
# Advanced Software Engineering

# Software Development of Online Theatre Ticket System


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# Contents

# Table of figures

# 1. Introduction

The aim of this project is to create a software application for Online Theatre Ticket system for a new movie theatre in Ealing that can be accessible via a mobile app or a website. Customers will be able to buy tickets online for the movie and theatre of their choice, as well as have some other facilities. For the development of this application we were asked to use plan driven development approach in this assignment. Plan driven development is an sequential process which includes all the phases of software development life cycle. The goal of this assessment is to develop application using customer given requirements, analysing, and implementing them. The scope of this assessment is to produce an algorithm which helps in decreasing single seat scattering in the theatre. This report shows the implementation of the application and the usage of plan driven development.

This report gives an overview of development of a web application for the topic Online Theatre Ticket System by following plan driven approach. This report comprises of the phases involved in plan driven development and has following sections; section 2 provides information about the work division among all the team members for successful completion of the application, section 3 explains the structure of plan driven development used, section 4 is an overview of requirements engineering where we investigate the requirements and expectations of our application, section 5 shows the system modelling where we designed different UML models for understanding aim of our application in detail, section 6 provides the implementation of the application, section 6 comprises of testing procedures used to test our application, section 7 and 8 includes conclusion describing the analysis of whole development process and the references.

## 2. Work Division

Planning of general structure which included UML drafting and selection technology stack of our project was discussed as a group during meeting throughout the lifecycle of the project.

- Hamza – Frontend engineer which performed wireframing that is matching the requirements and feature UI and UX aspects that compliment behaviour-driven development. Sourced and setup styling used within the websites, and coded visual elements.
- Chris – Frontend engineer responsible for handling website state management and flow of actions with the backend. Setup model-view-controller structure within the React environments alongside routing for different pages.
- Borys – Frontend engineer overseen progress and handled issues occurring between frontend and backend
- Yunus – Head engineer for backend functionality. Orchestrated cloud architecture and automated deployment to the cloud from our GitHub repository.
- Preethi – Backend engineering and responsible for ensuring tests are covering the whole functionality. Reviewed if test-driven development tests were in-line with behaviour-driven development specification.

## 3. Structure of the plan driven development

Development of different software products within given time and budget providing best quality is complex and many software companies follow an approach for developing software. One such approach is plan driven development. Plan driven development can be defined as a software development method which comprises of planning and developing all the requests which user needs. In this method, all the planning is executed in different levels. Plan driven approach is suitable to many software products because of its task specific levels, planning, gathering requirements, implementing those requirements, testing, and maintaining the software product. The most popular plan driven approaches are waterfall model, spiral model and DSDM. For our application, we used waterfall model to manage the development process. (Satyabrata, 2021)

Waterfall model can be defined as software development approach which comprises of various stages to emphasise starting to end of the project. It is a sequential approach which has the following phases:

- Planning
- Requirement Analysis
- Software Design
- Implementation
- Testing
- Maintenance

In this model, each phase should be completed to start the next phase. Waterfall model is advantageous as the customer requirements are gathered in the beginning and each member of team know what is needed to be done. It is also beneficial to calculate the time and duration to complete the software development. These waterfall model steps of our project are explained in below sections in detail. (The Manager's Guide to Mixing Agile and Waterfall, n.d.)

The below figure shows the waterfall model approach used for our project:

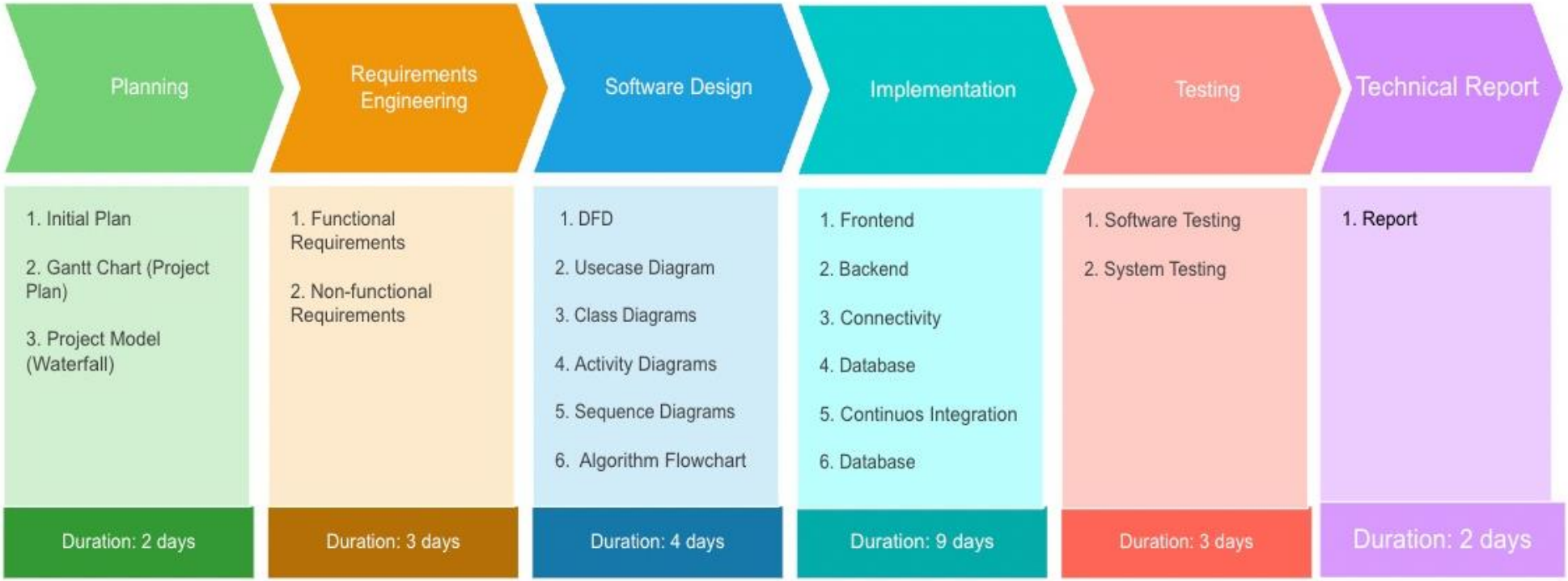
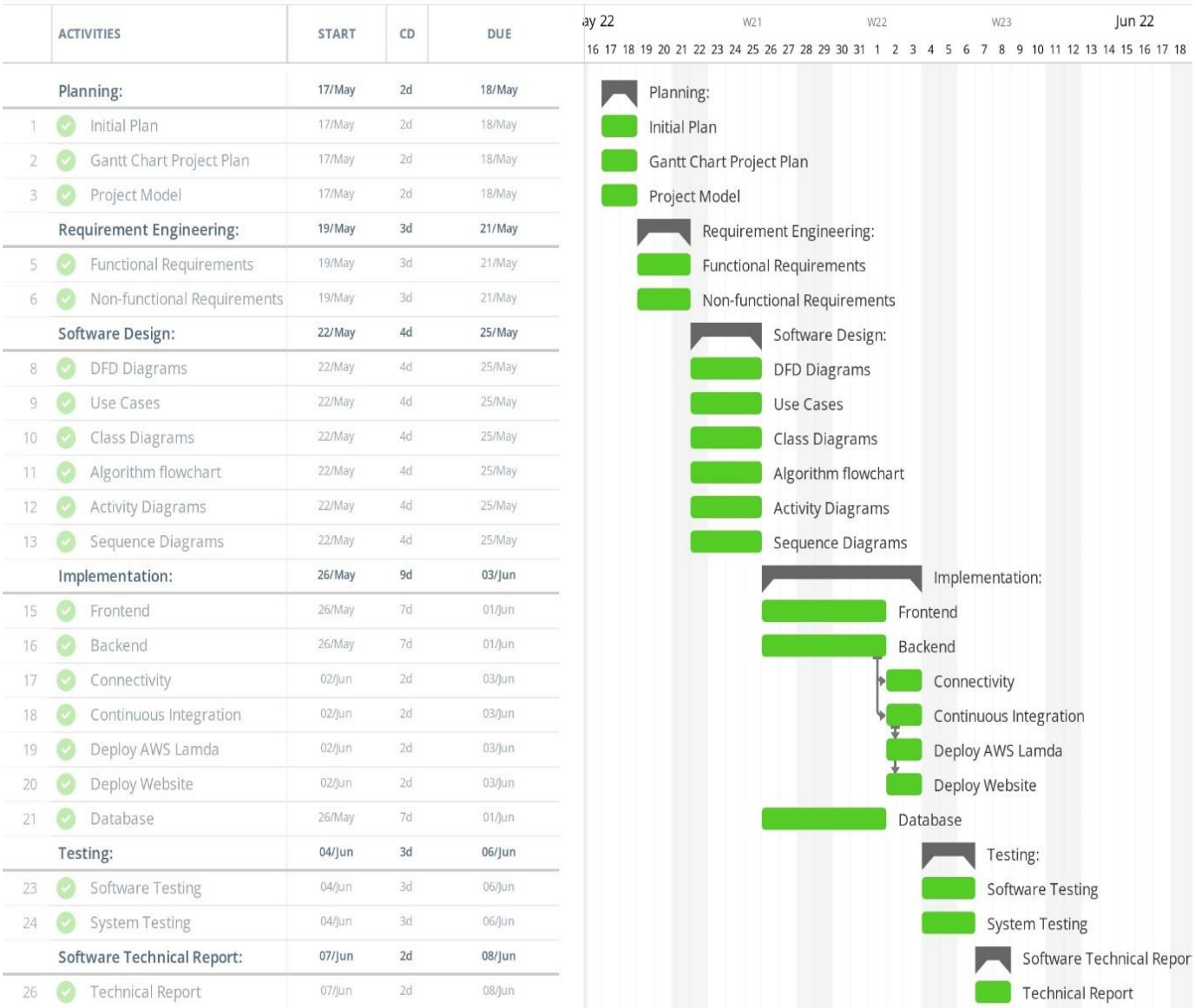



*Figure 1 - Plan Driven Approach*

To further explain, the usage of waterfall model and structure of our project, we have made a project schedule with Gantt chart. Gantt chart can be defined as a bar chart which is used to display project schedule, it includes the tasks and duration. This Gantt chart helped in planning our work, deadlines, and resources. The below figure shows the structure of our project with deadlines and the waterfall model steps,



| | ACTIVITIES | START | CD | DUE |
|---|---|---|---|---|
| | Planning: | 17/May | 2d | 18/May |
| 1 | Initial Plan | 17/May | 2d | 18/May |
| 2 | Gantt Chart Project Plan | 17/May | 2d | 18/May |
| 3 | Project Model | 17/May | 2d | 18/May |
| | Requirement Engineering: | 19/May | 3d | 21/May |
| 5 | Functional Requirements | 19/May | 3d | 21/May |
| 6 | Non-functional Requirements | 19/May | 3d | 21/May |
| | Software Design: | 22/May | 4d | 25/May |
| 8 | DFD Diagrams | 22/May | 4d | 25/May |
| 9 | Use Cases | 22/May | 4d | 25/May |
| 10 | Class Diagrams | 22/May | 4d | 25/May |
| 11 | Algorithm flowchart | 22/May | 4d | 25/May |
| 12 | Activity Diagrams | 22/May | 4d | 25/May |
| 13 | Sequence Diagrams | 22/May | 4d | 25/May |
| | Implementation: | 26/May | 9d | 03/Jun |
| 15 | Frontend | 26/May | 7d | 01/Jun |
| 16 | Backend | 26/May | 7d | 01/Jun |
| 17 | Connectivity | 02/Jun | 2d | 03/Jun |
| 18 | Continuous Integration | 02/Jun | 2d | 03/Jun |
| 19 | Deploy AWS Lamda | 02/Jun | 2d | 03/Jun |
| 20 | Deploy Website | 02/Jun | 2d | 03/Jun |
| 21 | Database | 26/May | 7d | 01/Jun |
| | Testing: | 04/Jun | 3d | 06/Jun |
| 23 | Software Testing | 04/Jun | 3d | 06/Jun |
| 24 | System Testing | 04/Jun | 3d | 06/Jun |
| | Software Technical Report: | 07/Jun | 2d | 08/Jun |
| 26 | Technical Report | 07/Jun | 2d | 08/Jun |



*Figure 2 - Gantt Chart*

# 4. Requirements Engineering

Requirement engineering can be explained as a procedure of investigating the needs, documenting it, and managing our software system requirements which can be used in design process and in implementation (JavaTPoint, 2021). Requirements engineering is beneficial to understand the function of the application, how the end product should be and how it performs. While analysing system requirements all the team members discussed and have listed the requirements and understood what needs to be done. We defined requirements in two different categories:

## Functional Requirements

Functional requirements can be referred as a requirement to define the system and its components. The main aim of functional requirements is to describe how our software should work (Chitrasingla, 2021). Few functional requirements for our application are given below:

1. Guest shall be able to login – a guest of website must have the option to login to the system if he is already registered
2. Visitor shall be able to register – a visitor of website must be able to register to system
3. Visitor shall be able to view movie list – a movie list should be visible for visitor without any criteria fulfilled
4. Guest shall be able to view the seating plan per theatre – a seating plan can be viewed only by the guest not the visitor
5. Anyone can view all performances per theatre with dates and prices – a list of all performances, in all locations, should be available to be seen by anyone
6. Only registered members shall be able to buy tickets – a guest should be logged in and be registered member in order to make the payment and secure his booking
7. Members shall be able to choose seat as per his choice – a guest can choose any seat to his likeness according to the amount of the party he is booking and following app's algorithm to prevent scattering
8. Members shall be able to pay online – a booking payment should be able to complete with and online payment
9. Customer shall be able to cancel tickets – customers must be able to amend or cancel their booking through their account.

10. Admin shall be able to add/delete/modify performances – the administrator should be able to add delete and modify performances according to new events, popularity, and sales
11. Staff should be able to book tickets for customers – customers with no access to online bookings, should have the option to call or visit and staff should be able to book a ticket for them.

## Non-functional Requirements

It can be referred as a requirement that mainly focus on the quality of the application. The aim of non-functional requirements is to give information on how system performs (Chitrasingla, 2021). Few non-functional requirements for our application are given below:

1. Client should receive a booking reference after successful booking – after the completion of a booking, a customer should receive a confirmation of booking, providing a reference number.
2. A ticket should not be able to be cancelled in less than 24 hours – a customer should be able to manage his booking and cancel it but if he tries to do it in less than 24 hours, system should not allow it as it's too close to the show time.
3. Web application should be loaded within 10 seconds when the application is running.

# 5. System Modelling

System modelling helps in designing a conceptual model to describe a different perspective or view of the system (Tutorial Space, 2021) . System modelling is represented in pictorial or graphical way using unified modelling language (UML). In this phase, we created different system models by taking the above functional requirements in consideration. Below few UML diagrams are provided for online theatre ticket system.

## 5.1 Data Flow Diagrams

Data flow diagrams are used to understand the flow of information of the system. For our application, we used dataflow diagrams to show the interaction between system and external entities (Lucidchart, 2021). There are multi-level DFD's however, in this section level 0 is given which is then levelled up to level 1 diagram. These diagrams have different shapes to describe different functionalities.

Level-0 DFD is also referred as context diagram, it gives overview of whole process and relationship between external entities, below diagram shows context diagram of online theatre ticket system,

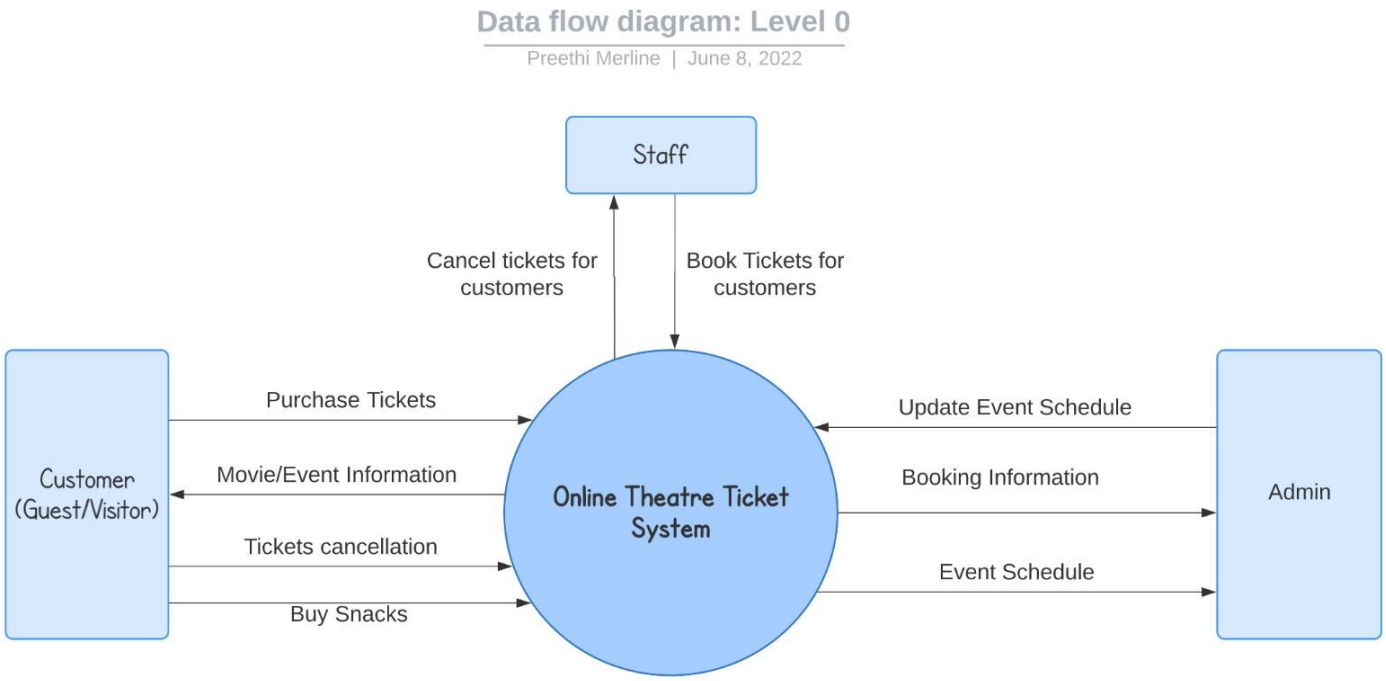



*Figure 3 - Level 0 DFD*

The above level-0 DFD is further split into level-1 DFD which has different process to provide detailed information of functions present in the system. Below diagram shows the levelled up 1 DFD.

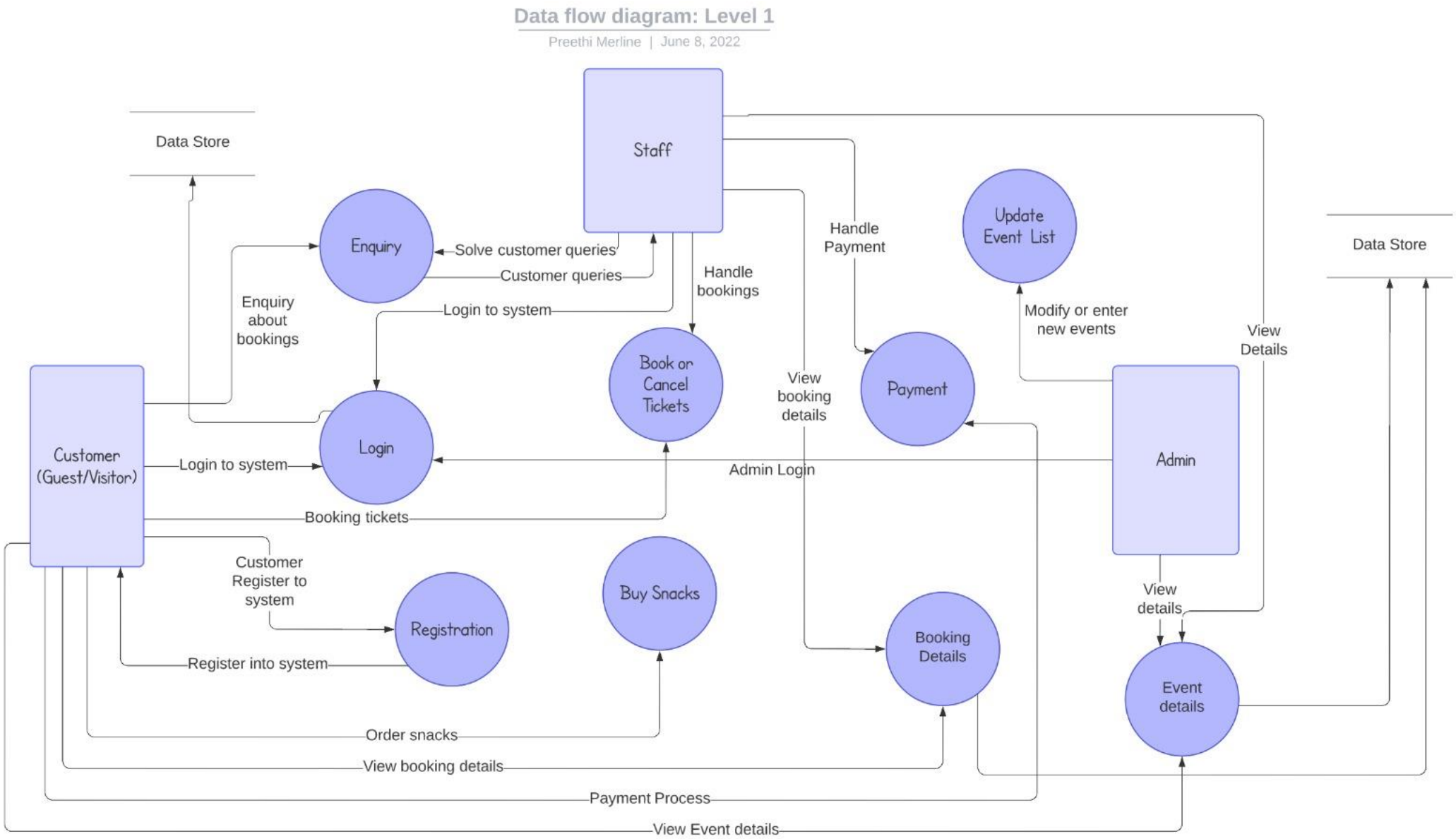



*Figure 4 - Level-1 DFD*

## 5.2 Use Case Diagram

Use Case diagram uses the above-mentioned functional requirements which system needs to fulfil and analyse it. Here all high-level requirements are considered as use cases and it shows relationship between its requirements with different actors present in system and association between them (Tallyfly, 2021). Below the use case diagram of online theatre ticket system is given.

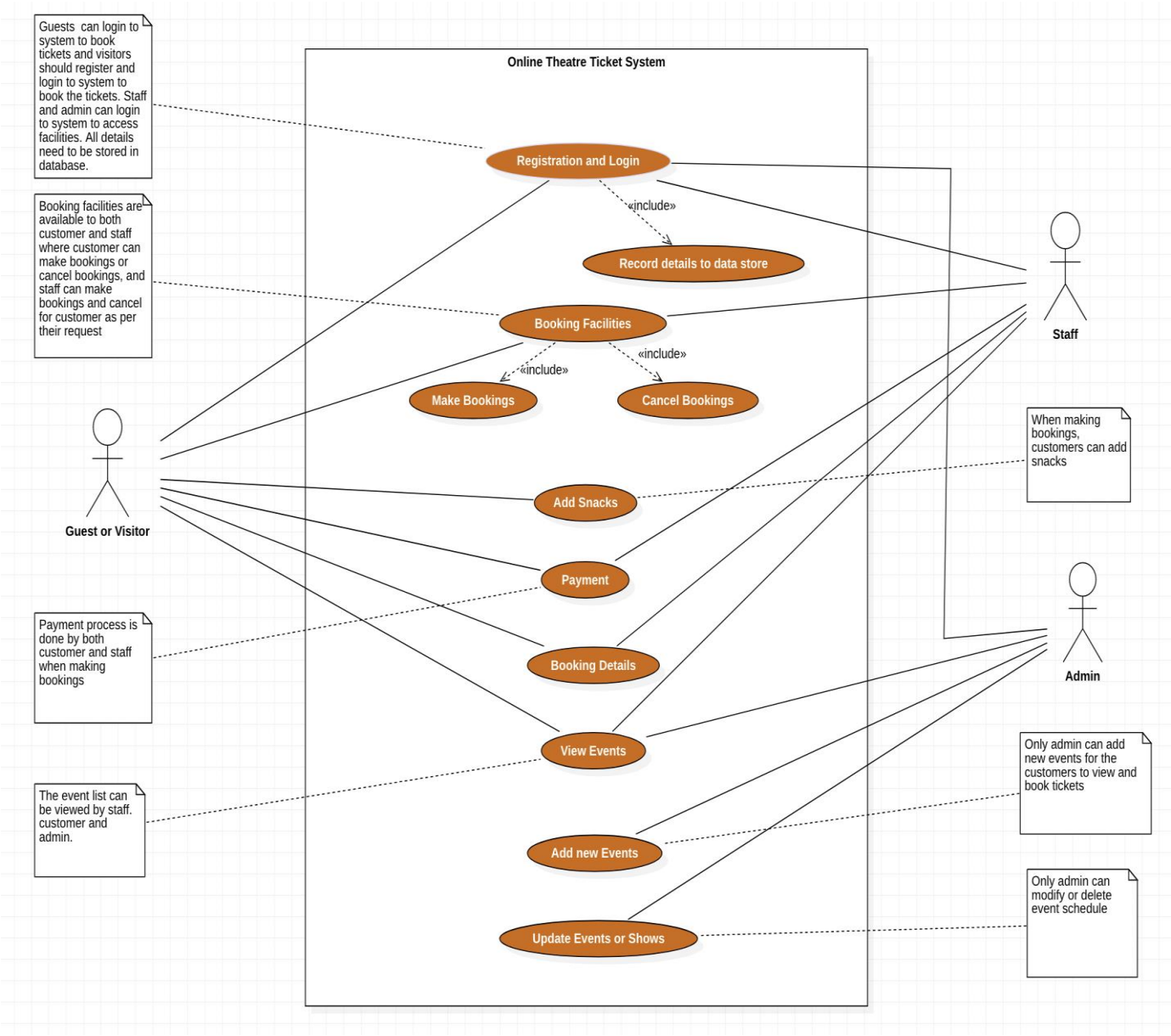



*Figure 5 - Use Case Diagram*

## 5.3 Activity Diagrams

Activity diagram is widely used to describe the business process model by giving information about flow of activities which can be parallel or sequential, it even describes relationships, conditions of the system (Tallyfly, 2021). Below 3 activity diagrams are given which gives details about flow of activities involved for customer, staff, and the admin. The customer here is guest/visitor, and this activity diagram shows activities of the customer to book events, cancel, register, login, adding snacks, and payment.

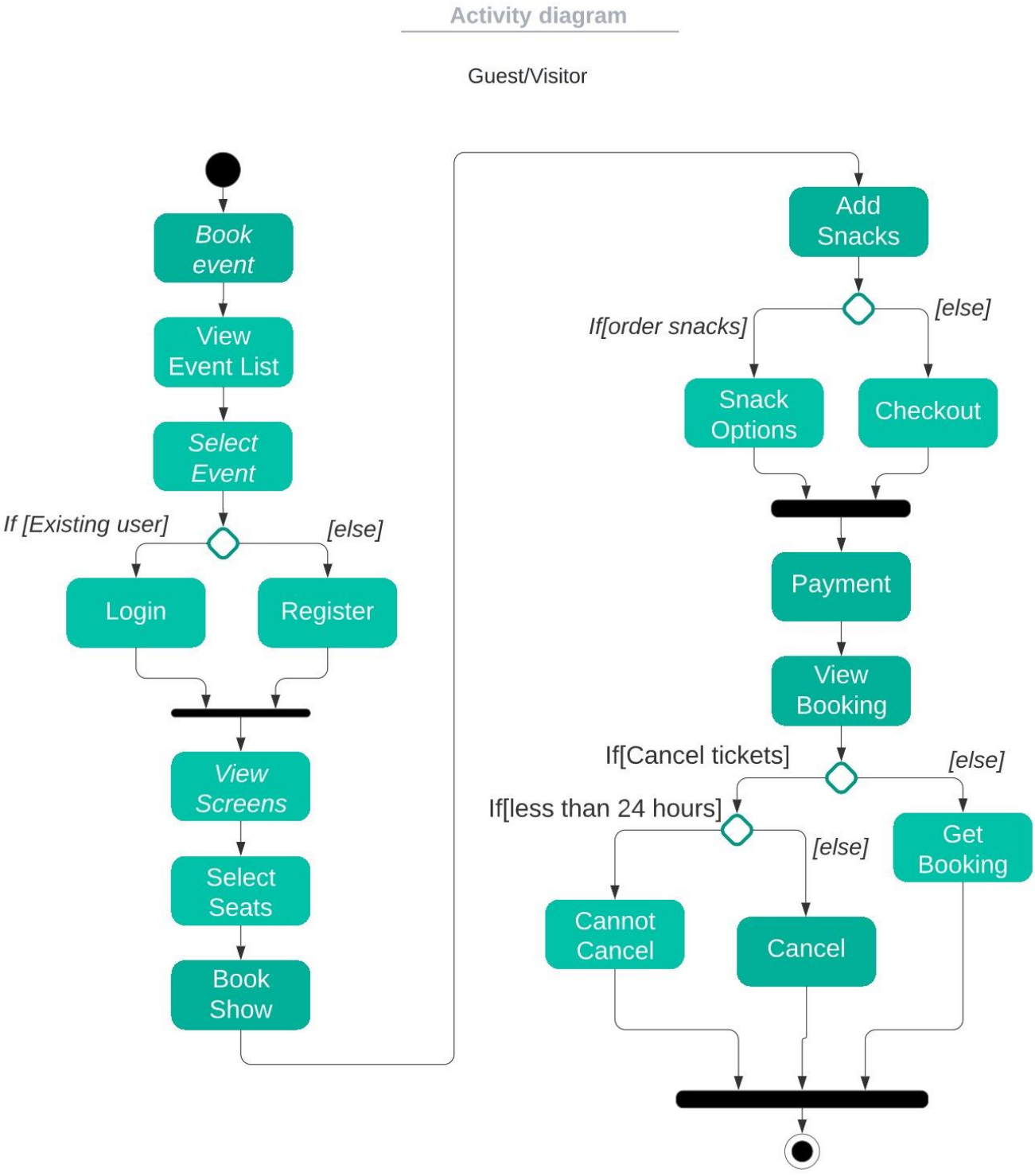



*Figure 6 - Guest/Visitor Activity Diagram*

The next diagram is the staff activity diagram which explains the actions of staff which are logging in, booking, or cancelling tickets as per customers request and other conditions as shown below.

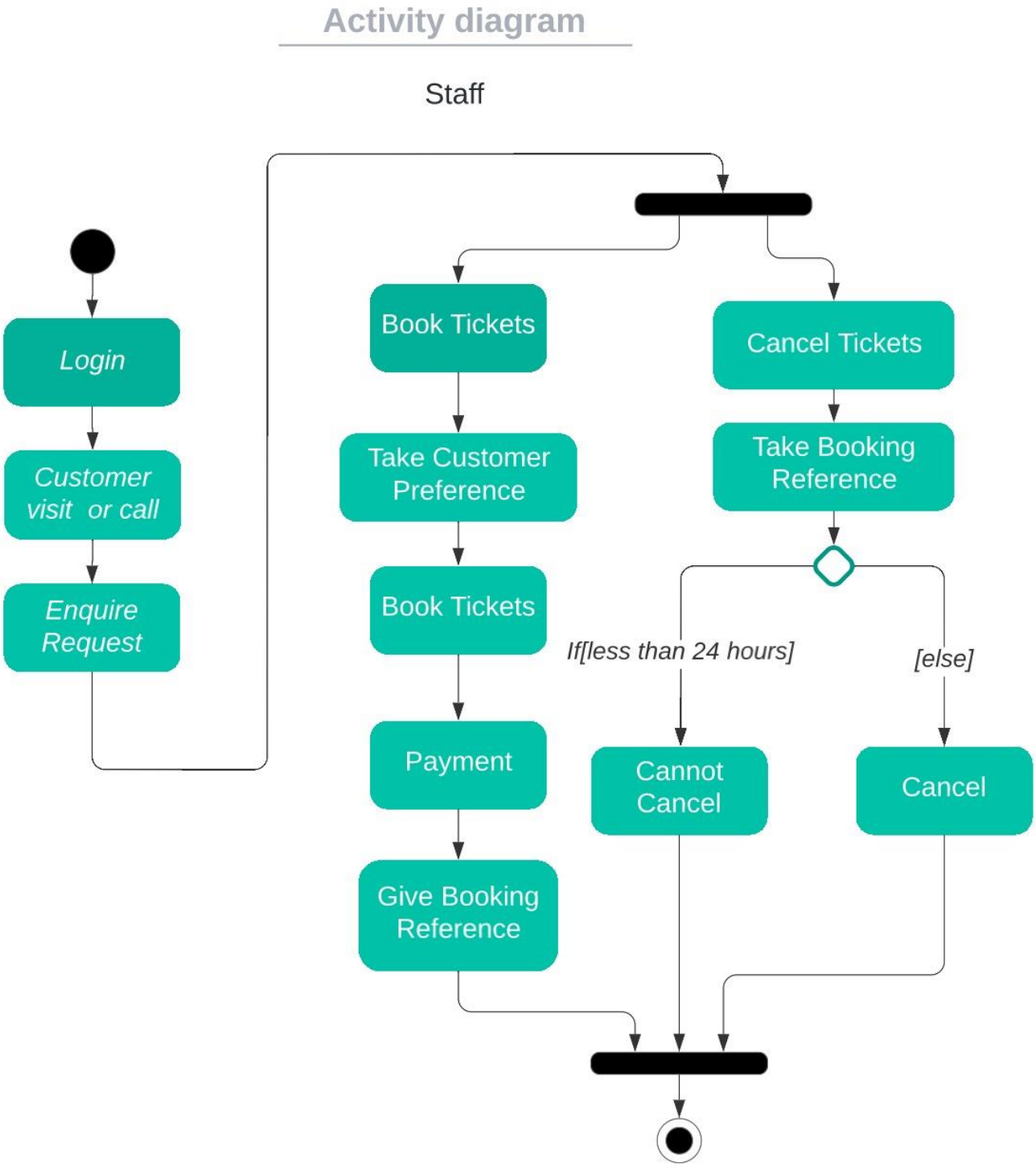



*Figure 7 - Staff Activity Diagram*

The below figure shows the admin activities and its flow in the system and demonstrates the business process.

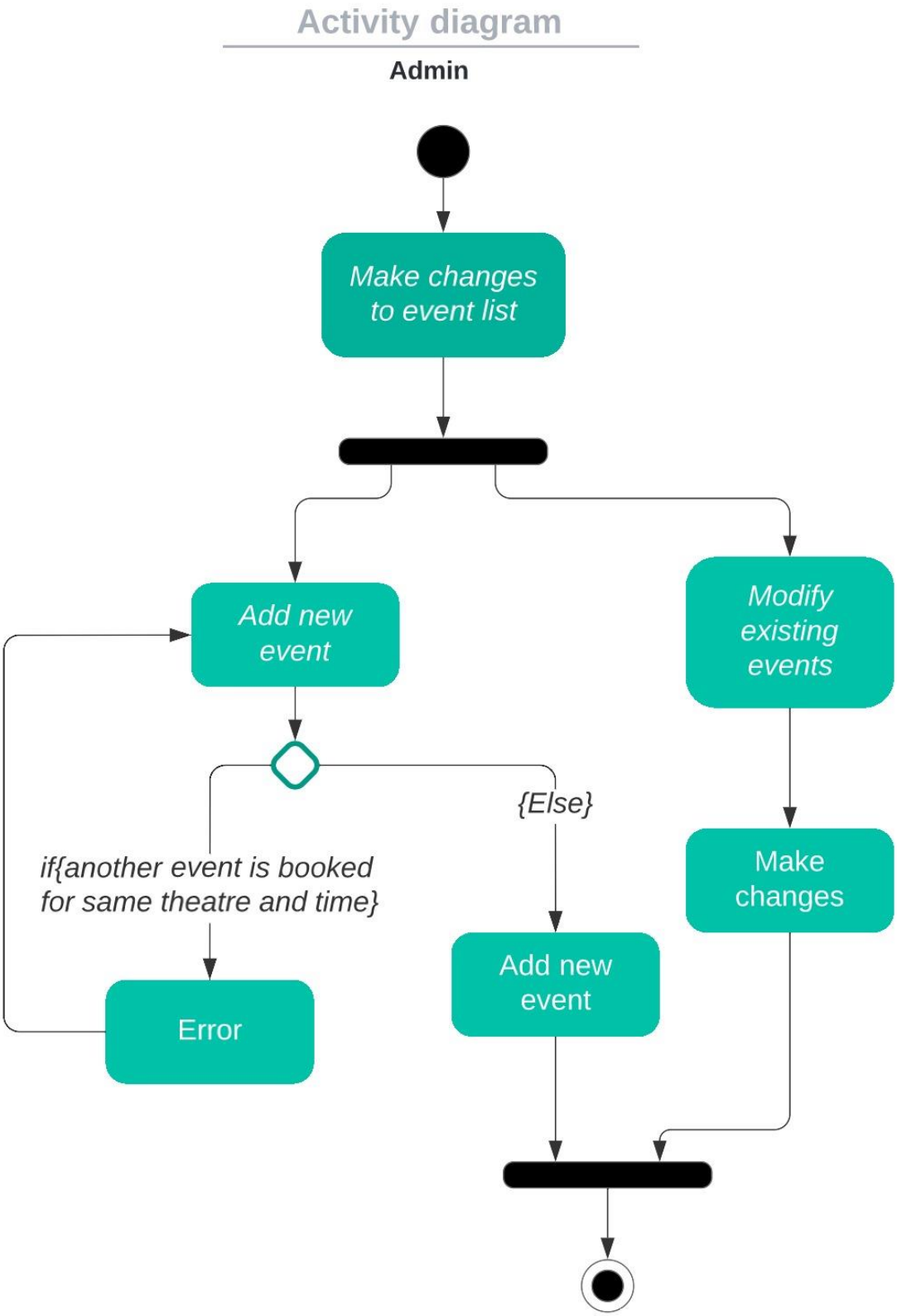



*Figure 8 - Admin Activity Diagram*

## 5.4 Sequence Diagrams

Sequence diagram is another widely used UML model which describes the behaviour of the system. This diagram shows the interaction between the system objects. These interactions have an order and are sequential between system components and the actors. There can be multiple objects or actors in a sequence diagram to support the system interaction (Tallyfly, 2021). This part consists of 4 sequence diagrams, each describing the behaviour of visitor (who is using the system for first time), member (an existing user), staff and the admin.

The below diagram is the staff diagram which shows the interaction of staff with the system and the customer showing its functionalities,

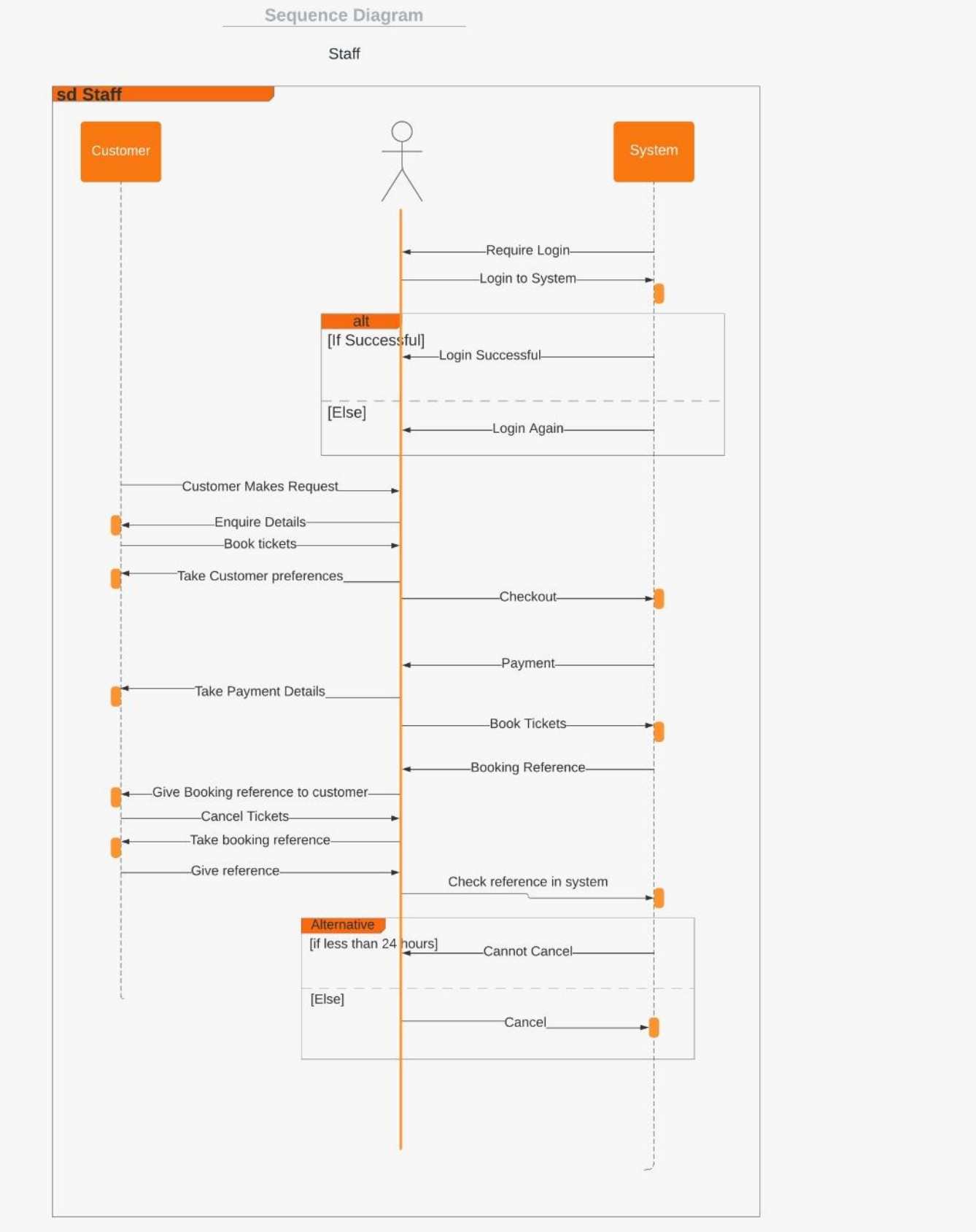



*Figure 9 - Staff Sequence Diagram*

The below diagrams are the visitor and member sequence diagrams which explains the customer behaviour of the system and shows the interaction and flow between customer with the system,

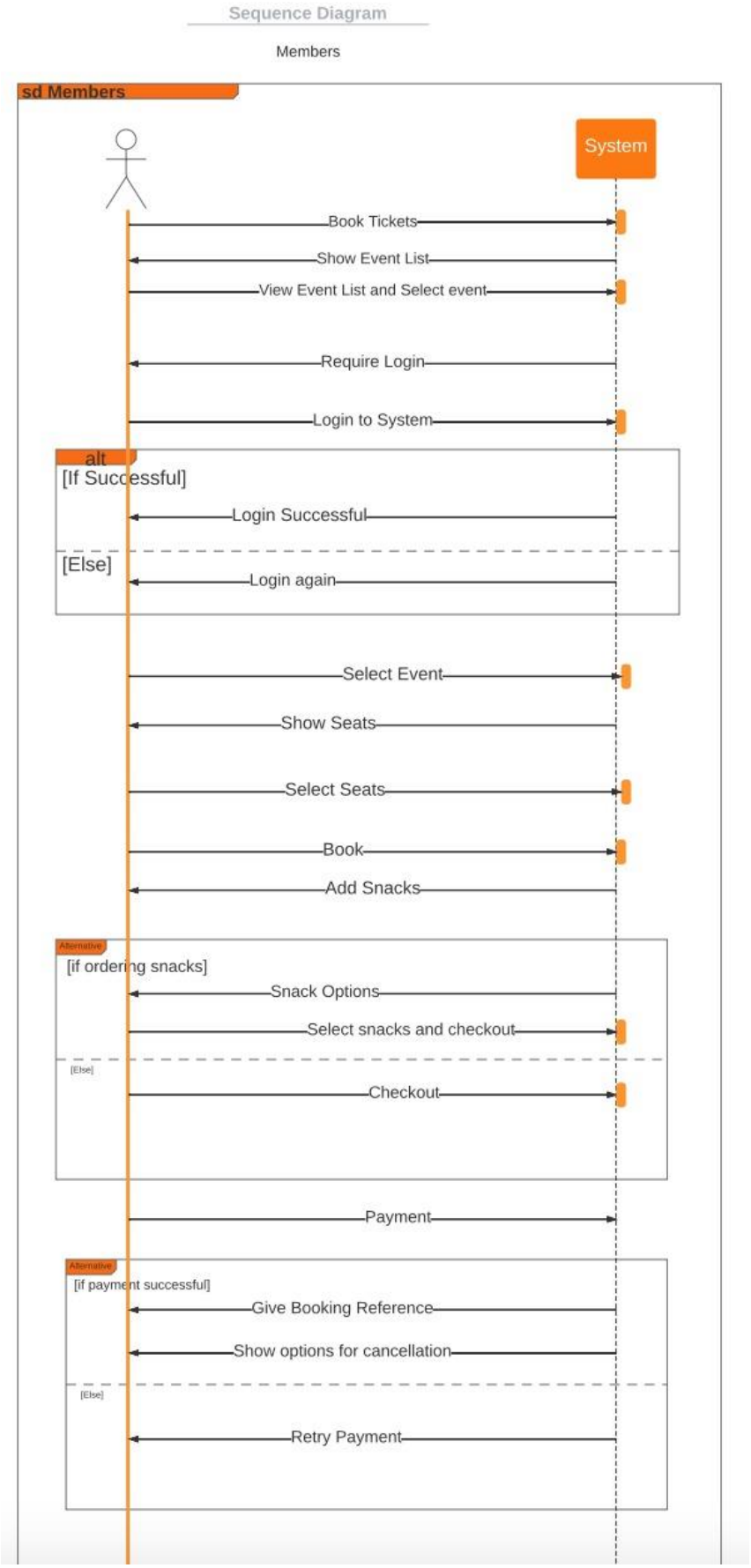



*Figure 10 - Member Sequence Diagram*

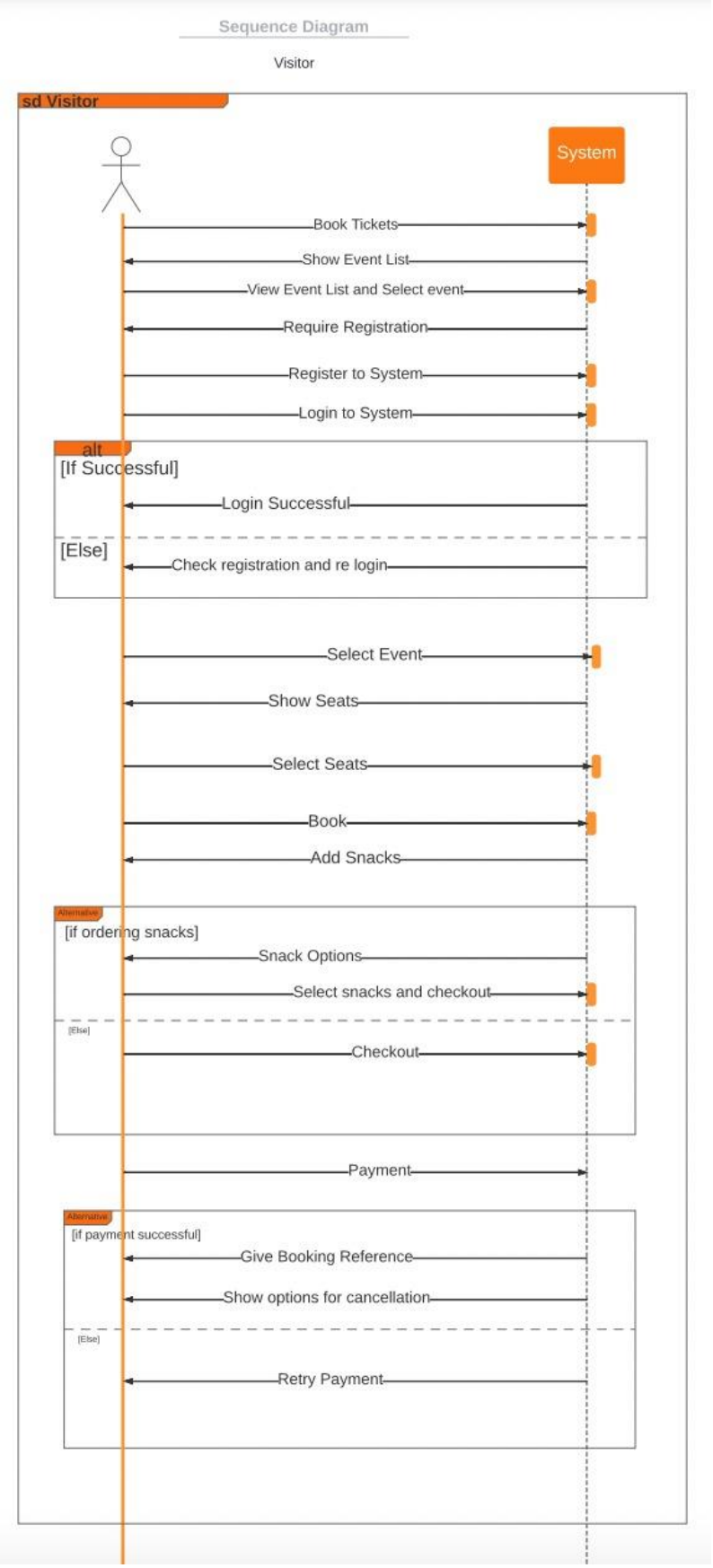



*Figure 11 - Visitor Sequence Diagram*

The next sequence diagram gives an overview of admin interaction with system and shows behaviour of admin and how he manages the application by adding events and other activities as shown below,

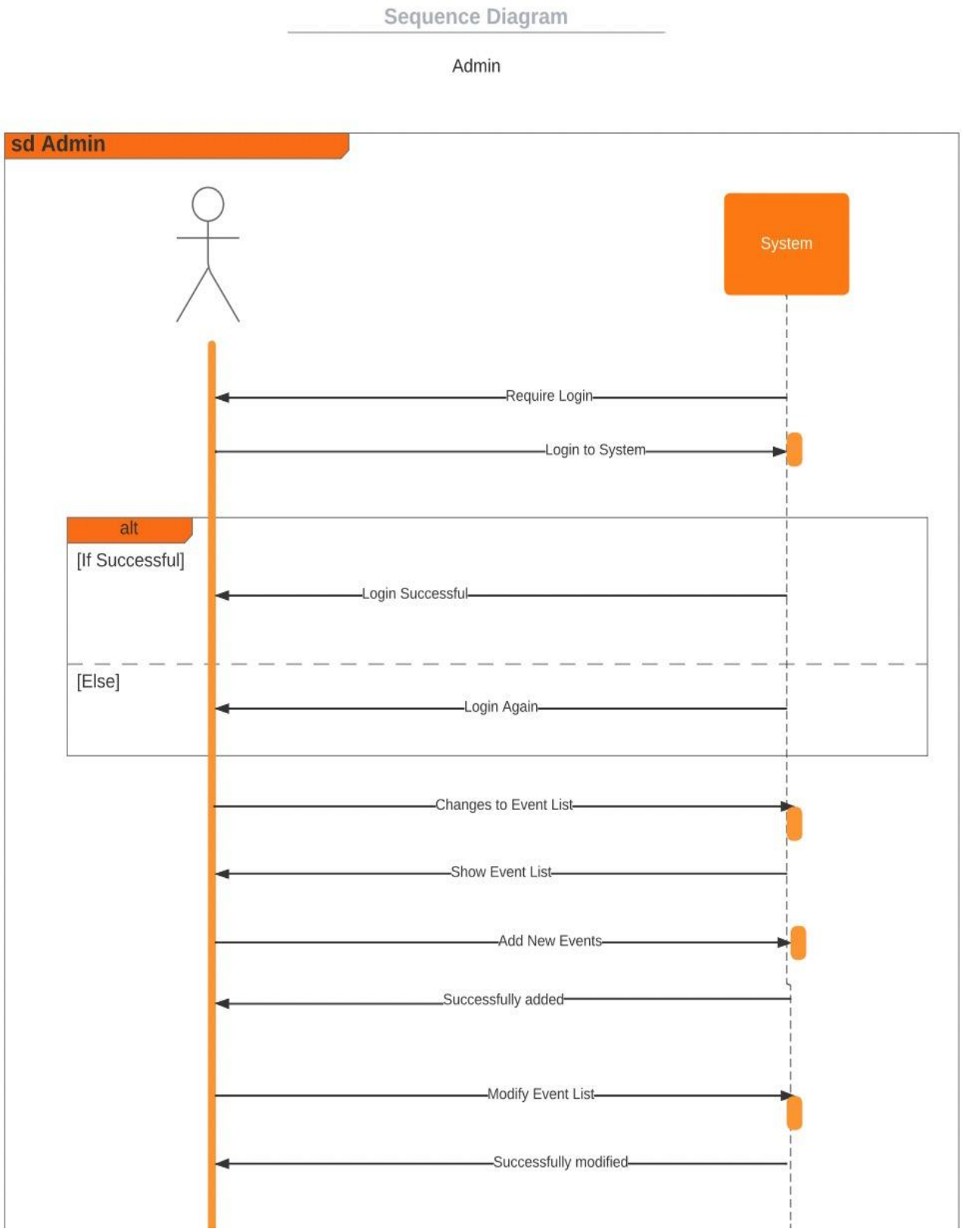



*Figure 12 - Admin Sequence Diagram*

## 5.5 Class diagrams

Class diagrams are most important structural UML model which helps in describing and developing the structure of the application. It helps and gives a path for the implementation phase. Class diagram follows the object-oriented concepts and consists of relationships and classes. In this section, we did 2 class diagrams, one showing the business concept model and other business type model.

The business concept model gives an overview of describing the business processes present and the organisation structure. It is an optimised class diagram (Tallyfly, 2021). The below figure shows the business concepts.

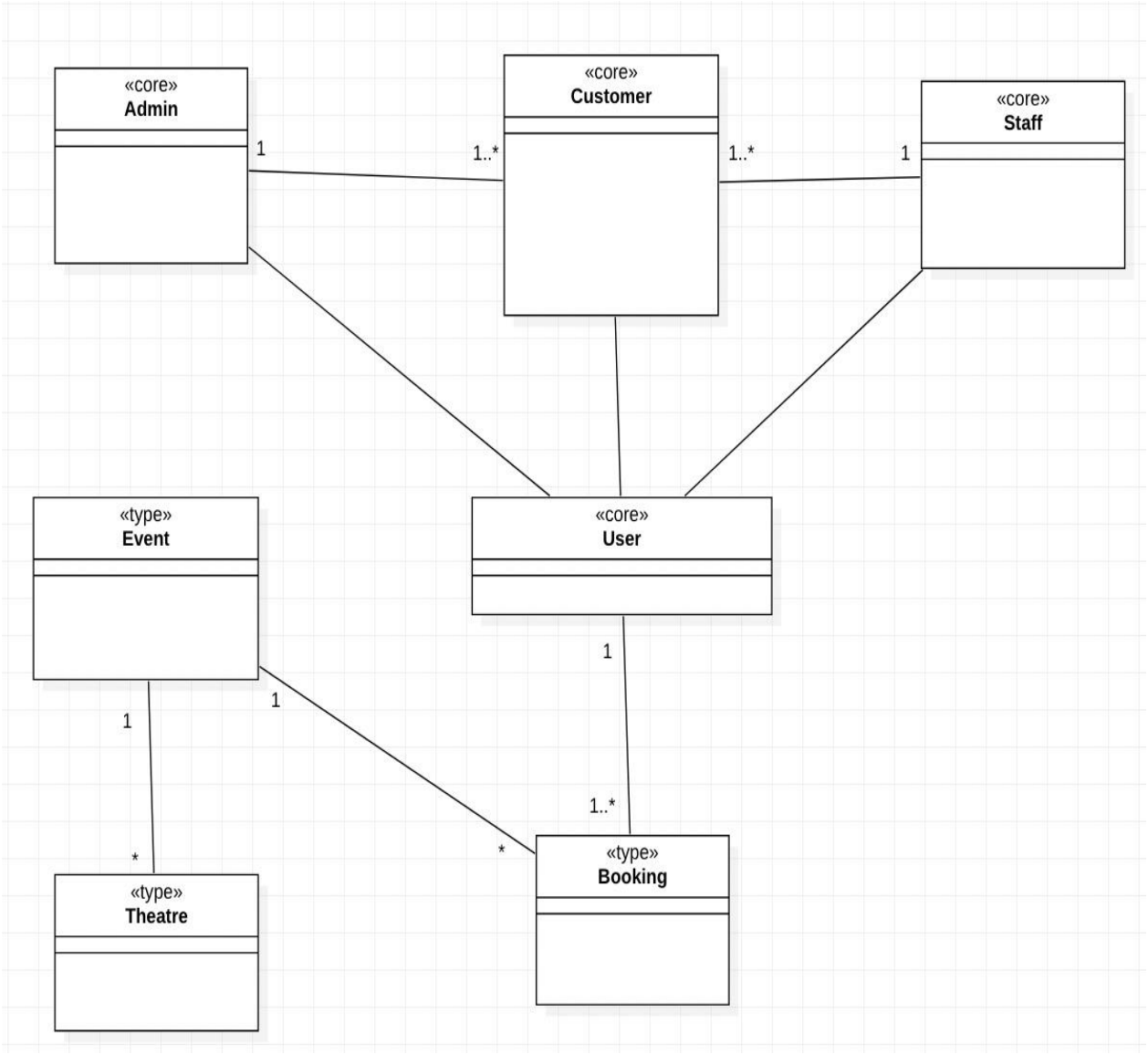



*Figure 13 - Business Concept Model (Class Diagram)*

The business type model can be defined as a static model which provides a static perspective or view of a system. This diagram shows classes, its attributes, operations, and relationship between the classes in a

detailed way (Tallyfly, 2021). Business type model is like an extension of business concept model. It creates the structure of the system. The below figure shows the business type model.

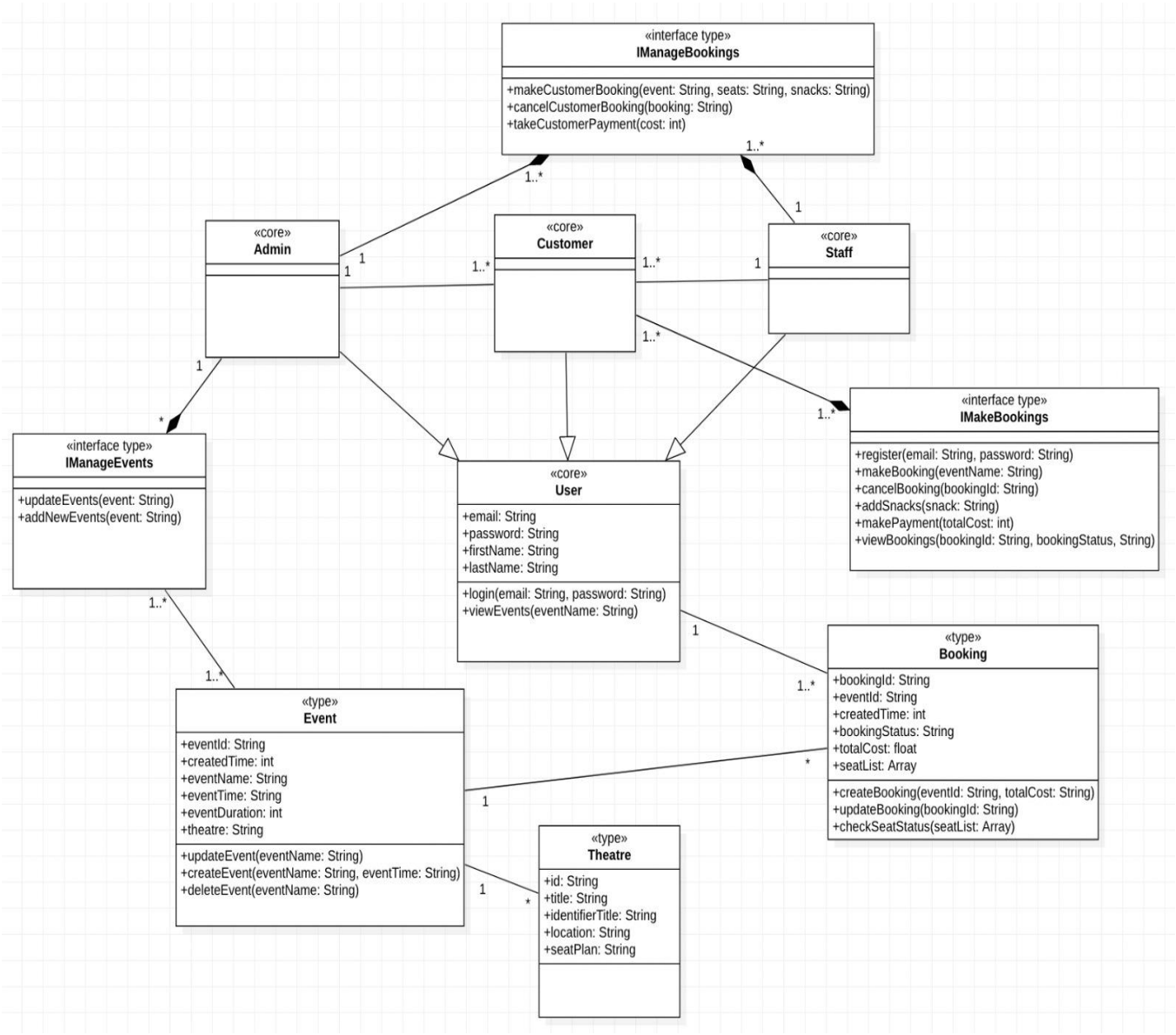



*Figure 14 - Business Type Model (Class Diagram)*

## 5.6 Wireframing

Withing the frontend team, wireframing was used to pass information to other team members of the group of how the whole structure is supposed to look like. Please see appendix for the charts.

## 5.7 Algorithm flowchart

The main objective of the algorithm implemented is to avoid scattering of single seats in the theatre as it helps in not splitting up the small to large group of customers. The algorithm we developed works on the concept of not letting the customer book a single seat if neighbour's neighbour seat is empty on both sides of the seat. Further it can be explained by the example where if the range of seats in a row are 5 and the single customer tries to book a seat in the middle, then system will not allow the customer to go ahead with booking as neighbour's neighbour seats are empty on both sides. This algorithm also gives a concept, where if there are only 10 last seats remaining in the entire hall then it provides the customers to book seats freely without any restrictions.

Below an algorithm flowchart is given, which describes the working of an algorithm with using pseudo code.

NOTE:

A sparse seat is an individual seat in a row which is identified as an available seat to be booked but its' left neighbour seat and right neighbour seat is already booked.

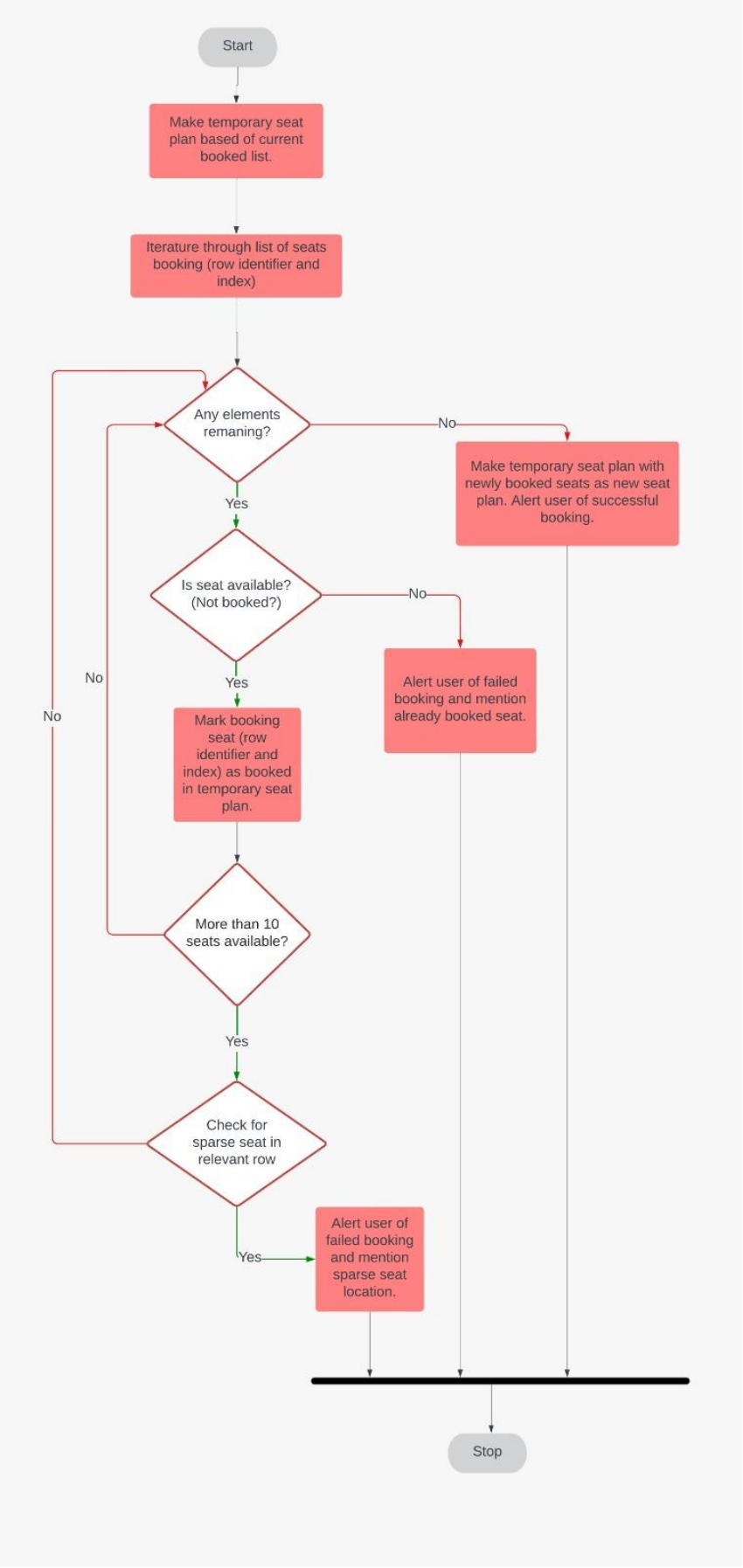



*Figure 15 - Algorithm Flowchart*

## 6. Implementation

After completing the design phase, we started the implementation phase. In this phase all team members worked on programming the code by following the given requirements and implement the product under plan driven approach. The entire application has been developed in this phase. After team meetings and discussions, we agreed on creating a website and using the following tools and technologies,

Frontend – React hosted on AWS amplify

Backend and API – NodeJS using AWS Lambda and AWS HTTP Gateway

Database - AWS DynamoDB

Our team has split into two to work on front and backend respectively. Front end and backend work was done concurrently by team coordination. In this stage, the algorithm has been produced to support the requirement of minimising scattering of seats in theatre. The code for the algorithm is given below:

```
// Seatplan is an object containing the row and the index of which seat is booked
for (let j = 0; j < seatPlan[row].length; j++) {
   const occurences = occurrencesOf(3, seatPlan[row].slice(0, j))

   // 3 is identified in seatplan as a white blank spot in the frontend
   //  1 is identified in seatplan as an available seat
   // 0 is identified in seatplan as a booked seat
   if (seatPlan[row][j] === 1 && seatPlan[row][j - 1] === 3 && seatPlan[row][j + 1] === 3) {
     continue
   }
   if (seatPlan[row][j] === 1 && seatPlan[row][j - 1] === 3 && seatPlan[row][j + 1] === 0) {
     return sendSeatSparseErrorMessage({ rowKey: row, index: (j - occurences) })
   }
   if (seatPlan[row][j] === 1 && seatPlan[row][j - 1] === 0 && seatPlan[row][j + 1] === 3) {
     return sendSeatSparseErrorMessage({ rowKey: row, index: (j - occurences) })
   }
   if (j === 0 && seatPlan[row][j] === 1 && seatPlan[row][j + 1] === 0) {
     return sendSeatSparseErrorMessage({ rowKey: row, index: (j - occurences) })
   }
   else if (j === (seatPlan[row].length - 1) && seatPlan[row][j] === 1 && seatPlan[row][j - 1] === 0) {
     return sendSeatSparseErrorMessage({ rowKey: row, index: (j - occurences) })
   }
   else if (
     seatPlan[row][j] === 1 &&
     (seatPlan[row][j - 1] === 0) &&
     (seatPlan[row][j + 1] === 0)) {
     return sendSeatSparseErrorMessage({ rowKey: row, index: (j - occurences) })
   }
```

The database we used for our application is DynamoDB and below figures shows a brief information of our database and table:

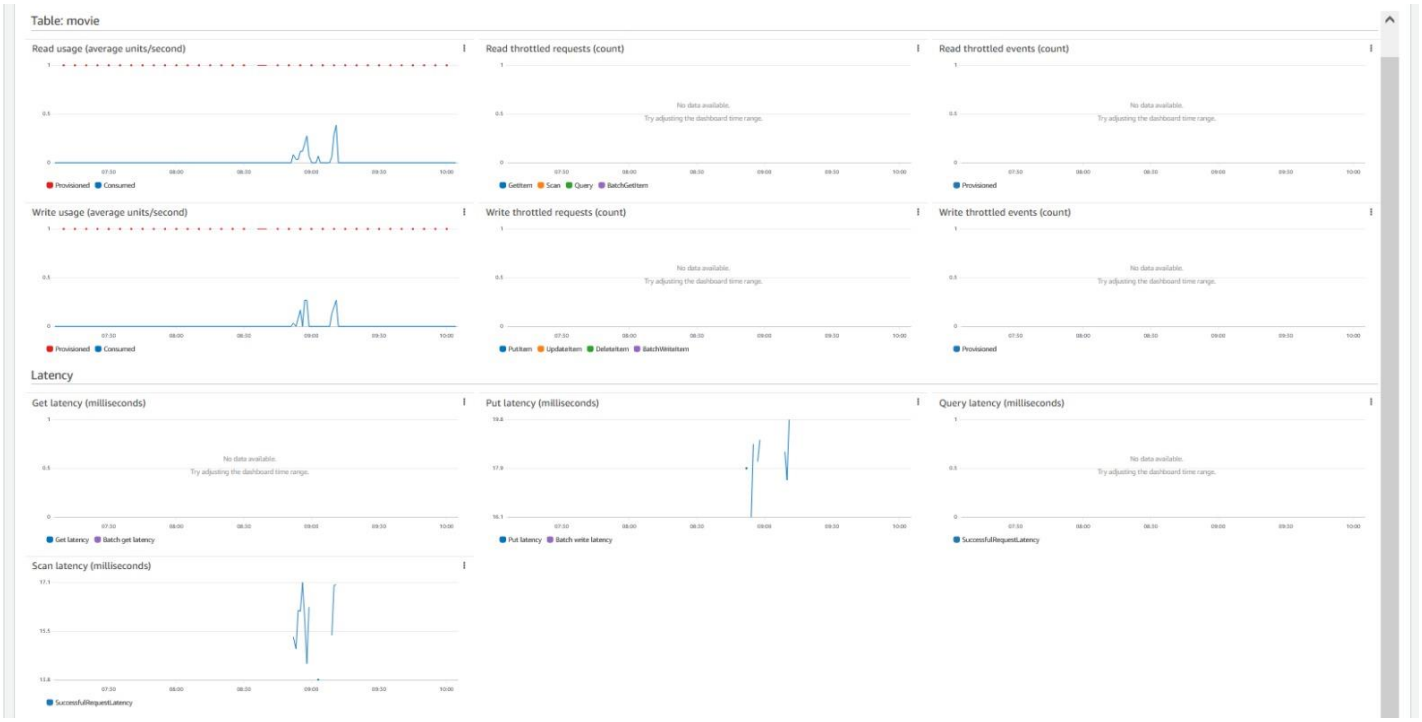



*Figure 16 - Database Table- Response Metrics*

**Items returned** (23)

| id | createdTime | booking... | custome... | custome... | dataType | email | eventDu... | eventId |
|---|---|---|---|---|---|---|---|---|
| BOOKING_4a372084_c5f4_407c_8591_c5dd7217ed0a | 1654592096024 | CONFIRMED | USER_808d... | 123 123 | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 | 1654592096024 | | | | EventBooking | | 60 | |
| 2 | 61009 | | | | MovieTheater | | | |
| BOOKING_4ac2b3a1_ec81_4f70_8937_a1da841b6ef1 | 1654592096024 | CONFIRMED | USER_a7e4... | asd asd | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| USER_a7e4a546_b139_4738_a8d3_4624d93784c9 | 1654592120189 | | | | User | asd@asd.com | | |
| 1 | 58429 | | | | MovieTheater | | | |
| 1 | 74091 | | | | User | adminS@movie.com | | |
| BOOKING_d06d9649_23fd_45d7_a538_ec0865ffb9b7 | 1654592096024 | CONFIRMED | USER_a7e4... | asd asd | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| BOOKING_cac351b1_b66a_4f9e_9971_219288ebf628 | 1654539810204 | CANCELLED | 0 | AdminM Ad... | TicketBooking | | 110 | EVENT_faa76101_50a8_4239_8372_894099492ddf |
| BOOKING_4cb48f8e_e8e8_44c1_bbbc_b4ea04eaddfe | 1654592096024 | CONFIRMED | USER_808d... | 123 123 | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| BOOKING_12c8d1c5_7925_4675_a958_ca28c208e10d | 1654593052394 | CONFIRMED | USER_a7e4... | asd asd | TicketBooking | | 60 | EVENT_8243065a_bcd6_4e5c_a7eb_10853aea3dc6 |
| EVENT_db001363_77c9_4297_9bf1_61ad0cf485ae | 1654539811222 | | | | EventBooking | | 110 | |
| USER_50bee413_8cb8_4e05_8533_c208508e1f70 | 1654540989288 | | | | User | yunus@gmail.com | | |
| 0 | 86798 | | | | MovieTheater | | | |
| 0 | 88310 | | | | User | adminM@movie.com | | |
| EVENT_8243065a_bcd6_4e5c_a7eb_10853aea3dc6 | 1654593052394 | | | | EventBooking | | 60 | |
| BOOKING_42f3cdab_ba0f_4f9e_b47c_af60f77219ac | 1654593052394 | CONFIRMED | USER_a7e4... | asd asd | TicketBooking | | 60 | EVENT_8243065a_bcd6_4e5c_a7eb_10853aea3dc6 |
| BOOKING_cdd0dcd3_40ba_4c08_a018_0ef19ea1fea2 | 1654592096024 | CONFIRMED | USER_808d... | 123 123 | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| BOOKING_e0a76431_a9b7_42d9_b82e_4f7160f7abb5 | 1654592096024 | CONFIRMED | USER_808d... | 123 123 | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |
| USER_8ae009a5_5976_4a98_93b2_3213e3dfb6df | 1654541067776 | | | | User | newuser@gmail.com | | |
| USER_c856673f_97e2_4d2d_ab6b_034ce7c2a88e | 1654541102390 | | | | User | chris@gmail.com | | |
| BOOKING_4a98d330_ad87_4a13_bb6d_3469845781a0 | 1654592096024 | CONFIRMED | USER_a7e4... | asd asd | TicketBooking | | 60 | EVENT_a15c2bf5_977b_4928_abbd_72b91b3afc37 |

*Figure 17 - Database Table-2*

After implementing all the requirements, the application has been developed and ready for the testing phase.

Our application is available on GitHub platform and the link for the repository is:

https://github.com/Yunus0or1/CP70032E-A3-Adv-backend-main

https://github.com/Yunus0or1/CP70032E-A3-Adv-frontend-client

https://github.com/Yunus0or1/CP70032E-A3-Adv-frontend-admin

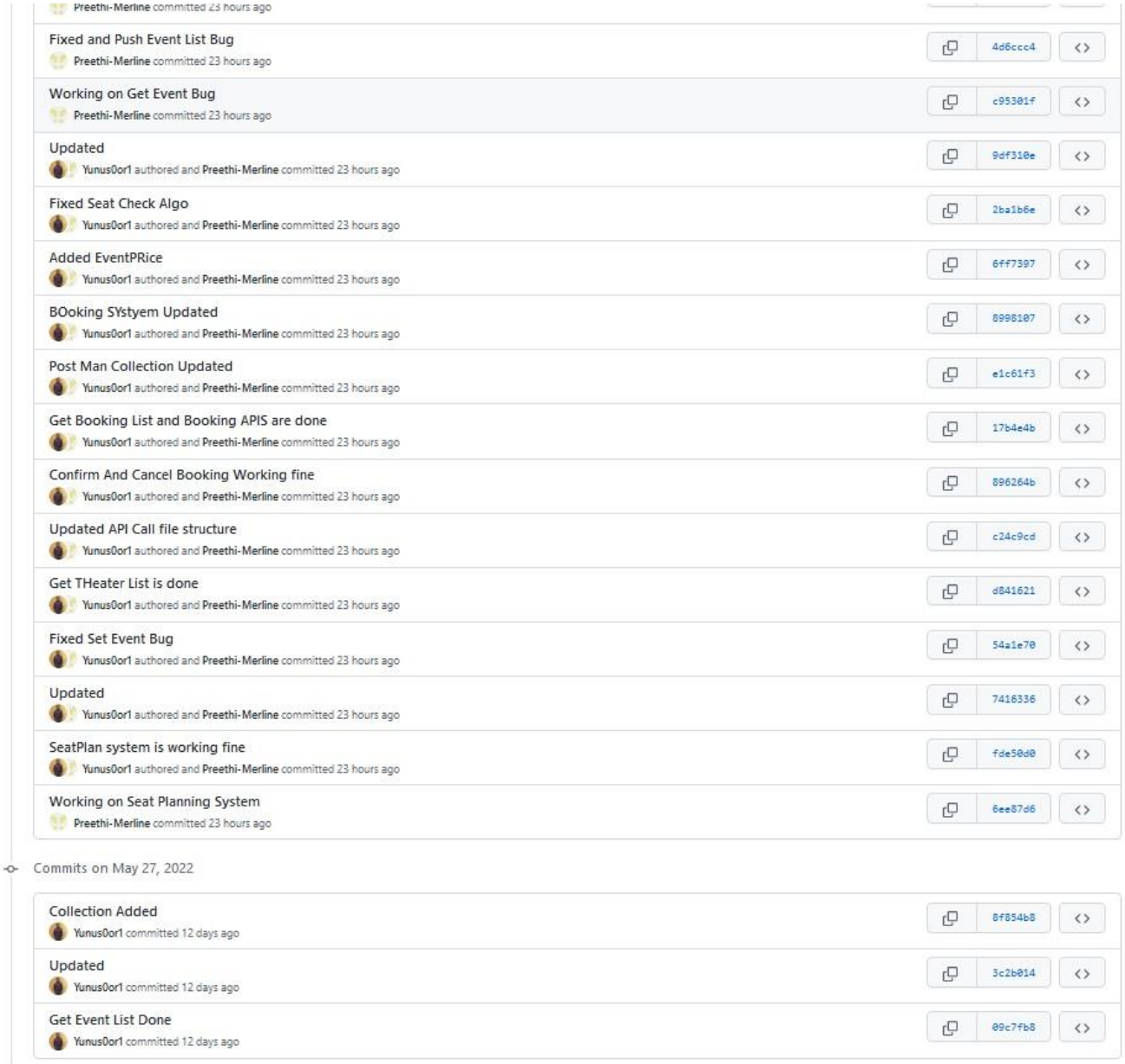



*Figure 18 - Backend*

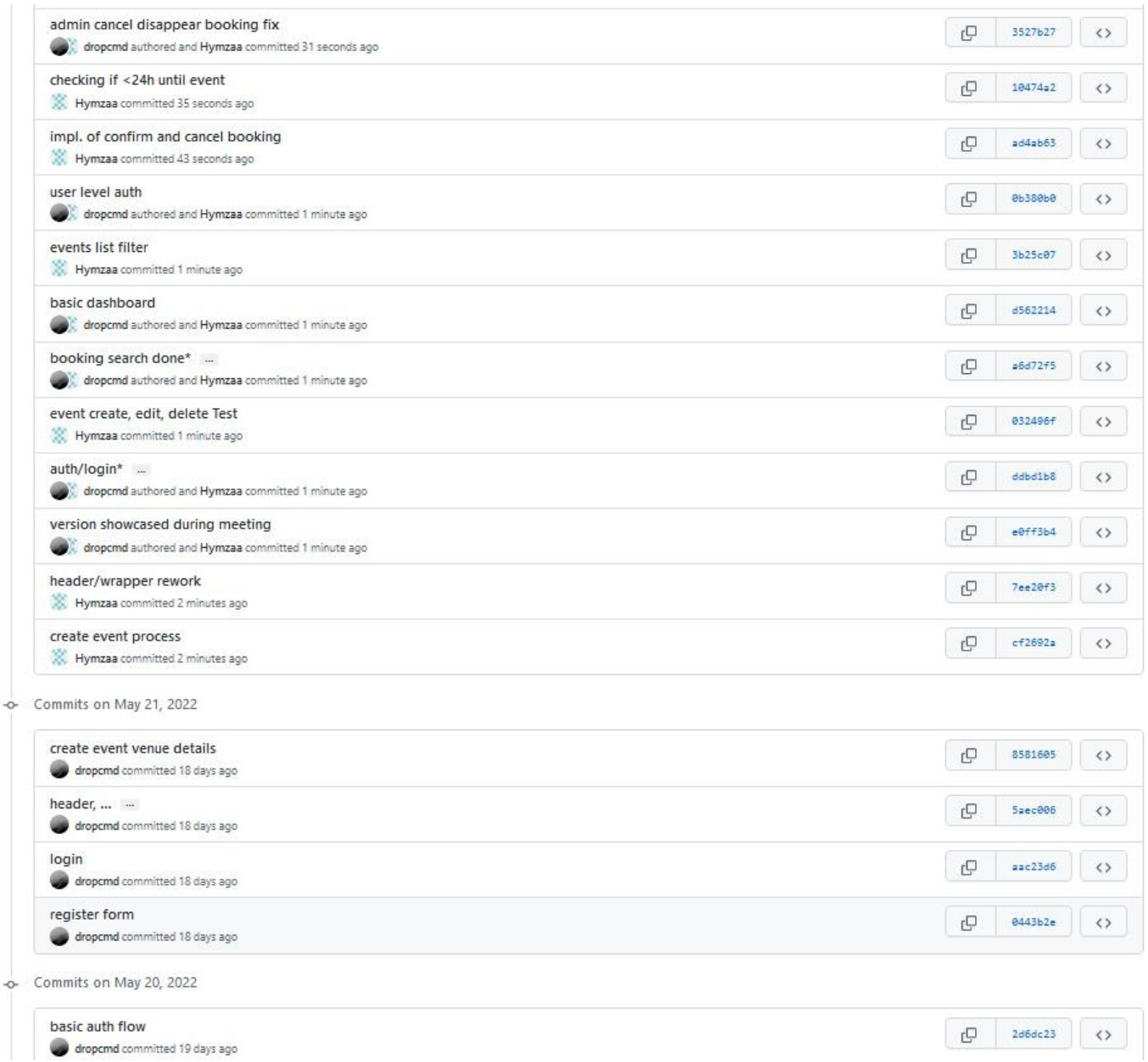



*Figure 19 - Frontend*

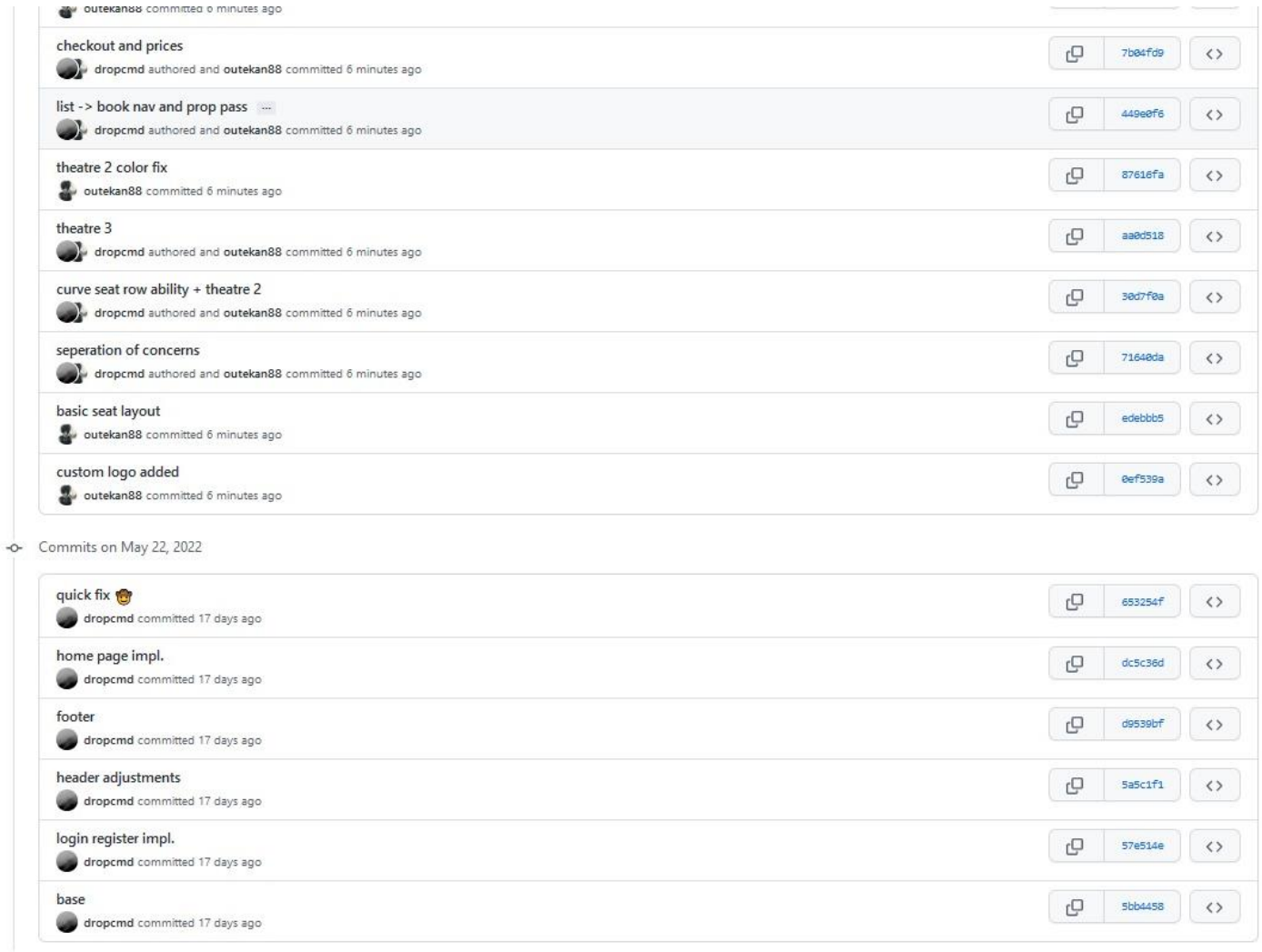



*Figure 20 - Frontend*

There are two portals in our application, customer portal, staff, and admin portal. The web application is available on links,

Admin/Staff: https://master.d3r9ted7jxv5qy.amplifyapp.com

Customer: https://master.d2g1ov2tfcuju4.amplifyapp.com/

The login details for staff are adminS@movie.com, 123123

The login details for admin are adminM@movie.com, 123123

The output screens of our application are given below:

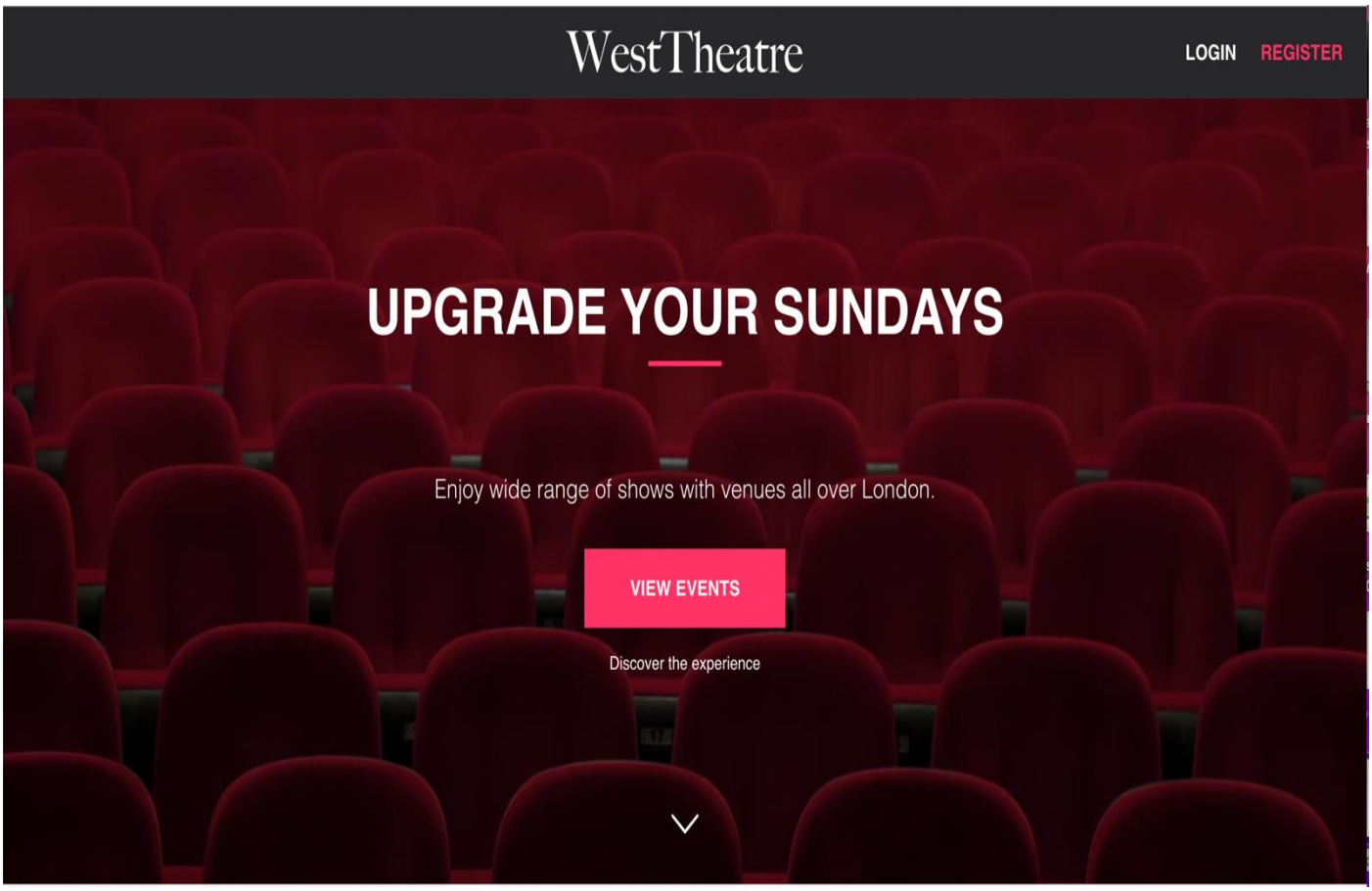



*Figure 21 - Customer Homepage*

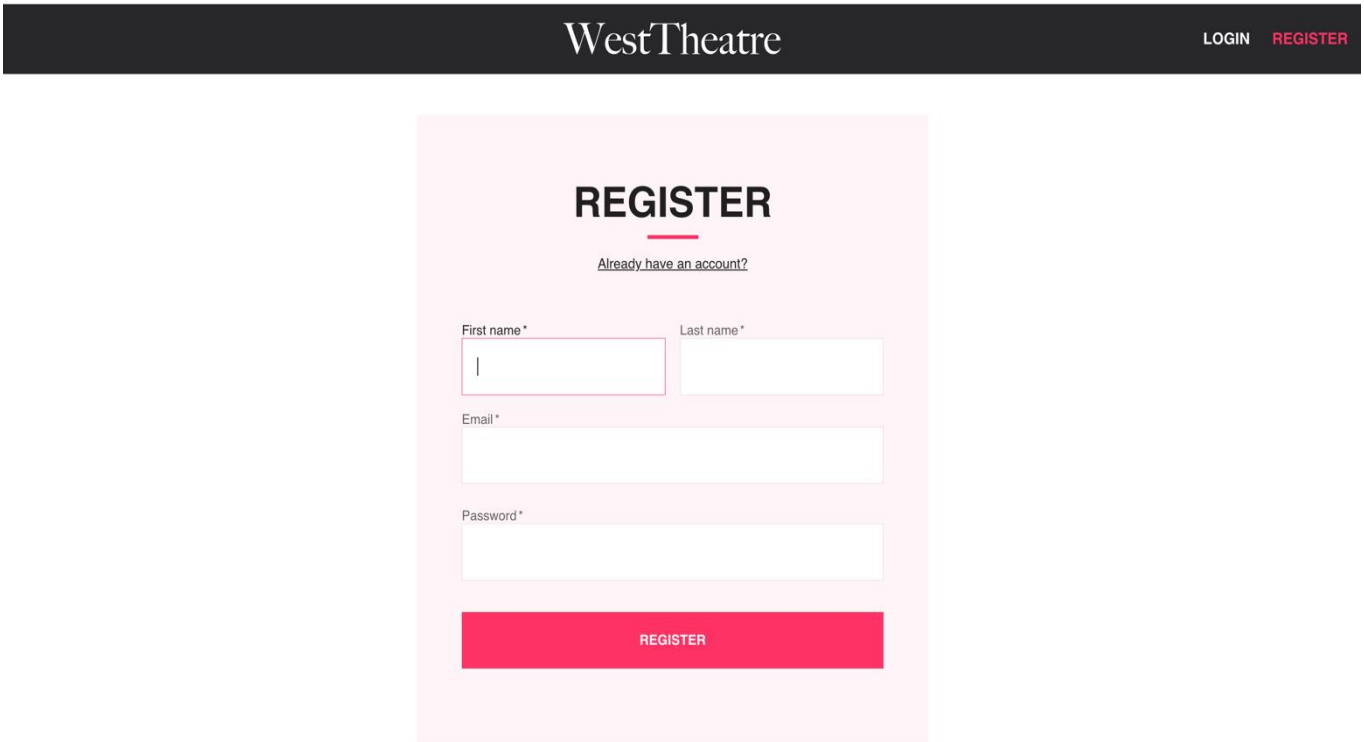



*Figure 22 - Customer Registration*

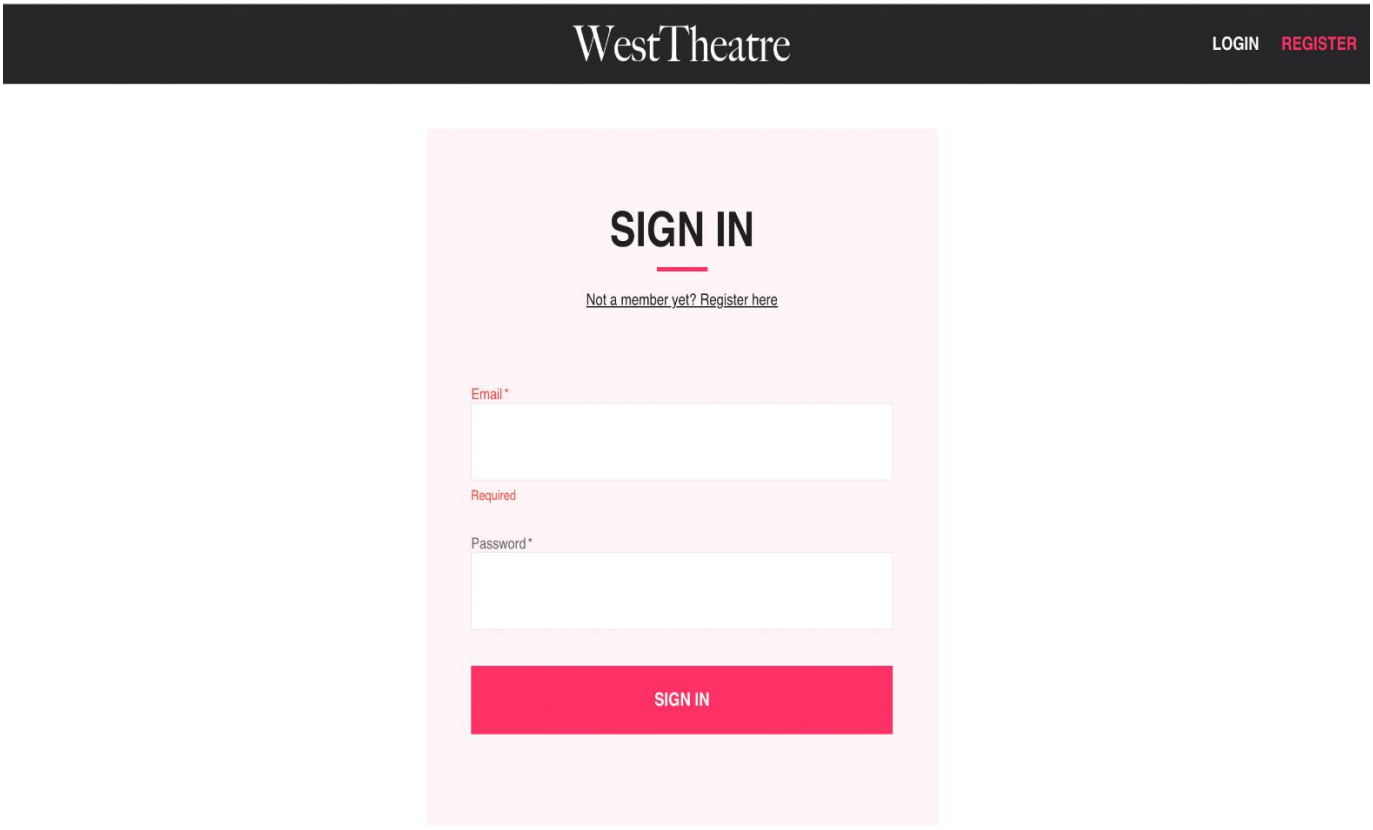



*Figure 23 - Customer Login*

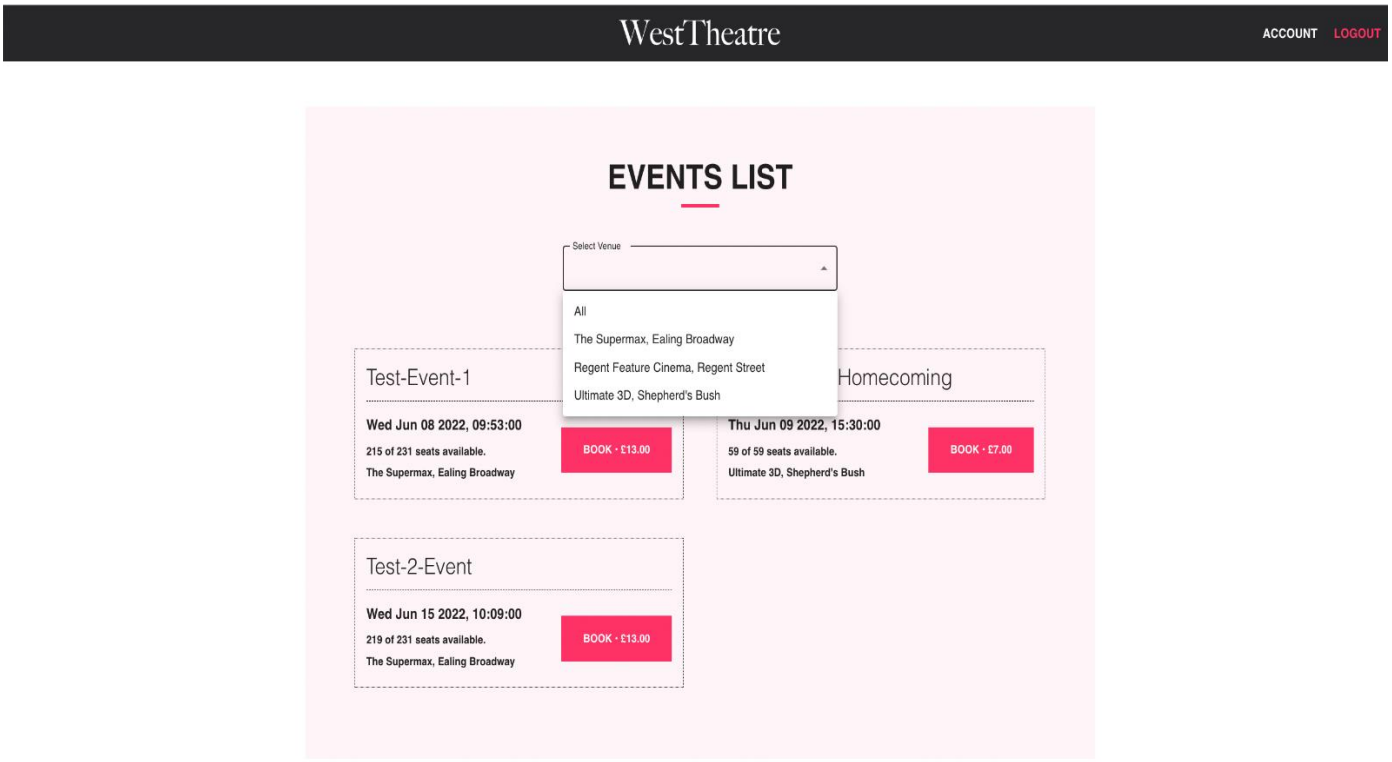



*Figure 24 - View Events for Customers*

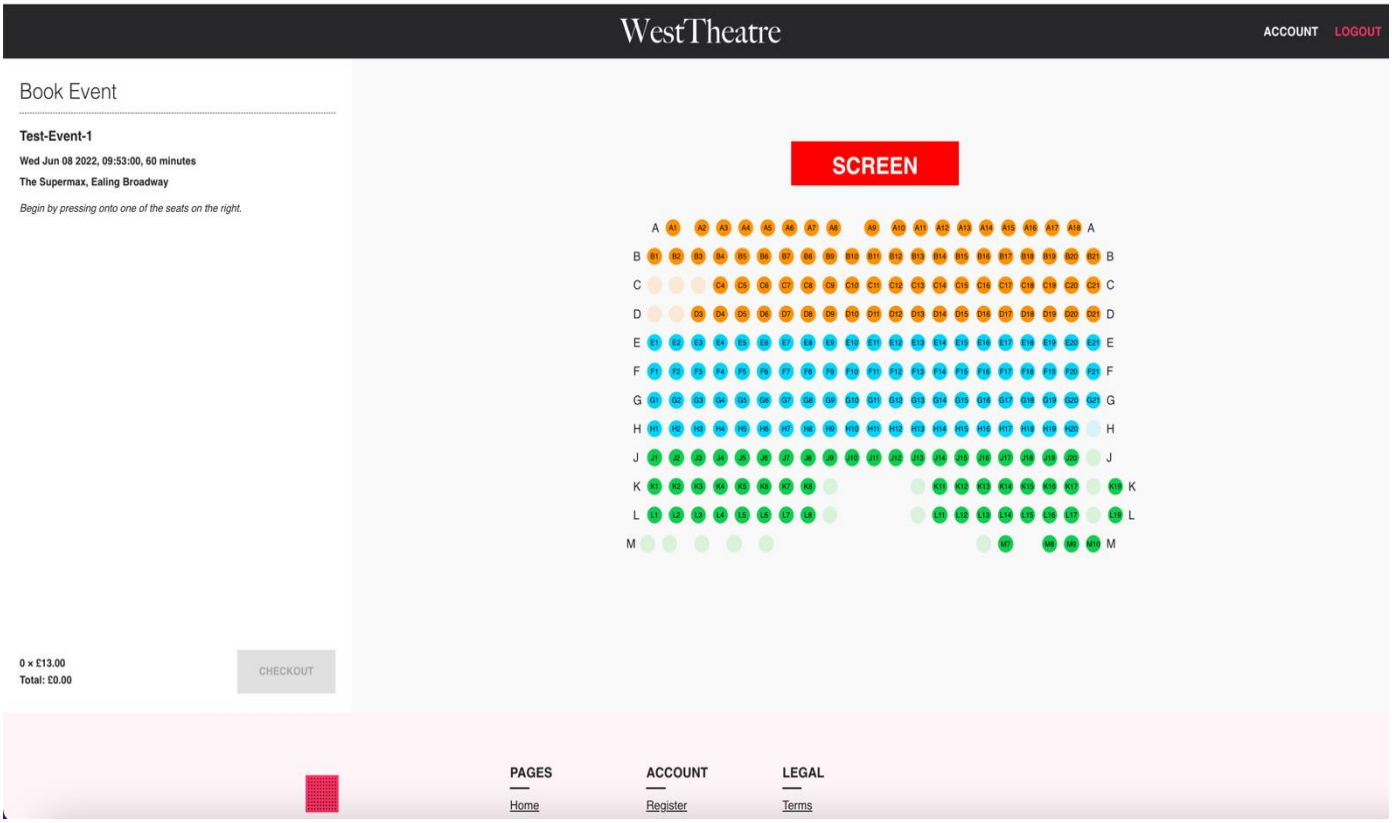



*Figure 25 - Customer Booking an Event*

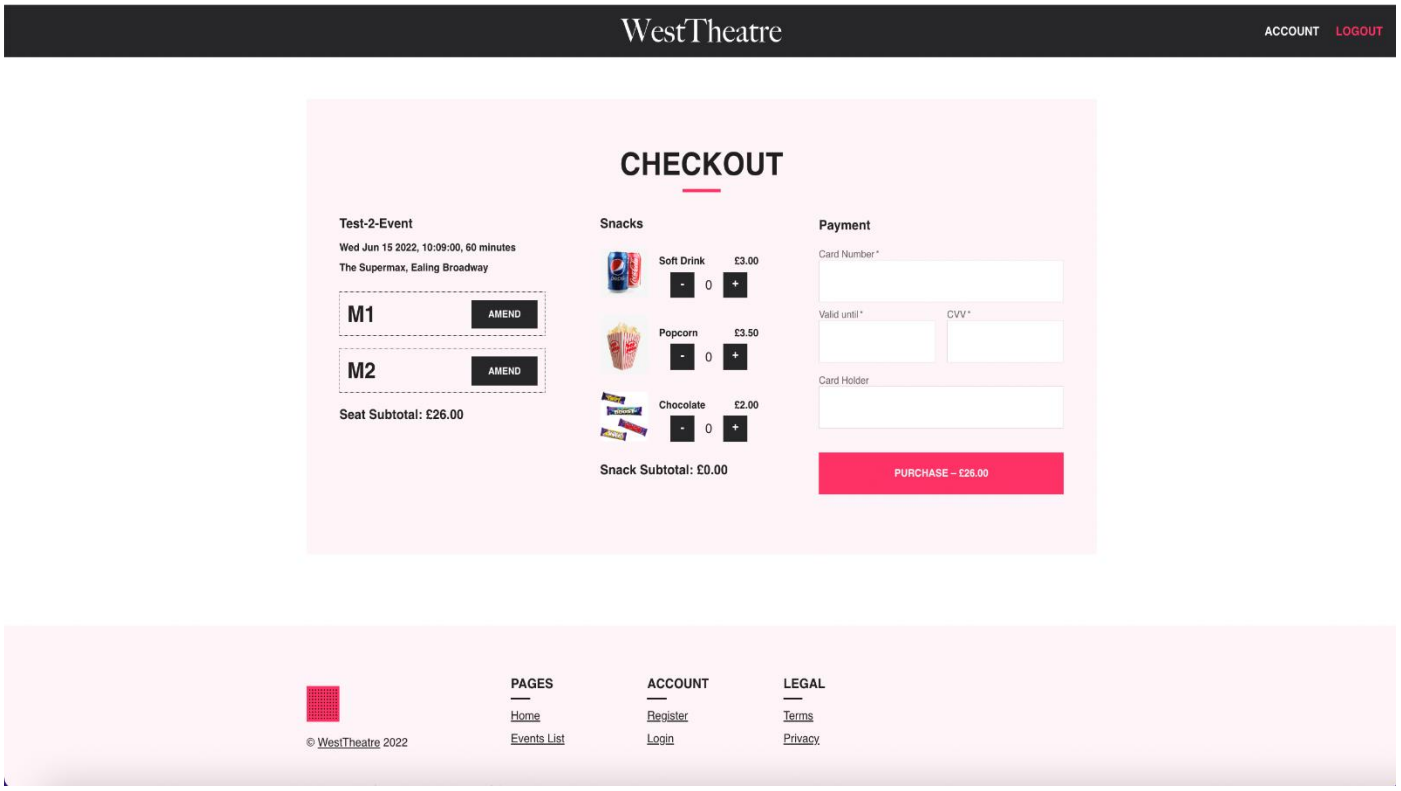



*Figure 26 - Customer Checkout Screen*

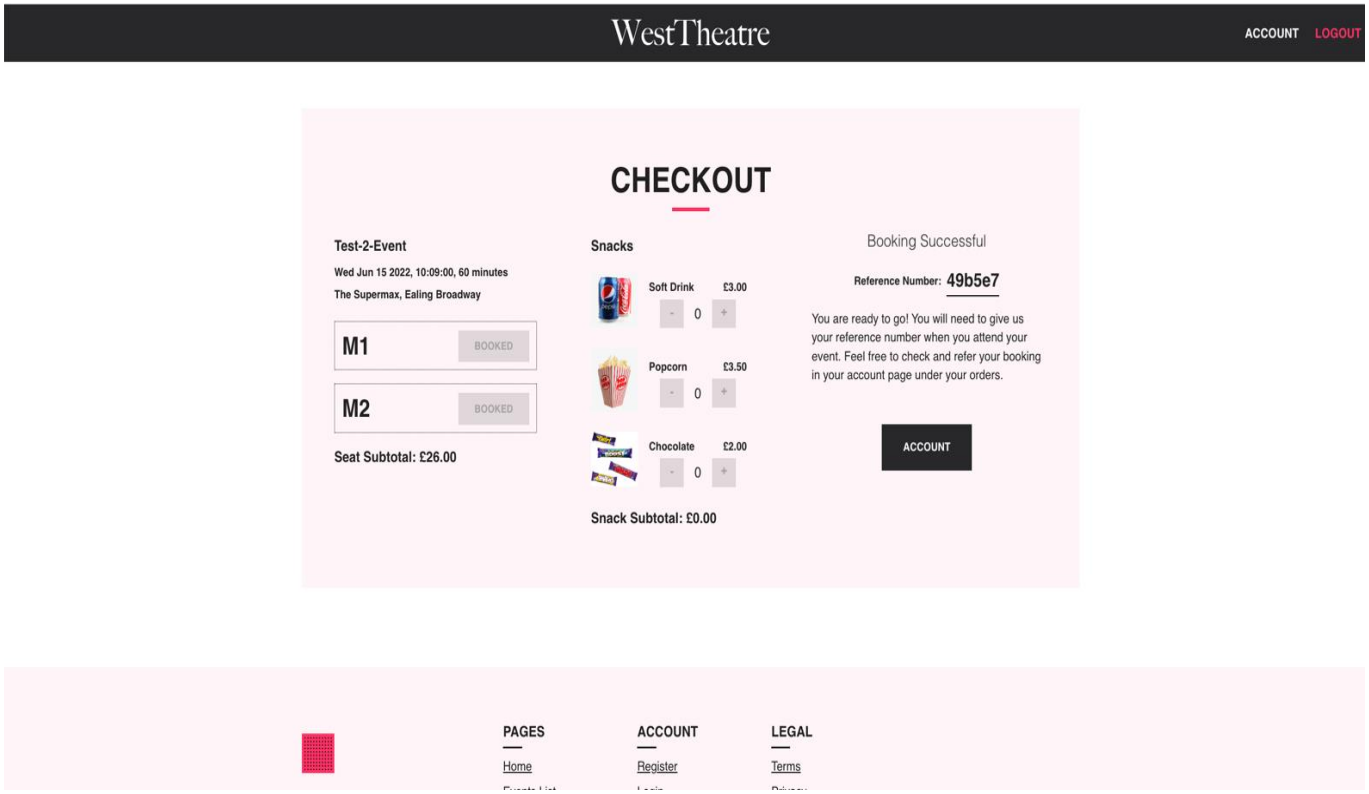



*Figure 27 - Customer Successful Booking*

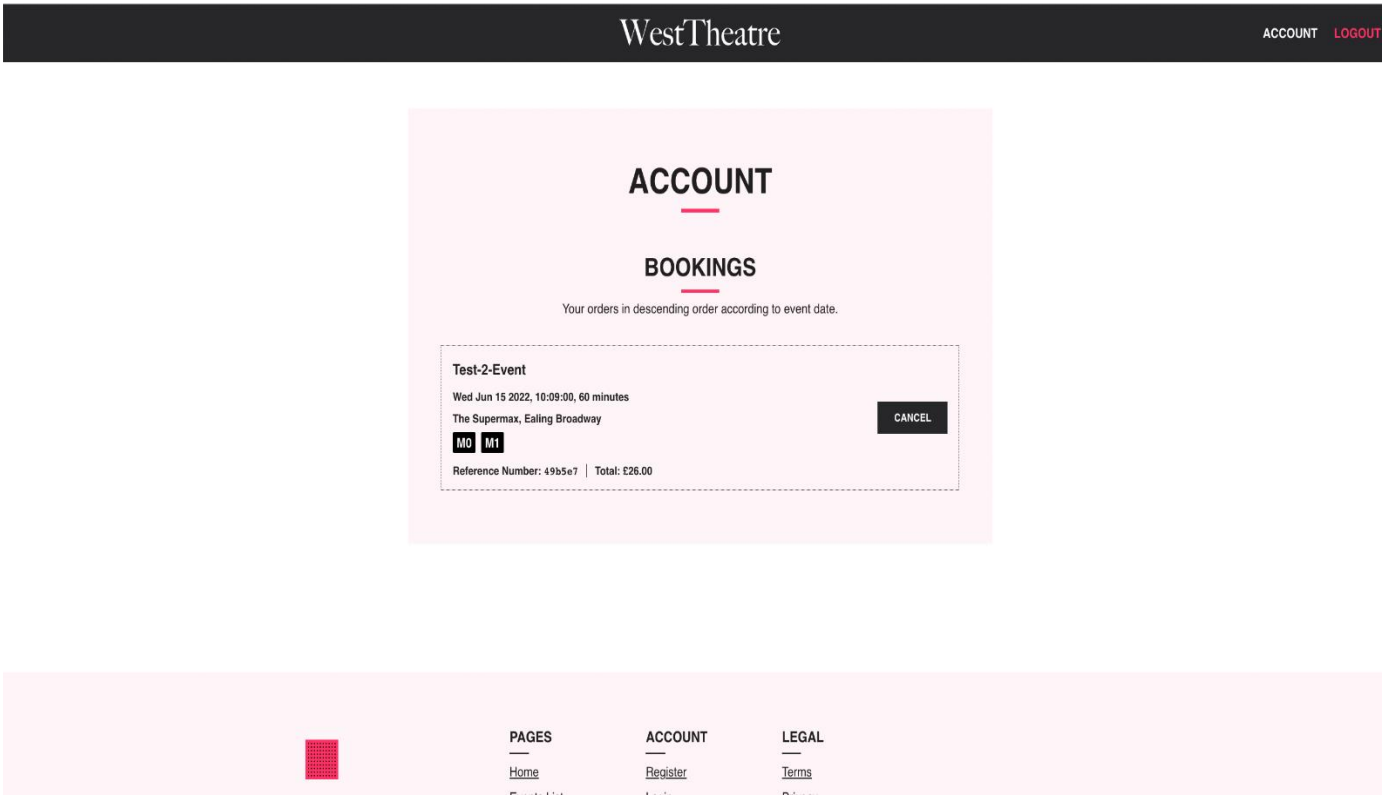



*Figure 28 - Customer Account Screen with Cancel Option*

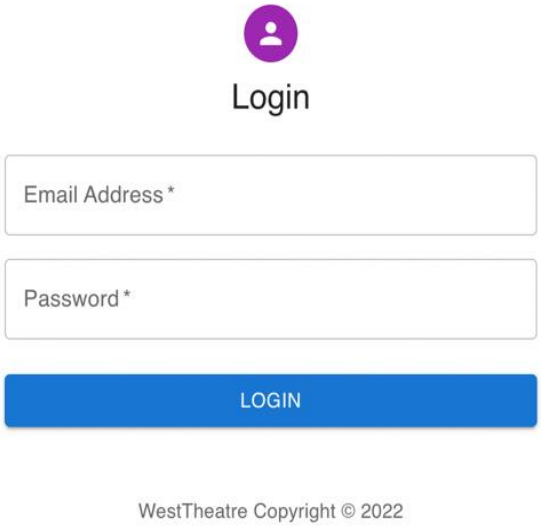



*Figure 29 - Staff and Admin Login*

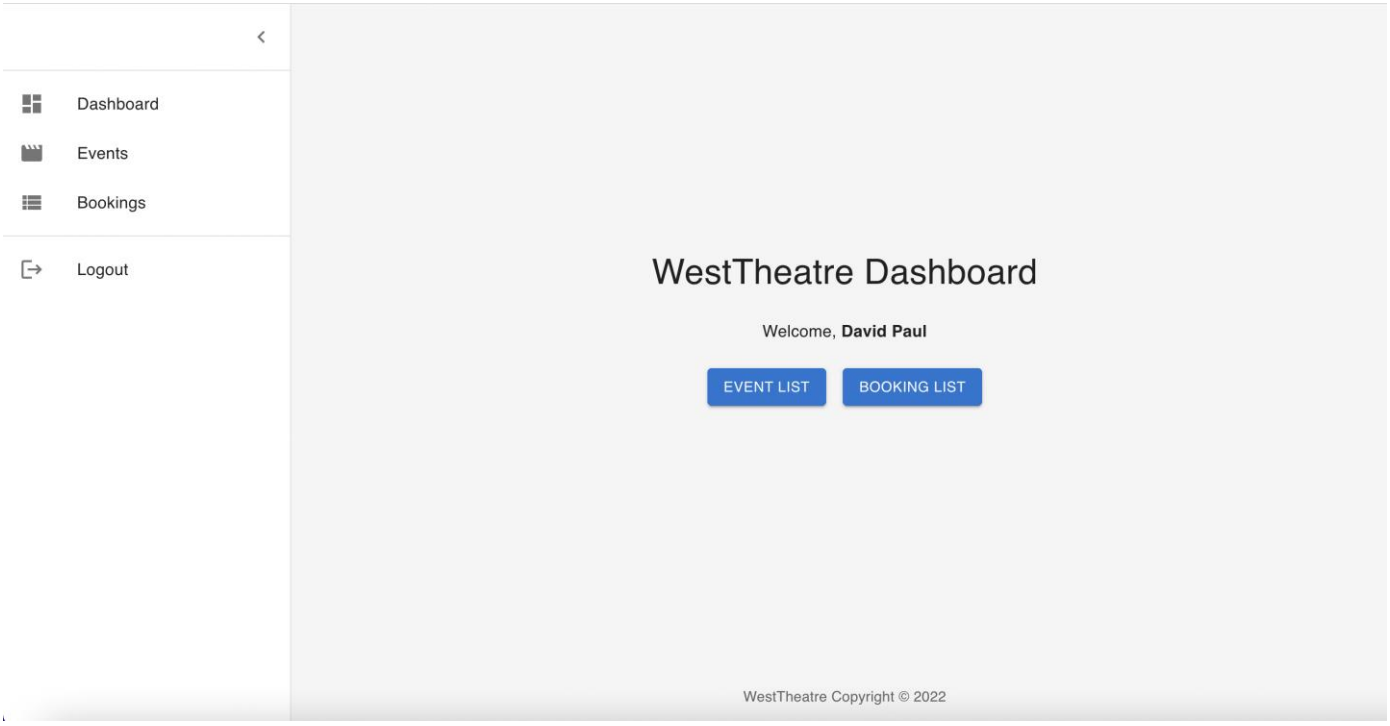



*Figure 30 - Staff Dashboard*

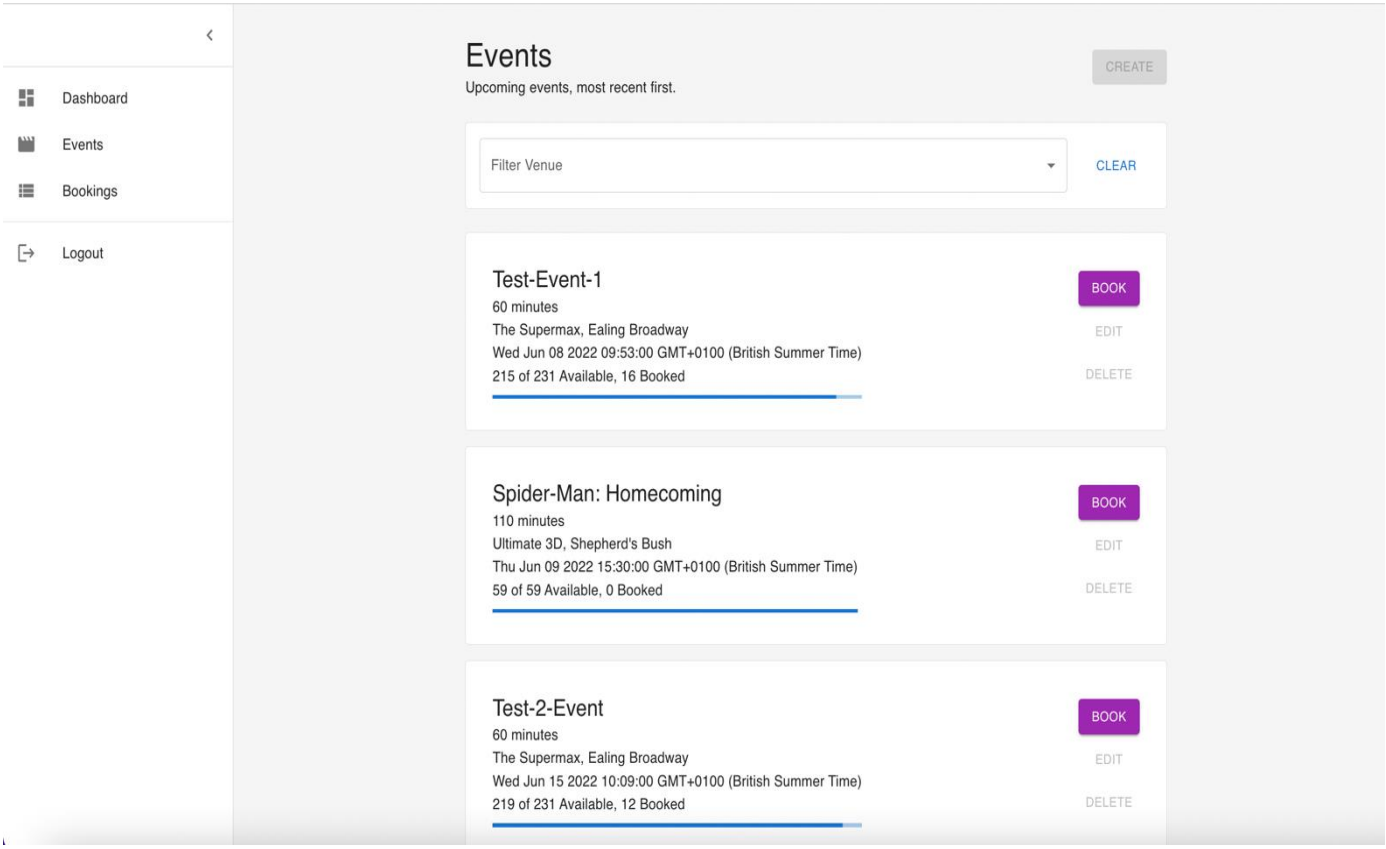



*Figure 31 - Staff Event List*

In above figure, view events for staff where the create button is greyed out to restrict them to add any events as it is admins responsibility.

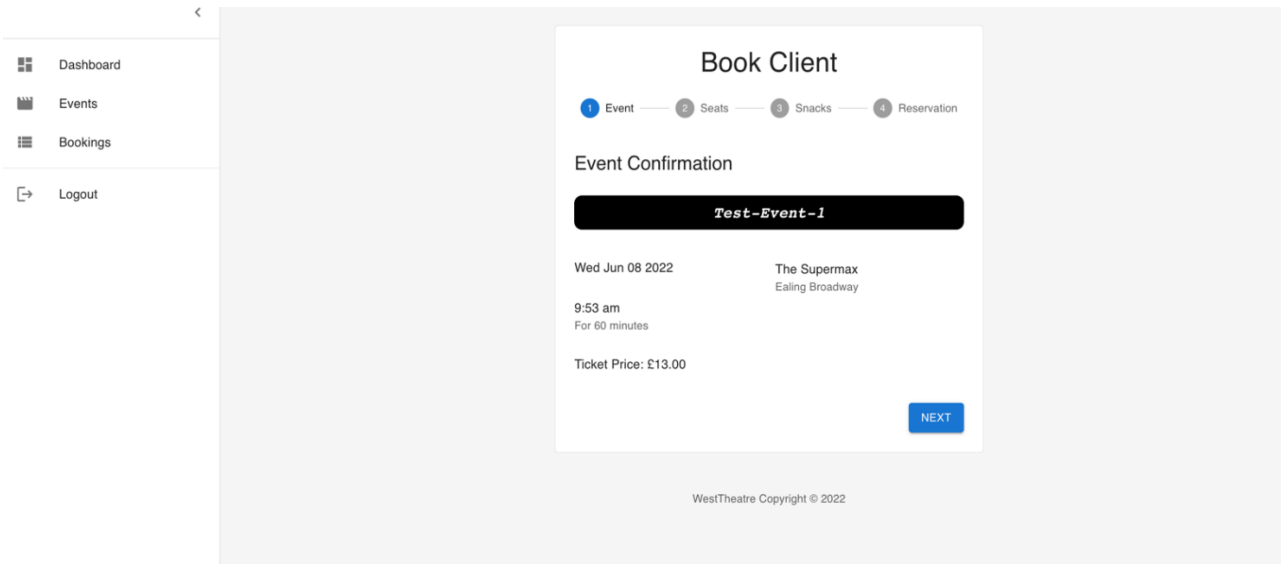



*Figure 32 - Staff Booking for Customer*

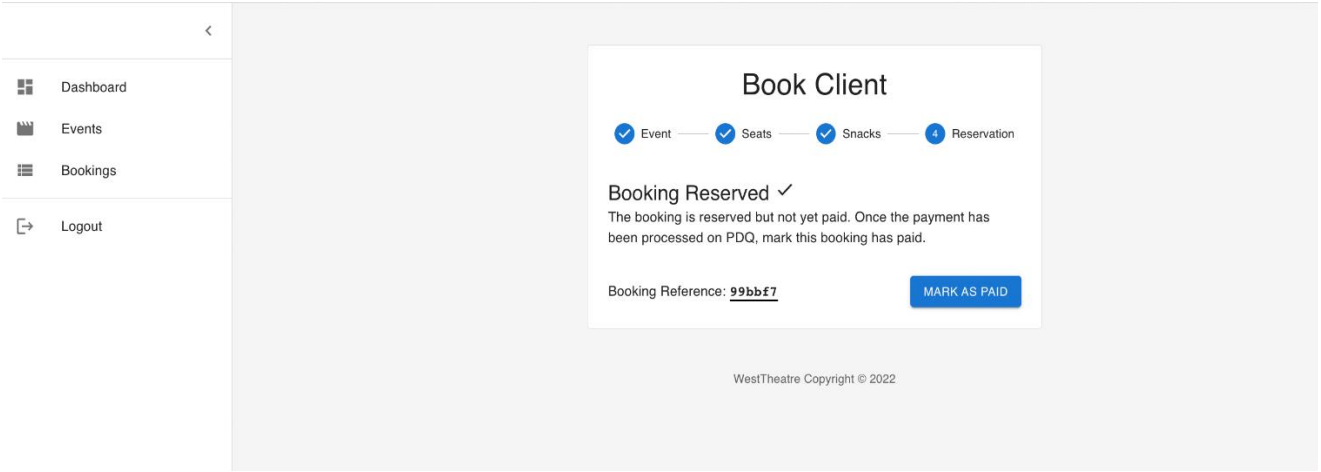



*Figure 33 - Staff Booking Confirmation*

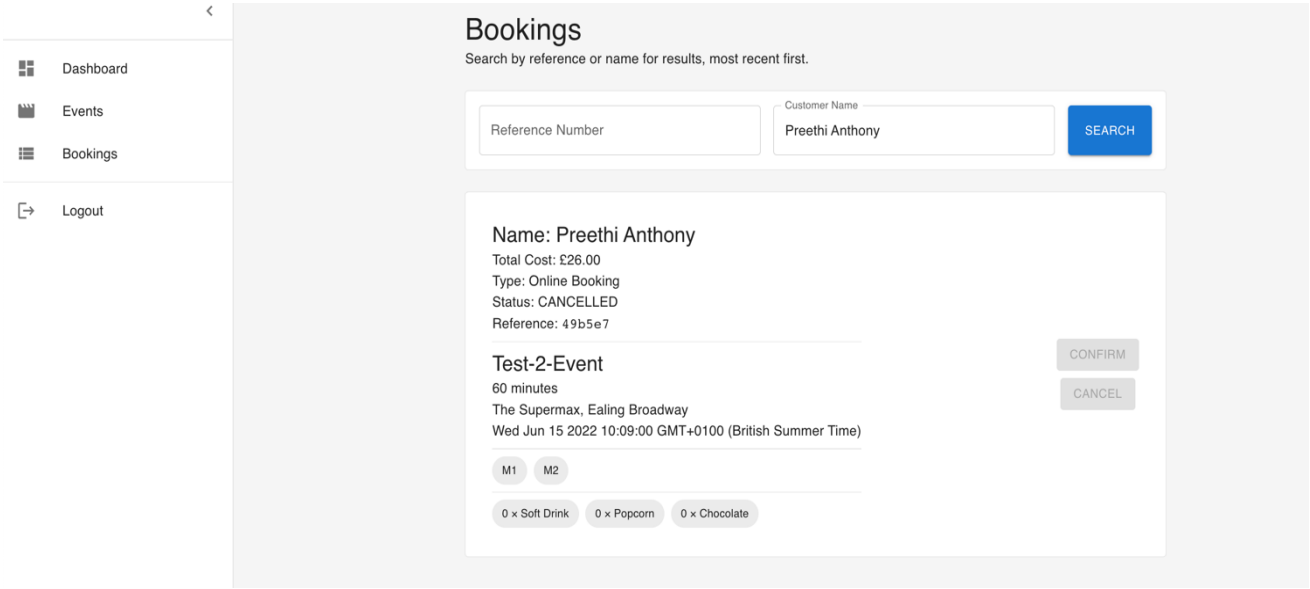



*Figure 34 - Staff Reference Search and Cancel Ticket Screen*

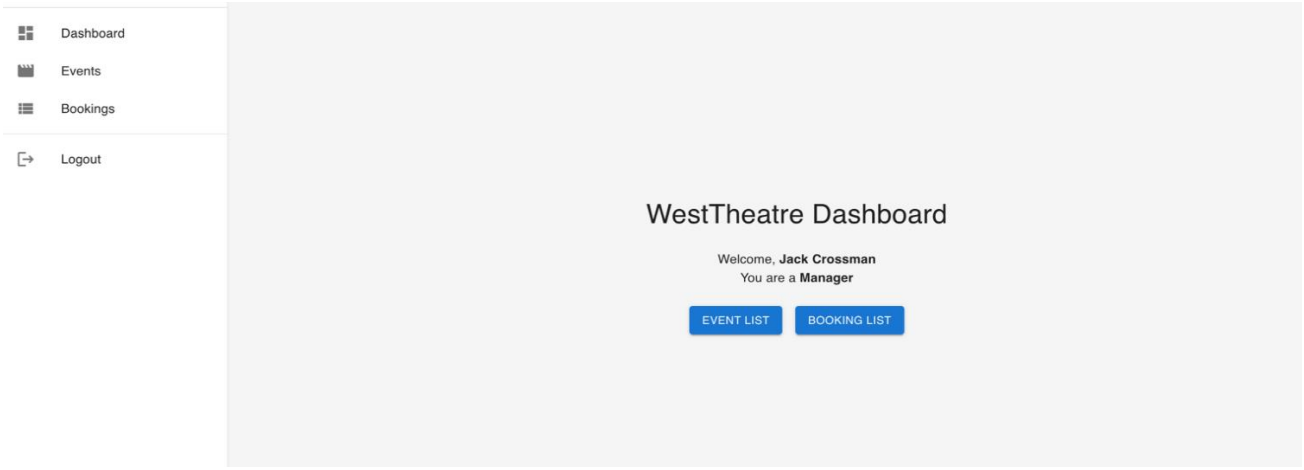



*Figure 35 - Admin Dashboard*

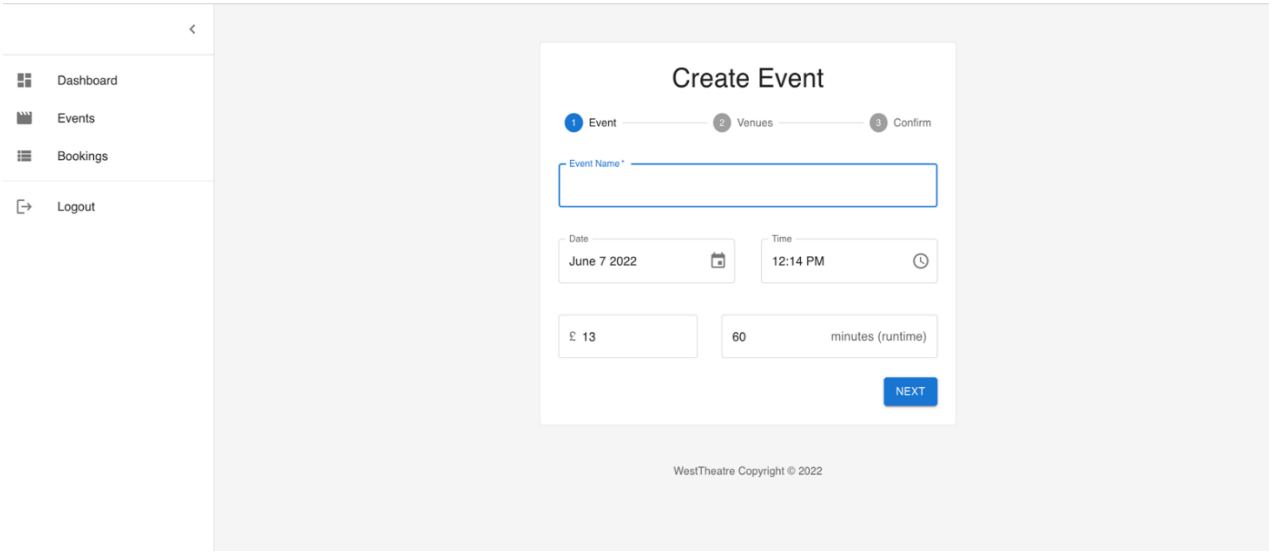



*Figure 36 - Admin Create Event Screen*

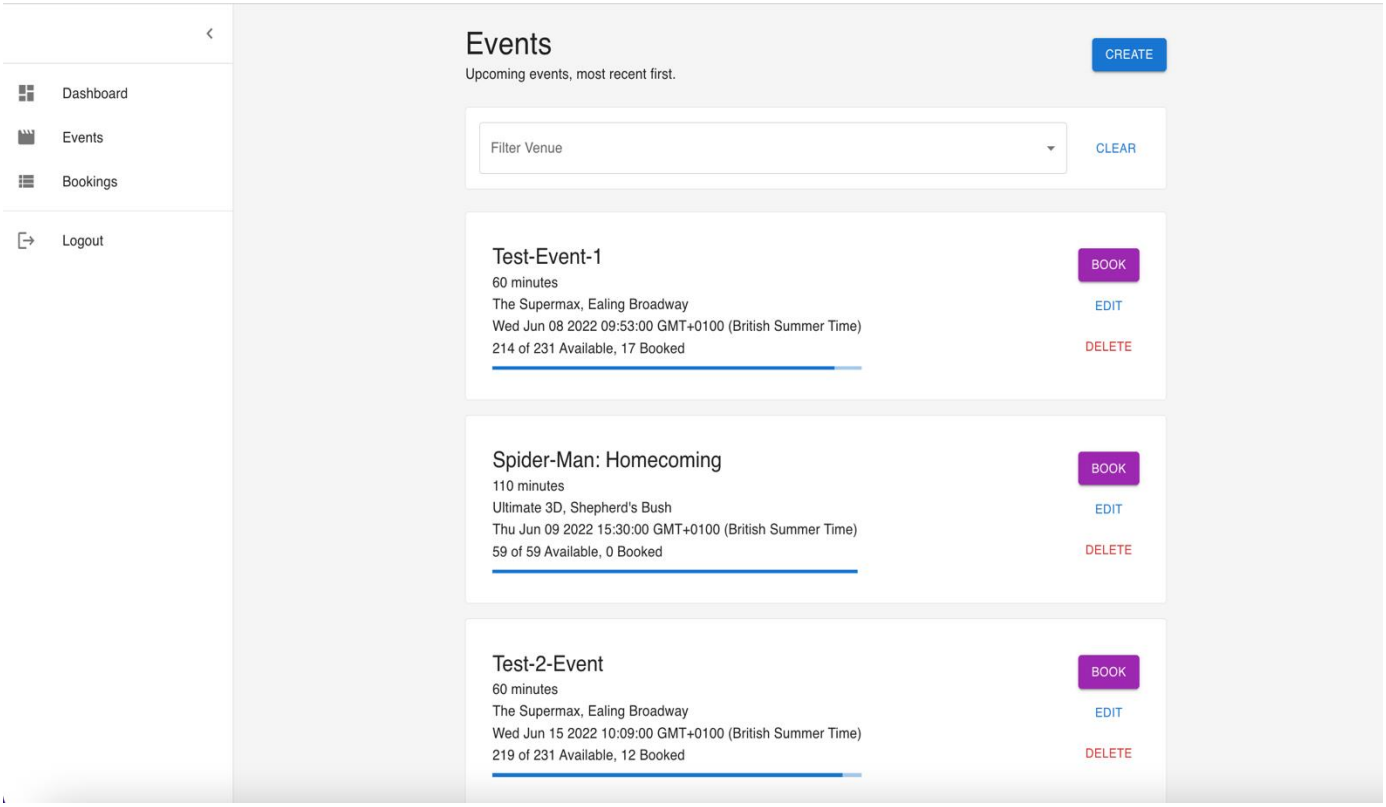



*Figure 37 - Admin Modify or Delete Events*

# 7. Testing Procedures

Testing is a most important phase in software development life cycle which helps in ensuring that the software is working as per the requirements, ensure great user experience and with no errors. Test cases or scenarios as known as user stories are created in this phase from taking requirements and modelling details from previous stages. Then, these test cases are implemented to test the system. For this application, we used various testing methods which are behaviour driven development, test driven development and manual testing of algorithm through created website. Below, these testing methods are discussed.

## 7.1 Behaviour Driven Development

Behaviour Driven Development or BDD has same concept of test-driven development (TDD) which is test first development. However, in BDD the test is more focused on behaviour of the system and is an extension of TDD. In BDD, we created major features and different scenarios to test the behaviour of the system. In, BDD we write the failing feature test, and it is written in simple language. The below figure shows how BDD and TDD work together.

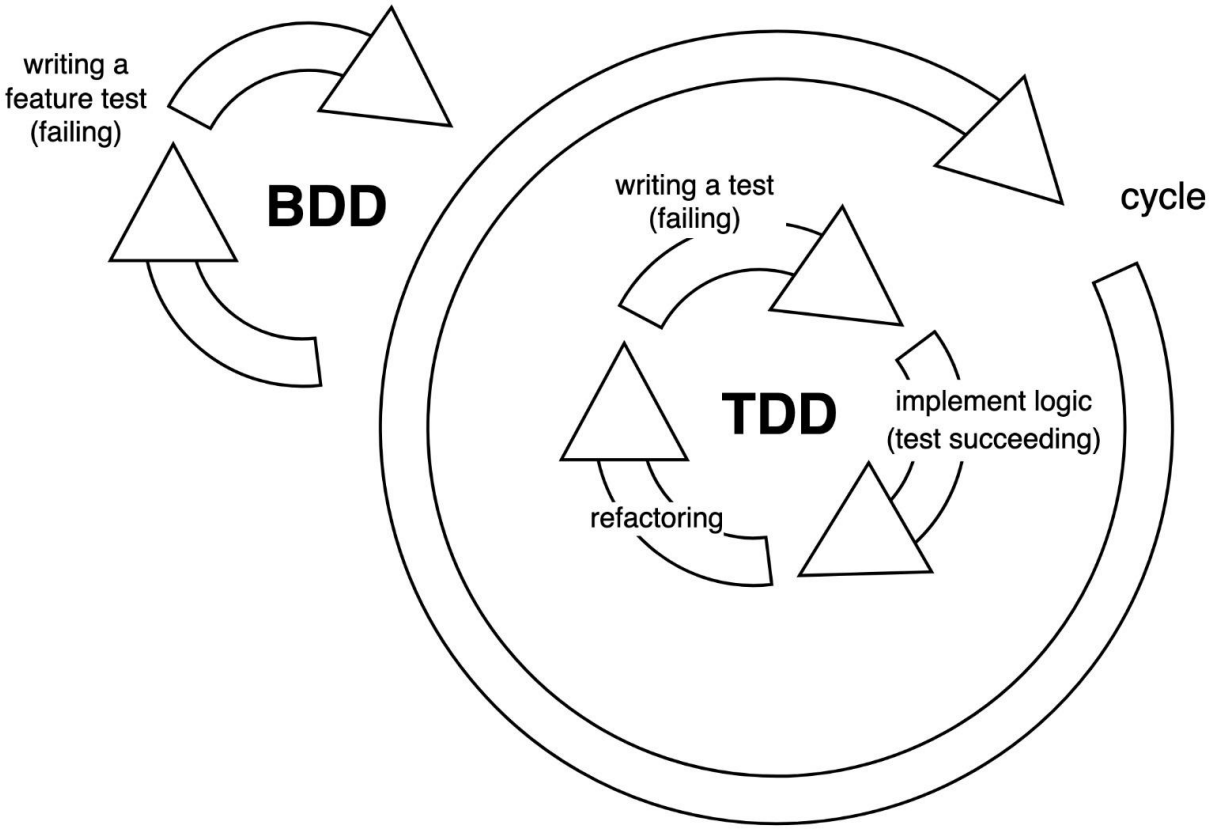



*Figure 38 - BDD and TDD*

Below few BDD scenarios of our application are written:

Feature: User Authentication

- Scenario: Check the registration form
- Given I am not an existing user
- When I open registration page
- And give correct details
- Then I am registered into system

- Scenario: Check the login form
- Given I am existing user of the system
- When I open login page
- And give correct username and password
- Then I am logged into system

See figure 39 for TDD testing based on User Authentication Scenarios.

Feature: Booking

- Scenario: Booking a ticket of an event
- Given I am a potential buyer
- When I view events listed
- And I am existing user
- And select preference, make payment
- Then I get booking reference

- Scenario: Cancelling ticket of an event
- Given I am existing user
- When I have booking reference
- And I request cancelling in system
- And it is more than 24 hours for the event
- Then my ticket is cancelled

See figure 40 for TDD testing based on Booking Scenarios.

Feature: Events

- Scenario: Adding new events
- Given I am the admin
- When I login to system
- And I add new event to the list
- Then event is added in the system

- Scenario: Modifying events
- Given I am the admin
- When I login to system
- And I make changes to existing event list
- Then event list is modified

See figure 41 for TDD testing based on Events Scenarios.

Feature: Staff

- Scenario: Booking a ticket for the customer
- Given I am the staff
- When I get booking request from customer
- And I take customer preferences, payment
- Then customers ticket is booked

- Scenario: Cancelling a ticket for the customer
- Given I am the staff
- When I get cancelling request from customer
- And I take booking reference
- And it is more than 24 hours for the event
- Then customers ticket is cancelled

## 7.2 Test Driven Development

Test driven development or TDD mainly focuses on creating unit test cases and test the functionality of the system before implementation. TDD is beneficial as it helps in faster development and clean code. In this application, we have used TDD for the user stories which are taken from requirements stage and BDD scenarios and implemented the test code. The below figures show the proof of TDD usage in our application,

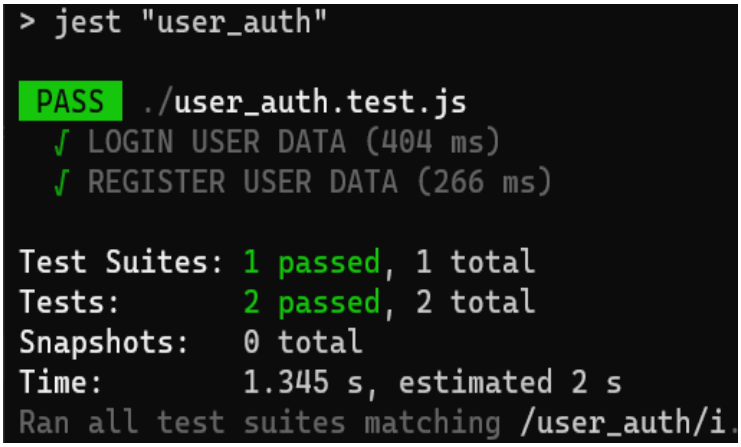



*Figure 39 - TDD 1*

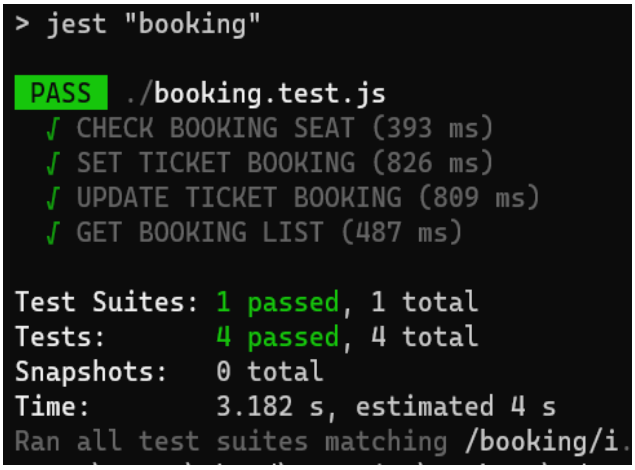



*Figure 40 - TDD 2*

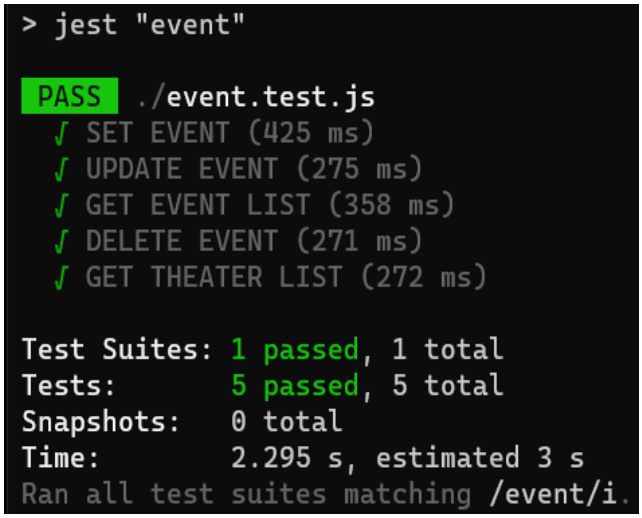



*Figure 41 - TDD 3*

We have done unit testing on the algorithm to check if the requirement of algorithm is met. The algorithm test code is:

```
let bookedSeat = [
 {
  "rowKey": "G",
  "index": 1
 },
 {
  "rowKey": "H",
  "index": 2
 },
 {
  "rowKey": "H",
  "index": 3
 },
 {
  "rowKey": "G",
  "index": 3
 },
 {
  "rowKey": "G",
  "index": 2
 },
 {
  "rowKey": "H",
  "index": 8
 },
 {
  "rowKey": "H",
  "index": 10
 },
]

const requestBody = {
 "eventId": "EVENT_cd01fca2_2b2b_474f_a0fd_64c4ef9b9810",
 "createdTime": 1654434376201,
 "bookedSeat": bookedSeat
}

const checkSeatBookingResponse = await checkSeatBooking(requestBody);
expect(checkSeatBookingResponse).toBeTruthy();
```

The manual testing results of the algorithm through website are given below.

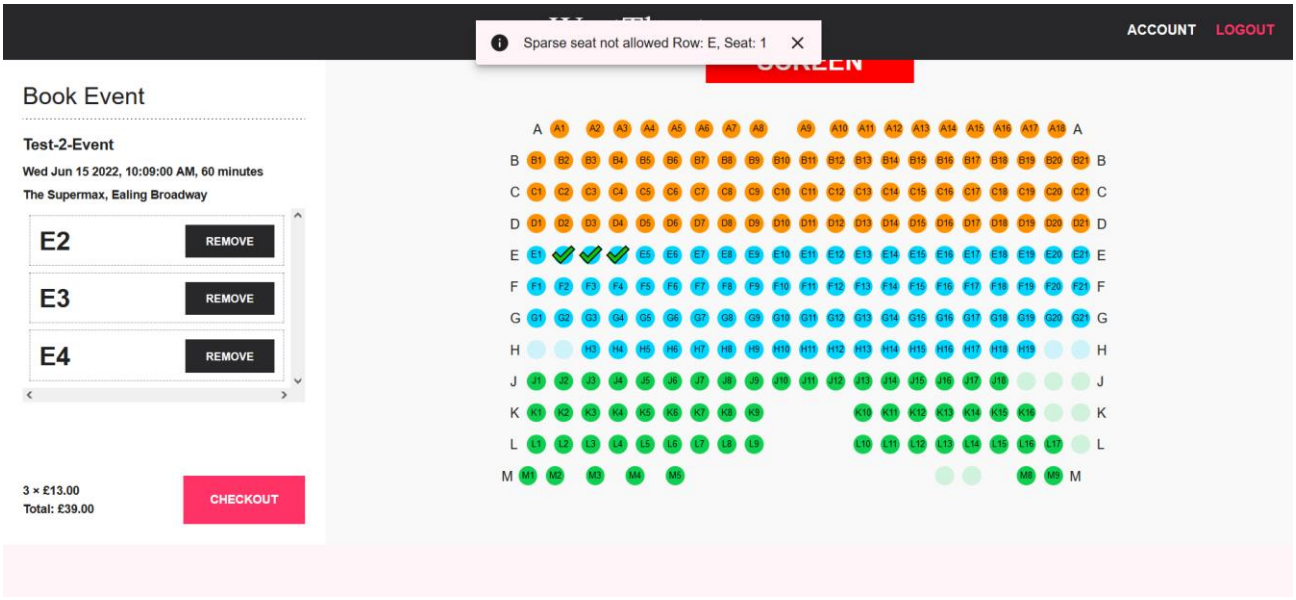



*Figure 42 - Manual Testing 1*

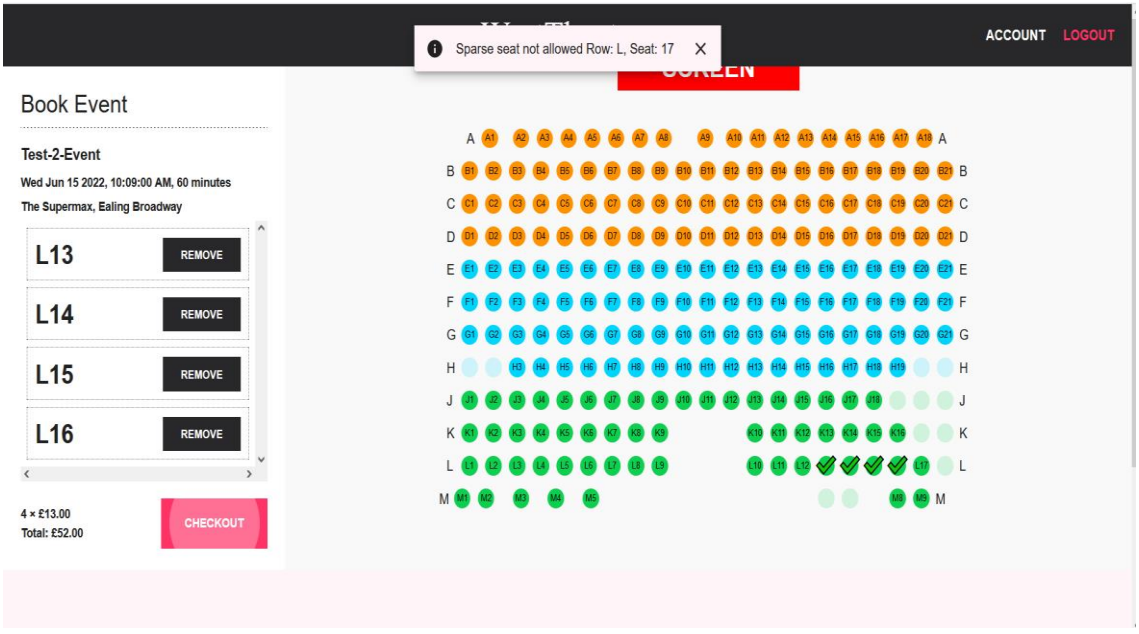



*Figure 43 - Manual Testing 2*

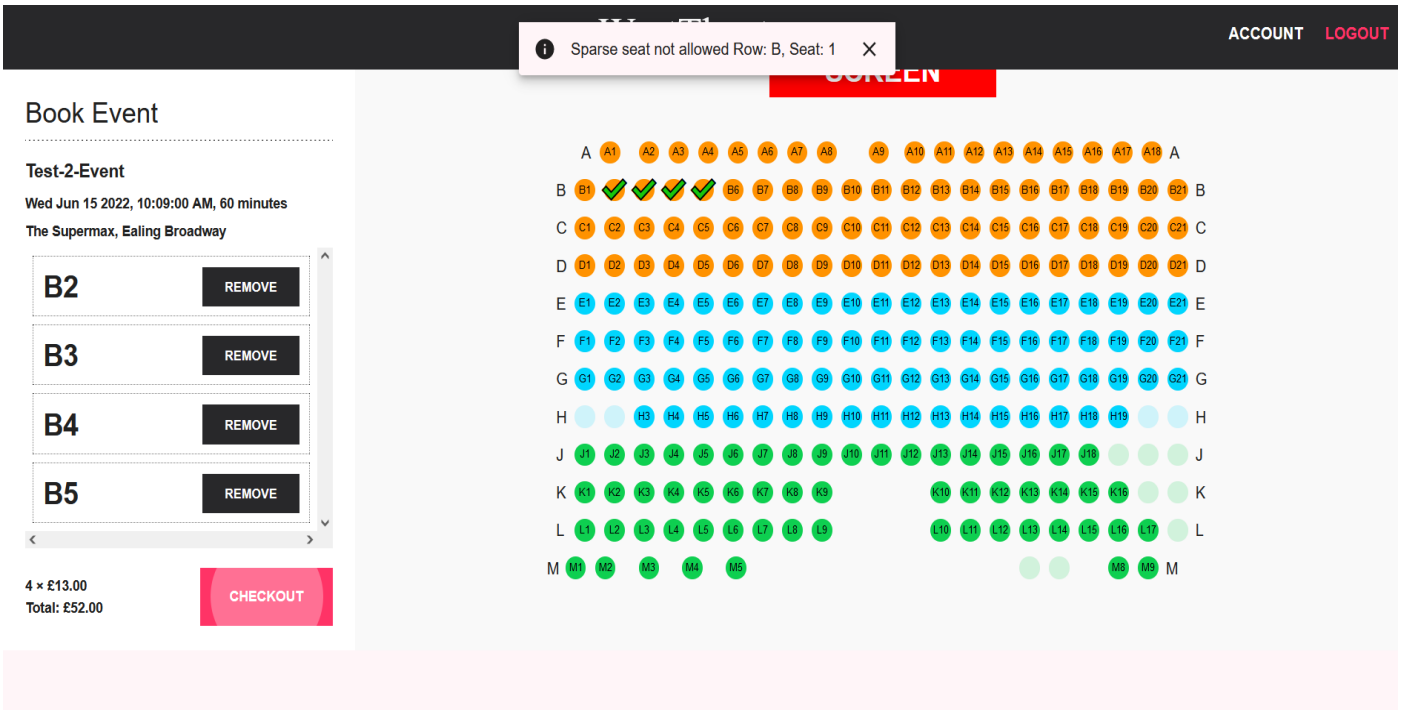



*Figure 44 - Manual Testing 3*

## 8. Critical discussion – Conclusion

Since day one of the part 3 assignment we set up a group meeting with all members to establish our plan and work distribution to make sure we deliver the best possible outcome. Upon meeting, we had to decide who is going to be in charge of which division and set a plan towards that.

We decided that two people would be in charge of the backend development and three in charge of the front end development, based on previous projects, skills and experience.

Based on the plan, deadlines were set and meetings were decided every week to go through with our work and share it amongst us to make sure that everyone is at the same point and no one is left behind. Meetings ideally were supposed to be in person but due to various factors, could be done online as well, as that was the only way to secure that everything is done according to our plan.

Working on our project, came with a variety of issues that were not anticipated from the beginning but with all team's effort, we reduced the issues to a bare minimum. The biggest problem that surfaced was that everyone had a different schedule or availability due to full time/part time jobs outside of university, which is something that might have been not be the case if we had all been employed and assigned specifically this task to implement as a team. On top of this, as everyone in the group has a different background in coding and programming, there was a knowledge gap that we had to cover between us, making the task harder to complete as we had to analyse and learn everything from the beginning in order to implement it. Which although it was more time consuming, it was an opportunity to learn at the same time and it made the whole project a source of knowledge and learning. Apart from these two, we faced couple of issues with our github repositories as well resulting us to rebase.

Taking issues aside, all group delivered what was expected from them and the effort to complete the project was up to standards. All ideas that were initially put on table were implemented and made sure that they are functioning the way they were supposed to. And although, we had one month to deliver a complete project, all deadlines with some small delays were met and our work was delivered. However there is always room for improvement.

In our initial discussion the group decided to implement two different version of the website, one facing the front of the business which handles customer bookings, and another that was used by administrations (staff and managers). The focus was on separation of concerns but in hindsight, we had to reuse some code elements like venue stage where the user has a visible seat layout to select seats from, which made making updates required in two different places. Apart from making one website which handled both customer and administrator actions, an alternative would include creating a monorepo. The goal of monorepos is to have an external set of visual elements and business logic which could be used in multiple areas, hosted on version control platforms like GitHub (Fernandez, 2021). Within our project, the application of such a concept could be applied to reusing the visual venue stage for seat selection as both implementations use the same code.

Aside from what we could have done differently, we were exposed to the benefits of working in a group project. The main one being that we were all exposed to a variety of perspectives and with a combination of different personalities gave us the opportunity to learn how to listen, interact and leverage the talent of our peers in order to achieve the best overall result for our project.

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# Appendix

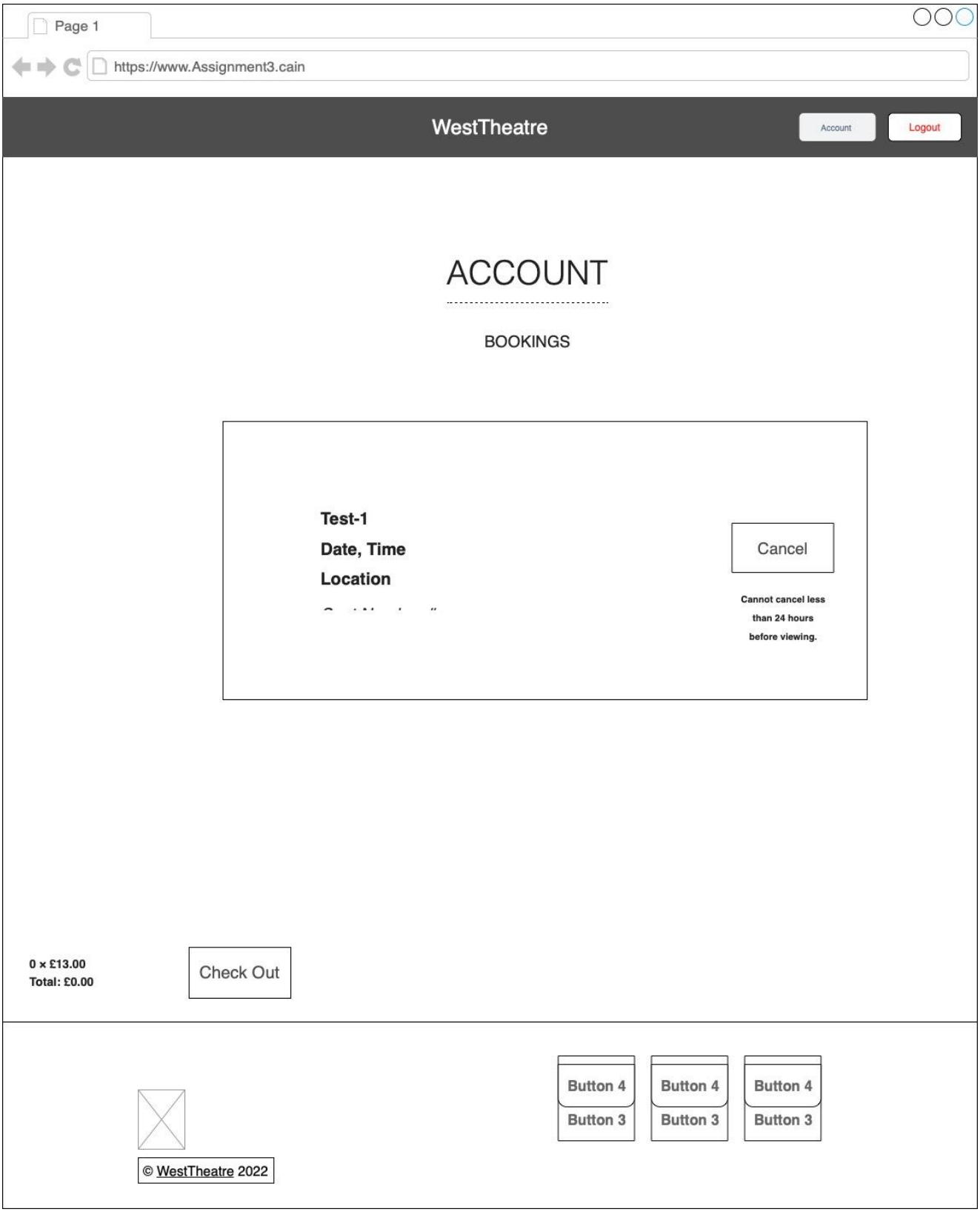


*Figure 45 - Account Page*

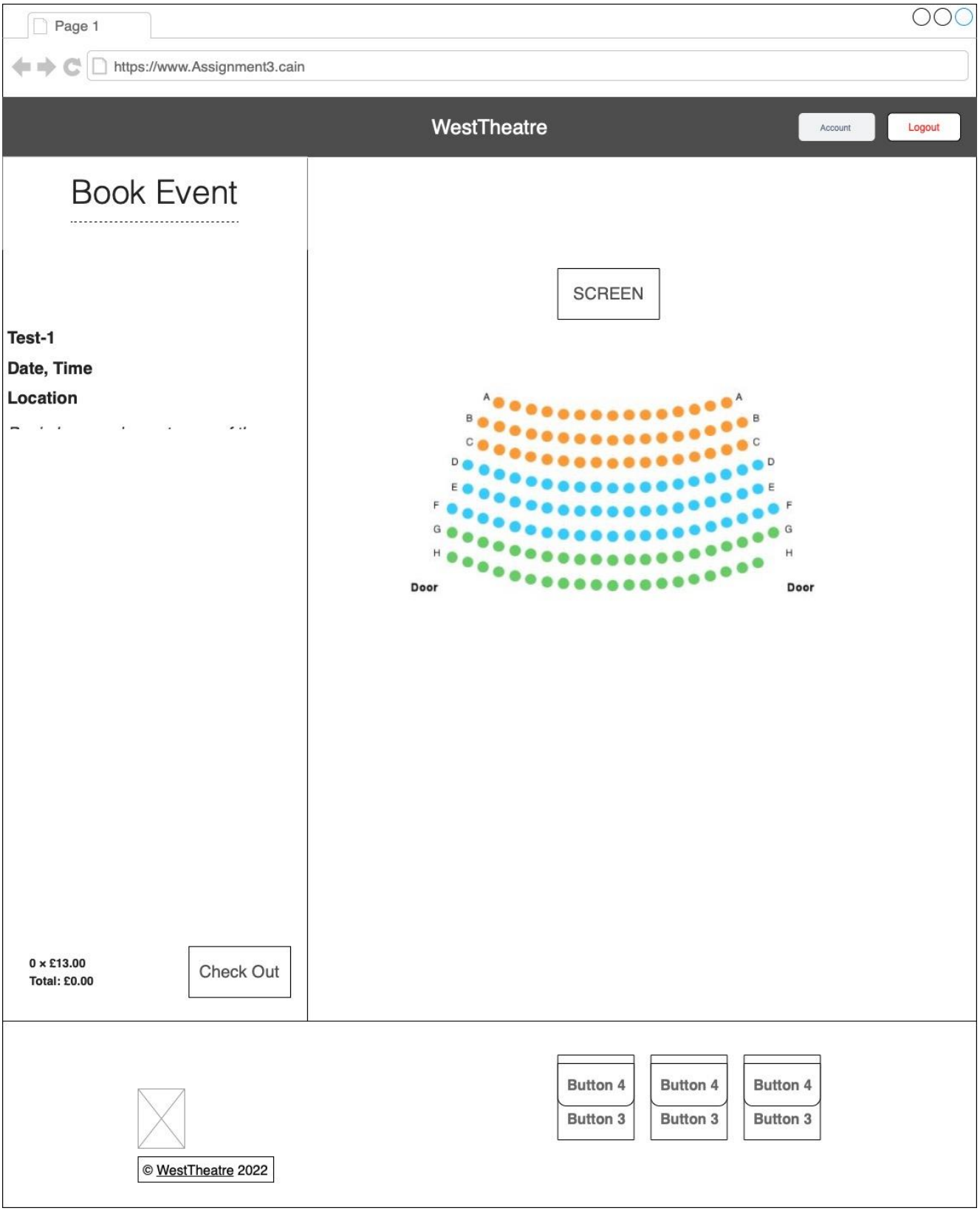


*Figure 46 - Book Event*

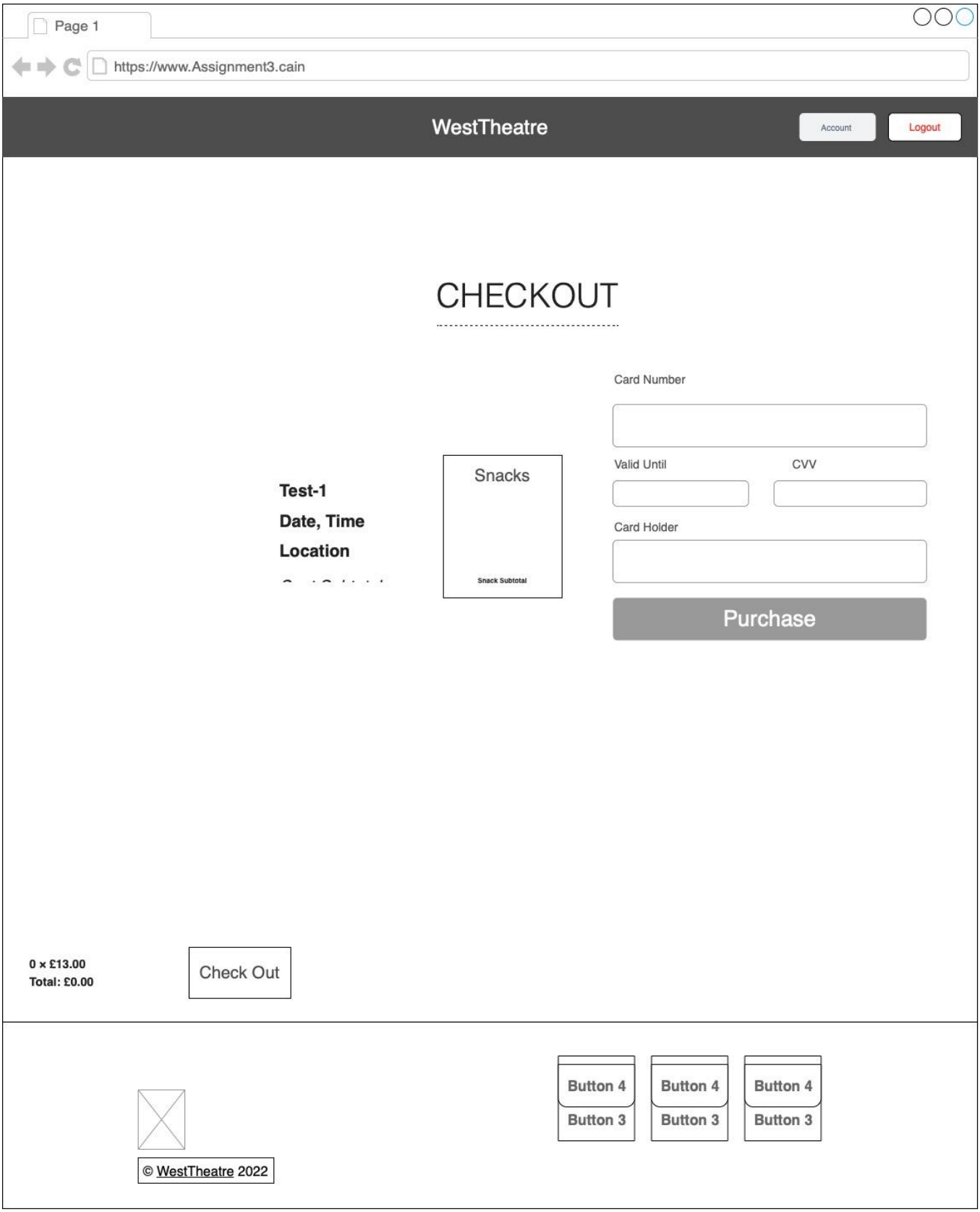


*Figure 47 - Checkout*

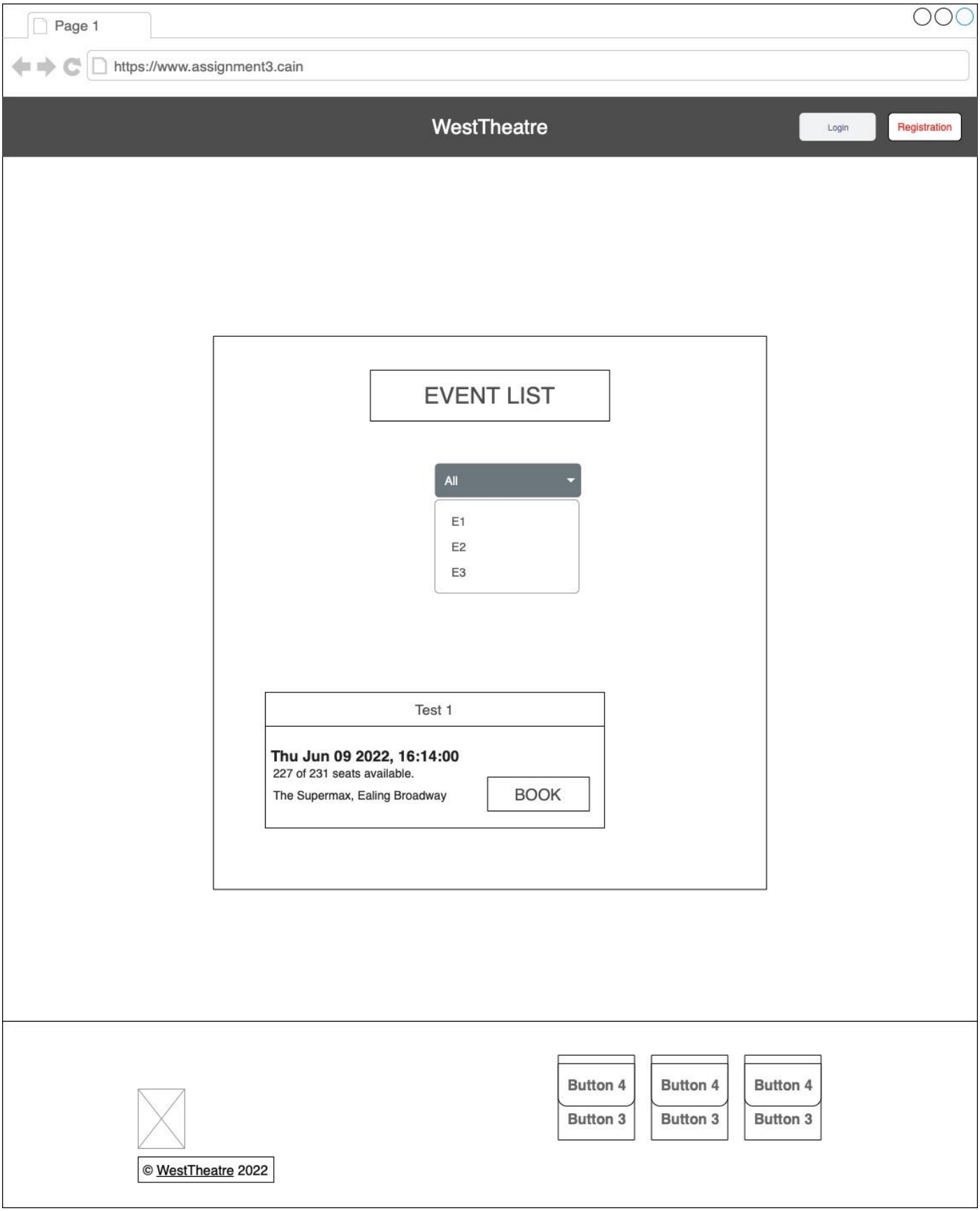


*Figure 48 - Event List*

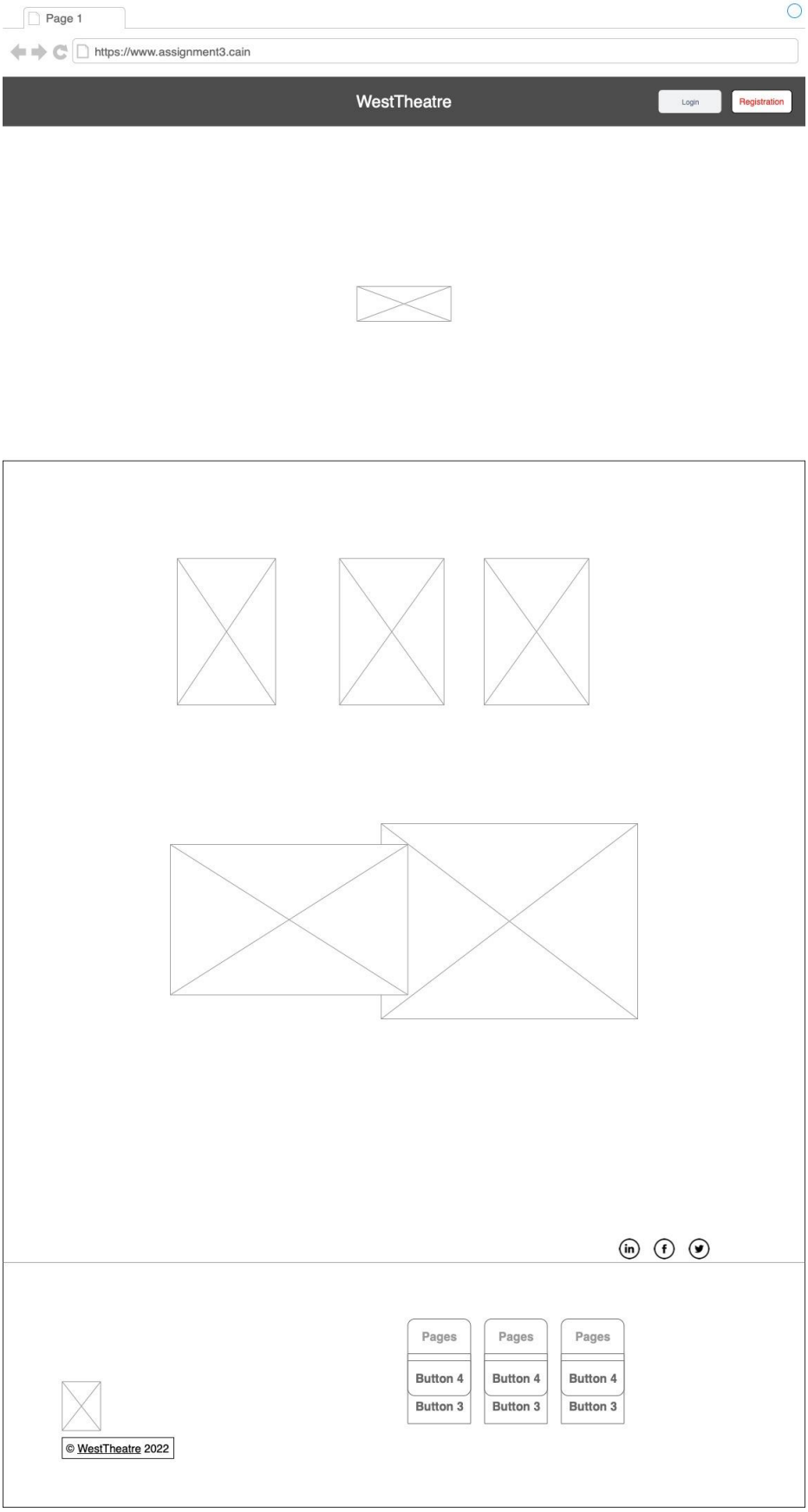


*Figure 49 - Homepage*

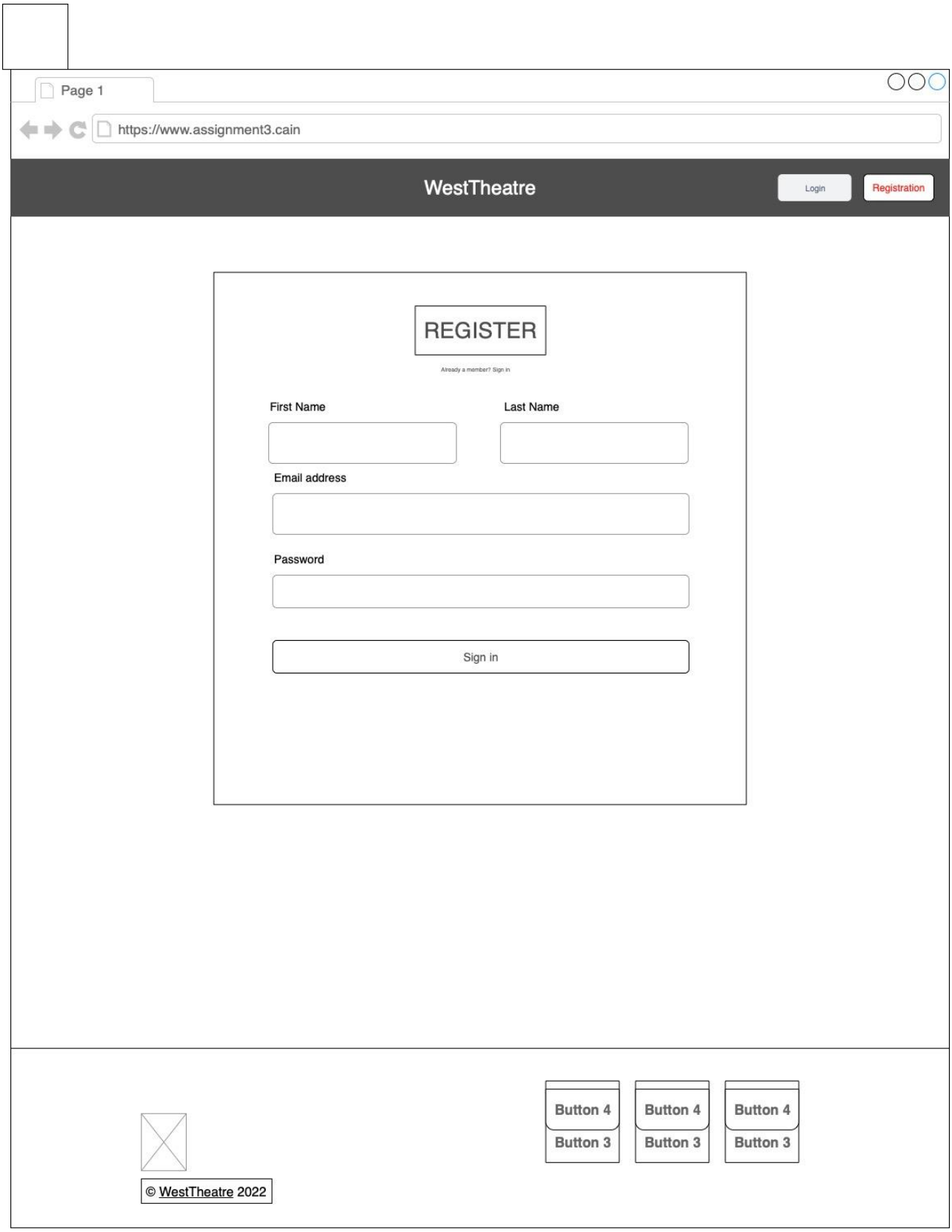


*Figure 50 - Register*

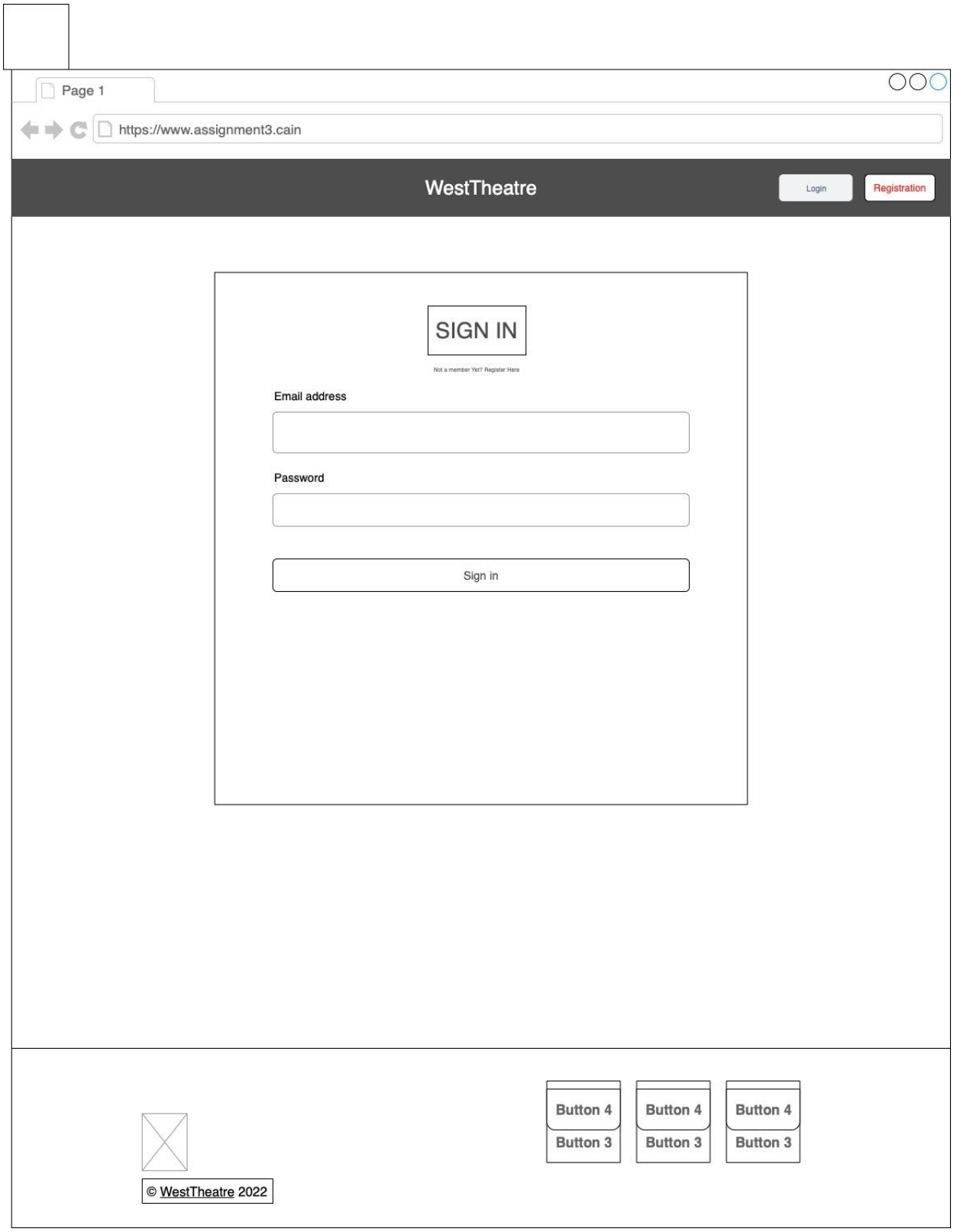


*Figure 51 - Sign In*