SAN JOSE STATE UNIVERSITY
SOFTWARE ENGINEERING DEPARTMENT
CMPE 273 – ENTERPRISE DISTRIBUTED SYSTEMS
CLASS PROJECT

VIDEO LIBRARY MANAGEMENT SYSTEM

PROJECT REPORT

Team 3
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Individual member contribution in project

Abhi Shah
Client GUI, client-side servlets, client-side validation, Database designing, Jmeter Performance measurement and server side validation.

Meet Mehta
Designing of web services and its Server side methods implementation, Database designing, Project Report and deployment on Google Cloud.

Snehal D'mello
Designing of web services and its Server side methods implementation, Database designing and Project Report.

Sweta Patel
Designing of web services and its Server side methods implementation, Connection Pooling, Database designing and Project Report.

Vidhi Shah
Client GUI, client-side servlets, Junit testing and Project Report.

Object Management Policy

Abstract:

In this project, we have designed a 3-tier system that implements the functions of Video Library Management System. Our system keeps track of all the movies in a database as well as members and rents out the movies to the members as needed. Depending upon the type of the member, we have limitations on the number of movies issued. Fine is imposed on the members if the movie is not returned back. It manages the transactions done by the members very well and depending on the type of member, he is charged in a different way. Developing a website is not a challenge but making it accessible to all the customers at the same time without delay is a real big challenge. Thus a website has to be scalable and should manage the increase in customer traffic very well without delays. In such cases, system's performance is put to test. We have tried overcoming the challenge by making the system efficient and have designed to make it more scalable and reliable.

Introduction:

In this electronic world, millions of websites are being created but the ultimate winner is the one with great performance and the one that is able to keep data secure. Major challenges faced in website creation are:

1. Accessibility:

Our website has to be accessible to people with different backgrounds, abilities and disabilities. The website should be designed in such a way that all the people have equal access to information and features of the website.

2. Compatibility:

One of the most common aspect of the website that is overlooked is the browser compatibility. A website that is developed has to be compatible with wide variety of browsers so that different users with different browsers have access to the website without facing any browser compatibility issues. Thus, a website has to be tested on different browsers.

3. Navigability:

The navigation done on the website has to be really simple so that any layman customer can access it too without facing any problem. If customers find it hard to navigate on your website, they will leave quickly and would never want to come back to the website again. Thus navigation should have an effective structure.

4. Readability:

The text and the fonts used on the website should be such that it enhances readability. Thus the website users focus on making it more readable for users regardless of age groups and background.

Thus we have designed our website keeping in mind the above points and security concerns and worked more on improving the performance so that it can handle more number of customers.

Implementation:

Video Library has vast collection of movies. When a customer wants to buy movies on a Video Library Management System, he has to SignUp first. Customer will be having two types of memberships to choose from: 1. Simple Members 2. Premium Members. Simple Members are allowed to rent maximum 2 movies while Premium customers have liberty to choose 10 movies at a time. As soon as a Simple Member buys a movie online, he has to pay for the movie rented while the Premium Member pays for the subscription fees. This payment for the subscription fees could be done monthly, quarterly or annually. While signing up, they are asked to give information such as name, address, membershipId etc. Fine is imposed if the movie is not returned on time. The User can see his information anytime with all the issued movies. We have created an admin to maintain all the information. He is responsible for managing the users as well as movies. Also, we have added the password encryption which will help to keep the member's account safe and secure. All these features makes our system better at the moment. Making it best would be a further challenge.

Performance

Apart from implementing technical details, one should always take care about web site's performance, scalability and robustness. As mentioned in a project description, we should take care of the real time scenarios of huge number of clients and movie data. In case of such bulky scenarios, database as well as website should work without any kind of problem and web site crash. Also in case of multiple queries or requests at the same time, it should work faster as much as possible. Below are the techniques those we have used in our project to improve the performance.

1) **Connection Pooling:**

Connection pooling is a one of the finest solution for performance when multiple requests occur at the same time. Normally when client do request to the database, it creates new connection to access data. Once data is fetched, connection gets closed. Same scenario executes every time when client make any request. This was a single client scenario. Now assume a case where thousands of clients make a request to the database at the same time. Also when number of client's requests gets increase, time required to fetch the content is also get increased due to the many resources utilization. So in such a case normal connection and disconnection is not feasible way for efficient working. So what we need in such a scenario is connection pooling. Main purpose of the connection pooling is performance enhancement. In connection pooling, we can open multiple number of connections (have to specify this number in java file) based on number of clients. This open connections assign to the client request when arrives and once client done with his task, he returns this connection to the pool back which will be available for the next client request. This way less time is spent in opening and closing of connections and heavy weight resources can be managed.

2) **INNODB over MYISAM engine in MYSQL:**

MYISAM uses table-level locking while MYSQL uses row-level locking system. So if for an example we have xxx no. of users updating anything into our database then in MYISAM the query processes one by one as table is locked by each and every query while in case with INNODB concurrent execution occurs as only row which is updating is locked. which reduces latency time. For example, a single query takes x milliseconds to update then in MYISAM have total time n*x milliseconds while in MYSQL have only x milliseconds.

Our Database uses more Insert and Update queries as compared to Select queries. Thus, we uses INNODB as our MYSQL engine

3) **Caching:**

Caching is technique of storing the previously fetched data temporarily on server side and eliminates the costly trip to database.

In our project we use HashMap technique in which we use (key, values) pairs. When any customer signs in to our website whole customer detail is stored as value and key for the same is his membershipID. So whenever customer signs in again and if key for customer is already there in HashMap then there is no costly trip to database for fetching its details and directly returns the value from HashMap. Again, which increase the overall performance and reduce latency time.

4) Database Tuning:

- **Using full column_names instead of * in select query**: We have used full column_names in all of our select queries instead of using *. The reason behind this is when we fire "Select * from table_name" MYSQL initially have to fetch the column names and then have to fire the query while in using column_names directly MYSQL fif not have to find out the column_names and hence execution of our query is slightly faster.
- **Using PreparedStatement over Statement:** the main difference between PreparedStatement and Statement is that PreparedStatement precompiles the query for the first time and then execute it everytime while in Statement it have to compile the query each and every time.

  For example

  - ✓ In Statement query

    ```
    " select customer_name from customer where membershipID='"+membershipID+"'";
    stmt.executeUpdate();
    ```

    here MYSQL have to make access plan (optimal way to execute SQL query) everytime it fires the query " select customer_name from customer where membershipID=12345"

  - ✓ While in Prepared Statement when we fire the query

    ```
    "select customer_name from customer where membershipID=?"
    ps.setString(1,membeshipID);
    ```

ps.executeUpdate();

Whenever the query is fired to MYSQL. It makes its own access plan with " select customer_name from customer where membershipID=" and this plan is used everytime when similar query is fired.

- **Avoided Like query:** We have used Like query in search functionality only and avoid to use it in any other functionality.

Database Table Details:

1. **Person:**

This table contains information of all the new customers added and their login information.

desc person;

Field	Type	Null	Key	Default	Extra
membershipId	bigint(11)	NO	PRI	NULL	
firstName	varchar(30)	NO		NULL	
lastName	varchar(30)	NO		NULL	
emailId	varchar(30)	NO	UNI	NULL	
password	varchar(1000)	YES		NULL	
address	varchar(50)	NO		NULL	
city	varchar(20)	NO		NULL	
state	varchar(20)	NO		NULL	
zipCode	bigint(10)	NO		NULL	
userType	int(1)	YES		NULL	
registrationDat	date	YES		NULL	
lastLogin	datetime	YES		NULL	

2. **PremiumMembers:**

This table contains information about the Premium Members. All the customers having userType as 0 in Person table will be added to the table PremiumMembers.

desc premiumMembers;

Field	Type	Null	Key	Default	Extra
premiumMemberId	int(11)	NO	PRI	NULL	auto_increment
membershipId	bigint(11)	YES	MUL	NULL	
dueAmount	float	YES		NULL	
totalOutstandingMovies	int(11)	YES		NULL	
expiryDate	date	YES		NULL	

3. **SimpleMembers:**

This table contains information about the Simple Customers. All the customers having userType as 1 in Person table will be added to the table SimpleMembers.

```
desc simpleMembers;
```

Field	Type	Null	Key	Default	Extra
simpleMemberId	int(11)	NO	PRI	NULL	auto_increment
membershipId	bigint(11)	YES	MUL	NULL	
rentForMoviesIssued	float	YES		NULL	
totalOutstandingMovies	int(11)	YES		NULL	

4. **Movie:**

This table contains all the information about the existing movies available in the Video Library.

```
desc movie;
```

Field	Type	Null	Key	Default	Extra
movieId	int(11)	NO	PRI	NULL	auto_increment
movieName	varchar(30)	YES		NULL	
movieBanner	varchar(30)	YES		NULL	
movieReleaseDate	date	YES		NULL	
movieRent	float	YES		NULL	
movieCategory	varchar(15)	YES		NULL	
availableCopies	int(11)	YES		NULL	

5. **Cart:**

This table contains all the information about the movies available in the cart before final checkout.

```
desc cart;
```

Field	Type	Null	Key	Default	Extra
cartId	int(11)	NO	PRI	NULL	auto_increment
membershipId	bigint(20)	NO	MUL	NULL	
movieId	int(11)	YES	MUL	NULL	

6. **Transaction**:

This table contains all the movies purchased by all the Members. Once the member does the final checkout, data enters into the transaction table.

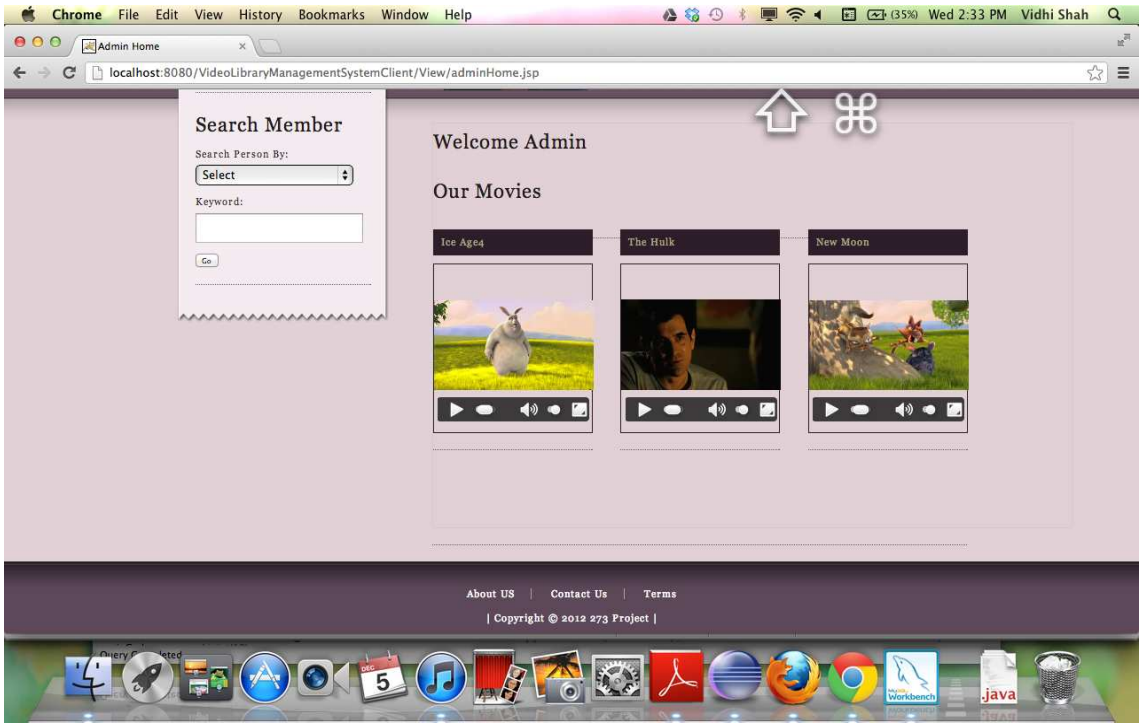
```
desc transactions;
```

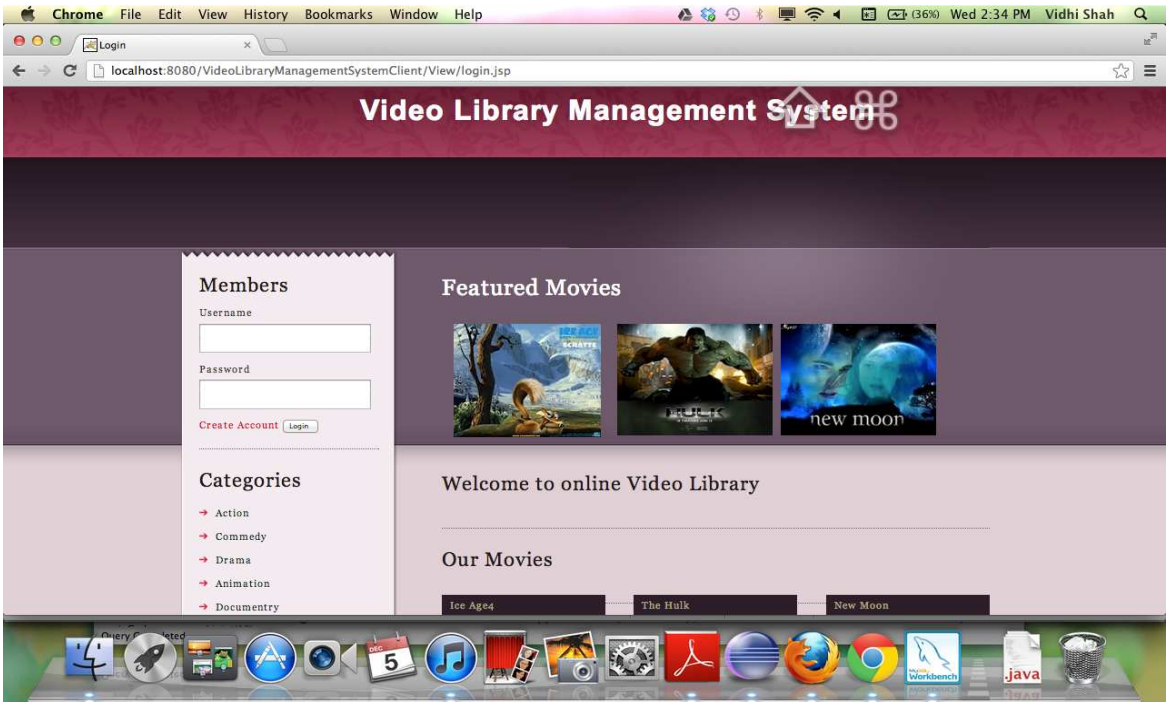
Query

Field	Type	Null	Key	Default	Extra
transactionId	bigint(20)	NO	PRI	NULL	auto_increment
membershipId	bigint(11)	YES	MUL	NULL	
movieId	int(11)	YES	MUL	NULL	
issueDate	date	NO		NULL	
dueDATE	date	YES		NULL	
actualReturnDate	date	YES		NULL	
fineAmount	float	YES		NULL	

Screenshots

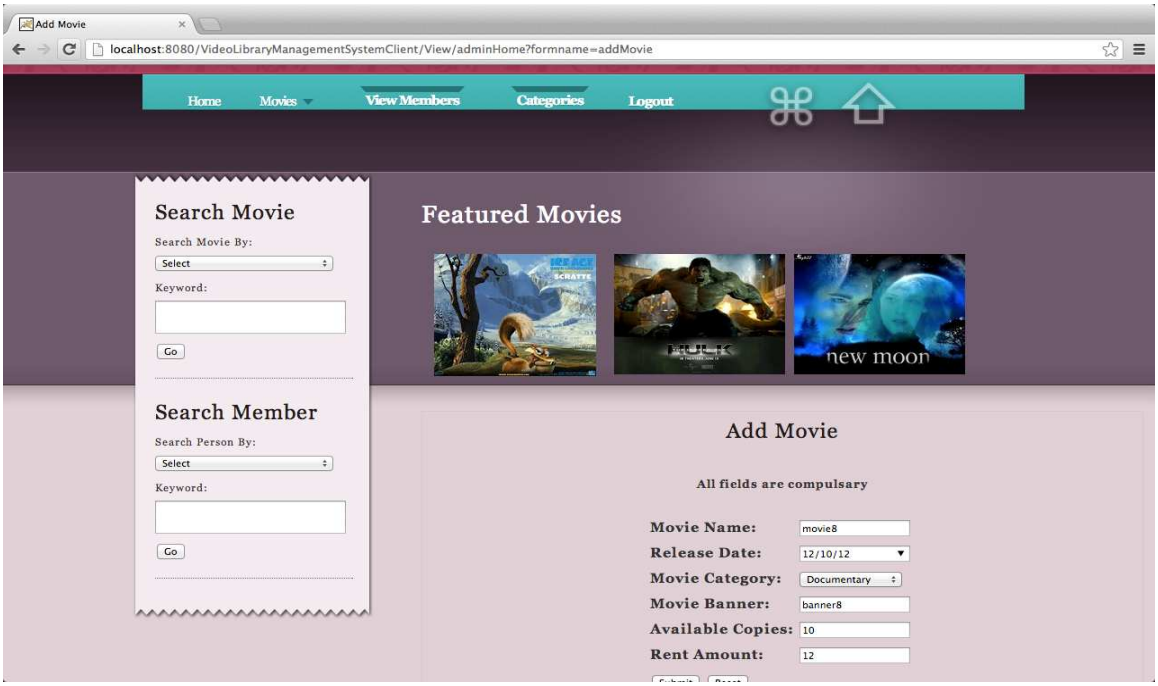
Home Screen



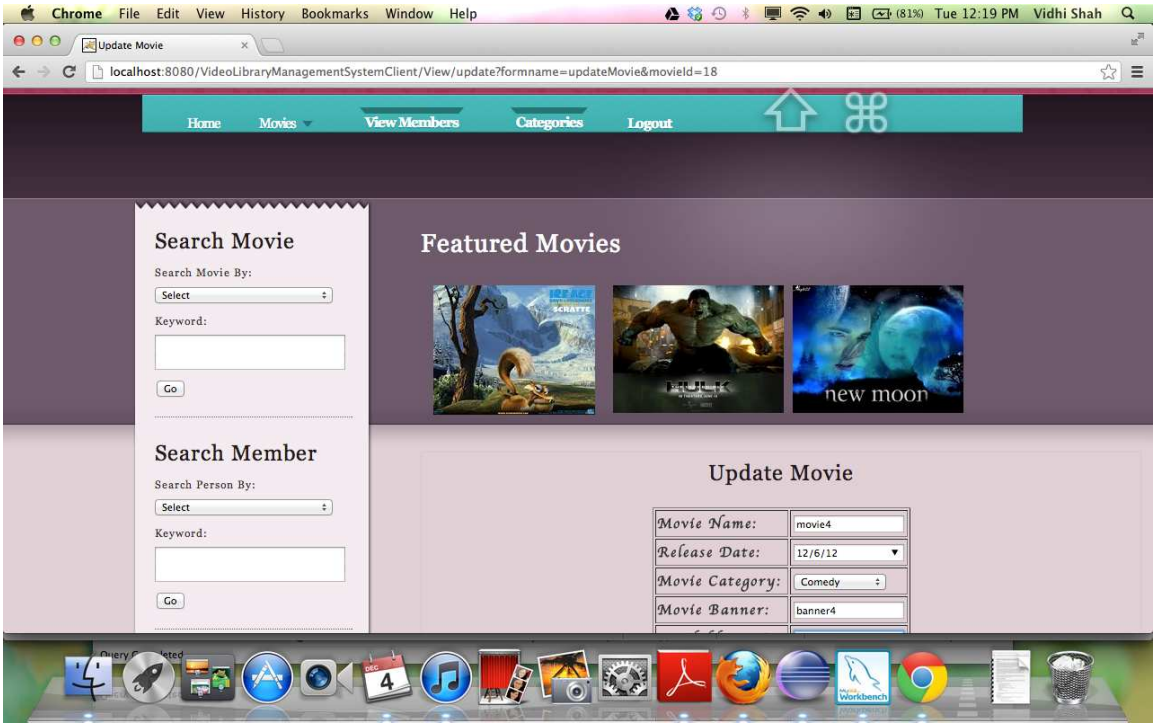


Admin

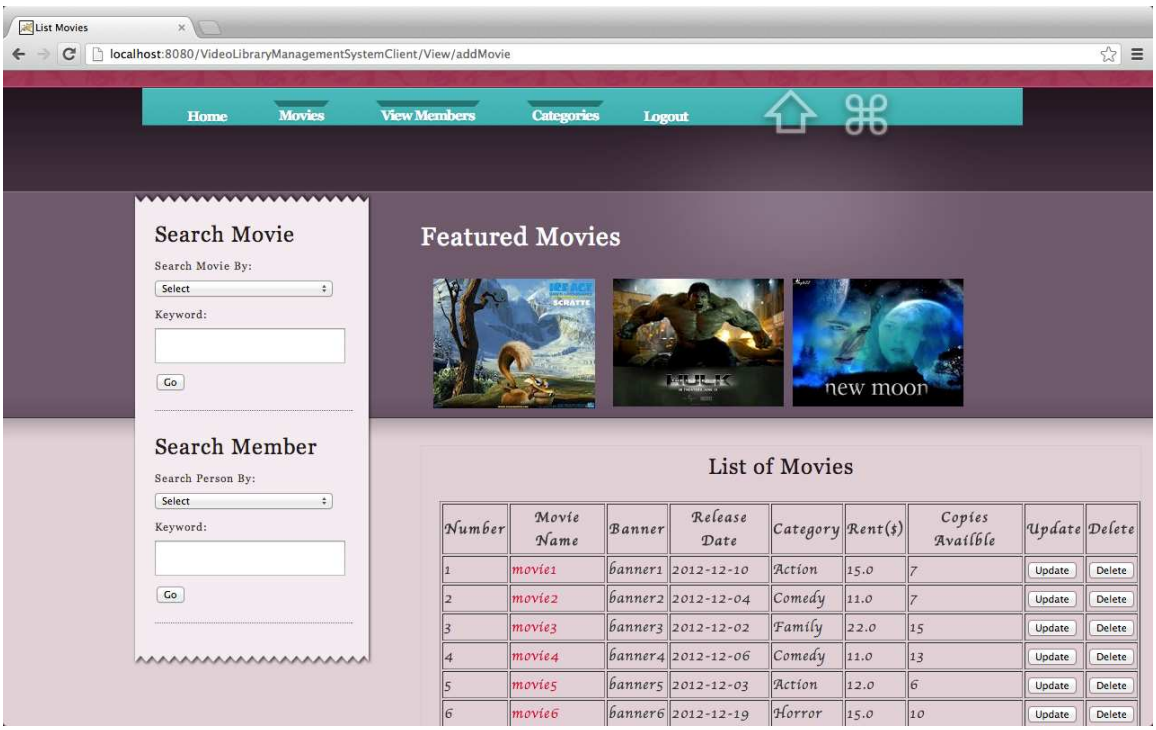
Add Movie



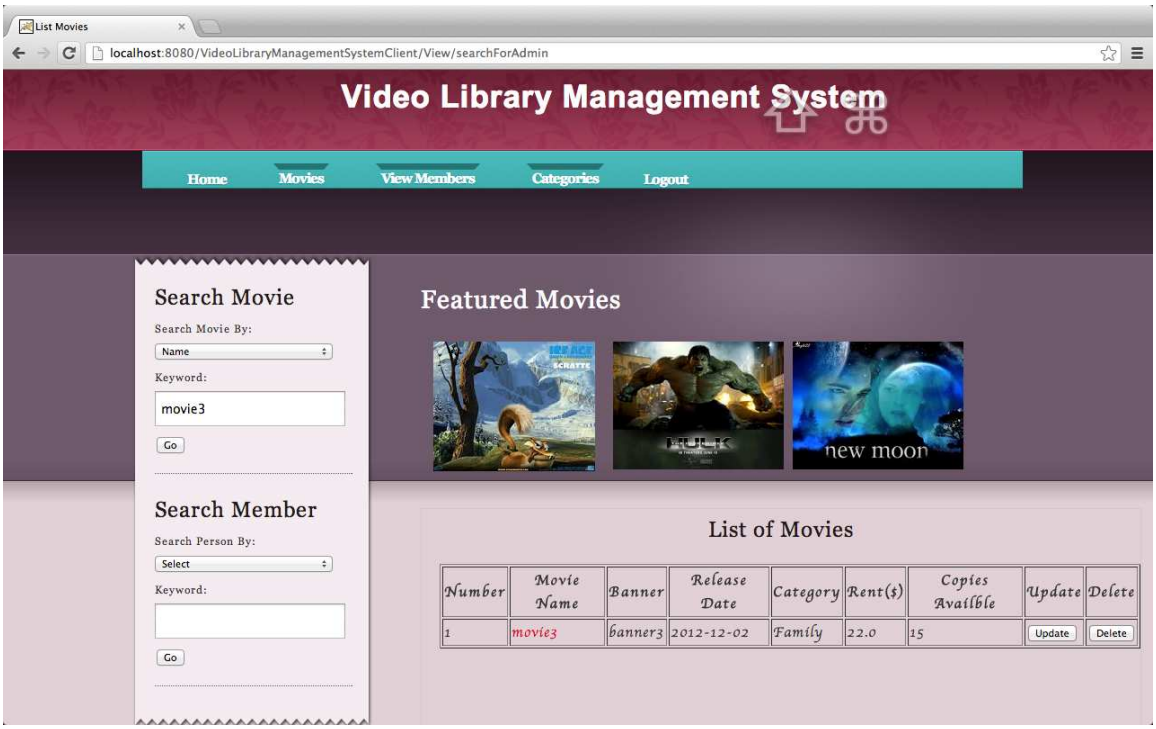
Update Movie



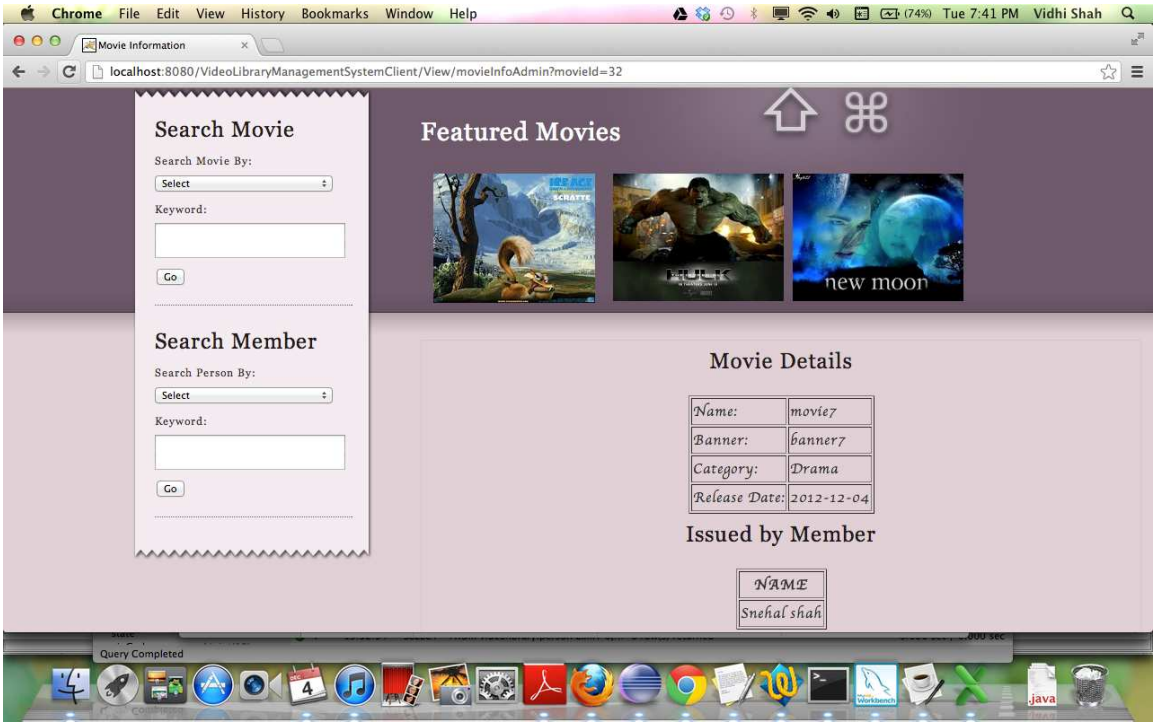
List Movies



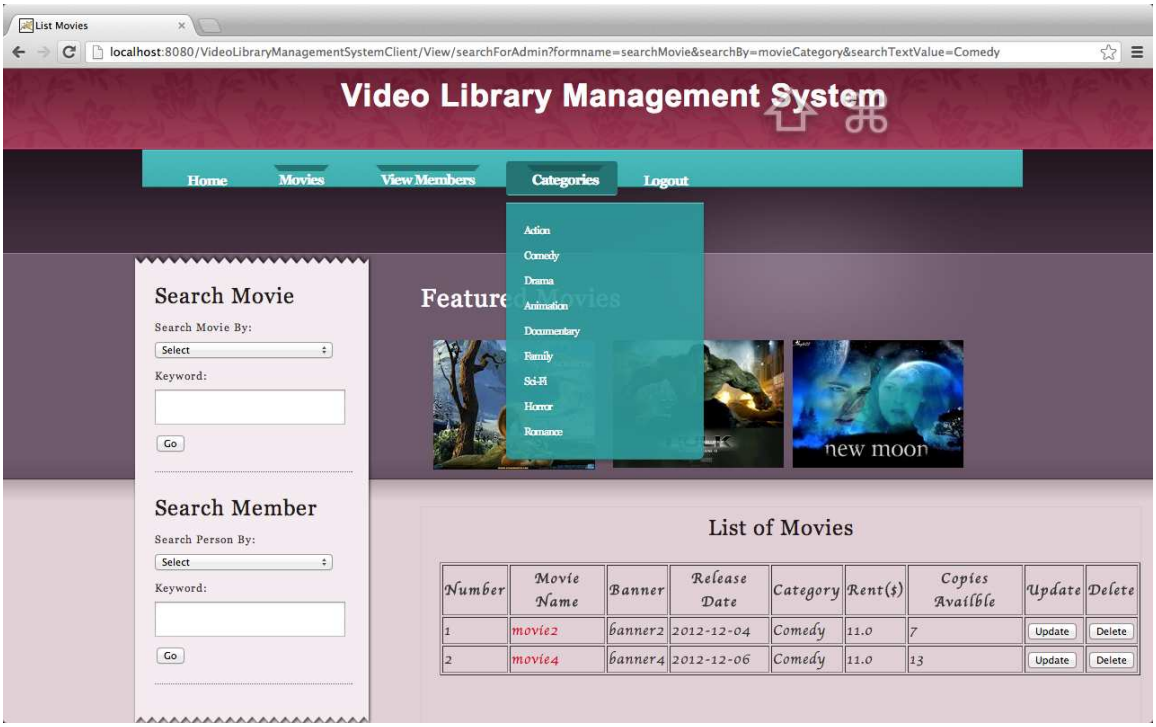
Search Movie



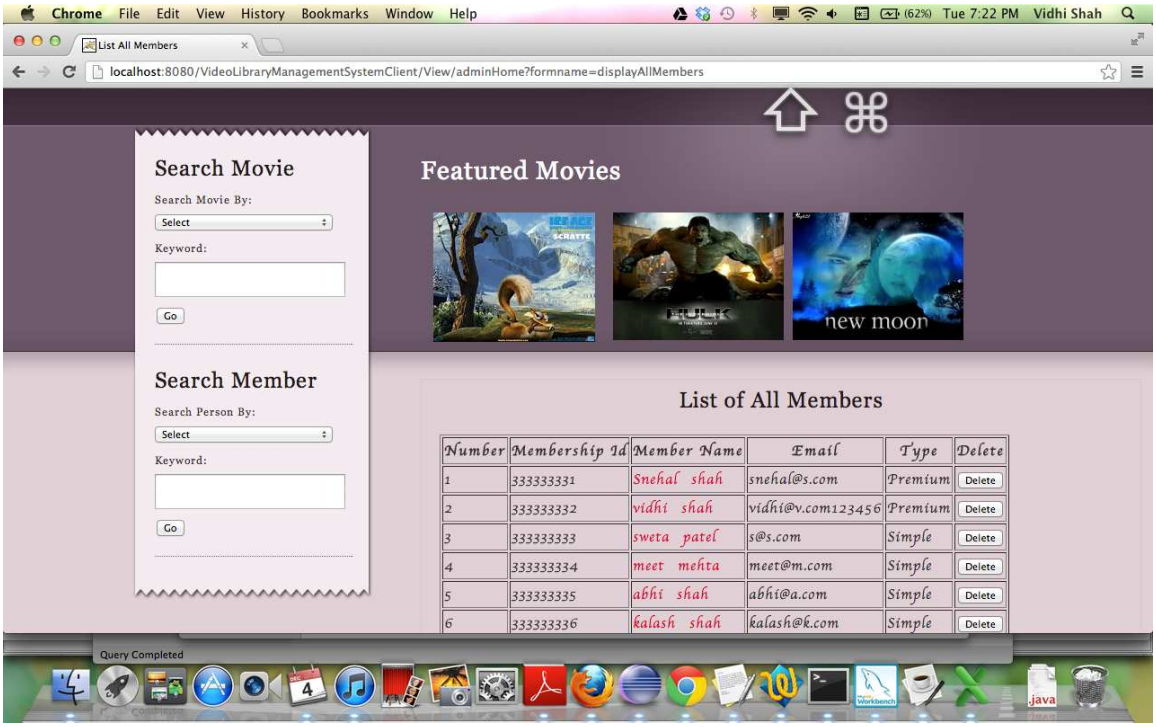
Movie information plus issued by members



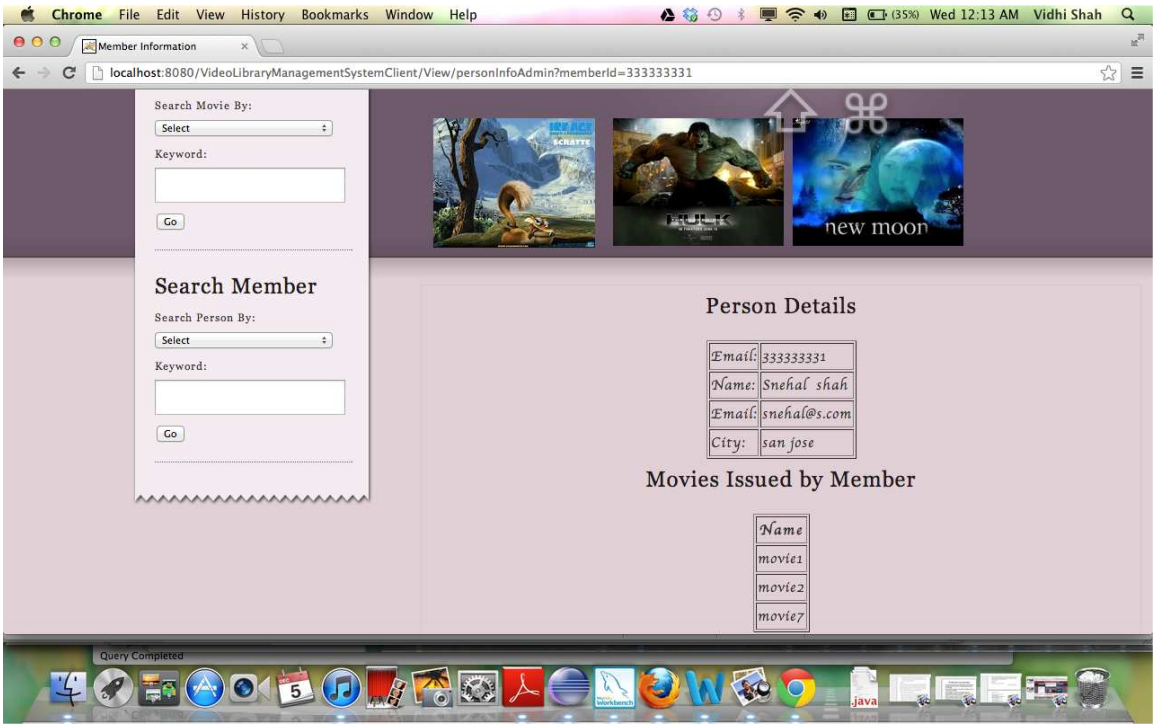
Movies according to Category



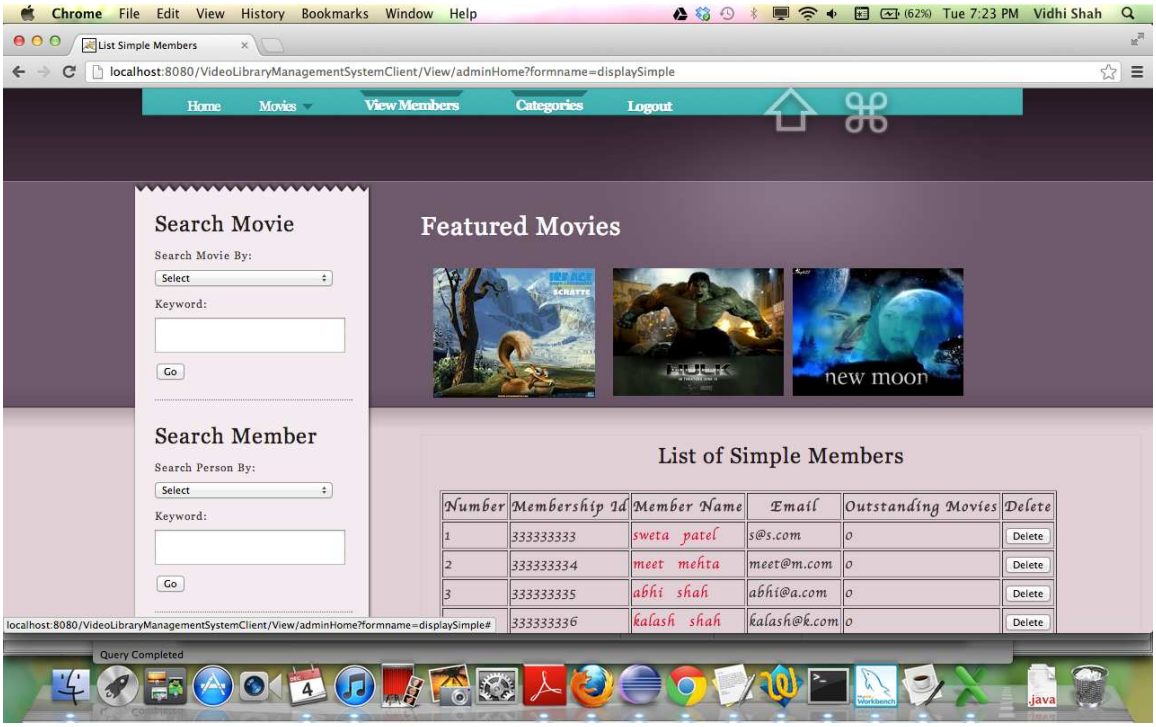
List of All Members



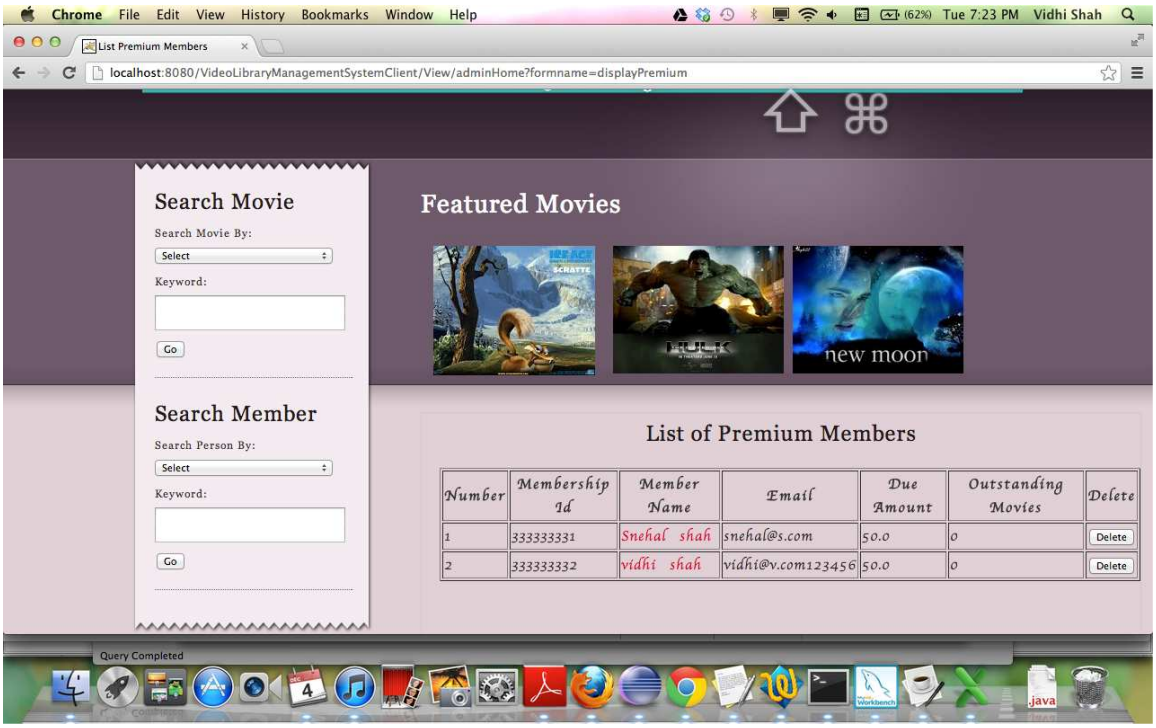
Member information plus movies issued to him



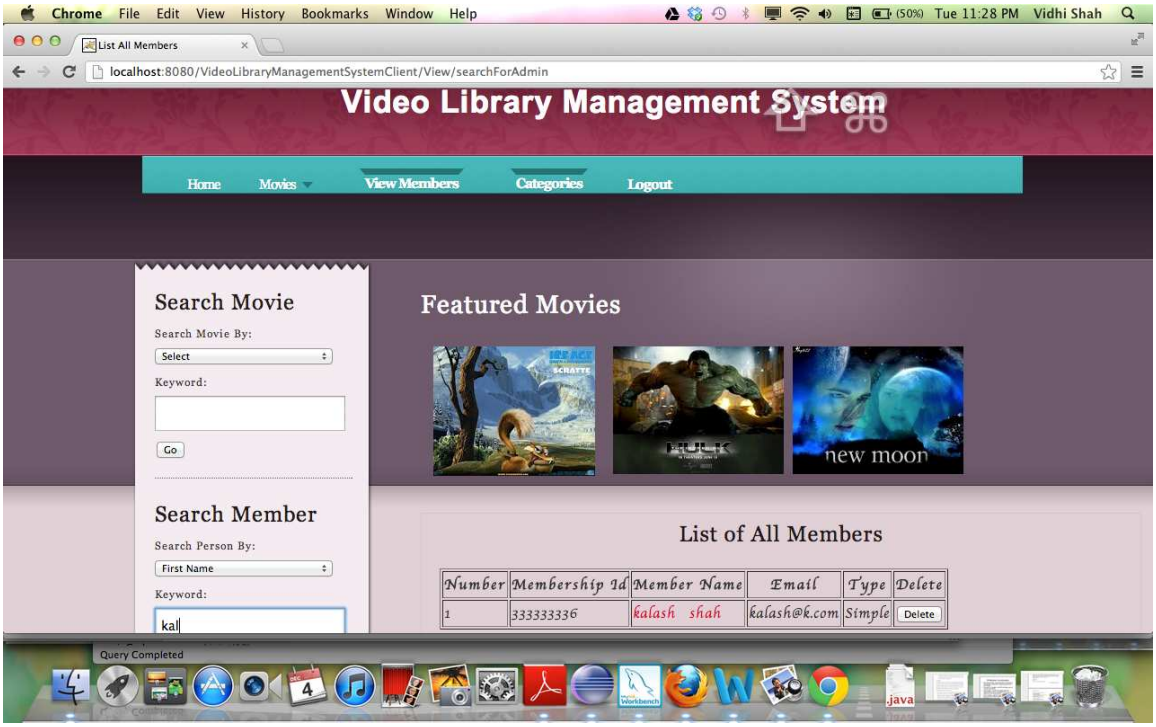
List of All Simple Members



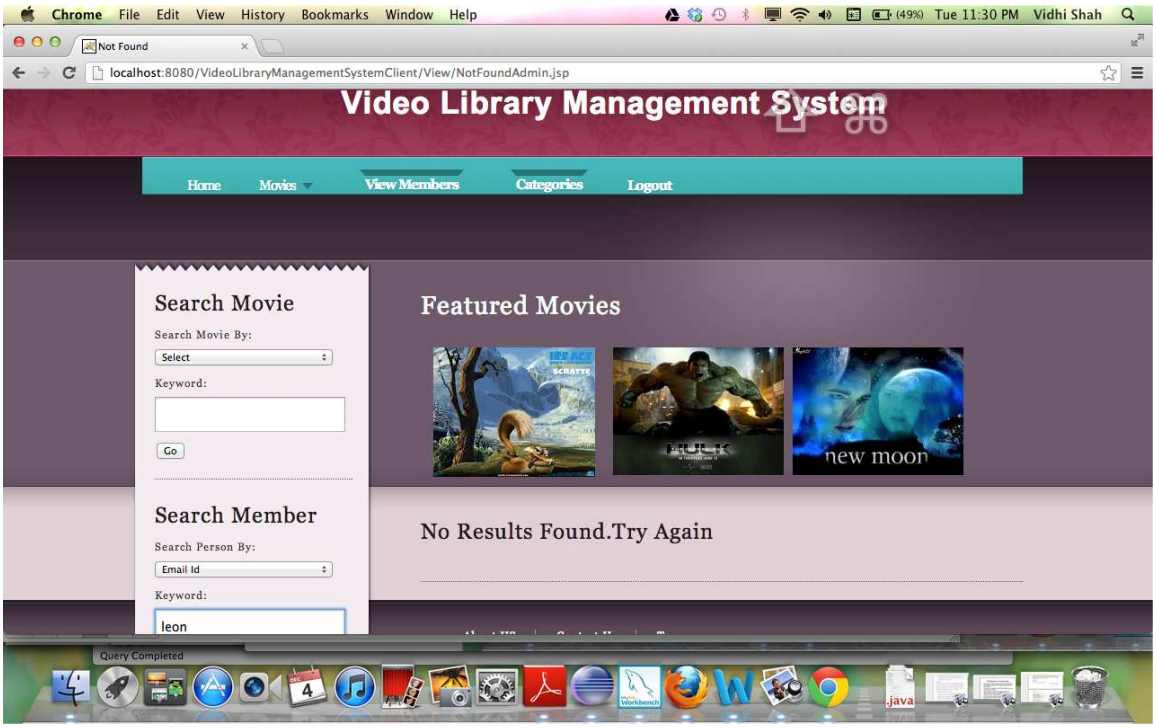
List all Premium Members



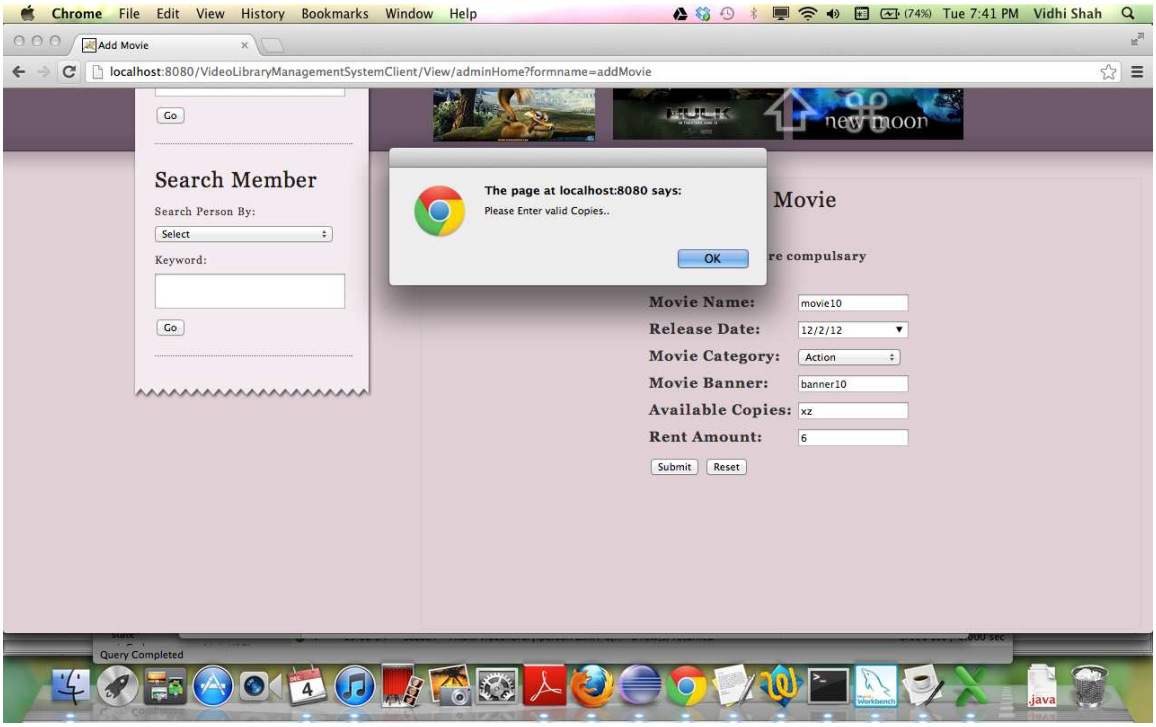
Search Person



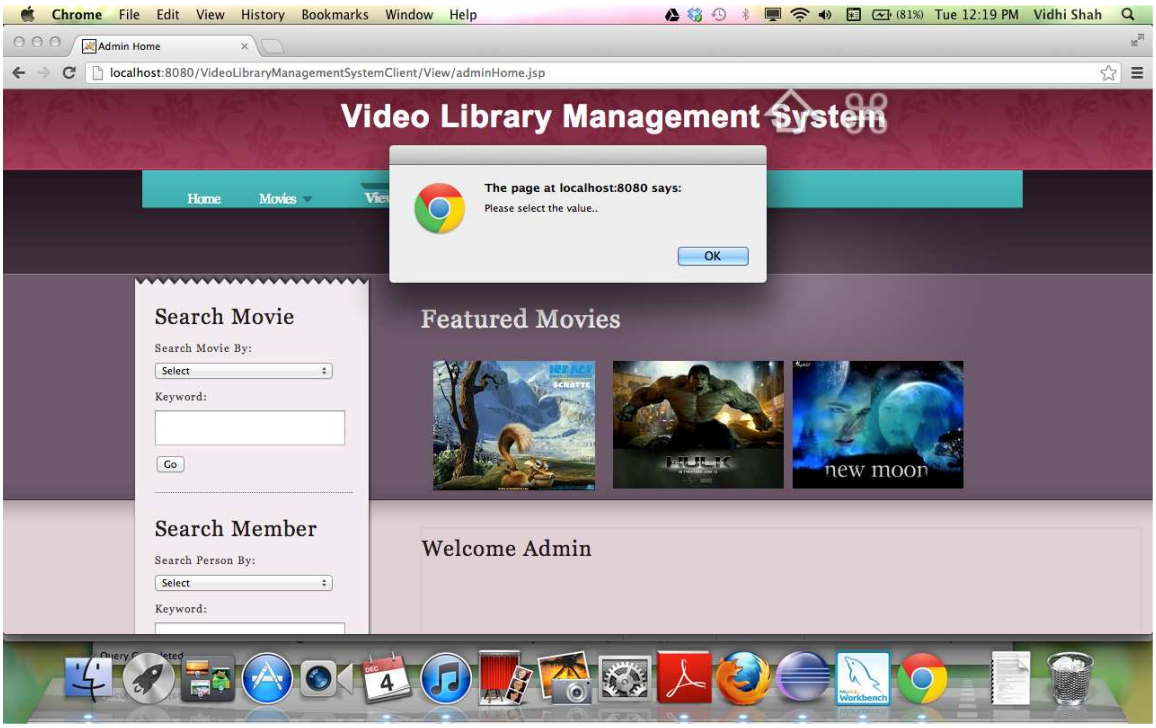
Search value Not Found



Invalid input for Available copies

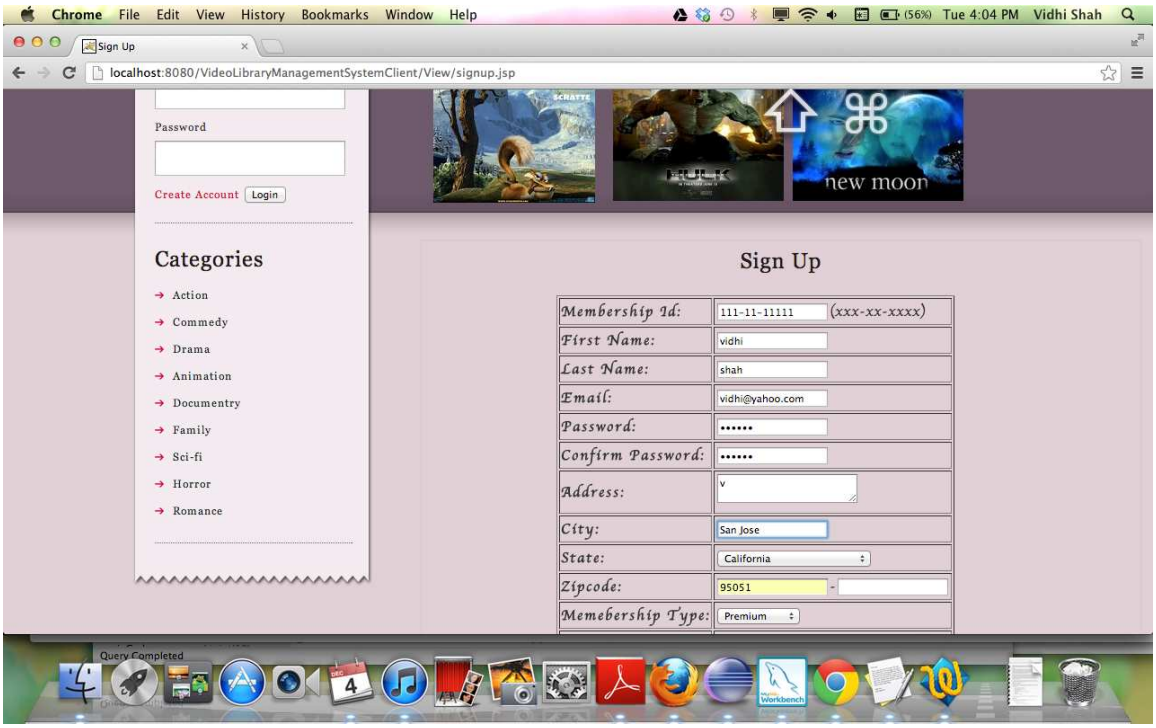


Go Pressed before selecting any option while searching

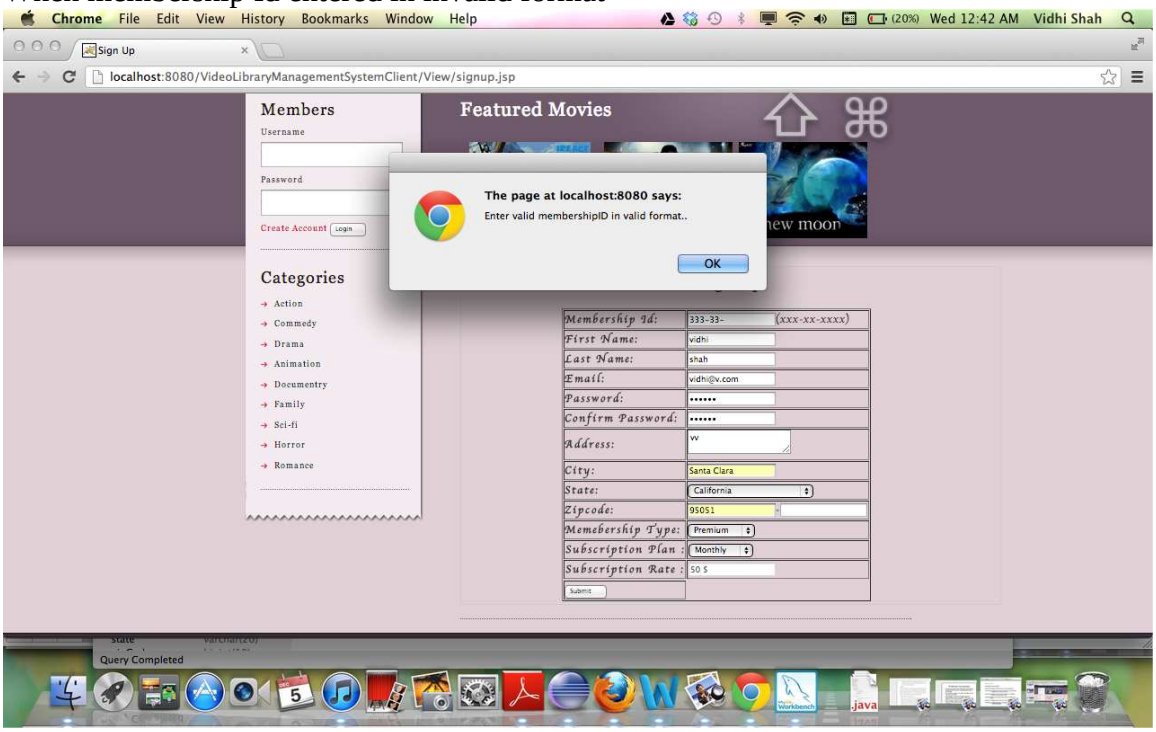


Member

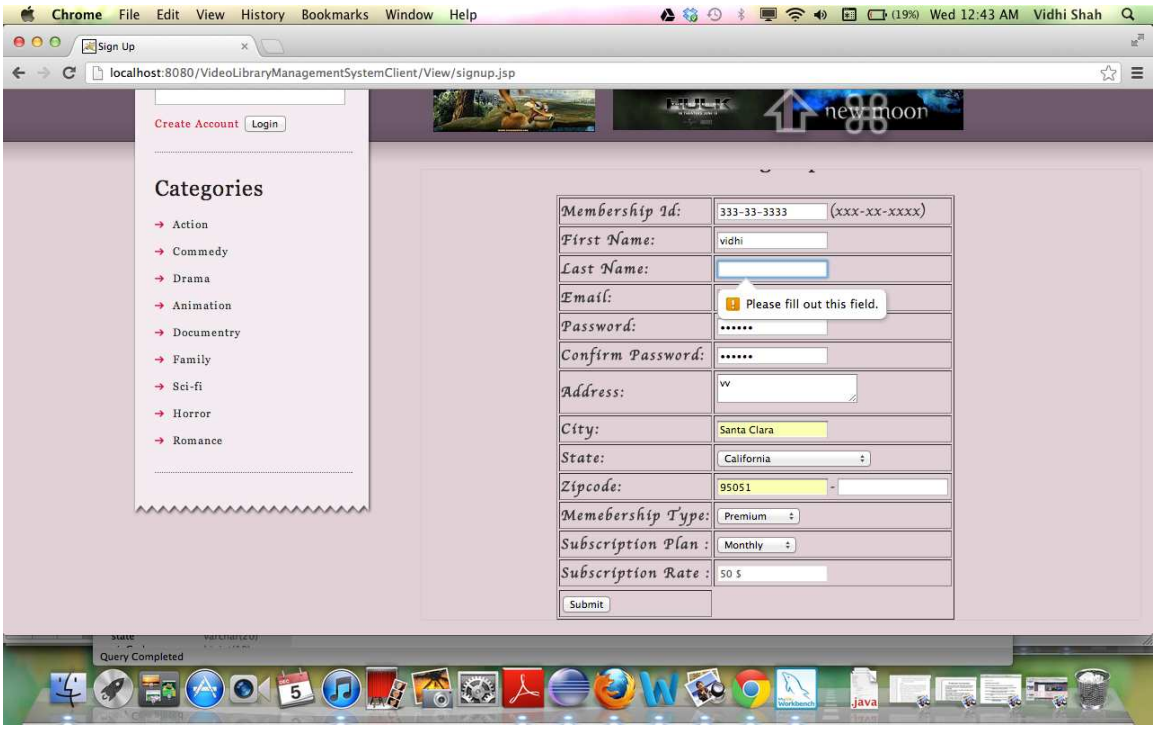
SignUp



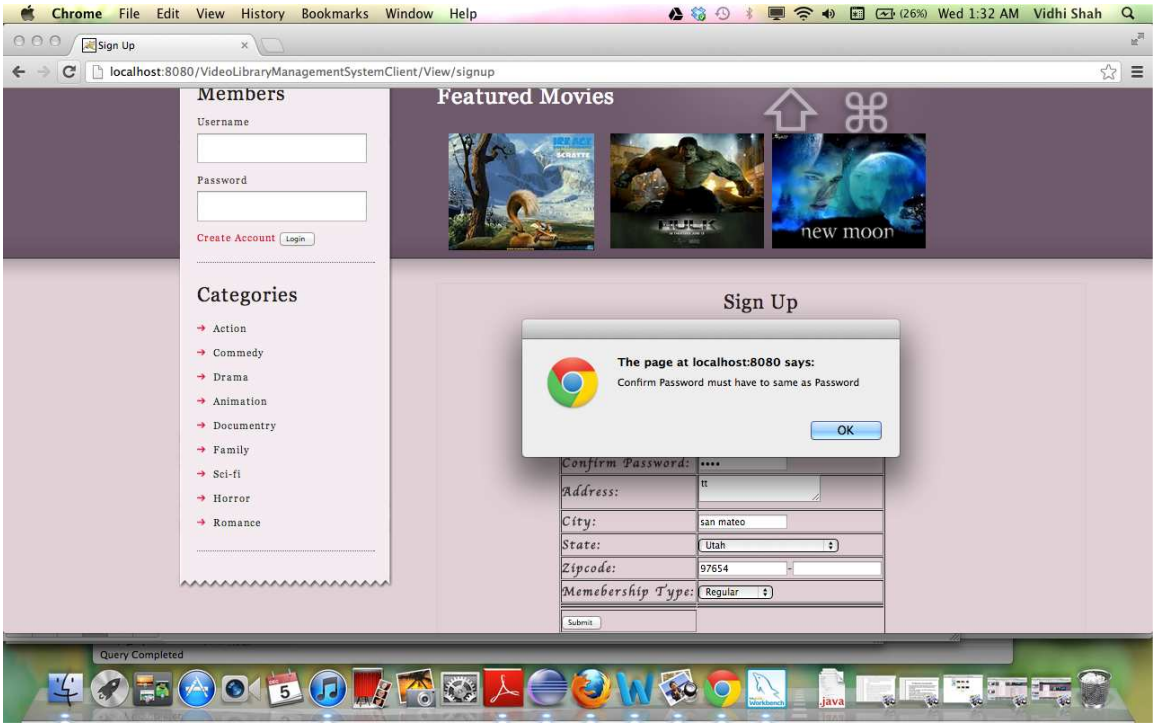
When membership Id entered in invalid format



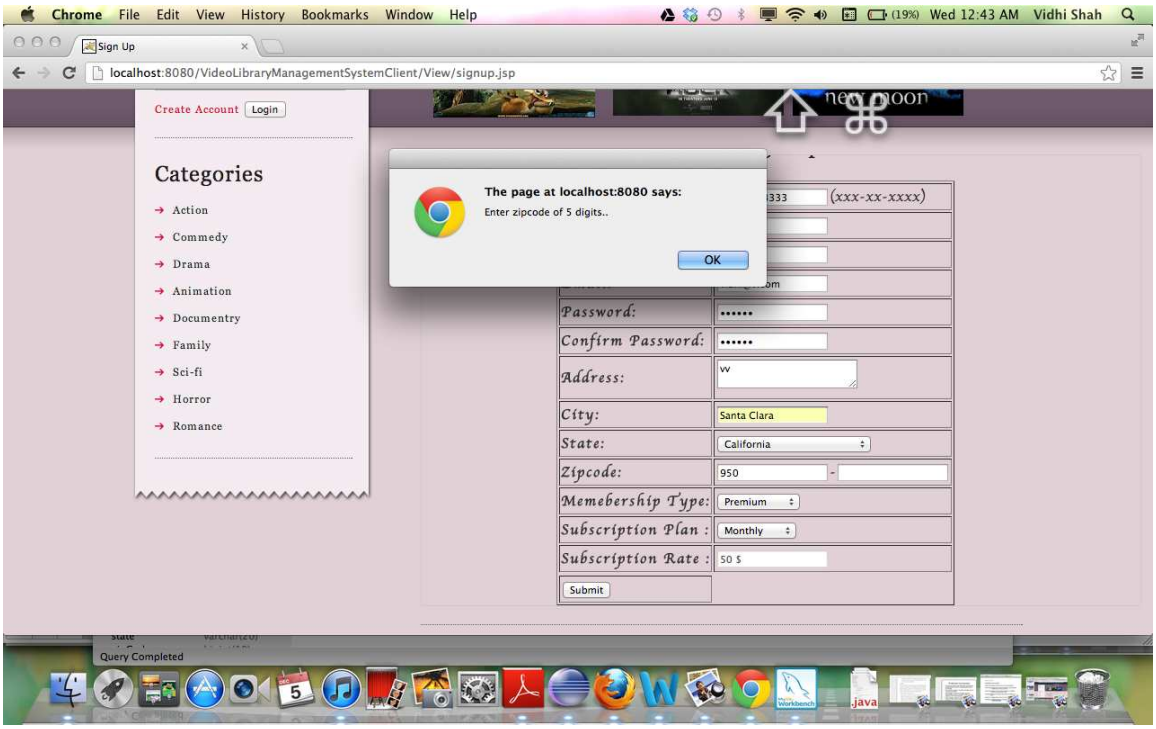
Empty Fields validation



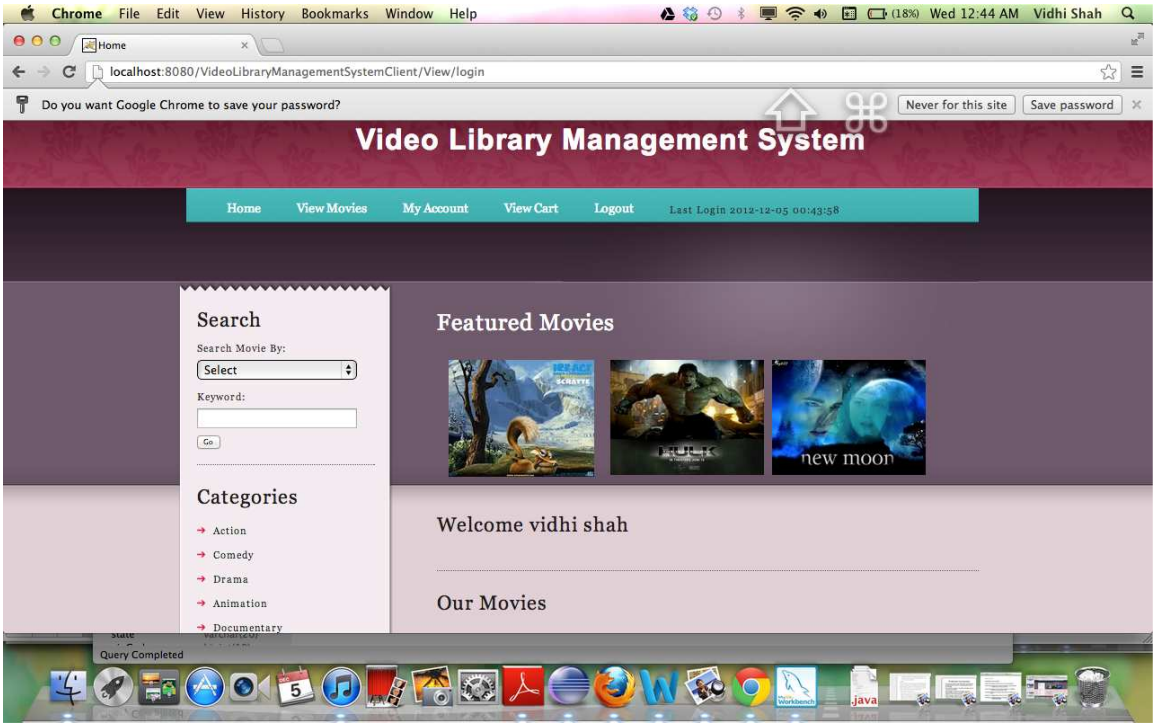
Password mismatch



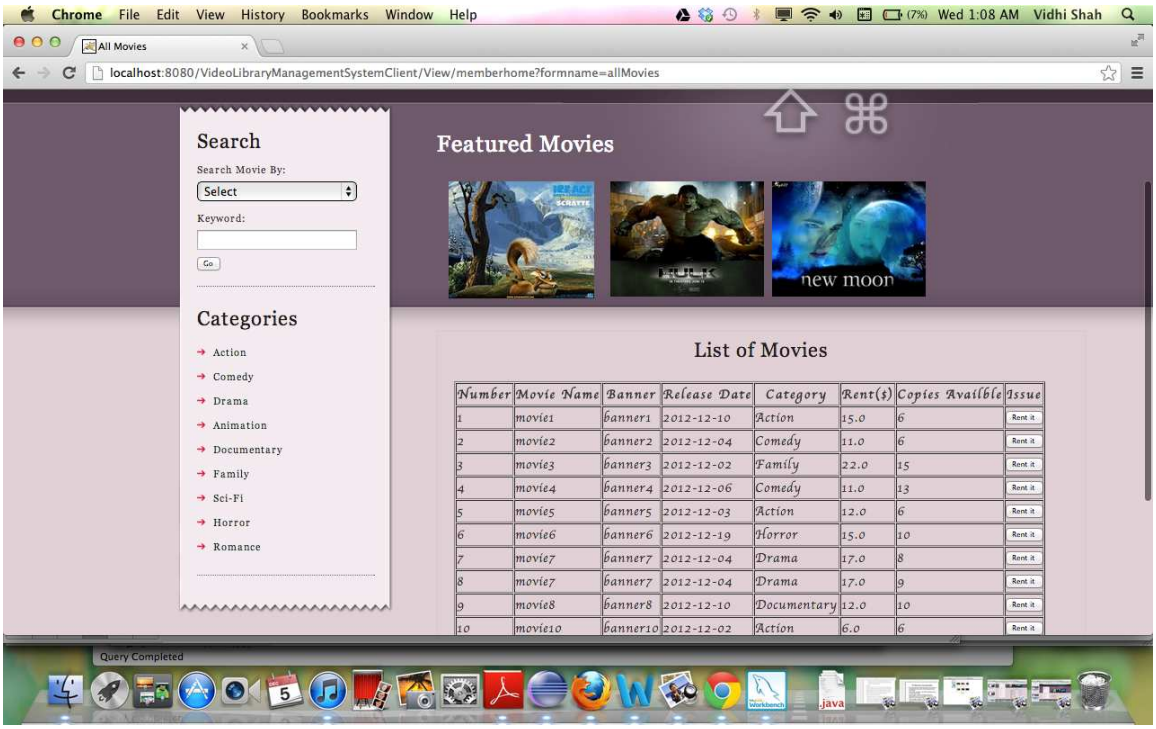
Invalid zip code validation



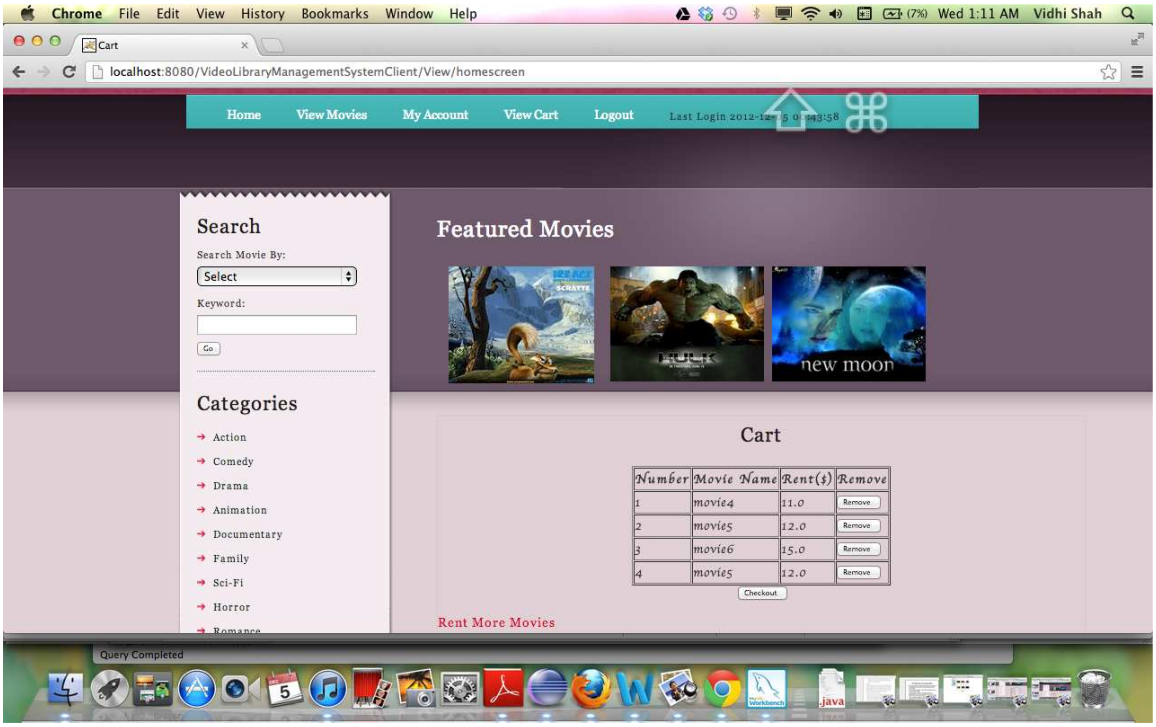
Successful Login (Premium Member)



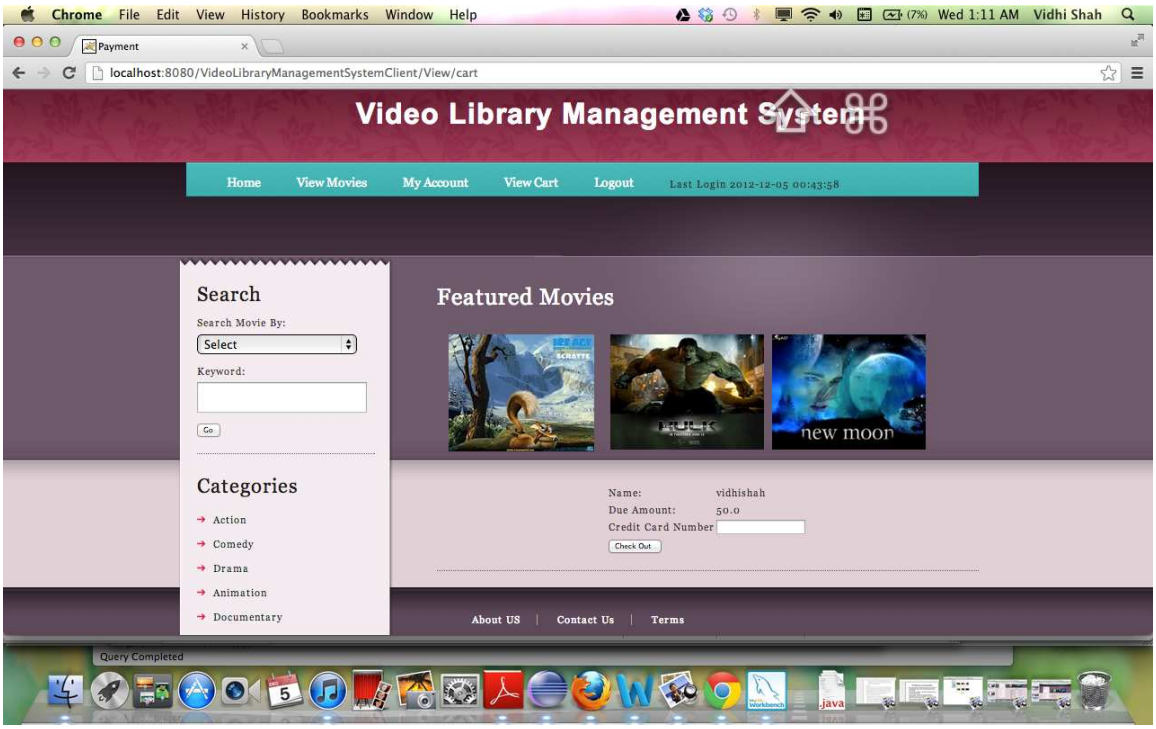
View All Movies



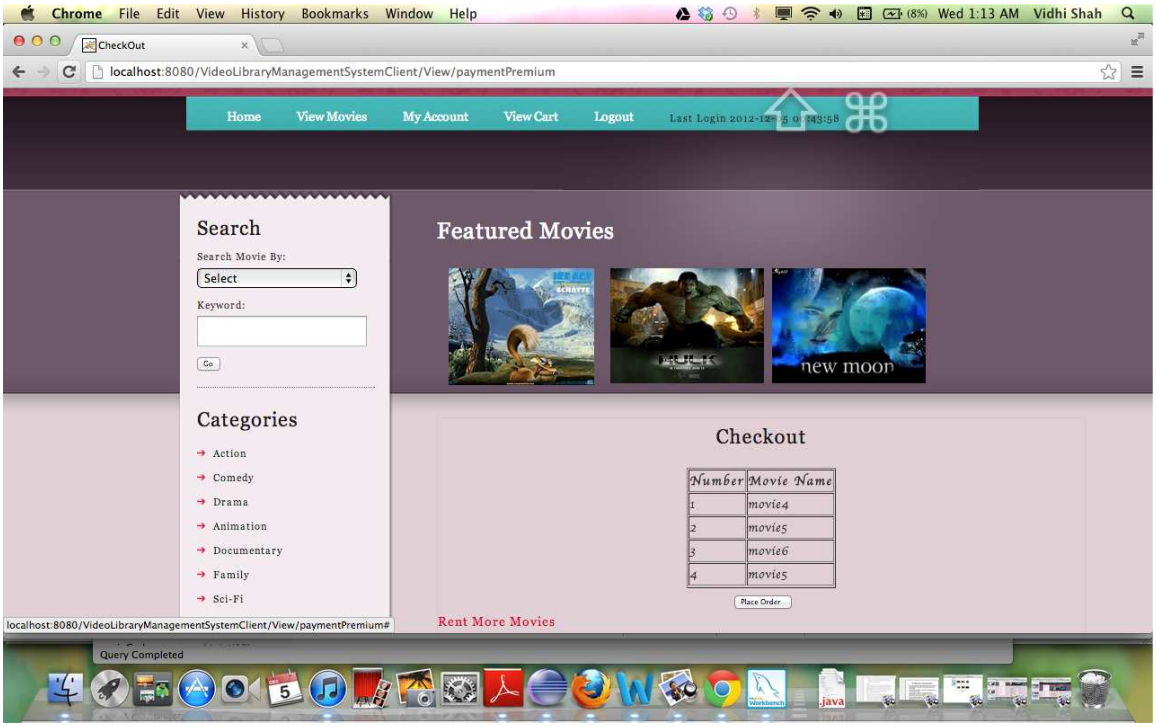
Add Movies to Cart



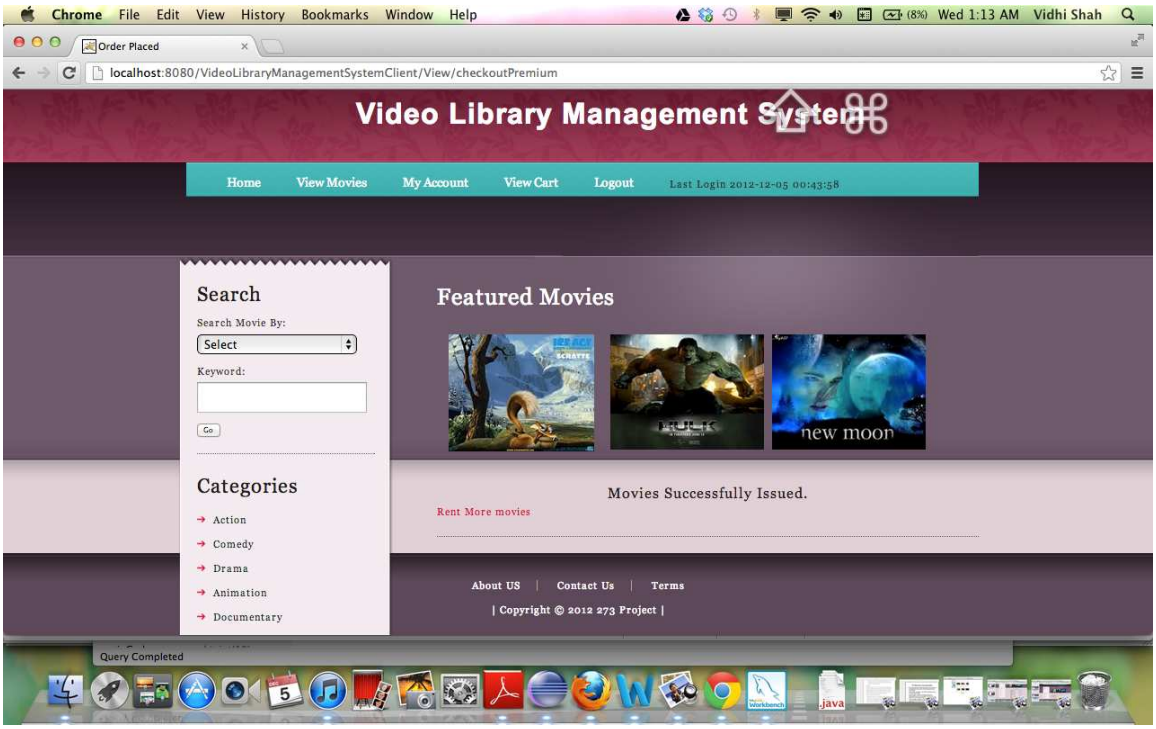
Pay the subscription fee



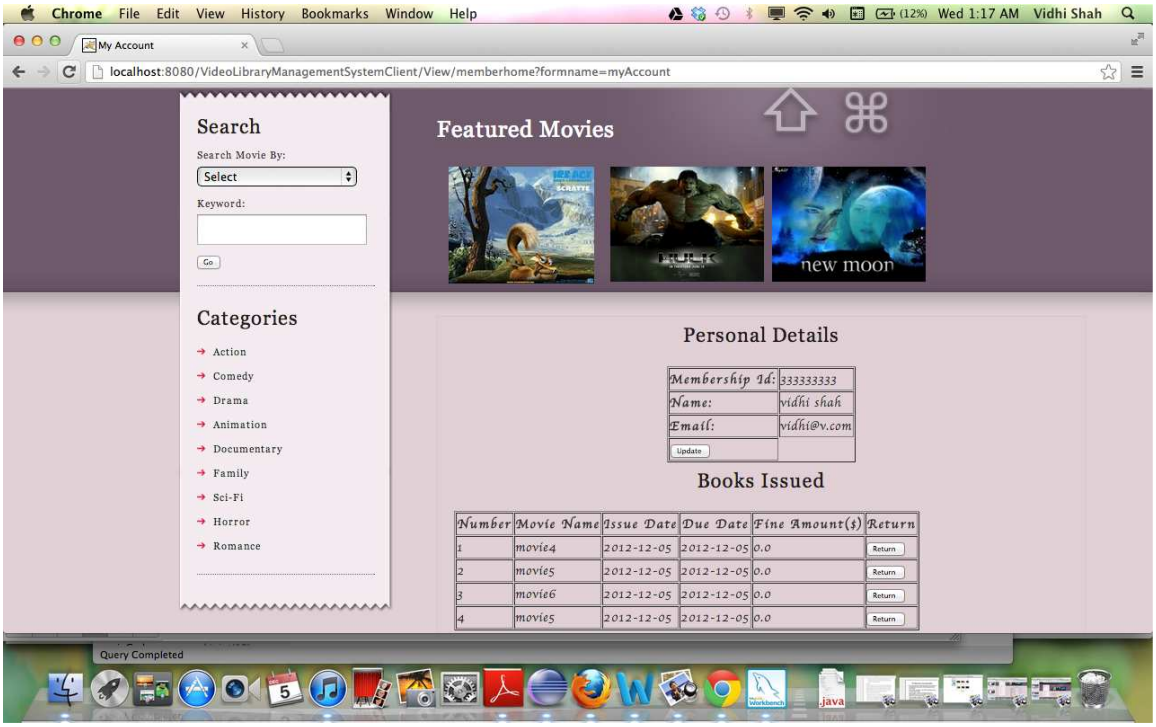
Place Order



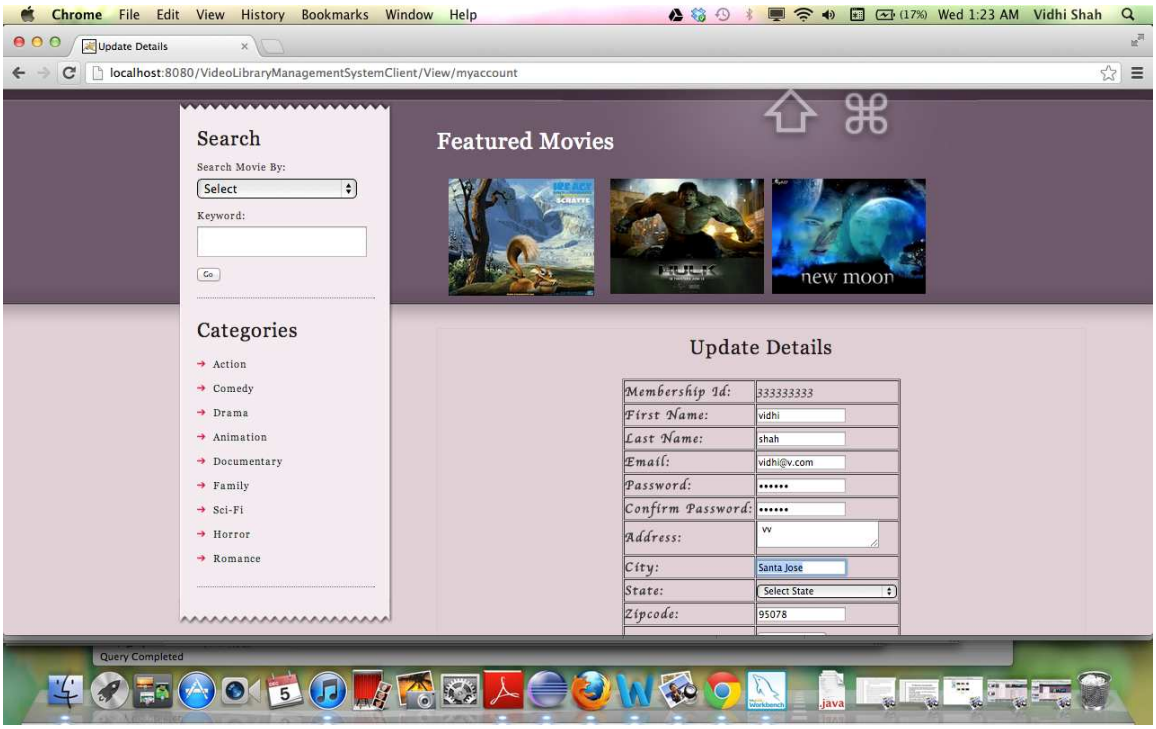
Movies Successfully Issued



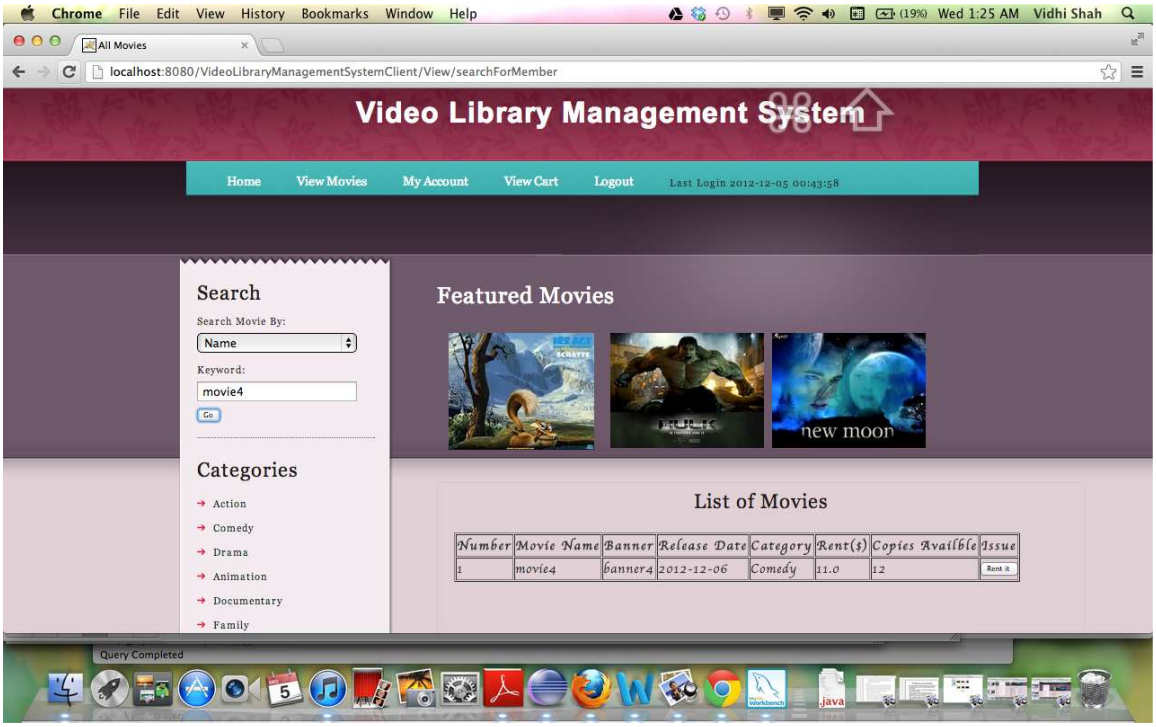
View Account with list of issued books yet to be returned



Update Personal Information

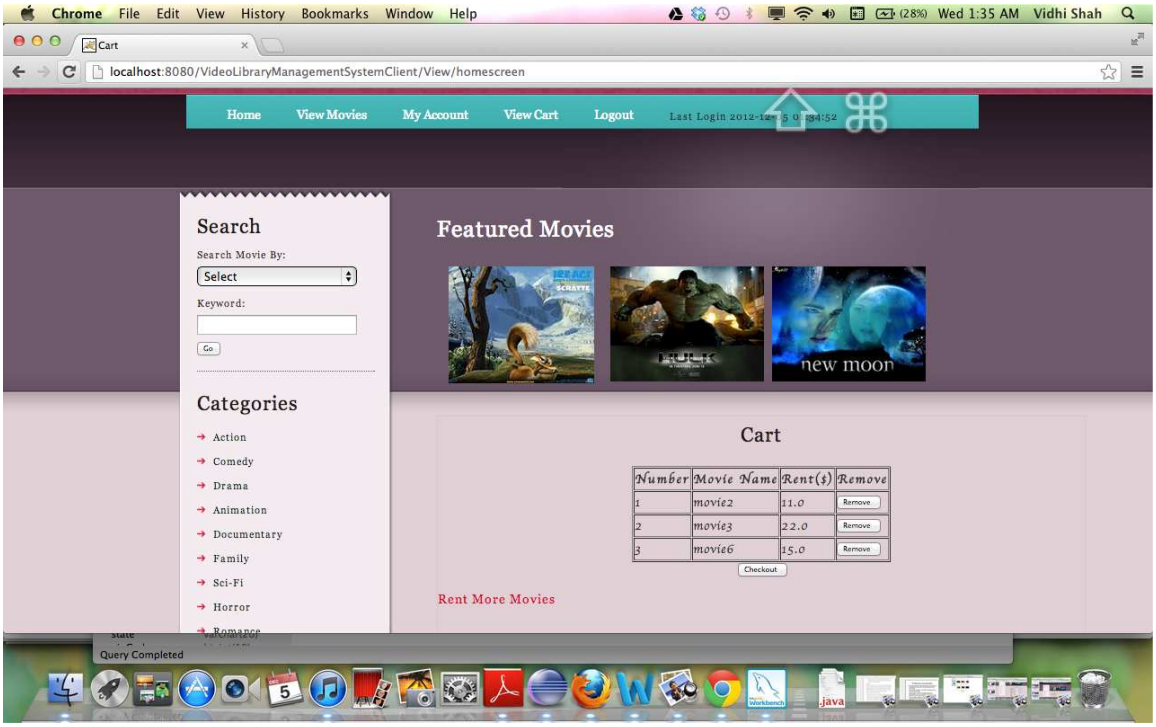


Search movie by any name

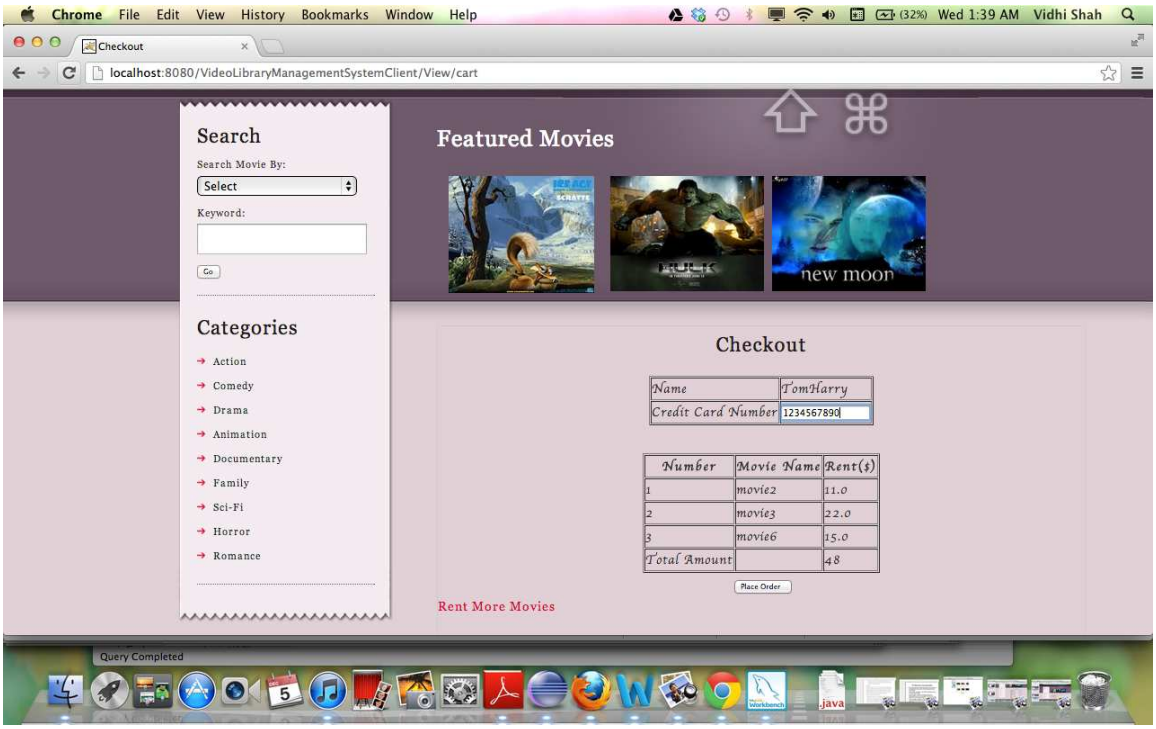


View movies by category ‘Action’

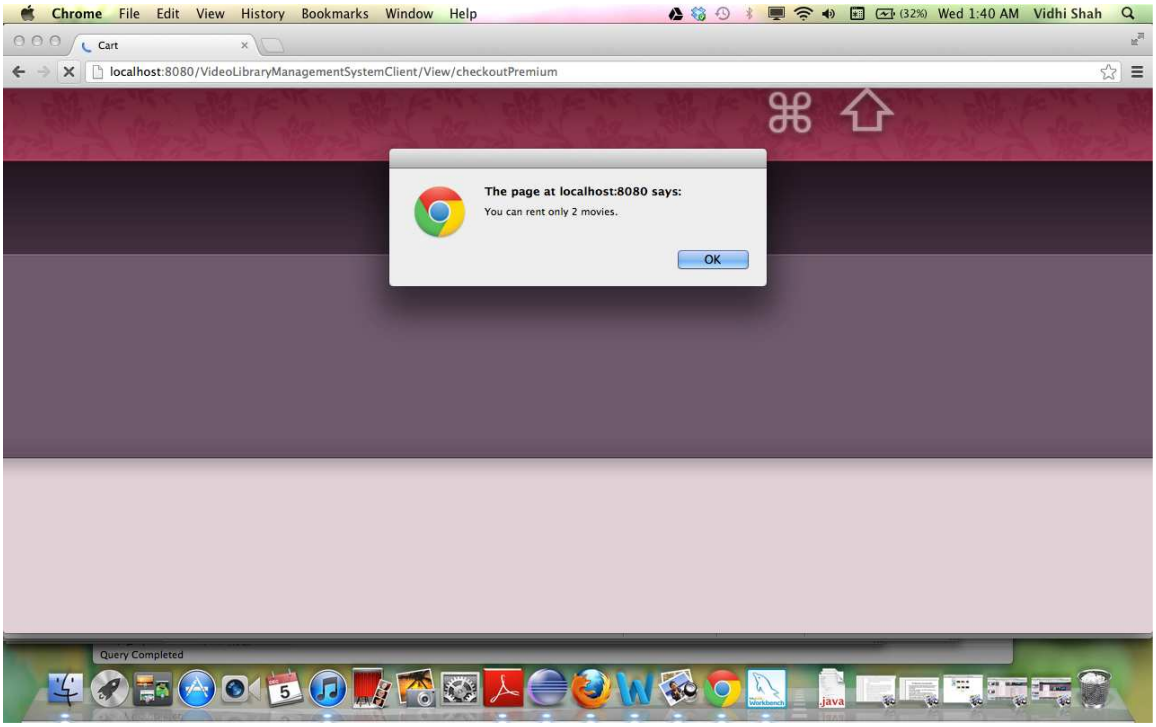
Cart (Simple Member)



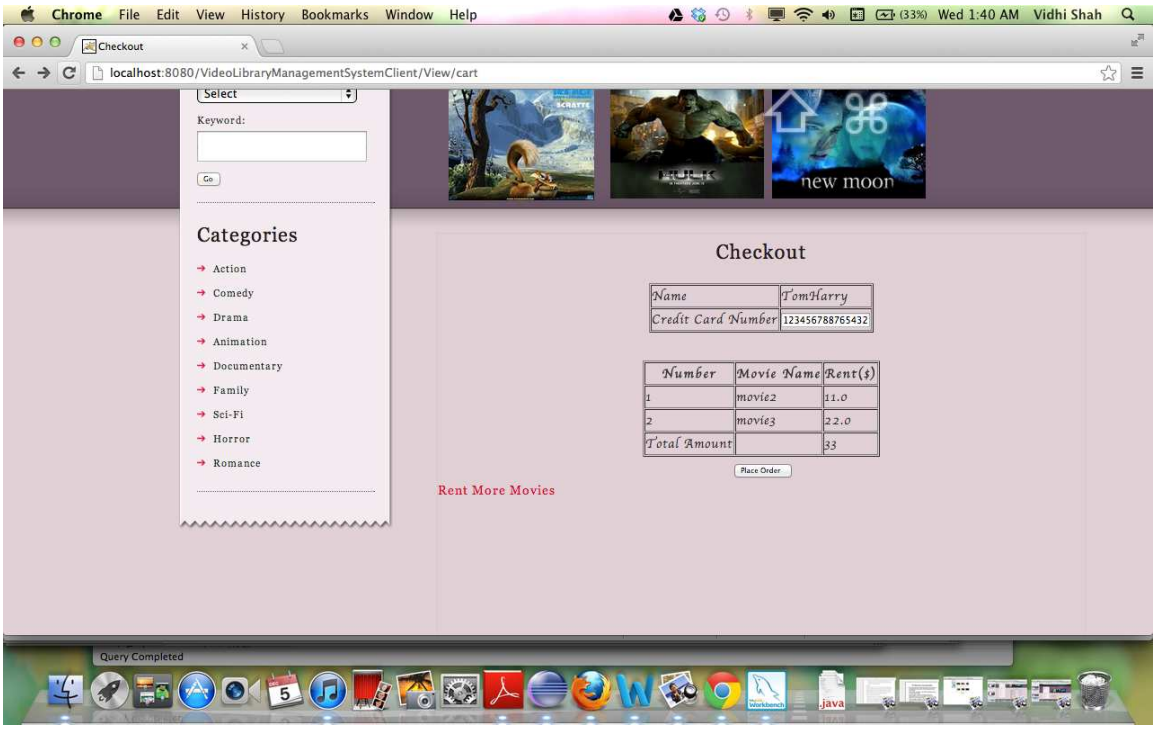
Trying to place order



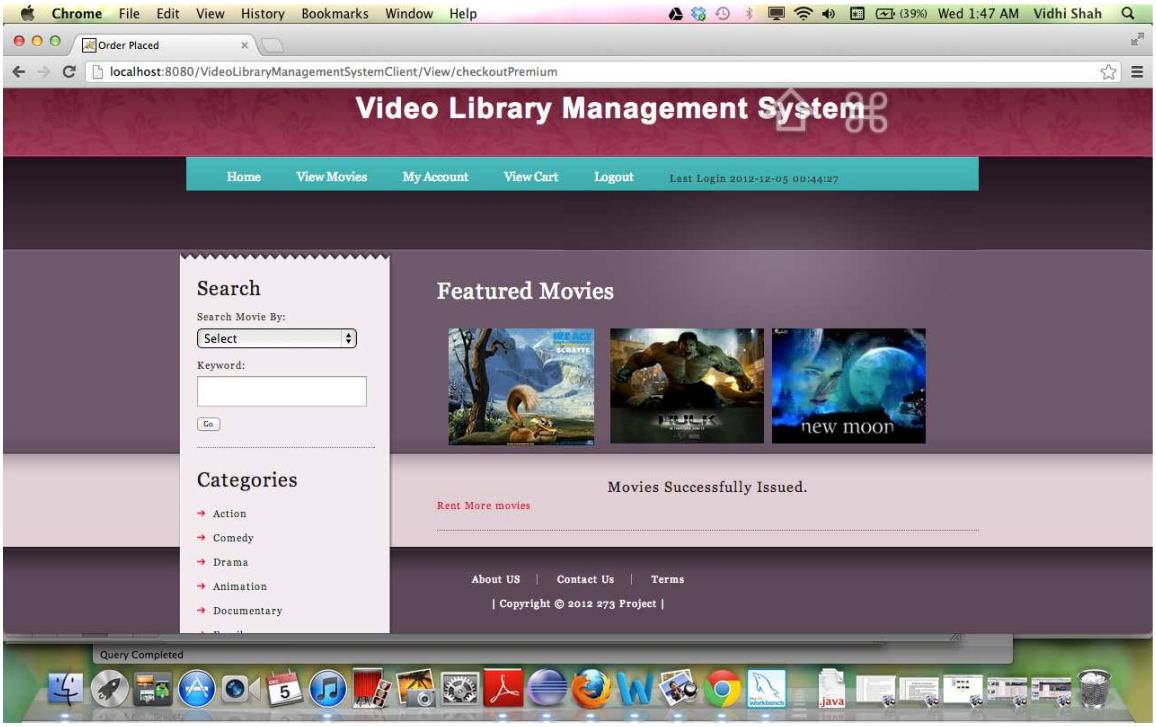
Simple Members can issue only 2 books



Pay Rent and checkout



Movies successfully issued

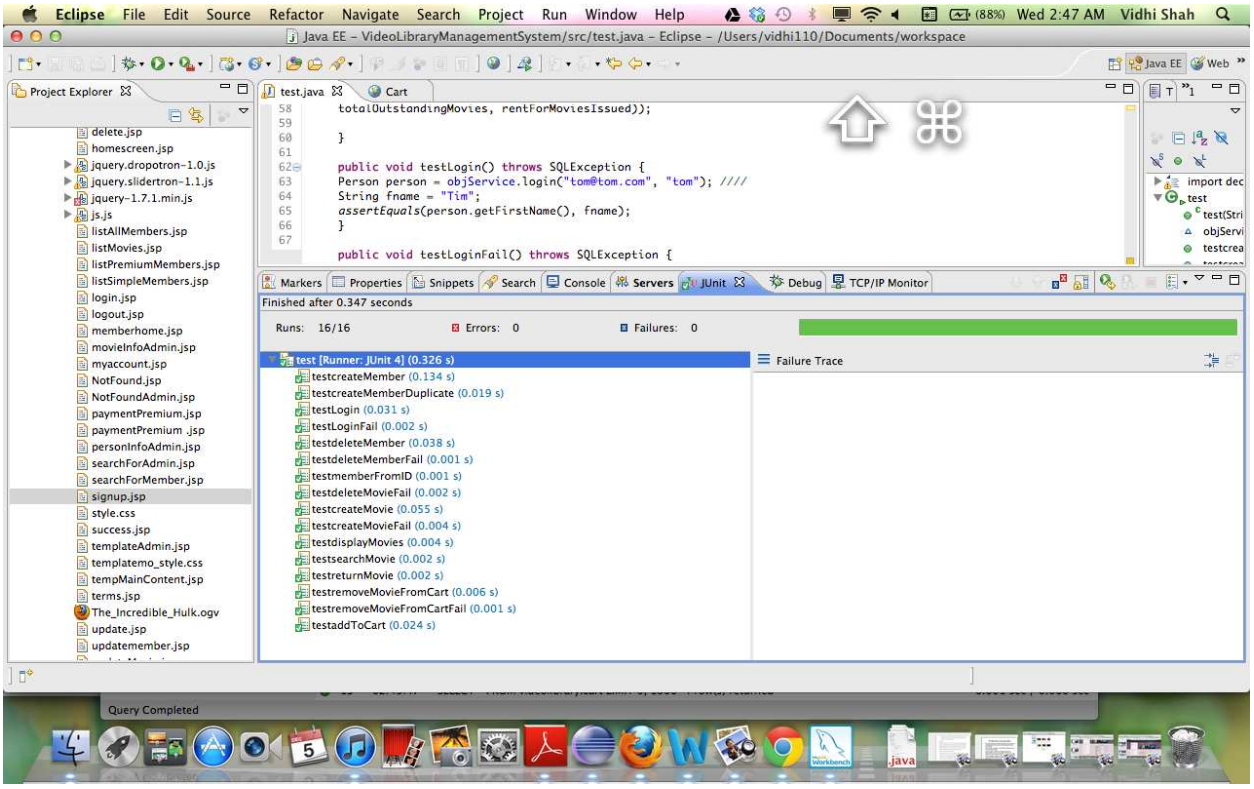


Software Testing

Software Testing is a very important and integral part of software development cycle. By doing testing, we can be confident of our project in terms of quality. A product needs to be tested to find missing or wrong functionality as well as to improve performance of software using few testing techniques like performance testing.

1) **Unit testing with Junit:**

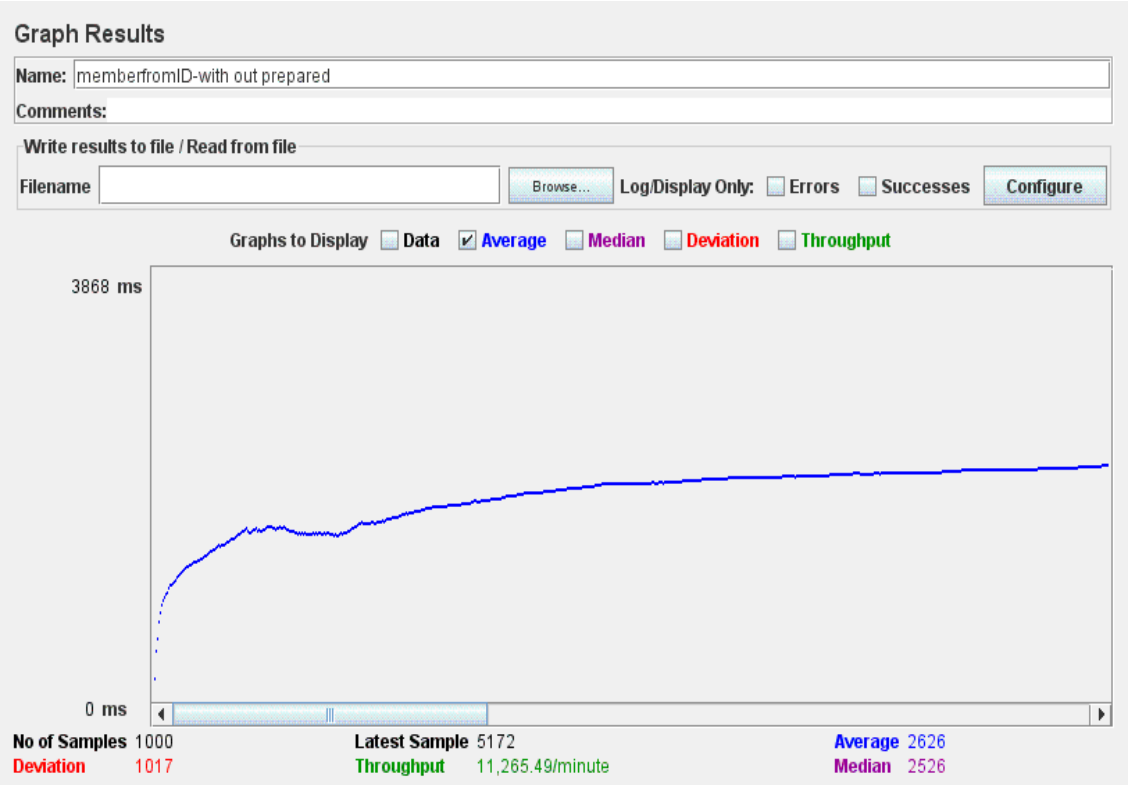
In our project, we have used Junit for unit testing. When we are debugging our software, we are trying to know what went incorrect but with unit testing, we set or confirm our expectations or correct result that should be reflected at the end of successful execution. When it fails, you can track where something went wrong and correct it. Also one Junit code created, it can be used every time to check validity of your code. So base line is Junit is used to validate code against correct result under different kind of inputs and find issues to fix. We have focused on unit testing and below are an output of the test cases:



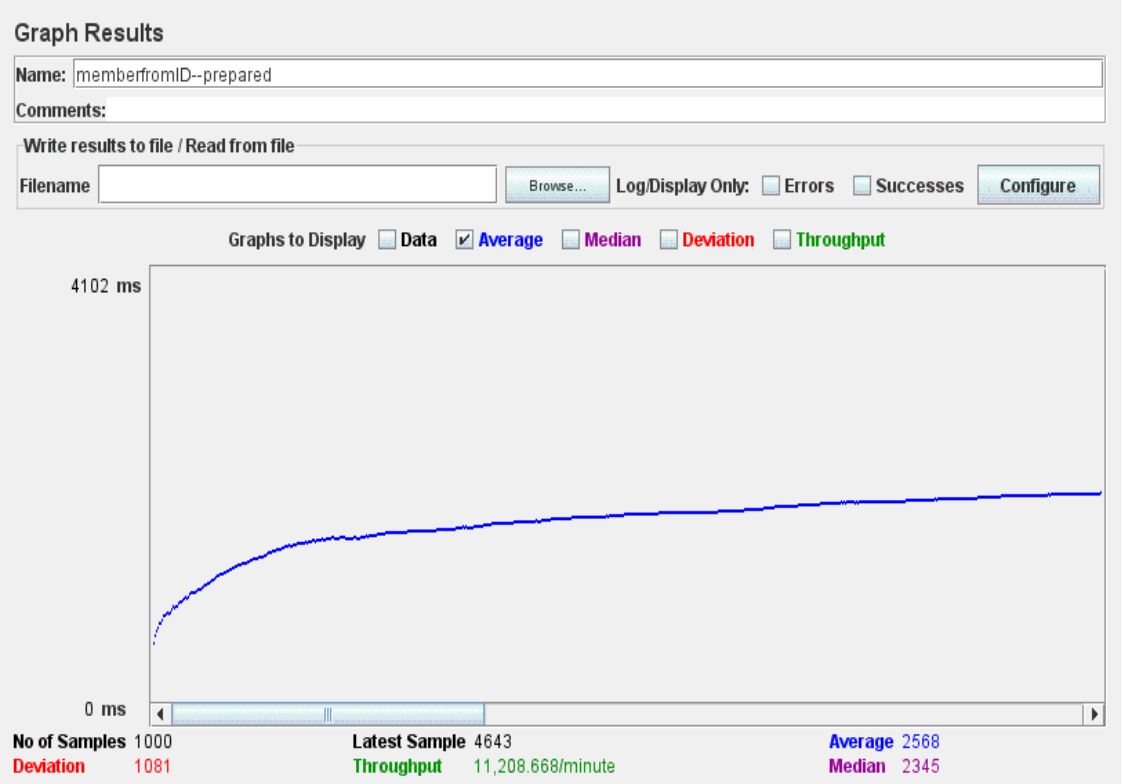
2) Performance testing with JMeter:

Performance testing is a part of software engineering and it is used to determine how a system responds in case of heavy load in terms of stability and responsiveness. It is also used to measure scalability and reliability of software. In our project, we have used JMeter for performance measurement. Apache JMeter is a load testing tool and can be used for measuring performance of different services mainly web applications. It is pure java desktop application. To simulate load on a server, JMeter can be used very efficiently. Also we can find use JMeter to validate that our application is returning expected results by creating test scripts with assertion. We have used JMeter to find performance of web application at different stages and results are as below:

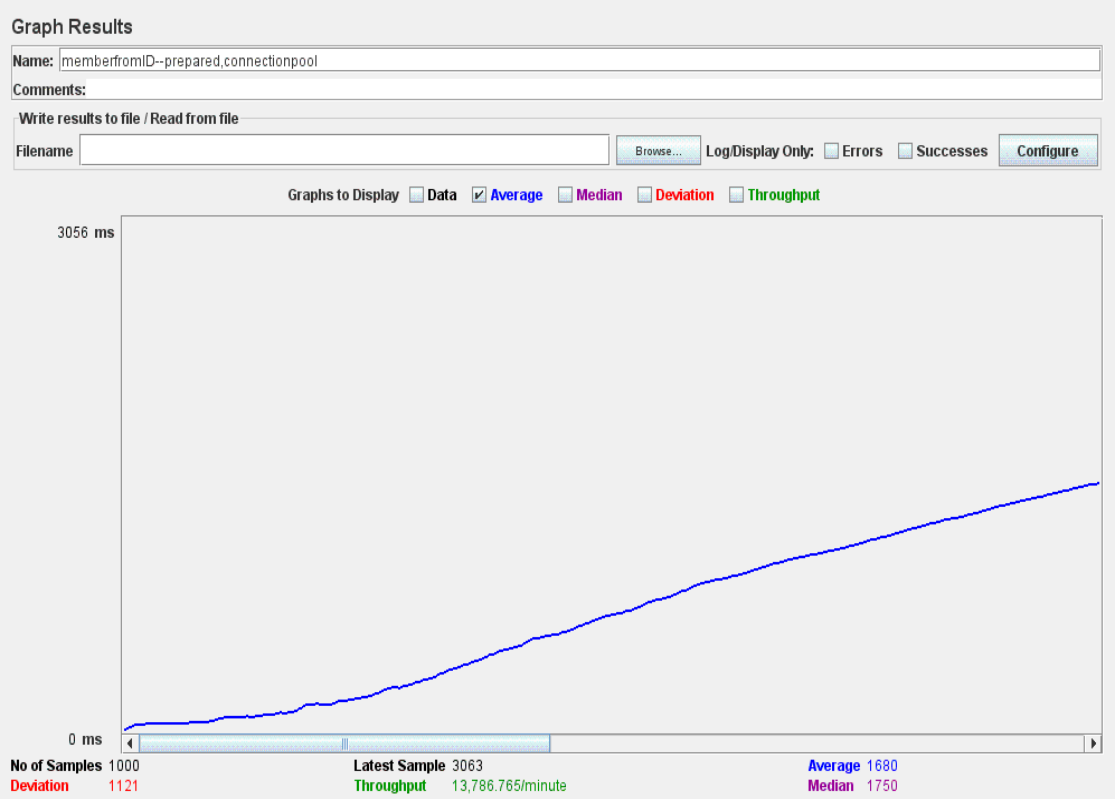
1) Base Class



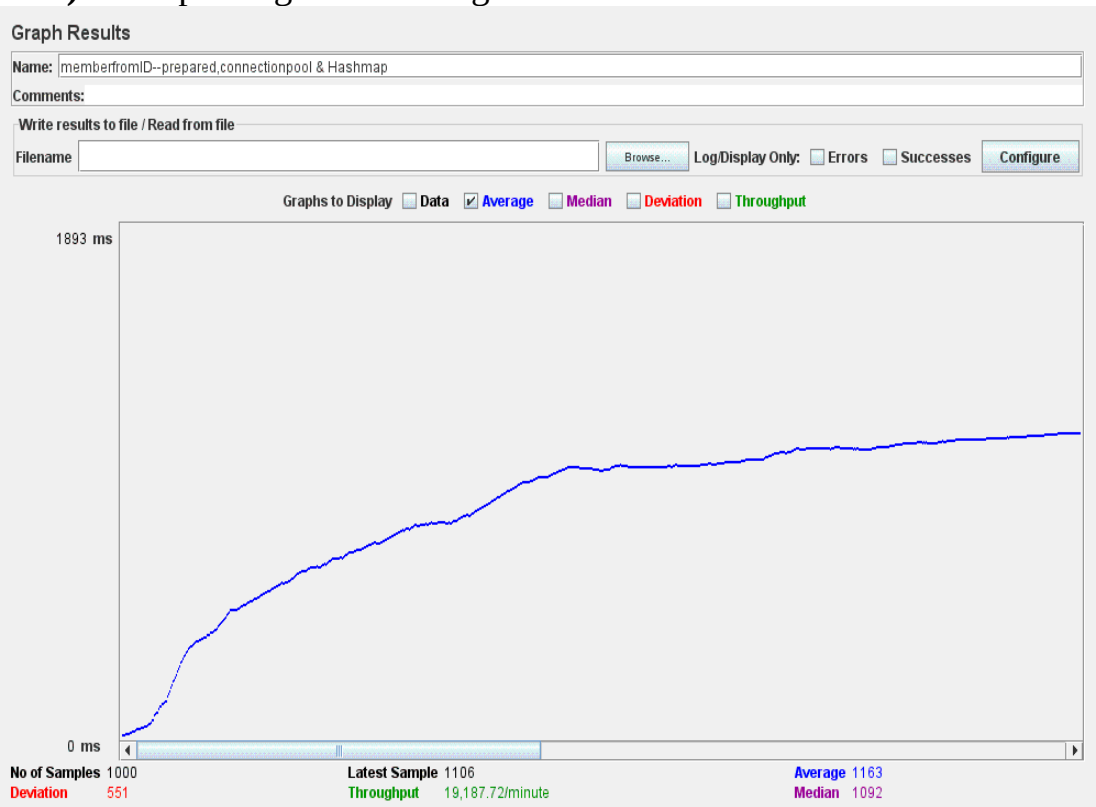
2) With Prepared Statement:



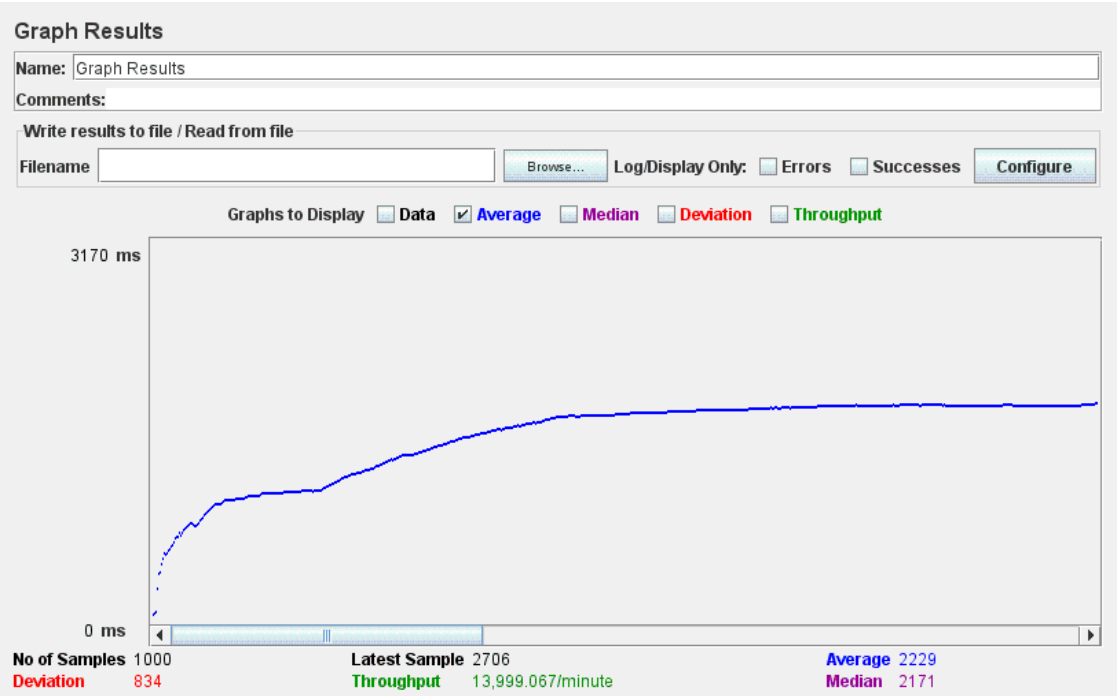
3) With Connection Pooling



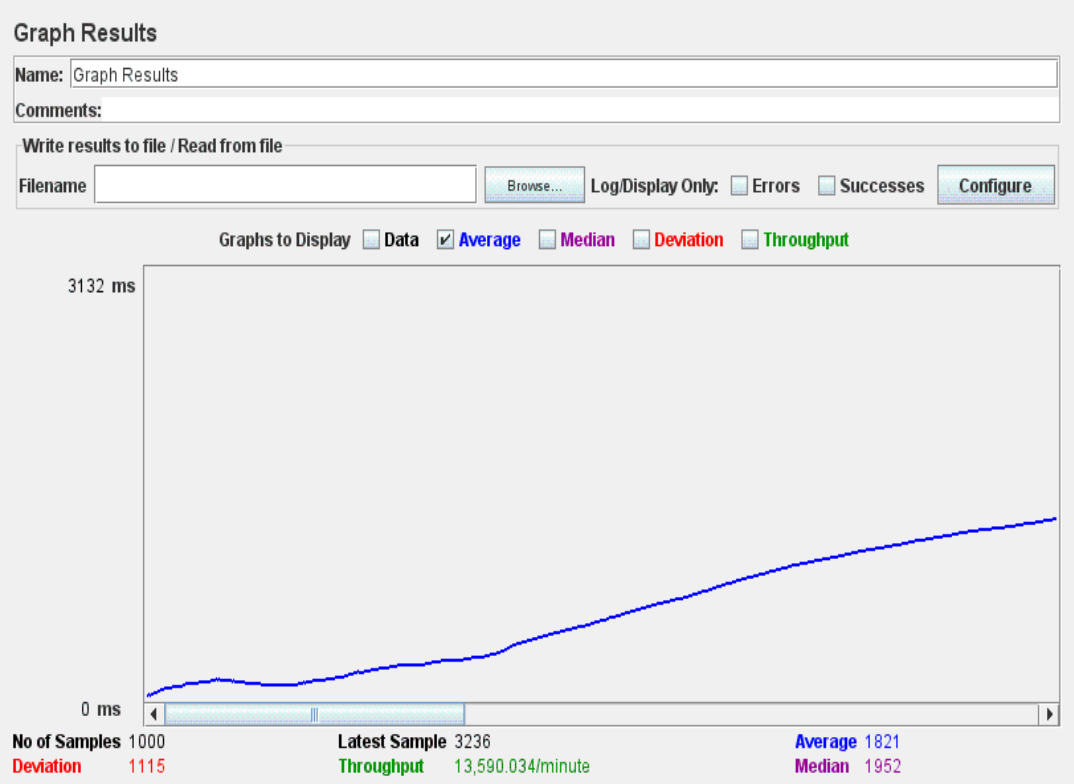
4) With pooling and Caching



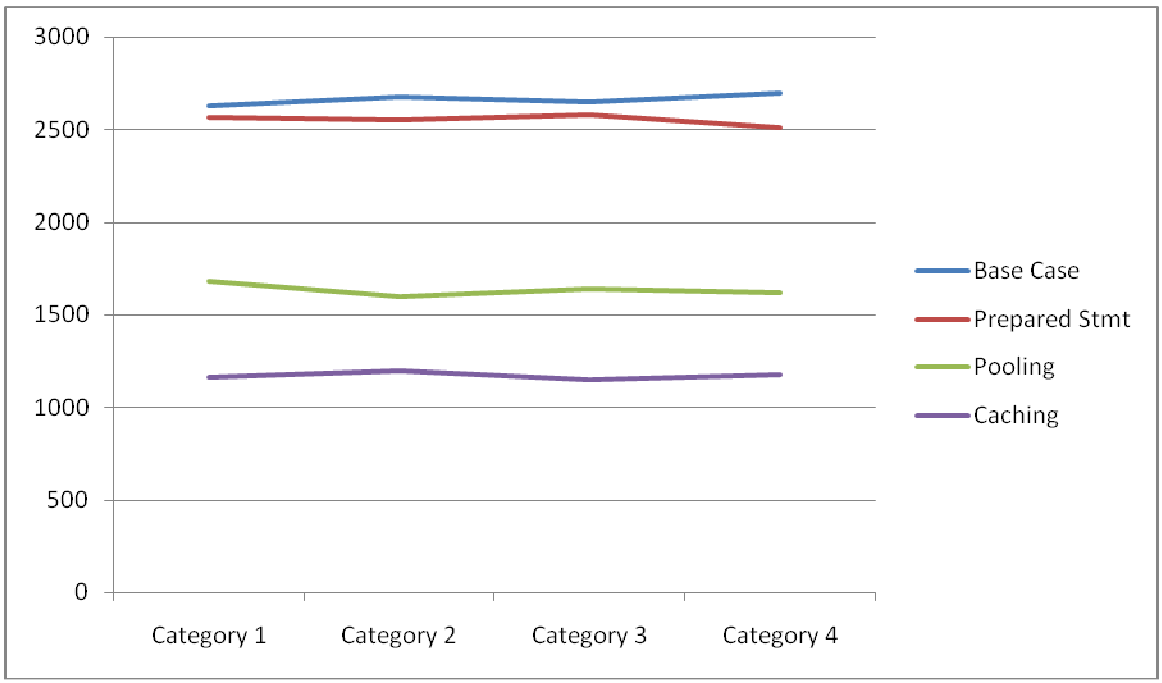
5) Display Movies without pooling



6) Display Movies with Pooling



7) Final Graph:



Extra

Deployed on Google App Engine:

We have studied google app and tried to move your video library management system to google cloud. We have installed Google App Engine SDK and WST and tried to deploy whole project. We got some problems in deploying web services as Google App Engine did not support web services directly. As an alternate solution, you have to use wsgen tool (find under $jdk/bin/wsgen.exe) so that wsdl file is created on server side. On client side we have to use wsimport tool (find under $jdk/bin/wsimport.exe) to extract the wsdl file on client side and use it. But while using it on client side we had some problems. Anyway, we deployed some .jsp pages (login, about, terms, contact us) to our below mentioned site:

http://videosystem273.appspot.com

Conclusion

Our implemented Video Library Management System provides functionality like creating members and movies, manage account and movie details and maintain all renting movie related transactions. We also take care about system's scalability and reliability by increasing its performance with the help of few techniques like Connection Pooling, InnoDB, use of Prepared Statement, Caching and also other database tuning techniques. And using these, we have managed to deal with heavy resources. Right now, our Video Library Management System is capable to maintain large database like 10000 simple customers, premium customers and movies in database without any kind of issues.

Observations and lessons learned

Web service is a core and very crucial in the middle tier architecture. Connection pooling boosts the performance and mainly helps to minimize resource load. Servlets and Jsp pages with CSS give web site eye catchy look. InnoDB is also very useful in case of accessing database very frequently and also very useful in data integrity. Junit helps us to resolve minor and can say hidden issues which were not possible to find with manual testing. To learn JMeter and run our application on it was the best experience. It really helps to observe the improvement of performance after applying different performance enhancement techniques. Thanks to Google drive, we could share and centralized our code, share our work and report status. Due to that we face fewer issues at the integration time and also save our time. The most exiting observations were time differences with and without applying performance enhancement techniques like connection pooling and caching.

Besides this, we learned how to work in team with task distribution and with the help of WSDL, it's easy to develop client side code without knowing server side code. And due to WSDL, there were no dependency between client side and server side development which is nice practice and will be helpful in future. Also learned that always give 40% time to development and 60% time to Integration. After integration, definitely you will face issues which were totally unknown and tough to solve because change in one's code may affect many other files. So be ready to face at least 50% more issues after integration compared to development.