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SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

Students & Companies

RASD Document
Software Engineering 2 Project

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1 | Introduction

1.1. Purpose

As the demand for skilled interns in various industries continues to rise, providing students with relevant internship opportunities is essential for their professional growth. Traditionally, students often struggle to find internships that match their skills, experiences, and career aspirations, while companies face challenges in sourcing qualified candidates. Students&Companies (S&C) aims to bridge this gap by creating a dynamic platform that helps the matching of university students with companies offering internships tailored to their profiles.

S&C provides a unified framework for students to search for internships, allowing them to showcase their CVs and preferences. Companies can advertise their internship opportunities, detailing the required skills, tasks, and benefits offered. The platform employs sophisticated recommendation mechanisms, utilizing keyword searches and statistical analyses to enhance the matching process, thereby ensuring a better fit between students and internships. Furthermore, S&C allows for the tracking of the interview process and provides constructive suggestions for improving project descriptions and CVs. Additionally, it facilitates the management of complaints from universities, enhancing overall communication and collaboration.

The main goals of the platform are the following:

1.1.1. Goals

[G1] Companies should be able to advertise the internships they want to offer

[G2] Students should be able to look for internships

[G3] Students should be able to be informed about internships that can be interesting

[G4] Companies should be able to be informed about the availability of a student's CV that its interesting to them

[G5] Students and Companies should be able to accept a recommendation of a possible match

[G6] Students should be able to apply for an internship. (?)

[G7] Students and Companies should be able to establish contact and participate in an interview

[G8] Companies should be able to finalize the selection.

[G9] Students and Companies should be able to provide feedback and suggestions on the provided recommendations

[G10] Students and companies should be able to receive suggestions regarding how to make their submissions (project descriptions for companies and CVs for students)

[G11] Students and companies should be able to keep track of the matchmaking and internship processes

[G12] Students and Companies should be able to complain and communicate problems

[G13] Universities should be able to monitor internships

[G14] Universities should be able to handle complaints

1.2. Scope

Students & Companies (S&C) is a comprehensive platform designed to facilitate the connection between students seeking internship opportunities and corporations offering such positions. This digital interface allows companies to advertise their available internship roles and receive tailored recommendations pertaining to potential candidates. When a recommendation of a candidate, made by the system, has been accepted by the company, an invitation is sent to the student.

Conversely, students can engage in both proactive and passive searches for internship opportunities. Proactively, they can explore open positions through customized alerts and autonomously apply to them, while passively, they receive notifications from the system when job offers align with their specified criteria.

Once both parties express interest and the student's application has been accepted, the platform facilitates the selection process, assisting companies in conducting interviews and selecting the right candidates. Throughout this process, users can leave comments and suggestions, which the system uses to enhance statistical analysis and provide tips

for improving their appeal.

Additionally, while internships are ongoing, the platform monitors the experience and collects feedback or complaints from both students and companies. In this stage, universities are involved in addressing complaints, handling them and taking action when necessary.

1.2.1. World Phenomena

[WP1] Students prepare their CVs

[WP2] Students want to take part in an internship experience

[WP3] Companies want to employ a student as an intern

[WP4] Companies interview possible candidates

[WP5] Students inform their university about the internship when it's in the course

[WP6] Companies choose the best candidate

1.2.2. Shared Phenomena

World-controllled

[SP] Unregistered users create an account

[SP1] Students upload their CVs

[SP2] Students go through available internships

[SP3] Companies advertise their internship

[SP3] Students accept the recommendation of an internship

[SP4] Companies accept the recommendation of a student

[SP5] Companies use the system to manage interviews

[SP6] Companies use the system to finalize the selections

[SP7] Universities monitor the situation of the internship

[SP8] Universities use the system to handle complaints

[SP9] Students and companies use the system to complain, communicate problems, and provide information about the internship status.

Machine-controllled

[SP10] The system informs students when an interesting internship becomes available

[SP11] The system informs companies when an interesting CV becomes available

[SP12] The system asks students and companies to provide feedback and suggestion

[SP13] The system provides suggestions both to companies and students on how to make submissions

[SP14] The system provides a mechanism to monitor the process and internship (? forse è già nel world controlled questa è solo una ripetizione al contrario)

1.3. Definitions, Acronymous, Abbreviations

Abbreviation	Description
RASD	Requirements Analysis & Specification Document
G*	Goal
WP*	World phenomena
SP*	Shared phenomena
D*	Domain assumption
R*	Functional requirement
UC*	Use case
S&C	Students & Companies
ST	Students
COM	Companies
UML	Unified Modelling Language
UI	User Interface

Table 1.1: List of Definitions, Acronymous, and Abbreviations

1.4. Revision History

- Version 1.0 (28/11/2024)

1.5. Reference Documents

The document is based on the following materials:

- IEEE Standard Documentation For RASD
- The specification of the RASD and DD assignment of the Software Engineering II course a.a. 2024/25
- Slides of the course on WeBeep

1.6. Document Structure

1. **Introduction**: it aims to give a brief description of the project. In particular, it's focused on the reasons and the goals that are going to be achieved with its development;
2. **Overall Description**: it is a high-level description of how the system works with a detailed explanation of the phenomena that involve the world, the machine, or both, there is also the domain description with its assumptions;
3. **Specific Requirements**: in this section, there is a detailed analysis of the requirements needed to achieve the goals. Moreover, it contains more information useful for developers (i.e constraints about HW and SW);
4. **Formal analysis**: it's a formal description of the world phenomena using Alloy;
5. **Effort spent**: it shows the time spent to realize this document organized by section;
6. **References**: it contains the references to any documents and software used to write this paper.

2 | Overall Description

This section is devoted to give an overall description of every part of the system.

2.1. Product Perspective

2.1.1. Scenarios

1. **A student creates an account**

   Mario Rossi, a university student eager to participate in an internship, is unsure of how to directly contact companies.

   After learning about Students&Companies, he decides to explore the platform and create an account. Searching for the site in his browser, Mario arrives at a login page, where he sees an option to create a new account if he is not yet registered. He clicks on this option and follows the account creation steps: entering his email, first name, last name, and date of birth.

   Upon completing these basic details, Mario is presented with additional options to enhance his profile, such as uploading a CV and adding a brief personal description. However, he decides to skip this step for now, intending to add these details later, as he is currently focused on just exploring what the platform looks like.

2. **A student uploads their CV**

   After exploring the site and deciding he would like to be contacted by companies, Mario decides it's time to enhance his profile by uploading his CV. To do this, he follows a series of steps:

   First, Mario clicks on his profile to access his personal information. Within his profile, he finds a button labeled *"Add your CV"* and selects it. This action opens his computer's file browser, where he locates his CV and clicks *"Upload."*

   Once the file is uploaded, Mario clicks *"Publish"*, making his CV visible to anyone who views his profile.

This update is also noted by the platform, which analyzes the information within his CV. Based on this analysis, the platform notifies relevant companies who may be searching for profiles similar to Mario's, informing them of the availability of a new candidate.

3. **A company advertizes their internship**

   TechSolutions, a company seeking interns for a new project, is already familiar with Students&Companies and has an active account on the platform.

   To advertise their open internship position, they navigate to their company profile and select the *"Add a new project description"* button. This opens a page where they write a detailed description of the job responsibilities and the type of student profile they are seeking.

   Once they have completed the description, they click *"Publish"*, making the internship opportunity visible to all visitors to their profile.

   The platform then analyzes this new project listing and notifies students whose profiles match the requirements for the position.

   Additionally, students visiting the profile will now be able to click an *"Apply"* button next to the project description to submit their applications directly, even if they have not received a notification from the system.

4. **A student accepts a recomendation**

   Mario, a student with a profile and CV on Students&Companies, receives a recommendation email from the platform and a message directly on the site, notifying him of an internship opportunity at a company, TechSolutions, that aligns with his interests.

   In this email, Mario clicks on a *"See Recommendation"* button, which redirects him to his profile. There, he finds a new message containing a link to the company's account.

   Mario reviews the company's profile and examines the project that the platform has recommended to him. If he finds it appealing, he can return to the message on his profile and click the *"Accept Recommendation"* button.

   This action is then flagged by the system to the company, allowing them to contact Mario directly through the platform to coordinate the next steps in the selection process.

5. **A company uses the system to manage the interview**

   TechSolutions has established contact with Mario Rossi, a student, via Students&Companies and begins the preselection process using the tools provided by the platform.

   The first step involves setting up a structured questionnaire through Microsoft Forms, featuring predefined questions designed to help TechSolutions better understand Mario's interests, skills, and overall suitability for the role.

   Mario completed the questionnaire, and TechSolutions was pleased with his responses. Based on his answers, they decided to move forward with the next stage of the interview process. (Had they found his responses unsatisfactory, they would have notified Mario that he was no longer being considered.)

   TechSolutions then initiates a direct chat with Mario to arrange an interview. The interview can be conducted in person if Mario is able to travel, or via video call if travel is not possible.

   During the interview, the company takes advantage of additional tools offered by Students&Companies, such as a shared digital whiteboard for collaborative problem-solving, real-time file and document sharing, and access to preloaded questions or skills assessments available within the system. These tools facilitate a more interactive and efficient interview experience, and TechSolutions is pleased with the outcome.

6. **A company uses the system to finalize the selection** TechSolutions, a company using the Students&Companies (S&C) platform, recently completed its selection process for an internship position. Four candidates were interviewed for the role: Mario Rossi, Giulia Verdi, Marco Blu, and Martina Azzurri.

   Throughout the process, each candidate was evaluated based on detailed scoring provided by the company, assessing both technical and behavioral competencies during various stages of the interview. After reviewing the results, TechSolutions considered whether to focus on specialized skills demonstrated during specific tasks or overall performance.

   Ultimately, Mario Rossi emerged as the ideal candidate. He excelled in the technical exercises while also embodying the company's core values, making him the perfect fit for the internship.

   Following the decision, TechSolutions initiated the formal internship agreement with Mario. The other candidates were notified of their rejection, in line with the com-

pany's policy of providing personalized feedback: Giulia Verdi was informed that her time management skills needed improvement, while Marco Blu and Martina Azzurri were advised that while they were strong candidates, the role was awarded to someone with a more specialized technical background. By using the S&C platform, TechSolutions successfully concluded its hiring process while maintaining transparency and professionalism, ensuring all candidates received constructive feedback to support their future endeavors.

7. **Students are asked to provide feedback and suggestions after an internship**

   Mario is a student who has participated in an internship found through Students&Companies. After completing the internship he receives both an email and a message on Students&Companies.

   The message reads:

   "Subject: Feedback Request on Your Internship Experience with TechSolutions

   Dear Mario,

   We would like to thank you for your participation in the internship with TechSolutions through Students&Companies. We hope you had a valuable experience and have gained new skills during your time with the company.

   In an effort to continuously improve our platform and the internship process, we would greatly appreciate your feedback. Please take a few moments to fill out a brief form where you can share your thoughts, suggestions, and any areas for improvement. Simply follow this link to access the form: [link].

   Your feedback is essential in helping us refine our services and support both students and companies more effectively.

   Thank you once again for your time and for being a part of Students&Companies.

   Best regards,

   The Students&Companies Team"

   Mario wishes to provide feedback, so he clicks on the link in the message and fills out the form with his insights.

8. **Companies recieve a suggestion on how to make their project description more appealing**

TechSolutions, a company with an active account on Students&Companies, has published a project description for an internship position they are looking to fill with a student. After the description is published on their profile, a button remains visible next to it, allowing the company to modify the description at any time.

A few days later, the company notices that they are not receiving many applications. The system, analyzing the lack of responses, sends both a message and an email to the company with helpful tips and suggestions to improve the visibility and appeal of their internship listing. The system provides specific feedback on their project description, pointing out what may be missing and offering recommendations on how to make it more engaging for students.

Upon reviewing the message and suggestions, TechSolutions chooses to update and modify their project description to enhance its appeal and attract more applicants.

9. **A student makes a complaint**

   Mario Rossi has been interning at TechSolutions for one month, working in a department focused on developing an interactive application for a gym. He joined the internship hoping to gain practical experience and explore his future career interests.

   However, Mario's experience has fallen far short of his expectations. Since his arrival, the department's supervisor has largely ignored him, assigning only menial tasks such as fetching coffee, operating the copy machine, and sending emails. Frustrated and disappointed, Mario feels the internship has failed to provide the meaningful learning opportunities he was promised.

   Determined to address the issue, Mario logs into the Students&Companies (S&C) platform and navigates to the page for monitoring his current internship. Using the formal complaint feature, he submits a detailed report about his dissatisfaction with the experience. In his complaint, Mario includes the official task schedule provided by the company and explains how the assigned duties have not aligned with his expectations or the internship's advertised role.

   This formal complaint will now be reviewed by the appropriate parties, initiating a process to address Mario's concerns and improve the situation.

10. **A university monitors the situation of an internship** Mario Rossi, a student at Politecnico di Milano, has been participating in an internship at TechSolutions for two months.

    Monica Marrone, a member of the HR department at Politecnico di Milano, is

responsible for overseeing the progress of students' internships. To carry out her duties, she logs into the Students&Companies (S&C) platform using the university's account, which grants her access to detailed information about students' ongoing experiences.

Focusing on Mario's journey, Monica reviews his internship data through the platform. She notes that Mario has consistently met his required working hours and reads glowing reviews from TechSolutions, highlighting him as a hardworking, open-minded individual who reliably meets deadlines.

In addition, Monica reviews Mario's feedback about the company. He shares that TechSolutions provided a warm and supportive onboarding experience, equipping him with learning materials and guidance right from the start. They also engaged him in meaningful projects, rather than relegating him to passive observation, which has greatly enriched his learning experience.

Satisfied with what she has learned about Mario's positive progress and the supportive environment at TechSolutions, Monica plans to check back in two weeks to monitor any updates or changes in the internship.

11. **A university handles a complaint** Mario Rossi has been interning at TechSolutions for three months, but his behavior has caused significant issues for the company. He has repeatedly failed to show up for work without prior notice, missed important deadlines, and even left a negative impression on one of the company's largest clients, resulting in disruptions for his technical department.

    As a result, TechSolutions submitted a detailed complaint through the Students&Companies (S&C) platform. In their report, they outlined specific concerns about Mario's behavior, including missed schedules, unmet deadlines, and the broader impact on their operations.

    Monica Marrone, who works in HR at Politecnico di Milano, the university where Mario is enrolled, received a notification about the complaint. She accessed Mario's internship monitoring page via the S&C platform and reviewed the formal document submitted by TechSolutions. After reading the complaint, Monica decided to follow up directly with the company to gather more details.

    Following her conversation with TechSolutions, Monica contacted Mario through his institutional email and summoned him to the HR office. After evaluating the situation, the university decided to terminate Mario's internship with immediate effect. Furthermore, this incident was recorded on Mario's institutional and S&C

accounts as a negative performance he held.

12. **A Student proactively search for an internship and apply** Mario Rossi, a new user of the Students&Companies (S&C) platform, decides to explore internship opportunities one afternoon. While browsing the available positions, in the gloabal browser page of the application, he discovers two that align with his interests: one at TechSolutions and another at InnovativeAI. Both internships focus on areas he is passionate about—IoT app design and neural network training.

    To carefully evaluate his options, Mario saves both advertisements to his favorites, giving himself time to consider which opportunity suits him best.

    After reflecting for a few days, Mario decides that TechSolutions aligns more closely with his personal values and professional goals. Confident in his choice, he uses the platform's dedicated application function to submit his interest in the TechSolutions internship.

    TechSolutions, in turn, receives a notification on their S&C account, along with Mario's full application and accompanying documents, ready to review and take the next steps in the selection process.

13. **A company accepts a recommendation of a student** TechSolutions recently posted an internship advertisement on the Students&Companies (S&C) platform for a research project focused on genetically inherited diseases. The project aims to develop high-performance computational solutions to identify genetic patterns in DNA efficiently.

    The S&C platform's recommendation system identifies two potential candidates for the role and notifies TechSolutions:

    - Mario Rossi, a Computer Science Engineer with a strong interest in biotechnological research.
    - Giulia Blu, a Biotechnical Engineer with a keen interest in computer science.

    Along with the recommendations, the platform provides the candidates' CVs and supporting documents for review. After evaluating the profiles, TechSolutions determines that Mario's background and interests make him an excellent fit for their internship. Using the platform's dedicated recommendation page, they formally invite Mario to apply for the position, signaling their acceptance of the system's suggestion.

    The following day, Mario logs into the platform and sees the invitation from Tech-

Solutions. If he is interested, he can proceed by submitting a formal application to the internship using the appropriate function..

14. **A student recieves a suggestion on how to make his cv more appealing and modifies his cv after**

    Mario Rossi created an account on the Students&Companies (S&C) platform two months ago. During this time, he applied to five different internship positions but was rejected each time. The rejections were largely due to shortcomings in how he composed his CV.

    In his CV, Mario only mentioned the name of his degree program, omitting critical details such as the technical skills he had acquired during his studies, the programming languages he knew, and the technologies or software he could use. This lack of information not only discouraged companies from considering his applications but also prevented the S&C system from accurately matching his profile with internship opportunities during the recommendation process.

    While attempting to generate recommendations for Mario, the system flagged the absence of key technical competencies in his CV. In response, the platform automatically created a suggestion to help him improve.

    Mario received a notification advising him to revise his CV by adding specific details about his technical skills. The suggestion emphasized that including such information would significantly enhance his chances of securing an internship.

    Taking the advice, Mario updated his CV to include his technical skills, programming expertise, and familiarity with various technologies and updated his profile loading this new version of his CV. Shortly after, one of his applications was accepted by TechSolutions, who invited him to an interview for an open internship position.

15. **A student/company provides feedback about the recomendation process**

    Mario Rossi, a Computer Science Engineer with a strong interest in the biological field, is an active user of the Students&Companies (S&C) platform. Recently, the platform sent him a recommendation for an internship at TechSolutions, a tech company offering a position to help program a website for a new restaurant.

    Mario was disappointed by the recommendation. His professional interests are focused exclusively on projects related to the biomedical field, and he felt that the suggested position did not align with his career goals or expertise.

After Mario declined the recommendation, the system prompted him to provide feedback on why he found the match unsuitable. Through the platform's feedback form, Mario explained that the suggested internship did not meet his expectations, as it was unrelated to his primary interest in biomedical applications.

By submitting this detailed feedback, Mario contributed valuable information to the platform's statistical analysis tools, helping to refine its recommendation algorithms and improve the accuracy of future matches for both himself and other users.

2.1.2. Class diagram

a

2.1.3. State diagrams

We will include some state diagrams to model the states of different objects, and the transitions between these states based on events and conditions; we chose a few examples that we illustrate below.

1. **Recomendation process**

   Entity Modeled: A recommendation generated by the platform (either for a student or a company)

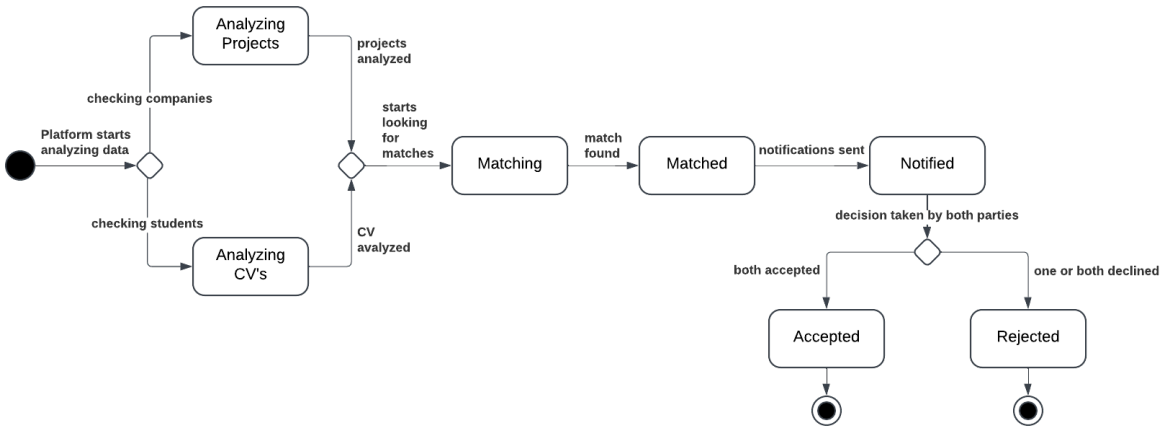

Figure 2.1

2. **Student's application**

   In this diagram, the student's internship application is the entity. We track the different states the application goes through as it moves from one stage to another

in the selection process.

(da rivedere perche non è un vero e proprio oggetto che cambia stato nel tempo)

The selection process begins once both the student and the company have accepted the recommendation, and contact has been established. Initially, the company uses tools provided by S&C to evaluate the candidate, such as sending a structured questionnaire. The student responds to the questionnaire, and if the company is satisfied with the answers, they proceed to schedule an interview. Both parties agree on a time and place for the interview, which then takes place. After the interview, the company makes a final decision on whether to offer the position to the student and communicates their choice to them.

3. **Interview process**

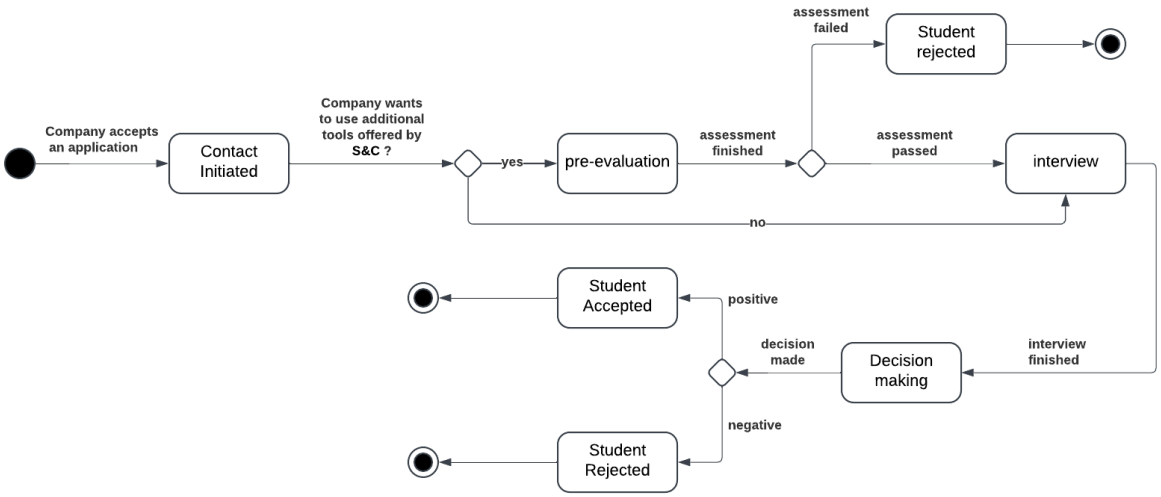

Figure 2.2

4. **CV suggestion**

The main entity here is the student's CV, which goes through different states based on the system's analysis.

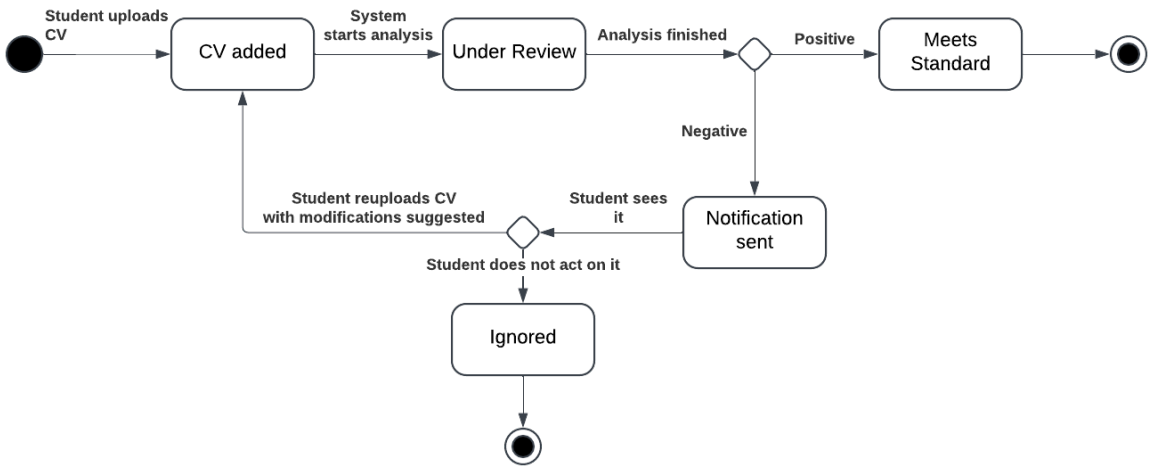

Figure 2.3

5. **University handlling complaints** The entity modeled is a complaint submitted by a student or company. The complaint goes through the following states:

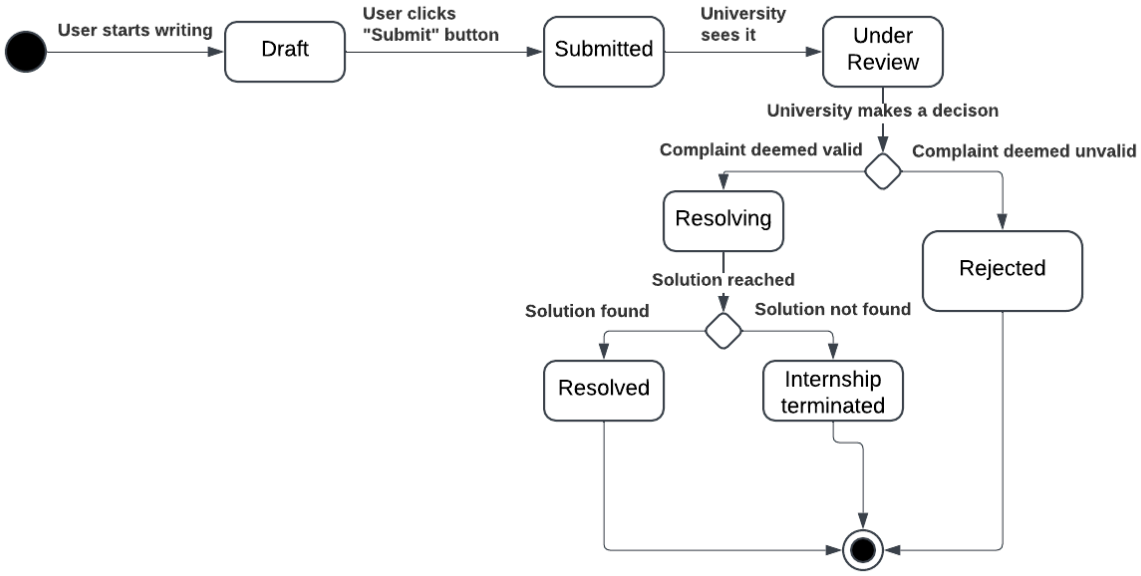

Figure 2.4

6. **Feedback collection process**

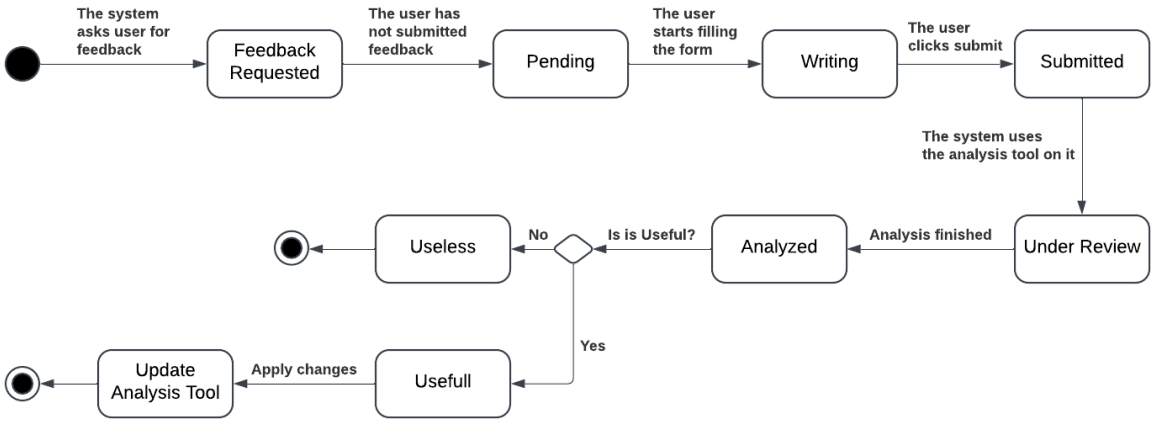

Figure 2.5

2.2. Product Functions

Here we will include the most important categories of use cases, so the main functions that the system should provide to its users (cose che fa il sistema)

-> dodici diagrammi da fare non sono un po' tanti????

1. **Account creation and User login**
2. **Internship posting**
3. **CV analysis**
4. **Project description analysis**
5. **Recomendation system and statistical analysis**

   One of the key features of Students&Companies is its recommendation system, which acts like a career matching service by connecting students with suitable internship opportunities and informing companies of potential candidates. This system operates through advanced statistical analysis methods, implementing a recommender system that uses data-driven algorithms within its system to optimize the matching process, making it easier for students and companies to connect over mutually beneficial opportunities. (? troppo specifico?)
6. **Interview and Selection management**
7. **Feedback collection and analysis**
8. **Complaint collection**

9. **Internship evolution monitoring**
10. **Complaints handling**

2.3. User charatteristic

There are three types of registered users in S&C: Students (STs) and Companies (COMs) and Universities (UNs). Each user type has distinct characteristics and roles within the platform:

- **STs**: Students use S&C to find a company offering internships. To access the platform, they must have a device with an internet connection and an account that includes their email and personal data. Once registered, students can browse available internships, apply for them, and participate in interviews with companies
- **COMs**: Companies join S&C to find students suitable for internships. To use the platform, they need a device with an internet connection and an account that includes their email and company information. Through S&C, companies can view student applications, schedule interviews, and select candidates for internships.
- **UNs**: Universities that allow their students to use the Students&Companies (S&C) platform to find internships are provided with a dedicated institutional account. This account is typically managed by the university's HR department or an equivalent administrative body. The HR department uses the account to periodically monitor the progress of internships involving their enrolled students. Through the platform, universities have access to comprehensive reports on the status of ongoing internships, including performance evaluations, feedback, and complaints submitted by either the students or the hosting companies.

Both STs and COMs must register with the platform to access its services, enabling seamless communication between students seeking internships and companies offering opportunities.

2.4. Assumptions, dependencies, constraints

[DA1] Students and companies need to have a device and an internet connection (?)

[DA2] Companies need to have detailed internship descriptions

[DA3] Students need to have a CV

[DA4] Students need to be enrolled at a university

[DA5] Students need to create an account on S&C as students.

[DA6] Companies need to create an account on S&C as Companies.

[DA7] Universities need to create an account on S&C as Universities.

[DA8] Companies need to be able to conduct an interview

[DA9] Companies need to be able to evaluate an interview

[DA10] Universities need to be informed about a current student's internship

[DA11] Universities need to be able to communicate with Students and Companies

3 | Specific Requirements

This section provides a detailed description of the various types of requirements the system must address to achieve all the functionalities outlined. These requirements are essential to ensure the platform operates efficiently, and securely meeting users needs.

3.1. External Interface Requirements

3.1.1. User Interfaces

The Students&Companies (S&C) user interface will be a web app developed to be used by both STs and COMs. It will be accessible to anyone with a device equipped with an internet browser and a reliable internet connection. The platform will provide an intuitive and user-friendly experience, ensuring that users can easily navigate and access its features regardless of their device or operating system.

3.1.2. Hardware Interfaces

The system will be accessible from every device with an Internet Browser to access the website and a reliable Internet connection. The User is free to choose his device like a computer, a tablet, or a smartphone.

The system will be accessible from any device with an internet browser and a reliable internet connection. Users can choose their preferred device, whether it is a computer, tablet, or smartphone. This ensures flexibility and convenience, allowing users to access the platform from anywhere and at any time.

3.1.3. Software Interfaces

The system requires an API to facilitate email sending. These emails can include, for instance, 2FA (two-factor authentication) confirmations or general notifications. This functionality is essential to ensure secure user authentication and to keep users informed about important updates and communications through email.

3.1.4. Communication Interfaces

The communication interfaces needed by the system are the HTTPS (Hypertext Transfer Protocol Secure) protocol and the Mail System Transfer Protocol (SMTP).

- **HTTPS** will be used to ensure secure communication between the client and the server, protecting data integrity and confidentiality during transactions such as login, registration, and other sensitive operations.
- **SMTP** will be used for sending emails, enabling the system to handle tasks such as sending account 2FA confirmations, notifications, and other user-related communications efficiently and securely.

3.2. Functional Requirements

[R1] The system allows unregistered users to create an account

[R2] The system allows students to upload their CV

[R3] The system allows companies to publish new internships

[R4] The system allows companies to add a description to their internships

[R5] When students want to do a proactive research, the system allows them to go through the available internships

[R6] When doing a search the system allows users to filter internships by a key (?)

[R7] When finding an internship that suits their interests, the system allows students to apply for it.

[R8] When a new internship that might interest some students becomes avaible, the system notifies them.

[R9] When a student's CV that corresponds to a company's needs becomes available the system informs them.

[R10] The system allows students to accept a recommendation, applying for that particular internship.

[R11] The system allows companies to accept a recommendation, inviting the candidate that was proposed.

[R12] The system allows students to accept an invitation of a company for a particular internship, applying for it.

[R13] When the two parties have accepted a recommendation, or when the company has accepted an application received, the system allows them to establish a contact

[R14] When conducting an interview, the system supports the companies with the interview process

[R15] When conducting an interview, the system supports the companis with the finalization of the selection

[R16] The system allows students and companies to provide feedback and suggestions to feed statistical analysis.

[R17] The system provides suggestions to students regarding how to make their CVs more appealing

[R18] The system provides suggestions to companies regarding how to make their project descriptions more appealing

[R19] During the matchmaking process, the system allows all users to keep track of its execution and outcome

[R20] During the internship the system allows all interested parties to monitor it

[R21] During and ongoing internship, the system allows all users to complain

[R22] During and ongoing internship, the system allows all users to communicate problems

[R23] During and ongoing internship, the system allows all users to provide information on its status

[R24] When reports or complaints about the status of an ongoing internship are made, the system allows Universities to see them.

[R25] When complaints about the status of an ongoing internship are made, the system allows Universities to handle them.

3.2.1. Use case diagrams

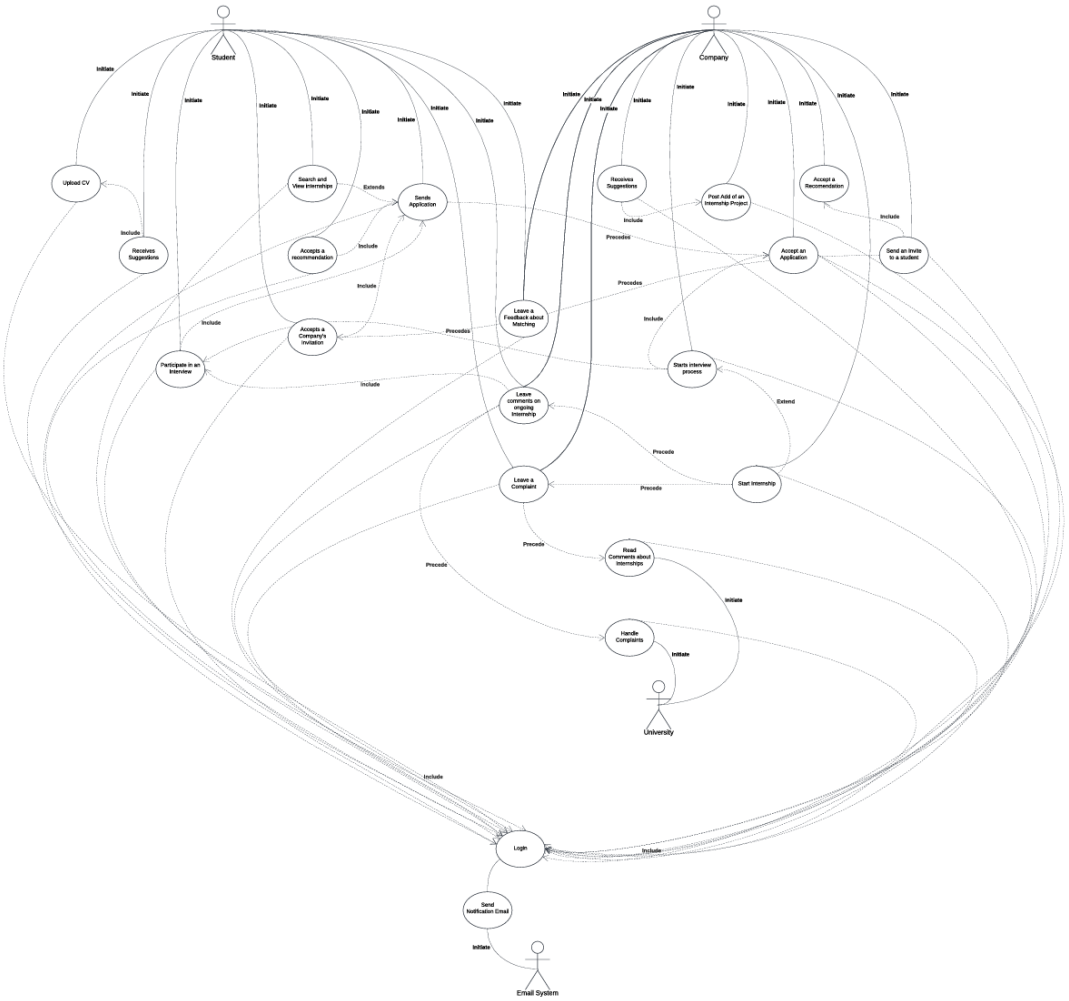

Figure 3.1: Use case diagrams

3.2.2. Use cases

tabella per ogni uc e poi aggiungi i sequence diagrams

- Students create an account
- Companies create an account
- Student searches and applies for an internship
- Student recieves an internship recomendation (accept / decline)
- Company recieves a student's recomendation (invite students + accept)

- Interview Process
- Student receives suggestions on CV
- Company receives suggestions on Add
- User leaves feedback
- User leaves comments on ongoing internship
- University monitors and handles complaints

Come gestiamo i reply messages? mettiamo il ritorno ogni volta che il sistema cambia pagina? (ci vuole la freccia tratteggiata di ritorno ogni volta che facciamo un operazione per segnalare l'azione del sistema in risposta a quell'operazione.)

UC1

Name	Student creates an account
Actor	Student
Entry Condition	• Student has a valid institutional email • Student enters the platform for the first time

Event Flow	1. The student opens the platform 2. The student selects the option of creating a new account 3. The student inserts his personal attributes: institutional email address, legal name, birth date, and location of residence 4. The student clicks the "sign-up" button 5. The student is assigned a valid username related to his legal name 6. The student receives a verification email to validate his identity 7. The student confirms his identity 8. The system creates and activates the account 9. The platform sends to the student a message asking him to upload a CV is they wish to. 10. Is the student chooses to do so he clicks on the message tham brings him to a different page in which he uploads his CV. 11. If he does not wish to do so for now he clicks X on the message.
Exit Condition	The new account is created
Exception	• The student's email address has already been connected to an existing account. In that case, the system returns an error and redirects the student to the login page. • The student's email address is incorrect or not valid. In this case, the system returns an error, and the flow won't continue until the student inserts a valid email address.

UC2

Name	Company creates an account

Actor	Company
Entry Condition	• Company has a valid email • Company enters the platform for the first time
Event Flow	1. The company opens the platform 2. The company selects the option of creating a new account 3. The company inserts their attributes: email address, company name, and location 4. The company clicks the "sign-up" button 5. The system gives the company their name as username. 6. The company receives a verification email to validate their identity 7. The company confirms their identity 8. The system creates and activates the account 9. The platform sends to the company a message asking them to upload project descriptions. 10. The company clicks on the message. 11. The system brings them to a page to upload project descriptions. 12. The company writes and publishes project descriptions
Exit Condition	The new account is created
Exception	• The company's email address has already been connected to an existing account. In that case, the system returns an error and redirects the company to the login page. • The company's email address is incorrect or not valid. In this case, the system returns an error, and the flow won't continue until the student inserts a valid email address.

UC

Name	Student searchs and applies for an internship
Actor	Student
Entry Condition	The student is correctly logged in and has decided he wants to look for an internship. He is on the home page of S&C.
Event Flow	• The student clicks on "Available internships" button. • S&C gives him the correct page. • The student scrolls and reads the list available internships. • If the student finds an internship that interests him, he clicks on its title. • S&C opens the project description of that internship. • The student reads the description. • If the student is still interested he clicks on the apply button. • S&C sends the application and the student's profile to the company associated to that internship. • If the student after reading the project description is no longer intersted, he goes back to the previous page by clicking on an arrow button. • S&C shows him the correct page. • if the student does not find any interesting projects he closes the browser.
Exit Codition	The application is sent and a confirmation message is shown to the student, or the student exits the system.
Exception	

UC

Name	Student recieves an internship recomendation
Actor	Student
Entry Condition	The student has a valid email account and is able to log into the system. The student has uploaded a CV on his profile.

Event Flow	• S&C finds a match between a student and a company. • S&C sends an email to the student with the recomendation. • The student recieves an email stating he has a new recomendation. • The student clicks on the button "Go to recomendation". • S&C opens his profile page with the recomendation message. • The student reads the project description of the internship recomended, if he is happy with it he clicks on the apply button. • S&C sends a notification to the company that a student recommended by the system has applied. • If the student is unhappy with the recomendation he clicks on the button "reject recomendation". • S&C removes the match from the system • S&C notifies the company they matched with that the recomendation has been rejected by the student.
Exit Codition	The application is sent and a confirmation message is shown to the student, or the student exits the system.
Exception	• The student does not see the email in time, and when he goes to apply the application window has already closed. • The email fails to send, or the link to the platform is broken.

UC

Name	Company recieves a student's recomendation
Actor	Company

Entry Condition	The company has a valid email account and is able to log into the system. The company has uploaded at least one project description on their profile.

Event Flow	• S&C finds a match between a student and a company. • S&C sends an email to the company with the recomendation. • The company recieves an email stating they have a new recomendation. • A company's employee clicks on the button "Go to recomendation". • S&C opens their profile page with the recomendation message. • The company's employee reads the CV of the student recomended, if they are intrested in the student CV: • If the student has already applied they click on the "accept application" button and begin contact with the client. • S&C sends a notification to the student that a company they sent an application to is requesting to contact them. • If the student has not already applied there is no "accept application" button, so they click on the "request an application" button and initiate contact with the student. • S&C sends a notification to the student that a company is requesting to contact them. • If they are not interested in the student CV: • If the student has already applied they click on the button "reject application" • S&C notifies the student they have been rejected. • Else, they click on the button "reject recomendation". • S&C removes the match from the system. • S&C notifies the student they matched with that the recomendation has been rejected by the company.

Exit Codition	Contact is established or the student recieves a notification of the failed match.
Exception	• The email fails to send, or the link to the platform is broken.

UC

Name	Interview
Actor	
Entry Condition	
Event Flow	
Exit Codition	
Exception	

UC

Name	User leaves feedback
Actor	User
Entry Condition	The user has an valid email account. The user has an account on S&C. The user has partecipated in an internship through S&C.
Event Flow	• The system sends an email to the user asking for feedback on the internship they took part in. • The user sees the email, if they wish to they click on the button leave feedback. • The system redirects them to the platform, in which there is an empty form to fill out with questions about the experience. • The user fills out the questinnaire. • If the user does not want to leave feedback they just ignore the email.
Exit Codition	The system collects and analyzes the feedback, or does not recieve any feedback.

Exception	The email fails to send, or the link to the platform is broken.

UC

Name	Student recieves suggestion on CV
Actor	Student
Entry Condition	The student has an valid email account. The student has an account on S&C. Th estudent has uploaded a CV
Event Flow	• The student recieves an email stating that he has a new suggestion from the system. • The student clicks on the button "see suggestion" • The system redicrects him to the platform, where he sees the complete message. • The student reads the suggestion, if he likes it he goes to his profile and clicks the button "modify CV" • The platform opens a page in which he is able to upload a new CV • The student creates a new CV with the suggestions and reuploads it to the platform. • If the student does not like the recomendations he just ignores the email
Exit Codition	The system has a new CV to analyze or does not have anything new.
Exception	The email fails to send, or the link to the platform is broken.

UC

Name	Company recieves suggestion on project description
Actor	Company
Entry Condition	The company has an valid email account. The company has an account on S&C. The company has uploaded a project description.

Event Flow	• The company recieves an email stating that they have a new suggestion from the system. • The company clicks on the button "see suggestion" • The system redicrects them to the platform, where they see the complete message. • The company reads the suggestion, if they like it they goes to their profile and click the button "modify project description" • The platform opens a page in which they are able to modify their description post. • The company writes a new description following the system's instructions. • If the company does not like the recomendations they just ignore the email.
Exit Codition	The system has a new project description to analyze or does not have anything new.
Exception	The email fails to send, or the link to the platform is broken.

UC0

Name	User makes a complaint
Actor	User
Entry Condition	The user is logged into their S&C account.
Event Flow	• The user goes on their profile page (qui ci va che S&C gli da la pagina?) • The user clicks on the button "leave a comment" (come vogliamo fare? si puo anche fare che c'è una sezione relativa all'internship in corso) • The user writes a comment or a complaint regarding ??
Exit Codition	
Exception	

3.2.3. Mapping

Goal	Requirements and Domain Assumptions
[G1] Companies should be able to advertise the internships they want to offer	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R3]** The system allows companies to publish new internships • **[R4]** The system allows companies to add a description to their internships **Domain Assumptions:** • **[DA1]** Students and companies need to have a device and an internet connection • **[DA2]** Companies need to have detailed internship descriptions • **[DA6]** Companies need to create an account on S&C as Companies.

[G2] Students should be able to look for internships	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R5]** When students want to do a proactive research, the system allows them to go through the available internships • **[R6]** When doing a search the system allows users to filter internships by a key **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G3] Students should be able to be informed about internships that can be interesting	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R8]** When a new internship that might interest some students becomes avaible, the system notifies them **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G4] Companies should be able to be informed about the availability of a student's CV that its interesting to them	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R9]** When a student's CV that corresponds to a company's needs becomes available the system informs them. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G5] Students and Companies should be able to accept a recommendation of a possible match	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R8]** When a new intership that might interest some students becomes avaible, the system notifies them • **[R9]** When a student's CV that corresponds to a company's needs becomes available the system informs them. • **[R10]** The system allows students to accept a recommendation, applying for that particular internship. • **[R11]** The system allows companies to accept a recommendation, inviting the candidate that was proposed. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G6] Students should be able to apply for an internship	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R5]** When students want to do a proactive research, the system allows them to go through the available internships • **[R7]** When finding an internship that suits their interests, the system allows students to apply for it • **[R8]** When a new intership that might interest some students becomes avaible, the system notifies them • **[R10]** The system allows students to accept a recommendation, applying for that particular internship. • **R11]** The system allows companies to accept a recommendation, inviting the candidate that was proposed. • **[R12]** The system allows students to accept an invitation of a company for a particular internship, applying for it. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G7] Students and Companies should be able to establish contact and participate in an interview	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R7]** When finding an internship that suits their interests, the system allows students to apply for it • **[R10]** The system allows students to accept a recommendation, applying for that particular internship. • **R11]** The system allows companies to accept a recommendation, inviting the candidate that was proposed. • **[R12]** The system allows students to accept an invitation of a company for a particular internship, applying for it. • **[R13]** When the two parties have accepted a recommendation, or when the company has accepted an application received, the system allows them to establish a contact • **[R14]** When conducting an interview, the system supports the companies with the interview process **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies. • **[DA8]** Companies need to be able to conduct an interview

[G8] Companies should be able to finalize the selection.	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R7]** When finding an internship that suits their interests, the system allows students to apply for it • **[R10]** The system allows students to accept a recommendation, applying for that particular internship. • **R11]** The system allows companies to accept a recommendation, inviting the candidate that was proposed. • **[R12]** The system allows students to accept an invitation of a company for a particular internship, applying for it. • **[R13]** When the two parties have accepted a recommendation, or when the company has accepted an application received, the system allows them to establish a contact • **[R14]** When conducting an interview, the system supports the companies with the interview process • **[R15]** When conducting an interview, the system supports the companis with the finalization of the selection **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA5]** Companies need an account on S&C • **[DA4]** Students need an account on S&C • **[DA9]** Companies need to be able to evaluate an interview

[G8] Students and Companies should be able to provide feedback and suggestions on the provided recommendations	**Requirements:** • **[R13]** The system allows students and companies to provide feedback and suggestions to feed statistical analysis. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.
[G10] Students and companies should be able to receive suggestions regarding how to make their submissions (project descriptions for companies and CVs for students)	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R17]** The system provides suggestions to students regarding how to make their CVs more appealing • **[R18]** The system provides suggestions to companies regarding how to make their project descriptions more appealing **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G11] Students and companies should be able to keep track of the matchmaking and internship processes	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R2]** The system allows students to upload their CV • **[R3]** The system allows companies to publish new internships • **[R13]** When the two parties have accepted a recommendation, or when the company has accepted an application received, the system allows them to establish a contact • **[R19]** During the matchmaking process, the system allows all users to keep track of its execution and outcome • **[R20]** During the internship the system allows all interested parties to monitor it **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G12] Students and Companies should be able to complain and communicate problems	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R21]** During and ongoing internship, the system allows all users to complain • **[R22]** During and ongoing internship, the system allows all users to communicate problems • **[R23]** During and ongoing internship, the system allows all users to provide information on its status **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies.

[G13] Universities should be able to monitor internships	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R21]** During and ongoing internship, the system allows all users to complain • **[R22]** During and ongoing internship, the system allows all users to communicate problems • **[R23]** During and ongoing internship, the system allows all users to provide information on its status • **[R24]** When reports or complaints about the status of an ongoing internship are made, the system allows Universities to see them. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies. • **[DA7]** Universities need to create an account on S&C as Universities • **[DA10]** Universities need to be informed about a current student's internship

[G14] Universities should be able to handle complaints	**Requirements:** • **[R1]** The system allows unregistered users to create an account • **[R21]** During and ongoing internship, the system allows all users to complain • **[R22]** During and ongoing internship, the system allows all users to communicate problems • **[R23]** During and ongoing internship, the system allows all users to provide information on its status • **[R24]** When reports or complaints about the status of an ongoing internship are made, the system allows Universities to see them. • **[R25]** When complaints about the status of an ongoing internship are made, the system allows Universities to handle them. **Domain Assumptions:** • **[DA1]** Students and companies need a device and internet connection • **[DA3]** Students need to have a CV • **[DA4]** Students need to be enrolled at a university • **[DA5]** Students need to create an account on S&C as students. • **[DA6]** Companies need to create an account on S&C as Companies. • **[DA7]** Universities need to create an account on S&C as Universities • **[DA10]** Universities need to be informed about a current student's internshi • **[DA11]** Universities need to be able to communicate with Students and Companies

3.3. Performance Requirements

- **Number of concurrent Users**: According to recent research, websites with similar goals as S&C have approximately 1.8 million users. Our target is to attract at least 25% of this user base, which means that S&C should be capable of handling up to 500,000 concurrent users. This is crucial to ensure the platform operates efficiently and provides a seamless, enjoyable experience for a substantial number of users.
- **Data storage**: The S&C platform needs to store and manage extensive data related to both STs and COMs. Additionally, it must handle data pertaining to interviews, complaints, issues, data analytics, and other critical information. This requires robust data storage solutions that ensure data integrity, security, and scalability.
- **Time response**: All operations directly executed by S&C, such as user registration, login, file upload, and evaluation, should have response times within the range of milliseconds. This quick response time is essential to deliver a smooth user experience and maintain user satisfaction.

3.4. Design Constraints

3.4.1. Standards Compliance

The S&C platform is designed to strictly follow several standards to ensure quality, security, and interoperability.

- **HTTPS Protocol**: The platform implements the HTTPS protocol according to the cryptographic standards established by the Internet Engineering Task Force (IETF), ensuring secure communication between users and the platform.
- **Accessibility Stand**: S&C complies with the Web Content Accessibility Guidelines (WCAG) to ensure that the platform is accessible to all users, including those with disabilities.
- **Security Standards**: The platform follows security best practices as defined by OWASP (Open Web Application Security Project) and NIST (National Institute of Standards and Technology). This includes password storage encryption using HASH512 + Salt, SSL certificates, and end-to-end communication encryption to protect user data.
- **API Standard**: The platform uses open standards for API design, such as RESTful APIs, and adheres to specifications like OpenAPI (Swagger) to ensure smooth

integration with other systems.

- **Coding Standards**: S&C follows universally accepted coding guidelines for the primary programming languages used in system development (e.g., Python, Java). This includes adherence to coding conventions such as PEP 8 for Python and Java Coding Conventions for Java.
- **Compliance and Privacy**: The platform complies with privacy regulations such as the General Data Protection Regulation (GDPR) for European citizens, ensuring the protection of user privacy and data rights.

3.4.2. Hardware Limitations

To access the S&C platform, both students and companies must have an electronic device, such as a computer, tablet, or smartphone, with a reliable internet connection.

- **STs**: Students need a device that allows them to access the platform, upload applications, attend interviews, and perform other required activities. They must also have the ability to upload and download files, such as resumes or application documents.
- **COMs**: Companies also need a device with internet access to view applications, schedule interviews, and manage internship postings.

Both types of users must have devices that enable them to receive notifications from the platform, ensuring they stay informed about important updates and actions required. The devices should be able to support modern web browsers to access the S&C platform effectively.

3.5. Software System Attributes

3.5.1. Reliability

The S&C platform does not manage critical operations. If an operation fails, it can be re-executed without any significant consequences. For example, if the curriculum upload fails, students can simply re-upload it without any issues. Given this non-critical nature, it is reasonable to permit a failure rate of around 1%, as it does not adversely impact the overall user experience or platform functionality.

3.5.2. Availability

The S&C platform should have high availability, aiming for 24/7 uptime. This is essential to provide continuous access to users without unexpected interruptions, ensuring they can reliably access services whenever needed.

To achieve this, techniques such as load balancing to distribute traffic evenly, failover systems to switch to backup resources during outages, and regular data backups to protect against data loss should be implemented. These measures help maintain seamless operation and ensure that the platform remains robust and dependable at all times.

3.5.3. Securuty

Communication between the user and the S&C platform is encrypted to avoid data breaches, and unauthorized access, and to ensure the confidentiality and integrity of information shared on the platform.

Furthermore, users must only be able to perform operations that they are authorized to do. For example, a student must not be able to publish an internship, as this function should be restricted to users with specific permissions, such as platform administrators or authorized representatives. Proper access controls and role-based permissions must be implemented to ensure that only authorized users can perform specific actions within the platform

3.5.4. Maintainability

The system should be divided into scalable and reusable modules, making it easier to maintain and replace components in case of failure. This modular approach enhances the platform's flexibility and simplifies the process of updating or scaling specific parts without affecting the entire system.

Ordinary maintenance, including bug fixes and improvements, will be scheduled during nighttime hours when user traffic is minimal to minimize disruption and maintain a smooth user experience. This strategy ensures that the system remains reliable and maintainable while supporting continuous service improvements.

3.5.5. Portability

The S&C platform does not require any specific hardware or software and must be accessible from any operating system with a modern web browser. This ensures broad

compatibility and ease of use for all users. Additionally, a mobile application can be developed to allow users to view the state of battles and other platform activities. Since the mobile app does not require any specialized functions, a non-native approach can be used. This makes it feasible to leverage cross-platform development tools, which can accelerate the development process and reduce the resources needed for maintaining separate codebases for different platforms.

4 | Formal Analysis using Alloy

This section provides a formal specification of the entire model using the Alloy language. We will use Alloy 6 to describe entities and relationships in systems. We choose Alloy 6 because is suited for modeling and analyzing the properties of software systems to ensure correctness and consistency.

4.1. Code

```
open util/relation
open util/boolean

//----SIGNATURES----
// User's role: it can be a student or a company
abstract sig Role {}
sig Student extends Role {
        applications: some Application,
        cv: one CV
}
sig CV{}
sig Company extends Role {
        postings: some Internship
}

// Users' personal information
sig User {
        email: one Email,
        otherInformation: one PersonalData,
        role: one Role
}
sig Email{}
sig PersonalData{}

```

```
25 // Internship
26 sig Internship {
27         postedBy: one Company,
28         applicants: some Application,
29         description: one Description,
30 }
31 sig Description{}
32
33 // Application for an internship
34 sig Application {
35         submittedBy: one Student,
36         relatedTo: one Internship,
37         interviews: one Interview,
38         var status:  Status
39 }
40 enum Status {Pending, Accepted, Rejected}
41
42 // Interview
43 sig Interview {
44         schedule: one DateTime,
45         var outcome:  Outcome
46 }
47 enum Outcome {Passed, Failed, InProgress}
48 sig DateTime{}
49
50 //----FACTS----
51 // No two Users can have the same email or personal info
52 fact UniqueUsersEmailsAndPersonalInfo {
53         all u1, u2: User | u1 != u2 implies
54                 u1.email != u2.email and
55                 u1.otherInformation != u2.otherInformation
56 }
57
58 // A role can only be associated with one User
59 fact OneUserPerStudentAndCompany{
60         all s: Student | one u: User |
61                 s in u.role
62         and
63         all c: Company |  one u: User |
```

```
64                  c in u.role
65  }
66
67  //DoubleArrowConstraint
68  fact DoubleAssociation {
69          //An application can only be associated with a student
70          all a: Application | one s: Student |
71                  s in a.submittedBy and
72                  a in s.applications and
73                  s.applications.submittedBy=s
74          //An application can only be associated with a Intenship
75          all a: Application | one i: Internship |
76                  a in i.applicants and
77                  i in a.relatedTo and
78                  i.applicants.relatedTo = i
79          //An internship can only be associated with a Company
80          all  i:Internship | one c: Company |
81                  c in i.postedBy and
82                  i in c.postings and
83                  c.postings.postedBy = c
84  }
85
86  //Unique Description, CV, and Interview
87  fact UniqueItems {
88          //description
89          all i1, i2: Internship | i1 != i2 implies
90                  i1.description != i2.description
91          all dd: Description | one ii:Internship |
92                  dd in ii.description
93          //CV
94          all s1,s2: Student| s1 != s2 implies
95                  s1.cv != s2.cv
96          all ccvv:CV | one ss: Student |
97                  ccvv in ss.cv
98          //interview
99           all a1,a2: Application | a1!=a2 implies
100                 a1.interviews != a2.interviews
101         all i: Interview | one a: Application |
102                  i in a.interviews
```

```
}

//Unique Application
fact UniqueApplications{
        all i1, i2: Internship | i1 != i2 implies
                #(i1.applicants & i2.applicants) <= 0
        all c1, c2: Company | c1 != c2 implies
                #(c1.postings & c2.postings) <= 0
        all s1,s2: Student | s1 !=s2 implies
                #(s1.applications & s2.applications) <=0
}

// A student can make only an application for one internship
fact UniqueApplicationsPerStudent {
        all s: Student | all i: Internship |
                #(s.applications & i.applicants) <= 1
}

//A role cannot have a mettengs the same day
fact SameDayMeetings {
        all ss1,ss2: Student | all cc1,cc2: Company |
        all a1,a2: Application | a1!=a2 and
                ((ss1 in a1.submittedBy and
                   ss2 in a2.submittedBy and
                   cc1 in a1.relatedTo.postedBy and
                   cc1 in a1.relatedTo.postedBy)
        or
                 (ss1 in a1.submittedBy and
                  ss1 in a2.submittedBy and
                  cc1 in a1.relatedTo.postedBy and
                  cc2 in a1.relatedTo.postedBy))
        implies a1.interviews.schedule != a2.interviews.schedule
}

// Interview process
fact InterviewProess{
        all a: Application |
                always( a.interviews.outcome = InProgress
                        implies a.status = Pending)
```

```
                and always(a.interviews.outcome = Passed
                        implies a.status = Accepted)
                and always(a.interviews.outcome = Failed
                        implies a.status = Rejected)
}
```

4.2. Models

4.2.1. Static Analysis

[MS1] The model shows the basic scenario where one student is applying for an internship at a company with pending status and an in-progress interview.

```
//one student and one company
pred oneStudentOneCompanyOneInternship {
    #Student = 1
    #Company = 1
    #Internship = 1
}
run oneStudentOneCompanyOneInternship for 2
```

#6:Instance found oneStudentOneCompanyOneInternship is consistent.

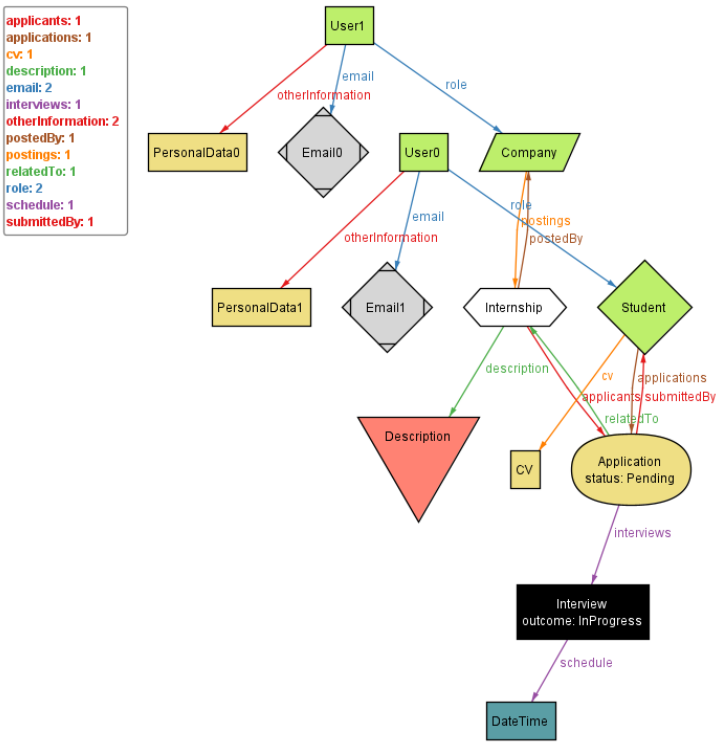

Figure 4.1: 1 Student, 1 Company, 1 Internship

[MS2] The model shows a scenario where two students are applying for an internship at a company with pending status and an in-progress interview.

```
1 //two students and one company
2 pred twoStudentOneCompanyOneInternship {
3     #Student = 2
4     #Company = 1
5     #Internship = 1
6 }
7 run twoStudentOneCompanyOneInternship for 3
```

#7:Instance found twoStudentOneCompanyOneInternship is consistent.

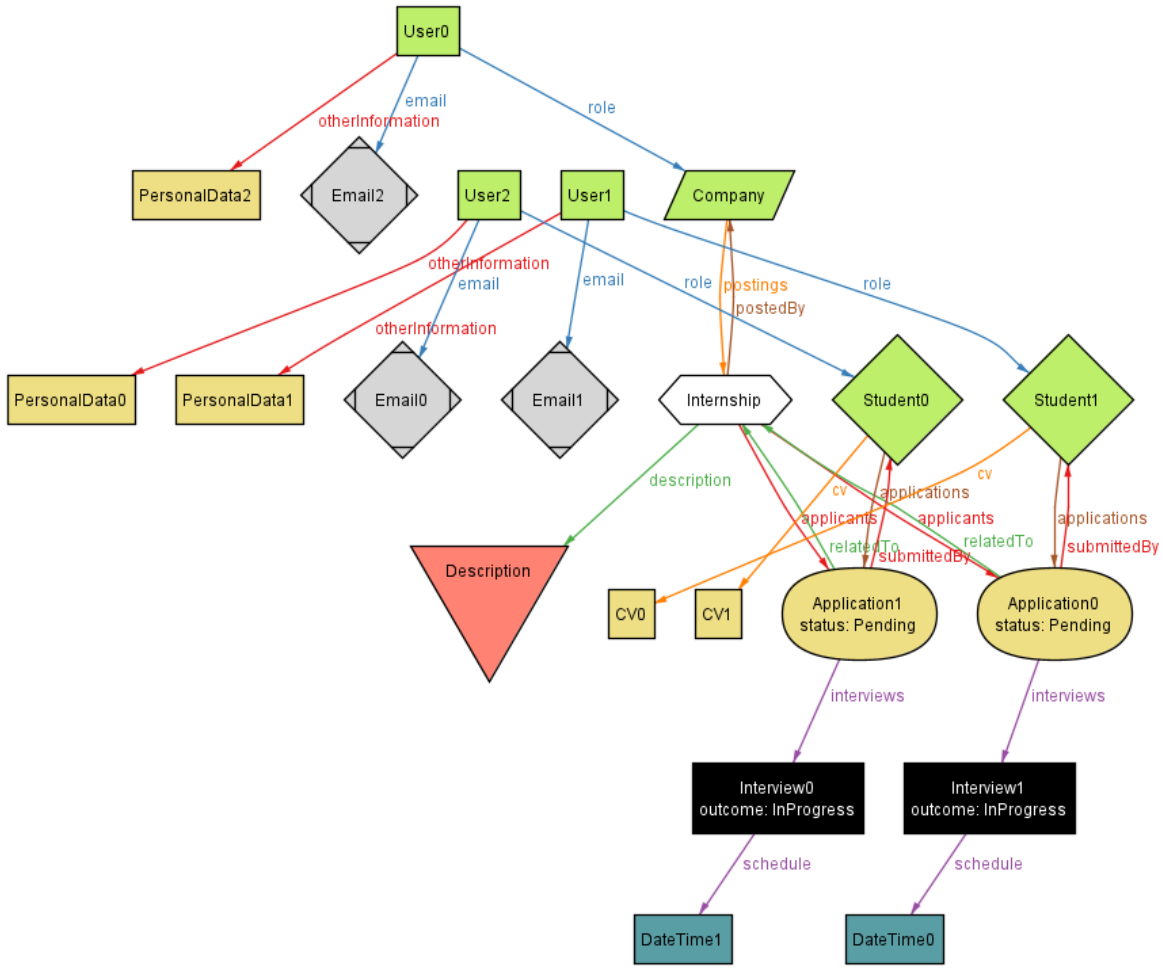

Figure 4.2: 2 Student, 1 Company, 1 Internship

[MS3] The model shows a scenario where one student is applying for three internships 2 at company A and one at company B with pending status and an in-progress interview.

```
1 //one student and one two companies
2 pred oneStudentTwoCompanyThreeInternship {
3     #Student = 1
4     #Company = 2
5     #Internship = 3
6 }
7 run oneStudentTwoCompanyThreeInternship for 3
```

#8:Instance found oneStudentTwoCompanyThreeInternship is consistent.

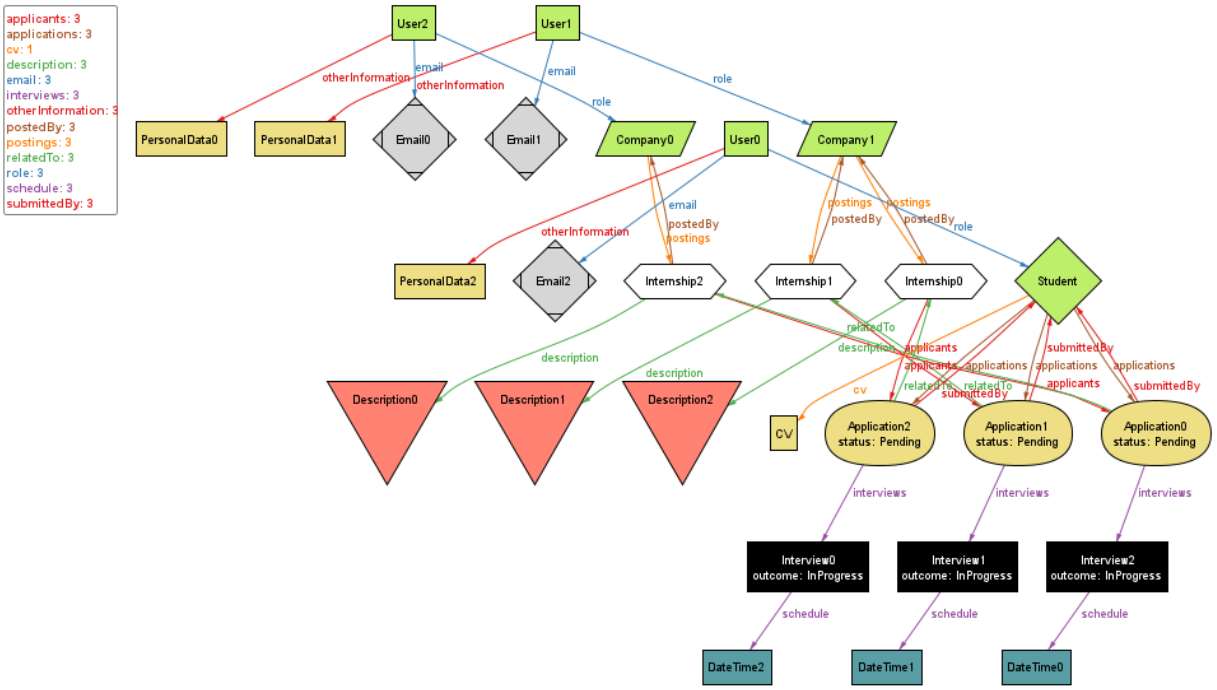

Figure 4.3: 1 Student, 1 Company, 3 Application

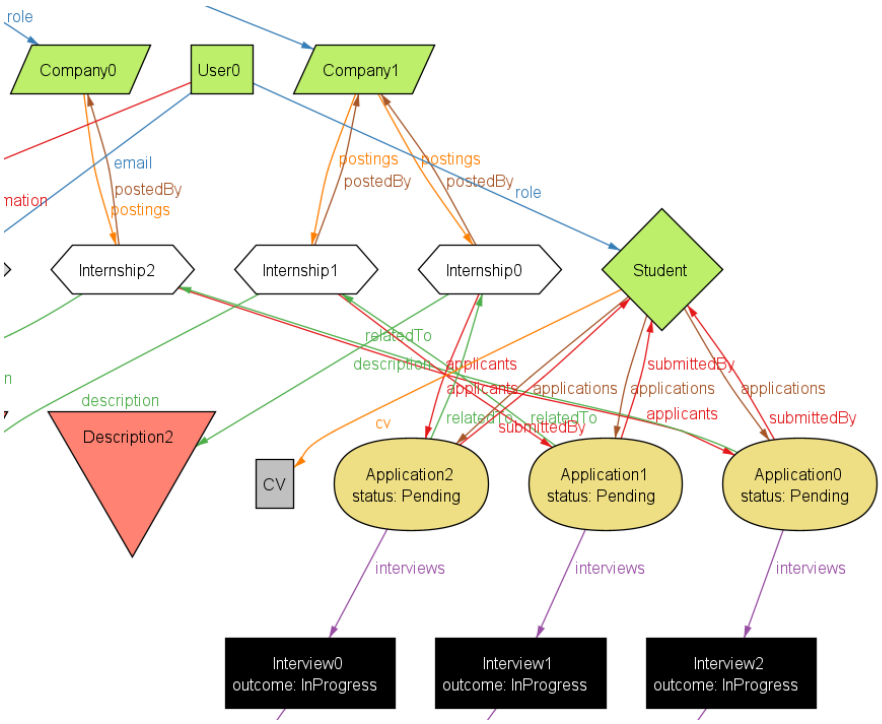

Figure 4.4: 1 Student, 1 Company, 3 Application - zoom on the relations

4.2.2. Dynamic Analysis

[MD1]The model shows the basic scenario where one student applies for an internship at a company. The dynamic analysis shows how the positive interview status influences the application outcome.

If InProgress => Passed then Pending => Accepted

```
//passed interview
pred interviewPassed[ap:Application, s:Student, c:Company]{
        ap.interviews.outcome = InProgress ;
        ap.interviews.outcome = Passed
        #Student = 1
        #Company = 1
        #Internship = 1
}
run interviewPassed for 2
```

#9:Instance found interviewPassed is consistent.

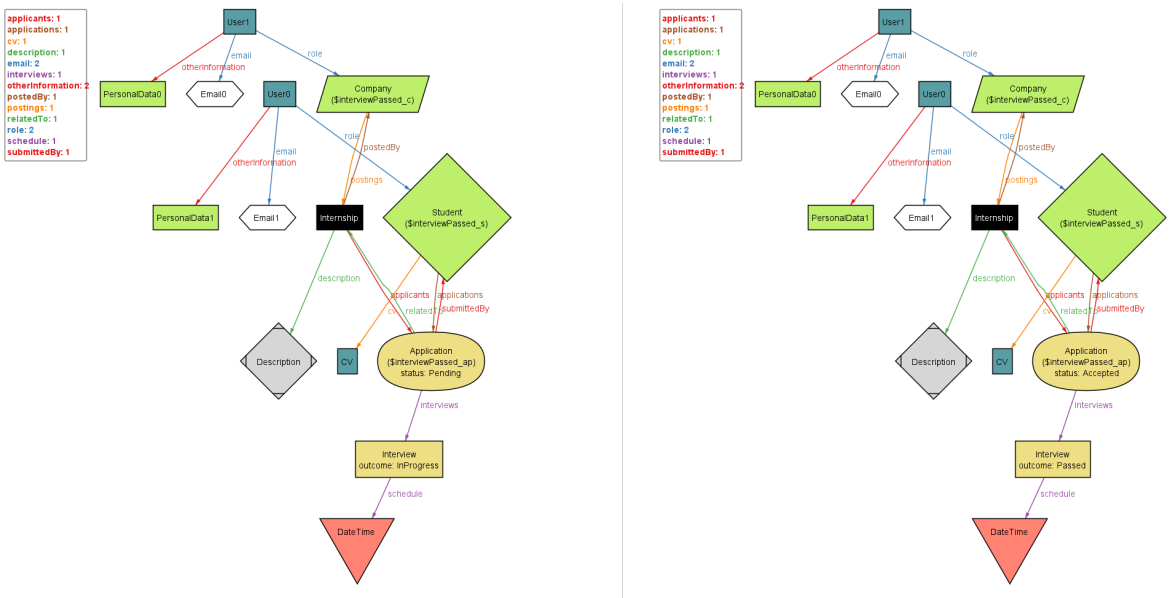

Figure 4.5: Passed inteview

[MD2]The model shows the basic scenario where one student applies for an internship at a company. The dynamic analysis shows how the negative interview status influences the application outcome.

If InProgress => Failed then Pending => Rejected

```
1
2  //failed interview
3  pred interviewRejected[ar:Application, s:Student, c:Company]{
4          ar.interviews.outcome = InProgress ;
5          ar.interviews.outcome = Failed
6          #Student = 1
7          #Company = 1
8          #Internship = 1
9  }
10 run interviewRejected for 2
```

#10:Instance found interviewRejected is consistent.

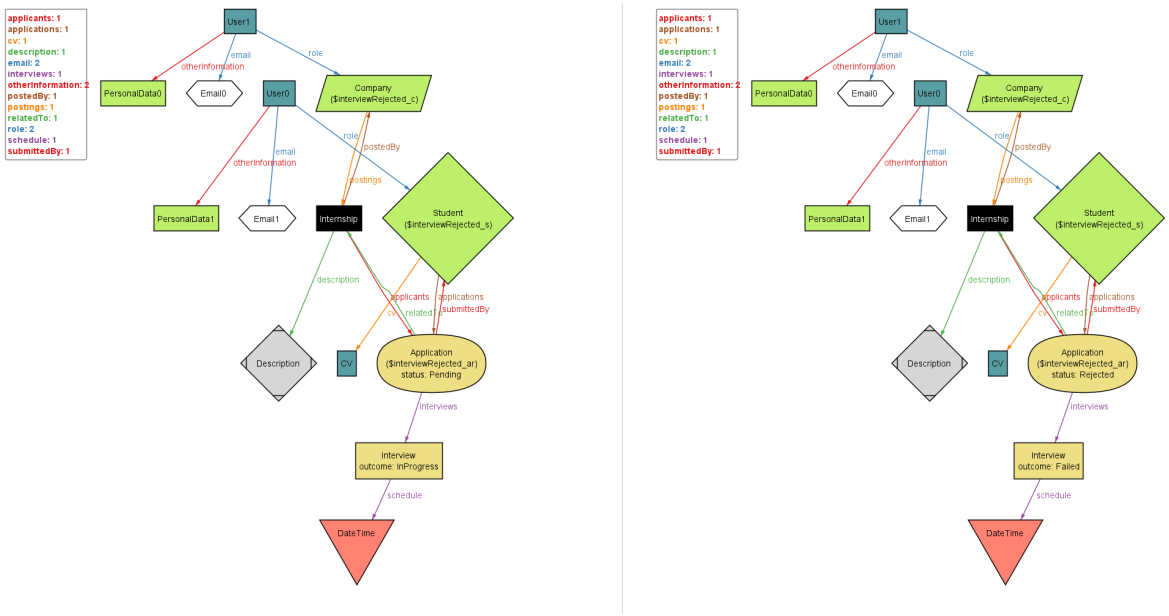

Figure 4.6: Failed interview

4.3. Assertions

[A1] Assertion to verify the correctness of the user structure as:

- No Users will have the same email or the Personal info
- Each role can only be associated with one User

```
1  // Assertion to verify the correctness of the user structure as:
2  assert VerifyUserStructure{
3          //mail and personal info
```

```
        all u1, u2: User | u1 != u2 implies
                u1.email != u2.email and
                u1.otherInformation != u2.otherInformation
        //role
        all s: Student | one u: User | u.role = s
        all c: Company | one u: User | u.role = c
}
check VerifyUserStructure
```

#1: VerifyUserStructure may be valid.

[A2] Assertion to verify DoubleArrowConstraint:

- An application can only be associated with a student
- An application can only be associated with a Intenship
- An internship can only be associated with a Company

```
//Assertion to verify DoubleArrowConstraint
assert VerifyDoubleAssociation {
        //An application can only be associated with a student
        all a: Application | one s: Student |
        s in a.submittedBy and a in s.applications and
        s.applications.submittedBy=s
        //An application can only be associated with a Intenship
        all a: Application | one i: Internship |
        a in i.applicants and  i in a.relatedTo and
        i.applicants.relatedTo = i
        //An internship can only be associated with a Company
        all  i:Internship | one c: Company |
        c in i.postedBy and i in c.postings and
        c.postings.postedBy = c
}
check VerifyDoubleAssociation
```

#2: VerifyDoubleAssociation may be valid.

[A3] Assertion to verify all Internship application structure

- Unique Description, CV, and Interview
- Unique Application

- A student can make only an application for one internship

```
// Assertion to verify all Internship application structure
assert VerifyInternshipStructures {
        //Unique Description, CV, and Interview
        all i1, i2: Internship | i1 != i2 implies
                i1.description != i2.description
        all dd: Description | one ii:Internship |
                dd in ii.description
        all s1,s2: Student| s1 != s2 implies s1.cv != s2.cv
        all ccvv:CV | one ss: Student |  ccvv in ss.cv
        all a1,a2: Application | a1!=a2 implies
                a1.interviews != a2.interviews
        all i: Interview | one a: Application |
                i in a.interviews
        //Unique Application
         all i1, i2: Internship | i1 != i2 implies
        #(i1.applicants & i2.applicants) <= 0
        all c1, c2: Company | c1 != c2 implies
        #(c1.postings & c2.postings) <= 0
        all s1,s2: Student | s1 !=s2 implies
        #(s1.applications & s2.applications) <=0
        ////Student can make only 1 application for 1 internship
        all s: Student | all i: Internship |
        #(s.applications & i.applicants) <= 1
}
check VerifyInternshipStructures
```

#3: VerifyInternshipStructures may be valid

[A4] Assertion to verify all Internship meeting schedules. Two meetings cannot be on the same day if:

- are carried by the same company
- are carried by the same student

Therefore meetings have a schedule if they are submitted by a student

```
//Two meetings cannot be in the same day if:
assert VerifyInterviewStructures {
        all ss1,ss2: Student | all cc1,cc2: Company |
        all a1,a2: Application | a1!=a2 and
```

```
                //are carried by the same company
                ((ss1 in a1.submittedBy and
                   ss2 in a2.submittedBy and
                   cc1 in a1.relatedTo.postedBy and
                   cc1 in a1.relatedTo.postedBy)
        or
                //are carried by the same student
                 (ss1 in a1.submittedBy and
                  ss1 in a2.submittedBy and
                  cc1 in a1.relatedTo.postedBy and
                  cc2 in a1.relatedTo.postedBy))
        implies a1.interviews.schedule != a2.interviews.schedule
        //meetings have a schedule if a student submits them
        all a: Application | a.interviews.schedule != none
                  implies a.submittedBy in Student
}
check VerifyInternshipStructures
```

#4: VerifyInterviewStructures may be valid

[A5] Assertion to verify if the interview process is correctly related to the application process. Three cases are considered:

- Failed => Rejected
- Passed => Accepted
- InProgress => Pending

```
//Check interview process
assert InterviewProcess{
    all a: Application |
        //Failed => Rejected
        some i: a.interviews | i.outcome = Failed
                implies a.status = Rejected
        and
        //Passed => Accepted
        some i: a.interviews | i.outcome = Passed
                implies a.status = Accepted
        and
        //InProgress => Pending
        some i: a.interviews | i.outcome = InProgress
```

```
14                  implies a.status = Pending
15  }
16  check InterviewProcess
```

#5: InterviewProcess may be valid

5 | Effort Spent

Member of group	Effort spent	
Arianna Paone	Introduction	6h
	Overall description	9h
	Specific requirements	6h
	Formal analysis	0h
	Homework	3h
Matteo Pasqual	Introduction	6h
	Overall description	3h
	Specific requirements	3h
	Formal analysis	9h
	Homework	3h
Matilde Restelli	Introduction	7h
	Overall description	5h
	Specific requirements	5h
	Formal analysis	0h
	Homework	3h

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