

M.Sc. Computer Science and Engineering

Software Engineering 2 Project

**CLup - Customers Line-Up**

**Requirements Analysis and Specification Document**



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Version 1.0

GitHub Repository: https://github.com/lucagrammer/LeoniLocarnoMinotti

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**Chapter 1**

# 1 Introduction

This document constitutes the Requirement Analysis and Specification Document (RASD). Its purpose is to analyse the requirements that will lay the foundations of application services, to specify the application domain, the entities involved and their relationship, to clearly explain the objectives, the constraints and the features that are going to be implemented.

## Purpose

In the midst of the Coronavirus outbreak even shopping at grocery stores and supermarkets has proven to be a problem due to interpersonal distancing rules and building access restrictions. In fact, this typically results in long lines forming outside, which is less than ideal for avoiding crowds.

CLup is a software with the aim of managing in a simple but effective way the queues to access the stores, allowing users to queue directly from the application and receive a notification just in time to physically reach the store. Furthermore, CLup allows users to book a visit to a specific store on a specific date or, in the case that this is not possible, recommends alternative slots or similar less crowded stores. Finally, users can also be notified of the availability of slots in the day/time range in which they typically shop. On the other hand, supermarket managers can easily keep access data under control and effortlessly ensure compliance with safety regulations.

### Goals

1. Allows managers to regulate the influx of the people in their store.
2. Allows to avoid the formation of long lines outside supermarkets.
   1. Allows customers to line up from their home.
   2. Allows people who don’t have access to the required technology to line up physically from a store.
3. Allows managers to keep access data under control.
4. Allows customers to constantly check the estimated waiting time to enter a specific store.
5. Allows customers to be notified when their number is close to being called, considering the time to get to the shop.
6. Allows customers to book a visit to a specific store in a specific date.
7. Suggests customers alternative slots for visiting a specific store.
8. Suggest customers similar stores if the preferred one does not have slots available for booking in the near future.
9. Provides the customer periodic notifications of available slots in the day/time range they usually shop.

## Scope

According to the World and Machine paradigm, introduced by M. Jackson and P. Zane, we can identify the Machine as the System to be developed and the environment, in which CLup will be used, as the World. The separation between these two concepts allows us to classify the phenomena into two different categories.

### World and Shared phenomena

***World phenomena***, events that take place in the real world and that the machine cannot observe.

* A person needs to buy goods at a supermarket.
* A person goes to a store without lining up from his home.
* The Manager wants to monitor the entrances to his shop.

***Shared phenomena***, events that involve both the real world and the machine. They could take place in the real world and be observed by the machine, or they could occur inside the machine and have an impact in the real world.

* The User signs up to the Application or logs in if already registered.
* The Manager registers his store to the Application or logs in if already registered.
* The System assigns a number to a User that gives his position in the queue of a store.
* The System sends an alert to a User inviting him to reach the selected store.
* The Guest receives a ticket from a Physical Ticket Dispenser located in front of the shop.
* The User books a visit to a specific store in a specific date.
* The User indicates the approximate expected duration of the visit.
* The User indicates the categories of items he intends to buy.
* The System suggests to a User an alternative slot.
* The System suggests to a User similar less crowded stores.
* The System sends notifications of available slots in a day/time range.
* The System generates the QR codes necessary to enter a store.
* The User uses a QR code to enter or leave the store.
* The Manager displays the access data of his store.

## 1.3 Definitions, Acronyms, Abbreviations

### 1.3.1 Definitions

* **CLup System**: refers to the whole system to be developed.
* **CLup Services**: refers to the functionalities offered by the CLup System, such as the queue management mechanism.
* **CLup Application**: refers to the mobile/web application that makes CLup Services available everywhere.
* **Physical Ticket Dispenser**: a computer connected to the System that distributes physical tickets. It acts as a proxy.
* **Guest**: a person who has not the access to Application but still uses some of its Services through the Physical Ticket Dispenser.
* **User**: a person that uses the Application and its Services.
* **QR** **Code**: quick response code, a type of matrix barcode.

### 1.3.2 Acronyms

* **RASD**: Requirement Analysis and Specification Document.
* **UML**: Unified Modelling Language.
* **API**: Application Programming Interface.
* **PTD**: Physical Ticket Dispenser.
* **GPS**: Global Positioning System.
* **API**: Application Programming Interface.

### 1.3.3 Abbreviations

* **[Gi]**: i-th goal.
* **[Ri]**: i-th requirement.
* **[Di]**: i-th domain assumption.
* **[UCi]**: i-th use case.

## Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Authors** | **Summary** |
| 1.0 | --/--/2020 | Leoni Luca  Locarno Silvia  Minotti Luca | First release |

## Reference Documents

* Specification document: Project Assignment A.Y. 2020-2021.pdf
* Software Engineering 2 course slides
* Previous project examples:
* Specification document: Mandatory Project Assignment A.Y. 2019-2020.pdf
* RASD to be analyzed.pdf
* IEEE Standard on Requirement Engineering (ISO/IEC/IEEE 29148)

## 1.6 Document Structure

This document is structured as follows:

1. ***Introduction*** - A general introduction to the goals, the phenomena and the scope of the system-to-be. It aims giving general but exhaustive information about what this document is going to explain.
2. ***Overall Description -*** A general description of the product to be and its requirements. This section provides several information that are explained in detail in Section 3.
3. ***Specific Requirements*** - All software requirements are explained using scenarios, use-case diagrams and activity diagrams. Non-functional and functional requirements are also cited.
4. ***Formal Analysis using Alloy -*** This section includes Alloy code that describes the model and shows its soundness and correctness.
5. ***Effort spent*** - Effort spent by all team members shown as the list of all the activities done during the realization of this document.
6. ***References*** - References of documents that this project was developed upon.

**Chapter 2**

# 2 Overall Description

## 2.1 Product Perspective

### 2.1.1 Scenarios

* **Scenario 1: *Simonetta discovers CLup***

Simonetta is really worried about the possibility of contracting Coronavirus and thus being able to endanger her daughter’s life, who unfortunately is immunocompromised. For this reason, Simonetta always wears the surgical mask and avoids crowded areas. What scares her the most are the long queues that form in front of supermarkets, which is why Simonetta is very happy when her colleagues introduce her to CLup. In fact, a little later Simonetta downloads the application on her smartphone. Then, enthusiastically, she signs up as a customer by filling out a simple form with her personal data and her email. The young mother, finally, completes the registration by accepting the Terms and Conditions of the service and the Privacy Statement.

* **Scenario 2: *Steve and the technology***

Steve is an elderly man who has neither a smartphone nor an internet connection. However, this does not prevent him from using the CLup services that the grocery store near his home has recently adopted. In fact, once he reaches the store, Steve presses a button on the monitor of a ticket dispenser and picks up his ticket. In this way, even if the wait is long, thanks to the estimation calculated by the system, Steve can still take a walk at the park next to the store without missing his position.

* **Scenario 3: *Filippo, the regular User***

Filippo, a well-informed young man, uses CLup from the day it was released. After a long workday, he finally arrives at home and opening the fridge he sadly realizes that it is quite empty. Therefore, he opens CLup and selects his usual supermarket in order to line-up. The estimation waiting time is only thirty minutes, so he decides to line-up and he selects he will go by foot. The app gives him a QR code. After twenty minutes, he receives a notification from the app that say that it is time to go. He goes out to reach the grocery store. After showing the received QR code, he enters the supermarket.

* **Scenario 4: *Serena, the transfer student***

Serena, a CLup User, is a transfer student in Milan. She usually goes down her local supermarket because it is difficult for her to carry the heavy shopping bags for a long way. For this reason, she always books a visit in order to have always her supermarket available. This week she has been very busy due to the mid-term exams and she forgot to book the visit in advance. Once Serena has finished the last exam, she opens the app and tries to book the visit to the supermarket for the next day. Unfortunately, the chosen day is unavailable, so CLup suggests her another available slot to go to the supermarket and another near grocery shop available at the date she selected. Serena picks up the first suggestion and decides to book a visit in another date at the same supermarket.

* **Scenario 5: *Matteo, the busy man***

Matteo, a CLup User, is a businessman. Usually, he goes to the supermarket on Tuesday evening. During the Covid-19 emergency, he lost a lot of time doing shopping, because everyone decided to go to the supermarket after work. Matteo is very organized, and, in order to optimize his time, he turned on the Periodic Notification service offered by CLup. His last visit was two weeks ago, and he has not booked the next one yet. CLup sends him a notification warning him about an available slot of time at his usual grocery store. Matteo decides to confirm the suggestion.

* **Scenario 6: *Michael, the Store Manager***

Michael is the Store Manager of Dunder Mifflin grocery store in Como. Dunder Mifflin is one of the major supermarket chains in Italy. After the official release of the last DCPM, all the stores on the Italian territory have to monitor the access to the buildings, with the aim of avoid gatherings. The CEO of Dunder Mifflin decides to leverage the functionalities offered by CLup. All the Store Managers must register their store on the platform. Michael opens the CLup Application and select the Registration process, dedicated to the stores. He inserts all the information, reads the Privacy statement and accepts the Terms and Conditions. He successfully completes the procedure. Now the Store is registered. All the Users can reach it on CLup.

* **Scenario 7: *A matter of shifts***

Philip is a young nurse who works at the Cantù hospital and he knows very well how important it is to avoid crowded areas. For this reason, he always books a slot in his favourite supermarket through CLup for the time he leaves the work on Thursdays. However, due to the increase in Coronavirus cases and the shortage of healthcare personnel, the hospital has extended Philip's shifts for the entire week. The young nurse opens the CLup application and in the section dedicated to his reservations presses the button to delete the one for this week. The slot is then available for other users.

* **Scenario 8: *Frozen food for everyone***

Jane, who is the manager of a supermarket in Milan, has activated CLup only a few weeks ago. That’s why she is very curious to analyse the data of her store. After authenticating with her credentials, Jane accesses the statistics section by pressing a button. From the shown graphs, she immediately realizes that many of her customers are interested in the frozen food aisle, which is currently not very large. In order to reduce waiting times, she decides to work on an expansion plan for this section.

### 2.1.2 Class Diagrams

### 2.1.3 State Charts

## 2.2 Product Functions

* **User Registration:** CLup Application will allow Users to register. These will register by entering all the required information. When registering to the application, they will first declare to have read the Privacy statement and secondly, they will have to accept the Terms and conditions, which specifically include their consent to the acquisition and processing of their data.
* **Store Registration:** CLup Application will allow Store Managers to register the store. These will register by entering all the required information. When registering to the application, they will first declare to have read the Privacy statement and secondly, they will have to accept the Terms and conditions, which specifically include their consent to the acquisition and processing of their data.
* **Line up from the Application:** The User can select a store between the available registered ones. Once the store has been selected, the User can decide to line up or not, depending on the waiting time. If the User decides to line up, he has to select the transportation he will use and then the System generates the QR code to access the store.
* **Line up from the PTD:** The Guest reaches the PTD of a store. Through the monitor he requires the ticket to line up. The PTD prints the ticket and the Guest will wait until its turn in the proximity of the shop.
* **Book a visit:** The User can select a store between the registered ones. Once the store has been selected, the User can select a date and a time he would like to book a visit. If the selected date and time is not available, the Application will suggest him the closest available slots for that store. In addition, the Application will recommend other stores available at the requested date.
* **Periodic Notifications:** The Application provides the User periodic notifications of available slots in the day/time range he uses to visit the store.

## 2.3 User Characteristics

The actors of the application are the following:

* **Guest**: a person who has not the access to Application but still uses the “Line Up” Service through a PTD.
* **User**: a single person who has registered as a customer to the Application and can use all the Services it offers.
* **Store Manager**: a single person who is in charge of a grocery store or a supermarket (either belonging to a chain or independent) and who has registered it on the Application.
* **Unregistered User**: single person who has downloaded the application but has not yet registered. He is only allowed to sign up or reach a store and use the “Line Up” Service through the PTD. In the first case he becomes either a User or a Store Manager depending on the type of membership, while in the second case he becomes a Guest.

## 2.4 Assumptions, Dependencies and Constraints

### 2.4.1 Domain Assumptions

1. No customer, be it a User or a Guest, can enter a store without having shown a QR code at the entrance.
2. No customer, be it a User or a Guest, can leave a store without having shown a QR code at the exit.
3. Data given by Store Manager and User during the registration process are assumed to be correct.
4. The GPS is assumed to be accurate.
5. The printer included in the PTD is assumed to work properly.
6. User and Store Manager own a working smartphone which has access to Internet connection.
7. User owns a working smartphone which has a working GPS antenna.
8. The time estimation for reaching the store is supposed to be accurate.

### 2.4.2 Dependencies

* The Application will use the GPS of the User’s smartphone.
* The Application will use the Internet connectivity of the User’s smartphone.
* The System will use some external services to estimate the time it will take for the User to reach the store.

**Chapter 3**

# 3 Specific Requirements

## 3.1 External Interface Requirements

### 3.1.1 User Interfaces

### 3.1.2 Hardware Interfaces

### 3.1.3 Software Interfaces

### 3.1.4 Communication Interfaces

## 3.2 Functional Requirements

### 3.2.1 Use Case Diagrams

Immagine che contiene testo

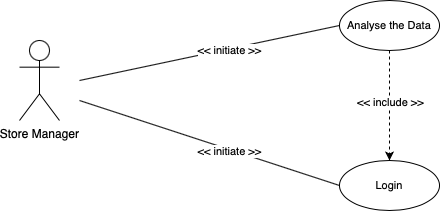
Descrizione generata automaticamente

Use Case Diagram 1: Unregistered User

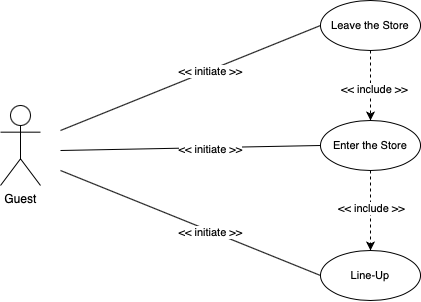
Immagine che contiene monitor, televisione, schermo, controllo

Descrizione generata automaticamente

Use Case Diagram 2: User



Use Case Diagram 3: Store Manager



Use Case Diagram 4: Guest

### 3.2.2 Use Case Analysis

|  |  |
| --- | --- |
| **Name** | **[UC1] User Registration** |
| **Actors** | Unregistered User |
| **Entry Conditions** | * Unregistered User successfully installed CLup Application on the smartphone |
| **Events Flow** | 1. Unregistered User taps on “User Registration” button 2. Unregistered User fills the “email” and “password” fields 3. Unregistered User checks the “Accept Terms and conditions” checkbox 4. Unregistered User taps on “Confirm” button 5. CLup saves Unregistered User information |
| **Exit Conditions** | * Unregistered User successfully registered on CLup |
| **Exceptions** | * Inserted email already registered for another User * Inserted password is not valid * Not all required fields are filled in * “Accept Terms and conditions” checkbox is not checked * “Accept Privacy statement” checkbox is not checked   In these situations, the System notifies the User. He is invited to try again signing up.   * User is already signed up   User is invited to Login, instead of Sign Up |

|  |  |
| --- | --- |
| **Name** | **[UC2] User Login** |
| **Actors** | User |
| **Entry Conditions** |  |
| **Events Flow** |  |
| **Exit Conditions** |  |
| **Exceptions** |  |

|  |  |
| --- | --- |
| **Name** | **[UC3] Store Registration** |
| **Actors** | Unregistered User |
| **Entry Conditions** |  |
| **Events Flow** |  |
| **Exit Conditions** |  |
| **Exceptions** |  |

|  |  |
| --- | --- |
| **Name** | **[UC4] Store Manager Login** |
| **Actors** | Store Manager |
| **Entry Conditions** |  |
| **Events Flow** |  |
| **Exit Conditions** |  |
| **Exceptions** |  |

|  |  |
| --- | --- |
| **Name** | **[UC5] User Line-Up** |
| **Actors** | User |
| **Entry Conditions** | * User successfully logged into CLup |
| **Events Flow** | 1. User selects the option “Line-Up” from the homepage 2. User selects a store in the list of the available ones 3. User selects the transportation he will use to go to the store 4. User presses the button “Line-Up” |
| **Exit Conditions** | * User visualizes the waiting time. |
| **Exceptions** | * None |

|  |  |
| --- | --- |
| **Name** | **[UC6] User receive a Line-Up alert** |
| **Actors** | User |
| **Entry Conditions** | * User successfully logged into CLup * User lined-up * The waiting time is almost over |
| **Events Flow** | 1. User receives on his smartphone a notification 2. User reads the notification 3. User is about to leave the place in which he is |
| **Exit Conditions** | * User headed to the store |
| **Exceptions** | * None |

|  |  |
| --- | --- |
| **Name** | **[UC7] Guest Line-Up** |
| **Actors** | Guest |
| **Entry Conditions** | * Guest arrived at the store |
| **Events Flow** | 1. Guest reaches the PTD of the store and presses the button “Start” 2. Guess presses the button “Line-Up” |
| **Exit Conditions** | * Guest receives the ticket from the PTD |
| **Exceptions** | * None |

|  |  |
| --- | --- |
| **Name** | **[UC8] User books a visit** |
| **Actors** | User |
| **Entry Conditions** | * User successfully log-in CLup |
| **Events Flow** | 1. User selects the option “Book a Visit” from the homepage 2. User selects a store in the list 3. User selects the date he would like to go to the store 4. User selects the time he would like to go to the store 5. User presses the button “Book” |
| **Exit Conditions** | * User receives the QR code to access the store |
| **Exceptions** | * The desired time/date is not available   In this situation, CLup application will suggest him another slot or another supermarket available at the desired time/date. |

|  |  |
| --- | --- |
| **Name** | **[UC9] User cancels a booking** |
| **Actors** | User |
| **Entry Conditions** | * User successfully logged into CLup * User successfully booked a visit |
| **Events Flow** | 1. Users select the option “My Reservations” in the homepage 2. User selects the reservation he wants to cancel 3. User presses the button “Cancel the visit” |
| **Exit Conditions** | * The visit is successfully cancelled |
| **Exceptions** | * None |

|  |  |
| --- | --- |
| **Name** | **[UC10] User enters a store** |
| **Actors** | User |
| **Entry Conditions** | * User received the QR code on the smartphone from CLup application |
| **Events Flow** | 1. User arrives at the store 2. User open CLup on his smartphone 3. User exhibits the QR code to the scanner 4. The automatic sliding doors open 5. User can enter the store |
| **Exit Conditions** | * User enters the store |
| **Exceptions** | * User forgets the smartphone at home * User’s battery of the smartphone is dead * User’s QR code is not valid   In these situations, User must Line-Up at the PTD of the store as a Guest or must come back home. |

|  |  |
| --- | --- |
| **Name** | **[UC11] Guest enters a store** |
| **Actors** | Guest |
| **Entry Conditions** | * Guest received the ticket with the QR code from the PTD outside the store |
| **Events Flow** | 1. Guest exhibits the ticket with the QR code to the scanner 2. The automatic sliding doors open 3. Guest can enter the store |
| **Exit Conditions** | * Guest enters the store |
| **Exceptions** | * Guest’s ticket is not valid   In this situation Guest must request another ticket to the PTD or must come back home. |

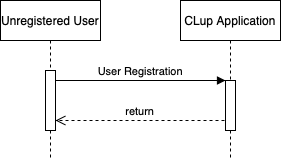
|  |  |
| --- | --- |
| **Name** | **[UC12] User leaves a store** |
| **Actors** | User |
| **Entry Conditions** | * User entered the store |
| **Events Flow** | 1. User open CLup on his smartphone 2. User exhibits the QR code to the scanner 3. The automatic sliding doors open 4. User can exit the store |
| **Exit Conditions** | * User exits the store |
| **Exceptions** | * User’s battery of the smartphone is dead   In this situation, User must ask for help to the Assistance. |

|  |  |
| --- | --- |
| **Name** | **[UC13] Guest leaves a store** |
| **Actors** | Guest |
| **Entry Conditions** | * Guest entered the store |
| **Events Flow** | 1. Guest exhibits the ticket with the QR code to the scanner 2. The automatic sliding doors open 3. Guest can exit the store |
| **Exit Conditions** | * Guest exits the store |
| **Exceptions** | * Guest loses his ticket during the visit to the supermarket   In this situation, Guest must ask for help to the Assistance. |

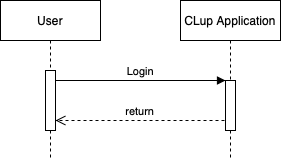
|  |  |
| --- | --- |
| **Name** | **[UC14] Store Manager analyses the data** |
| **Actors** | Store Manager |
| **Entry Conditions** | * Store Manager successfully logged into CLup |
| **Events Flow** | 1. Store Manager presses the “Check access data” button in the homepage |
| **Exit Conditions** |  |
| **Exceptions** |  |

|  |  |
| --- | --- |
| **Name** | **[UC15] User receives a periodic notification** |
| **Actors** | User |
| **Entry Conditions** |  |
| **Events Flow** |  |
| **Exit Conditions** |  |
| **Exceptions** |  |

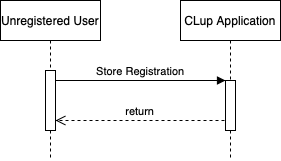
### Sequence Diagrams



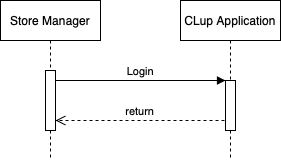
Sequence Diagram 1: Unregistered User Registration



Sequence Diagram 2: User Login



Sequence Diagram 3: Unregistered User Store Registration



Sequence Diagram 4: Store Manager Login

### 3.2.4 Requirements

### 3.2.5 Traceability Matrix

## 3.3 Performance Requirements

## 3.4 Design Constraints

### 3.4.1 Standard compliance

### 3.4.2 Hardware limitations

### 3.4.3 Any other constraint

* The Application should be very intuitive and simple to use, as the range of users include all demographics.

## 3.5 Software System Attributes

### 3.5.1 Reliability

### 3.5.2 Availability

### 3.5.3 Security

### 3.5.4 Maintainability

### 3.5.5 Portability

**Chapter 4**

# 4 Formal Analysis using Alloy

## 4.1 Alloy model

### 4.1.1 Analysis results

## 4.2 Graph

**Chapter 5**

# 5 Effort Spent

The following tables summarize the effort spent by each member of the team to create the RASD document.

## 5.1 Leoni Luca

|  |  |
| --- | --- |
| **Description of the task** | **Hours** |
| Discussion about the Assignment 2020-2021 | 1 |
| Document structure and Scope and Purpose | 2 |
| Revision First chapter, Definition of Scenarios and Product Functions | 2 |
| Scenarios (5-6) | 1 |
| Definition of Use Case and related diagrams | 2 |
| Use Case and Sequence diagrams (draw.io) | 1 |
| User characteristics and Domain Assumptions | 2 |
|  |  |

## 5.2 Locarno Silvia

|  |  |
| --- | --- |
| **Description of the task** | **Hours** |
| Discussion about the Assignment 2020-2021 | 1 |
| Document structure and Scope and Purpose | 3 |
| Revision First chapter, Definition of Scenarios and Product Functions | 2 |
| Scenarios (3-4) | 1 |
| Definition of Use Case and related diagrams | 2 |
| Use Case and Sequence diagrams (draw.io) | 1 |
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## 5.3 Minotti Luca

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| **Description of the task** | **Hours** |
| Discussion about the Assignment 2020-2021 | 1 |
| Document structure and Scope and Purpose | 3 |
| Revision First chapter, Definition of Scenarios and Product Functions | 2 |
| Scenarios (1-2-7-8) | 2 |
| Definition of Use Case and related diagrams | 2 |
| Use Case and Sequence diagrams (draw.io) | 1 |
|  |  |
|  |  |

**Chapter 6**

# 6 References