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SCUOLA DI INGEGNERIA INDUSTRIALE
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Software Engineering II
Computer Science and Engineering

Design Document
Students&Companies

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Contents

1 | Introduction

1.1. Purpose

The *Students&Companies (S&C)* platform bridges the gap between university students seeking internships and companies offering them. It simplifies the process of matching students with internship opportunities based on their skills, experiences, and preferences, as well as companies' requirements and offered benefits.

The software involves three main actors: **students**, **companies**, and **universities**.

- **Students** use the platform to search and apply for internships, submit their CVs, and receive recommendations tailored to their profiles.
- **Companies** advertise internships, specify requirements, and manage the selection process for suitable candidates.
- **Universities** monitor the execution of internships and handle complaints or issues that may arise.

S&C features a **recommendation system** that matches students and internships using mechanisms ranging from keyword-based searches to advanced statistical analyses. The platform also facilitates communication, supports the selection process, and tracks internship progress to ensure transparency for all involved parties.

1.2. Scope

The Students&Companies (S&C) platform is a web application designed to facilitate communication and matchmaking between university students seeking internships and companies offering them. The platform simplifies and automates the process by enabling students to explore and apply for internships, while also allowing companies to advertise their openings and identify suitable candidates. Additionally, a sophisticated recommendation system enhances the user experience by automatically suggesting relevant matches to both students and companies based on their preferences and requirements.

This document aims to outline the key architectural decisions behind the design and implementation of the S&C platform. Given the diverse user base, which includes students, companies, and universities, and the need for simultaneous interaction among these parties, a web application was chosen as the foundation. Its accessibility and ease of use ensure a seamless experience for users across various locations and devices.

The complexity of the platform, along with the distinct functionalities it provides—such as recommendations, selection processes, and feedback collection—led to the choice of a microservices architecture. This architectural style was selected due to its ability to offer scalability, flexibility, resilience, and modularity. Each microservice operates independently, allowing for targeted scaling based on demand, individual updates and deployments, and clear separation of responsibilities. The result is a system that is both maintainable and adaptable to evolving requirements.

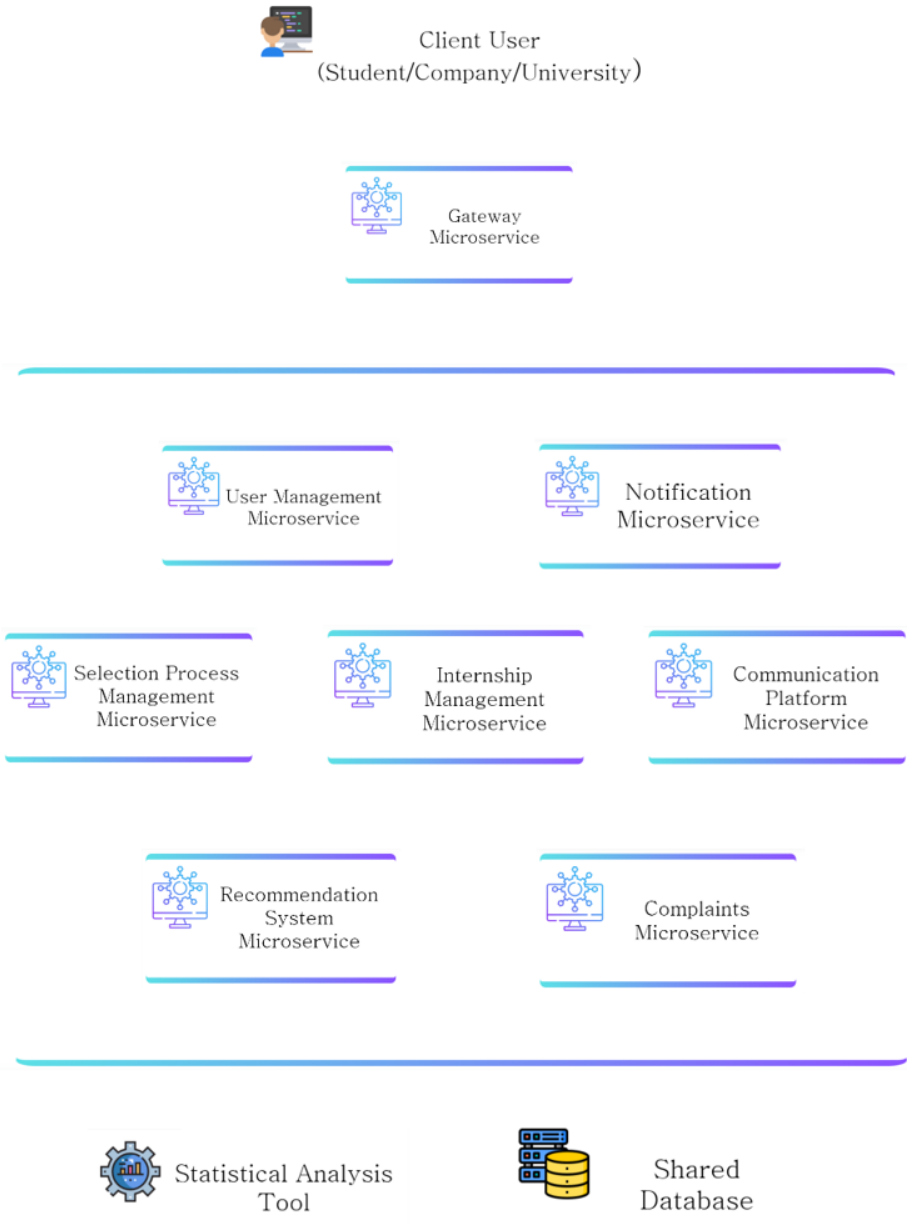
From a deployment perspective, the system adopts a three-tier architecture. The user client layer represents the web and mobile interfaces used by students, companies, and universities. The server layer hosts all microservices, which manage the business logic and application functionality. Finally, the shared database layer ensures consistency in data storage, maintaining information about users, internships, recommendations, and feedback.

To manage interactions between microservices, the platform uses a combination of communication patterns based on specific functional needs. For real-time or asynchronous interactions, an event-driven communication model is employed. In this approach, some microservices act as event publishers while others function as consumers. For example, the Notification Microservice processes events related to complaints, messages, and new recommendations, while other services publish events to reflect changes in system states, such as the pubblication of a new message on the communication platform or the acceptance of a student for an interview.

For functionalities that do not require immediate interactions, synchronous communication mechanisms are used. This includes scenarios such as retrieving a list of internships or submitting CVs, where sequential processing and immediate feedback are necessary. The combination of event-driven and synchronous communication ensures that the system remains both responsive and straightforward to use, catering to the dynamic needs of its users.

All these architectural choices are just mentioned here to provide an overview of the system; they will be better explained and unpacked down the line of this document. The

following image shows the major components of the Students&Companies system.



1.3. Definitions, Acronyms, Abbreviations

1.3.1. Definitions

A brief list of the most meaningful and relevant terms and synonyms used in this document is reported here, in order to make reading process smoother and clearer:

Term	Definition
Internship, Placement, Work-Experience	A temporary work opportunity offered by a company, designed for students to gain practical experience in a professional environment while applying their academic knowledge.
CV, Resume	A document created by a student containing their personal information, skills, educational background, and work experience, used to apply for internships or jobs.
Recommendation System, Suggestion System	A feature of the platform that identifies and matches suitable internships for students or suitable candidates for companies based on their profiles, preferences, and requirements.
Student Profile	A digital representation of a student within the system, containing personal details, uploaded CVs, skills.
Company Profile	A digital representation of a company within the system, containing details about the company, uploaded projects or internships.
Recommendation Process	The sequence of steps executed by the system to align the skills and preferences of students with the requirements of available internships offered by companies.
Feedback, Suggestions	Information collected from students and companies during the selection process and the internship to refine the matching system and improve user satisfaction.

Term	Description
Communication Space, Chat Feature, Messaging System	A feature in the platform that allows students, companies, and universities to interact and share important updates or resolve concerns.
Selection Process	A phase in which companies evaluate student applications, conduct interviews, and finalize the selection of candidates for internships.
Interview Setup, Interview Management	The process supported by the system to schedule, conduct, and manage interviews between companies and students.
Monitoring by University	The process where the university oversees the activities and outcomes of student internships and intervenes if necessary.
Complaint Resolution	The process of identifying and addressing issues raised by students or companies during or after the internship period.
Submission Deadline, Application Deadline	The last date for students to submit applications for an internship or for companies to post available projects on the platform.
Notification System, Alert System	A functionality in the platform that keeps users informed about new opportunities, deadlines, or important events.
Platform, System, Application	All synonyms for the software platform being developed to manage the interactions and processes related to internships.
Statistical Analysis	The process by which the system evaluates collected feedback and interactions to improve its recommendation algorithms and user experience.
Architectural Style	A way of designing a system that defines general principles and patterns for how different parts should interact and be organized.

Term	Description
Structure/View	A representation of a system that highlights specific aspects, such as how components are connected, how they interact, or how they are distributed across different locations.
Component	An independent part of a system that performs a specific function and can often be reused in different systems or contexts.
API	A set of rules and tools that allow different software programs to communicate and share information or functionality with each other.
RESTful API	A type of API that uses standard web protocols like HTTP to let systems access and manipulate resources, following specific guidelines for simplicity and scalability.
Web Application	A program accessed through a web browser that combines client-side and server-side resources to provide interactive features and services.
Microservice	A design approach where a system is divided into small, self-contained services that handle specific tasks and can be developed, deployed, and updated independently.
Three-tier architecture	A system divided into three parts: one for displaying information to users (presentation), one for processing logic (application), and one for managing and storing data (database).
Event-Driven Architecture	A system where actions are triggered by events, such as a notification being sent when a user performs a specific action.
Synchronous communication among microservices	A communication method where one service sends a request to another and waits for the response before continuing.

Term	Description
Asynchronous communication among microservices	A communication method where one service sends a request and does not wait for a response, allowing the system to handle tasks more flexibly.

1.3.2. Acronyms

A list of acronyms used throughout the document for simplicity and readability:

- RASD - Requirements Analysis and Specification Document
- DD - Design Document
- S&C - Students & Companies
- API - Application Programming Interface
- UI - User Interface
- UML - Unified Modeling Language
- DB - Database
- DBMS - Database Management System

1.4. Reference Documents

Here's a list of reference documents that have been used in order to shape the Design Document of the *Students&Companies* system. In the following, all external sources of information that have contributed to the design of this document are mentioned.

1. Stakeholders' specification provided by the R&DD assignment for the Software Engineering II course at Politecnico Di Milano for the year 2024/2025.
2. "29148-2018, ISO/IEC/IEEE International Standard, Systems and software engineering, Life cycle processes, Requirements engineering", by IEEE, 2018.
   Link: `https://ieeexplore.ieee.org/document/8559686`
3. UML specifications, version 2.5.1.
   Link: `https://www.omg.org/spec/UML/2.5.1/About-UML`
4. Alloy documentation, version 6.1.0.8.
   Link: `https://alloy.readthedocs.io/en/latest/`

1.5. Document Structure

The Design Document for the Student&Company project are organized into five primary parts: the first is the introduction, while the remaining four each focus on a specific aspect of the system's overall design, which will help facilitate the development and final implementation of the product.

The **Introduction** serves to provide a concise overview of the project, detailing the objectives and goals that are to be accomplished through its development, as outlined earlier in the RASD.

Moving on, Section 2, titled **Architectural Design**, is the most critical design-related section and aims to present the software architecture of Student&Company through various views and structural representations. This section is divided into multiple parts:

The first part, Overview, delivers a high-level summary of the core components of the system and how they interact with each other, explained in an informal notation that makes the structure more accessible.

The second part, Component View, presents the first of the architectural structures, the Component & Connector structure, which is crucial for demonstrating the system's components from a dynamic perspective and the way in which they collaborate to meet the final objectives; it largely uses UML component diagrams to convey these interactions.

The Deployment View, the third part, focuses on the deployment structure of Student&Company, illustrating how the software components correspond to the physical hardware that will run the application. The mapping between the software and hardware is illustrated with UML deployment diagrams, which are extremely helpful in visualizing this relationship.

Then, the Runtime View follows, employing sequence diagrams to describe the flow of events and interactions within the system's components, ensuring consistency with the previously discussed sections.

The Component Interfaces section comes next, where a detailed specification of the important methods and functions exposed by each interface of the system's components is provided, making sure to cover all relevant aspects.

The final part of Section 2 discusses the Selected Architectural Styles and Patterns, offering a review of the primary architectural styles and patterns, followed by a detailed explanation of why they were selected for this particular project.

Section 3, on **User Interface Design**, shifts focus to the design of user interfaces (UI), offering guidelines for UI designers on how the final application should appear, including color schemes, the placement of key UI elements, and also the logical role that these interfaces play in the development process, clarifying what functionalities they provide to the user.

Following this, Section 4, which covers **Requirement Traceability**, provides a matrix that clearly shows how the requirements for Student&Company, which were previously

drawn up, map onto the components discussed in earlier sections of the document, ensuring that all requirements are adequately addressed by the system.

Finally, Section 5, **Implementation, Integration, and Test Plan**, explains the strategy for implementing the system, detailing the order in which the components will be developed, the approach for integrating new sub-components into the application as it progresses, and the testing strategy to ensure that all components work seamlessly together within the system.

2 | Architectural Design

2.1. Overview

2.1.1. High Level View

2.2. Component View

2.2.1. RESTful APIs Component Diagram

2.2.2. Service Discovery Component Diagram

2.2.3. Event-Driven Pattern Components

2.2.4. Data Layer Access Component Diagram

2.2.5. User Interfaces Component Diagram

2.3. Deployment View

2.3.1. High-Level Deployment View

2.3.2. Detailed Deployment View

2.4. Run Time View

2.5. Component Interfaces

2.6. Selected Architectural Styles and Patterns

2.6.1. Database Management

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3.1. External Interface Requirements

3.1.1. User Interface

3.1.2. Hardware Interfaces

3.1.3. Software Interfaces

3.2. Functional Requirements

3.2.1. Use Case Diagrams

3.2.2. Use Cases

3.2.3. Sequence Diagrams

4 | Requirements Traceability

5 | Implementation, Integration and Test plan

5.1. Overview

This section outlines the processes of implementation, integration, and testing for the Students&Companies (S&C) platform, describing how its key functionalities were developed and validated to ensure reliability and effectiveness.

The chapter is divided into three main parts:

1. Feature Identification: This part focuses on the platform's key functionalities, derived from primary use cases, and highlights the microservices that support them.
2. Component Integration and Testing: This section describes the integration of microservices to test features, using a thread-based strategy that mirrors real-world scenarios.
3. System Testing: Here, the focus shifts to testing the platform as a whole, ensuring that all components work together seamlessly to deliver a complete and robust system.

The platform was designed with a microservices-based architecture, enabling the division of functionalities into modular components. During implementation, each microservice was developed to address a specific aspect of the system, such as recommendation, selection process management, or feedback handling. However, the testing strategy was designed to go beyond validating individual components, ensuring that the overall system functionalities meet the required specifications.

The testing process was executed in three phases:

1. Unit Testing: In the first phase, unit tests were performed on individual microservices to ensure that each component functions correctly in isolation. This phase focused on verifying the internal logic and functionality of each microservice, ensuring a solid foundation for the system.
2. Feature Integration Testing: The next phase involved integration testing based on the platform's key features. Microservices were integrated to test specific use cases, such as the matching process between students and companies, ensuring that they worked together as intended. A thread-based strategy was used to test these features incrementally, starting from simple interactions and gradually integrating more

complex functionalities.

3. System Testing: In the final phase, comprehensive system tests were performed to validate the entire platform. This stage involved testing the system as a whole, ensuring that all microservices and integrated features functioned cohesively and met the overall functional requirement

By combining unit tests, feature-based integration tests, and comprehensive system testing, this approach provides a robust framework to identify and resolve issues progressively. This ensures that the final system is both scalable and reliable, meeting the diverse needs of its users.

5.2. Implementation Plan

5.2.1. Features Identification

For the development of the Students&Companies (S&C) platform, several key features have been identified, each representing a core functionality that directly supports user interactions and business processes. The order in which these features are listed reflects the sequence in which they will be implemented and tested. Each feature is a logical component of the system, providing specific, user-visible functionalities that contribute to the overall experience and effectiveness of the platform.

Profile Creation Features

The profile creation feature is available for students, companies, and universities. For students and companies, the feature is more detailed compared to universities.

For students, the functionality includes the ability to initially register on the platform, add information to their profile, and upload photographs and documents. For companies, they must be able to upload information and photographs to their profiles and create pages for internships, where they can also upload relevant information, photos, and documents. For universities, the profile functionality is simpler; they only need to upload basic information.

Selection Process Management Features

Communication Features

Feedback and Complaints Collection Features

Providing Recommendations Features

Complaints Report Generation Features

5.2.2. Components Integration and Testing

In the integration testing phase of the Students&Companies (S&C) platform, a hread-based strategy was chosen to ensure a systematic and realistic evaluation of the system. This approach focuses on testing complete end-to-end flows, or "threads," that represent specific use cases, such as matching students with internships or managing the selection process.

The thread-based strategy was selected because it allows the system to be tested in a way that closely mirrors real-world usage. By focusing on functional threads derived from key features, we can ensure that the microservices interact seamlessly to deliver the desired functionalities. This incremental approach also simplifies the detection and resolution of issues, as it starts with the core features and progressively integrates additional functionalities.

In practice, the strategy involves first testing simpler flows that require fewer components, such as user profile creation, and then gradually introducing more complex scenarios, like recommendation and communication. This ensures that each functionality is

validated individually and in combination with others, providing confidence in the system's robustness and reliability.

Profile Creation Features

The profile creation feature supports students, companies, and universities, with students and companies having more detailed functionalities than universities.

The process starts with user registration via the gateway microservice, which validates the user's information, such as email and password. For students, the registration is managed by the student user management microservice, which processes and stores the data in the database. Similarly, companies and universities have their data handled by their respective microservices.

After registration, users log in through the gateway microservice. Students can add detailed information to their profiles, including skills, experiences, and documents, managed by the student user management microservice and stored in the database. Companies can add company descriptions, upload documents and photos, and create internship pages, with the company user management microservice handling these operations. Universities have simpler profiles, where only basic details are uploaded through the university user management microservice.

Throughout this process, the gateway microservice handles connections and secure data transfer, while the user management microservices ensure proper profile creation, updates, and storage.

Selection Process Management Features

Communication Features

Feedback and Complaints Collection Features

Providing Recommendations Features

Complaints Report Generation Features

5.3. System Testing

System testing is a critical phase of the development lifecycle where the fully integrated Students & Companies (S&C) platform is rigorously evaluated to ensure that it meets both functional and non-functional requirements. The testing environment is carefully designed to closely replicate the actual production setup, enabling a comprehensive analysis of the platform's behavior under realistic conditions.

Functional testing is focused on verifying that the platform meets the functional specifications outlined in the requirements documentation, such as use cases. Key functionalities are examined, including profile creation and management for both students and companies, the recommendation system's ability to match students with internships based on CV data and company requirements, and support for the selection process, such as interview scheduling and structured questionnaires. Communication features, including notifications and messaging, are tested to ensure seamless interaction between users, while feedback and complaint management functionalities are validated to confirm that users can effectively submit and track concerns.

Non-functional testing evaluates the system's performance, scalability, and reliability under a variety of conditions. This includes:

- Performance Testing: Measuring response times, throughput, and resource utilization to ensure that the system operates efficiently under typical conditions.
- Load Testing: Gradually increasing the number of concurrent users or sustaining a steady workload to verify that the platform can handle expected user volumes without performance degradation.
- Stress Testing: Simulating extreme conditions, such as sudden spikes in user activity or system failures, to test the platform's ability to recover and maintain availability in challenging scenarios.

To ensure thorough coverage, the testing methodology combines manual and automated approaches. Manual testing is employed to validate specific scenarios, such as edge cases in the recommendation system or workflows related to complaint resolution. Automated testing leverages techniques such as fuzz testing, concolic execution, and search-based strategies, enabling repeated evaluations of the system under varying conditions. These methods ensure the platform's robustness, reliability, and consistency across diverse environments.

Through this structured and comprehensive system testing approach, the S&C platform is validated to perform reliably and effectively in real-world scenarios, meeting the needs of students, companies, and universities alike.

6 | Effort Spent

7 | References

8 | Per fare prove

Ciao ragazzi come va?

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Questo lo ho aggiunto dopo.

Questo aggiunto dopo da VS code direttamente.

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Tabella tipo 2:

Bibliography

[1] Simone. provabibliografia, 2024.

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