

CMPE 273 - Enterprise Distributed Systems
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Final Report



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Project – Fandango Simulation

Project Guide:
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1. Introduction

1.1 Motivation

For this project, we design an Fandango simulation web application, which built upon distributed system. Fandango is online movie ticket booking website. It's has tie up with multiple Movie Halls and you can book the ticket/select seats directly from Fandango. It also provides movie information and other details of the movie. We realized the full stack work including client side, server side, database.

1.2 Team member contribution

	Team Member	Contribution
1	Weiyu Jin	Report Writing. Back-end Api, database designing, Performance Testing
2	Mutian Wang	Client side Kafka connection modules, Client web server framework, Client side session management design and implementation, Access control mechanism design and implementation, Multi-type search modules, Page layouts design and implementation
3	Hongyuan Li	Backend Spring Boot architecture and API. MySQL Data Model design. Business logic design. Kafka setup. Spring Cache with Redis. Backend cloud deployment. Sample data generation and collection.
4	Xiaoran Lin	Frontend UI design and implementation.

		Frontend router management and controller implementation
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1.3 Commit History

Commit History for Client Side

<https://github.com/manymeeting/movie-kingdom-client/commits/master>

Commit History for Server Side

<https://github.com/hychrsl/fandango-backend/commits/master>

1.4 Object management policy

For the object management, we will follow the 3NF of the database. More details can be found at chapter 5.

1.5 Heavy resource handling

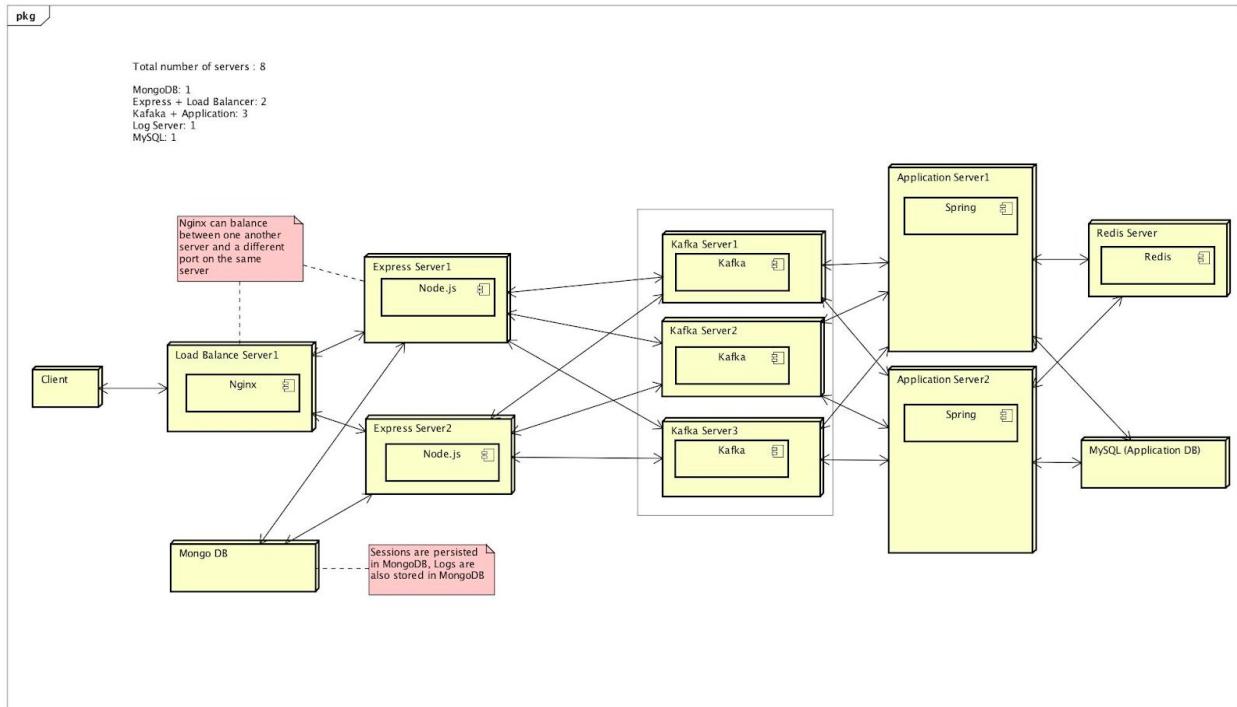
We divided our whole team two groups, which is Front-end team and back-end team. Each team will only doing research and deal with their resource. Therefore, the team member will only focus on their part.

1.6 The policy we used to decide when to write data into database

We use shared lock strategy to manage database concurrency. Read_lock : several transactions can simultaneously read. Write_lock : one transaction exclusive access to write to a resource.

2. System Design

2.1 Architecture Overview



Front-end: HTML(EJS) + CSS + node.js + Express

Back-end: Spring Boot

Database: MySql + MongoDB

Message: Kafka

MySql caching: Redis

2.2 Scalability, Performance and Reliability

To improve our scalability and performance, we implement multiple servers on both client side and server side. For the client side, we have two server. For the server side, we have 3 servers and one redis server for Sql caching.

Backend servers are written with Spring Boot to offer RESTful API. These servers are designed to be stateless, which offers high scalability. Therefore, we can scale out as many instances as needed.

Using Kafka as the messenger to handle the communication with many different components helps us to build a system with loosely coupled micro-services, which can be developed, deployed and scaled independently. For example, we can register multiple backend instances as consumers in one consumer group. Each one of them acquires equal number of partitions from subscribed topics. We can add and remove

components to this network easily, since our components are stateless. In addition, Kafka monitors the liveness of all consumers. When instances join or leave the group, Kafka would rebalance the assignments of partitions to each consumers. This feature enables our system to scale in and out even more easily.

Another good feature brought by kafka is reliability. Serving as a buffer, Kafka handles the difference in throughput of each components gracefully. Messages will be kept safely within the retention period, even though one end of the communication is significantly slower than the other. In such situation, message are likely to be dropped without Kafka. Kafka also guarantees more than once delivery, which covers the uncertainty of network communication.

Our system is built to achieve high performance. We leveraged the built-in connection pool options when creating data source objects. On the JPA/Hibernate level, we carefully designed our query strategy. For example, complex joins are pushed down to database to take advantage of query optimization in MySQL. When conditions are met, we also purposefully limit select fields through Query override to eliminate unnecessary joins. In addition, pagination is implemented on all API endpoints that need to return lists, with default of 20 items per page. Such restrictions prevents unwanted long running queries that retrieve too much data.

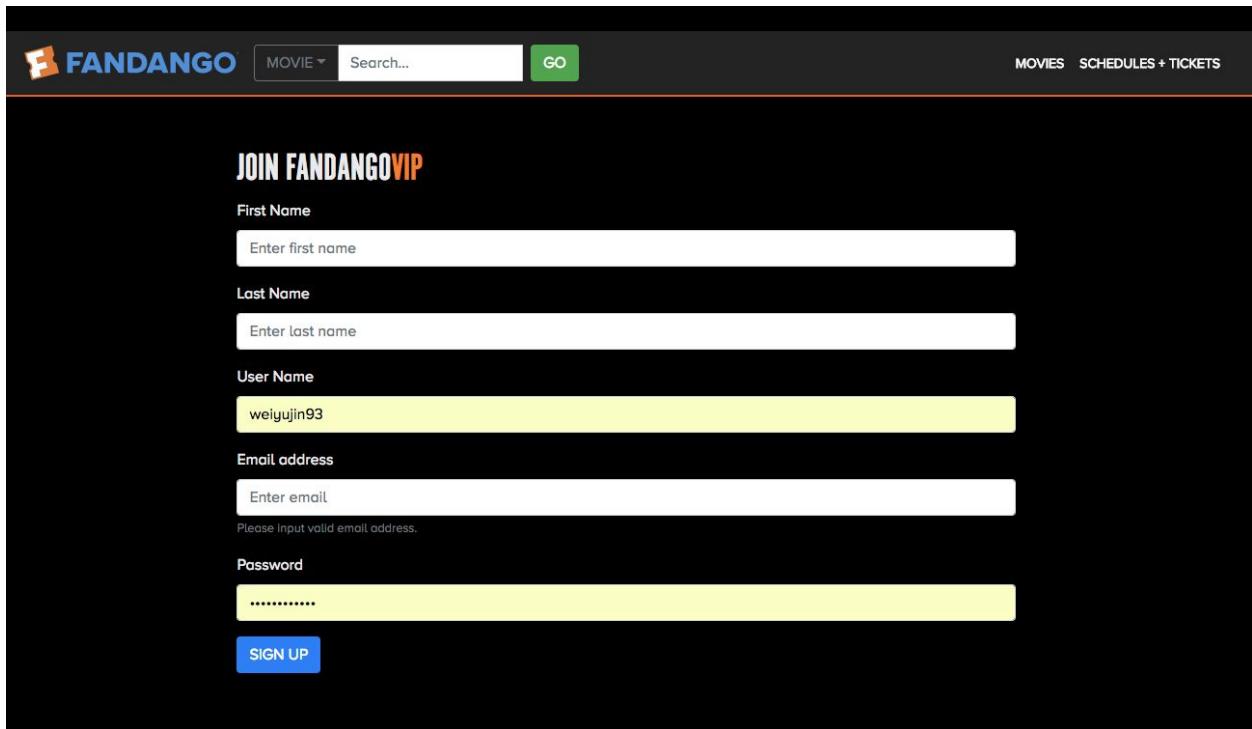
Query caching serves an important role in support of our performance improvement efforts. Redis is used for SQL caching in junction with Spring Caching, which greatly improves the performance of retrieving data, especially after complex data transformation. For instance, our system caches the return results of movie schedules. These results usually requires intensive processing to transform row-by-row data into hierarchical JSON format for the display on the frontend. Further, the return results are relatively static within one day. Caching these results in Redis bypasses the repeating selection and computation, greatly boosted the performance.

On client side, we use “connect-mongo” package to persist our session data into MongoDB server, which means that all session data can be synchronized among multiple Express servers. Therefore, we achieved good scalability on both client side and server side.

3. Client side overview

3.1 User Module/ Service

3.1.1 Create a new User



The screenshot shows the Fandango VIP sign-up page. At the top, there's a navigation bar with the Fandango logo, a dropdown menu labeled "MOVIE", a search bar with placeholder text "Search...", and a green "GO" button. To the right of the search bar are links for "MOVIES", "SCHEDULES + TICKETS", and other account-related options. Below the navigation, the main heading reads "JOIN FANDANGO VIP". The form consists of several input fields: "First Name" (placeholder: "Enter first name"), "Last Name" (placeholder: "Enter last name"), "User Name" (value: "weiyujin93"), "Email address" (placeholder: "Enter email", with a note below: "Please input valid email address."), and "Password" (placeholder: "....."). A blue "SIGN UP" button is located at the bottom of the form.

3.1.2 Delete an existing User

Click the top right button. Then you will jump to the signin page.

Role: Hall Admin Profile Log Out

MOVIE Search... GO MOVIE SCHEDULE

User ID 257

Account Type
HAD

Select Image

Image URL
<https://res.cloudinary.com/dxgw2lspw/image/upload/v1525052>

First Name
Tester

Last Name
TTT

Street

City

State

Zip Code

Phone Number

Email
x@x.com

Credit Card Details

Card Number

Expire Date

年 /月/日

Security Code

3.1.3 Change a user's information

Click the blue update button on the profile page.

Role: Hall Admin Profile Log Out

MOVIE Search... GO MOVIE SCHEDULE

User ID 257

Account Type
HAD

 Select Image

Image URL
<https://res.cloudinary.com/dxgzw2lspw/image/upload/v1525052>

First Name
Tester

Last Name
TTT

Street
408 N12 ST

City
San Carlos

State
CA

Zip Code
92351

Phone Number
408-533-3223

Email
x@x.com

Credit Card Details

Card Number

Expire Date
 年 / 月 / 日

Security Code

UPDATE CANCEL

3.1.4 Display information about a User.

After sign in, click the profile on the top right of the page. Then you will see your current profile.

Role: Hall Admin Profile Log Out

MOVIE Search... GO MOVIE SCHEDULE

User ID 257

Account Type
HAD

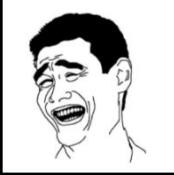
 Select Image

Image URL
<https://res.cloudinary.com/dxgw2lspw/image/upload/v1525052>

First Name
Tester

Last Name
TTT

Street
408 N12 ST

City
San Carlos

State
CA

Zip Code
92351

Phone Number
408-533-3223

Email
x@x.com

Credit Card Details

Card Number

Expire Date
 年 / 月 / 日

Security Code

3.1.5 Search listing for different categories

On the main page, you can track different categories of movies when you click the genres buttons.



MOVIE ▾

Search...

GO

MY ORDERS MOVIES SCHEDULES + TICKETS

FILTER BY MOVIE GENRES

[Action](#) [Adventure](#) [Comedy](#) [Crime](#) [Drama](#) [Fantacy](#) [Historical](#) [Historical Fiction](#) [Horror](#) [Mystery](#) [Political](#) [Romance](#)
[Science Fiction](#) [Thriller](#) [Western](#)

MOVIES

Whether you're planning a romantic first date, a family movie night, or anything in-between, we can help you find the perfect movie for any occasion.



Heartbreaker (L'Amac...



Age of the Medici, Th...



Memphis Belle: A Stor...



His Kind of Woman



Telephone, The



Rage at Dawn



Commare secca, La ...



Bambou



Attila



Very Thought of You, ...



My Dear Secretary



Josie and the Pussy...



Nobody Lives Forever



Locked Out (Enfermés...)



Star Wars: The Clone ...



Easy Wheels



Night Strangler, The



Salt of the Earth



In the Bedroom



Obvious Child

3.1.6 Search Movies / Halls (Filter based on Price and Ratings)

Role: User Profile Log Out

FANDANGO MOVIE Str GO MY ORDERS MOVIES SCHEDULES + TICKETS

FILTER BY MOVIE GENRES

Action Adventure Comedy Crime Drama Fantasy Historical Historical Fiction Horror Mystery Political Romance
Science Fiction Thriller Western

MOVIES

Whether you're planning a romantic first date, a family movie night, or anything in-between, we can help you find the perfect movie for any occasion.

Night Strangler, The City Streets Lonely Street Strip-tease My Little Pony: Equest...
District 13: Ultimatum ... Stockholm East (Stock... When a Stranger Calls

(Search by movie name)

Role: User Profile Log Out

FANDANGO CITY Sa GO MY ORDERS MOVIES SCHEDULES + TICKETS

SEARCH RESULT FOR: SA

Find available movie times in your city

Pasadena, CA Sacramento, CA Salinas, CA San Bernardino, CA San Diego, CA San Francisco, CA San Jose, CA
San Luis Obispo, CA San Mateo, CA San Rafael, CA Santa Ana, CA Santa Barbara, CA Santa Clara, CA Santa Cruz, CA
Santa Monica, CA Santa Rosa, CA

(Search by city name, show all matched cities)

Role: User Profile Log Out

FANDANGO CITY ▾ Pasadena, CA GO

MY ORDERS MOVIES SCHEDULES + TICKETS

MOVIE TIMES + TICKETS NEAR PASADENA, CA

FILTER BY:

Price (USD) All Rating All REFRESH

DALTFRESH THEATER
93865 Brickson Park Drive, Pasadena, CA, 91199

LONELY STREET
EVL HAS A DESTINY
 ★★★★★
Select a movie time to buy tickets
11:05:00 14:35:00 16:45:00
Mystery, Romance, Western

CHILD'S PLAY 3
LEONARD KUTLER
 ★★★★★
Action, Science Fiction, Thriller, Adventure, Comedy, Fantasy
Select a movie time to buy tickets
11:06:00 11:16:00 14:36:00 16:46:00
20:06:00

MANHATTAN
JESSIE JONES
 ★★★★★
Mystery, Political, Western, Crime, Horror
Select a movie time to buy tickets
11:11:00 17:01:00 18:04:20 20:01:00
Mystery, Political, Western, Crime, Horror

(Click any city name, show all movie schedules in this city)



ZIP CODE ▾

92825

GO

MY ORDERS MOVIES SCHEDULES + TICKETS

MOVIE TIMES + TICKETS NEAR 92825

FILTER BY:

Price (USD)

All

Rating

All

REFRESH

TOUGHJOYFAK THEATER

132 Old Shore Court, Anaheim, CA, 92825



LONELY STREET

★★★★★

Mystery, Romance, Western

Select a movie time to buy tickets

10:59:00

14:29:00

16:39:00



MANHATTAN

★★★★★

Mystery, Political, Western, Crime, Horror

Select a movie time to buy tickets

16:55:00

17:58:20

19:21:40



LA PETITE REINE

★★★★★

Action, Thriller, Historical

Select a movie time to buy tickets

11:01:00

14:31:00

16:41:00

17:01:00

18:04:20

19:27:40



THE WILD WORLD OF LYDIA LUNCH

★★★★★

Crime, Historical Fiction

Select a movie time to buy tickets

11:15:00

14:45:00

16:55:00

17:15:00

18:18:20

19:41:40



HEARTS OF THE WEST

★★★★★

Mystery, Political, Thriller, Western, Adventure, Historical, Historical Fiction

Select a movie time to buy tickets

11:04:00

14:34:00

16:44:00

17:04:00

18:07:20

(Search by zip code, show all movie schedules in this specified area)

3.1.7 Book a Movie



(Click on any schedule, go to buy ticket page)

A screenshot of the Fandango website showing the 'BUY TICKETS' page for 'LA PETITE REINE'. The movie poster is on the left. To the right, the movie title 'LA PETITE REINE' and a 5-star rating are shown. Below this is a block of placeholder text: 'Proin eu mi. Nulla ac enim. In tempor, turpis nec euismod scelerisque, quam turpis adipiscing lorem, vitae mattis nibh ligula nec sem.' To the right of this text is a theater information box for 'TOUGHJOYFAX THEATER' located at '132 Old Shore Court, Anaheim, CA, 92825'. It shows the show time 'SHOW TIME: 2018-04-29 18:04:20', format 'FORMAT: Digital 3D', and price 'PRICE: 15.5'. There are input fields for 'Ticket Number' and 'Total Price', and a 'BUY' button.

(Select number of ticket to buy and continue to checkout)

3.1.8 Add Review/Rating to Movie.

A screenshot of the Fandango website showing the review page for the movie "Heartbreaker (L'Arnacoeur)". The page includes a movie poster for "Adam Sandler: You Don't Mess with the Zohan", release date (2018-01-05), rating (PG-13), runtime (146 mins), and a 4-star rating. A form allows users to rate the movie from 1-5 stars, write a review, and include a title and body. A note says reviews appear publicly and personal info is not allowed. Buttons for CANCEL and SAVE REVIEW are at the bottom.

MOVIE ▾ Search... GO

MY ORDERS MOVIES SCHEDULES + TICKETS

HEARTBREAKER (L'ARNACOEUR) REVIEWS

OVERVIEW MOVIE TIMES + TICKETS MOVIE REVIEWS POST REVIEW

Release Date
2018-01-05
PG-13
146 mins
RATING
★★★★★

PLEASE RATE THIS MOVIE FROM 1-5 STARS

5

WRITE A REVIEW

Title:

Body:

Note: Your review will appear publicly on our site. Please do not include any personal information (full street address, etc.) Allow up to 24 hours for your review to post.

CANCEL **SAVE REVIEW**

SYNOPSIS

Curabitur gravida nisi at nibh. In hac habitasse platea dictumst. Aliquam augue quam, sollicitudin vitae, consectetuer eget, rutrum at, lorem.

3.1.9 Make Payment

A screenshot of the Fandango website showing the ticket purchase page for "Age of the Medici". It shows a movie poster for "Push", the show time (2018-05-13 11:46:00), format (Digital), and price (\$12.8). A form allows users to enter the number of tickets (4) and total price (51.2) before clicking BUY.

Role: User Profile Log Out

MOVIE ▾ Search... GO

MY ORDERS MOVIES SCHEDULES + TICKETS

BUY TICKETS

AGE OF THE MEDICI, THE (L'ÈTA DI COSIMO DE MEDICI)
★★★★★
Pellentesque at nulla. Suspendisse potenti. Cras in purus eu magna vulputate luctus.

NAMFIX THEATER
93 Logan Pass, Alhambra, CA, 91841

SHOW TIME: 2018-05-13 11:46:00 FORMAT: Digital PRICE: 12.8

4 51.2 **BUY**

(Type the number of ticket you want to buy, the total price will automatically updated, click on BUY to confirm payment)

3.1.10 View Past/Current purchases

The screenshot shows the Fandango website's 'MY ORDERS' section. At the top, there is a navigation bar with links for 'MOVIE', 'Search...', 'GO', 'MY ORDERS', 'MOVIES', and 'SCHEDULES + TICKETS'. The 'Role: User Profile Log Out' link is also visible. Below the navigation, the title 'MY ORDERS' is displayed. The page lists four movie purchases:

- JOHN DIES AT THE END** (★★★★★)
Movie poster: A man with a rifle looking through binoculars.
Text: Cum sociis natoque penatibus et magnis dis parturient montes, nascentur ridiculus mus. Vivamus vestibulum sagittis sapien. Cum sociis natoque penatibus et magnis dis parturient montes, nascentur ridiculus mus.
- SOLARBREEZE THEATER**
Address: 204 Starling Terrace, San Francisco, CA, 94154
Show Time: 2018-05-01 11:25:00 Format: IMAX
Ticket Number: 1 Price (Total): 13.38
Purchased At: 2017-08-16 11:47:00 By: Valentin Dusting
- THE BUTTER BATTLE BOOK** (★★★★★)
Movie poster: Two men in military uniforms.
Text: Integer ac leo. Pellentesque ultrices mattis odio. Donec vitae nisi.
- Y-SLOWARM THEATER**
Address: 47 Straubel Alley, Long Beach, CA, 90810
Show Time: 2018-05-11 14:50:00 Format: Digital
Ticket Number: 2 Price (Total): 26.75
Purchased At: 2017-04-26 02:52:00 By: Valentin Dusting
- BAD GIRL** (★★★★★)
Movie poster: A woman standing in front of a city skyline.
Text: Nullam sit amet turpis elementum ligula vehicula consequat. Morbi a ipsum. Integer a nibh.
- HOME ING THEATER**
Address: 2090 Cherokee Road, Escondido, CA, 92030
Show Time: 2018-05-12 17:00:00 Format: Digital 3D
Ticket Number: 2 Price (Total): 26.75
Purchased At: 2017-11-18 00:50:00 By: Valentin Dusting

(Click on MY ORDERS nav link, go to My Orders page)

3.2 Movie Hall Module/ Service

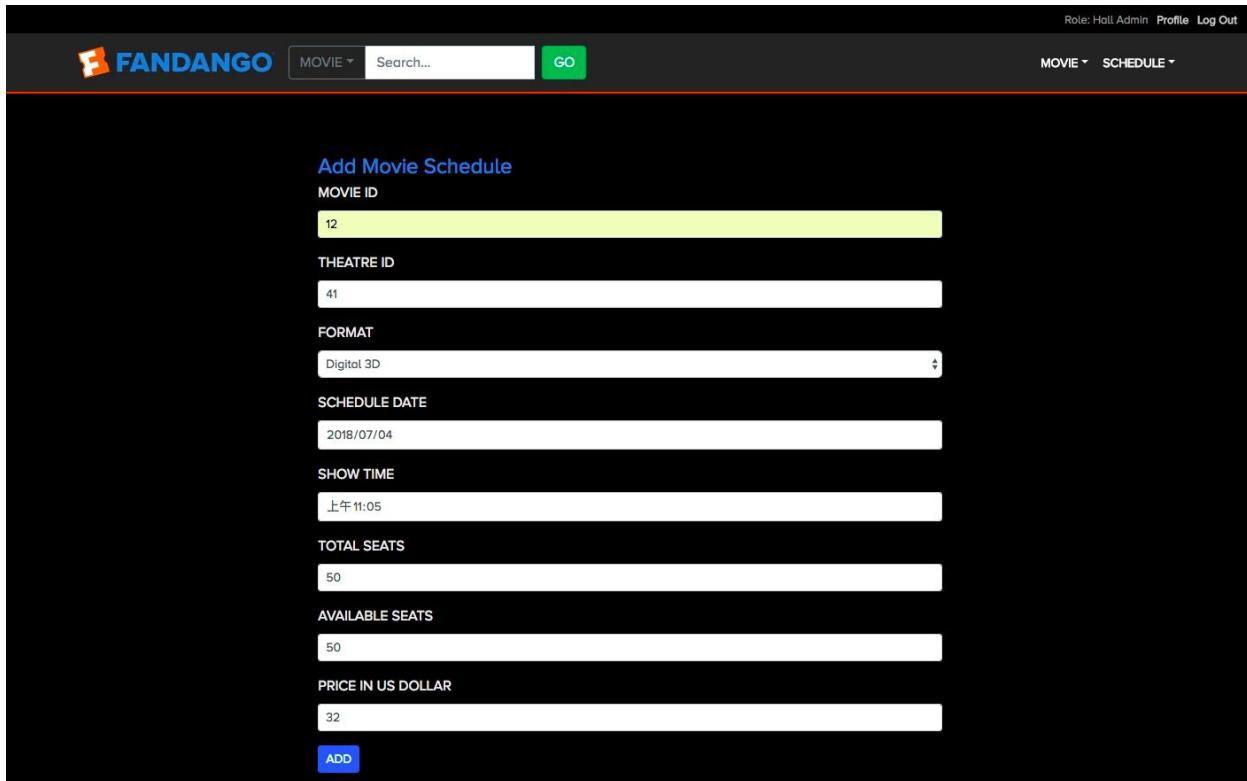
3.2.1 Allow only the authorized user to access this module

The screenshot shows the Fandango website's 'MOVIE HALL' section. At the top, there is a navigation bar with links for 'MOVIE', 'Search...', 'GO', 'MOVIE', 'SCHEDULE', and 'LOG OUT'. The 'Role: Hall Admin Profile Log Out' link is also visible. Below the navigation, the title 'MOVIE HALL' is displayed. The page lists movie schedules:

- FANDANGO** MOVIE Search... GO
- MOVIE SCHEDULE**

(In this application, different user has different role, and the view will change according to the role of the current user. Modules like Add/Edit movie are only accessible & visible to users with the role - "Hall Admin")

3.2.2 Add movie information like time etc.



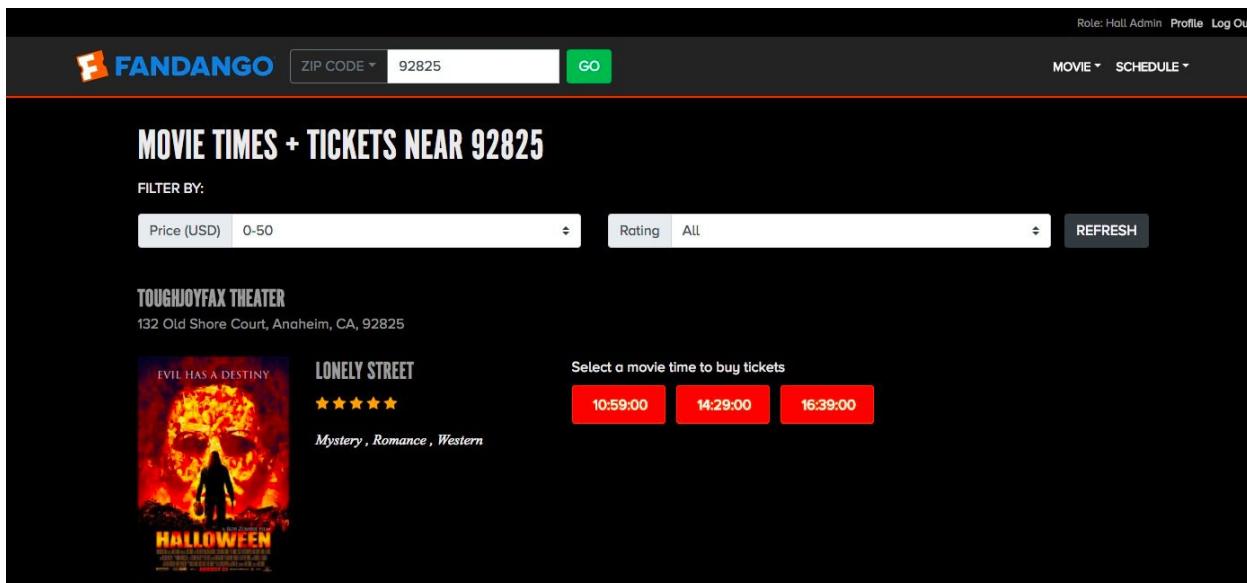
The screenshot shows the Fandango Hall Admin interface for adding a movie schedule. The top navigation bar includes the Fandango logo, a search bar with placeholder "Search...", a "GO" button, and links for "MOVIE" and "SCHEDULE". The user is logged in as "Hall Admin". The main form is titled "Add Movie Schedule" and contains the following fields:

- MOVIE ID: 12
- THEATRE ID: 41
- FORMAT: Digital 3D
- SCHEDULE DATE: 2018/07/04
- SHOW TIME: 上午11:05
- TOTAL SEATS: 50
- AVAILABLE SEATS: 50
- PRICE IN US DOLLAR: 32

A blue "ADD" button is located at the bottom of the form.

(Add movie schedule to a hall)

3.2.3 Search for listing and edit it.



The screenshot shows the Fandango Hall Admin interface for searching movie times and tickets. The top navigation bar includes the Fandango logo, a search bar with placeholder "ZIP CODE" containing "92825", a "GO" button, and links for "MOVIE" and "SCHEDULE". The user is logged in as "Hall Admin". The main section displays "MOVIE TIMES + TICKETS NEAR 92825" and includes a "FILTER BY:" section with dropdowns for "Price (USD)" set to "0-50" and "Rating" set to "All", along with a "REFRESH" button. Below this, it lists a theater:

TOUGHJOYFAK THEATER
132 Old Shore Court, Anaheim, CA, 92825

Movie listing for **LONELY STREET**:

EVIL HAS A DESTINY
★★★★★
Mystery, Romance, Western

Select a movie time to buy tickets

10:59:00 14:29:00 16:39:00

(Hall Admin can use the same search feature as normal user, however, by clicking on the schedule tag, Hall Admin will be able to edit the corresponding schedule information)

Role: Hall Admin | Profile | Log Out

FANDANGO MOVIE ▾ Search... GO MOVIE ▾ SCHEDULE ▾

Edit Movie Schedule

SCHEDULE ID
1179642

SCHEDULE DATE
2018/12/29

SHOW TIME
下午 11:55

TOTAL SEATS
50

AVAILABLE SEATS
50

PRICE IN US DOLLAR
12

UPDATE

(Editing schedule details)

3.2.4 Get revenue by each movie and cancel the booking by user.

Role: Hall Admin | Profile | Log Out

FANDANGO MOVIE ▾ Search... GO MOVIE ▾ SCHEDULE ▾

LOPUTON GEHENNA LIEKKI

OVERVIEW TICKETS MOVIE REVIEWS VIEW ORDERS Movie Revenue: 173159.96 Tickets Sold: 10572 | Edit Movie

Release Date
2018-04-15

G

144 mins

RATING

★★★★★

SYNOPSIS
Duis aliquam convallis nunc. Proin at turpis a pede posuere nonummy. Integer non velit.

Johnny English Strikes Again Trailer #1 (2018) | Movieclips Trailers

(Revenue of each movie is displayed at the top right corner of movie details page, these information are only visible to Hall Admin)

Role: Hall Admin Profile Log Out

FANDANGO MOVIE Search... GO

MOVIE SCHEDULE

LOPUTON GEHENNA LIEKKI ORDERS

OVERVIEW TICKETS MOVIE REVIEWS VIEW ORDERS



Release Date
2018-04-15
G
144 mins
RATING
★★★★★

SYNOPSIS
Duis aliquam convallis nunc. Proin at turpis a pede posuere nonummy. Integer non velit.

BYTECARD THEATER
59 Carey Trail, San Jose, CA, 95113 Cancel
SHOW TIME: 2018-04-21 19:40:40 FORMAT: IMAX 3D
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2017-04-05 00:44:00 BY: Fredra Dudden

CARDIFY THEATER
58 Glendale Plaza, Pasadena, CA, 91117 Cancel
SHOW TIME: 2018-04-24 20:23:00 FORMAT: IMAX
TICKET NUMBER: 2 PRICE (TOTAL): 26.75
PURCHASED AT: 2018-04-05 01:32:00 BY: Margalit Lantoph

NAMFIX THEATER
93 Logan Pass, Alhambra, CA, 91841 Cancel
SHOW TIME: 2018-04-23 16:59:00 FORMAT: Digital
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2017-10-05 04:36:00 BY: Argil de Mullett

OTCOM THEATER
69 Fordem Drive, San Francisco, CA, 94164 Cancel
SHOW TIME: 2018-04-24 14:43:00 FORMAT: Digital
TICKET NUMBER: 2 PRICE (TOTAL): 26.75
PURCHASED AT: 2017-12-24 16:30:00 BY: Marcellus Pedersen

(By clicking on “VIEW ORDERS” navigation link on movie details page, Hall Admin is able to view all orders on the current movie. There is a Cancel link on each order container, Hall Admin can cancel an order by clicking on this link)

3.3 Admin Module/ Service

3.3.1 Allow only the authorized (admin user) to access Admin Module

Role: Super Admin Profile Log Out

FANDANGO MOVIE Search... GO

HALL MOVIE ORDERS DASHBOARD

(As mentioned above, the items on top navigation will change as role changes, only Admin user can access modules like Dashboard, Orders and Edit/Add movie hall page)

3.3.2 Add Movie hall to the system.

The screenshot shows the Fandango Admin interface with a dark theme. At the top, there's a navigation bar with the Fandango logo, a search bar, and links for 'MOVIE', 'HALL', 'ORDERS', and 'DASHBOARD'. The main content area is titled 'Add Movie Hall' and contains four input fields: 'THEATRE NAME' (with placeholder 'Input theatre name'), 'STREET' (placeholder 'Input street address'), 'CITY NAME' (placeholder 'Input city name'), and 'ZIP CODE' (placeholder 'xxxxx'). Below these fields is a blue 'ADD' button.

(Type required information and add movie hall to the system)

3.3.3 Search for Movies and/or Halls and edit it.

The screenshot shows the Fandango Admin interface displaying information for 'TOUGHJOYFAX THEATER'. The theater's address is listed as '132 Old Shore Court, Anaheim, CA, 92825' and its Hall Revenue is '76200.95'. A 'Tickets Sold' count of '4773' is also shown. Below this, there's an 'EDIT HALL' button. The page lists two movies with their posters, titles, genres, and ticket purchase options:

- LONELY STREET**: A movie poster for 'HALLOWEEN' is shown. It has a rating of ★★★★☆ and is categorized as 'Mystery, Romance, Western'. Below the poster, there are three red buttons for ticket purchase times: 10:59:00, 14:29:00, and 16:39:00.
- LA PETITE REINE**: A movie poster for '21 GRAMS' is shown. It has a rating of ★★★★☆ and is categorized as 'Action, Thriller, Historical'. Below the poster, there are four red buttons for ticket purchase times: 11:01:00, 14:31:00, 16:41:00, 17:01:00, 18:04:20, and 19:27:40.

(For each hall, there is a page displaying all schedules of this hall. Admin users will see a Edit button below the name of the hall, and go to Edit Hall page)

Role: Super Admin | Profile | Log Out

FANDANGO MOVIE ▾ Search... GO HALL ▾ MOVIE ▾ ORDERS DASHBOARD

Edit Movie Hall

THEATRE ID
94

THEATRE NAME
TOUGHJOYFAX THEATER

STREET
132 Old Shore Court

CITY NAME
Anaheim, CA

ZIP CODE
92825

UPDATE

(Hall Edit page)

Role: Super Admin | Profile | Log Out

FANDANGO MOVIE ▾ Search... GO HALL ▾ MOVIE ▾ ORDERS DASHBOARD

LONELY STREET

OVERVIEW TICKETS MOVIE REVIEWS

Movie Revenue: 0 Tickets Sold: 0 | Edit Movie



EVIL HAS A DESTINY

HALLOWEEN

Release Date
2018-04-29

G

136 mins

RATING
★★★★★

SYNOPSIS

Integer ac leo. Pellentesque ultrices mattis odio.
Donec vitae nisi.



The Equalizer 2 Trailer #1 (2018) | Movieclips Trailers

TRAILER

F HD

(For each movie, Admin users will see an edit link on the right side)

Role: Super Admin | Profile | Log Out

FANDANGO MOVIE Search... GO HALL MOVIE ORDERS DASHBOARD

Edit Movie

MOVIE ID
20

TITLE
Someone Else's America

DESCRIPTION
Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Proin risus. Praesent lectus."

 QUANTUM OF SOLACE NO TIME TO DIE

选择文件 未选择任何文件

Cover Image URL
<https://image.ibb.co/exgJoc/51.jpg>

LENGTH
139

MPAA ID
G

RELEASE DATE
2018/03/12

TRAILER URL
<https://www.youtube.com/embed/1HcoMNJuIMO>

STARS
1

UPDATE

(Type all required information and update the movie)

3.3.4 View/Modify user/hall account

The screenshot shows the Fandango Admin interface. At the top, there is a navigation bar with the Fandango logo, a search bar, and links for MOVIE, HALL, ORDERS, and DASHBOARD. On the far right, it shows "Role: Super Admin Profile Log Out". The main content area is a form for editing a user account. The form has a red border around its content area. It includes fields for User ID (259), Edit ID (16), and a "DELETE YOUR ACCOUNT" button. There is also a dropdown for Account Type set to "SAD". A placeholder image for a profile picture is shown with a "Select Image" button. Below this are input fields for First Name (Tester), Last Name (Three), Street, City, State, Zip Code, Phone Number, and Email (tigt3.com). A section titled "Credit Card Details" contains fields for Card Number, Expire Date (显示为 "年 / 月 / 日"), and Security Code.

User ID 259 Edit ID: 16 | [EDIT](#) | [DELETE YOUR ACCOUNT](#)

Account Type
SAD

Select Image

Image URL

First Name
Tester

Last Name
Three

Street

City

State

Zip Code

Phone Number

Email
tigt3.com

Credit Card Details

Card Number

Expire Date
年 / 月 / 日

Security Code

(Admin user will be able to edit any users by searching their account with user ID, then click on Edit button to enter edit mode, and type information to update the user account)

Role: Super Admin | Profile | Log Out

FANDANGO MOVIE ▾ Search... GO HALL ▾ MOVIE ▾ ORDERS DASHBOARD

User ID 16

Account Type
USER

174 x 208 Select Image

Image URL
http://dummyimage.com/174x208.jpg/ff4444/ffffff

First Name
Valery

Last Name
Espodater

Street
08 Di Loreto Circle

City
San Jose

State
CA

Zip Code
95194

Phone Number
408-155-9127

Email
vespodaterb@techcrunch.com

Credit Card Details

Card Number
56022567064692100

Expire Date
年 /月 /日

Security Code
161

UPDATE CANCEL

(Edit mode)

3.3.5 Search for a Bill based on attributes (fetch all bills By date, By months)

Screenshot of the Fandango Admin interface showing the 'SEARCH ORDERS' page.

The top navigation bar includes links for MOVIE, HALL, ORDERS, and DASHBOARD, along with user information: Role: Super Admin, Profile, and Log Out.

SEARCH ORDERS

Search all orders in this site, please provide movie id or user id

User ID: Movie ID: SEARCH

JOHN DIES AT THE END
★★★★★
Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Vivamus vestibulum sagittis sapien. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus.

SOLARBREEZE THEATER
204 Starling Terrace, San Francisco, CA, 94154
SHOW TIME: 2018-05-01 11:25:00 FORMAT: IMAX
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2017-08-16 11:47:00 BY: Valentin Dusting

LOPUTON GEHENNA LIEKKI
★★★★★
Duis aliquam convallis nunc. Proin at turpis a pede posuere nonummy. Integer non velit.

BYTECARD THEATER
59 Carey Trail, San Jose, CA, 95113
SHOW TIME: 2018-04-21 19:40:40 FORMAT: IMAX 3D
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2017-04-05 00:44:00 BY: Fredra Dudden

(Admin users will be able to view all orders, as well as search by user ID or movie ID)

3.3.6 Display information about a Bill.

Role: Super Admin | Profile | Log Out

FANDANGO MOVIE Search... GO HALL MOVIE ORDERS DASHBOARD

SEARCH ORDERS

Search all orders in this site, please provide movie id or user id

User ID Movie ID SEARCH

KATZE IM SACK



★★★★★

In quis justa. Maecenas rhoncus aliquam lacus. Morbi quis tortor id nulla ultrices aliquet.

COOKLEY THEATER

58 Sheridan Plaza, Los Angeles, CA, 90010

SHOW TIME: 2018-04-23 19:28:40 FORMAT: IMAX 3D
TICKET NUMBER: 2 PRICE (TOTAL): 26.75
PURCHASED AT: 2017-03-03 12:08:00 BY: Dulce Hiddy

ABBOTT AND COSTELLO MEET THE MUMMY



★★★★★

Aenean fermentum. Donec ut mauris eget massa tempor convallis. Nulla neque libero, convallis eget, eleifend luctus, ultricies eu, nibh.

LOTLUX THEATER

58 Oriole Junction, Petaluma, CA, 94975

SHOW TIME: 2018-05-04 19:51:40 FORMAT: IMAX 3D
TICKET NUMBER: 2 PRICE (TOTAL): 26.75
PURCHASED AT: 2017-03-16 18:49:00 BY: Dulce Hiddy

STILL LIFE



★★★★★

Cras mi pede, malesuada in, imperdiet et, commodo vulputate, justo. In blandit ultrices enim. Lorem ipsum dolor sit amet, consectetuer adipiscing elit.

ZAMIT THEATER

5 Tennyson Way, Fresno, CA, 93794

SHOW TIME: 2018-05-19 10:55:00 FORMAT: Digital
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2017-03-30 17:57:00 BY: Dulce Hiddy

TAXIDERMIA



★★★★★

Vestibulum ac est lacinia nisi venenatis tristique. Fusce congue, diam id ornare imperdiet, sapien urna pretium nisl, ut volutpat sapien arcu sed augue. Aliquam erat volutpat.

ZATHIN THEATER

26 Reinke Parkway, Modesto, CA, 95354

SHOW TIME: 2018-04-15 17:09:00 FORMAT: Digital 3D
TICKET NUMBER: 2 PRICE (TOTAL): 26.75
PURCHASED AT: 2017-11-28 15:49:00 BY: Dulce Hiddy

GREEN HORNET, THE



★★★★★

Nullam sit amet turpis elementum ligula vehicula consequat. Morbi a ipsum. Integer a nibh.

SUBIN THEATER

1 Haas Street, San Diego, CA, 92115

SHOW TIME: 2018-04-28 18:10:20 FORMAT: Digital 3D
TICKET NUMBER: 1 PRICE (TOTAL): 13.38
PURCHASED AT: 2018-01-31 19:45:00 BY: Dulce Hiddy

(All bills are displayed with details)

3.3.7 Display revenue by movie and Movie hall

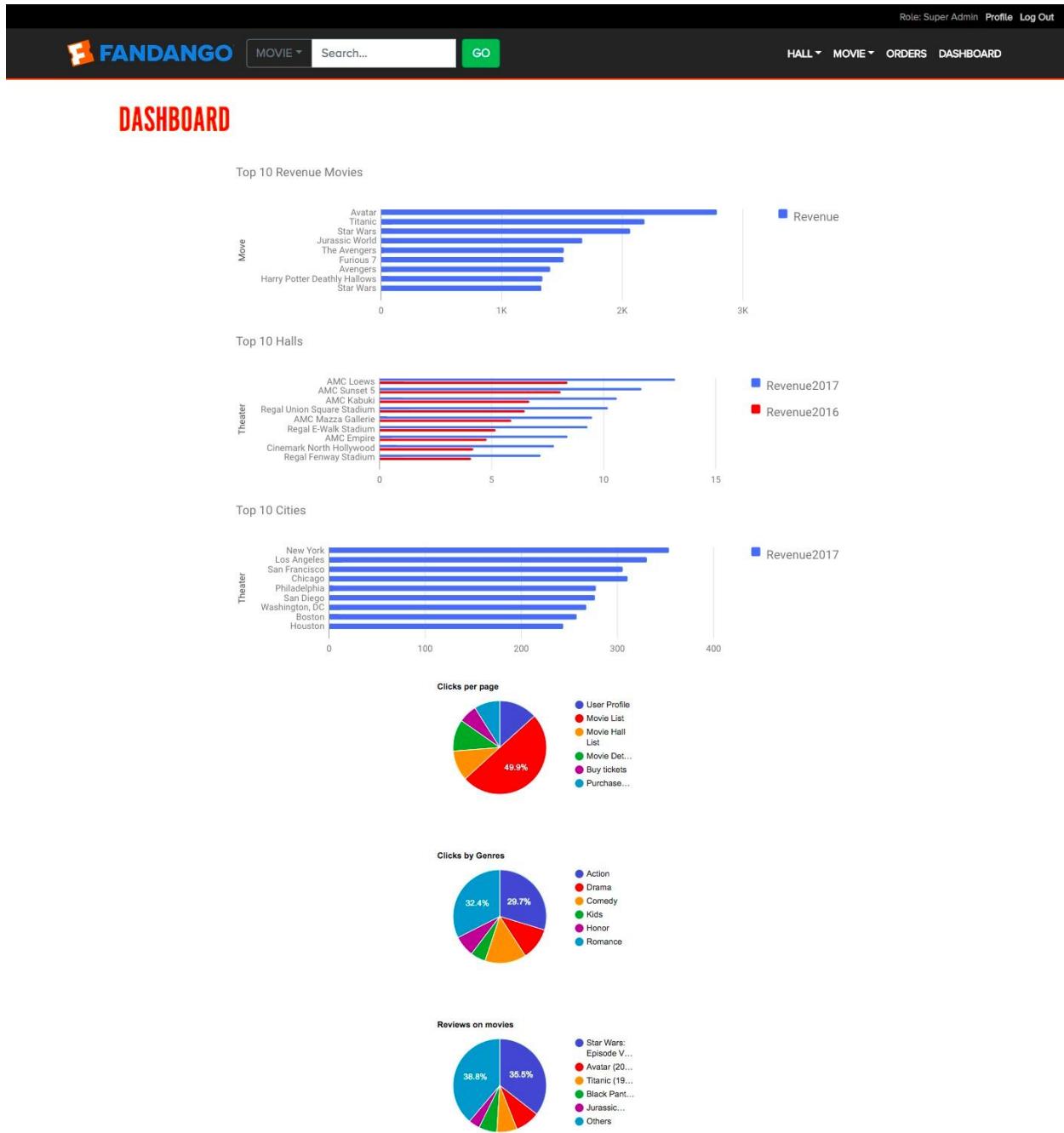
The screenshot shows the Fandango Admin interface. At the top, there are navigation links for 'HALL', 'MOVIE', 'ORDERS', and 'DASHBOARD'. On the left, the 'Y-SOLOWARM THEATER' section displays the address '47 Straubel Alley, Long Beach, CA, 90810' and the message 'Hall Revenue: 38769.84 Tickets Sold: 2316'. Below this is a button labeled 'EDIT HALL'. The main content area features a movie poster for 'PUBLIC ENEMIES' with a rating of 4 stars. To the right, it says 'Select a movie time to buy tickets' with options for 17:07:00, 18:10:20, and 19:33:40. Below the poster, genres listed are Mystery, Political, Western, Crime, and Horror.

(Revenue of movie hall is visible to Admin users on Hall Details page)

The screenshot shows the Fandango Admin interface. At the top, there are navigation links for 'HALL', 'MOVIE', 'ORDERS', and 'DASHBOARD'. The main content area displays movie details for 'CHILD'S PLAY 3'. It includes a poster for 'GAMER', release date '2018-04-29', rating 'PG-13', and runtime '137 mins'. A synopsis is provided: 'Proin interdum mauris non ligula pellentesque ultrices. Phasellus id sapien in sapien iaculis congue. Vivamus metus arcu, adipiscing molestie, hendrerit at, vulputate vitae, nisl.' To the right, there is a movie clip for 'Tomb Raider Movie Clip - Boat (2018) | Movieclips Coming Soon' with a rating of 4 stars and an 'HD' label.

(Revenue of movie is visible to Admin users on Movie Details page)

3.4 Dashboard

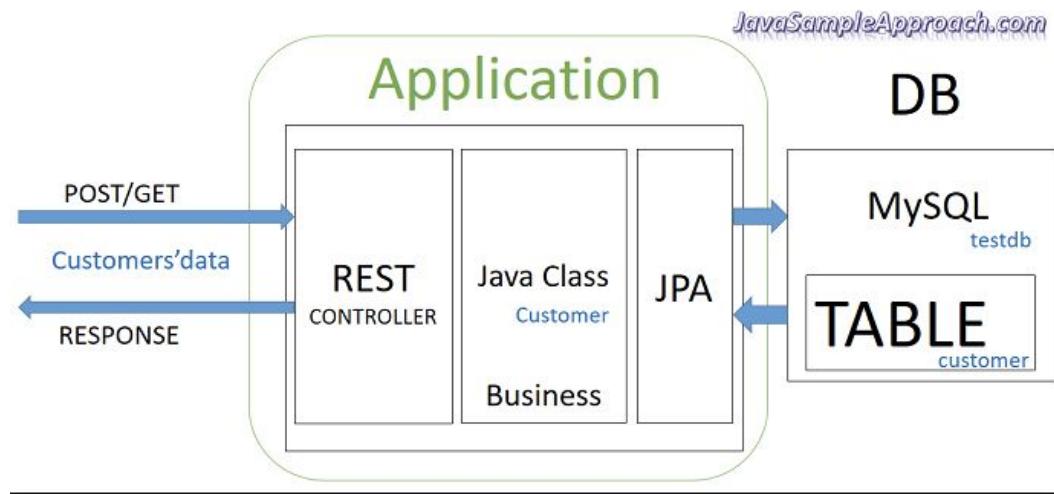


(Admin can view dashboard by clicking on the link on the top navigation bar, which is visible only to Admin users)

4. Server side overview

4.1 Architecture

For the back-end, we choose to use spring-boot architecture.



4.2 API Overview

Following by the API document we submitted before. Our all back-end api is deployed on the <http://swagger.hychris.li/>. You can see more details on our api website.

User Controllers provides basic CRUD services on user, including sign up and login.

Movie, Movie Characters, Movie Formats, Movie Genres, and Movie Images controllers handles CRUD operation on movies and their features.

Theater (Movie Hall) and City includes the movie location information. A City can have many theaters.

The Search controller allows user to search for movie, theater and city by name. Schedules controller let admins to post, delete and update a movie schedule, with date, theater, price and seats information. This controller also offers comprehensive schedule query endpoints. Users can find all available movies schedules or a particular movie in all theaters within a city or a postal code area. They also find all movie schedules in a certain theater. All the results can be filter by price, stars and given date.

Review controller allows user post, view and edit reviews. Admin can also use this controller to monitor and curate reviews.

Order Controller allows user to place, pay and cancel an order. Users can also list their own orders, with filter option for a particular movie. Admins can also list all user orders or orders for a particular movie. Admins are given the rights to cancel a order.

Analytics controller give analytical results such as movie or theater revenue and ticket sales. It also contains GET endpoints for top 10 movies, theaters, or cities by revenue, or ticket sales.

The screenshot shows the Fandango.com Backend API documentation on the Swagger interface. The top navigation bar includes links for 'swagger', 'default (/v2/api-docs)', and 'Explore'. The main title is 'Fandango.com Backend' with the subtitle 'API for movie searching, ticket booking and review'. Below this, a table lists various controllers with their corresponding operations:

Controller	Show/Hide	List Operations	Expand Operations
Analytics : Analytic Controller			
basic-error-controller : Basic Error Controller			
City : City Controller			
Movie : Movie Controller			
Movie Characters : Movie Character Controller			
Movie Formats : Movie Format Controller			
Movie Genres : Movie Genre Controller			
Movie Images : Movie Image Controller			
Order : Order Controller			
Review : Movie Review Controller			
Schedule : Schedule Controller			
Search : Search Controller			
Theater : Theater Controller			
User : User Controller			

[BASE URL: /fandango/api , API VERSION: 0.1]

5. Database overview

5.1 Table List

Based on the requirement, we follow the 3NF of the database to design this table list.

User

userId:	Id
username	
password:	bcrypt encrypted password
firstName:	first name of the user
lastName:	last name of the user
address:	street address
city	
state	
zipcode:	postal zip code
phone:	phone number
email	
imageUrl:	profile image url
creditCard:	credit card information

Genre:

genreId:	Genre ID
name:	Genre name

Movie

movieId:	Movie ID
title	
trailerUrl:	a trailer url of the movie
releaseDate	
mpaaRatingId	
length:	

MovieImage

A movie can have multiple photos and images.

imageId:	movie image ID
movieId:	movie ID
imageUrl:	movie image url

MovieCharacter

A movie can have multiple characters

characterId:	movie character ID
movieId:	movie ID
name:	character name

MovieFormat

A movie can be viewed in multiple formats

formatId:	movie format ID
movieId:	movie ID
format:	format type (IMAX, Digital,)

MovieReview

A movie can have multiple reviews and stars

reviewId:	movie review ID
movieId:	movie ID
userId:	User ID
stars:	stars from 1 to 10
comment:	comment text

MovieGenre

A movie can be categorized with multiple genres

movieGenreId:	movie genre ID
movieId:	movie ID
genreId:	genre ID

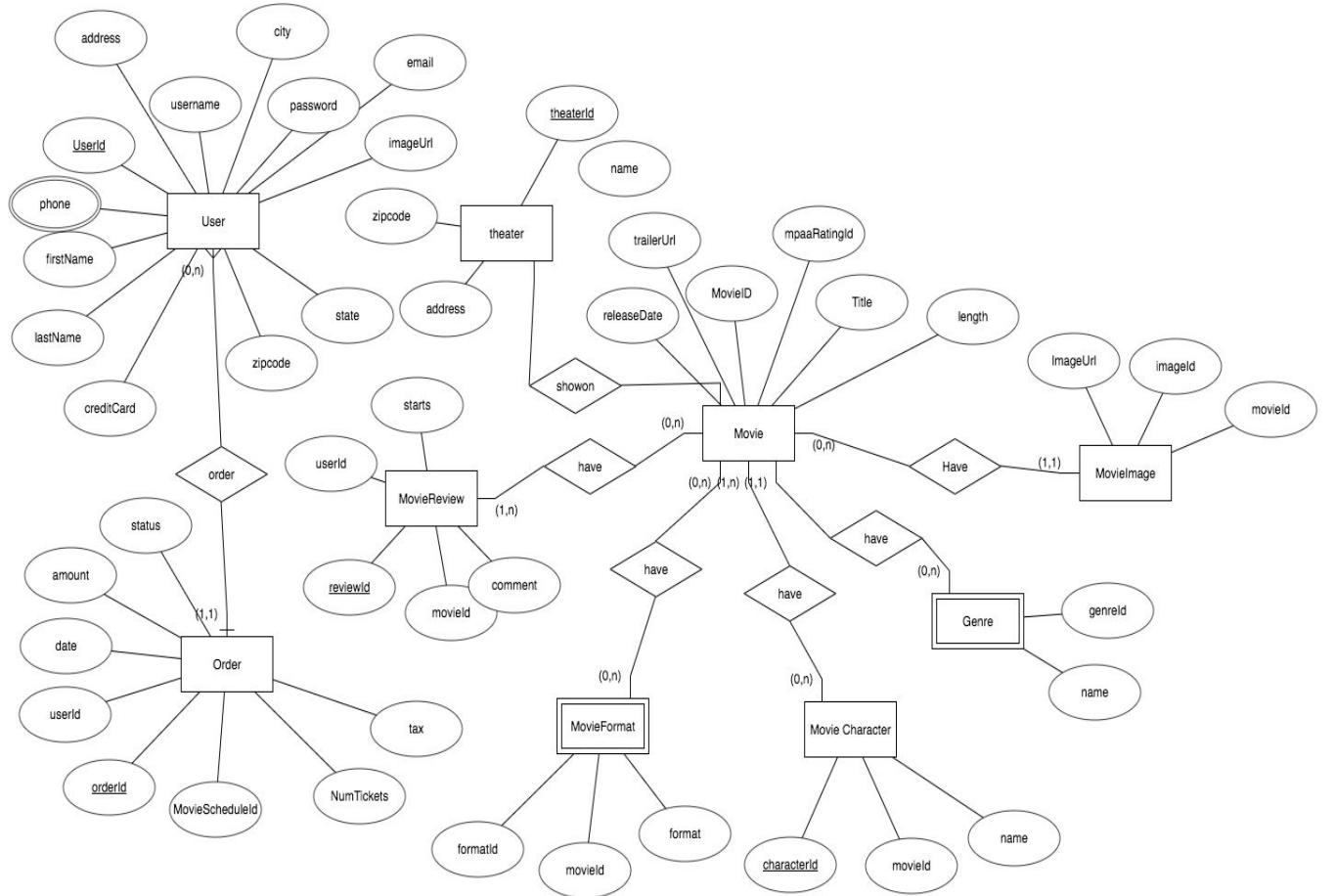
MpaaRating

mpaaRatingId
mpaaRatingName

Theater

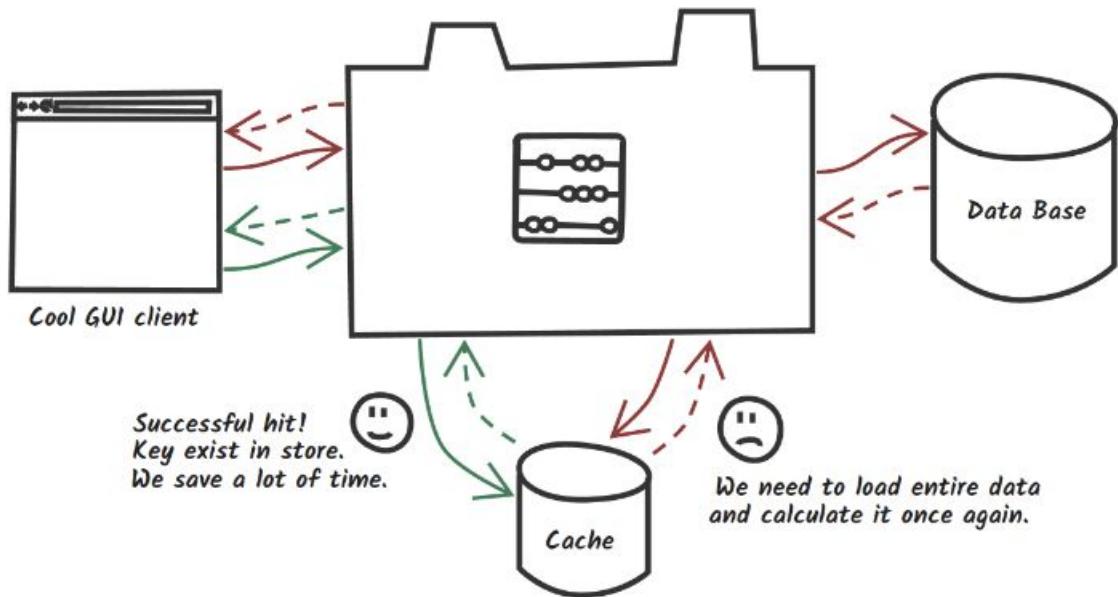
theaterId:	movie theater ID
name:	movie theater name

5.2 ER Diagram



5.3 MySQL Cache Strategy

In order to improve our performance, we will use Spring Boot cache with Redis strategy. We cached the state of the entity object in the share Redis data store, which resides in the memory of one of the nodes. Spring Boot offers convenient solutions to serialize and cache these objects. Simply by configuring the application properties and adding `EnableCaching` annotation, Spring Boot prepares the data access objects for caching with Redis. We could add `Cacheable` annotation at any level of the backend server, either on the controllers, services or data access objects. The cache keys can be input parameters of the methods, or simply sql statements. We only need to make sure that cache keys are comprehensive enough to avoid ambiguity. we can reconstitute the object without checking the database. The maximum memory is 3GB and the basic eviction algorithms is LRU cache and LFU cache.

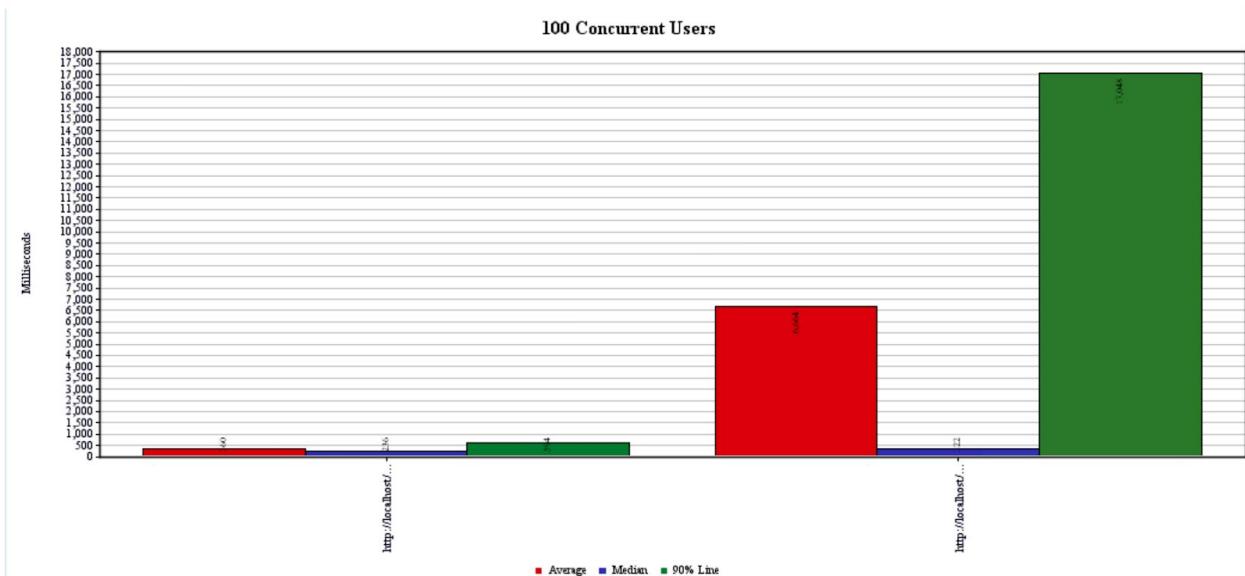


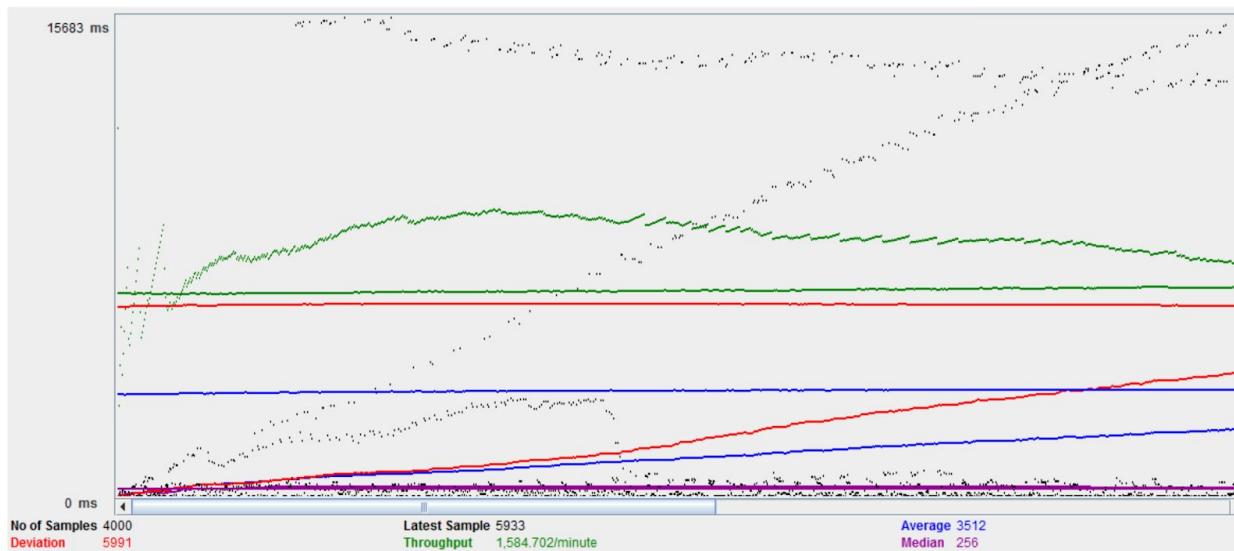
6. Testing

6.1 Performance Test

6.1.1 Concurrent access of 100 , 200 users.

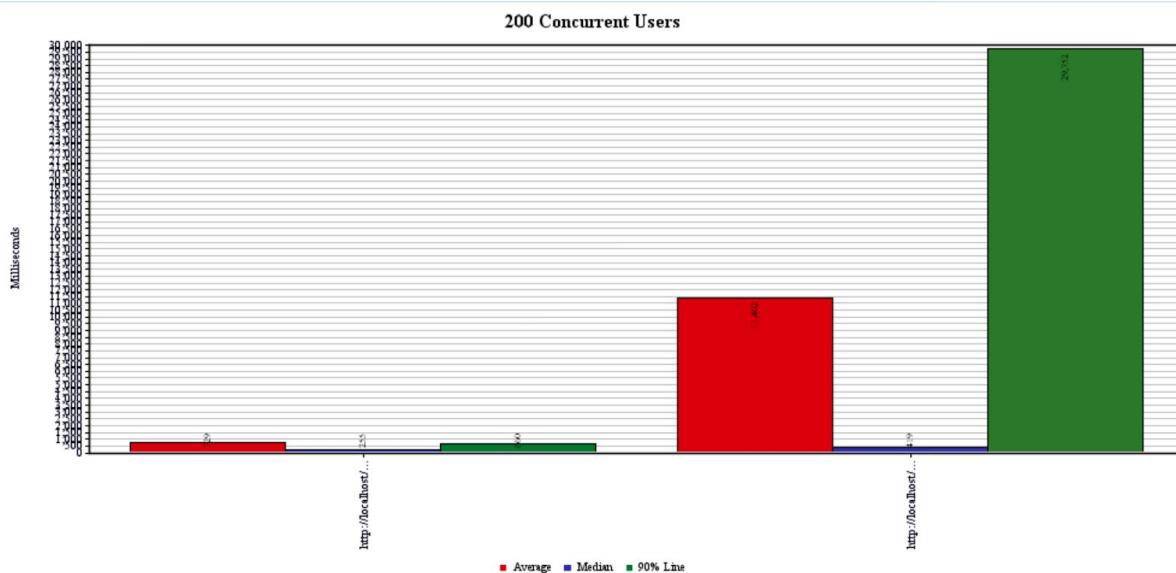
6.1.1.1 100 Users:

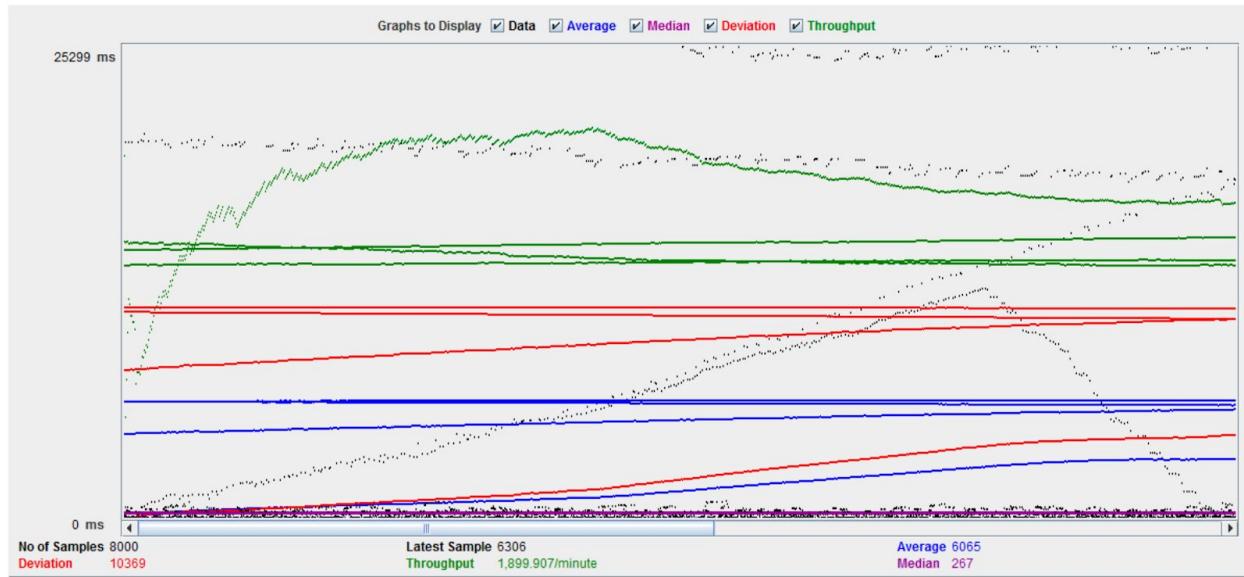




Label	#Samples	Average	Median	90% Line	Min	Max	Error %	Throughput	KB/sec
Login	2000	360	236	594	1	3204	0	13.74495	38.35144
addMember	2000	6664	322	17048	2	19944	0	13.22218	87.19771
TOTAL	4000	3512	256	14350	1	19944	0	26.41171	123.9373

6.1.1.2 200 Users:





Label	# Samples	Average	Median	90% Line	Min	Max	Error %	Throughput	KB/sec
Login	4000	729	255	660	1	12313	0	16.23877	45.31088
addMember	4000	11402	419	29752	2	34873	0	15.89617	112.3977
TOTAL	8000	6065	267	25212	1	34873	0	31.66511	156.1253

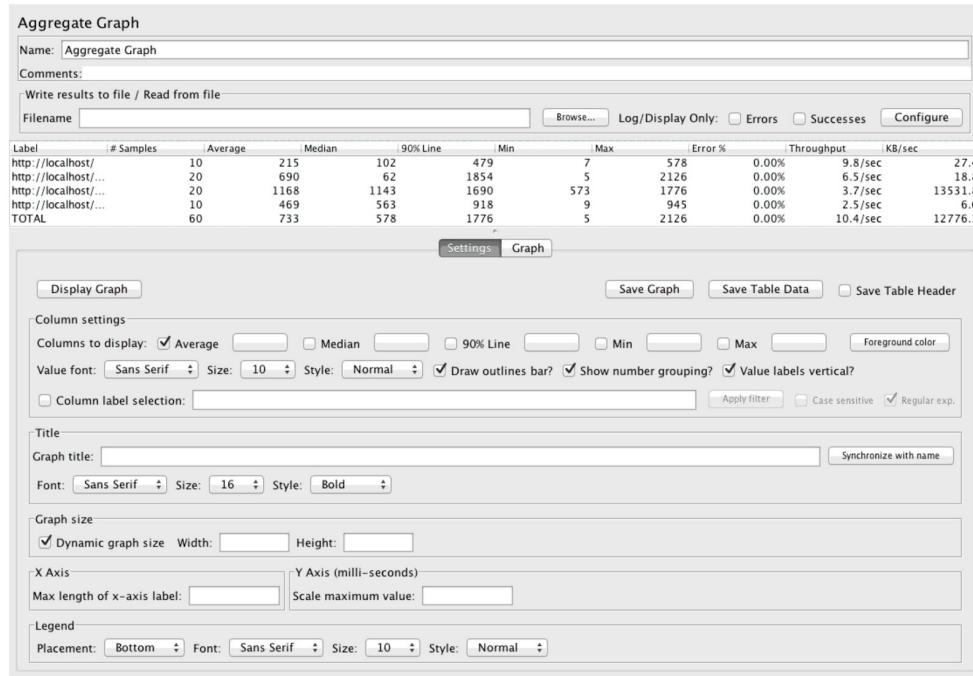
6.1.1.3 Summary

As we can see from the result, our system can handle large of user concurrently access with 0% error. As the user increasing, the response got a little bit down.

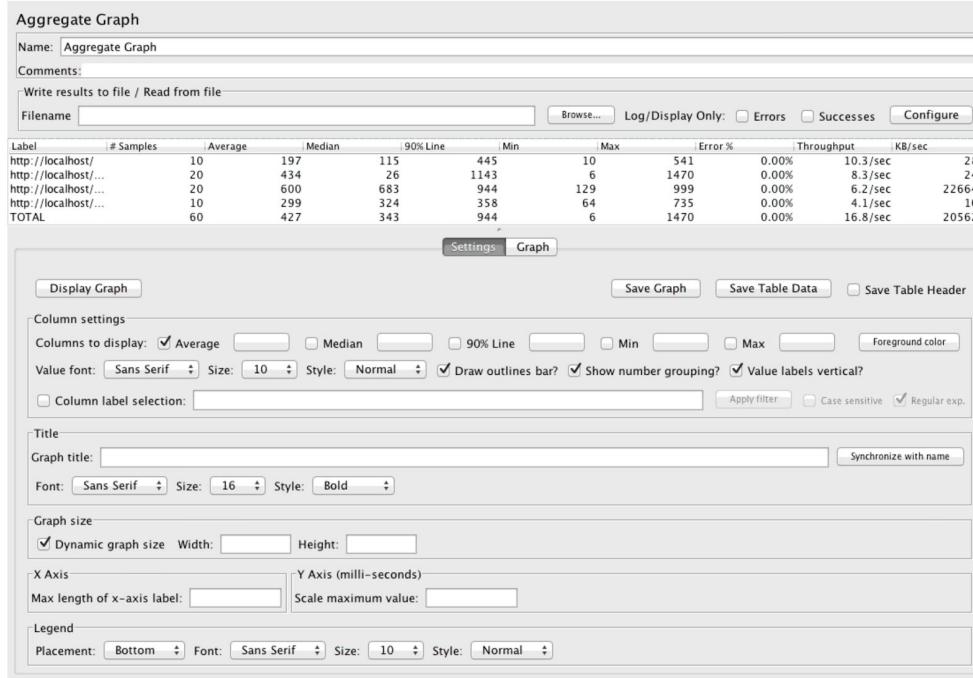
6.1.2 Caching and Connecting pool.

6.1.1.1 View Profile function

MySql:



With Caching:



With connecting Pool:

Aggregate Graph

Name: Aggregate Graph
Comments:

Write results to file / Read from file
Filename: Browse... Log/Display Only: Errors Successes

Label	# Samples	Average	Median	90% Line	Min	Max	Error %	Throughput	KB/sec
http://localhost/...	10	387	368	763	7	829	0.00%	7.8/sec	21.9
http://localhost/...	20	600	64	1447	5	2041	0.00%	6.1/sec	17.6
http://localhost/...	20	1143	1079	1605	397	1615	0.00%	3.8/sec	14023.8
http://localhost/...	10	293	216	638	10	961	0.00%	2.9/sec	7.9
TOTAL	60	694	665	1448	5	2041	0.00%	10.8/sec	13156.5

Save Table Header

Column settings
 Columns to display: Average Median 90% Line Min Max
 Value font: Size: Style: Draw outlines bar? Show number grouping? Value labels vertical?
 Column label selection: Case sensitive Regular exp.

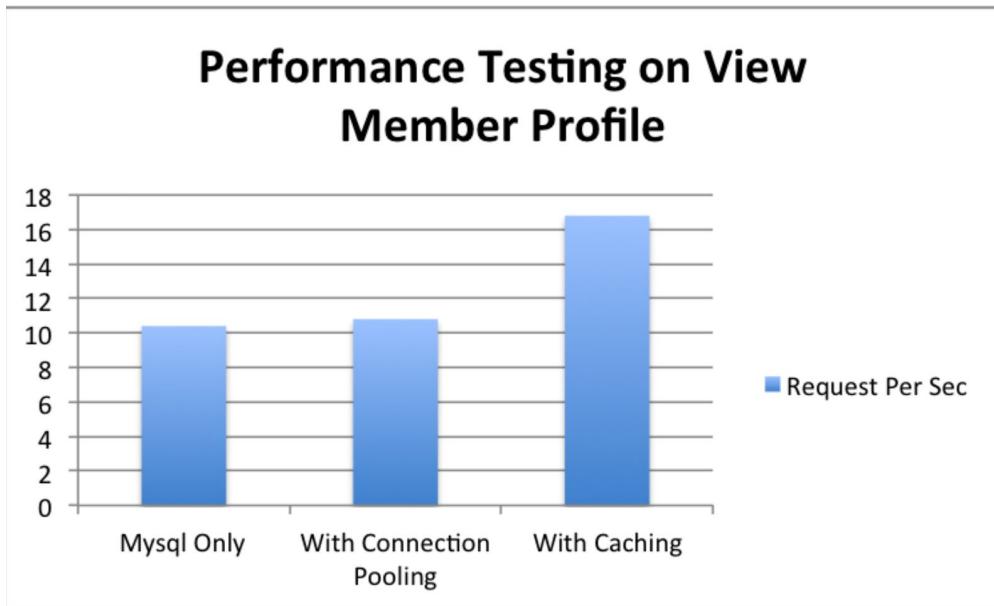
Title
 Graph title:

Font: Size: Style:

Graph size
 Dynamic graph size Width: Height:

X Axis Y Axis (milli-seconds)
 Max length of x-axis label: Scale maximum value:

Legend
 Placement: Font: Size: Style:

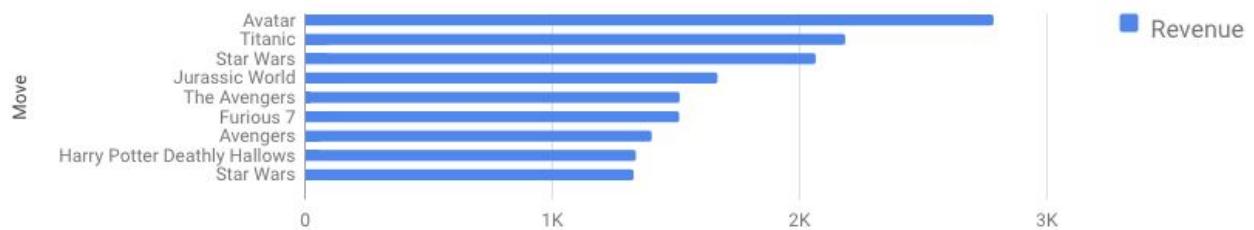


6.1.1.2 Summary

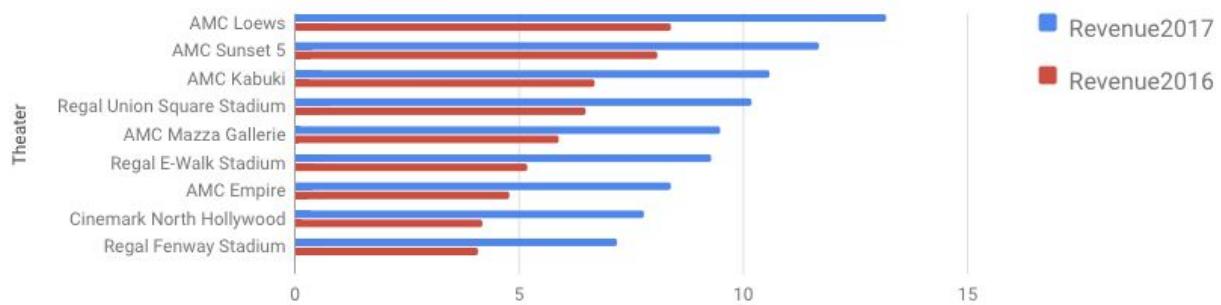
As we can see that, by using mysql caching can got the best performance.

7. Analysis Report

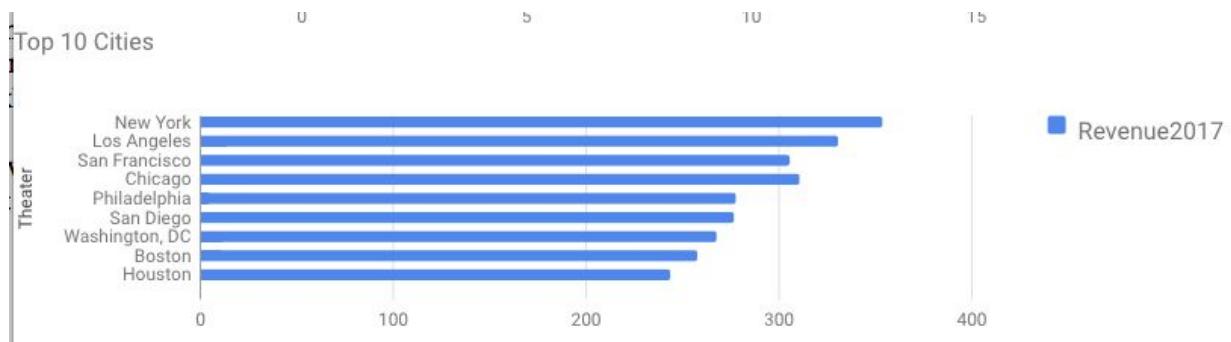
7.1 Top 10 Movie Revenue



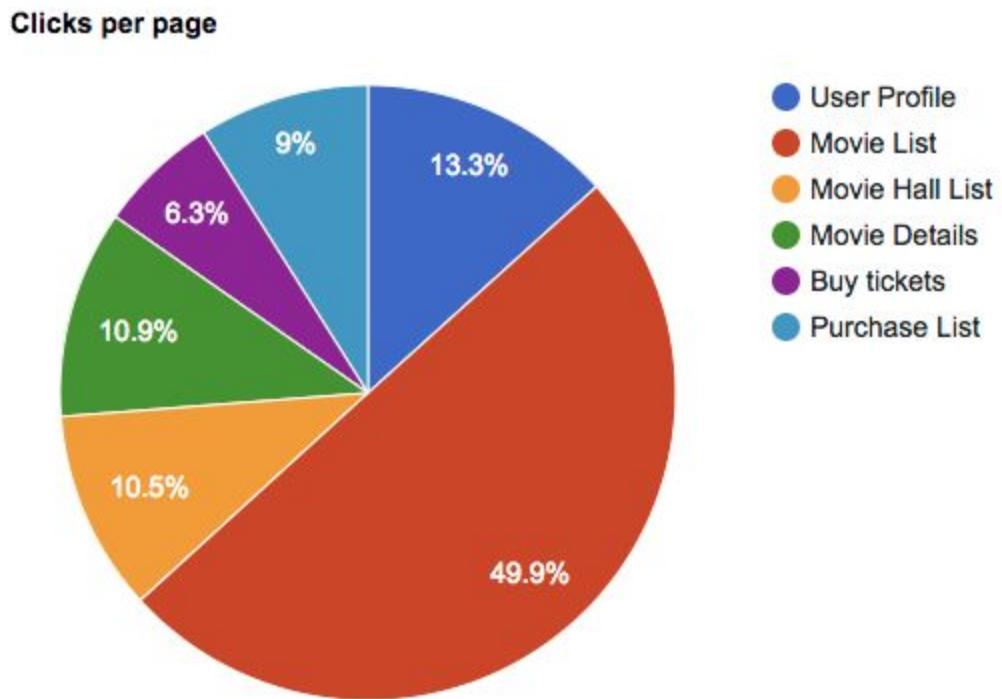
7.2 Top 10 Halls



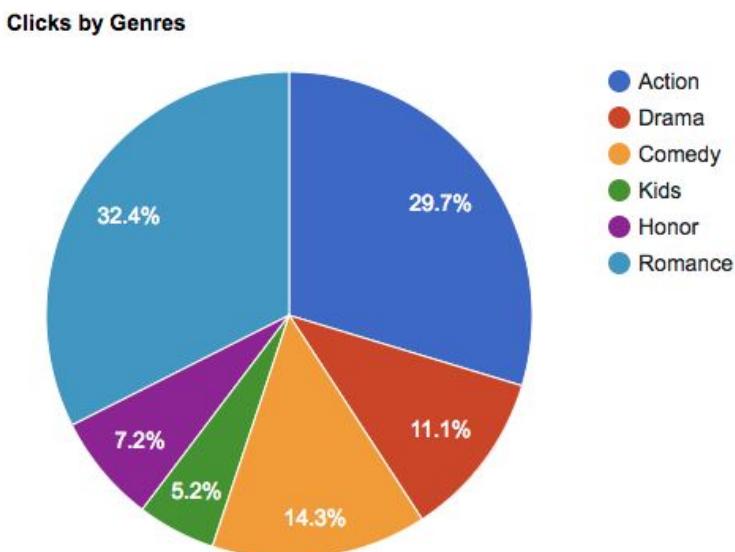
7.3 Top 10 Cities



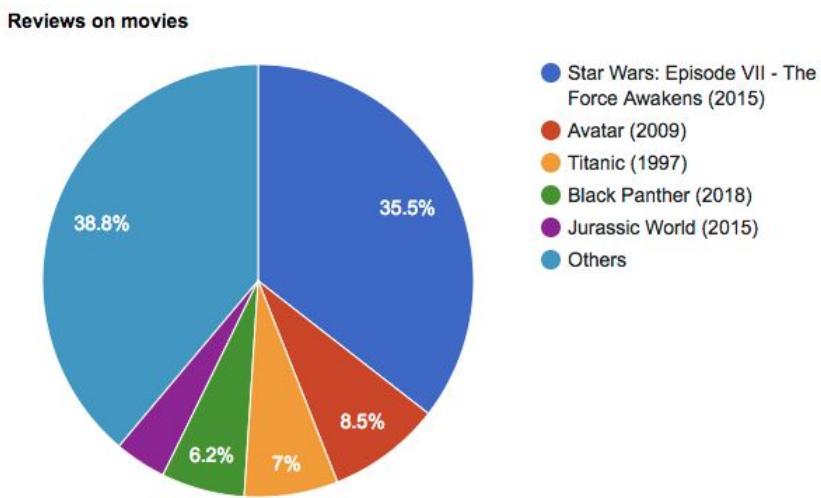
7.4 Clicks per pages



7.5 Clicks by genres



7.6 Reviews on movies



7.7 Summary

The analysis on log and user behavior is very important. For the server, we can track clearly on which page has more pressure, what time has the most user request. It helps us to optimize the server strategy. For the business, it will help the company to see their performance on the revenue.

8. Lesson We Learned

To be honest, this class is a tough class. On the other hand, this class is a meaningful class. First of all, different from the individual lab, we learned how to manage our process in a group level. We divided the 4 people into 2 groups. Front-end group and the backend group. We hold team meeting every 3 days. This project improve our large project management skills a lot. What's more, we set a whole distributed system by our own and we are trying our best to optimize it. Such as connecting pool, sql caching, load balancing, log analysis and so on. Last but not the least, we realized a real industry website by our own which is very excited for us.

9. Appendixes

I. Coding list of client application

```
michaelwang (master) movie-kingdom-client $ ls -LR
README.md           config          kafka          public
values
app.js             controllers     package-lock.json routes
views
bin               interceptors   package.json    utils

./bin:
www

./config:
default.json

./controllers:
ctl-add-edit-hall.js      ctl-dashboard.js      ctl-multi-type-search.js
ctl-profile.js
ctl-add-edit-movie.js      ctl-halls.js        ctl-orders.js
ctl-schedule.js
ctl-buy-tickets.js        ctl-movies.js       ctl-portal.js

./interceptors:
AuthValidation.js      FlashDataHandler.js

./kafka:
ClientMessenger.js    KafkaClientService.js

./public:
assets      favicon.ico   images      scripts      stylesheets

./public/assets:
fonts      images

./public/assets/fonts:
Mark Simonson - Proxima Nova Alt Regular-webfont.eot
alternate_gothic_no1_d_regular-webfont.woff
Mark Simonson - Proxima Nova Alt Regular-webfont.woff
alternate_gothic_no1_d_regular-webfont.woff2

./public/assets/images:
fandango-logo.svg      medium-default-avatar.png

./public/images:

./public/scripts:
add-movie.js          buy-tickets.js      header-search.js    pg-admin-dashboard.js
profile-edit.js
```

```

./public/stylesheets:
components-lxr.css    order-list.css        pg-login.css        pg-sign-up.css
styles.css
components.css          pg-admin-dashboard.css   pg-movie-list.css
styles-lxr.css          top-nav.css

./routes:
api-router.js    router.js

./utils:
StringUtil.js

./values:
AccessControlCodes.js      PathDictionary.js    constants.js

./views:
add-button.ejs           movie-dt-orders.ejs    pg-admin-dashboard.ejs
  pg-no-access.ejs
form-login.ejs            movie-dt-post-review.ejs  pg-admin-order-list.ejs
  pg-portal.ejs
form-sign-up.ejs          movie-dt-reviews.ejs    pg-buy-tickets.ejs
pg-profile.ejs
hall-schedule-list-item.ejs movie-dt-schedules.ejs  pg-city-list.ejs
pg-user-order-list.ejs
header-search.ejs          movie-dt-subnav.ejs     pg-error.ejs
profile-info.ejs
header.ejs                 order-list.ejs       pg-hall-details.ejs
update-button.ejs
lib-url.ejs                pg-add-edit-hall.ejs  pg-hall-list.ejs
meta-resources.ejs          pg-add-edit-movie.ejs  pg-movie-details.ejs
movie-dt-info.ejs          pg-add-edit-schedule.ejs pg-movie-list.ejs
michaelwang (master) movie-kingdom-client $

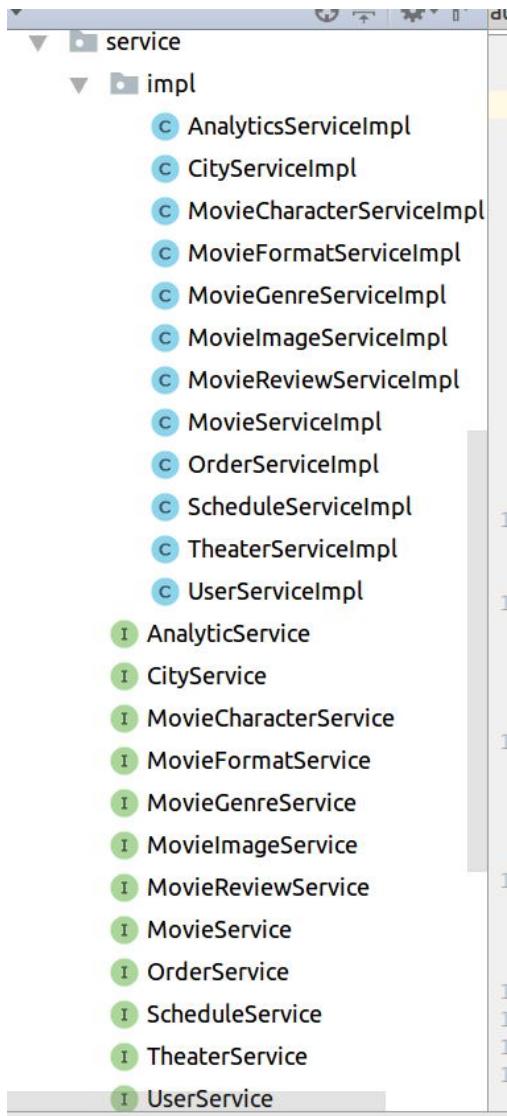
```

I. Coding list of server implementation of entity object

- ▼  entity
 - City
 - Format
 - Genre
 - Movie
 - MovieCharacter
 - MovieFormat
 - MovieGenre
 - MovieImage
 - MovieReview
 - MpaaRating
 - Revenue
 - Sales
 - Schedule
 - Theater
 - TicketOrder
 - User

I. Coding list of main server code

- ▼  controller
 - AbstractController
 - AnalyticController
 - CityController
 - MovieCharacterController
 - MovieController
 - MovieFormatController
 - MovieGenreController
 - MovieImageController
 - MovieReviewController
 - OrderController
 - ScheduleController
 - SearchController
 - TheaterController
 - UserController
 - .



I. Coding list of database access class

```
▼ └── dao
    ├── Filter
    │   └── CityDao
    │   └── FormatDao
    │   └── GenreDao
    │   └── MovieCharacterDao
    │   └── MovieDao
    │   └── MovieFormatDao
    │   └── MovieImageDao
    │   └── MovieReviewDao
    │   └── MpaaRatingDao
    │   └── OrderDao
    │   └── SalesDao
    │   └── ScheduleDao
    │   └── TheaterDao
    └── UserDao
```

I. Coding list of database schema

```
DROP DATABASE IF EXISTS fandango;
CREATE DATABASE fandango;
USE fandango;

CREATE TABLE USER
(
    user_id      INT PRIMARY KEY AUTO_INCREMENT,
    username     VARCHAR(20) UNIQUE NOT NULL,
    password     VARCHAR(100) NOT NULL,
    first_name   VARCHAR(30),
    last_name    VARCHAR(30),
    street       VARCHAR(100),
    city         VARCHAR(30),
    state        CHAR(2),
    zipcode      CHAR(5),
    phone        CHAR(15),
    email        VARCHAR(50) NOT NULL,
    image_url    VARCHAR(100),
    role         INTEGER NOT NULL DEFAULT 1,
    card_num     VARCHAR(20),
```

```

card_cvv      VARCHAR(4),
card_expire  DATE
);

CREATE TABLE GENRE
(
genre_id INTEGER PRIMARY KEY AUTO_INCREMENT,
genre_name VARCHAR(30)
);

CREATE TABLE MPAA_RATING
(
mpaa_id INTEGER PRIMARY KEY AUTO_INCREMENT,
mpaa_name VARCHAR(10)
);

CREATE TABLE FORMAT
(
format_id INTEGER PRIMARY KEY AUTO_INCREMENT,
format_name VARCHAR(10)
);

CREATE TABLE MOVIE
(
movie_id INTEGER PRIMARY KEY AUTO_INCREMENT,
movie_title VARCHAR(100) NOT NULL,
movie_desc VARCHAR(500),
trailer_url VARCHAR(200),
cover_image_url VARCHAR(200),
release_date DATE,
mpaa_id INTEGER,
mpaa_rating VARCHAR(10),
length INTEGER,
stars DECIMAL(2,1) DEFAULT 5.0,
FOREIGN KEY (mpaa_id) REFERENCES MPAA_RATING(mpaa_id)
);

CREATE TABLE MOVIE_IMAGE
(
image_id INTEGER PRIMARY KEY AUTO_INCREMENT,
movie_id INTEGER,

```

```

image_title VARCHAR(50),
image_desc VARCHAR(500),
image_url VARCHAR(200),
FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id)
);

CREATE TABLE MOVIE_CHARACTER
(
character_id INTEGER PRIMARY KEY AUTO_INCREMENT,
movie_id INTEGER,
character_name VARCHAR(50),
FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id)
);

CREATE TABLE MOVIE_GENRE
(
movie_genre_id INTEGER PRIMARY KEY AUTO_INCREMENT,
movie_id INTEGER,
genre_id INTEGER,
FOREIGN KEY (genre_id) REFERENCES GENRE(genre_id),
FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id),
UNIQUE movie_genre_uniq (genre_id, movie_id)
);

CREATE TABLE MOVIE_FORMAT
(
movie_format_id INTEGER PRIMARY KEY AUTO_INCREMENT,
format_id INTEGER,
movie_id INTEGER,
FOREIGN KEY (format_id) REFERENCES FORMAT(format_id),
FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id),
UNIQUE movie_format_uniq (format_id, movie_id)
);

CREATE TABLE CITY
(
city_id INTEGER PRIMARY KEY AUTO_INCREMENT,
city_name VARCHAR(20),
state CHAR(2)
);

```

```
CREATE TABLE THEATER
```

```
(  
    theater_id      INTEGER PRIMARY KEY AUTO_INCREMENT,  
    city_id         INTEGER,  
    theater_name   VARCHAR(100),  
    street          VARCHAR(100),  
    zipcode         CHAR(5),  
    FOREIGN KEY (city_id) REFERENCES CITY(city_id)  
) ;
```

```
CREATE TABLE SCHEDULE  
(  
    schedule_id     BIGINT PRIMARY KEY AUTO_INCREMENT,  
    movie_id        INTEGER,  
    theater_id     INTEGER,  
    format_id       INTEGER,  
    schedule_date   DATE,  
    showtime        TIME,  
    tot_seats       INTEGER DEFAULT 50,  
    avail_seats     INTEGER DEFAULT 50,  
    price           FLOAT DEFAULT 15.0,  
    FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id),  
    FOREIGN KEY (theater_id) REFERENCES THEATER(theater_id),  
    FOREIGN KEY (format_id) REFERENCES FORMAT(format_id)  
) ;
```

```
CREATE TABLE MOVIE REVIEW  
(  
    review_id      INTEGER PRIMARY KEY AUTO_INCREMENT,  
    movie_id       INTEGER,  
    user_id        INTEGER,  
    review_title   VARCHAR(100),  
    stars          INTEGER,  
    comment        VARCHAR(10000),  
    post_date      DATE,  
    FOREIGN KEY (user_id) REFERENCES USER(user_id),  
    FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id)  
) ;
```

```
DROP TABLE IF EXISTS `TICKET_ORDER` ;  
CREATE TABLE `TICKET_ORDER`  
(
```

```
order_id      BIGINT PRIMARY KEY AUTO_INCREMENT,
schedule_id   BIGINT,
user_id       INTEGER,
ticket_num    INTEGER,
order_total   DECIMAL(6, 2),
tax           DECIMAL(4, 2),
grand_total   DECIMAL(6, 2),
order_ts      DATETIME,
order_date    DATE,
order_month   DATE,
status        INTEGER DEFAULT 1,
FOREIGN KEY (schedule_id) REFERENCES SCHEDULE (schedule_id),
FOREIGN KEY (user_id) REFERENCES USER (user_id)
);
```

```
DROP TABLE IF EXISTS SALES;
CREATE TABLE SALES
(
sales_id      BIGINT PRIMARY KEY AUTO_INCREMENT,
movie_id      INTEGER,
theater_id    INTEGER,
ticket_num    INTEGER,
dollar_amount DECIMAL (10, 2),
FOREIGN KEY (movie_id) REFERENCES MOVIE(movie_id),
FOREIGN KEY (theater_id) REFERENCES THEATER(theater_id),
UNIQUE sales_uniq (sales_id, movie_id)
);
```