over time.

2.3. User Characteristics

The S&C platform is designed for three categories of users:

Students University students seeking internships. They are typically proficient users, familiar with app navigation and common interaction patterns such as registration, profile management, and document uploads (e.g., CVs). Their primary motivation is to find internships aligned with their skills and career goals efficiently. Students generally access the platform a few times each week while searching for internships and reviewing recommendations, with increased frequency during the interview phases.

Companies Human Resources professionals responsible for posting internship opportunities, reviewing candidate recommendations, conducting the selection process, and providing feedback on

ongoing internships. These users may vary in technical proficiency with the platform, but expect a straightforward interface to accomplish core tasks efficiently. They typically interact with the platform multiple times daily during work hours, particularly during active recruitment periods.

Universities University staff responsible for monitoring internship outcomes and addressing their student-related complaints during internships. While their technical expertise may vary, they require tools for monitoring and complaint management. They have minimal involvement in day-to-day activities on the platform. The typical number of interactions can be a few times per week, depending on the number of students they manage.

All users expect a user-friendly interface, reliable notifications, and support features. The system accommodates varying levels of technical proficiency and ensures accessibility for all user groups.

2.4. Assumptions, Dependencies and Constraints

2.4.1. Domain Assumptions (need to be checked and confirmed)

[DA1] People who are not students or representatives for either companies or universities never use the system and never disguise themselves as being one of them. (Students must verify their status as university students?)

[DA2] Users always interact with the system only through a device with a reliable connection to the Internet.

[DA3] Companies never lie about any characteristic of their internship offers.

[DA4] Companies never withdraw an internship offer after it has been posted on the system. (a little strange, however we should assume this in the goals otherwise and take this into consideration)

[DA5] Students never lie about their skills and experiences etc. when submitting their CVs in the system.

[DA6] Students only apply for internships if these match their interests and if they really want to undertake them.

[DA7] Users never leave pending recommendations unanswered (or are they discarded after some time with the other party notified?).

[DA8] Contact is always established as soon as students and companies have both accepted

the reciprocal recommendation(/request if the student started it?).

[DA9] Companies always set up interviews only with the students whom they have had a contact established with.

[DA10] Companies always finalize the selection process and bring it to completion, even if they haven't found any fitting candidate among the interviewed students.

[DA11] Users regularly upload information about the ongoing internships.

[DA12] Complaints inserted into the system are always meaningful and happen relatively rarely.

[DA13] Universities always act upon received complaints and solve the exposed issues, promptly terminating the internship if necessary.

3 | Specific Requirements

3.1. External Interface Requirements

3.1.1. User Interfaces

The user interface shall comply with web standard technologies for delivering a responsive and interactive user experience: thus, it should adequately adapt to the display of the used device, providing a suitable layout of the graphical elements.

+ usability

- Provide some mockups to important features - Provide workflow of operations to better comprehend platform functionalities

3.1.2. Software Interfaces

(Understand if you can already decide about client-server or database presence here or not)

The system is meant to be a platform-independent WebApp, which does not rely on external APIs or essential third-party software to perform its core functionalities. However, the system shall adhere to the following requirements:

- It shall function across the most widely adopted operating systems, including but not limited to Microsoft Windows, MacOSX, Linux, Android, iOS and ChromeOS.
- It shall function across the most widely used browsers, including but not limited to Google Chrome, Opera, Mozilla Firefox, Safari, and Microsoft Edge, without requiring additional software installation on the user's device.
- It shall interact appropriately with the chosen services or network protocols for email management (in order to carry on sign-up and log-in functionalities).

No additional software installations or configurations are required on the user's device beyond the availability of a supported web browser.

3.1.3. Communication Interfaces

The system shall support standard communication protocols for reliable interaction between the components. Specifically, the following requirements apply:

- The system shall operate over standard Internet connections, including wired and wireless networks (e.g. Ethernet, Wi-Fi, mobile data).
- The system shall support encrypted communication/secure sessions (e.g. through TLS/SSL) to protect sensitive data, including user credentials and personal information, during transmission.
- The system shall utilize a widely adopted web communication protocol (such as HTTPS) to ensure secure and reliable data transmission between the user's browser and the web server.
- The system shall not require users to install additional software to facilitate communication.
- The system shall minimize communication latency to provide a responsive user experience, with server response times aligning with industry standards for web applications.

3.1.4. Hardware Interfaces

The system shall be implemented following the client-server paradigm, as indicated above. Thus, different needs arise for the devices involved.

Client side

(add eventual camera/microphone integration for video calls for interviews if they can be carried this way).

The WebApp shall be designed to be platform-independent and accessible from any device with modern hardware capabilities:

- The system shall support the most widely used devices: desktop and laptop computers, tablets, and smartphones. The suggested minimum specs for support are a 1GHz CPU, 2GB RAM, 1GB free space for caching data, and a screen resolution of 1024x768.

Server side

The WebApp shall be hosted on server infrastructure, which is therefore required to have some minimum capabilities:

- The system shall be able to handle multiple concurrent user sessions at the same time, as well as intensive data processing background tasks. Thus, the back-end shall be run on a server machine with hardware which can regularly withstand high workloads: a 64-core CPU, 64GB RAM, and 2 TB SSD are proposed as minimum specs. Moreover, a network adapter is required for handling communication.

3.2. Functional Requirements

3.2.1. Requirements

In this section, the requirements for the system to be developed are outlined:

Sign up and profile creation (and profile management? also missing above)

[R1] Whenever a sign-up request is received, the system shall request data for profile creation to the user involved.

[R2] Whenever a user submits all the data required for signing up, the system shall create the profile for the user after verifying its identity and role (keep this? contrasts with the domain assumptions) and that a profile doesn't already exist.

[R3] Whenever a log-in request is received, the system shall grant the user access to its profile if and only if the authentication is successful (i.e., if username and/or email and password match with an entry for the possible database?). (add log-in functionality above?)

[R4] Whenever a new internship is inserted, the system shall store it and make it available for future searching and recommendations.

[R5] Whenever a student searches for an internship position, the system shall return the list of all the best-matching offers according to the search parameters.

[R6] Whenever a student applies for an internship position, the system shall send a recommendation notification to the company which has advertised the position, if the deadline has not expired.

[R7] Whenever an internship offer is advertised or information about some new or existing student changes (split in 2?), the system shall identify recommendations between all the users (who are not already in an internship? who are presumably active in the last x period?) and all the open (non-finalized) internship offers (add constraint of action to specify according to which criteria/thresholds recommendations are identified as such, e.g. minimum degree of relevance).

[R8] Whenever recommendations are being generated, the system shall use all the available

mechanisms in order to not leave out anything and be the most accurate and precise possible (rewrite this and specify)

[R9] Whenever simple keyword searching is employed for generating recommendations, the system shall identify correspondences with an appropriate and sufficient "degree of freedom" (i.e., not exact matches - specify how much freedom).

[R10] Whenever a statistical analysis is carried out, the system shall feed it with (all the data? only the relevant data?), including feedback received about the internships...

[R11] Whenever a recommendation is identified, the system shall send the related notification to all (if symmetric) the users involved, as soon as possible (specify the timing).

[R12] Whenever both parties have accepted the respective recommendation, the system establishes a contact (which contact?) between them.

[R13] Whenever ... (interview requirements TBD).

[R14] Whenever a company finalizes the selection process, the system shall make the outcome visible to all the participating students.

[R15] Whenever a user reports information about an ongoing internship, the system shall store it and make it available to all the other authorized users.

[R16] Whenever a user files a complaint about an ongoing internship, the system shall store it and make it available to only the university of the involved student (confirm this).

[R17] Whenever a user provides feedback (feedback = suggestions?) about an internship, the system shall store it.

[R18] Whenever a user accesses data about an internship, the system shall retrieve and return all the information for which it is authorized to access.

[R19] Whenever a suggestion aimed at a user is identified, the system shall notify the user of it and communicate it in the clearest way.

[R20] Whenever any notification needs to be sent to a user (for recommendations, complaints, suggestions, etc.), the system shall immediately "append" it to the user's profile, so that it is available during the next instant in which the user is logged in.

Recommendations

[G17] Recommendations should be identified by the system through at least the use of:

- **[G17.1]** simple keyword searching.

[G17.2] statistical analyses on students and companies.

3.2.2. Use Case Diagrams

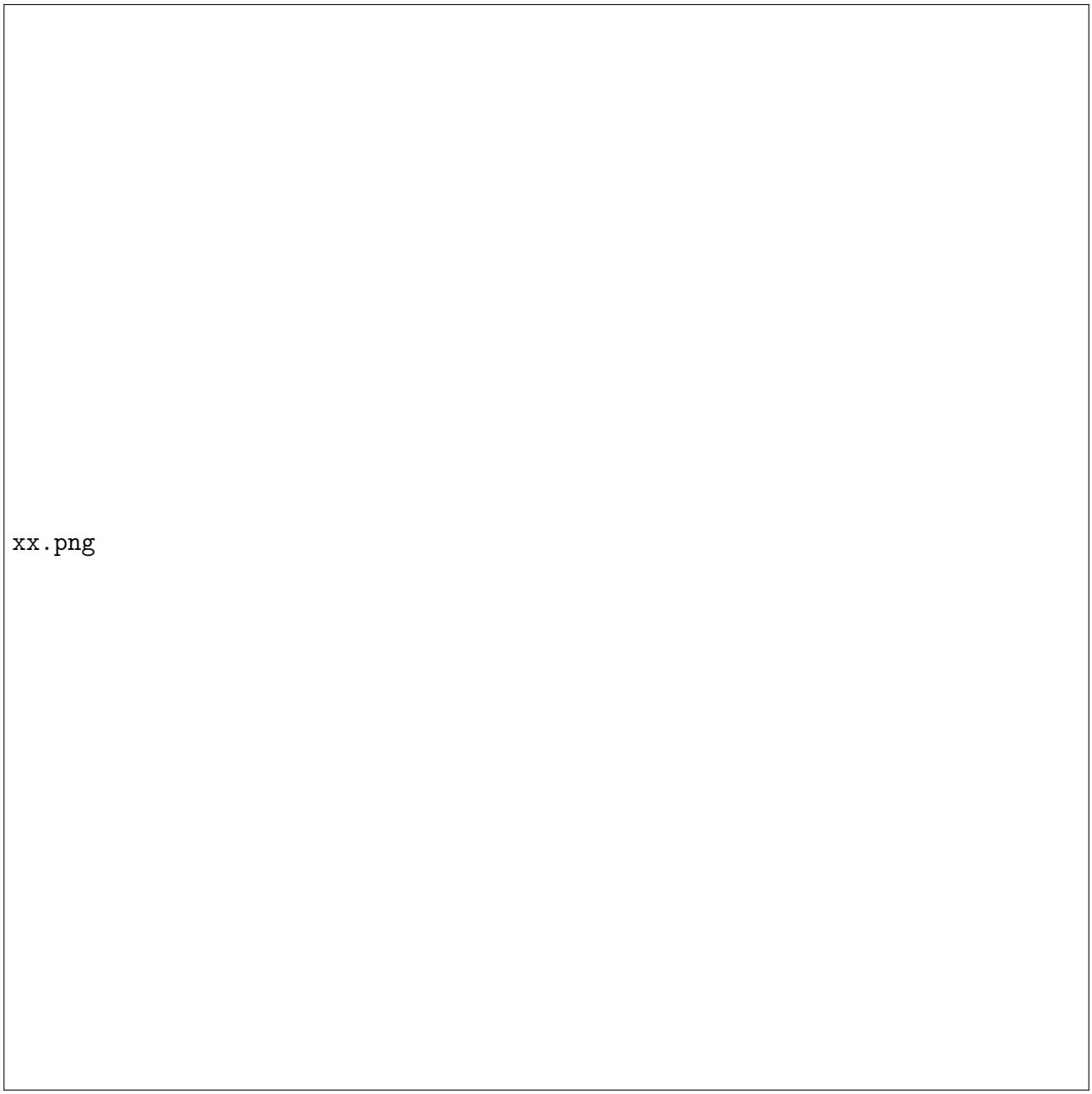

Figure 3.1: Use Case.

3.2.3. Use Cases

UC1. Sign Up by a Student

Actor	Student
Entry Conditions	The Student is not logged into the S&C platform.
Flow of Events	1. On the homepage, the Student clicks the "Sign Up" button, entering the students' registration page. 2. The Student provides the required details: name, surname, date of birth, gender, email, and password. 3. The Student confirms the provided information by clicking the "Register" button. 4. The system sends to the indicated mailbox a confirmation email with a link that expires in 24 hours for account verification purposes. 5. The Student clicks the link in the confirmation email before it expires and logs into the platform. 6. On the profile page, the Student completes its profile by uploading its CV, selecting its university from a drop-down list (if present) and adding relevant details: skills, education, and career aspirations.
Exit Conditions	The profile is complete and the Student has access to all the functionalities.
Exceptions	• The email address is already linked to an existing account: an error message is shown, and the Student is redirected to the login page. • The password does not meet the platform's security requirements: an error message is displayed, and the Student is prompted to correct the password. • Some mandatory fields are missing: the system doesn't allow the Student to complete the procedure until all the mandatory fields are filled out. • The confirmation link sent to the indicated mailbox expires: all the information previously inserted into the system by the Student is discarded, and the link is invalidated.

Table 3.1: Sign Up by a Student

UC2. Sign Up by a Company

Actor	Company
Entry Conditions	The Company is not logged into the S&C platform.
Flow of Events	1. On the homepage, the Company clicks the "Sign Up" button, entering the companies' registration page. 2. The Company provides the required details: company name, phone number, address, email, password. 3. The Company confirms the provided information by clicking the "Register" button. 4. The system sends to the indicated mailbox a confirmation email with a link that expires in 24 hours for account verification purposes. 5. The Company clicks the link in the confirmation email and logs into the platform. 6. On the profile page, the Company completes the company's profile by adding relevant details: company description, mission, vision, and field in which it operates, and uploading its logo.
Exit Conditions	The profile is complete and the Company has access to all the functionalities.
Exceptions	• The email address is already linked to an existing account: an error message is shown, and the Company is redirected to the login page. • The password does not meet the platform security requirements: An error message is displayed, and the Company is prompted to correct the password. • Some mandatory fields are missing: the system does not allow the Company to complete the procedure until all the mandatory fields are filled out. • The confirmation link sent to the indicated mailbox expires: all information previously inserted into the system by the Company is discarded and the link is invalidated.

Table 3.2: Sign Up by a Company

UC3. Sign Up by an University

Actor	University
Entry Conditions	The University is not logged into the S&C platform.
Flow of Events	1. On the homepage, the University clicks the "Sign Up" button, entering the companies' registration page. 2. The University provides the required details: university name, phone number, address, email, password, and additional information about the university. 3. The University confirms the provided information by clicking the "Register" button. 4. The system sends to the indicated mailbox a confirmation email with a link that expires in 24 hours for account verification purposes. 5. The University clicks the link in the confirmation email and logs into the platform. 6. On the profile page, the University completes the university's profile by adding relevant details:
Exit Conditions	The profile is complete and the University has access to all the functionalities.
Exceptions	• The email address is already linked to an existing account: an error message is shown, and the University is redirected to the login page. • The password does not meet the platform security requirements: An error message is displayed, and the University is prompted to correct the password. • Some mandatory fields are missing: the system does not allow the University Representative to complete the procedure until all the mandatory fields are filled out. • The confirmation link sent to the indicated mailbox expires: all information previously inserted into the system by the University Representative is discarded and the link is invalidated.

Table 3.3: Sign Up by an University

UC4. Log In by an User

Actor	User (Student, Company or University)
Entry Conditions	The User is not already logged into the S&C platform.
Flow of Events	1. In the homepage, the User clicks the "Login" button, which displays the login form. 2. The User enters their email and password into the designated fields. 3. The User clicks the "Login" button. 4. The system validates the provided credentials. 5. The system redirects the User to the dashboard page.
Exit Conditions	The User is successfully logged in.
Exceptions	• The inserted credentials are incorrect: the system displays an error message indicating that the credentials are invalid and the User remains on the login page. • The account hasn't been verified yet: if the User has not confirmed their email and confirmation link has not expired yet, the system shows a message requesting to complete the verification process.

Table 3.4: Log In by an User

UC5. Publish an Internship Offer

Actor	Company
Entry Conditions	The Company is logged into the S&C platform.
Flow of Events	1. In the dashboard, the Company clicks on the "Create New Offer" button, entering in the internship creation page. 2. The Company fills out the internship creation form, inserting: • Application domain • Tasks to be performed • Required skills • Internship duration • Compensation terms • Location (on-site, hybrid, or remote) • Application deadline 3. The Company clicks on the "Submit" button, waiting for the automatic review. 4. The system verifies the provided data to ensure the provided information is compliant with platform guidelines, and the data is consistent and accurate. 5. The system publishes the internship offer on the platform, making it visible to all students. 6. The system confirms to the Company that its offer has been published.
Exit Conditions	The internship offer is published on the platform and accessible to students.
Exceptions	• Some mandatory fields are missing: the system doesn't allow the Company to complete the procedure until all the mandatory fields are filled out. • Some information is not compliant with platform guidelines: the system notifies the Company about the issue and requires revisions.

Table 3.5: Publish an Internship Offer

UC6. Search Internships

Actor	Student
Entry Conditions	The Student is logged into the S&C platform.
Flow of Events	1. In the dashboard, the Student navigates to the "Search Offers" section. 2. The system displays a search interface which allows for the application of various filters: • Domain of interest • Location (on-site, hybrid, or remote) • Internship duration • Compensation terms • Keywords (an offer matches a keyword if it contains that keyword or a semantically similar one in any of its fields). 3. The Student selects the desired filters on the front-end and submits them to the system. 4. The system retrieves and displays a list of internship offers that match the selected criteria. 5. The Student reviews the list and selects an internship offer of interest. 6. The Student applies to the selected internship by clicking the corresponding "Apply Now" button. 7. The system confirms that the application has been successfully registered into the internship offer.
Exit Conditions	The Student has successfully identified and made an application to an internship offer that aligns with their preferences.
Exceptions	• The system doesn't find any matching results: if none of the active internship offers match the selected criteria, the system displays a message suggesting to adjust the filters.

Table 3.6: Internship Search by a Student

UC7. Recommend Internships

Actor	System, Student
Entry Conditions	The student has a profile on the platform.
Flow of Events	1. 2. The system retrieves the following information from the student's profile: academic background, skills, and interests. 3. The system compares the student's profile data with the details of all available internship offers on the platform. 4. Using a recommendation algorithm, the system identifies internship opportunities that closely align with the student's qualifications, preferences, and career aspirations. 5. The system compiles a list of recommended internships. 6. The system notifies the student about the availability of new recommendations and provides access to the curated list.
Exit Condition	The student receives a list of internships recommended based on their profile and preferences.
Exceptions	• Incomplete Student Profile: If the profile lacks critical information for example missing any skill or educational details, the system doesn't consider the student's profile in the recommendation process. • No Matching Internships: If no internship offers match the student's profile, the system notifies the student and suggests improving their preferences or exploring the "Search Offers" section.

Table 3.7: Automatic Internship Recommendation

UC8. Recommend Students

Actor	System, Company
Entry Conditions	The company has created and published an internship offer on the platform.
Flow of Events	1. The system retrieves information from the published internship, including criteria such as required skills, academic background, and duration. 2. The system compares the details of the internship with the profiles of students registered on the platform. 3. Using a recommendation algorithm, the system identifies students whose profiles align closely with the internship criteria. 4. The system compiles a list of recommended students based on the match results. 5. The system notifies the company about the recommendations and provides access to list of suitable candidates.
Exit Conditions	The company receives a list of recommended students who match the internship requirements.
Exceptions	• Incomplete internship details: If the internship lacks essential criteria (e.g., required skills or duration), the system cannot generate recommendations and prompts the company to update the job posting. • No matching students: If no student profiles align with the internship criteria, the system notifies the company and suggests revising the job description or broadening the criteria.

Table 3.8: Automatic Student Recommendation

UC9. Manage an Interview

Actor	Company Representative, Student
Entry Conditions	The company has an active internship offer and has received applications from students.
Flow of Events	1. The company selects a student from the list of candidates for their internship offer. 2. The company sends an interview invitation to the student through the platform, specifying the date, time, format (e.g., online or in-person), and additional details. 3. The student receives a notification about the interview and navigates to the platform to review the invitation details. 4. The student accepts the interview invitation, confirming their availability through the platform. 5. The interview is conducted according to the set details, enabling the company to assess the student's suitability for the internship. 6. After the interview, the company representative provides feedback on the student's performance, such as strengths, weaknesses, and suitability for the role, and submits the results through the platform. 7. The system records the feedback and updates the student's status in the selection process (e.g., "Interview Completed," "Selected," or "Rejected").
Exit Conditions	The interview is completed, and the student's status in the selection process is updated on the platform.
Exceptions	• Student declines the invitation: If the student is unable to attend the interview or rejects the invitation, the company receives a notification, and the system marks the interview as declined. • Scheduling conflicts: If the proposed interview time conflicts with the student's availability, the platform allows the student to request rescheduling, and the company receives a notification to revise the details. • Failure to provide feedback: If the company does not submit feedback within a specified time, the platform sends a reminder to complete the process.

Table 3.9: Managing an interview between company and student

UC10. Report and Handle Problems during an Internship

Actor	Student, University Representative, Company
Entry Conditions	The student is actively participating in an internship and has identified an issue requiring university intervention.
Flow of Events	1. The student identifies an issue during their internship that affects their experience or the agreed terms of the internship. 2. The student logs into the platform using their credentials and navigates to the "Report Problems" section. 3. The system prompts the student to provide a detailed description of the issue, including: • The nature of the problem (e.g., misalignment of tasks, lack of supervision, or unsafe working conditions). • Relevant details about when and how the issue occurred. 4. The student submits the problem report through the platform. 5. The system forwards the student's report to the university's internship coordinator or relevant representative. 6. The university receives the report and reviews the details to understand the problem. 7. The university communicates with the student and the company to gather additional information and work collaboratively to resolve the issue. 8. Based on the outcome, the university updates the student on the resolution steps and ensures the issue is addressed appropriately.
Exit Conditions	The issue reported by the student is formally addressed, and the university ensures appropriate action is taken to resolve it.
Exceptions	• Incomplete problem report: If the student fails to provide sufficient details in the report, the system prompts them to add the missing information before submission. • No response from the company: If the company does not cooperate or respond to the university's communication, the system notifies the university to escalate the matter or explore alternative solutions.

Table 3.10: Monitoring and reporting problems during an internship

UC11. Suggest an Optimization for a Student Profile

Actor	Student
Entry Conditions	The student is logged into the platform.
Flow of Events	1. The student navigates to their profile page on the platform. 2. The system automatically analyzes the student's profile, reviewing details such as: • Academic background • Skills • Uploaded CV • Certifications and extracurricular activities 3. Based on the analysis, the system generates a list of personalized suggestions to improve the profile, such as: • Adding additional skills or certifications. • Updating academic details or achievements. • Including a more detailed description of projects. 4. The student reviews the suggestions and decides which to implement.
Exit Conditions	The student's profile is optimized, increasing its visibility and relevance for internship opportunities.
Exceptions	None

Table 3.11: Profile Optimization Suggestions for Students

UC12. Suggest an Optimization for a Company Offer

Actor	Company Representative
Entry Conditions	The company is logged into the platform.
Flow of Events	1. The company representative navigates to the company's profile page on the platform. 2. The system automatically analyzes the company's profile, reviewing details such as: • Company description • Industry focus • Internship postings and their completeness • Technical and soft skill requirements listed in job descriptions 3. Based on the analysis, the system generates a list of suggestions to improve the profile, such as: • Refining job descriptions to better specify tasks and requirements. • Including more detailed information about the company mission and values. • Adding missing branding elements (e.g., company logo or links to official websites). 4. The company representative reviews the suggestions and decides which to implement.
Exit Conditions	The company's profile is optimized, making it more attractive to students and improving internship visibility.
Exceptions	None

Table 3.12: Profile Optimization Suggestions for Companies

3.2.4. Mapping On Requirements

Row ID	Goal ID	Req ID	DA ID	Use Case ID
1	G1	R1	D1	UC1
2	G2	R2	D2	UC2
3	G3	R3	D3	UC3
4	G4	R4	D4	UC4
5	G5	R5	D5	UC5
6	G6	R6	D6	UC6

Table 3.13: Traceability Matrix

3.3. Performance Requirements

As the system does not supply any particular critical functionality to its users, it is acceptable if there are relatively small delays in the system's response times: therefore, constraints about the system's performance are in principle very lax/loose. On the other hand, requirements for the quality of the system are instead tight:

- The system shall handle a load of up to 10000 concurrent users without significant performance degradation: however, it shall also be scalable enough for this amount to be increased as a consequence of business decisions which cause the system's scope to widen.
- Both accuracy and F1 score of the mechanisms employed for identifying recommendations shall be at least 0.8.
- For every possible requested action, the system shall respond to the users in less than 5 seconds (eventually sending a time-out message?). This includes recommendations generation, which should be able to be carried out for up to 1.000.000.000 different users in the time constraint given.

3.4. Design Constraints

3.4.1. Standards Compliance

SISTEMARE

By integrating these security measures, the S&C platform aims to foster user trust and compliance with legal regulations, such as GDPR.

The system is designed in compliance with industry standards, such as W3C for web technologies and WCAG for accessibility, to guarantee compatibility across web browsers.

3.4.2. Hardware Limitations

3.4.3. Any Other Constraint

3.5. Software System Attributes

The main attributes that the system to be developed shall present are outlined here, listed in order of importance for its correct functioning.

3.5.1. Reliability

The system shall ensure high reliability: namely, it shall handle failures effectively and promptly recover from disruptions, minimizing total downtime, frequency of failures and number of functionalities involved. This shall be achieved by employing standard mechanisms for fault tolerance, such as replication of data storage or back-end computation nodes, ensuring no single point of failure compromises the system.

3.5.2. Availability

The system shall guarantee at least a 2-nines availability (99%, or a total downtime of at most 3.65 days/year), ensuring it is available except for planned maintenance, which should occur outside peak hours and be announced in advance anyway. The decision is based on the fact that it does not offer any critical service to users that cannot be postponed in time. A robust monitoring system shall track application health and trigger alerts for any performance issues or downtime.

3.5.3. Security

The system shall implement secure authentication and authorization mechanisms to verify user identities and restrict access to features based on user roles. Such guarantees may be implemented through strong password policies, 2FA, encrypted communication protocols (e.g., HTTPS), etc. Additionally, the platform must ensure data integrity by preventing unauthorized modifications and preserving the accuracy of stored information, both physically and virtually.

To uphold confidentiality, the system shall encrypt sensitive data both in transit and at rest, ensuring that data remains unreadable even if intercepted or exposed. Secure data storage practices must be observed. Moreover, the system must be resilient to common attack vectors, including SQL injection, cross-site scripting (XSS), and cross-site request forgery (CSRF). The platform should also incorporate regular security patches to address newly discovered vulnerabilities.

3.5.4. Maintainability

System maintenance shall be planned for hardware or software upgrades, or for the deployment of production code containing additional functionalities, bug fixes or security updates. It should last 8 hours on average, theoretically enabling it to be carried out entirely outside peak traffic periods; in any case, it shall not exceed 24 hours. Maintenance bursts should happen exceptionally, possibly no more than twice or thrice a year, and shall always be announced in advance to the public (minimum 48 hours before). Software maintenance shall instead be employed right from the start of the development process by enforcing the application of best-practices, in compliance with the industry standards; code shall be clean, modular, reusable and low-coupled, to facilitate the introduction of new functionalities as needed.

3.5.5. Portability

Since the platform is offered as a WebApp, it operates through standard web browsers and inherently supports compatibility across various operating systems. Given this architecture, there is no need for native application installations, ensuring ease of use and minimizing setup complexity. Therefore, the chosen architecture and platform's reliance on web standards already solves all aspects related to portability. The server-side architecture of the platform shall be designed to offer portability, ensuring that it can be deployed across various environments and, eventually, hosting services. By utilizing containerization technologies, the application shall be easily migrated regardless of the underlying infrastructure.

Decide if and where to put these...

- The system shall be resilient to intermittent network disruptions, ensuring appropriate error handling and user notifications when connectivity issues arise.
- All internal data exchanges shall maintain data integrity and consistency across the system.

4 | Formal Analysis Using Alloy

5 | Effort Spent

Group Member	Effort Spent in each Section	
Riccardo Piantoni	Introduction	3.5h
	Overall Description	1.5h
	Specific Requirements	6h
	Formal Analysis	0h
	Reasoning	6h
Matteo Rossi	Introduction	3.5h
	Overall Description	6.5h
	Specific Requirements	5h
	Formal Analysis	0h
	Reasoning	5.5h
Jacopo Sacramone	Introduction	3.5h
	Overall Description	5.5h
	Specific Requirements	3.5h
	Formal Analysis	0h
	Reasoning	5h

Table 5.1: Effort spent by each member of the group.

6 References

6.1. References

6.2. Used Tools

List of Figures

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