Parking Garage Software

Software Requirements Specification

Revision History

Date	Revision	Description	Author
09/23/2024	1.0	Initial Version	Aric Adiego Rajvir Kaur Maji Pearson Leslie Scott Zackary Stephens
10/29/2024	1.0.1	Reformatted document to fix TOC	Aric Adiego
10/29/2024	1.1	Updated UML Class Diagram	Aric Adiego
10/29/2024	1.2	Switched references to “assigned” parking spots to “update the count of available spots”	Maji Pearson
10/29/2024	1.3	Fixed errors in UML Class Diagram	Aric Adiego
10/30/2024	1.4	Added Server, Client, and GUI to UML Class Diagram	Aric Adiego
11/17/2024	1.5	Updated UML Class Diagram	Aric Adiego

Table of Contents

1. Purpose

This document outlines the requirements for the Parking Garage Management System (PGMS).

1.1. Scope

The PGMS is designed to manage a network of parking garages, enabling customers to self-park for a fee, while employees handle the process of charging customers based on their parking duration. The system will track parking spots automatically, calculate fees, and generate usage reports. This Java-based application will have a GUI and will operate over TCP/IP without utilizing any external libraries or frameworks.

1.2. Definitions, Acronyms, Abbreviations

- **PGMS**: Parking Garage Management System
- **TCP/IP**: Transmission Control Protocol/Internet Protocol
- **GUI**: Graphical User Interface

1.3. References

- Appendix 1: Use Case Specification
- Appendix 2: UML Use Case Diagrams
- Appendix 3: Class Diagrams
- Appendix 4: Sequence Diagrams

1.4. Overview

The PGMS aims to provide an efficient and reliable solution for managing parking garage operations, allowing customers to self-park, while employees charge them based on their parking time. The system will handle the tracking of parking spots automatically.

2. Purpose

2.1. Product Perspective

The PGMS is a standalone software solution for parking garages, allowing real-time tracking of available spaces, fee calculation, and report generation. It is intended to work with a network of parking garages connected via TCP/IP.

2.2. Product Architecture

The system consists of two main modules:

- **Client Module**: A GUI-based application for customers and employees.
- **Server Module**: A central server that manages parking data, fee calculations, and report generation.

2.3. Product Functionality/Features

The high-level features of the system are as follows:

- Track available parking spaces.
- Calculate parking fees based on time spent.
- Employee interface to charge customers based on the system's calculations.
- Provide detailed reports on garage usage.

2.4. Constraints

- No external libraries, frameworks, or databases can be used without approval.
- The system must communicate using TCP/IP.
- No web or HTML components are permitted.

2.5. Assumptions and Dependencies

- Assumes a Java environment is available.
- The parking garages have the necessary network infrastructure.

3. Specific Requirements

3.1. Functional Requirements

3.1.1. Common Requirements

3.1.1.1. The system shall track the number of available parking spaces in real-time.
3.1.1.2. The system shall calculate parking fees based on the time the vehicle has been parked.
3.1.1.3. The system shall allow employees to charge customers using the calculated fees provided by the system.
3.1.1.4. The system shall generate daily, weekly, and monthly usage reports.

3.1.2. Client Module Requirements

3.1.2.1. Employee Interface (GUI)

- Charge customers based on their parking duration.
- View parking statuses, payment details, and transaction history.

3.1.2.2. Customer Interface

- Customers can see the amount of spots available, see the fee, park and exit/request to pay.

3.1.3. Server Module Requirements

- **Tracking Parking Spaces**: The server keeps track of all available, occupied, and reserved parking spots in real-time.
- **Managing Parking Durations**: It calculates entry and exit times for customers and determines the total fee.
- **Processing Payments**: When the client sends payment information, the server validates and records it.
- **Maintaining a Central Database**: The server acts as the central repository for all data, including employee actions, customer transactions, and usage reports.

3.2. External Interface Requirements

The system must provide a user-friendly GUI for customers to interact with and for employees to charge customers.

3.3. Internal Interface Requirements

- The client module must communicate with the server module over a TCP/IP connection.
- Data exchange between the client and server should be structured and efficient.

4. Non-Functional Requirements

4.1. Security and Privacy Requirements

- Only authorized employees should have access to administrative features.

4.2. Environmental Requirements

- The system should be able to operate in a networked environment with multiple garages.
- It should function correctly on systems running a Java environment.

4.3. Performance Requirements

- The system should process user commands (e.g., adding a car, generating a report) quickly.
- The system should support many users accessing the parking management system without performance degradation.
- The system should be able to process and store many new transactions per hour.
- The system should maintain uptime, allowing access and management at all times, except during maintenance.
- The system should be scalable to handle additional garages with minimal changes to the existing codebase.

Appendix 1: Use Case Specifications

- The goals of the customers are to generate tickets, process payment, and remove a vehicle.
- The employee will manage the parking spots, authenticate users, generate reports, and process payments.
- The payment system will process payments.
- The Parking garage system will manage the parking spaces, calculate fees, remove a vehicle, authenticate users, and generate reports
- The primary actors include customers, employees, the parking system, and the parking garage system

Use Case ID: UC1
Use Case Name: Ticket generation
Primary Actor: Employee or Customer
Pre-conditions:

- The user must be authenticated.
- The spot for parking needs to be present.

Post-conditions:

- Ticket generation
- The system updates the count of available spots

Basic Flow or Main Scenario:

1. The clients enter the garage.
2. The system checks in real time the parking spot availability.
3. A ticket is generated for the client.
4. The system updates the count of available spots.
5. The client can freely choose any unoccupied parking spot in the garage.
6. The user can view from the GUI the details of the ticket.

Alternate Flows:

- The client is notified if the garage is full in case no parking spots are present.

Exceptions:

- Invalid Ticket Details

Related Use Cases: UC3

Use Case ID: UC2
Use Case Name: Parking Spot Management
Primary Actor: Employee, Customer
Pre-conditions:

- The client is in the parking garage.
- The client has logged in to the system.
- There is an unoccupied parking spot.

Post-conditions:

- The parking system's available spots count is updated accordingly
- A ticket is generated with a timestamp.

Basic Flow or Main Scenario:

1. The clients enter the garage.
2. The system checks in real time the parking spot availability.
3. A ticket is generated for the client.
4. The system updates the count of available spots
5. The client can freely choose any unoccupied spot in the garage.
6. The customer views a printed ticket, which they may use later for exit or payment processing.
7. The user can view from the GUI the details of the ticket.

Alternate Flows:

- There are no spots available
- An error is recorded during ticket generation, prompting the process to restart.

Exceptions:

- System failure

Related Use Cases: UC3 and UC5

Use Case ID: UC3
Use Case Name: Payment processing
Primary Actor: Employee, Customer
Pre-conditions:

- The client wants to remove the car.
- The ticket has all the relevant details, and the parking fee is computed.

Post-conditions:

- The fee is paid.
- The transaction is logged.
- The spot is marked unoccupied.
- The revenue is updated.

Basic Flow or Main Scenario:

1. The clients pay for the tickets using their preferred mode.
2. The fee is computed based on the duration of the vehicle in the parking lot.
3. The payment is processed using the method used to pay for the fee.
4. The status of the parking spot is updated
5. The client receives a payment receipt.

Alternate Flows:

- Lack of funds

Exceptions:

- System failure

Related Use Cases: UC2

Use Case ID: UC4
Use Case Name: Generating reports
Primary Actor: System Admin
Pre-conditions:

- Admin logs to the system
- Monthly data is available.

Post-conditions:

- A comprehensive report is provided.

Basic Flow or Main Scenario:

1. The administrator logs into the system.
2. They generate reports, either a report on the availability of parking spaces or a revenue report.
3. The data is retrieved in the form of a text file.
4. The report is generated.

Alternate Flows:

- No data is selected

Exceptions:

- Corruption of data

Related Use Cases: UC2 and UC5

Use Case ID: UC5
Use Case Name: Removing car from the spot
Primary Actor: Employee, Customer
Pre-conditions:

- There is a valid ticket.

Post-conditions:

- The parking spot count in the garage is updated to reflect the spot as available.
- The client has exited the garage.

Basic Flow or Main Scenario:

1. The client offers a parking ticket to the machine or staff
2. The details of the ticket are retrieved by the system
3. The fees are computed, and the client pays
4. The system updates the count of available spots to reflect the freed space.
5. The client exits the garage.

Alternate Flows:

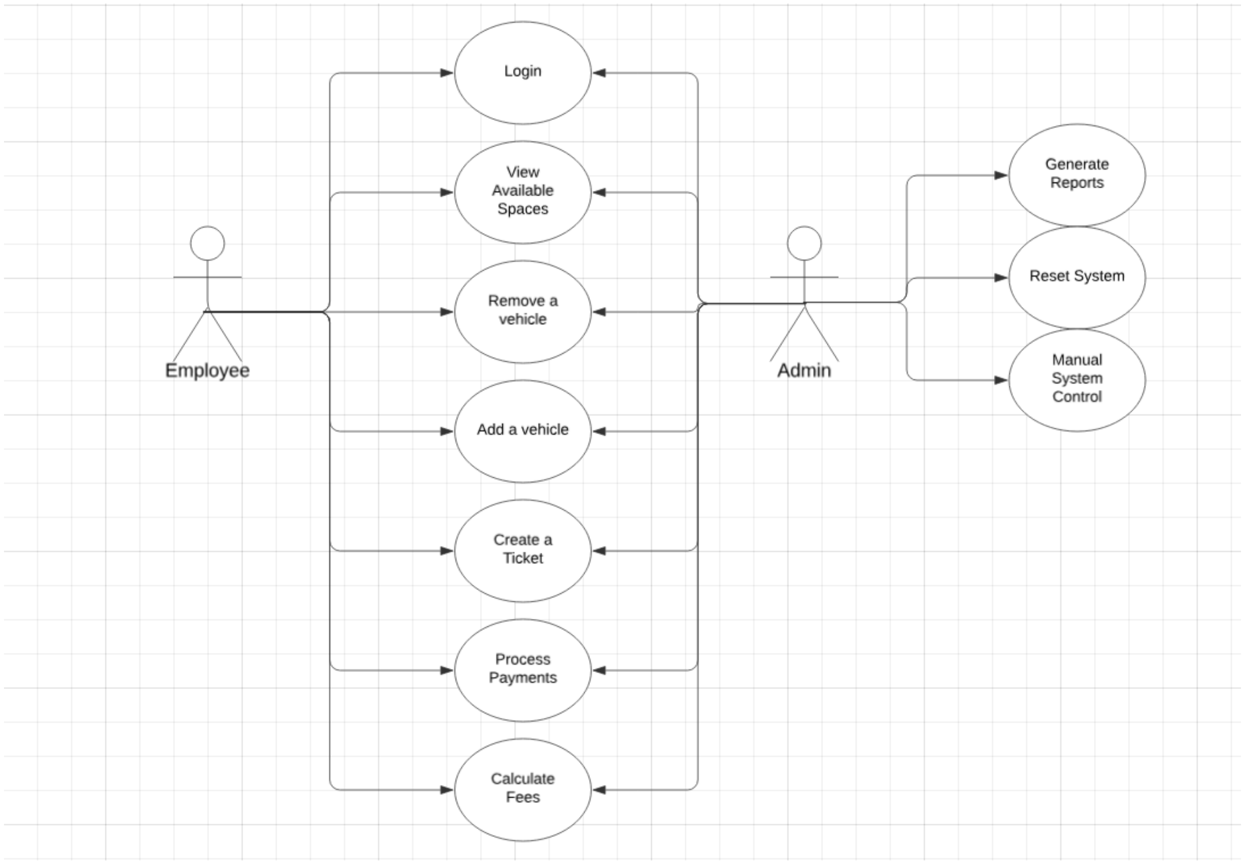
- Lost tickets requiring manual input

Exceptions:

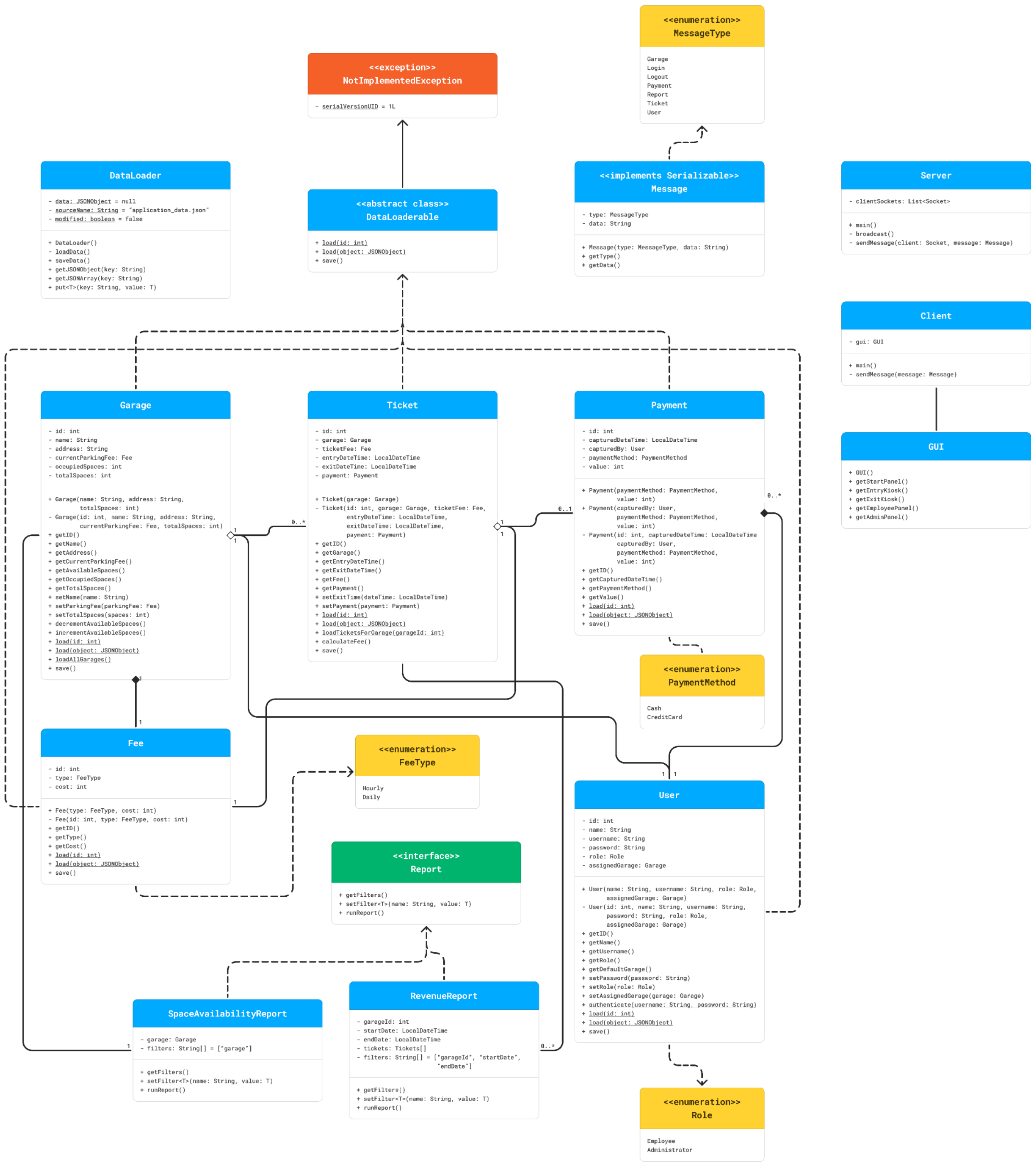
- N/A

Related Use Cases: UC2 and UC4

Appendix 2: UML Use Case Diagrams



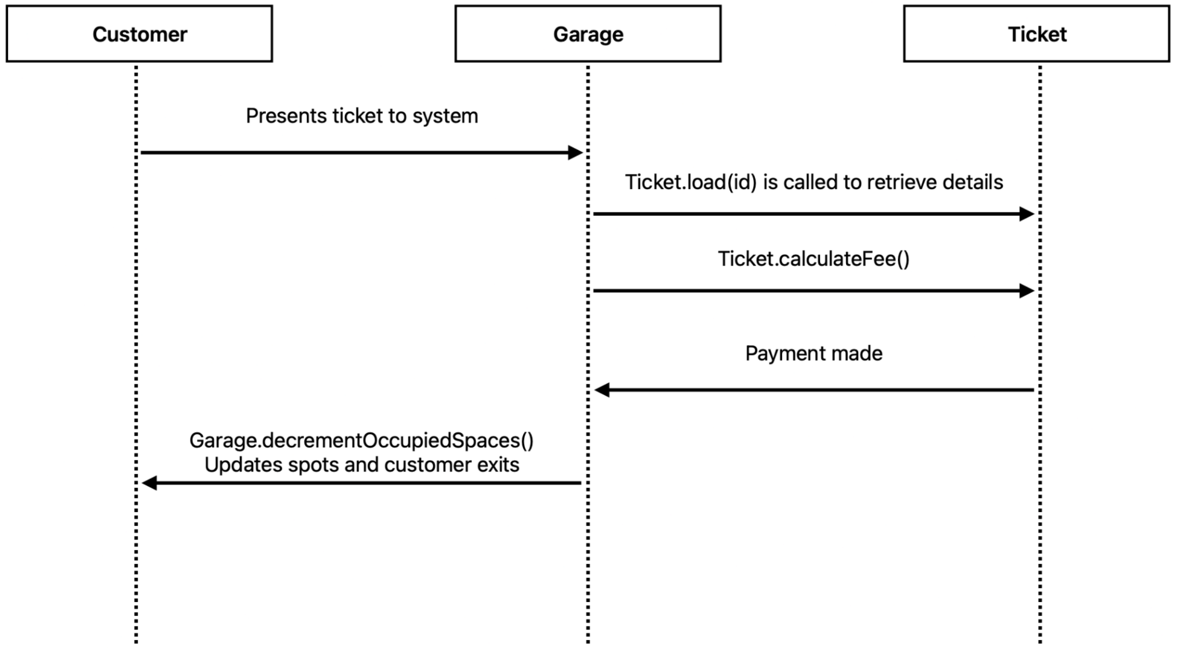
Appendix 3: Class Diagrams



<<exception>>
NotImplementedException
- serialVersionUID = 1L
<<enumeration>>
MessageType
Garage
Login
Logout
Payment
Report
Ticket
User
DataLoader
- data: JSONObject = null
- sourceName: String = "application_data.json"
- modified: boolean = false
+ DataLoader()
- loadData()
+ saveData()
+ getJSONObject(key: String)
+ getJSONArray(key: String)
+ put<T>(key: String, value: T)
<<abstract class>>
DataLoaderable
+ load(id: int)
+ load(object: JSONObject)
+ save()
<<implements Serializable>>
Message
- type: MessageType
- data: String
+ Message(type: MessageType, data: String)
+ getType()
+ getData()
Server
- clientSockets: List<Socket>
+ main()
- broadcast()
- sendMessage(client: Socket, message: Message)
Client
- gui: GUI
+ main()
- sendMessage(message: Message)
GUI
+ GUI()
+ getStartPanel()
+ getEntryKiosk()
+ getExitKiosk()
+ getEmployeePanel()
+ getAdminPanel()
Garage
- id: int
- name: String
- address: String
- currentParkingFee: Fee
- occupiedSpaces: int
- totalSpaces: int
+ Garage(name: String, address: String, totalSpaces: int)
- Garage(id: int, name: String, address: String, currentParkingFee: Fee, totalSpaces: int)
+ getID()
+ getName()
+ getAddress()
+ getCurrentParkingFee()
+ getAvailableSpaces()
+ getOccupiedSpaces()
+ getTotalSpaces()
+ setName(name: String)
+ setParkingFee(parkingFee: Fee)
+ setTotalSpaces(spaces: int)
+ decrementAvailableSpaces()
+ incrementAvailableSpaces()
+ load(id: int)
+ load(object: JSONObject)
+ loadAllGarages()
+ save()
Ticket
- id: int
- garage: Garage
- ticketFee: Fee
- entryDateTime: LocalDateTime
- exitDateTime: LocalDateTime
- payment: Payment
+ Ticket(garage: Garage)
- Ticket(id: int, garage: Garage, ticketFee: Fee, entryDateTime: LocalDateTime, exitDateTime: LocalDateTime, payment: Payment)
+ getID()
+ getGarage()
+ getEntryDateTime()
+ getExitDateTime()
+ getFee()
+ getPayment()
+ setExitTime(dateTime: LocalDateTime)
+ setPayment(payment: Payment)
+ load(id: int)
+ load(object: JSONObject)
+ loadTicketsForGarage(garageId: int)
+ calculateFee()
+ save()
Payment
- id: int
- capturedDateTime: LocalDateTime
- capturedBy: User
- paymentMethod: PaymentMethod
- value: int
+ Payment(paymentMethod: PaymentMethod, value: int)
+ Payment(capturedBy: User, paymentMethod: PaymentMethod, value: int)
- Payment(id: int, capturedDateTime: LocalDateTime capturedBy: User, paymentMethod: PaymentMethod, value: int)
+ getID()
+ getCapturedDateTime()
+ getPaymentMethod()
+ getValue()
+ load(id: int)
+ load(object: JSONObject)
+ save()
<<enumeration>>
PaymentMethod
Cash
CreditCard
Fee
- id: int
- type: FeeType
- cost: int
+ Fee(type: FeeType, cost: int)
- Fee(id: int, type: FeeType, cost: int)
+ getID()
+ getType()
+ getCost()
+ load(id: int)
+ load(object: JSONObject)
+ save()
<<enumeration>>
FeeType
Hourly
Daily
<<interface>>
Report
+ getFilters()
+ setFilter<T>(name: String, value: T)
+ runReport()
SpaceAvailabilityReport
- garage: Garage
- filters: String[] = ["garage"]
+ getFilters()
+ setFilter<T>(name: String, value: T)
+ runReport()
RevenueReport
- garageId: int
- startDate: LocalDateTime
- endDate: LocalDateTime
- tickets: Tickets[]
- filters: String[] = ["garageId", "startDate", "endDate"]
+ getFilters()
+ setFilter<T>(name: String, value: T)
+ runReport()
User
- id: int
- name: String
- username: String
- password: String
- role: Role
- assignedGarage: Garage
+ User(name: String, username: String, role: Role, assignedGarage: Garage)
- User(id: int, name: String, username: String, password: String, role: Role, assignedGarage: Garage)
+ getID()
+ getName()
+ getUsername()
+ getRole()
+ getDefaultGarage()
+ setPassword(password: String)
+ setRole(role: Role)
+ setAssignedGarage(garage: Garage)
+ authenticate(username: String, password: String)
+ load(id: int)
+ load(object: JSONObject)
+ save()
<<enumeration>>
Role
Employee
Administrator
1
1
0..*
1
1
0..1
0..*
1
1
1
1
1
1
0..*

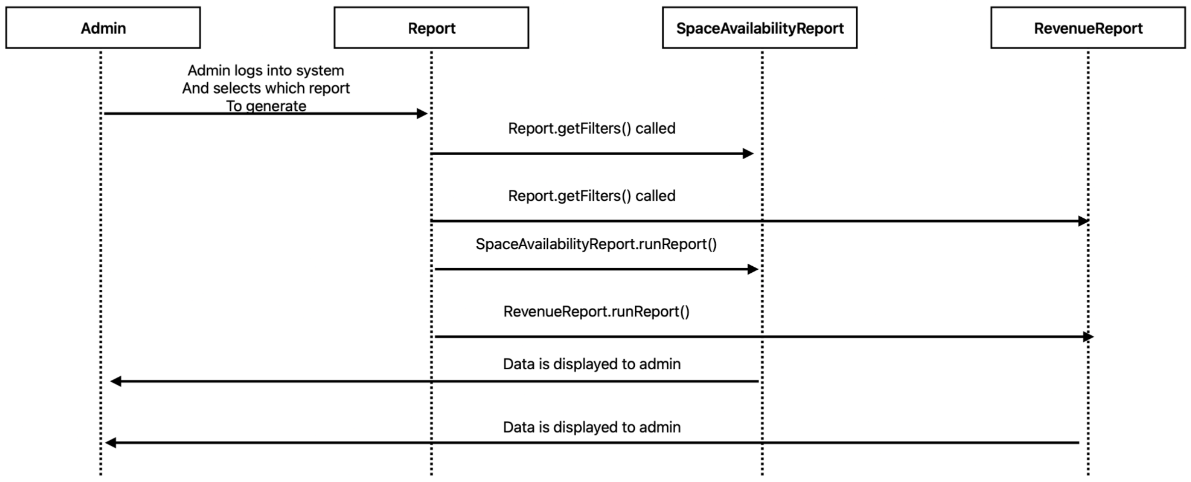
Appendix 4: Sequence Diagrams

Car Removal



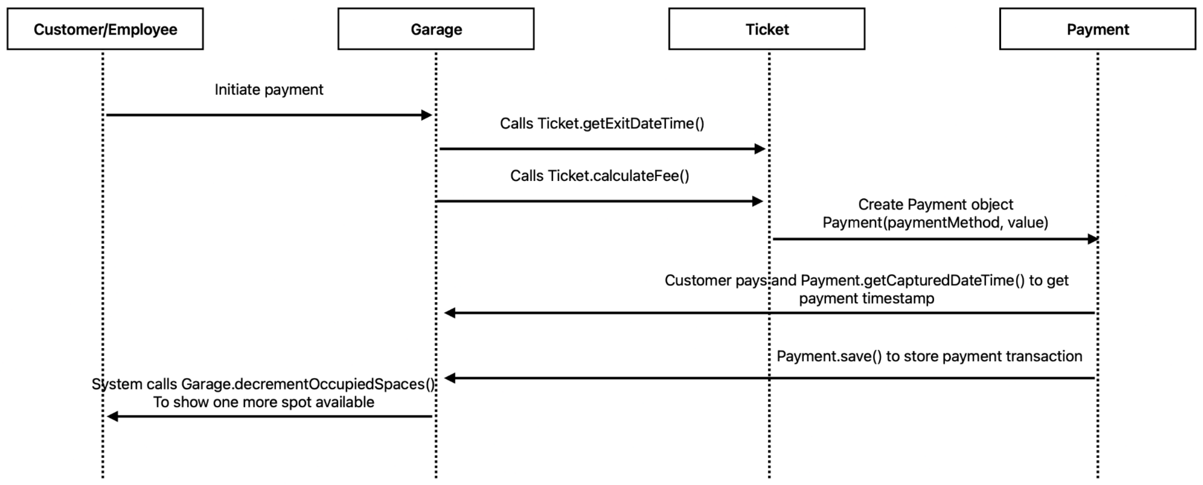
Customer
Garage
Ticket
Presents ticket to system
Ticket.load(id) is called to retrieve details
Ticket.calculateFee()
Payment made
Garage.decrementOccupiedSpaces()
Updates spots and customer exits

Report Generation



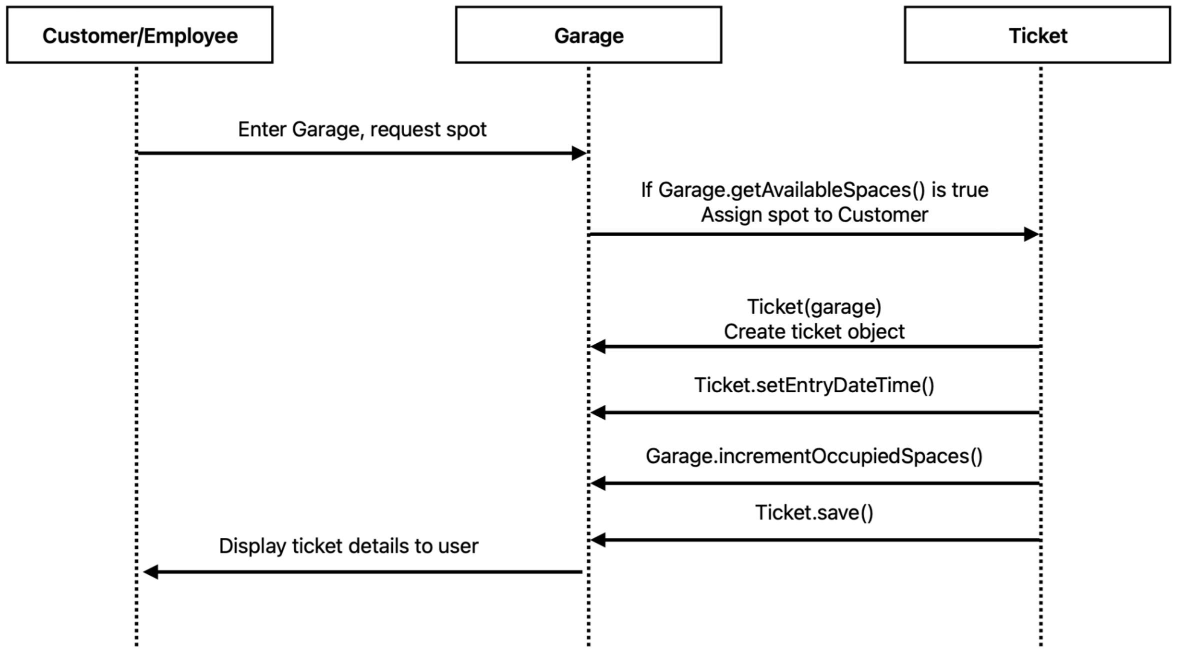
Admin
Report
SpaceAvailabilityReport
RevenueReport
Admin logs into system
And selects which report
To generate
Report.getFilters() called
Report.getFilters() called
SpaceAvailabilityReport.runReport()
RevenueReport.runReport()
Data is displayed to admin
Data is displayed to admin

Payment Processing



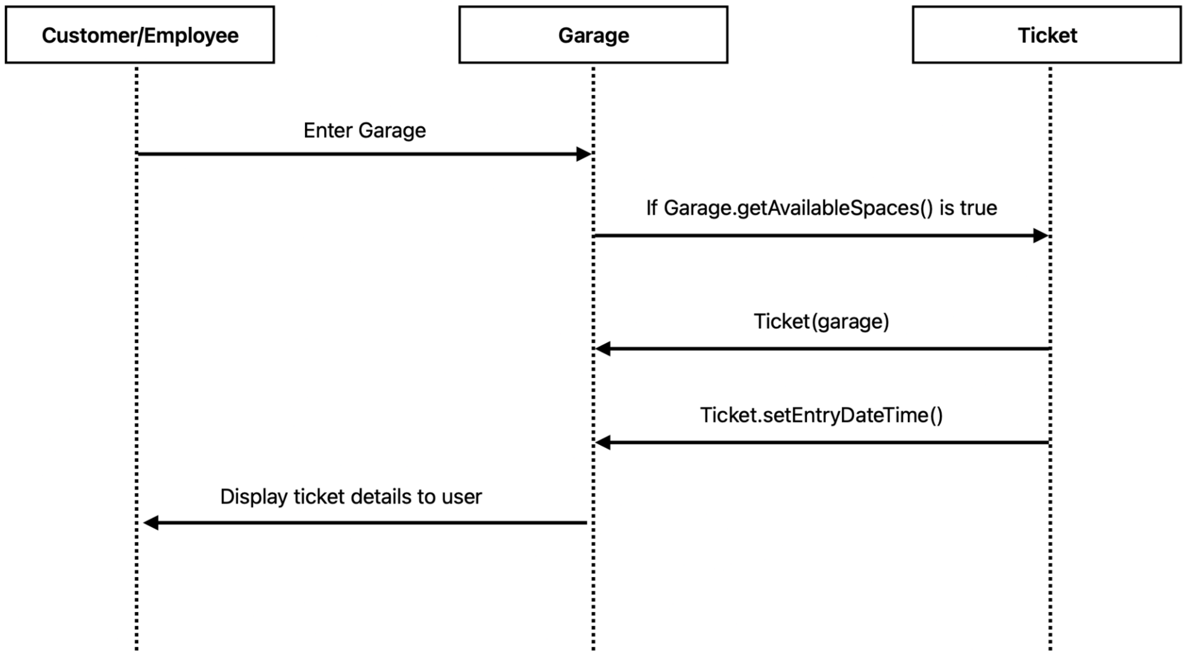
Customer/Employee
Garage
Ticket
Payment
Initiate payment
Calls Ticket.getExitDateTime()
Calls Ticket.calculateFee()
Create Payment object
Payment(paymentMethod, value)
Customer pays and Payment.getCapturedDateTime() to get payment timestamp
Payment.save() to store payment transaction
System calls Garage.decrementOccupiedSpaces()
To show one more spot available

Parking Spot Assignment



Customer/Employee
Garage
Ticket
Enter Garage, request spot
If Garage.getAvailableSpaces() is true
Assign spot to Customer
Ticket(garage)
Create ticket object
Ticket.setEntryDateTime()
Garage.incrementOccupiedSpaces()
Ticket.save()
Display ticket details to user

Ticket Generation


Customer/Employee
Garage
Ticket
Enter Garage
If Garage.getAvailableSpaces() is true
Ticket(garage)
Ticket.setEntryDateTime()
Display ticket details to user