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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 (04/11/2024)

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 an overall description of every part of the system.

2.1. Product Perspective

2.1.1. Scenarios

(forse li ho fatti troppo generici)

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 completes the questionnaire, and TechSolutions is pleased with his responses. Based on his answers, they decide 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**

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**
10. **A university monitors the situation of an internship**
11. **A university handles a complaint**
12. **A Student proactively search for an internship (also apply maybe)**
13. **A company accepts a recomendation**

14. **A student recieves a suggestion on how to make his cv more appealing**
15. **A student/company provides feedback about the recomendation process**
16. **A student modifies his cv after a suggestion / completation of an internship**

2.1.2. Class diagram

a

2.1.3. State diagrams

1. **Recomendation**
2. **University handles complaint**

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

1. **Account creation**
2. **User log in**
3. **CV uploading**
4. **Project uploading**
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. **Notification of students and companies**
7. **Interview managing**
8. **Selection finalization**

9. **Providing feedback**
10. **Providing suggestions**
11. **Execution monitoring**
12. **Complaining**
13. **Complaints handling**

2.3. User charatteristic

Università??

There are two types of registered users in S&C: Students (STs) and Companies (COMs). 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.

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. 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 | s in u.role and
61     all c: Company |  one u: User | c in u.role
62 }
63
```

```
//DoubleArrowConstraint
fact DoubleAssociation {
    //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
}

//Unique Description, CV, and Interview
fact UniqueItems {
    //description
    all i1, i2: Internship | i1 != i2 implies
    i1.description != i2.description
    all dd: Description | one ii:Internship | dd in ii.description
    //CV
    all s1,s2: Student| s1 != s2 implies s1.cv != s2.cv
    all ccvv:CV | one ss: Student |  ccvv in ss.cv
    //interview
    all a1,a2: Application | a1!=a2 implies
    a1.interviews != a2.interviews
    all i: Interview | one a: Application | 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
}

fact InitialApplicationStatus {
    all a: Application | a.status = Pending
}
fact InitialInterviewOutcome {
    all i: Interview | i.outcome = InProgress
}
```

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.

```
run {} for 2 but
exactly 1 Student, exactly 1 Company, exactly 1  Internship
```

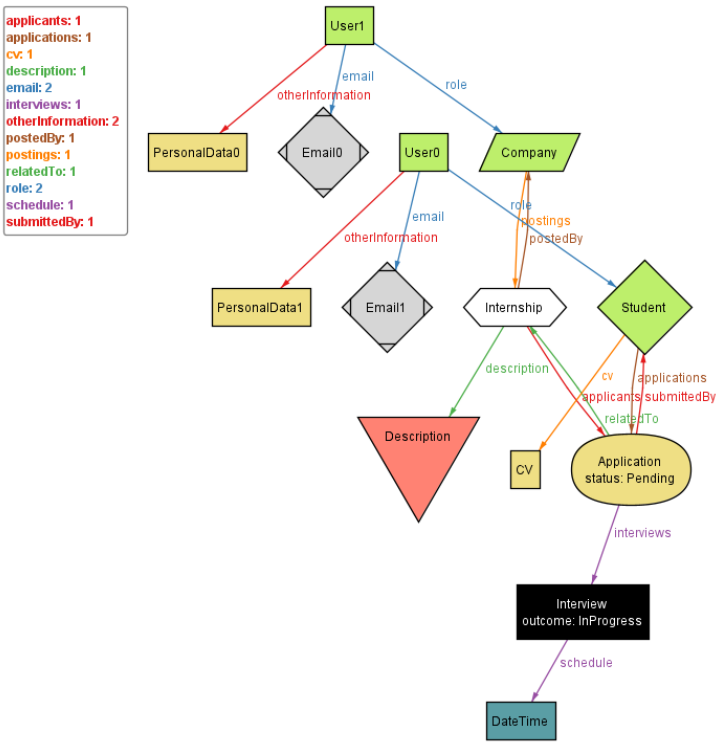

Figure 4.1: 1 Student, 1 Company, 1 Internship

[MS1] 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 run {} for 3 but
2 exactly 2 Student, exactly 1 Company, exactly 1  Internship
```

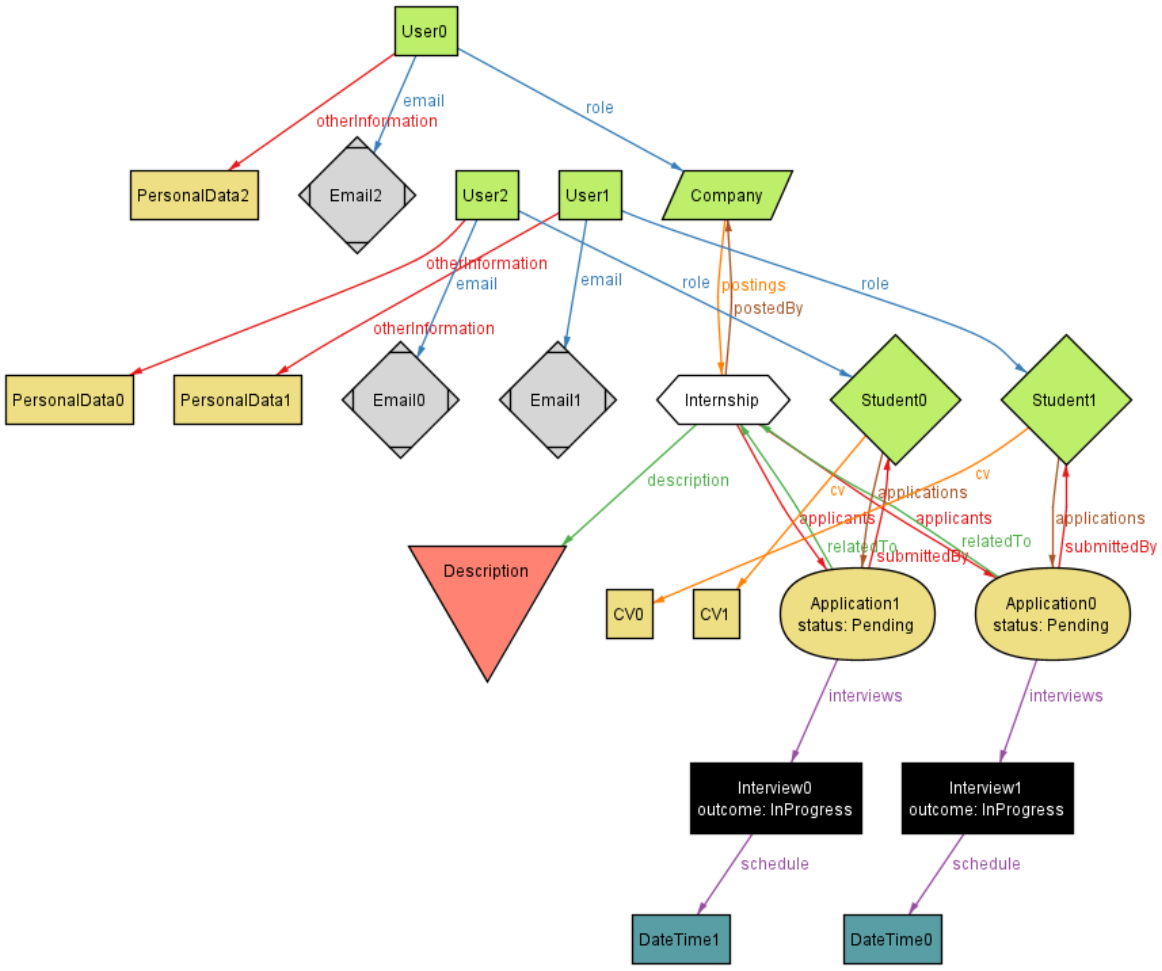

Figure 4.2: 2 Student, 1 Company, 1 Internship

[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 run {} for 3 but
2 exactly 1 Student, exactly 1 Company, exactly 3 Internship
```

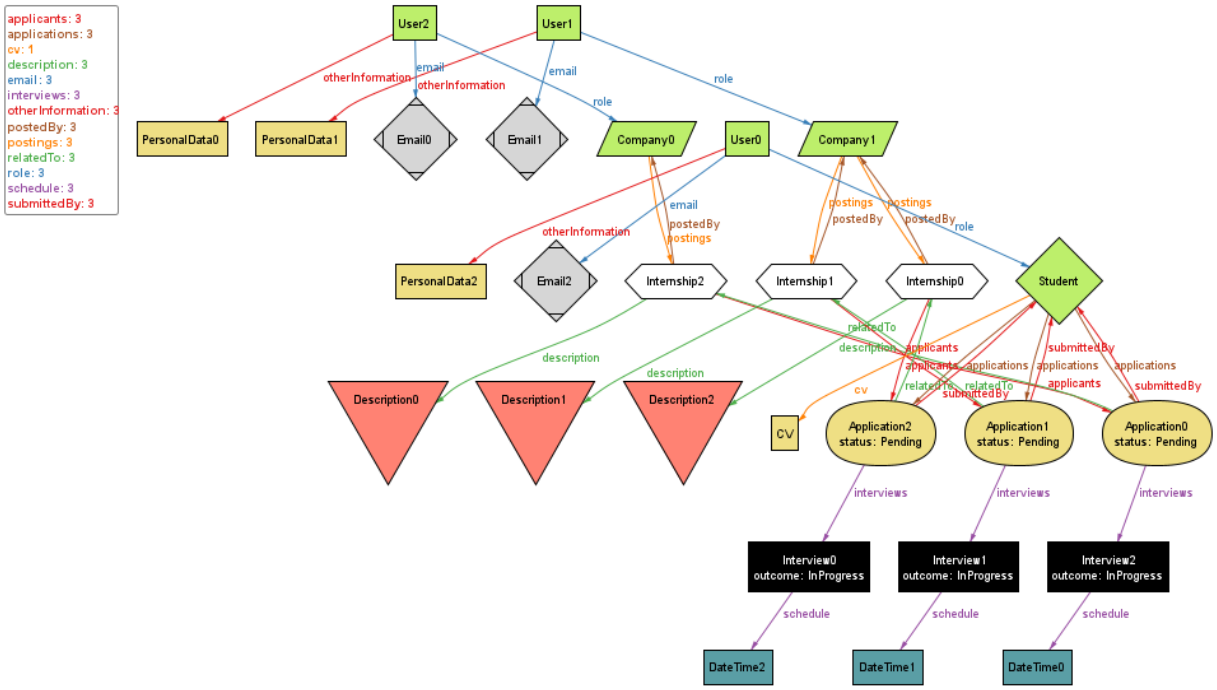

Figure 4.3: 1 Student, 1 Company, 3 Application

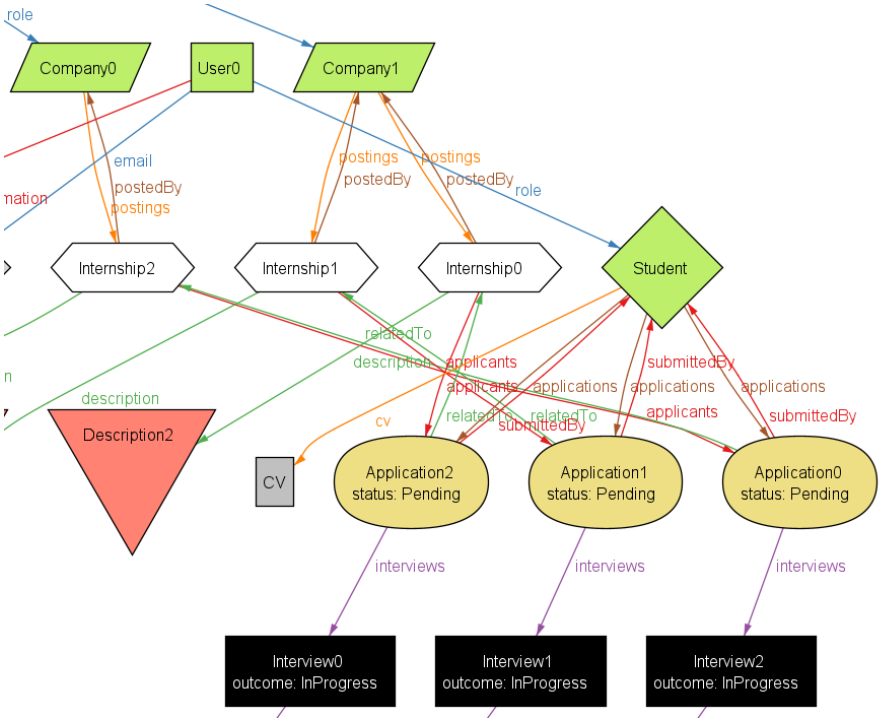

Figure 4.4: 1 Student, 1 Company, 3 Application - zoom on the relations

4.2.2. Dynamic Analysis

[MD1]

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

```
// Assertion to verify the correctness of the user structure as:
assert VerifyUserStructure{
    all u1, u2: User | u1 != u2 implies
    u1.email != u2.email and  u1.otherInformation != u2.
       otherInformation
    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 an Internship
    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
    // A student can make only an application for one 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 they are submitted by a student
    all a: Application | a.interviews.schedule != none
    implies a.submittedBy in Student
}
check VerifyInternshipStructures
```

#4: VerifyInterviewStructures may be valid

5 | Effort Spent

Member of group	Effort spent	
Arianna Paone	Introduction	6h
	Overall description	4h
	Specific requirements	5h
	Formal analysis	0h
	Homework	3h
Matteo Pasqual	Introduction	6h
	Overall description	2h
	Specific requirements	3h
	Formal analysis	6h
	Homework	3h
Matilde Restelli	Introduction	7h
	Overall description	1h
	Specific requirements	5h
	Formal analysis	0h
	Homework	3h

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

6 | References